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Inland Waterway Travel Time Prediction
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DISCLAIMER

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EXECUTIVE SUMMARY

This report focuses on the portion of the Upper Mississippi River between Mile Marker 338 and Mile Marker 462—a stretch encompassing Locks 16 through 20 in southeast Iowa and northeast Missouri (study segment). This part of the river system is an important artery for agricultural shipments. The objective of this study was to develop a statistical profile of the study segment using Automated Identification System (AIS) data. This study also analyzed the impact of several variables on system performance and developed forecast models based on these variables. The data used in this study are for 2018, 2019, and 2020. Figure 1 shows the study segment.

Figure 1. Study Segment Map.

This report builds on prior work undertaken by the U.S. Army Corps of Engineers (USACE). It explores topics that have not been specifically addressed.

The complete methodology comprises several methods with corresponding steps. Specifically, the methodology is formed by four main activities:

1. Data acquisition, cleansing, and management.
2. Travel time, speed calculation, and descriptive statistics.
3. Case/scenario definition and travel time results (i.e., origin-destinations [O-Ds], routes, link split/selection, time periods, and unit of observation).
4. Statistical forecast method and models.

The study relies primarily on AIS and Lock Performance Monitoring System data provided by USACE. The raw AIS data must be cleaned before they can be used. Two main problems must be addressed:

- The snapshot of data may include vessels that do not use the river for freight transportation. Such vessels might include dredging equipment, construction equipment, recreational vessels, and other miscellaneous vessels.
- Many of the AIS records are incomplete or have obviously incorrect data in the record. External sources must be used to complete or correct the data as much as possible.

The travel time estimate methodology consists of five main steps:

1. Divide the waterway between the O-D pairs into shorter, consecutive sections, called links.
2. Estimate the travel time and speed for each link.
3. Identify and remove travel time/speed outliers. (This step may also involve a determination of the causes of these outliers.)
4. Calculate link travel time/speed performance measures.
5. Calculate the O-D travel time/speed performance measures from the link travel time/speed performance measure results.

For this study, the definition of a link transit is a one-way trip from one boundary of a link to the other made by a single vessel. The travel time is simply the time it takes to accomplish this movement. To normalize the data and allow a comparison across links, the travel time is converted to speed in miles per hour.

For purposes of evaluating different factors on system performance, links containing locks were subdivided into three sublinks—a sublink on the north (upstream), the lock itself, and a sublink on the south side (downstream). This subdivision enabled an analysis of travel times from lock to lock.

This study employed a numerical method based on field knowledge about tow movements to identify outliers. Any transit time that exceeds a predefined cutoff is considered an outlier. This study employs two cutoffs:

- For links containing locks, the cutoff is 72 hours (3 days).
- For links without locks, the cutoff is the amount of time it takes to travel the entire link at 0.5 knots (0.575 mph).

This study removes outliers and then calculates travel time and speed performance measures for each link. The following statistics are recorded for each link:

- Total number of transits.
- Average travel time in hours and speed in miles per hour.
- Standard deviation of travel time in hours and speed in miles per hour.
- 25th, 50th (median), and 75th percentile travel times in hours and speed in miles per hour.
- Total travel time above the baseline in hours.

Both mean and median times are recorded because the median provides a better representation of the central tendency if the mean is skewed by very slow or very fast transits.

The datasets used in this analysis do not allow for the development of measures by tow size (number of barges). There may be significant differences depending on tow size (e.g., towboats with no barges, towboats with fewer then 15 barges, or towboats with 15 barges.) Therefore, the measures produced by

this study should be indicators of general performance, but will not necessarily be accurate for a specific tow size.

The times/speeds were consistent across the 3 years and between the directions with only minor variations. The highest variability in through traffic occurred in the links containing river terminals, indicating there is some friction between terminal operations and tow movements.

Although there was significant flooding in 2019, the statistics were not appreciably different. However, the sample sizes were much smaller, which indicates that operators do not attempt to navigate when waters are high, and, therefore, the statistics remain stable.

Based on the calculated speeds, the research team developed a methodology to obtain speed forecast models and to assess if, and how, different factors affect such speeds.

The factors of interest were continuous and Boolean (binary). Therefore, the methodology was divided in two groups:

- Group 1 focuses on the forecast models for continuous variables: Sample size (as a proxy for traffic or congestion) and water stage/level.
- Group 2 focuses on evaluating the statistical significance and estimating the impact on speeds from the Boolean variables: Flooded condition of the river segment and direction.

Researchers used several non-linear regressions for Group 1 analysis. Results from Group 1 show that non-linear models do a very good job at describing the relationship between speed, sample size (traffic level), and water level.

The statistical analysis of Group 2 suggested that direction has a statistically significant effect on speeds, with southbound traffic having higher speeds in general than traffic headed north.

The statistical analysis suggested that the flooded condition as defined for this study had no strong statistical significance, which may be due to the fact that flooded conditions are arbitrarily set at each river segment with no consistent criteria across all segments. Therefore, there is no consistent relationship between a segment considered flooded and the impact on speed due to that condition. One of the contributions of this work is that selected non-linear forecast models can help determine how water level affects speeds on specific sublinks of the system and thus function as a quantitative tool to set flood thresholds more consistently across river segments.

CHAPTER 1: INTRODUCTION

Background

This report focuses on the portion of the Upper Mississippi River (UMR) between Mile Marker 338 and Mile Marker 462—a stretch encompassing Locks 16 through 20 in southeast Iowa and northeast Missouri. This part of the river system is an important artery for agricultural shipments. The principal objective of this study was to develop a statistical profile of the study segment using Automated Identification System (AIS) data. This study also analyzed the impact of several variables on system performance and developed forecast models based on these variables. The data used in this study are for 2018, 2019, and 2020. Figure 2 shows the study segment.

Figure 2. Study Segment Map.

The selected segment of the UMR (study segment) is an important part of the national transportation system, especially for agricultural-related commodities (grains, fertilizers, etc.). Five locks are in the study segment. The average of commodity tonnage that passed through the five locks from 2015 through 2019 emphasizes this importance.[1] For example, Lock 16, the northern boundary of the study segment, recorded an average of 27.2 million tons of cargo processed annually. The food and farm products commodity group (60) is 62 percent of the total; the chemicals and related products commodity group (30) is 17 percent. Commodity group 30 includes fertilizers and ethanol. Figure 3

[1] The average is used because simply adding up the tonnages at each lock would count each trip multiple times and severely inflate the tonnage figures.

shows the commodity breakdown according to the commodity groups used by the Lock Performance Monitoring System (LPMS).

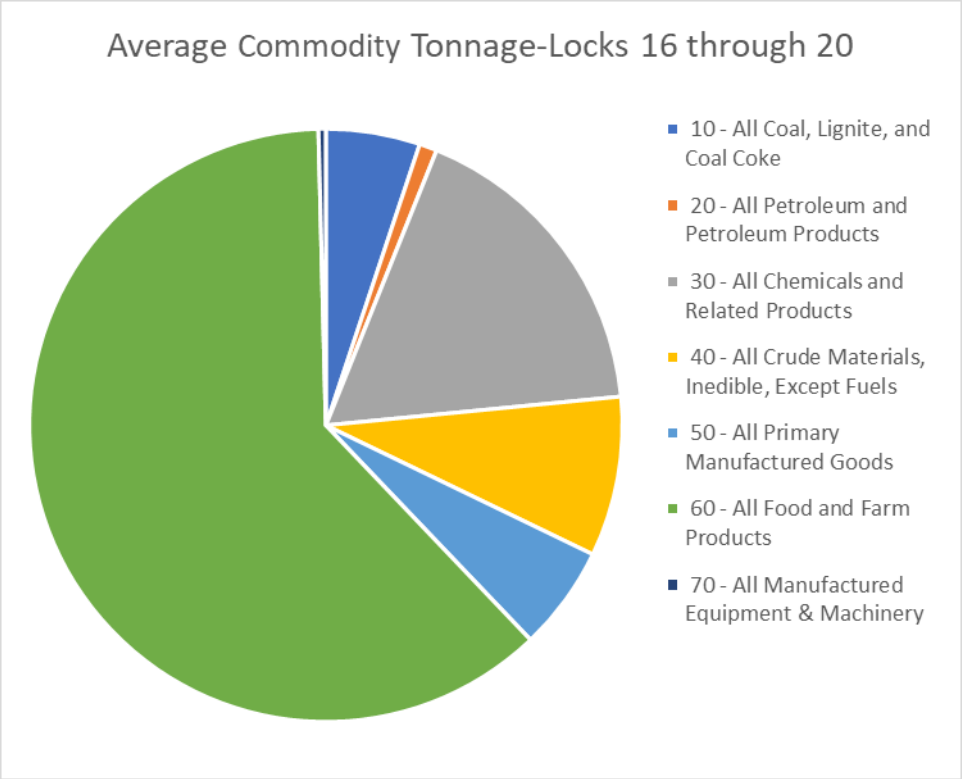


Figure 3. Commodity Breakdown.

The flows are heavily weighted in the southbound direction. For the UMR between Minneapolis and St. Louis, the southbound flows were 68 percent of the total commodity flows—that is, the ratio of southbound tonnage to northbound tonnage was roughly 2:1 (*1*).

The only origins and destinations within the study segment that appeared to have significant traffic are both located in the pool created by Lock and Dam 19.

The maintenance of the UMR is the responsibility of the U.S. Army Corps of Engineers (USACE). USACE pays 100 percent of maintenance costs and 50 percent of major rehabilitations and new projects (the remainder comes from the Inland Waterways Trust Fund, which is capitalized with fuel taxes paid by barge operators). Maintaining the UMR is an important priority for the federal government and the Midwest region of the United States. Travel time reliability is important for users of the UMR. Travel time reliability allows system stakeholders to predict travel times with greater accuracy, which in turn allows operators to optimize departure times and achieve on-time arrivals. Travel time reliability is primarily a matter of consistency or dependability in travel times. Reliability can be affected by factors such as allisions (collision with a stationary object), collisions, dredging operations, weather, fluctuations in demand, and structures such as locks.

Travel time and speed statistical profiles allow decision makers to evaluate the state of the system, determine baseline measures, quantify the effects of factors that affect reliability, quantify impacts of operations or maintenance decisions, and measure capacity and congestion.

This report builds on prior work undertaken by USACE on the Ohio River, the Illinois River, and the UMR (*2*). This report explores topics that have not been specifically addressed in the USACE research, such as the effect of high water on operations, possible differences in the operational effects of locks, and unusual events. Both the USACE study and this study provide a statistical profile of waterway travel times based on AIS data. AIS data indicate the identity of a vessel, its location, its heading, and its speed, among other variables. These data points are broadcast every few seconds and stored by USACE, the Coast Guard, or private vendors. This report relies on AIS data provided by USACE.

The study also incorporates methodologies developed by the researchers in previous work focused on the Gulf Intracoastal Waterway (GIWW) (*3*).

Objective

The objective of this study was to develop a statistical profile of travel times for the study segment using AIS data. This study also analyzed the impact of several variables on system performance and developed forecast models based on these variables.

Report Organization

Chapter 2 introduces AIS data. Chapter 3 discusses the methodology to establish the framework for the calculation of various performance measures for the study segment. This third chapter also discusses data issues and how they were resolved. The chapter also describes how the study segment is defined and how performance measures are calculated. At the end of the third chapter, a description of results of the performance measure calculations is presented. Chapter 4 describes the statistical analyses that were performed to evaluate the significance of various factors that could influence speed and consequently travel time reliability. Chapter 5 discusses conclusions and recommendations for future research.

CHAPTER 2: INTRODUCTION TO AIS

The following is taken from *Enhancing Accessibility and Usability of Automatic Identification System (AIS) Data across the Federal Government and for the Benefit of Public Stakeholders* (*4*):

> Automatic Identification System (AIS) is a technology that came about in the 1990s. … It was designed to promote ship-to-ship navigation safety, facilitate the provision of vessel traffic services, and allow coastal nations to monitor vessel activity in and near their waters.
>
> AIS technology relies upon global navigational positioning systems, navigation sensors, and digital very high frequency (VHF) radio communication equipment that permit the exchange of navigation information between vessels and shore-side stations. AIS equipment on vessels can broadcast information about the vessel, such as its name or call sign, dimensions, type, position, course, speed, heading, navigation status and other pertinent navigation data. This information is continually updated in near real-time and received by all AIS-equipped stations in its vicinity. The advantage of this automatic and continuous exchange of information is that all can access it, tailored to the users' needs and desires. …
>
> In 2002, the International Maritime Organization (IMO) made it mandatory for AIS to be fitted aboard all ships of 300 gross tonnage and upwards engaged on international voyages, cargo ships of 500 gross tonnage and upwards not engaged on international voyages, and all passenger ships irrespective of size. In 2004, the U.S. accelerated and expanded upon these requirements to most commercial domestic vessels operating in U.S. navigable water. …
>
> When AIS data is transmitted, it contains a large amount of vessel data. In all, about 400 data elements can be transmitted over AIS. The most commonly used data are position reports along with static and voyage related data that enables users to track a vessel's whereabouts and future direction. Position reports describe where a vessel is at a point in time. This information includes the maritime mobile service identity (MMSI) number, latitude, longitude, speed, direction of travel, and rate of turn. Static and voyage data include MMSI number, IMO number, call sign, type of ship and cargo type, estimated time of arrival (ETA), destination, and vessel status (docked or moving).

The following is from a study report published by USACE's Engineering Research and Development Center in 2019 (*2*):

> AIS technical specifications are standardized by the International Telecommunication Union and adopted by the International Maritime Organization for vessel carriage re-casts, in real-time, the vessel's identity, vessel type, position, heading, course, and speed, among other information. These messages are detailed in [Appendix A of the current report]. Note that while most of this information is collected electronically by onboard equipment, some information (e.g., those pertaining to vessel characteristics and voyage) is manually entered and may contain errors or be out of date. Vessel AIS

position report transmissions are at discrete time intervals, every 2 to 10 seconds while a vessel is underway (depending on speed and rate of turn), and every 3 minutes while at anchor. In the United States, AIS carry requirements are set by federal regulations. See US Code of Federal Regulations, 33CFR164.46. …

AIS data as received by AIS equipment is in a common format, NMEA 0183 (*5*), but is not decipherable in the native format without a conversion software. The NMEA 0183 standard provides information on the format; there are many open-source and commercial applications that can read and decode AIS data.

In the United States, the USCG runs the Nationwide Automatic Identification System (NAIS) project, which, in conjunction with transceivers on the inland system maintained by the USACE, has approximately 200 VHF receiver sites located throughout the coastal continental United States, inland rivers, Alaska, Hawaii and Guam. NAIS consists of an integrated system of AIS, data storage, processing, and networking infrastructure. …

The USACE and other federal partners may access AIS data with direct requests to the USCG or with the Automatic Identification System Analysis Package (AISAP). AISAP can be used to analyze the AIS data for MTS usage and travel time statistics and trends, to inform waterway operations and maintenance decisions, and to aid vessel operators in voyage planning. [For this study, the Corps of Engineers used AISAP to extract the required AIS data and make it available to the study team.] …

For non USACE users, the US Coast Guard will also consider requests for data, in particular for use in research. There are also several commercial sources of AIS data available. Some offer decoding, analysis, and other value-added services that may be beneficial for certain projects.

CHAPTER 3: METHODOLOGY

Overview

This study presents a method to estimate travel time and speeds on the study segment using AIS data. This study also analyzes the impact of several variables on system performance and develops forecast models based on these variables. The data used in this study are for 2018, 2019, and 2020.

The datasets used in this analysis do not allow for the development of measures by tow size (number of barges). There may be significant differences depending on tow size (e.g., towboats with no barges, towboats with fewer then 15 barges, or towboats with 15 barges.) Therefore, the measures produced by this study should be indicators of general performance, but will not necessarily be accurate for a specific tow size. The complete methodology comprises several methods with corresponding steps. Specifically, the methodology is formed by four main activities:

1. Data acquisition, cleansing, and management.
2. Travel time, speed calculation, and descriptive statistics.
3. Case/scenario definition and travel time results (i.e., origin-destinations [O-Ds], routes, link split/selection, time periods, and unit of observation).
4. Statistical forecast method and models.

This chapter covers items 1 through 3. Chapter 4 discusses the statistical analysis. Finally, Chapter 5 offers conclusions and recommendations for future research.

Selection of Study Segment

Several selection criteria were used to select the river segment for this study. Ideally, the study segment would include:

- Good AIS coverage.
- Both uninterrupted lock pools and lock pools divided by O-Ds or bridge structures.
- Locks that are generally spread out but with at least two that are in close proximity to each other.
- High volume of traffic that would lead to meaningful statistics.
- Bridges that could be obstacles.

Initially, the project team developed two river segments that looked promising: the UMR in southeast Iowa and northeast Missouri and the GIWW between Morgan City, Louisiana, and Lake Charles, Louisiana. The UMR segment offered the possibility of analyzing the effect of river conditions that the GIWW did not, so the study team selected the UMR segment for this project.

AIS Data Acquisition, Cleansing, and Management

Acquisition

The AIS data acquired for this study covered the years 2018, 2019, and 2020. USACE provided the data. The sampling interval was 5 minutes.

AIS data are not always complete and continuous for a given vessel. Incomplete data may be due to atmospheric conditions, physical obstructions, or equipment malfunctions. The methodology used in this study considers this discontinuity in the following ways:

- The methodology allows for the fact that transit data may not be available for the entirety of the waterway between the O-D pair.
- The methodology relies on a robust sample of the population—the methodology does not require transit data to be available for the entire population of vessels on the waterway.
- The methodology takes into account that each vessel may not transit the entire distance between the O-D pair, instead making shorter transits.

Cleansing

The raw AIS data must be cleaned before they can be used. Many AIS records have incomplete or obviously incorrect data. External sources were used to complete or correct the data as much as possible. Furthermore, recreational, dredging, and other vessels not related to the movement of cargo were removed from the dataset because the focus of this research is on towing operations.

The task of cleaning the AIS data is one of the most time-consuming tasks in any project based on such data. The process of cleansing the data involved the following steps:

1. Remove all records where the stated ship type is not an inland towing vessel.
2. Remove all remaining records where the Maritime Mobile Service Identity (MMSI) is not a valid U.S. MMSI.[2]
3. Remove all remaining records where the MMSI is clearly invalid (not enough or too many digits).
4. Examine all remaining records using multiple public sources to determine the vessel type and remove vessel types that are not inland towing vessels.
5. Remove all records where no information could be found.
6. Use the remaining records as the inland towing dataset.

Researchers identified 463 unique vessels in the AIS data. Of these, 284 were towboats engaged in commerce. Many of these towboats transit this segment of the river multiple times during a year.

Travel Time, Speed Calculation, and Statistics

The travel time estimate methodology consists of five main steps:

1. Divide the waterway between the O-D pairs into shorter, consecutive sections, called links.
2. Estimate the travel time for each link.
3. Identify and remove travel time outliers. (This step may also involve a determination of the causes of these outliers.)
4. Calculate link travel time performance measures.
5. Calculate the O-D travel time performance measures from the link travel time performance measure results.

The flowchart in Figure 4 summarizes these steps, and the following sections describe them in detail.

[2] The MMSI is a unique nine-digit number that is assigned to a digital selective calling radio or an AIS unit. Similar to a cell phone number, the MMSI serves as a unique calling number.

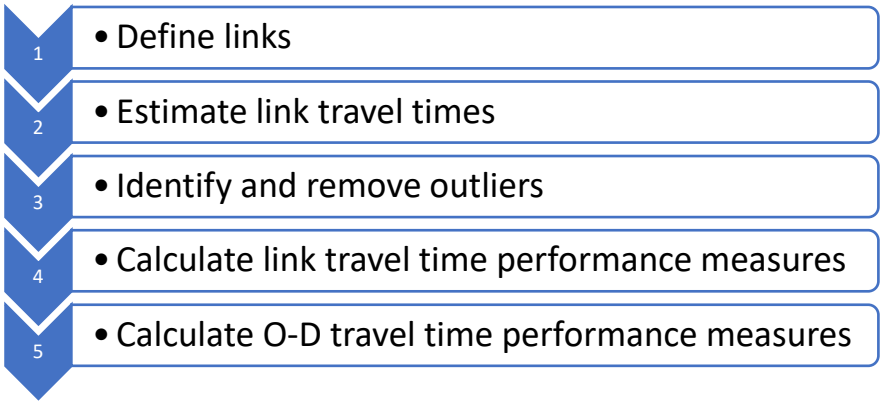


Figure 4. Summary Methodology Flowchart.

Step 1: Define Links

The first step of the methodology is to segment the waterway between the O-Ds into shorter, consecutive links. Each link has an entrance boundary and exit boundary that extend across the waterway from shore to shore, serving as a start and finish line for calculations. For the study segment, there are two types of links.

The first type of link represents an area that has homogeneous vessel travel behavior that is uninterrupted through transits—transits that pass from one end of the link to the other. These link boundaries should be placed where vessels change their behavior or speed, at the beginning and end of stretches of waterway with high variability in trip behavior or speed, at intermediate O-Ds along the waterway or at places where vessels make stops, at places where vessels may detour from the fastest route between the origin and destination, and at places that begin or end vessel trip data availability. Examples are:

- Boundaries of an area encompassing a navigation lock.
- Boundaries of port/terminal infrastructure complexes.

Figure 5 illustrates a waterway segment with multiple links. Link boundaries were placed at the northern extremity of the trip segment, upstream and downstream of an O-D point, upstream and downstream of a lock, and at the southern extremity of the trip segment.

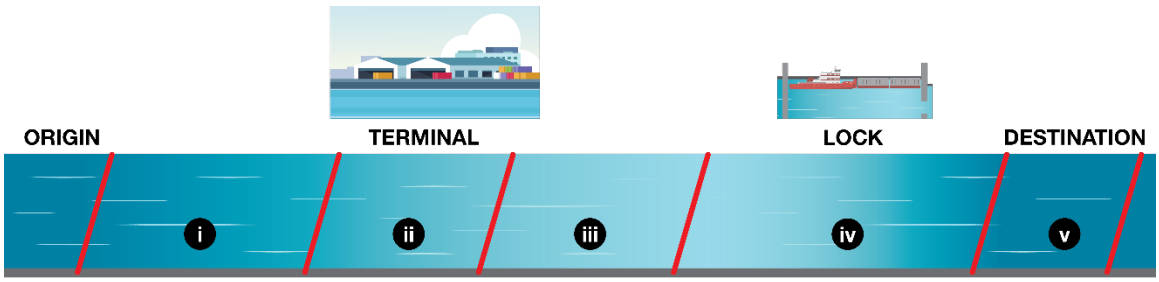


Figure 5. Example of Segmentation of Waterway.

The advantages to a link-based approach for estimating O-D transit times are:

- The approach allows shorter transits that take place along the waterway but that do not necessarily complete a full trip between the O-D pair to be included in the analysis. Inclusion of these shorter transits increases the sample size of observations from which to calculate the travel time statistics, thereby providing more robust measures of system performance.
- Segmenting the waterway allows for isolating travel behavior on sections of the waterway that are the main contributors to overall O-D travel times and travel time variability (i.e., locks and mooring area).

In addition to the physical characteristics of a waterway, link transit times may be affected by other factors, such as seasonal variations owing to prevailing congestion or adverse weather conditions. As explained later in this report, the available data did not indicate seasonal variations or congestion on the study segment. Data were insufficient to evaluate weather conditions.

Step 2: Estimate Link Travel Times

The second step of the methodology is to estimate link travel times of individual transits. For this study, the definition of a link transit is a one-way trip from one boundary of a link to the other made by a single vessel. The travel time is simply the time it takes to accomplish this movement.

Vessels may make multiple trips on a link, and therefore there may be records from different trips. The records were sorted by vessel ID and then by ascending chronological order. An instance in which a record from the entrance area is immediately followed by a record from the exit area represents a transit through the link from the entrance to the exit. If a given vessel's records do not cross either the entrance to or exit from the link for a vessel transit, then the associated transit is not included. In some cases, due to the incompleteness of AIS records, a vessel's records include the entrance area from one trip and the exit area from another trip without in-between records. Then the resulting travel time was an unusually large number, and the transit was excluded. Table 1 is an example of sorted vessel records from the UMR AIS data.

Table 1. Example of Sorted Vessel Records.

Record Number	Vessel ID	Vessel Name	Date and Time	Latitude	Longitude	Vessel Location
1	3456	ABC	9/1/2018 02:42:30	41.424159	–90.9247925	Link A entrance
2	3456	ABC	…	…	…	Intermediate records within Link A
3	3456	ABC	9/1/2018 07:42:30	41.3760015	–91.0604655	Link A exit/ Link B entrance
4	3456	ABC	…	…	…	Intermediate records within Link B
5	3456	ABC	9/1/2018 09:32:30	41.2432165	–91.1136885	Link B exit/ Link C entrance
6	3456	ABC	…	…	…	…

In Table 1, records that can be used as entrance and exit times are included, and the records have been sorted by vessel ID and by time stamp. Record 1 is an entrance record of Link A and is followed by record 3, an exit record of Link A. Record 3 is also an entrance point of Link B that is followed by record 5, an exit record of Link B and so on. Therefore, according to the methodology, vessel ABC completed a transit that had a Link A entrance time of 2:42, an exit time of 7:42, and thus a Link A travel time of 5 hours. Likewise, Link B travel time is the time between record 3 and record 5—that is, 1 hour 50 minutes.

Step 3: Identify and Remove Outliers

Outliers are data points that differ significantly from other observations. In the case of this study, they may represent errors in the data or deviations from standard practice by barge operators. Vessels may make an unplanned stop; there may be an equipment failure of either the AIS broadcast unit or the receiver. Outliers can distort statistical analyses and inordinately influence conclusions.

This study employed a numerical method based on field knowledge about inland waterway (IWW) vessel movements to identify outliers. Any transit time that exceeds a predefined cutoff is considered an outlier. This study employs two cutoffs:

- For links containing locks, the cutoff is 72 hours (3 days).
- For links without locks, the cutoff is the amount of time it takes to travel the entire link at 0.5 knots (0.575 mph).

The first cutoff considers that lock capacity and maintenance issues can cause traffic delays. The cutoff allows for the influence of locks to be manifested in the performance calculations. The second cutoff is necessary because links are different lengths; therefore, the cutoff time needs to vary by length in order to normalize the statistics for purposes of comparison.

Step 4: Calculate Link Travel Time Performance Measures

This study removes outliers and then calculates travel time performance measures for each link. The following statistics are recorded for each link:

- Total number of transits.
- Average travel time in hours.
- Standard deviation of travel time in hours.
- 25th, 50th (median), and 75th percentile travel times in hours.
- Total travel time above the baseline in hours.

Both mean and median times are recorded because the median provides a better representation of the central tendency if the mean is skewed by very slow or very fast transits.

The total travel time above the baseline is the additional travel time incurred to complete a transit through a link over the baseline travel time. The baseline travel time is defined as the time that can be achieved with no impediments or unusual circumstances. Previous studies conducted by USACE and the Texas A&M Transportation Institute (TTI) have used the 25th percentile as the baseline. The same was used in this study.

The total is the sum of the time spent above the baseline of all transits for the time period. The sum depends on two components: the number of transits with travel time above the baseline and the amount of travel time above the baseline for each transit (i.e., either of two scenarios can result in similar totals). In the first case, there may be many transits, each of which has a small travel time above the baseline. In the second, there may be a few transits with a large travel time above the baseline. This study does not try to determine which is preferable.

Time above the baseline can be caused by several factors requiring further investigation. Such factors might include congestion, inadequate lock capacity, fog, extreme weather, or waterway conditions (e.g., dredging) that required additional or slower maneuvering.

Step 5: Calculate O-D Travel Time Performance Measures

Average O-D travel times are the summation of the values from the links that make up the O-D path. However, percentiles are order statistics and cannot be summed because the sum of the sample populations collected from the links may not be the same population as the O-D pair due to the different characteristics of the links, such as cutoff measures and lengths.

Case/Scenario Definition and Travel Time Results

There are few origins or destinations within the study segment. The ones identified for purposes of this study both lie within the pool created by Lock 19. The north and south ends of the study segment are also defined as O-Ds.

Table 2 presents the O-D points used for this study. Figure 6 presents the locations.

Table 2. Origin-Destination Boundaries.

Origin-Destination	Eastern/Northern Mile Marker	Western/Southern Mile Marker
North end of study segment (Lock 16)	462	452
Hall Towing	384	380
Hendricks River Logistics	373.1	369.1
South end of study segment (Lock 20)	349	338

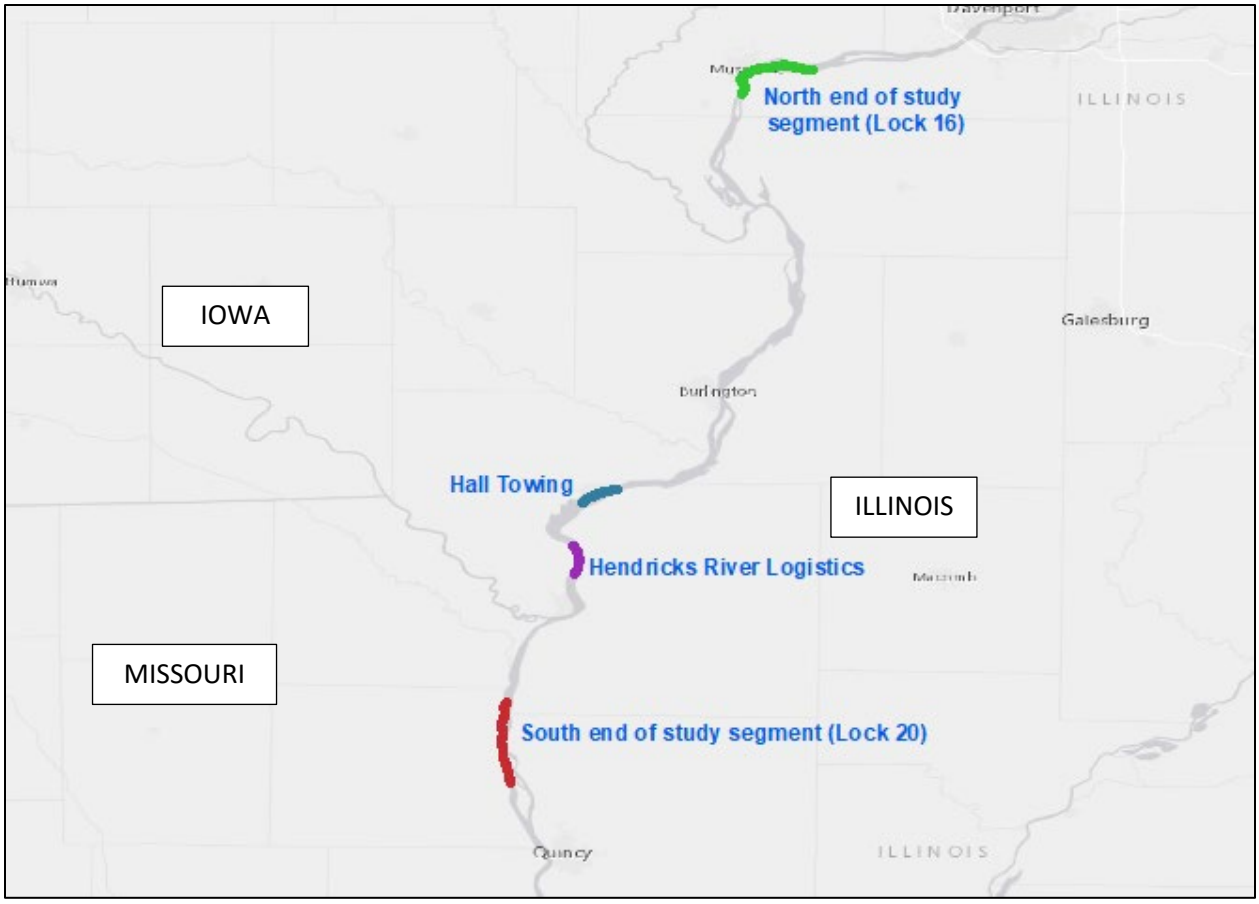


Figure 6. Locations of O-Ds in Study Segment.

Links

As explained previously in this chapter, the study segment was segmented into links. The lengths of these links were primarily determined by geographical features, the goal being to define links with homogeneous operational characteristics. The longest link (22 miles) is found in the upper Lock 19 pool, above Hall Towing. The next longest link (16 miles) is the Lock 18 pool. The shortest links are the links for the two identified O-Ds (4 miles) and the middle Lock 19 pool between the two O-Ds (6.9 miles). The remaining links are all in the range of 10 to 11 miles.

The links for the lock links include the staging areas on each side of the lock. The lengths of these links were made identical in order to not allow one location to unduly influence the analysis of traffic behavior. These travel-time-related behaviors included deceleration time approaching the lock, queuing time to enter the lock, passage time through the lock, and acceleration time away from the lock. Table 3 indicates the boundaries of these links. Figure 7 indicates the locations of the five locks.

Table 3. Study Segment Links.

Link No.	Northern Boundary (River Mile)	Southern Boundary (River Mile)	Length (River Miles)	Notes
1	462	452	10.0	Lock 16 (RM 457.2)
2	452	442	10.0	Lock 17 pool
3	442	432	10.0	Lock 17 (RM 437.10)
4	432	416	16.0	Lock 18 pool
5	416	406	10.0	Lock 18 (RM 410.5)
6	406	384	22.0	Lock 19 upper pool
7	384	380	4.0	Hall Towing O-D
8	380	373.1	6.9	Lock 19 middle pool
9	373.1	369.1	4.0	Hendricks River Logistics O-D
10	369.1	359	10.1	Lock 19 lower pool
11*	359	349	10.0	Lock 19 (RM 354.3)
12*	349	338	11.0	Lock 20 (RM 343.2)

* Locks 19 and 20 are so close together that a pool between them was not defined.

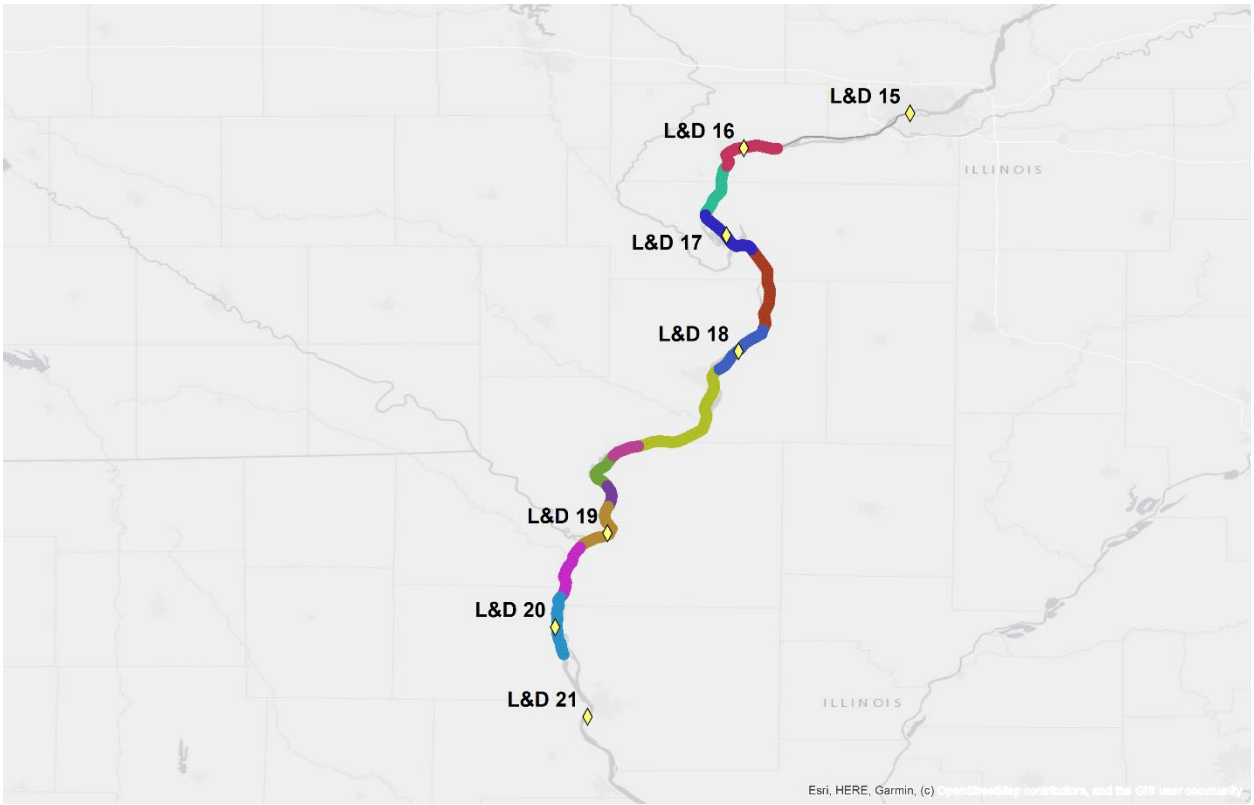


Figure 7. Location of Locks in Study Segment.

The total number of links created for the study segment was 12. Table 3 lists each link, its boundaries, its length in river miles, and notes regarding special features. Figure 8, Figure 9, and Figure 10 depict the locations of the links.

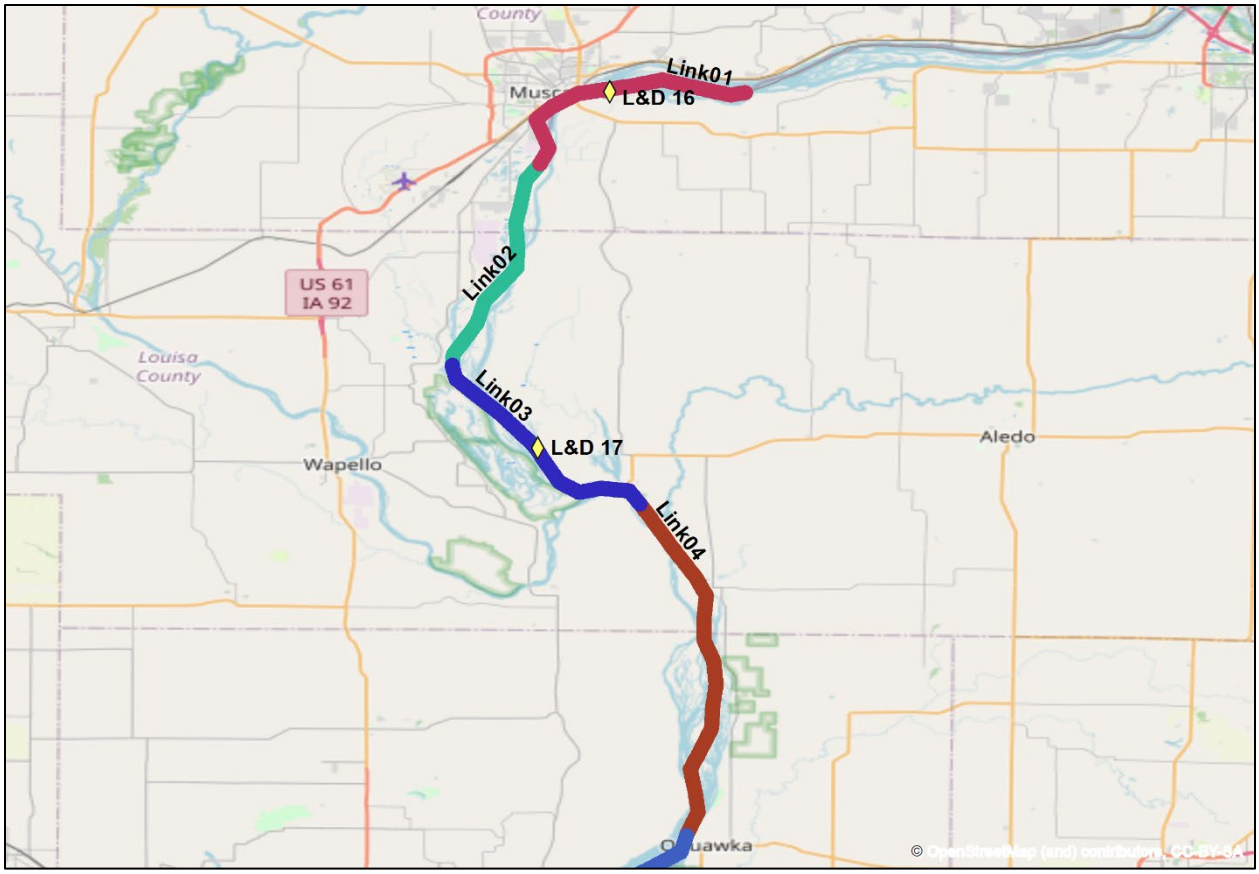


Figure 8. IWW Links 1–4.

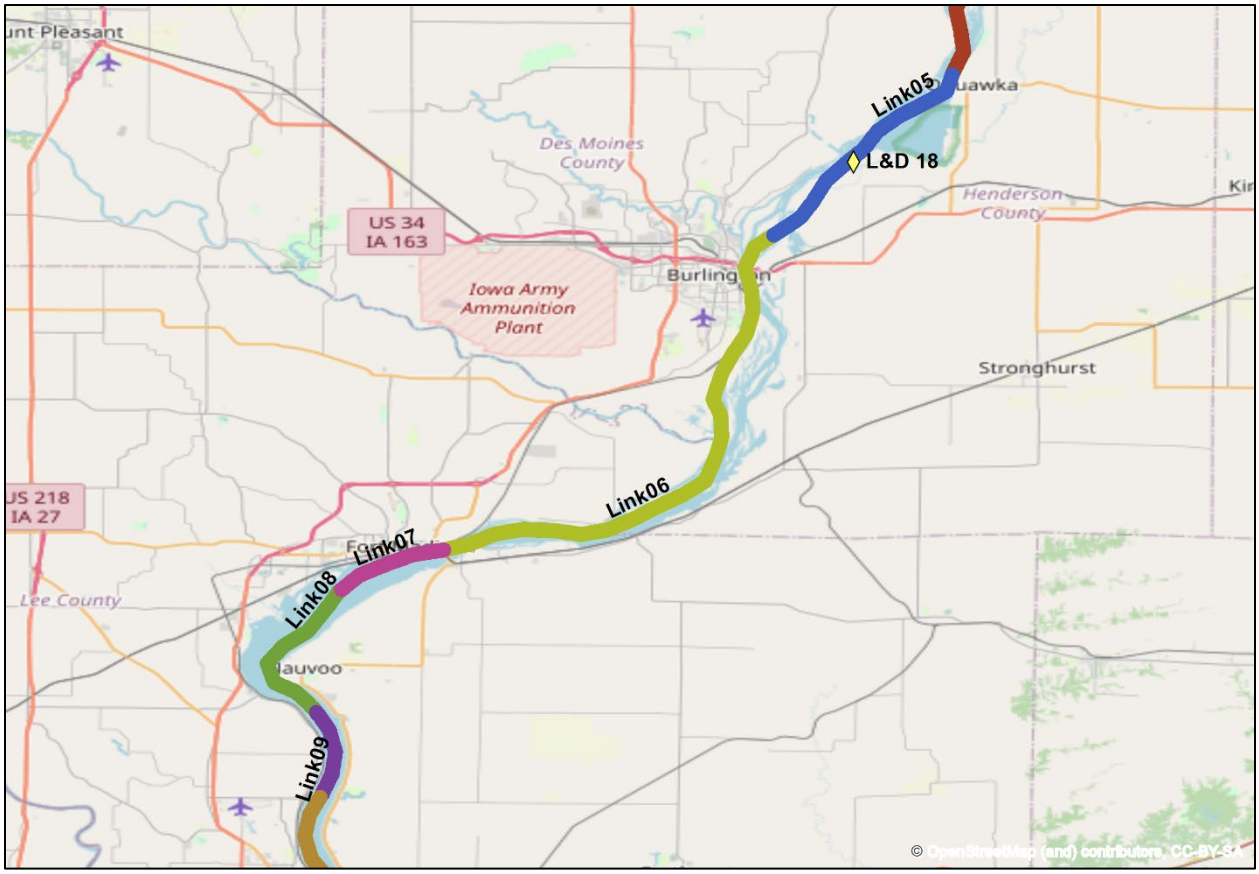


Figure 9. IWW Links 5–9.

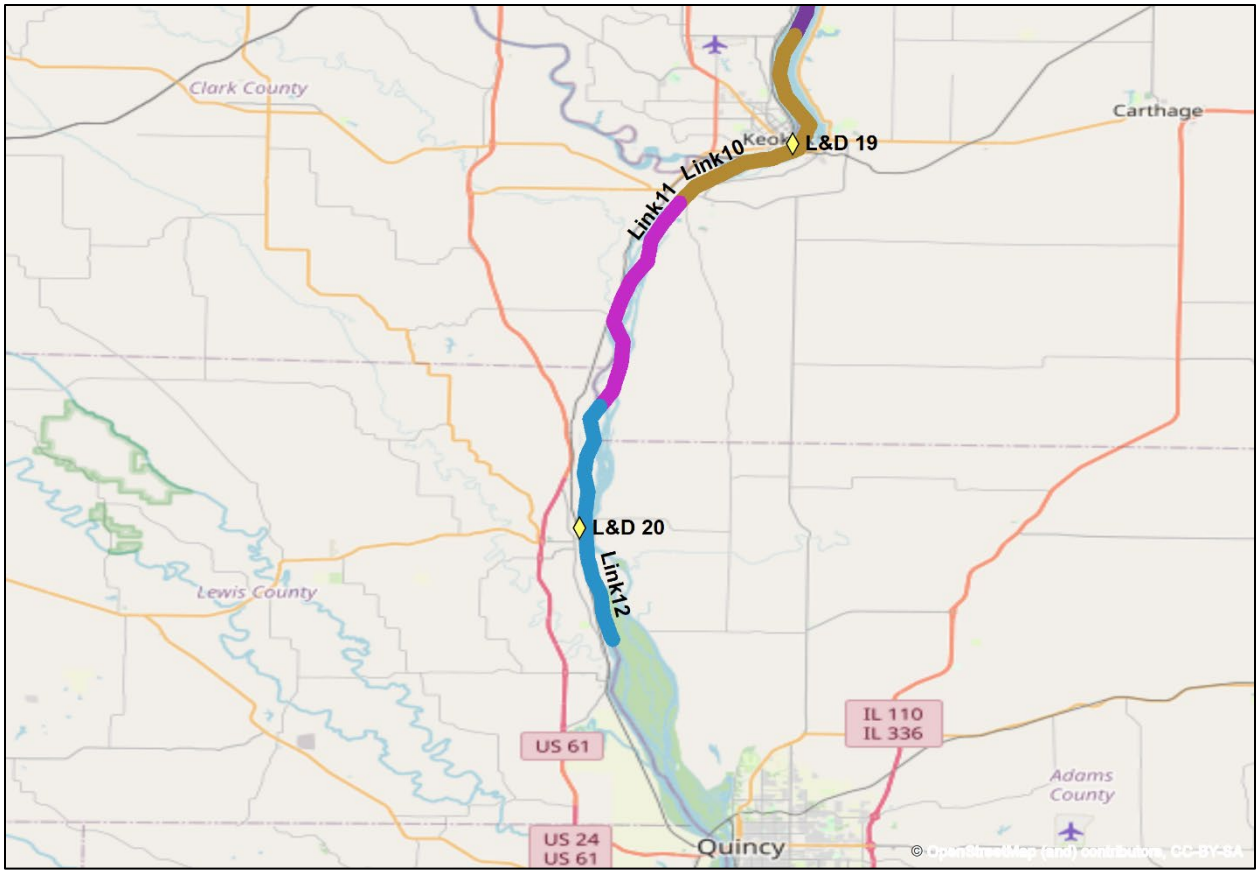


Figure 10. IWW Links 10–12.

For a more detailed analysis, the links containing locks were further split into three sublinks—above the lock, at the lock, and below the lock. The boundaries of the middle sublink (the sublink containing the lock) were determined by examining heat maps of the entire link. For each lock, there were clear clusters of data points on each side of the lock, indicating the presence of a waiting area for access to the lock. The boundaries of the middle sublink were then defined to include the waiting areas on each side of the lock and the lock itself. These boundary definitions enabled a statistical analysis and comparison of lock operational efficiency. As will be explained in later sections of this report, the upper and lower sublinks also allowed evaluation of continuous segments between the lower waiting area of one lock and the upper waiting area of the lock downriver, which is important when evaluating the effect of high water.

Figure 11 through Figure 15 illustrate the sublinks.

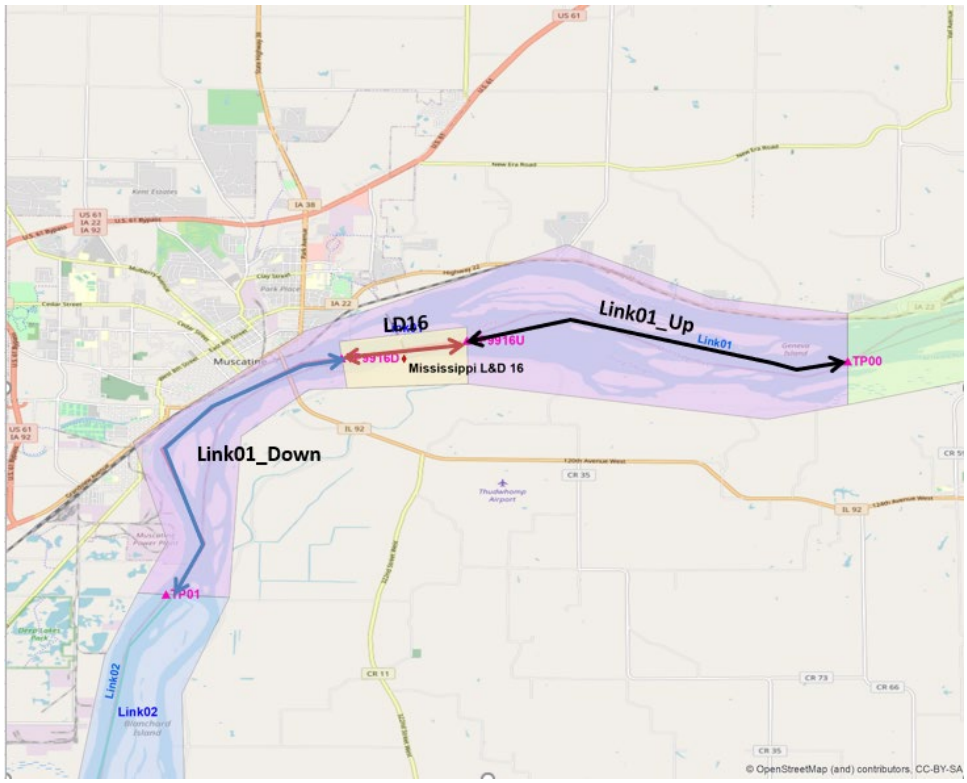


Figure 11. Sublinks for Link 1 (Lock and Dam 16).

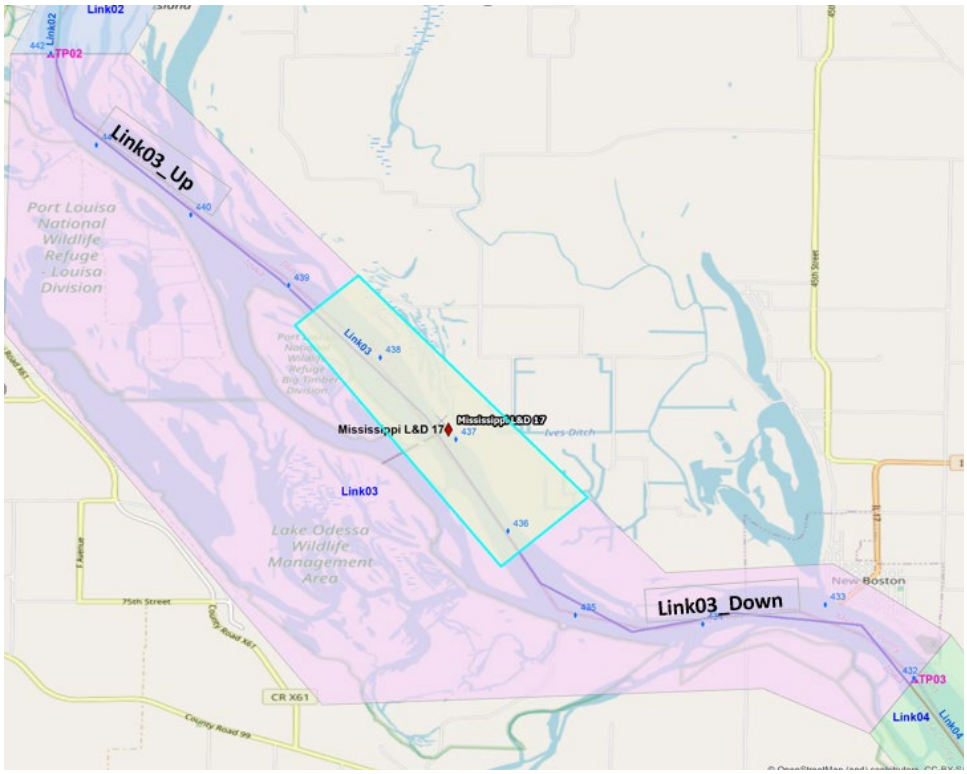


Figure 12. Sublinks for Link 3 (Lock and Dam 17).

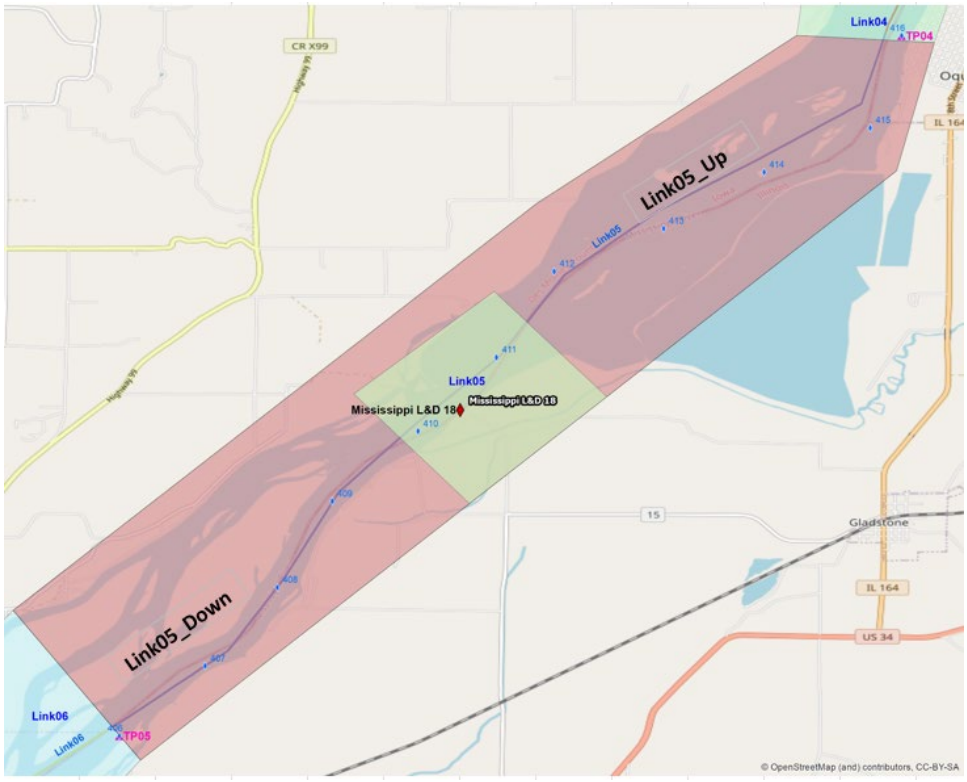


Figure 13. Sublinks for Link 5 (Lock and Dam 18).

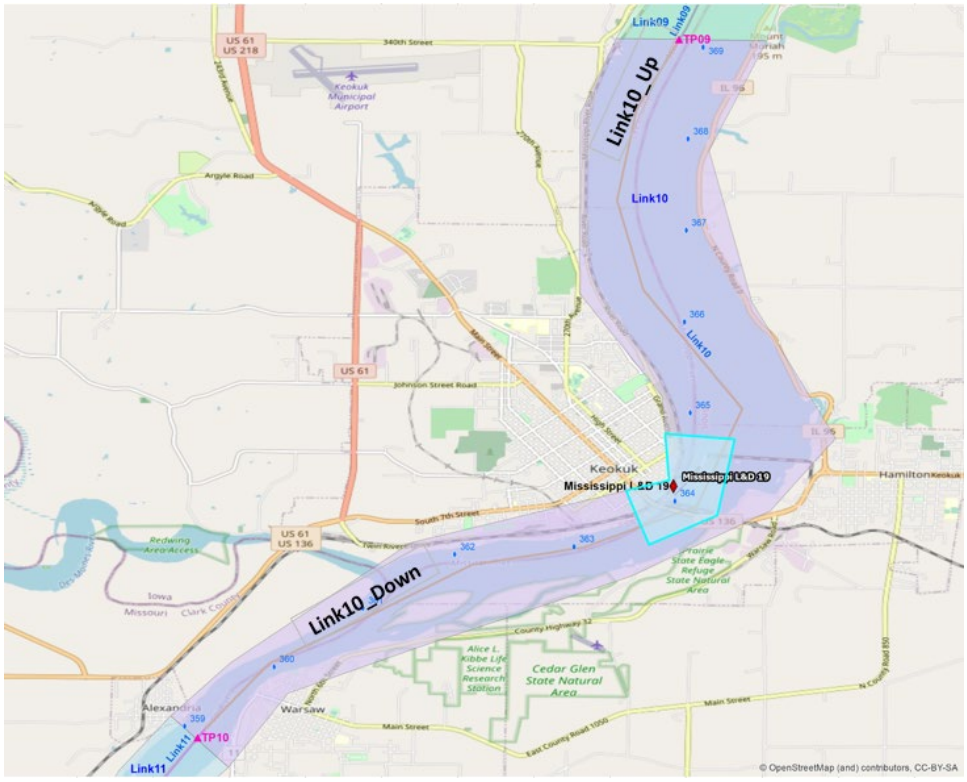


Figure 14. Sublinks for Link 10 (Lock and Dam 19).

Figure 15. Sublinks for Link 12 (Lock and Dam 20).

Number of Transits by Link and Sampling Rate

The study attempted to determine the sampling rate, or the percentage of actual transits captured via the AIS dataset.

Detailed lock activity reports were provided by USACE. The AIS data were compared to the lock data to determine what percentage of vessels appearing in the lock activity reports also appeared in the AIS data. While this is not a precise comparison of trips, it is a good indicator of the completeness of the AIS data. Table 4 shows how the two datasets compared.

Table 4. Comparison of Vessels in LPMS Data versus AIS Data.

	2018	2019	2020
Total LPMS entries	17,601	12,056	18,586
LPMS towboat entries	15,001	10,277	16,429
Entries where vessel also appeared in AIS*	14,505	9,792	15,993
Estimated coverage	96.7%	95.2%	97.3%

* If a vessel that is in an LPMS entry appears anywhere in the AIS data, that vessel activity is considered to be covered in the AIS data.

The statistics published by USACE's Waterborne Commerce Statistics Center (WCSC) depend on voluntary reporting by the barge operators and may not include all activity although history has shown a relatively high compliance rate.

Travel Time Results

This section provides a travel time statistical profile for the study segment. The study determined the statistics by applying the methodologies described previously to AIS data for 2018, 2019, and 2020. The statistics are as follows:

- Number of transits by link.
- AIS sampling rate for links containing locks.
- 25th, 50th, and 75th percentile travel times by link.
- Average travel time, standard deviation, and coefficient of variation by link.
- Total travel time above the baseline for links containing locks.
- 25th, 50th, and 75th percentile travel times by O-D pair.

The study provides results aggregated into the following time periods: weekly, monthly, and annually. The study does not provide results disaggregated to time periods less than 1 week or to individual transits to help protect the possible commercial sensitivity of the data.

Link Travel Times by Average and Percentile

The study estimated the 25th, 50th (median), and 75th percentile travel times by link based on 2018 through 2020 AIS data. Figure 16 and Figure 17 show the percentile travel times of the 3 years by direction. In general, the links with locks have a wider range of percentile values than the links without locks. Link 1 and Link 12 especially show higher ranges of transit times between the 25th percentile and 75th percentile than the rest of the links for both directions. It is also noticeable that Link 4 and Link 6 have higher travel times and variabilities for northbound trips than southbound trips.

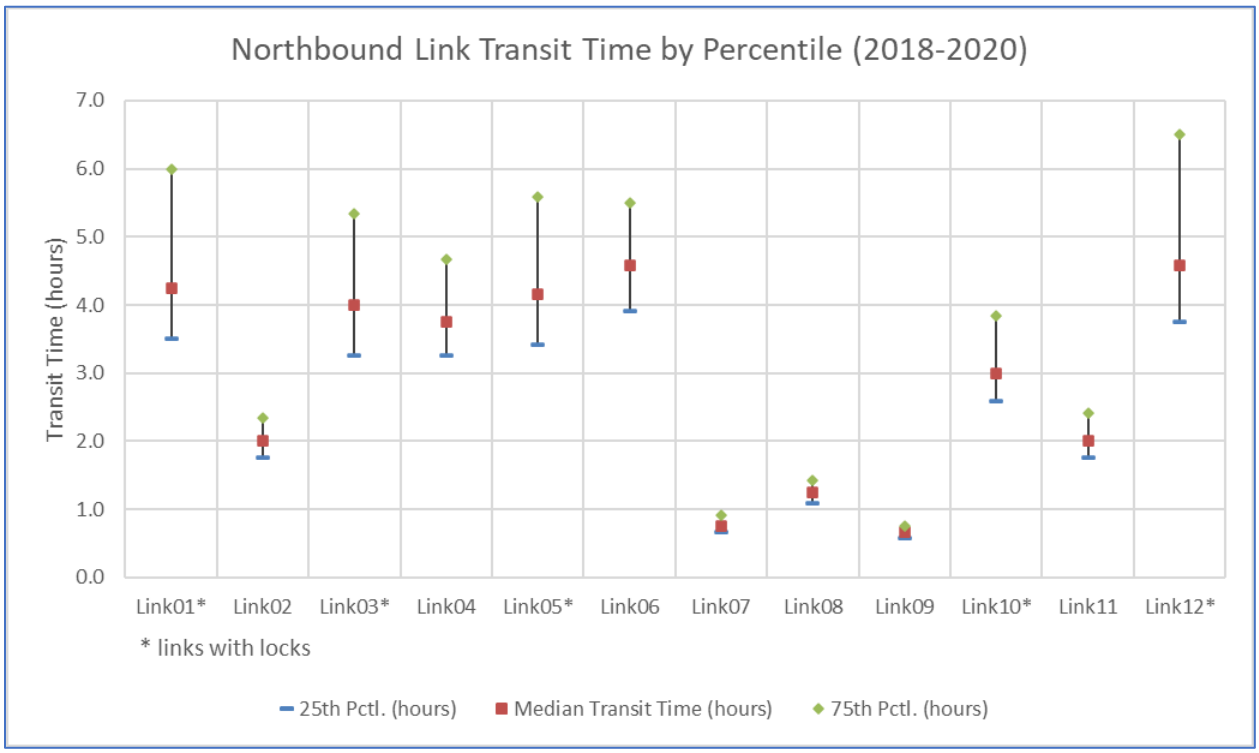


Figure 16. Northbound Link Transit Time by Percentile, 2018–2020.

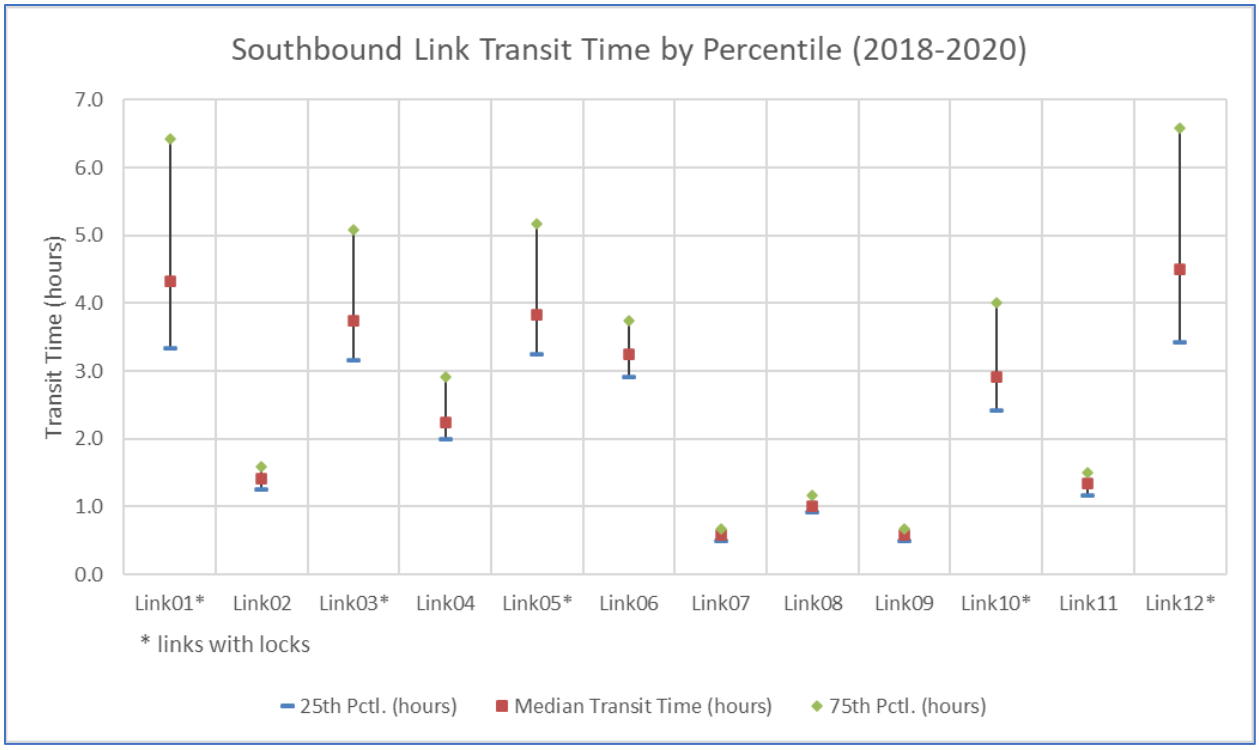
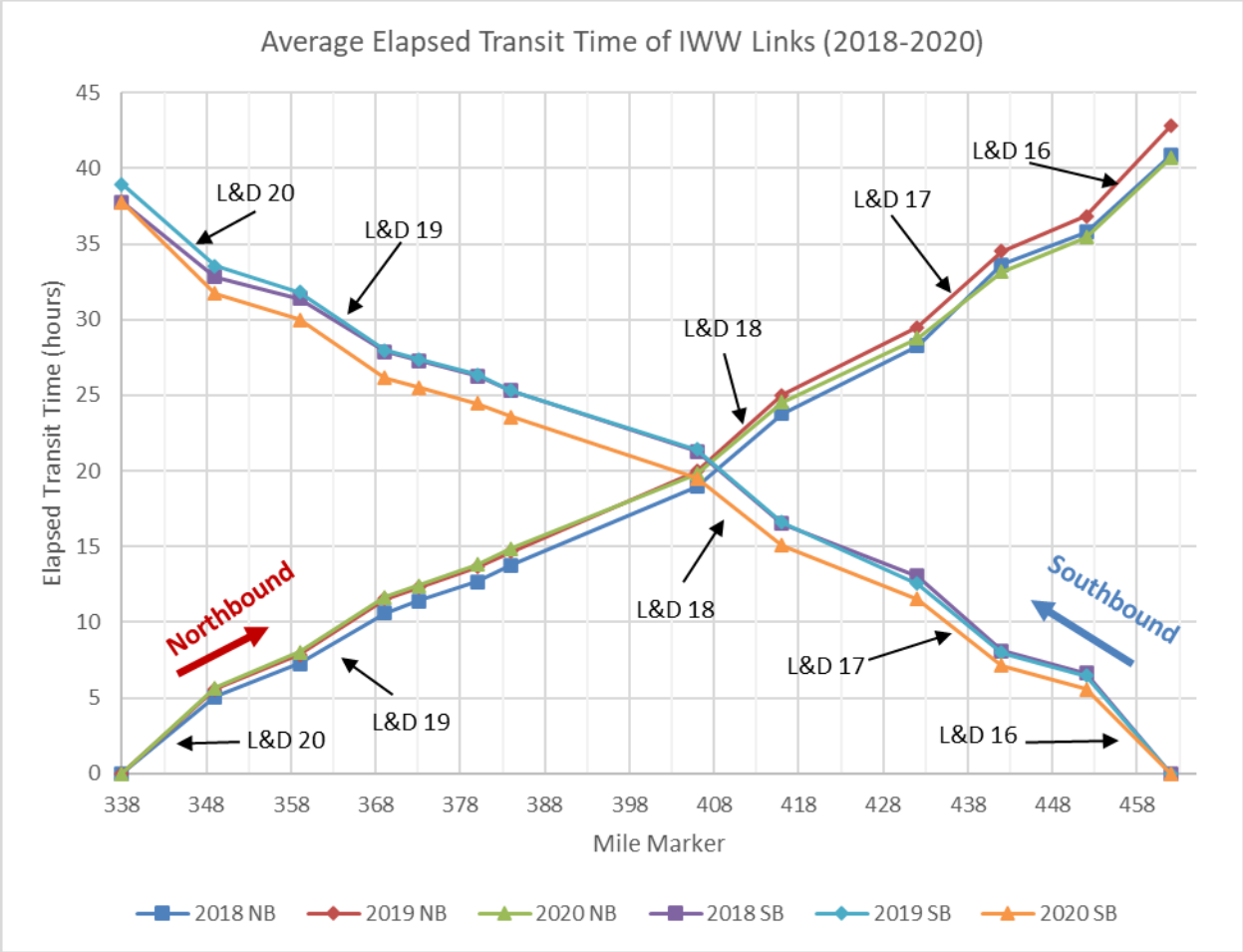


Figure 17. Southbound Link Transit Time by Percentile, 2018–2020.

The graphs in Figure 18 and Figure 19 illustrate the annual results, with estimated trajectory plots of vessels as if they were to transit the entire study segment at the annual average travel time for northbound and southbound trips. The time begins at hour zero. Vessels traveling southbound begin at Mile Marker 462, east of Muscatine, Iowa. Vessels traveling north begin at Mile Marker 338, north of Quincy, Illinois. The arrow on each line represents the direction of travel. On the graphs, the mile marker numbers are on the x-axis; total elapsed transit times are on the y-axis.

As shown in Figure 18, overall transit times are similar for the 3 years. However, 2020 southbound trips (orange triangle) show shorter transit times between Mile Marker 349 and Mile Marker 452 though the total transit time at the end of the trip is the same as 2018 southbound (purple square). Appendix B lists the results of the average transit times by year, month, and week in table format.

Figure 19 displays the trajectories of 25th, 50th, and 75th percentiles of the elapsed transit times for the 3-year total. Both directions of the trips show a similar pattern of variability between the 25th and 75th percentiles though the total trip time for northbound trips is longer than for southbound trips. It is also noticeable that the slopes are steeper when a trip passes links with locks. It is more noticeable for 75th percentile travel time trajectories for both directions.



L&D = lock and dam, NB = northbound, SB = southbound

Figure 18. Average Travel Time Trajectories on Study Segment Links, 2018–2020.

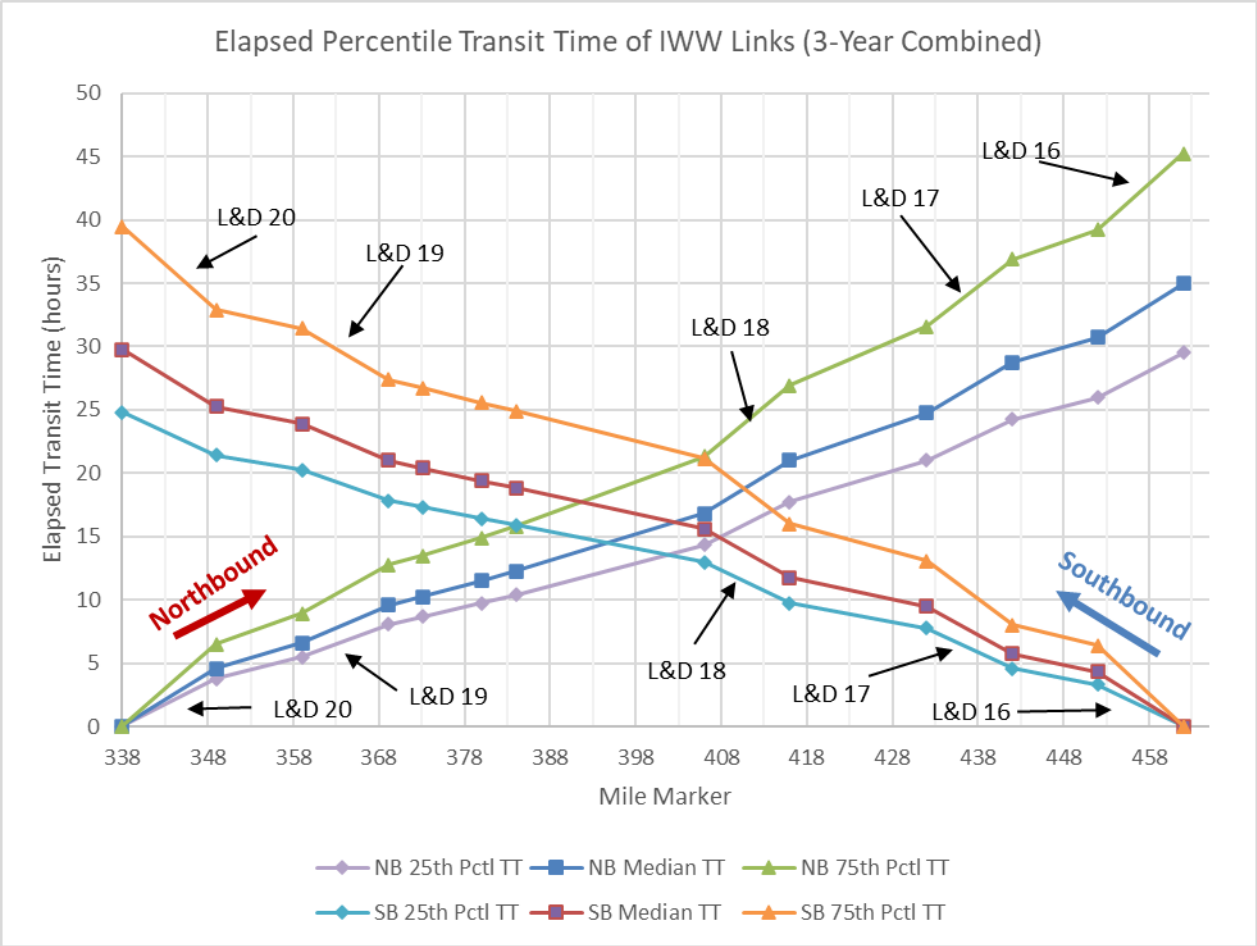


Figure 19. Overall Percentile Travel Time Trajectories on Study Segment Links.

Several conclusions may be drawn from the results. From the slopes of the lines, trends are identified in the waterway travel times and speeds. The slope of the line for each link is equivalent to the vessel travel time per mile (i.e., reciprocal of speed). Steeper slopes represent more time per mile to navigate a link, and less steep slopes represent less time per mile to navigate a link. Thus, this type of visualization allows for the comparison of links, even though they are of different lengths. For example, slopes are steeper on links containing locks and dams, and thus travel speeds are slower on these links. The next section provides more detailed information about the average travel times and variabilities.

Link Travel Time Average, Standard Deviation, and Coefficient of Variation

The IWW consists of many navigation segments with different characteristics. Measuring the performance of the segments is an important step to identify problem areas and prioritize the links for planning, operations, and maintenance. Average link travel time and standard deviation are basic statistics to understand the performance of the links. The coefficient of variation is the ratio of the standard deviation to the mean and provides the relative deviation adjusted by the average travel time.

Table 5 shows average transit time, standard deviation, and coefficient of variation by direction for 2018 through 2020. The link numbers and link lengths are in bold face for the links with locks. Conditional color formatting by variable in each column highlights higher values in red and lower values in green. In

the table, there are no striking changes in color patterns over the 3 years. That means there is no noticeable change in the average link travel times between the directions and the years.

Table 5. Study Segment Link Average and Standard Deviation of Travel Time, 2018–2020.

Trip Direction	Link No.	Link Length (mile)	2018			2019			2020		
			Average Transit Time (hours)	Std Dev (hours)	Coeff. of Variation	Average Transit Time (hours)	Std Dev (hours)	Coeff. of Variation	Average Transit Time (hours)	Std Dev (hours)	Coeff. of Variation
Southbound Trips	**1**	**10**	6.63	7.61	1.1	6.47	5.41	0.8	5.59	5.50	1.0
	2	10	1.50	0.92	0.6	1.51	1.18	0.8	1.56	0.69	0.4
	3	**10**	4.95	3.62	0.7	4.59	4.04	0.9	4.38	2.35	0.5
	4	16	3.45	3.34	1.0	4.03	4.24	1.1	3.55	2.89	0.8
	5	**10**	4.79	4.00	0.8	4.84	3.71	0.8	4.43	2.40	0.5
	6	22	4.02	2.97	0.7	3.89	2.45	0.6	4.06	2.47	0.6
	7	4	0.94	1.20	1.3	1.06	1.26	1.2	0.89	1.01	1.1
	8	6.9	1.03	0.38	0.4	1.01	0.41	0.4	1.07	0.18	0.2
	9	4	0.57	0.11	0.2	0.59	0.23	0.4	0.63	0.16	0.3
	10	**10.1**	3.52	2.25	0.6	3.83	3.17	0.8	3.83	2.17	0.6
	11	10	1.44	1.09	0.8	1.72	1.91	1.1	1.75	1.63	0.9
	12	**11**	4.96	2.39	0.5	5.41	5.35	1.0	6.05	4.17	0.7
Northbound Trips	**1**	**10**	5.07	3.89	0.8	5.94	4.89	0.8	5.21	3.79	0.7
	2	10	2.17	1.01	0.5	2.31	1.38	0.6	2.30	1.22	0.5
	3	**10**	5.36	4.97	0.9	5.06	4.97	1.0	4.40	2.57	0.6
	4	16	4.48	2.89	0.6	4.45	2.53	0.6	4.22	1.84	0.4
	5	**10**	4.82	2.83	0.6	5.03	3.18	0.6	4.75	2.65	0.6
	6	22	5.16	2.26	0.4	5.31	2.16	0.4	4.92	1.89	0.4
	7	4	1.09	0.94	0.9	1.02	0.86	0.8	1.08	1.03	1.0
	8	6.9	1.30	0.44	0.3	1.38	0.67	0.5	1.38	0.84	0.6
	9	4	0.80	0.90	1.1	0.74	0.61	0.8	0.76	0.75	1.0
	10	**10.1**	3.32	1.46	0.4	3.67	2.40	0.7	3.63	1.77	0.5
	11	10	2.19	0.96	0.4	2.29	1.00	0.4	2.36	1.28	0.5
	12	**11**	5.08	2.05	0.4	5.59	3.74	0.7	5.68	3.00	0.5

The four links with the highest average transit time (Links 1, 3, 5, and 12) are the links with locks. They take more time to transit than Links 4 and 6, which are the two longest segments. The short segments (Links 7, 8, and 9) all display green for average transit time and standard deviation, but Link 7 has the highest coefficient of variation for southbound trips, and Link 9 has the highest coefficient of variations for northbound trips.

Both Link 7 and Link 9 include terminals in the middle. Link 7 has the Hall Towing River Terminal in Fort Madison, Iowa, and Link 9 has the Hendricks River Logistics Terminal in Keokuk, Iowa (Figure 20). The high variability for through traffic in these links may be due to friction between the traffic to and from the terminal and passing vessels. Figure 20 shows slow traffic around the Hall Towing area (Link 7) and Hendricks River Logistics (Link 9) as shown in red dots. There is significant intermingling of slow and normal traffic in these areas.

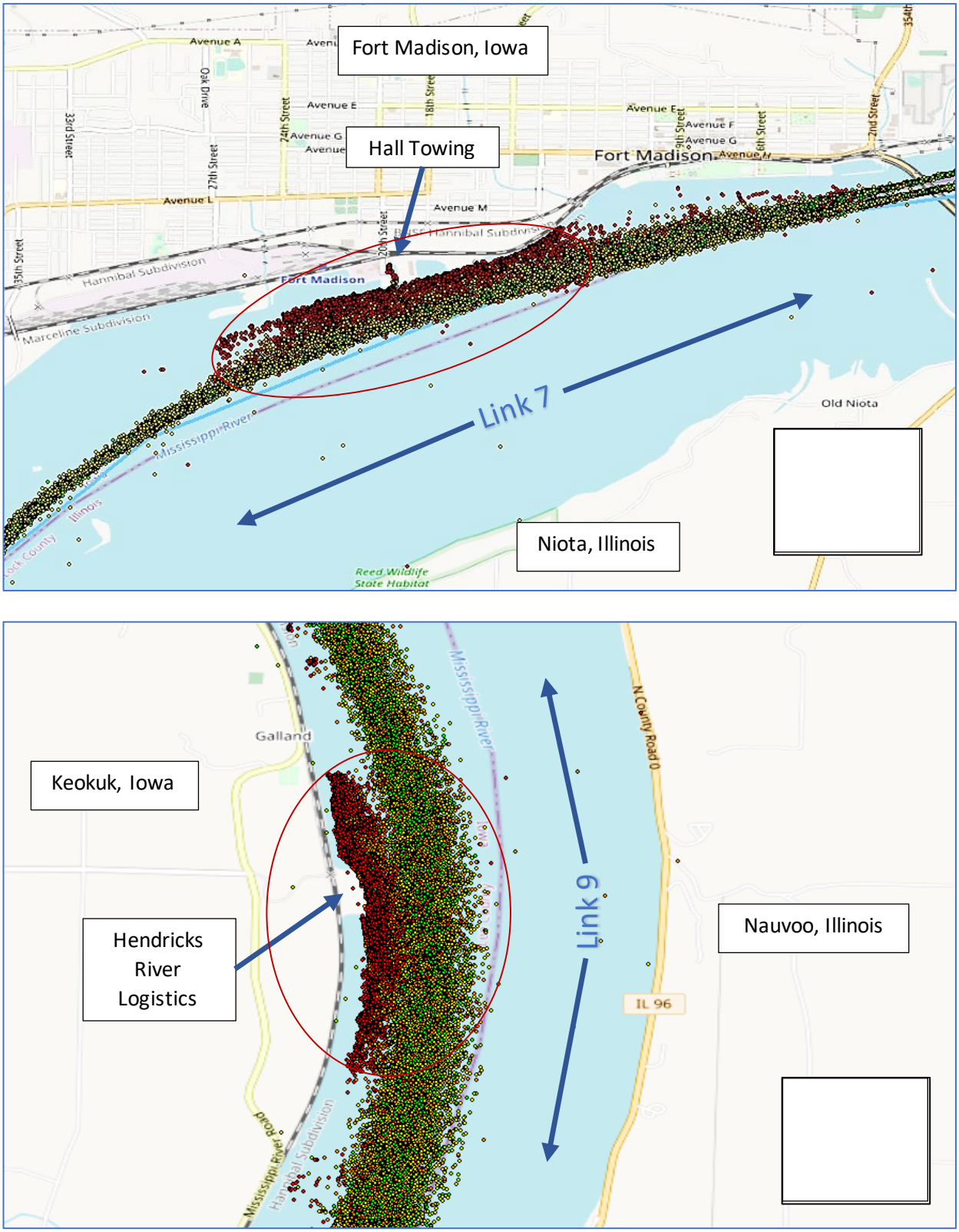


Figure 20. Study Segments Link 7 and Link 9 AIS Trajectories.

Link Total Travel Time above Baseline

The study estimated the annualized link total travel time above the baseline from 2018 through 2020 AIS data. The baseline travel time is defined as a travel time of a link when a vessel navigates the link without any interruption or impediments. In this study, 25th percentile link travel time is used as a proxy for the baseline travel time.

The total travel time above the baseline for a link is equal to the sum of the time spent above the baseline of all transits for the time period. It depends on both the number of transits with travel time above the baseline for the time period and the amount of travel time above the baseline for each transit. By definition, total travel time above the baseline does not distinguish between a link with many transits with small travel times above the baseline and a link with few transits each with large travel time above the baseline. However, the link travel time distribution plots could provide additional information about the skewness of the transit times. Appendix C includes the link travel time histograms by year by direction.

Figure 21 shows the total travel time above the baseline in 2018 through 2020. In the figure, the links that stand out are the links with relatively long distances or locks. The year 2019 shows consistently lower total travel time above baseline. It is because 2019 has only about 60 percent of the samples compared to the other 2 years due to flooding.

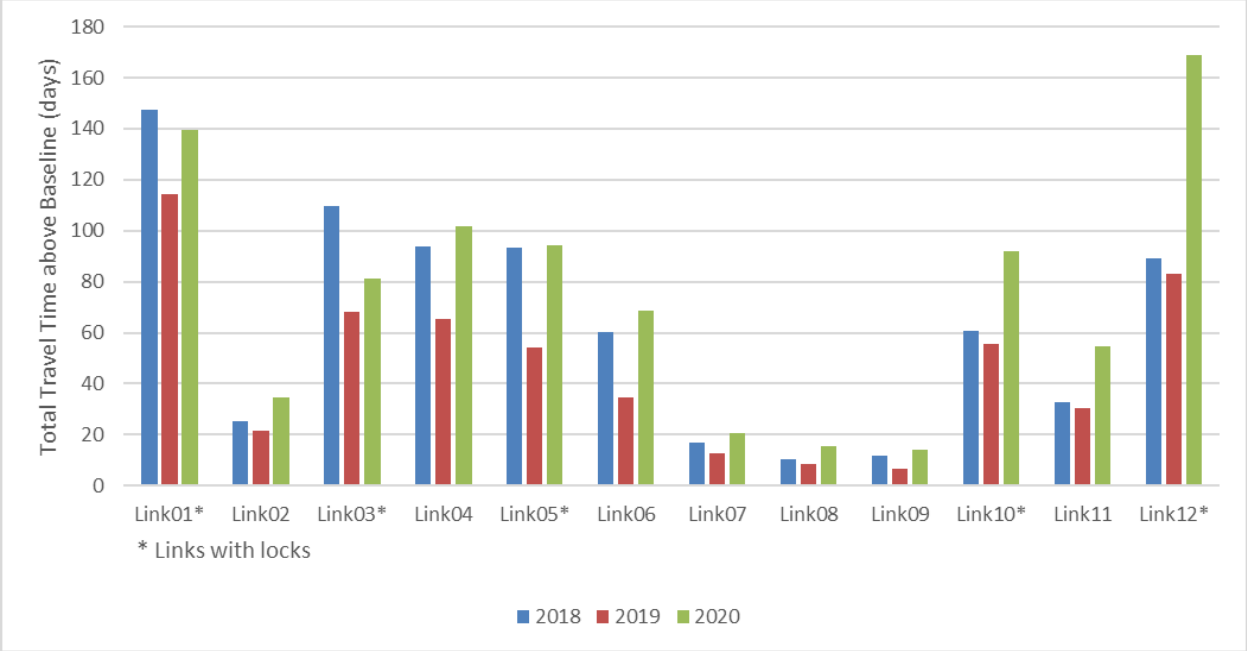


Figure 21. Study Segment Total Travel Time above Baseline by Link, 2018–2020.

To exclude the effect of the different link lengths, the per-mile total travel time above the baseline is calculated and plotted in Figure 22. Now the figure shows Links 7 and 9 with more total travel times above the baseline though the length is relatively short (4 miles each). Link 7 and Link 9 have Hall Towing Terminal and Hendricks River Logistics, respectively, that would create more cargo transfer activity and delays in each link.

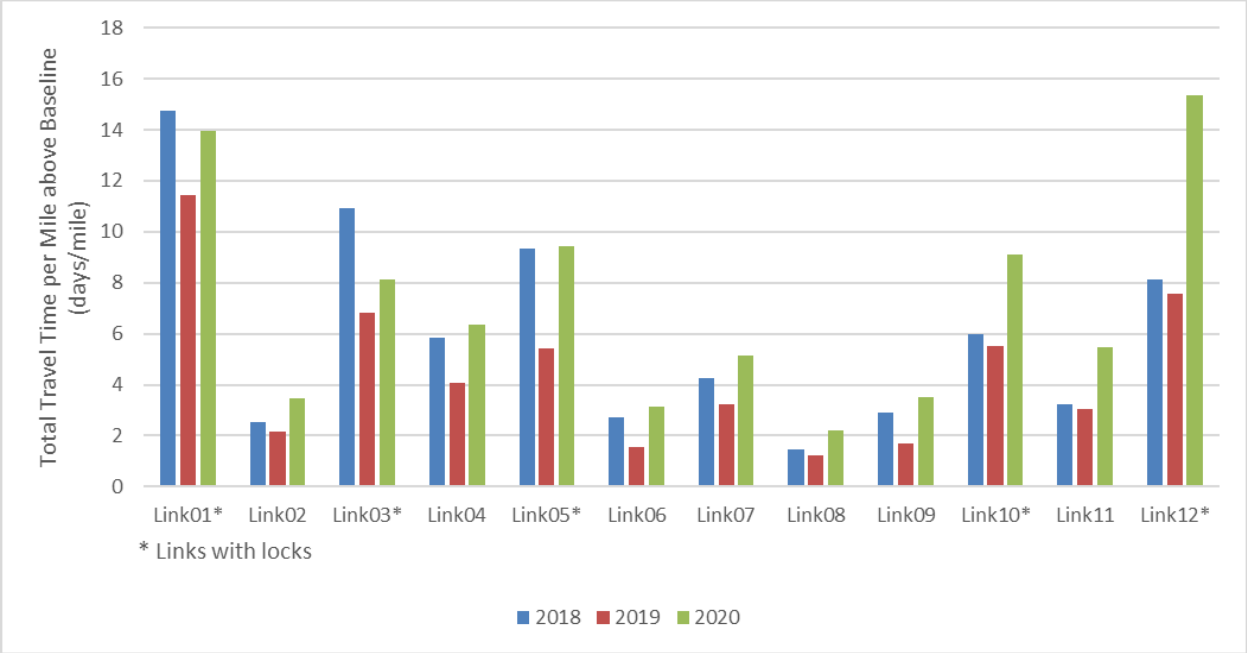


Figure 22. Study Segment Total Travel Time per Mile above Baseline by Link, 2018 and 2019.

O-D Travel Times

This study analyzed various travel time statistics for the links between the O-D locations from 2018–2020 AIS data. The most accurate travel time estimates would be calculated from the vessel trips that navigate the O-D points in one path of a trip. However, this path-based approach usually suffers from a lack of enough samples when the distance between the origin and the destination increases, or the sample includes areas with very low traffic volumes for various reasons. In this section, a link-based approach is used. All the in-between links' average travel times between an origin and a destination are added together. Percentiles are not calculated because with the differences in the lengths of links and the cutoff parameters, the percentiles are likely to produce erroneous results.

Table 6 shows the 3-year average travel time between major O-Ds in the study segments for 2018 and 2020. The values in the table are directional. For example, the southbound (downstream direction) average travel time, 18.43 hours, from the north end of the study segment to the Hall Towing segment is different from the northbound (upstream direction) travel time, 21.43 hours, from the Hall Towing segment to the north end of the study segment. As shown in the previous sections, the northbound trips take longer between the same O-D pair.

Table 6. Three-Year Average Travel Times between O-Ds (Hours).

Origin \ Destination	North End of Study Segment	Hall Towing Segment	Hendricks River Logistics Segment	South End of Study Segment
North End of Study Segment	-	18.43	20.42	26.37
Hall Towing Segment	21.43	-	1.04	7.00
Hendricks River Logistics Segment	23.85	1.35	-	5.36
South End of Study Segment	30.44	7.94	5.82	-

Comparison between Link-Based and Path-Based Travel Time Calculation

The calculation of the average travel times between O-D pairs in the previous section used a link-based approach where the individual average travel times of each link between an O-D were added together. A path-based approach is preferable but requires relatively homogeneous characteristics between the links in the O-D pair to produce reliable estimates. This assumption could not be guaranteed in every situation.

Figure 23 illustrates the difference between a link-based and a path-based estimate between the north and south ends of the study segment. As shown in the diagram, the link-based route consists of 12 consecutive links that have the samples collected separately. Therefore, the sample distributions are different from each other. On the other hand, the path-based route has samples collected from the vessel trips that make a complete voyage as one link between the two O-D locations. Inherently, the path-based approach gives more reliable estimates. However, for a path-based approach to work, every combination of O-D pairs has to have its own samples and be evaluated independently. It is not always practical when the survey area is large and the number of time periods is increasing.

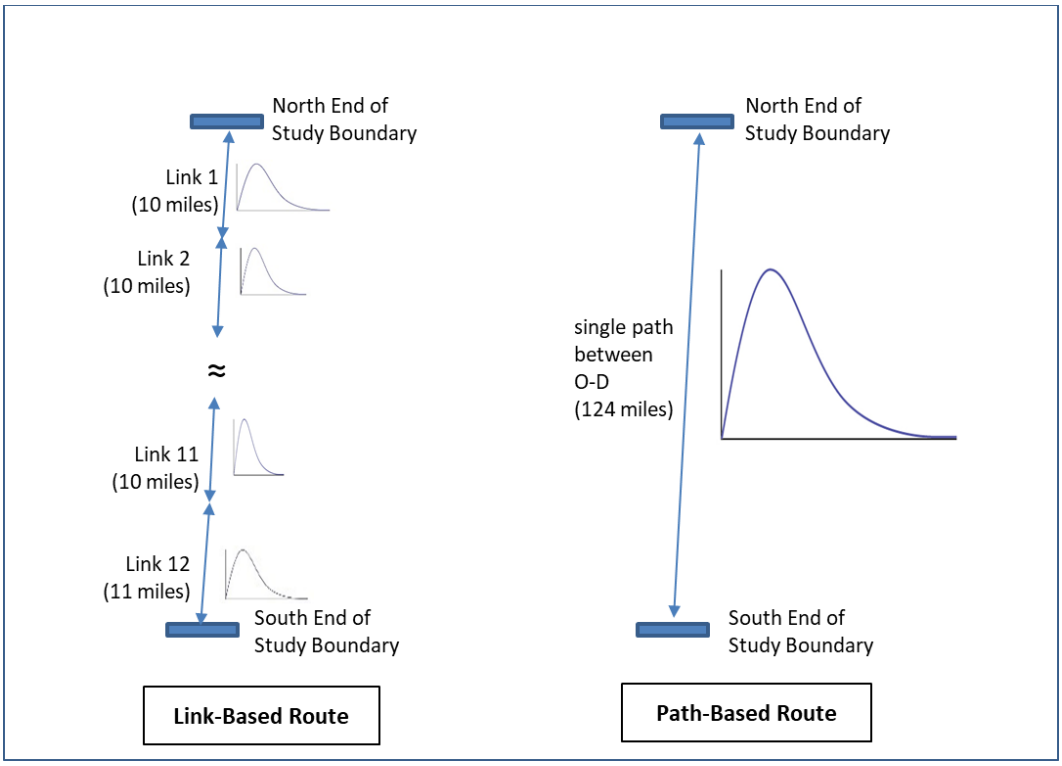


Figure 23. Schematic Diagram of Link-Based and Path-Based Travel Time Calculation.

Table 7 compares the travel time estimates for the link-based and the path-based calculations. In the table, the median value (50th percentile) of the path-based estimate is about 20 percent larger than the link-based estimate for an O-D pair between Link 1 and Link 12. The average travel times show relatively small differences between the two approaches. Figure 24 confirms this trend in the plots. The path-based approach has a smaller number of samples in all direction and year combinations. The link-based approach includes samples from the 12 individual links, while the path-based approach needs complete trips from the beginning to the end between Link 1 and Link 12.

Table 7. Comparison of Travel Times (Hours) Using Link-Based and Path-Based Approaches.

Travel Time between Link 1 and Link 12		2018		2019		2020	
		SB	NB	SB	NB	SB	NB
		Avg TT	Avg TT	Avg TT	Avg TT	Avg TT	Avg TT
Average Travel Time (hours)	Link-Based	37.79	40.87	38.94	42.79	37.78	40.67
	Path-Based	37.15	41.98	39.85	42.47	37.46	41.04
25th Percentile Tavel Time	Link-Based	24.79	29.33	24.54	30.12	25.75	29.21
	Path-Based	29.92	35.25	31.25	35.88	31.25	35.50
50th Percentile Travel Time	Link-Based	29.33	34.96	29.25	35.50	30.87	34.67
	Path-Based	37.15	41.98	39.85	42.47	37.46	41.04
75th Percentile Travel Time	Link-Based	38.29	44.67	39.83	46.58	40.58	45.17
	Path-Based	40.08	45.67	46.25	46.54	42.17	45.25
Number of Samples	Link-Based	616	656	407	443	731	786
	Path-Based	539	558	353	348	621	647

Note: Link-based sample numbers indicate the average values.

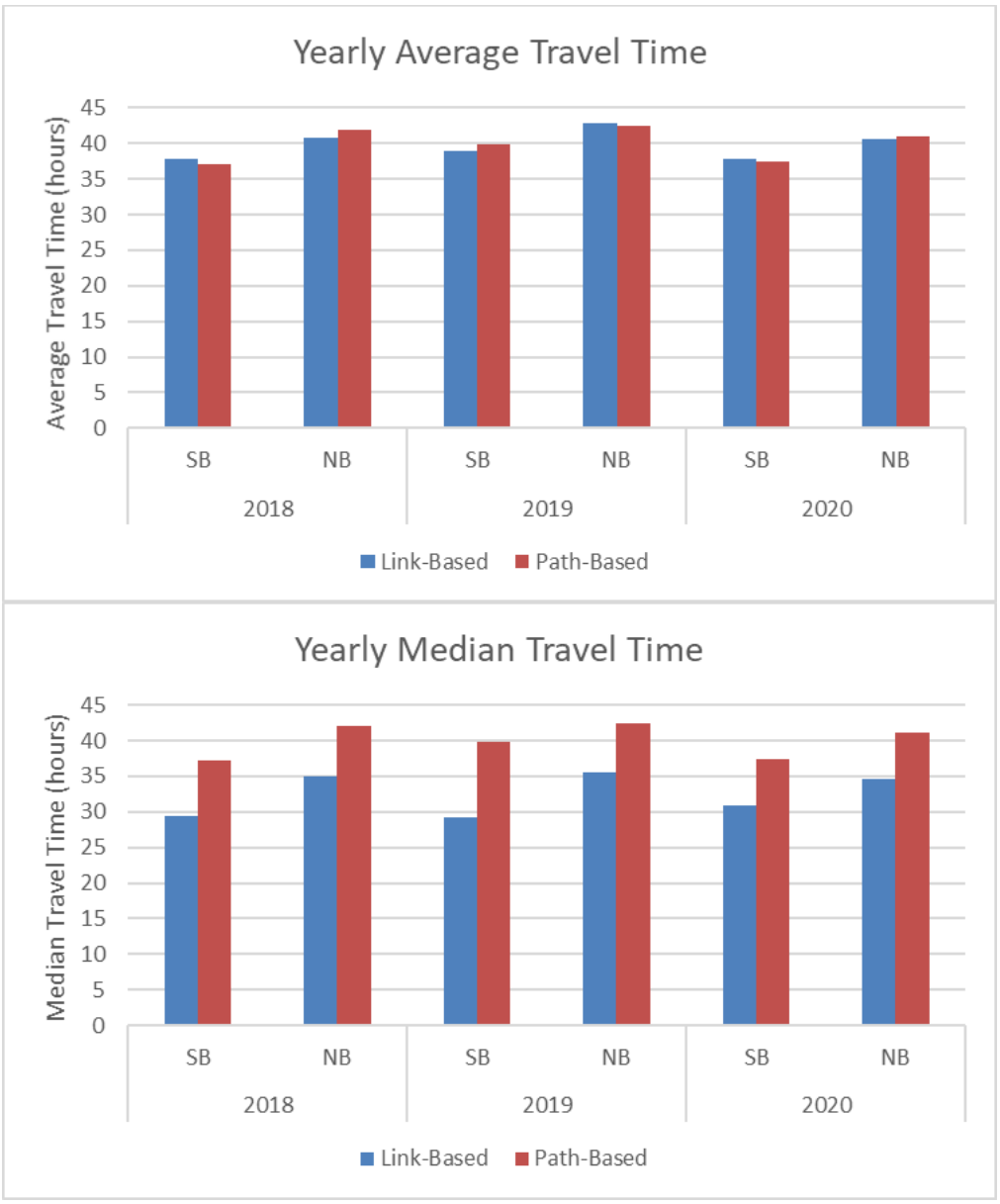


Figure 24. Comparison of Average and Median Travel Times (Hours) Using Link-Based and Path-Based Approaches.

CHAPTER 4: STATISTICAL ANALYSIS: FORECASTS AND SPECIAL CONDITIONS

Based on speeds derived from the travel times calculated in Chapter 3, the research team developed a methodology to obtain speed forecast models and to assess if, and how, different factors or variables affect such speeds and consequently travel times.

The factors of interest were continuous and Boolean (binary). Therefore, the methodology was divided in two groups:

- Group 1 focuses on the forecast models for continuous variables: Sample size (as a proxy for traffic or congestion) and water stage/level.
- Group 2 focuses on evaluating the statistical significance and estimating the impact on speeds from the Boolean variables: Flooded condition of the river segment and direction.

This chapter describes the methodologies, methods, and results of these analyses.

The input data consisted of 1,388 data points representing 3 years (2018–2020) of daily travel time averages for 22 different (sub)links.

The statistical analysis relied primarily on four sets of data:

1. Estimated speeds from AIS data.
2. Direction from AIS data.
3. River gauge-water level readings.
4. River flooded conditions.

Datasets 1 and 3 are formed of continuous values by nature, while datasets 2 and 4 contain binary values.

Gauges

Daily river gauge readings were acquired for gauges operated by the Rock Island District of the Corps of Engineers in the vicinity of each lock in the study segment. It is important to understand what these readings represent. These readings are typically referred to as river stages. They indicate the height of the water in the stream above a reference point. Gauge height refers to the elevation of the water surface above that reference point in the specific pool at the gauge station. Actual river depth may vary between gauges. Additionally, the reference point used by the gauges differs from station to station. For this reason, the readings are not comparable from gauge to gauge.

The definition of flood stage for each gauge is important because of the differences in the reference points established for each gauge. For this analysis, the gauge readings are used as a continuous variable for water levels and as a Boolean/binary variable to indicate whether a river is in a flood condition based on thresholds determined by the National Weather Service's Advanced Hydrologic Prediction Service for each of the links.

An important aspect of the analysis is the relationships between links, sublinks, and gauge readings. The reported gauges are close to the locks. The locks hold back the water, so a gauge at a lock would

represent the pool created by the lock, which could include several links and corresponding sublinks. The links with locks have the lock in the middle, so the gauge reading would cover the distance from the sublink on the upstream side of a lock to the downstream sublink of the next lock upriver. Based on this understanding, the TTI team developed Table 8, which shows the relations between links, sublinks, and gauge readings (i.e., locks).

Table 8. Links, Sublinks, and Gauge Readings.

Link	Sublink	Lock
1	Link01U	16
	LD16	
	Link01D	17
2	Link02	
3	Link03U	
	LD17	
	Link03D	18
4	Link04	
5	Link05U	
	LD18	
	Link05D	19
6	Link06	
7	Link07	
8	Link08	
9	Link09	
10	Link10U	
	LD19	
	Link10D	20
11	Link11	
12	Link12U	
	LD20	
	Link12D	N/A

Group 1 and 2—Analysis and Results

For the analysis of Group 1 variables, the methodology included the following steps:

1. Check linearity.
2. Check homogeneity and normality.
3. Run linear or non-linear models.
4. Select a model.

The linearity check between the sample size and speeds was necessary to decide the general type of models to use for assessing the effects of the number of trips on transit time. Homogeneity and normality are assumptions needed in linear models. Homogeneity looks at having a steady or constant variability (i.e., variance) through different values of the explanatory variable (i.e., sample count). Normality looks at the shape of the distribution, which when not normal would yield inaccurate results

using simple linear regression, and thus other techniques such as generalized linear models should be implemented.

When the relation between sample size and speeds were found not linear, researchers evaluated eight different non-linear models:

- Exponential trend.
- Logarithmic.
- Power curve.
- Reciprocal.
- Log reciprocal.
- Modified exponential.
- Gompertz.
- Logistic.

For Group 1 analysis, researchers evaluated 357 models for the continuous variable and used the R-squared and adjusted R-squared statistical measures, and the coefficient significance (i.e., p-value) to determine the best models for each of those variables.

For the case of Group 2 (binary variables) researchers used analyses of variance (ANOVAs) to determine the statistical significance of the mean differences between subgroups. Those subgroups were defined as South or Northbound direction subgroups and Flooded or Not Flooded subgroups.

Group 1 Results

The statistical analysis suggested that sample size (i.e., completed trips through a link or sublink) did influence travel time significantly in all links but not linearly. For most links, the relationships between sample size and speeds were found to follow an exponential curve, and a few were also found to follow a power curve and a log reciprocal.

Figure 25, Figure 26, and Figure 27 show the behavior of speeds (y-axis) based on traffic (sample size on the x-axis) for Sublink 2 (exponential), Sublink 7 (log reciprocal), and Sublink 9 (power curve). The red line represents the estimates (i.e., forecasted values), and the green dashed line shows the averages by traffic (sample size) level from real data.

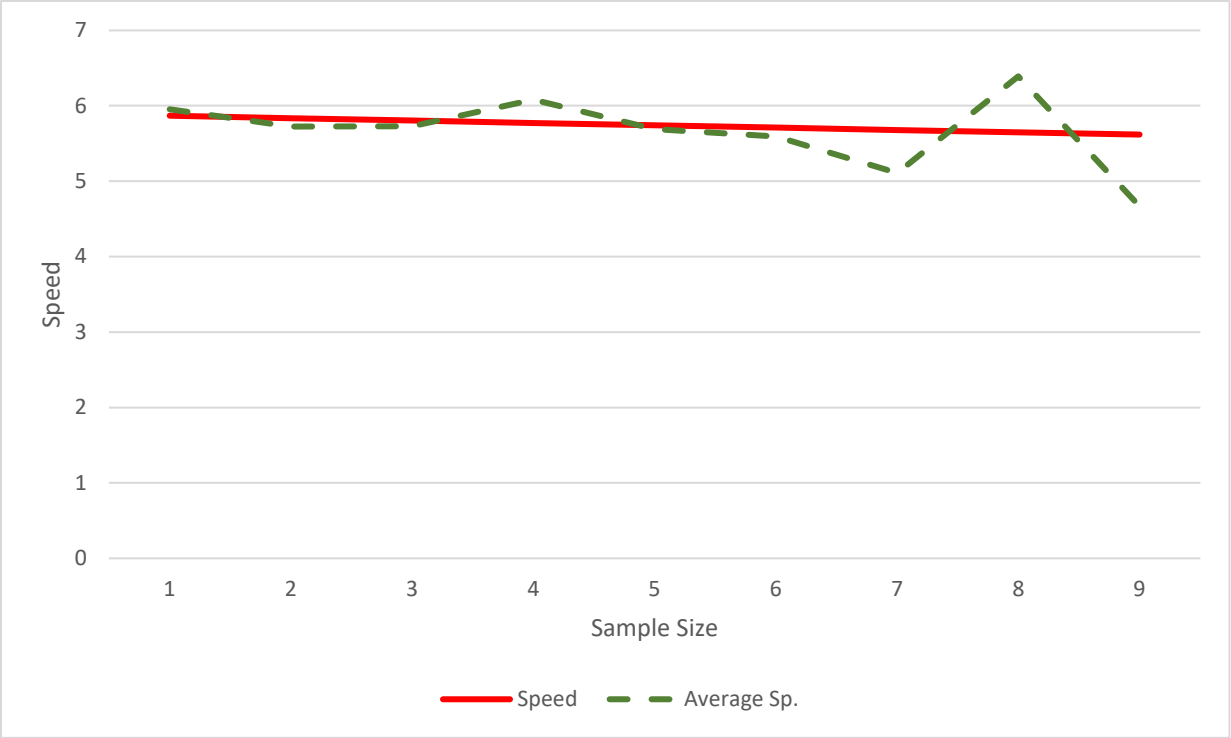


Figure 25. Sublink 2 Speed versus Traffic (Sample Size).

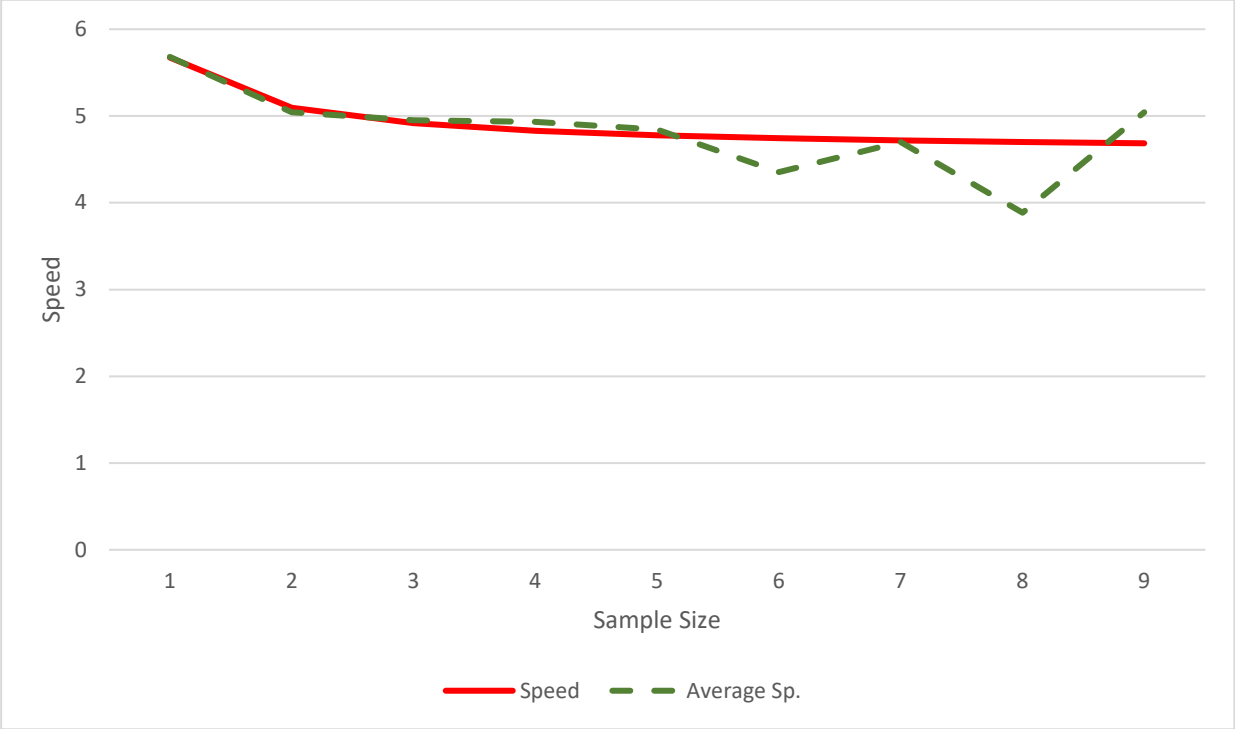


Figure 26. Sublink 7 Speed versus Traffic (Sample Size).

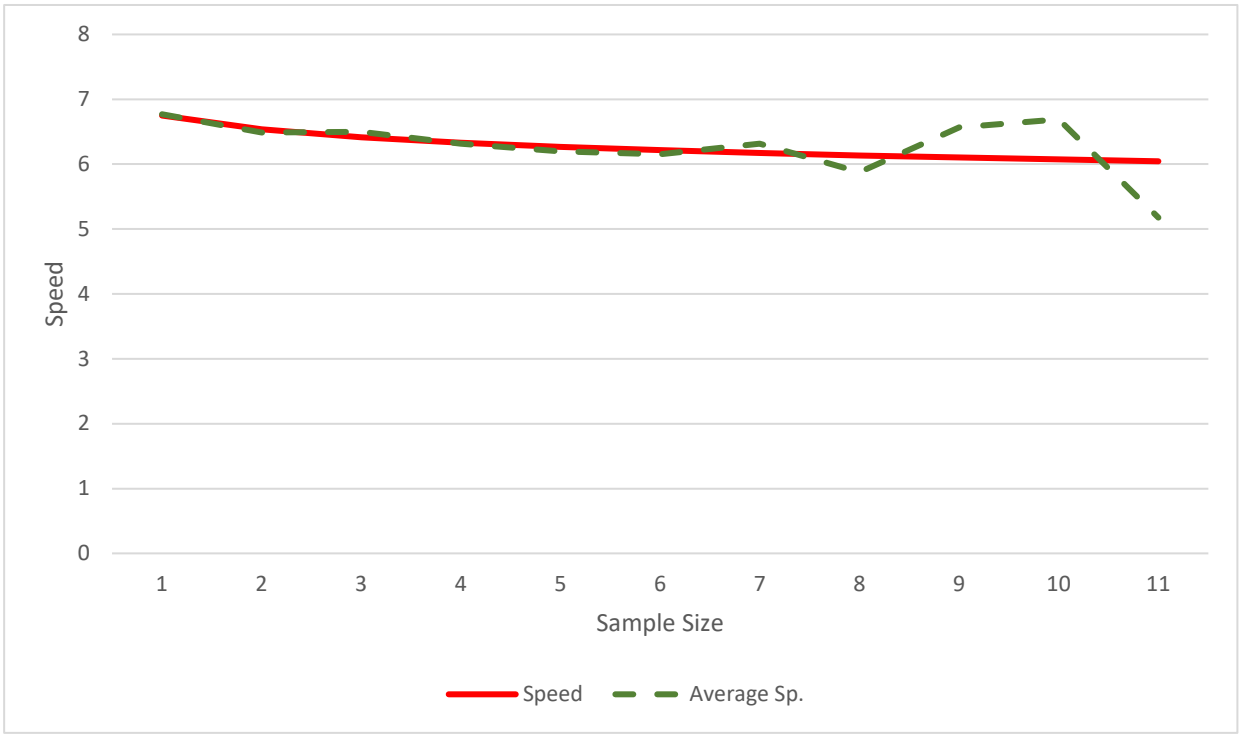


Figure 27. Sublink 9 Speed versus Traffic (Sample Size).

As these figures show, the estimated speed behavior (red line) matches almost identically the actual behavior of speed derived from real data (green dashed line), which supports the statistical analysis numerical results and confirms the accuracy of the models for predicting speeds.

Also, one would expect that the amount of traffic in a given (sub)link would affect speed (and travel time) in the same (sub)link. This relationship is analogous to the effect of road congestion in road travel time. Based on this, the estimates and real speeds behave as expected by decreasing when traffic level increases. However, this inverse relation between speed and traffic level is not linear; therefore, speed does not change at a constant rate when traffic level changes, given its non-linear nature.

For the case of water stage/level effect on speeds, although the statistical analysis produced models with good R-squared and adjusted R-squared values, results also yielded low significance of coefficients in several of the models. Figure 28. Sublink 2 Speed versus Water Level (Stage).

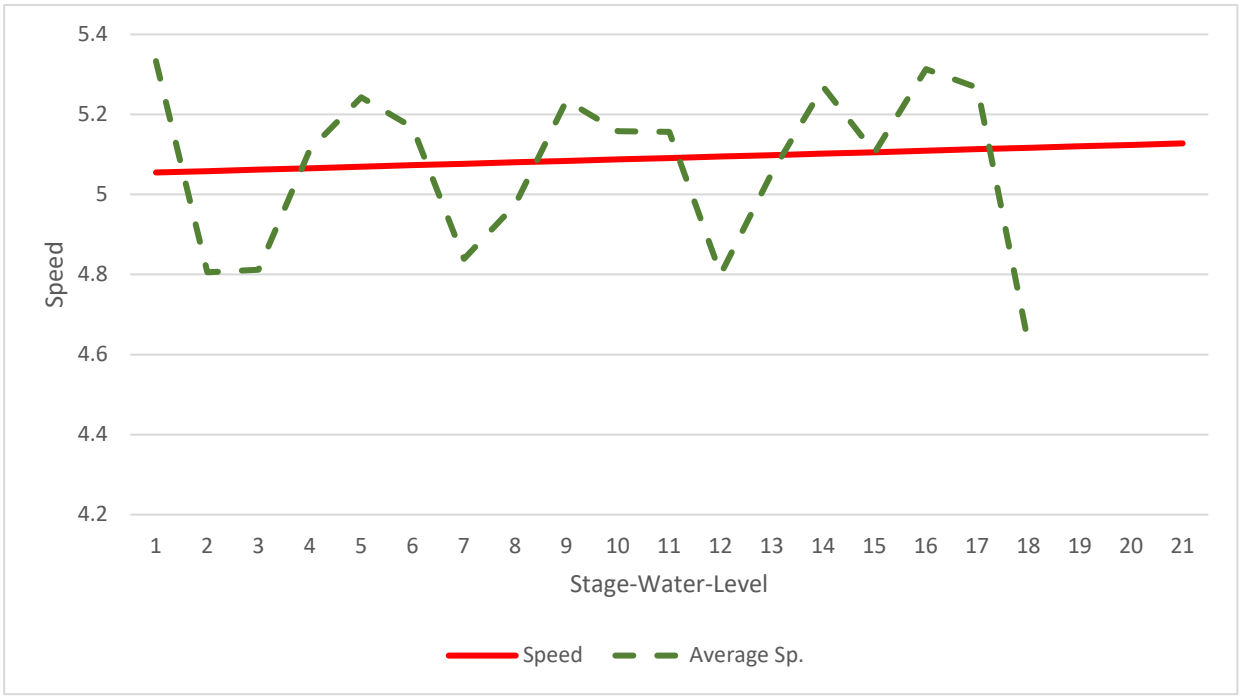


Figure 28, Figure 29, and Figure 30 show the water level relationships to speeds in the same links previously presented. As before, the red line denotes model estimates, and the green dashed line represents real data averages for water level.

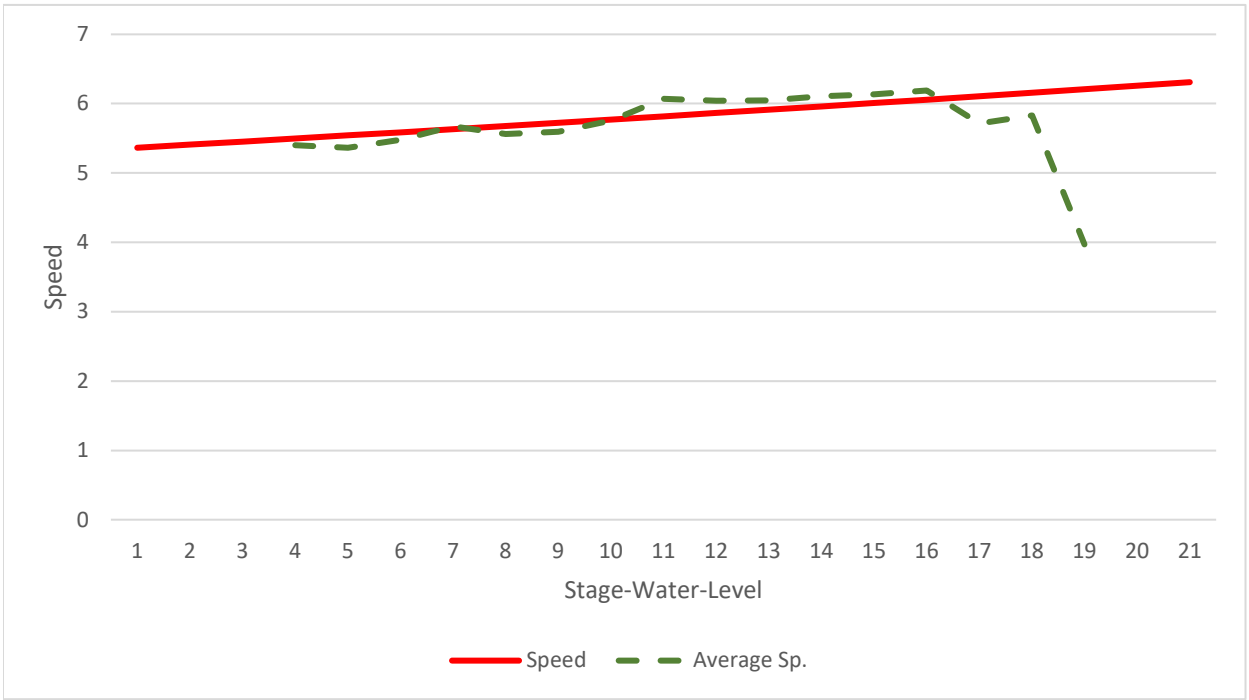


Figure 28. Sublink 2 Speed versus Water Level (Stage).

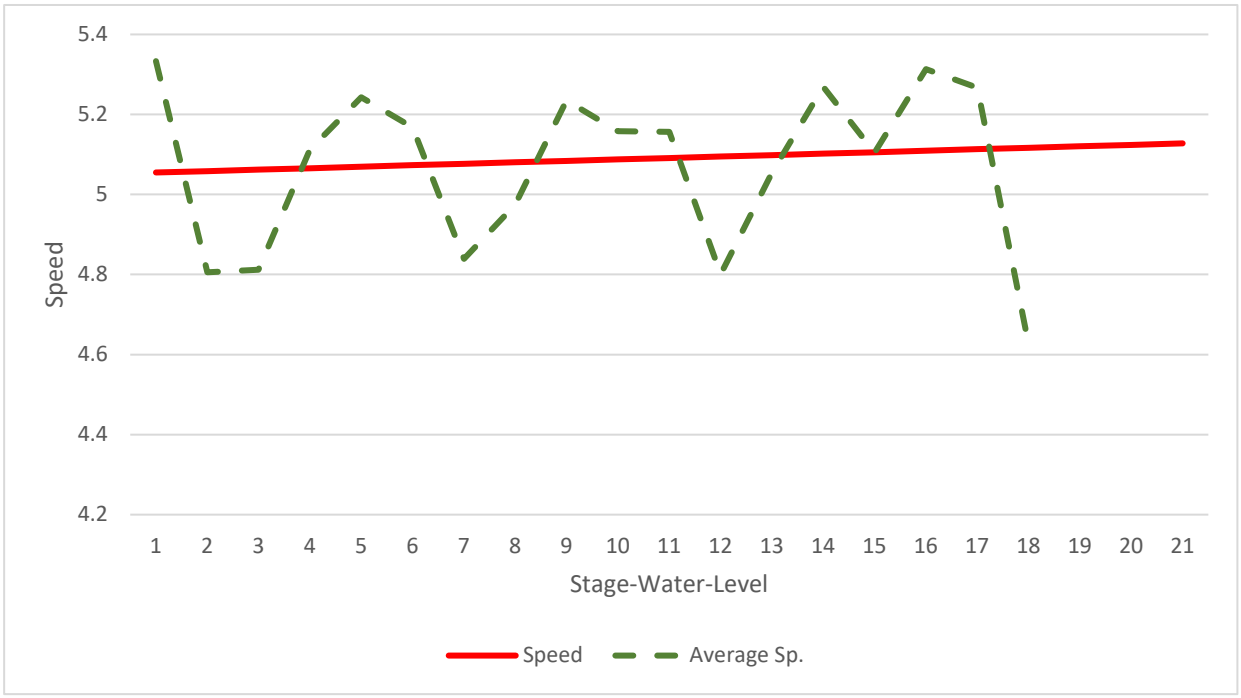


Figure 29. Sublink 7 Speed versus Water Level (Stage).

Figure 30. Sublink 9 Speed versus Water Level (Stage).

The stage versus speed models perform better for Sublinks 2 and 9 than for Sublink 7. However, it seems counterintuitive to find a positive relationship that increases speed when water level increases as well.

Regardless of the reason for this positive behavior, real data support this positive relationship, judging by how the green dashed curve mimics the trend of the red line estimates.

Graphs for all sublinks are shown in Appendix E: Graphs of Speed versus Water Level (Stage) by Sublink and Appendix F: Graphs of Speed versus Traffic (Sample size) by Sublink. Appendix G: Statistical Results for Selected Models shows the models deemed as best fit.

Group 2 Results

The ANOVA suggests that the speed differences between the two directions is significant in all but one of the sublinks. Figure 31 presents graphically the results from the ANOVA for speeds by direction that are deemed significant. Blue columns denote speeds for southbound trips, orange columns show speeds for the opposite direction, and gray columns represent the differences between these two.

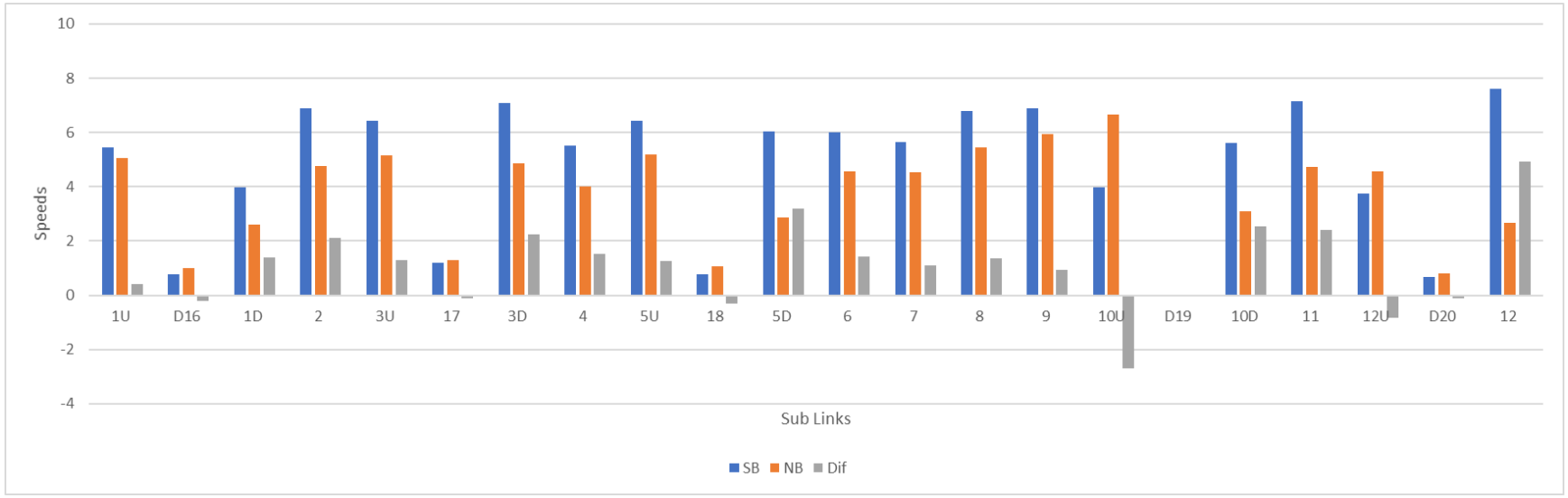


Figure 31. Speeds by Direction (ANOVA).

The only sublink deemed as nonsignificant was Sublink 10 center containing Lock and Dam 19. Also, most sublinks show higher speeds southbound than northbound.

In the case of flooded versus not-flooded speeds, ANOVA results suggest that most sublinks present non-significant differences. Figure 32 shows results from ANOVA for speeds deemed significant by flood condition.

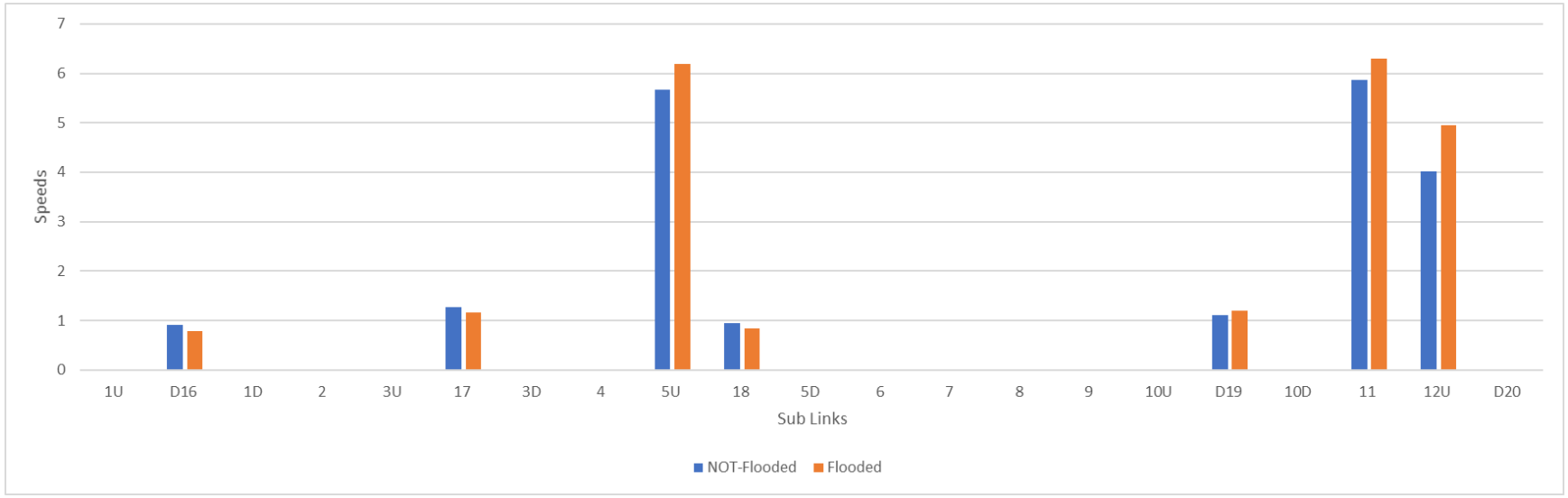


Figure 32. Speeds by Flood Condition (ANOVA).

This flood condition figure shows that some of the significant differences show higher speeds when flooded than when water levels are deemed “normal.” The low level of significance in speed averages by flood conditions and the inconsistency in speed behavior when water levels are considered normal may be due to the fact that flooded conditions are set arbitrarily without a consistent criteria across locks, links, and sublinks. In other words, the parameters to set the threshold for a segment to be considered flooded appear to vary from segment to segment. The ANOVA is capturing these inconsistencies by deeming the average differences among many sublinks as non-significant.

These statistical analysis results confirmed the accuracy of the models developed, which are a useful tool to forecast speed behavior given a level of traffic (sample size) for each of the sublinks. These results could also help set a more consistent flood threshold by providing a clear quantitative analysis of travel behavior (i.e., speed) at different water or stage levels.

CHAPTER 5: CONCLUSIONS/FUTURE RESEARCH

Based on statistics published by WCSC, AIS data provide a reasonably robust sample for the calculation of performance measures. Much of the effort involved in using AIS data is focused on cleaning the data and reducing it to inland towing traffic.

A path-based approach is the preferred method for calculating travel times between O-D pairs, but some practical considerations led the researchers to opt for the use of link-based travel times. A path approach requires a separate sample to be developed and maintained for each O-D pair, and each pair must be evaluated independently. Given the complexity of the GIWW, this was not a viable approach for this research.

The statistical analysis was divided in two groups. The first group looked at developing the forecast models for continuous variables (ample size and water level stage) based on historical data. The second group focused on assessing the effects of Boolean factors (direction and flood condition) on speed.

Results from the Group 1 analysis suggest that sample size (i.e., completed trips through a link or sublink) impacted travel time significantly in all links but in a non-linear manner. For most links, the relationship between sample size and speed was found to follow an exponential curve, and a few were also found to follow a power curve and a log reciprocal. In any case, the relationship between speed and traffic behaves as expected by decreasing speed when traffic level increases. However, because this inverse relation is inherently non-linear, speed does not change at a constant rate when traffic level changes. Counterintuitively, the relationship of speed to water stage/level is found to be positive in some sublinks. Regardless of the reason for this positive behavior, real data support this positive relationship by how real data averages match the trend of the estimates.

The Group 2 analysis found that the speed differences between northbound and southbound directions are significant in all but one of the sublinks. The northbound travel speeds tend to be slower than the southbound, which would be expected given the river current. The links containing river terminals showed the highest degree of variability in travel times, which suggests that there is friction between terminal operations and passing tows. The analysis for the second group also suggests that most sublinks present non-significant differences for the case of flooded versus not-flooded speeds. This low level of significance in speed averages by flood conditions and the inconsistency in speed behavior when water levels are considered normal may be due to the fact that flooded conditions are set arbitrarily without a consistent criteria across locks, links, and sublinks.

These statistical analysis results confirmed the accuracy of the models developed, which are a useful tool to forecast speed behavior given a level of traffic (sample size) for each of the sublinks. These results could also help set a more consistent flood threshold by providing a clear quantitative analysis of travel behavior (i.e., speed) at different water or stage levels.

The methodology developed provides quantitative results that predict, describe, and validate future travel time behaviors based on specific factors. Users of the IWW can use statistics such as those provided by this study to have a sense of estimated travel time and potential effects of different factors in a link they may need to traverse. If this type of study is performed regularly, it would highlight

significant changes in links and allow analysts to focus on trouble spots along the waterway. Such data will also aid in planning the timing and magnitude of maintenance activities on the IWW.

Future research should focus on obtaining additional data that enable more robust projections by including additional explanatory variables such as weather-related information.

APPENDIX A: AIS MESSAGES

There are 27 defined AIS message types. Types 28–63 are undefined and reserved for future use.

Only a few of these types are relevant to the study objectives. Types 1–3 are various position reports. Type 5 is static and voyage-related data. This appendix shows the contents of these message types (*6*). For this study, USACE stripped unnecessary fields and consolidated relevant information into single records for each vessel at 5-second intervals.

Message Types 1, 2, and 3: Position Reports

Parameter	Number of Bits	Description
Message ID	6	Identifier for this message 1, 2, or 3
Repeat indicator	2	Used by the repeater to indicate how many times a message has been repeated. See Section 4.6.1, Annex 2; 0-3; 0 = default; 3 = do not repeat any more.
User ID	30	MMSI number
Navigational status	4	0 = under way using engine 1 = at anchor 2 = not under command 3 = restricted maneuverability 4 = constrained by her draught 5 = moored 6 = aground 7 = engaged in fishing 8 = under way sailing 9 = reserved for future amendment of navigational status for ships carrying dangerous goods (DG), harmful substances (HS), or marine pollutants (MP), or IMO hazard or pollutant category C, high speed craft (HSC) 10 = reserved for future amendment of navigational status for ships carrying dangerous goods (DG), harmful substances (HS) or marine pollutants (MP), or IMO hazard or pollutant category A, wing in ground (WIG) 11 = power-driven vessel towing astern (regional use) 12 = power-driven vessel pushing ahead or towing alongside (regional use) 13 = reserved for future use 14 = AIS-SART (active), MOB-AIS, EPIRB-AIS 15 = undefined = default (also used by AIS-SART, MOB-AIS and EPIRB-AIS under test)
Rate of turn ROTAIS	8	0 to +126 = turning right at up to 708 deg per min or higher 0 to –126 = turning left at up to 708 deg per min or higher Values between 0 and 708 deg per min coded by ROTAIS = 4.733 SQRT(ROTsensor) degrees per min where ROTsensor is the Rate of Turn as input by an external Rate of Turn Indicator (TI). ROTAIS is rounded to the nearest integer value +127 = turning right at more than 5 deg per 30 s (No TI available) –127 = turning left at more than 5 deg per 30 s (No TI available) –128 (80 hex) indicates no turn information available (default). ROT data should not be derived from COG information.
SOG	10	Speed over ground in 1/10 knot steps (0–102.2 knots) 1 023 = not available, 1 022 = 102.2 knots or higher

Parameter	Number of Bits	Description
Position accuracy	1	The position accuracy (PA) flag should be determined in accordance with the table below: 1 = high (<= 10 m) 0 = low (> 10 m) 0 = default
Longitude	28	Longitude in 1/10 000 min (+/–180 deg East = positive [as per 2's complement], West = negative (as per 2's complement). 181= (6791AC0h) = not available = default)
Latitude	27	Latitude in 1/10 000 min (+/–90 deg, North = positive (as per 2's complement), South = negative (as per 2's complement). 91deg (3412140h) = not available = default)
COG	12	Course over ground in 1/10 = (0–3599). 3600 (E10h) = not available = default. 3 601-4 095 should not be used
True heading	9	Degrees (0-359) (511 indicates not available = default)
Time stamp	6	UTC second when the report was generated by the electronic position system (EPFS) (0–59, or 60 if time stamp is not available, which should also be the default value, or 61 if positioning system is in manual input mode, or 62 if electronic position fixing system operates in estimated (dead reckoning) mode, or 63 if the positioning system is inoperative)
Special maneuvre indicator	2	0 = not available = default 1 = not engaged in special maneuver 2 = engaged in special maneuver (i.e., regional passing arrangement on Inland Waterway)
Spare	3	Not used. Should be set to zero. Reserved for future use.
RAIM-flag	1	Receiver autonomous integrity monitoring (RAIM) flag of electronic position fixing device; 0 = RAIM not in use = default; 1 = RAIM in use.
Communication state (see below)	19	See Rec. ITU-R M.1371-5 Table 49
Number of bits	168	

Message Type 5: Ship Static and Voyage Related Data

Parameter	Number of Bits	Description
Message ID	6	Identifier for this Message
Repeat indicator	2	Used by the repeater to indicate how many times a message has been repeated. Refer to §4.6.1, Annex 2; 0-3; 0 = default; 3 = do not repeat any more
AIS version indicator	2	0 = station compliant with Recommendation ITU-R M.1371-1 1 = station compliant with Recommendation ITU-R M.1371-3 (or later) 2 = station compliant with Recommendation ITU-R M.1371-5 (or later) 3 = station compliant with future editions
IMO number	30	0 = not available = default – Not applicable to SAR aircraft 0000000001-0000999999 not used 0001000000-0009999999 = valid IMO number 0010000000-1073741823 = official flag state number
Call sign	42	7?=?6-bit ASCII characters, @@@@@@@ = not available = default Craft associated with a parent vessel should use “A” followed by the last 6 digits of the MMSI of the parent vessel. Examples of these craft include towed vessels, rescue boats, tenders, lifeboats, and life rafts.
Name	120	Maximum 20 characters 6-bit ASCII “@@@@@@@@@@@@@@@@@@@@” = not available = default The Name should be as shown on the station radio license. For SAR aircraft, it should be set to “SAR AIRCRAFT NNNNNNN” where NNNNNNN equals the aircraft registration number.
Type of ship and cargo type	8	0 = not available or no ship = default 1–99 = as defined at U.S. Coast Guard Navigation Center 100–199 = reserved, for regional use 200–255 = reserved, for future use Not applicable to SAR aircraft
Overall dimension/ reference for position	30	Reference point for reported position. Also indicates the dimension of ship (m). For SAR aircraft, the use of this field may be decided by the responsible administration. If used it should indicate the maximum dimensions of the craft. As default should A = B = C = D be set to “0.”

Parameter	Number of Bits	Description
Type of electronic position fixing device	4	0 = undefined (default) 1 = GPS 2 = GLONASS 3 = combined GPS/GLONASS 4 = Loran-C 5 = Chayka 6 = integrated navigation system 7 = surveyed 8 = Galileo 9–14 = not used 15 = internal GNSS
ETA	20	Estimated time of arrival; MMDDHHMM UTC Bits 19-16: month; 1–12; 0 = not available = default Bits 15-11: day; 1–31; 0 = not available = default Bits 10-6: hour; 0–23; 24 = not available = default Bits 5-0: minute; 0–59; 60 = not available = default For SAR aircraft, the use of this field may be decided by the responsible administration.
Maximum present static draught	8	In 1/10 m, 255 = draught 25.5 m or greater, 0 = not available = default; in accordance with IMO Resolution A.851 Not applicable to SAR aircraft, should be set to 0
Destination	120	Maximum 20 characters using 6-bit ASCII; @@@@@@@@@@@@@@@@@@@@ = not available For SAR aircraft, the use of this field may be decided by the responsible administration.
DTE	1	Data terminal equipment (DTE) ready (0 = available, 1 = not available = default)
Spare	1	Spare. Not used. Should be set to zero. Reserved for future use.
Number of bits	424	Occupies 2 slots

APPENDIX B: ADDITIONAL RESULTS

This appendix includes summary tables for each link. Each yearly table contains the following estimates for a link: the number of transits (labeled “count”); 25th, 50th, and 75th percentile travel times; average travel time; and standard deviation of travel time. Each monthly and weekly table contains average travel times and the number of transits. The tables provide the results by direction of travel. In addition, the tables provide the results by the following time periods: annual, monthly, and weekly. This disaggregation is to support future studies that may want to consider different factors, such as weather conditions, that affect travel time. The tables label the weeks by number, and Table 9 provides the corresponding dates for each week number for 2018, 2019, and 2020. Each table contains its link number in the first row of the table. The study provides the tables in link order from 1 through 12.

Table 9. Weeks of the Year by Number, 2018–2020.

2018			2019			2020		
Week Number	Start Date	End Data	Week Number	Start Date	End Data	Week Number	Start Date	End Data
1	1/1/2018	1/7/2018	53	12/31/2018	1/6/2019	105	12/30/2019	1/5/2020
2	1/8/2018	1/14/2018	54	1/7/2019	1/13/2019	106	1/6/2020	1/12/2020
3	1/15/2018	1/21/2018	55	1/14/2019	1/20/2019	107	1/13/2020	1/19/2020
4	1/22/2018	1/28/2018	56	1/21/2019	1/27/2019	108	1/20/2020	1/26/2020
5	1/29/2018	2/4/2018	57	1/28/2019	2/3/2019	109	1/27/2020	2/2/2020
6	2/5/2018	2/11/2018	58	2/4/2019	2/10/2019	110	2/3/2020	2/9/2020
7	2/12/2018	2/18/2018	59	2/11/2019	2/17/2019	111	2/10/2020	2/16/2020
8	2/19/2018	2/25/2018	60	2/18/2019	2/24/2019	112	2/17/2020	2/23/2020
9	2/26/2018	3/4/2018	61	2/25/2019	3/3/2019	113	2/24/2020	3/1/2020
10	3/5/2018	3/11/2018	62	3/4/2019	3/10/2019	114	3/2/2020	3/8/2020
11	3/12/2018	3/18/2018	63	3/11/2019	3/17/2019	115	3/9/2020	3/15/2020
12	3/19/2018	3/25/2018	64	3/18/2019	3/24/2019	116	3/16/2020	3/22/2020
13	3/26/2018	4/1/2018	65	3/25/2019	3/31/2019	117	3/23/2020	3/29/2020
14	4/2/2018	4/8/2018	66	4/1/2019	4/7/2019	118	3/30/2020	4/5/2020
15	4/9/2018	4/15/2018	67	4/8/2019	4/14/2019	119	4/6/2020	4/12/2020
16	4/16/2018	4/22/2018	68	4/15/2019	4/21/2019	120	4/13/2020	4/19/2020
17	4/23/2018	4/29/2018	69	4/22/2019	4/28/2019	121	4/20/2020	4/26/2020
18	4/30/2018	5/6/2018	70	4/29/2019	5/5/2019	122	4/27/2020	5/3/2020
19	5/7/2018	5/13/2018	71	5/6/2019	5/12/2019	123	5/4/2020	5/10/2020
20	5/14/2018	5/20/2018	72	5/13/2019	5/19/2019	124	5/11/2020	5/17/2020
21	5/21/2018	5/27/2018	73	5/20/2019	5/26/2019	125	5/18/2020	5/24/2020
22	5/28/2018	6/3/2018	74	5/27/2019	6/2/2019	126	5/25/2020	5/31/2020
23	6/4/2018	6/10/2018	75	6/3/2019	6/9/2019	127	6/1/2020	6/7/2020
24	6/11/2018	6/17/2018	76	6/10/2019	6/16/2019	128	6/8/2020	6/14/2020
25	6/18/2018	6/24/2018	77	6/17/2019	6/23/2019	129	6/15/2020	6/21/2020
26	6/25/2018	7/1/2018	78	6/24/2019	6/30/2019	130	6/22/2020	6/28/2020
27	7/2/2018	7/8/2018	79	7/1/2019	7/7/2019	131	6/29/2020	7/5/2020
28	7/9/2018	7/15/2018	80	7/8/2019	7/14/2019	132	7/6/2020	7/12/2020
29	7/16/2018	7/22/2018	81	7/15/2019	7/21/2019	133	7/13/2020	7/19/2020
30	7/23/2018	7/29/2018	82	7/22/2019	7/28/2019	134	7/20/2020	7/26/2020
31	7/30/2018	8/5/2018	83	7/29/2019	8/4/2019	135	7/27/2020	8/2/2020
32	8/6/2018	8/12/2018	84	8/5/2019	8/11/2019	136	8/3/2020	8/9/2020
33	8/13/2018	8/19/2018	85	8/12/2019	8/18/2019	137	8/10/2020	8/16/2020
34	8/20/2018	8/26/2018	86	8/19/2019	8/25/2019	138	8/17/2020	8/23/2020
35	8/27/2018	9/2/2018	87	8/26/2019	9/1/2019	139	8/24/2020	8/30/2020
36	9/3/2018	9/9/2018	88	9/2/2019	9/8/2019	140	8/31/2020	9/6/2020
37	9/10/2018	9/16/2018	89	9/9/2019	9/15/2019	141	9/7/2020	9/13/2020
38	9/17/2018	9/23/2018	90	9/16/2019	9/22/2019	142	9/14/2020	9/20/2020
39	9/24/2018	9/30/2018	91	9/23/2019	9/29/2019	143	9/21/2020	9/27/2020
40	10/1/2018	10/7/2018	92	9/30/2019	10/6/2019	144	9/28/2020	10/4/2020
41	10/8/2018	10/14/2018	93	10/7/2019	10/13/2019	145	10/5/2020	10/11/2020
42	10/15/2018	10/21/2018	94	10/14/2019	10/20/2019	146	10/12/2020	10/18/2020
43	10/22/2018	10/28/2018	95	10/21/2019	10/27/2019	147	10/19/2020	10/25/2020
44	10/29/2018	11/4/2018	96	10/28/2019	11/3/2019	148	10/26/2020	11/1/2020
45	11/5/2018	11/11/2018	97	11/4/2019	11/10/2019	149	11/2/2020	11/8/2020
46	11/12/2018	11/18/2018	98	11/11/2019	11/17/2019	150	11/9/2020	11/15/2020
47	11/19/2018	11/25/2018	99	11/18/2019	11/24/2019	151	11/16/2020	11/22/2020
48	11/26/2018	12/2/2018	100	11/25/2019	12/1/2019	152	11/23/2020	11/29/2020
49	12/3/2018	12/9/2018	101	12/2/2019	12/8/2019	153	11/30/2020	12/6/2020
50	12/10/2018	12/16/2018	102	12/9/2019	12/15/2019	154	12/7/2020	12/13/2020
51	12/17/2018	12/23/2018	103	12/16/2019	12/22/2019	155	12/14/2020	12/20/2020
52	12/24/2018	12/30/2018	104	12/23/2019	12/29/2019	156	12/21/2020	12/27/2020

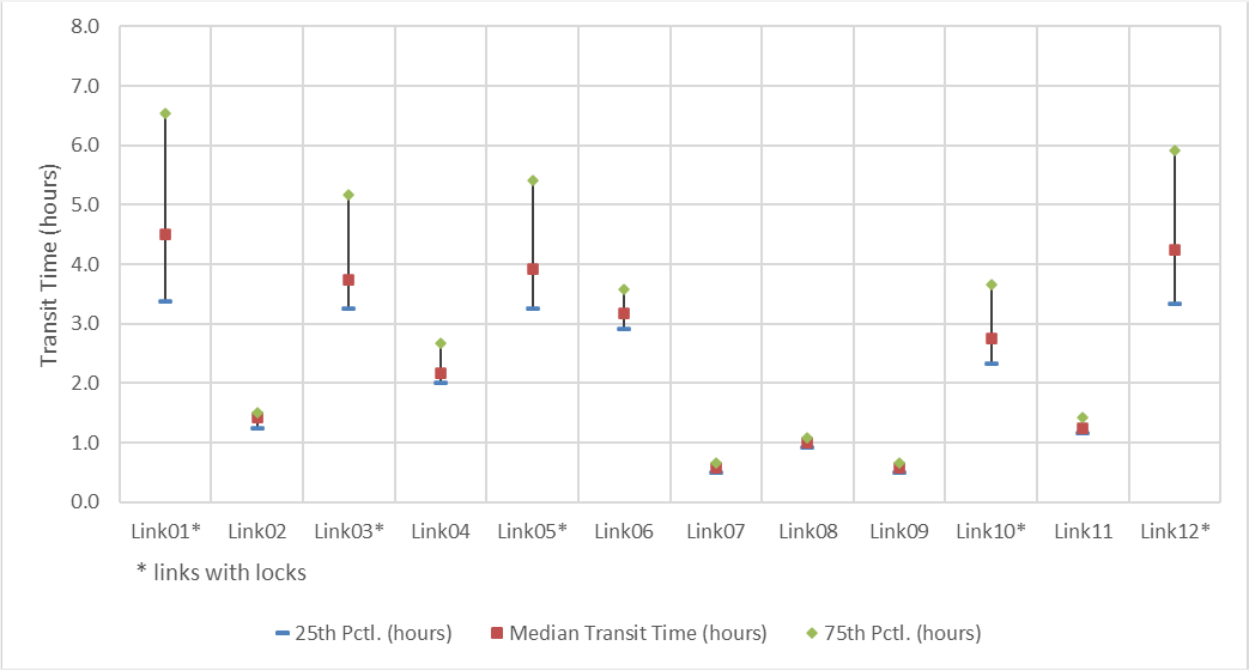


Figure 33. Southbound Link Transit Time by Percentile, 2018.

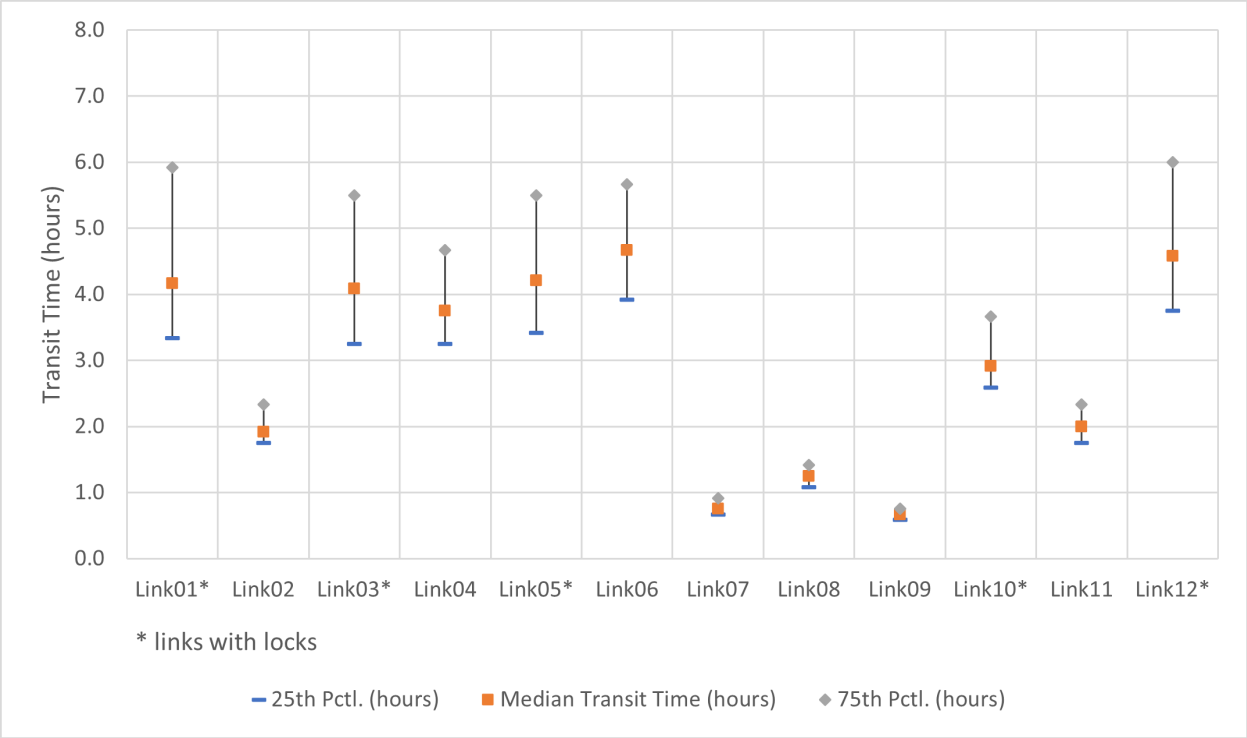


Figure 34. Northbound Link Transit Time by Percentile, 2018.

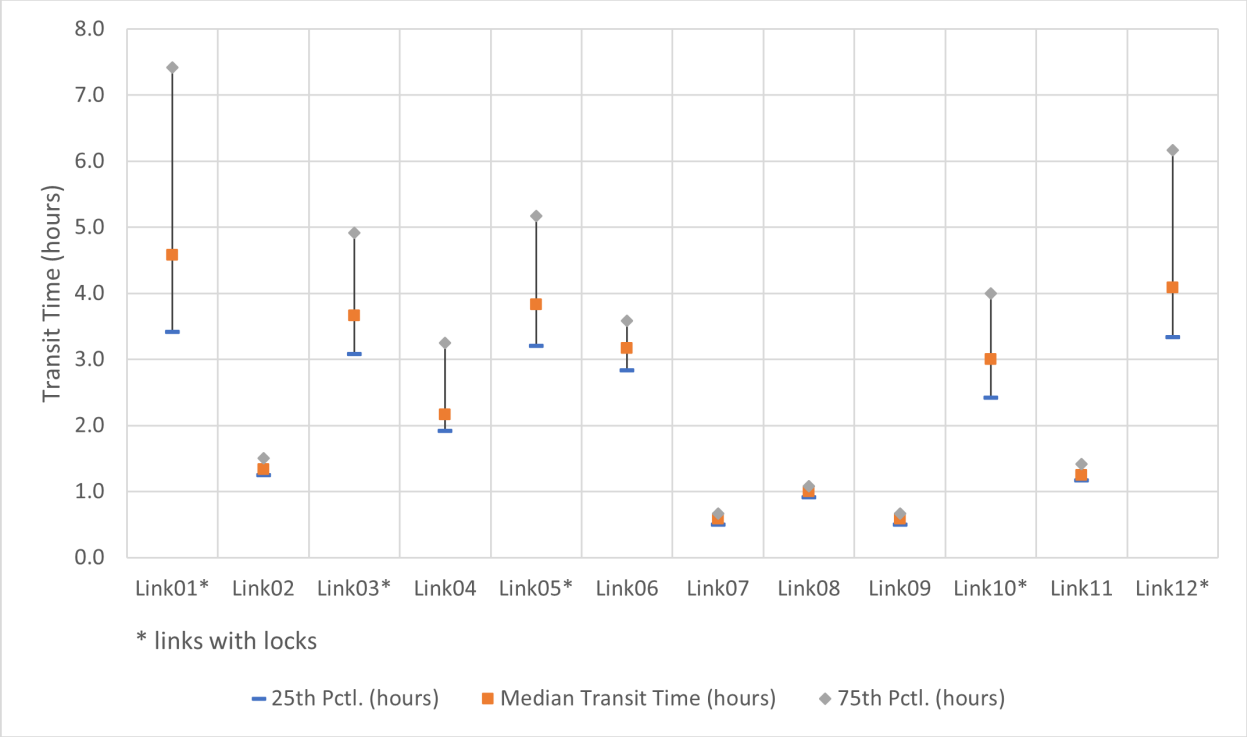


Figure 35. Southbound Link Transit Time by Percentile, 2019.

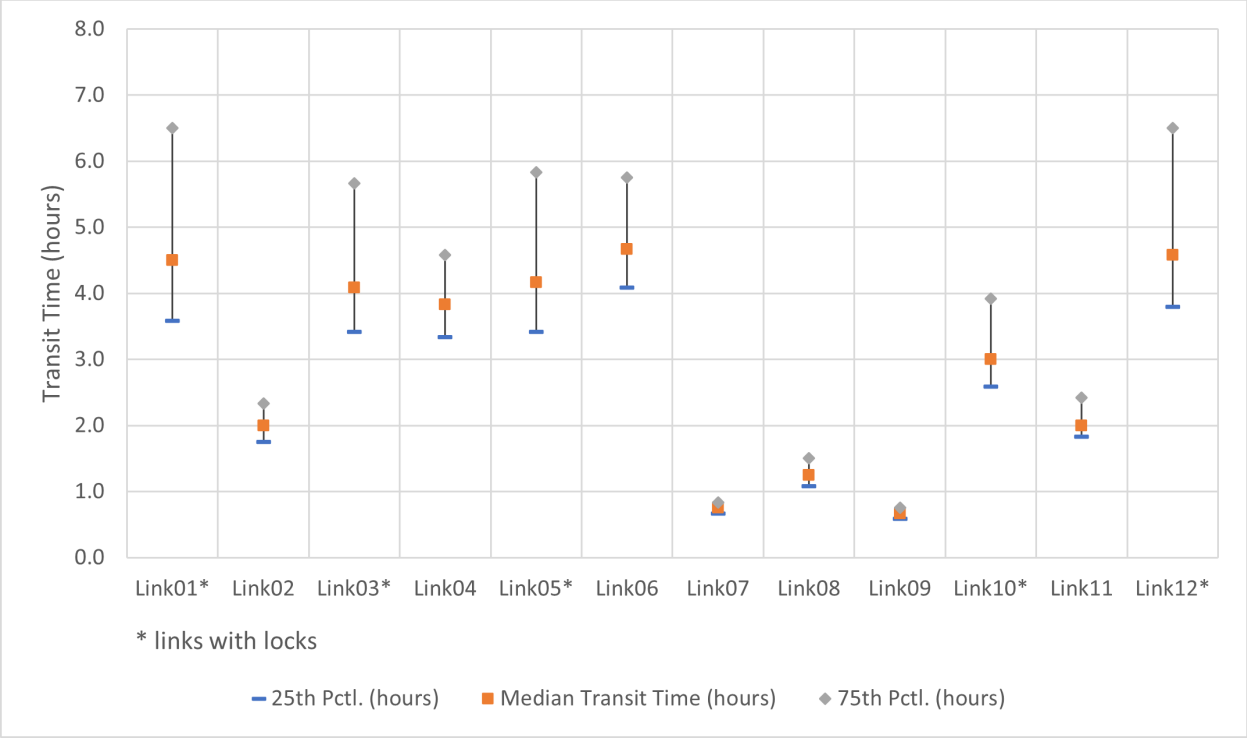


Figure 36. Northbound Link Transit Time by Percentile, 2019.

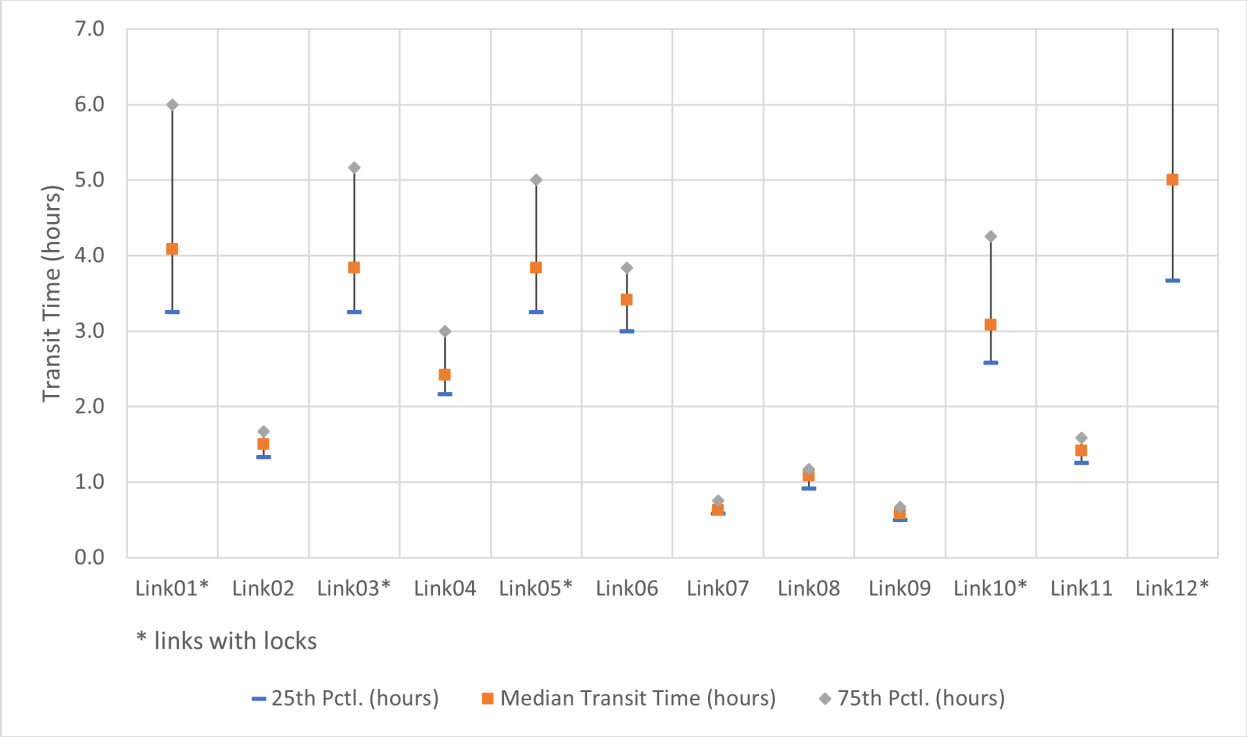


Figure 37. Southbound Link Transit Time by Percentile, 2020.

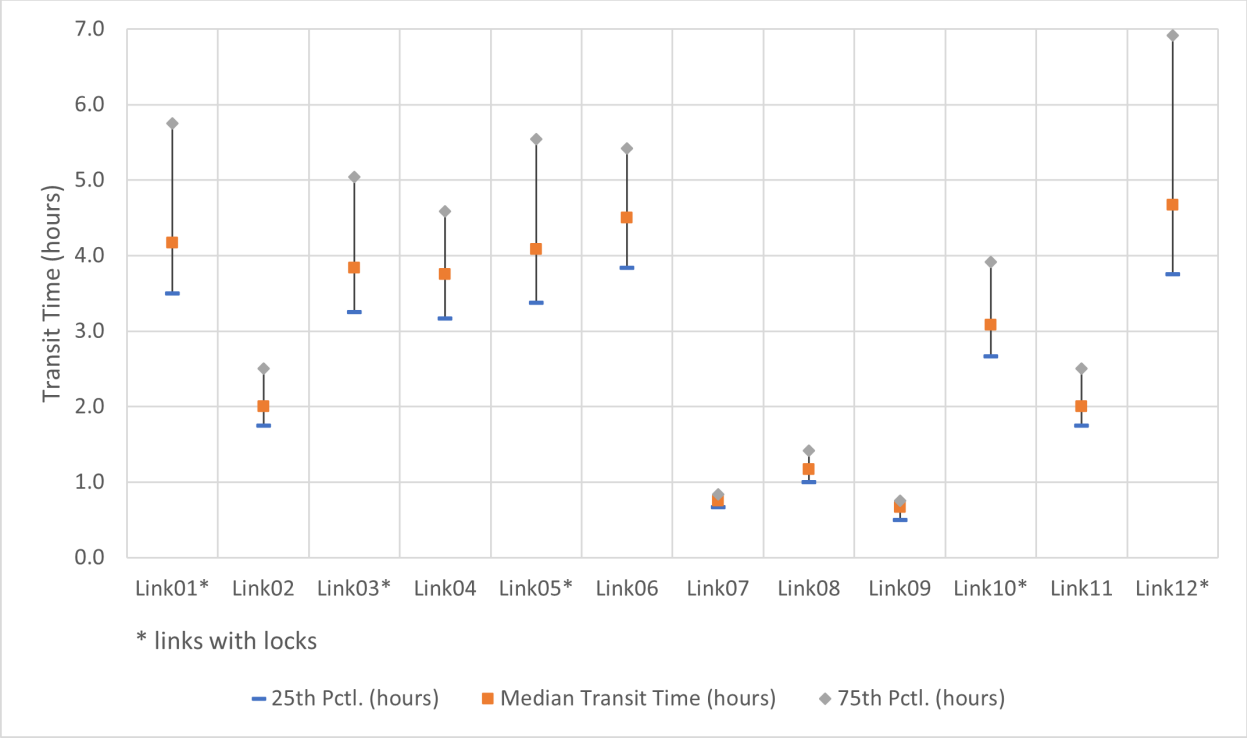


Figure 38. Northbound Link Transit Time by Percentile, 2020.

Travel Time Estimate Results by Link, 2018

Table 10. Yearly Transit Time Estimates, 2018.

Year	Both Directions						Southbound Trips						Northbound Trips					
	Link Number	Average Transit Time (hours)	Std Dev (hours)	25th Pctl. (hours)	50th Pctl. (hours)	75th Pctl. (hours)	Sample Size	Link Number	Average Transit Time (hours)	25th Pctl. (hours)	Median Transit Time (hours)	75th Pctl. (hours)	Sample Size	Link Number	Average Transit Time (hours)	25th Pctl. (hours)	Median Transit Time (hours)	75th Pctl. (hours)	Sample Size
2018	Link01	5.8	6.1	3.3	4.3	6.2	1366	6.6	7.6	3.4	4.5	6.5	668	5.1	3.9	3.3	4.2	5.9	698
	Link02	1.8	1.0	1.3	1.6	2.0	1292	1.5	0.9	1.3	1.4	1.5	622	2.2	1.0	1.8	1.9	2.3	670
	Link03	5.2	4.4	3.3	3.9	5.4	1275	4.9	3.6	3.3	3.8	5.2	616	5.4	5.0	3.3	4.1	5.5	659
	Link04	4.0	3.2	2.2	3.2	4.4	1247	3.4	3.3	2.0	2.2	2.7	605	4.5	2.9	3.3	3.8	4.7	642
	Link05	4.8	3.5	3.3	4.0	5.5	1374	4.8	4.0	3.3	3.9	5.4	670	4.8	2.8	3.4	4.2	5.5	704
	Link06	4.6	2.7	3.2	3.8	5.1	986	4.0	3.0	2.9	3.2	3.6	472	5.2	2.3	3.9	4.7	5.7	514
	Link07	1.0	1.1	0.6	0.7	0.8	888	0.9	1.2	0.5	0.6	0.7	413	1.1	0.9	0.7	0.8	0.9	475
	Link08	1.2	0.4	0.9	1.1	1.3	1148	1.0	0.4	0.9	1.0	1.1	534	1.3	0.4	1.1	1.3	1.4	614
	Link09	0.7	0.7	0.5	0.6	0.7	1426	0.6	0.1	0.5	0.6	0.7	710	0.8	0.9	0.6	0.7	0.8	716
	Link10	3.4	1.9	2.5	2.8	3.7	1457	3.5	2.3	2.3	2.8	3.7	714	3.3	1.5	2.6	2.9	3.7	743
	Link11	1.8	1.1	1.3	1.6	2.0	1444	1.4	1.1	1.2	1.3	1.4	701	2.2	1.0	1.8	2.0	2.3	743
	Link12	5.0	2.2	3.6	4.5	5.9	1358	5.0	2.4	3.3	4.3	5.9	666	5.1	2.0	3.8	4.6	6.0	692

Table 11. Monthly Average Transit Time Estimates (Hours), 2018.

Year	Link Number	Both Directions								Southbound Trips								Northbound Trips							
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
2018	Link01	4.95	5.86	6.10	5.41	6.13	6.22	9.64	4.76	4.63	6.14	6.53	5.91	7.67	7.22	15.75	5.49	5.20	5.60	5.61	4.90	4.81	5.25	4.88	3.96
	Link02	1.87	1.84	1.74	1.87	1.92	1.82	2.58	1.67	1.45	1.36	1.39	1.35	1.64	1.43	3.35	1.49	2.18	2.26	2.13	2.41	2.14	2.20	2.18	1.87
	Link03	3.72	5.57	4.58	4.31	4.74	6.10	13.43	4.46	3.43	5.09	4.48	4.14	5.24	5.87	10.44	5.15	3.93	6.02	4.68	4.48	4.33	6.30	15.14	3.71
	Link04	3.98	3.83	3.66	3.62	3.99	4.33	6.89	3.83	3.67	3.08	3.19	3.20	3.86	4.03	3.92	3.29	4.21	4.51	4.13	4.07	4.09	4.61	9.73	4.39
	Link05	3.70	4.50	4.99	4.72	5.09	5.72	5.73	4.39	3.35	4.30	5.23	4.94	4.96	5.30	5.27	4.76	3.97	4.69	4.75	4.49	5.19	6.14	6.05	3.99
	Link06	4.95	4.31	4.56	4.79	4.55	4.86	5.34	4.05	4.54	3.57	3.92	4.09	4.09	4.20	4.46	3.77	5.28	4.91	5.23	5.50	4.89	5.57	5.82	4.37
	Link07	0.94	1.00	0.89	1.04	1.08	1.28	1.00	0.93	0.75	0.87	0.73	1.05	0.91	1.32	1.18	0.85	1.09	1.11	1.05	1.04	1.21	1.24	0.90	1.00
	Link08	1.22	1.19	1.17	1.14	1.16	1.20	1.23	1.15	1.09	0.97	1.03	0.99	1.12	0.98	1.10	1.08	1.31	1.40	1.32	1.27	1.19	1.38	1.31	1.21
	Link09	0.69	0.76	0.68	0.62	0.76	0.72	0.64	0.63	0.61	0.55	0.57	0.55	0.65	0.55	0.56	0.56	0.75	0.97	0.80	0.68	0.86	0.90	0.71	0.72
	Link10	3.27	3.13	3.38	3.37	3.85	3.70	3.60	3.25	3.25	2.99	3.51	3.29	4.11	3.94	3.81	3.59	3.29	3.26	3.25	3.46	3.62	3.44	3.44	2.91
	Link11	1.90	1.77	1.80	1.71	2.06	1.87	1.89	1.72	1.36	1.38	1.49	1.32	1.88	1.38	1.62	1.26	2.28	2.13	2.11	2.10	2.23	2.35	2.11	2.20
	Link12	4.71	4.72	5.62	4.83	6.04	4.65	4.99	4.40	4.44	4.44	5.67	4.55	6.57	4.25	4.36	4.65	4.91	4.97	5.56	5.10	5.49	5.04	5.50	4.12

Table 12. Monthly Link Transit Count, 2018.

Year	Link Number	Both Directions								Southbound Trips								Northbound Trips							
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
2018	Link01	166	193	230	214	154	174	64	171	73	92	121	108	71	86	28	89	93	101	109	106	83	88	36	82
	Link02	157	184	223	195	145	156	58	174	68	86	116	99	65	77	20	91	89	98	107	96	80	79	38	83
	Link03	155	182	224	188	140	152	58	176	66	88	117	97	62	73	21	92	89	94	107	91	78	79	37	84
	Link04	148	181	212	188	146	157	47	168	65	86	107	96	65	77	23	86	83	95	105	92	81	80	24	82
	Link05	146	195	226	219	165	180	61	182	64	96	116	109	77	89	25	94	82	99	110	110	88	91	36	88
	Link06	93	143	167	160	134	135	43	111	41	64	86	80	58	70	15	58	52	79	81	80	76	65	28	53
	Link07	83	129	152	151	120	119	43	91	36	58	75	71	54	59	15	45	47	71	77	80	66	60	28	46
	Link08	121	157	190	191	148	154	55	132	50	74	97	89	67	71	22	64	71	83	93	102	81	83	33	68
	Link09	162	194	249	220	175	167	70	189	68	97	132	111	85	86	31	100	94	97	117	109	90	81	39	89
	Link10	170	201	249	231	179	168	70	189	71	99	130	116	85	86	31	96	99	102	119	115	94	82	39	93
	Link11	170	194	245	226	180	167	72	190	71	92	125	114	86	82	33	98	99	102	120	112	94	85	39	92
	Link12	162	193	244	210	161	160	67	161	67	90	129	104	82	79	30	85	95	103	115	106	79	81	37	76

Table 13. Weekly Average Transit Time Estimates (Hours): Both Directions, Week 13–Week 30, 2018.

Start Date		3/26/18	4/2/18	4/9/18	4/16/18	4/23/18	4/30/18	5/7/18	5/14/18	5/21/18	5/28/18	6/4/18	6/11/18	6/18/18	6/25/18	7/2/18	7/9/18	7/16/18	7/23/18
End Date		4/1/18	4/8/18	4/15/18	4/22/18	4/29/18	5/6/18	5/13/18	5/20/18	5/27/18	6/3/18	6/10/18	6/17/18	6/24/18	7/1/18	7/8/18	7/15/18	7/22/18	7/29/18
Year	Link Number	Week 13	Week 14	Week 15	Week 16	Week 17	Week 18	Week 19	Week 20	Week 21	Week 22	Week 23	Week 24	Week 25	Week 26	Week 27	Week 28	Week 29	Week 30
2018	Link01	3.75	5.20	6.45	4.57	4.17	4.93	5.66	7.30	6.19	4.50	5.96	6.45	5.89	6.27	5.77	5.79	5.43	4.81
	Link02	3.67	2.11	1.83	1.85	1.70	2.05	1.73	1.75	1.80	1.72	1.75	1.82	1.76	1.69	1.69	2.27	1.84	1.66
	Link03	3.92	4.02	3.43	3.54	3.84	3.65	4.88	8.65	5.77	4.07	4.38	4.37	4.71	5.08	4.69	4.22	4.56	3.36
	Link04	3.69	4.42	4.43	3.47	3.90	4.16	4.91	3.33	3.59	3.62	3.97	3.62	3.70	3.26	3.94	3.65	3.41	3.61
	Link05	3.56	4.05	3.37	3.85	3.65	4.25	5.75	4.18	4.54	4.33	4.27	4.92	4.97	5.66	4.87	5.87	4.18	4.06
	Link06	5.58	5.81	4.78	4.23	5.08	4.41	4.33	4.00	4.18	4.81	4.36	4.46	4.55	4.49	4.64	4.88	5.24	4.56
	Link07	0.97	0.93	1.01	0.93	0.91	1.03	1.67	0.67	0.91	0.89	0.91	0.85	0.98	0.89	1.01	0.97	0.93	1.09
	Link08	1.15	1.24	1.16	1.37	1.15	1.27	1.07	1.17	1.29	1.08	1.15	1.18	1.20	1.18	1.13	1.17	1.07	1.18
	Link09	0.70	0.68	0.78	0.72	0.62	0.87	0.83	0.69	0.66	0.78	0.80	0.59	0.71	0.58	0.63	0.62	0.61	0.61
	Link10	4.83	3.50	3.31	3.02	3.10	2.86	3.14	3.21	3.06	3.41	4.29	3.23	3.14	2.92	3.41	3.31	3.38	3.44
	Link11	4.00	1.82	1.88	1.84	1.72	1.70	1.68	1.90	1.81	1.70	1.88	1.99	1.73	1.59	1.71	1.73	1.71	1.62
	Link12	3.00	4.30	4.64	4.83	4.75	4.70	5.08	4.45	4.72	5.27	5.61	6.17	5.90	4.94	4.62	4.34	4.40	5.59

Table 14. Weekly Average Transit Time Estimates (Hours): Both Directions, Week 31–Week 48, 2018.

Start Date		7/30/18	8/6/18	8/13/18	8/20/18	8/27/18	9/3/18	9/10/18	9/17/18	9/24/18	10/1/18	10/8/18	10/15/18	10/22/18	10/29/18	11/5/18	11/12/18	11/19/18	11/26/18
End Date		8/5/18	8/12/18	8/19/18	8/26/18	9/2/18	9/9/18	9/16/18	9/23/18	9/30/18	10/7/18	10/14/18	10/21/18	10/28/18	11/4/18	11/11/18	11/18/18	11/25/18	12/2/18
Year	Link Number	Week 31	Week 32	Week 33	Week 34	Week 35	Week 36	Week 37	Week 38	Week 39	Week 40	Week 41	Week 42	Week 43	Week 44	Week 45	Week 46	Week 47	Week 48
2018	Link01	4.78	6.49	6.62	6.40	6.73	5.29	7.24	4.82	7.05	0.00	18.00	16.94	10.47	5.16	6.40	3.62	3.87	3.44
	Link02	1.71	1.88	2.34	1.88	1.87	1.77	1.82	1.96	1.60	0.00	1.42	3.54	2.78	1.93	1.68	1.66	1.69	1.40
	Link03	4.59	4.32	6.30	4.50	4.45	4.44	13.81	3.92	4.34	4.25	0.00	0.00	16.59	5.65	5.38	4.01	3.66	3.72
	Link04	3.61	3.49	5.56	3.45	3.28	4.03	5.52	3.78	4.81	0.00	4.21	3.88	9.55	4.42	4.10	3.39	3.46	2.06
	Link05	4.90	4.81	5.86	5.59	4.70	5.82	8.07	4.31	5.36	0.00	6.81	0.00	6.16	4.61	4.84	3.90	4.23	3.92
	Link06	4.69	4.42	4.29	5.76	4.18	4.69	4.10	4.68	6.51	0.00	4.33	0.00	5.59	4.63	3.93	3.71	4.32	3.04
	Link07	1.02	1.37	0.82	0.76	1.32	1.25	1.41	1.64	0.98	0.00	0.67	0.00	1.03	1.06	1.02	0.90	0.71	0.73
	Link08	1.11	1.15	1.20	1.19	1.15	1.21	1.15	1.27	1.13	0.00	1.35	0.00	1.14	1.23	1.29	1.10	1.03	0.96
	Link09	0.63	0.97	0.77	0.63	0.63	0.74	0.77	0.78	0.63	0.00	0.62	0.00	0.65	0.61	0.63	0.59	0.72	0.60
	Link10	3.50	3.57	3.59	4.88	4.19	3.80	3.51	3.66	3.70	0.00	2.58	0.00	3.88	3.21	3.90	2.75	2.98	2.77
	Link11	1.87	1.87	2.48	2.61	1.98	1.88	1.64	1.73	2.06	0.00	1.51	0.00	1.84	1.88	1.86	1.64	1.64	1.38
	Link12	5.40	5.40	6.63	9.23	5.32	5.05	3.96	4.18	4.48	0.00	5.62	0.00	5.31	4.38	4.68	3.68	4.70	4.02

Table 15. Weekly Link Transit Count: Both Directions, Week 13–Week 30, 2018.

Start Date		3/26/18	4/2/18	4/9/18	4/16/18	4/23/18	4/30/18	5/7/18	5/14/18	5/21/18	5/28/18	6/4/18	6/11/18	6/18/18	6/25/18	7/2/18	7/9/18	7/16/18	7/23/18
End Date		4/1/18	4/8/18	4/15/18	4/22/18	4/29/18	5/6/18	5/13/18	5/20/18	5/27/18	6/3/18	6/10/18	6/17/18	6/24/18	7/1/18	7/8/18	7/15/18	7/22/18	7/29/18
Year	Link Number	Week 13	Week 14	Week 15	Week 16	Week 17	Week 18	Week 19	Week 20	Week 21	Week 22	Week 23	Week 24	Week 25	Week 26	Week 27	Week 28	Week 29	Week 30
2018	Link01	1	29	37	45	49	44	25	49	52	51	53	60	47	52	49	52	47	46
	Link02	3	26	31	46	46	43	24	44	48	50	49	59	52	48	45	47	42	46
	Link03	3	27	32	43	44	45	22	43	45	55	47	58	53	48	43	47	41	44
	Link04	3	23	33	38	45	44	24	41	46	53	37	61	53	44	47	44	41	42
	Link05	3	18	34	39	47	44	28	46	52	57	36	64	50	55	52	47	46	51
	Link06	4	18	23	19	26	34	20	36	30	45	25	43	41	42	40	37	31	40
	Link07	5	20	21	16	18	31	16	32	32	36	28	36	37	41	38	38	26	37
	Link08	5	24	28	25	32	40	24	37	39	39	40	53	44	45	50	42	34	46
	Link09	5	30	34	44	42	47	29	46	48	55	54	67	54	59	55	46	44	51
	Link10	7	33	37	39	47	47	31	47	51	57	49	68	57	60	54	51	48	53
	Link11	6	34	37	38	46	50	27	45	50	55	52	66	58	56	53	51	42	53
	Link12	3	34	38	32	45	48	26	48	50	55	49	66	61	53	55	46	39	51

Table 16. Weekly Link Transit Count: Both Directions, Week 31–Week 48, 2018.

Start Date		7/30/18	8/6/18	8/13/18	8/20/18	8/27/18	9/3/18	9/10/18	9/17/18	9/24/18	10/1/18	10/8/18	10/15/18	10/22/18	10/29/18	11/5/18	11/12/18	11/19/18	11/26/18
End Date		8/5/18	8/12/18	8/19/18	8/26/18	9/2/18	9/9/18	9/16/18	9/23/18	9/30/18	10/7/18	10/14/18	10/21/18	10/28/18	11/4/18	11/11/18	11/18/18	11/25/18	12/2/18
Year	Link Number	Week 31	Week 32	Week 33	Week 34	Week 35	Week 36	Week 37	Week 38	Week 39	Week 40	Week 41	Week 42	Week 43	Week 44	Week 45	Week 46	Week 47	Week 48
2018	Link01	44	47	29	21	41	42	41	38	40	0	4	4	34	43	58	54	35	3
	Link02	39	40	33	18	38	41	32	38	32	0	2	4	31	45	56	56	34	4
	Link03	39	40	29	18	37	35	30	40	33	1	0	0	39	46	54	54	37	3
	Link04	37	42	35	21	38	37	29	41	33	0	2	2	25	45	51	54	33	3
	Link05	47	50	36	22	48	44	34	44	37	0	4	0	41	42	56	56	40	4
	Link06	36	34	32	17	39	40	25	30	25	0	3	0	31	32	29	35	22	2
	Link07	32	31	28	12	34	39	21	27	22	0	4	0	31	27	24	28	16	4
	Link08	42	42	34	17	39	45	30	34	31	0	5	0	40	35	41	41	21	4
	Link09	51	48	38	22	49	46	34	36	33	0	5	0	48	48	63	53	36	6
	Link10	51	50	36	23	52	45	34	38	33	0	6	0	47	48	63	54	37	4
	Link11	52	50	36	22	56	44	35	38	30	0	7	0	47	50	63	52	36	7
	Link12	43	42	28	22	52	44	32	39	29	0	7	0	44	43	54	43	32	5

Table 17. Weekly Average Transit Time Estimates (Hours): Southbound, Week 13–Week 30, 2018.

Start Date		3/26/18	4/2/18	4/9/18	4/16/18	4/23/18	4/30/18	5/7/18	5/14/18	5/21/18	5/28/18	6/4/18	6/11/18	6/18/18	6/25/18	7/2/18	7/9/18	7/16/18	7/23/18
End Date		4/1/18	4/8/18	4/15/18	4/22/18	4/29/18	5/6/18	5/13/18	5/20/18	5/27/18	6/3/18	6/10/18	6/17/18	6/24/18	7/1/18	7/8/18	7/15/18	7/22/18	7/29/18
Year	Link Number	Week 13	Week 14	Week 15	Week 16	Week 17	Week 18	Week 19	Week 20	Week 21	Week 22	Week 23	Week 24	Week 25	Week 26	Week 27	Week 28	Week 29	Week 30
2018	Link01	0.00	6.13	5.39	4.42	3.98	4.72	6.65	5.90	9.07	4.12	6.24	6.93	6.84	6.61	6.63	6.45	6.10	5.05
	Link02	0.00	1.56	1.55	1.40	1.42	1.37	1.24	1.39	1.41	1.41	1.46	1.39	1.41	1.27	1.28	1.38	1.33	1.38
	Link03	0.00	3.10	3.12	3.24	3.73	3.71	4.20	7.41	5.54	3.76	4.25	4.07	4.58	5.36	4.52	3.85	4.10	3.23
	Link04	0.00	5.50	5.30	2.89	3.13	3.36	3.83	2.60	3.15	3.17	3.56	3.19	3.23	2.61	3.98	2.66	3.11	3.02
	Link05	0.00	2.92	2.94	3.46	3.48	4.19	5.54	4.06	4.36	4.17	4.52	4.89	5.23	6.12	5.18	7.29	4.10	4.04
	Link06	7.00	5.32	4.68	3.53	4.94	3.75	3.70	3.30	3.63	4.28	4.28	3.54	3.85	3.51	3.62	3.11	5.98	4.02
	Link07	0.71	0.85	0.73	0.59	0.93	0.90	1.56	0.52	0.77	0.83	0.76	0.59	0.57	0.93	0.87	0.71	1.09	1.18
	Link08	1.17	1.30	1.11	1.08	0.99	1.05	0.90	0.91	0.99	1.02	1.06	0.97	1.07	1.04	0.93	1.03	0.95	1.08
	Link09	0.71	0.73	0.60	0.60	0.57	0.60	0.54	0.51	0.55	0.58	0.60	0.57	0.56	0.52	0.52	0.57	0.56	0.58
	Link10	4.39	4.00	2.98	2.92	3.25	2.67	3.34	3.22	2.47	3.28	5.31	3.27	2.98	2.79	3.44	3.42	3.00	3.39
	Link11	1.61	1.43	1.37	1.34	1.30	1.28	1.18	1.61	1.29	1.38	1.62	1.75	1.34	1.24	1.44	1.22	1.25	1.34
	Link12	2.42	3.88	4.24	4.24	4.67	4.66	4.52	4.08	4.75	4.91	5.95	6.56	6.19	4.30	4.14	3.98	4.10	5.58

Table 18. Weekly Average Transit Time Estimates (Hours): Southbound, Week 31–Week 48, 2018.

Start Date		7/30/18	8/6/18	8/13/18	8/20/18	8/27/18	9/3/18	9/10/18	9/17/18	9/24/18	10/8/18	10/15/18	10/22/18	10/29/18	11/5/18	11/12/18	11/19/18	11/26/18
End Date		8/5/18	8/12/18	8/19/18	8/26/18	9/2/18	9/9/18	9/16/18	9/23/18	9/30/18	10/14/18	10/21/18	10/28/18	11/4/18	11/11/18	11/18/18	11/25/18	12/2/18
Year	Link Number	Week 31	Week 32	Week 33	Week 34	Week 35	Week 36	Week 37	Week 38	Week 39	Week 41	Week 42	Week 43	Week 44	Week 45	Week 46	Week 47	Week 48
2018	Link01	4.78	10.09	8.40	5.60	8.23	5.77	9.59	5.48	7.49	25.88	16.94	21.02	5.30	7.43	4.48	4.32	4.17
	Link02	1.46	1.72	1.79	1.60	1.63	1.49	1.35	1.42	1.37	1.17	3.54	5.02	1.64	1.43	1.44	1.69	1.40
	Link03	5.34	5.57	6.88	4.82	4.76	4.38	12.42	3.69	4.28	0.00	0.00	13.61	5.18	5.78	5.60	3.96	3.72
	Link04	2.99	3.26	7.21	2.82	2.57	3.88	3.69	3.57	5.49	0.00	0.00	4.56	3.53	3.76	2.88	2.94	2.06
	Link05	4.79	5.16	5.28	5.13	4.51	6.08	5.20	3.77	5.93	0.00	0.00	5.79	4.75	4.89	4.56	4.79	3.92
	Link06	4.48	3.51	3.83	4.93	3.89	3.78	3.00	3.10	7.08	3.08	0.00	4.66	4.12	3.50	3.36	4.72	3.04
	Link07	1.10	1.23	0.93	0.70	0.97	1.10	1.55	1.87	1.12	0.50	0.00	1.33	1.35	0.70	0.93	0.52	0.83
	Link08	1.02	1.11	1.20	1.20	1.13	0.90	0.89	1.02	1.03	0.79	0.00	0.87	1.24	1.30	0.97	0.96	0.88
	Link09	0.62	0.60	0.70	0.67	0.65	0.50	0.49	0.58	0.59	0.50	0.00	0.53	0.57	0.58	0.54	0.54	0.58
	Link10	3.43	3.86	3.36	5.21	4.45	4.23	3.88	3.98	3.94	2.14	0.00	4.47	3.44	4.44	2.94	3.04	2.78
	Link11	1.43	1.68	2.67	2.63	1.45	1.25	1.14	1.26	1.83	1.13	0.00	1.15	1.85	1.25	1.22	1.30	1.33
	Link12	5.73	6.38	7.90	9.69	5.04	4.57	3.61	3.74	4.20	4.67	0.00	4.96	4.37	4.67	4.06	4.95	3.96

Table 19. Weekly Link Transit Count: Southbound, Week 13–Week 30, 2018.

Start Date		3/26/18	4/2/18	4/9/18	4/16/18	4/23/18	4/30/18	5/7/18	5/14/18	5/21/18	5/28/18	6/4/18	6/11/18	6/18/18	6/25/18	7/2/18	7/9/18	7/16/18	7/23/18
End Date		4/1/18	4/8/18	4/15/18	4/22/18	4/29/18	5/6/18	5/13/18	5/20/18	5/27/18	6/3/18	6/10/18	6/17/18	6/24/18	7/1/18	7/8/18	7/15/18	7/22/18	7/29/18
Year	Link Number	Week 13	Week 14	Week 15	Week 16	Week 17	Week 18	Week 19	Week 20	Week 21	Week 22	Week 23	Week 24	Week 25	Week 26	Week 27	Week 28	Week 29	Week 30
2018	Link01	0	10	12	23	24	21	14	26	19	26	29	32	23	29	26	24	21	27
	Link02	0	9	10	22	23	20	13	24	17	25	27	32	23	27	24	21	18	27
	Link03	0	9	10	22	21	22	12	24	15	29	25	32	24	27	24	21	18	26
	Link04	0	8	10	21	21	22	11	24	15	28	16	34	25	25	25	20	17	25
	Link05	0	6	11	22	22	23	13	27	20	30	15	36	23	31	27	20	21	30
	Link06	2	6	7	12	12	18	8	19	10	20	13	21	20	25	21	17	14	22
	Link07	2	6	7	10	9	15	7	18	10	17	14	18	14	24	22	16	9	18
	Link08	2	7	9	14	15	18	13	21	12	21	20	29	19	23	29	17	12	24
	Link09	2	10	11	21	21	23	14	26	19	31	26	37	27	33	30	22	19	30
	Link10	3	10	12	20	23	22	16	27	19	31	24	38	26	34	29	24	21	30
	Link11	3	10	13	19	22	23	13	25	18	28	25	36	27	32	29	24	17	31
	Link12	2	11	12	16	21	22	13	26	18	30	25	34	30	30	29	22	18	28

Table 20. Weekly Link Transit Count: Southbound, Week 31–Week 48, 2018.

Start Date		7/30/18	8/6/18	8/13/18	8/20/18	8/27/18	9/3/18	9/10/18	9/17/18	9/24/18	10/8/18	10/15/18	10/22/18	10/29/18	11/5/18	11/12/18	11/19/18	11/26/18
End Date		8/5/18	8/12/18	8/19/18	8/26/18	9/2/18	9/9/18	9/16/18	9/23/18	9/30/18	10/14/18	10/21/18	10/28/18	11/4/18	11/11/18	11/18/18	11/25/18	12/2/18
Year	Link Number	Week 31	Week 32	Week 33	Week 34	Week 35	Week 36	Week 37	Week 38	Week 39	Week 41	Week 42	Week 43	Week 44	Week 45	Week 46	Week 47	Week 48
2018	Link01	22	19	13	9	21	22	19	16	24	2	4	13	20	29	23	24	2
	Link02	21	16	13	7	20	23	12	16	21	1	4	7	19	28	24	24	4
	Link03	22	16	10	7	20	16	15	16	20	0	0	14	20	28	22	26	3
	Link04	20	16	14	10	19	16	19	16	19	0	0	14	22	26	22	22	3
	Link05	24	20	15	11	23	20	20	18	23	0	0	16	20	30	24	25	4
	Link06	19	13	9	8	20	18	16	13	16	1	0	8	14	17	18	13	2
	Link07	19	11	9	5	18	18	12	12	13	2	0	8	12	14	13	9	2
	Link08	23	17	11	7	20	19	15	14	17	2	0	13	16	23	19	11	2
	Link09	27	20	15	12	26	22	20	14	21	3	0	16	23	37	25	23	4
	Link10	27	21	14	12	26	23	20	15	20	3	0	16	22	36	24	23	3
	Link11	27	20	14	13	27	22	19	15	18	4	0	16	24	35	23	23	6
	Link12	23	16	12	13	26	23	18	15	18	4	0	15	22	30	19	21	4

Table 21. Weekly Average Transit Time Estimates (Hours): Northbound, Week 13–Week 30, 2018.

Start Date		3/26/18	4/2/18	4/9/18	4/16/18	4/23/18	4/30/18	5/7/18	5/14/18	5/21/18	5/28/18	6/4/18	6/11/18	6/18/18	6/25/18	7/2/18	7/9/18	7/16/18	7/23/18
End Date		4/1/18	4/8/18	4/15/18	4/22/18	4/29/18	5/6/18	5/13/18	5/20/18	5/27/18	6/3/18	6/10/18	6/17/18	6/24/18	7/1/18	7/8/18	7/15/18	7/22/18	7/29/18
Year	Link Number	Week 13	Week 14	Week 15	Week 16	Week 17	Week 18	Week 19	Week 20	Week 21	Week 22	Week 23	Week 24	Week 25	Week 26	Week 27	Week 28	Week 29	Week 30
2018	Link01	3.75	4.71	6.96	4.73	4.36	5.11	4.40	8.88	4.53	4.91	5.63	5.91	4.98	5.83	4.79	5.23	4.88	4.46
	Link02	3.67	2.39	1.96	2.26	1.97	2.64	2.32	2.18	2.01	2.03	2.11	2.32	2.03	2.23	2.16	2.98	2.22	2.07
	Link03	3.92	4.47	3.57	3.86	3.93	3.59	5.69	10.21	5.89	4.41	4.53	4.74	4.82	4.73	4.91	4.51	4.93	3.56
	Link04	3.69	3.84	4.05	4.18	4.57	4.96	5.83	4.37	3.80	4.12	4.29	4.16	4.13	4.11	3.89	4.48	3.63	4.47
	Link05	3.56	4.62	3.58	4.36	3.81	4.31	5.93	4.36	4.65	4.51	4.10	4.97	4.75	5.06	4.54	4.82	4.25	4.07
	Link06	4.17	6.06	4.82	5.43	5.21	5.16	4.76	4.78	4.46	5.25	4.46	5.33	5.21	5.94	5.76	6.38	4.63	5.22
	Link07	1.14	0.97	1.15	1.50	0.89	1.15	1.76	0.86	0.97	0.95	1.05	1.12	1.23	0.85	1.20	1.15	0.85	1.00
	Link08	1.14	1.22	1.18	1.75	1.28	1.45	1.27	1.50	1.43	1.14	1.25	1.42	1.30	1.33	1.39	1.27	1.13	1.30
	Link09	0.69	0.65	0.87	0.82	0.67	1.14	1.11	0.92	0.74	1.04	0.99	0.61	0.85	0.66	0.75	0.67	0.64	0.64
	Link10	5.17	3.28	3.47	3.12	2.96	3.02	2.93	3.19	3.40	3.57	3.31	3.18	3.27	3.09	3.38	3.21	3.68	3.51
	Link11	6.39	1.99	2.16	2.35	2.10	2.06	2.15	2.25	2.10	2.04	2.12	2.28	2.08	2.06	2.04	2.19	2.02	2.01
	Link12	4.17	4.51	4.82	5.42	4.82	4.73	5.64	4.88	4.71	5.70	5.25	5.75	5.61	5.77	5.15	4.67	4.66	5.59

Table 22. Weekly Average Transit Time Estimates (Hours): Northbound, Week 31–Week 48, 2018.

Start Date		7/30/18	8/6/18	8/13/18	8/20/18	8/27/18	9/3/18	9/10/18	9/17/18	9/24/18	10/1/18	10/8/18	10/15/18	10/22/18	10/29/18	11/5/18	11/12/18	11/19/18	11/26/18
End Date		8/5/18	8/12/18	8/19/18	8/26/18	9/2/18	9/9/18	9/16/18	9/23/18	9/30/18	10/7/18	10/14/18	10/21/18	10/28/18	11/4/18	11/11/18	11/18/18	11/25/18	12/2/18
Year	Link Number	Week 31	Week 32	Week 33	Week 34	Week 35	Week 36	Week 37	Week 38	Week 39	Week 40	Week 41	Week 42	Week 43	Week 44	Week 45	Week 46	Week 47	Week 48
2018	Link01	4.78	4.04	5.17	7.01	5.16	4.77	5.22	4.33	6.39	0.00	10.13	0.00	3.94	5.03	5.37	2.97	2.90	2.00
	Link02	2.01	1.98	2.69	2.06	2.14	2.13	2.10	2.36	2.06	0.00	1.67	0.00	2.13	2.14	1.93	1.83	1.68	0.00
	Link03	3.62	3.49	5.99	4.30	4.08	4.49	15.19	4.07	4.43	4.25	0.00	0.00	18.27	6.01	4.95	2.91	2.95	0.00
	Link04	4.35	3.63	4.46	4.02	4.00	4.14	9.00	3.91	3.88	0.00	4.21	3.88	15.90	5.28	4.46	3.75	4.49	0.00
	Link05	5.01	4.58	6.27	6.05	4.87	5.61	12.18	4.68	4.43	0.00	6.81	0.00	6.41	4.48	4.78	3.41	3.31	0.00
	Link06	4.93	4.98	4.47	6.51	4.47	5.44	6.06	5.89	5.48	0.00	4.96	0.00	5.92	5.03	4.55	4.09	3.74	0.00
	Link07	0.92	1.44	0.76	0.80	1.71	1.37	1.22	1.45	0.78	0.00	0.83	0.00	0.92	0.84	1.48	0.87	0.96	0.63
	Link08	1.23	1.19	1.20	1.18	1.18	1.43	1.41	1.45	1.26	0.00	1.72	0.00	1.27	1.22	1.26	1.22	1.10	1.04
	Link09	0.65	1.24	0.82	0.58	0.59	0.95	1.17	0.90	0.69	0.00	0.79	0.00	0.71	0.66	0.70	0.64	1.03	0.63
	Link10	3.57	3.36	3.73	4.53	3.94	3.35	2.99	3.46	3.35	0.00	3.03	0.00	3.58	3.01	3.18	2.60	2.88	2.75
	Link11	2.35	2.00	2.37	2.58	2.47	2.50	2.23	2.03	2.42	0.00	2.03	0.00	2.19	1.91	2.62	1.96	2.26	1.67
	Link12	5.02	4.80	5.69	8.58	5.60	5.58	4.41	4.45	4.93	0.00	6.89	0.00	5.49	4.38	4.69	3.38	4.23	4.25

Table 23. Weekly Link Transit Count: Northbound, Week 13–Week 30, 2018.

Start Date		3/26/18	4/2/18	4/9/18	4/16/18	4/23/18	4/30/18	5/7/18	5/14/18	5/21/18	5/28/18	6/4/18	6/11/18	6/18/18	6/25/18	7/2/18	7/9/18	7/16/18	7/23/18
End Date		4/1/18	4/8/18	4/15/18	4/22/18	4/29/18	5/6/18	5/13/18	5/20/18	5/27/18	6/3/18	6/10/18	6/17/18	6/24/18	7/1/18	7/8/18	7/15/18	7/22/18	7/29/18
Year	Link Number	Week 13	Week 14	Week 15	Week 16	Week 17	Week 18	Week 19	Week 20	Week 21	Week 22	Week 23	Week 24	Week 25	Week 26	Week 27	Week 28	Week 29	Week 30
2018	Link01	1	19	25	22	25	23	11	23	33	25	24	28	24	23	23	28	26	19
	Link02	3	17	21	24	23	23	11	20	31	25	22	27	29	21	21	26	24	19
	Link03	3	18	22	21	23	23	10	19	30	26	22	26	29	21	19	26	23	18
	Link04	3	15	23	17	24	22	13	17	31	25	21	27	28	19	22	24	24	17
	Link05	3	12	23	17	25	21	15	19	32	27	21	28	27	24	25	27	25	21
	Link06	2	12	16	7	14	16	12	17	20	25	12	22	21	17	19	20	17	18
	Link07	3	14	14	6	9	16	9	14	22	19	14	18	23	17	16	22	17	19
	Link08	3	17	19	11	17	22	11	16	27	18	20	24	25	22	21	25	22	22
	Link09	3	20	23	23	21	24	15	20	29	24	28	30	27	26	25	24	25	21
	Link10	4	23	25	19	24	25	15	20	32	26	25	30	31	26	25	27	27	23
	Link11	3	24	24	19	24	27	14	20	32	27	27	30	31	24	24	27	25	22
	Link12	1	23	26	16	24	26	13	22	32	25	24	32	31	23	26	24	21	23

Table 24. Weekly Link Transit Count: Northbound, Week 31–Week 48, 2018.

Start Date		7/30/18	8/6/18	8/13/18	8/20/18	8/27/18	9/3/18	9/10/18	9/17/18	9/24/18	10/1/18	10/8/18	10/15/18	10/22/18	10/29/18	11/5/18	11/12/18	11/19/18	11/26/18
End Date		8/5/18	8/12/18	8/19/18	8/26/18	9/2/18	9/9/18	9/16/18	9/23/18	9/30/18	10/7/18	10/14/18	10/21/18	10/28/18	11/4/18	11/11/18	11/18/18	11/25/18	12/2/18
Year	Link Number	Week 31	Week 32	Week 33	Week 34	Week 35	Week 36	Week 37	Week 38	Week 39	Week 40	Week 41	Week 42	Week 43	Week 44	Week 45	Week 46	Week 47	Week 48
2018	Link01	22	28	16	12	20	20	22	22	16	0	2	0	21	23	29	31	11	1
	Link02	18	24	20	11	18	18	20	22	11	0	1	0	24	26	28	32	10	0
	Link03	17	24	19	11	17	19	15	24	13	1	0	0	25	26	26	32	11	0
	Link04	17	26	21	11	19	21	10	25	14	0	2	2	11	23	25	32	11	0
	Link05	23	30	21	11	25	24	14	26	14	0	4	0	25	22	26	32	15	0
	Link06	17	21	23	9	19	22	9	17	9	0	2	0	23	18	12	17	9	0
	Link07	13	20	19	7	16	21	9	15	9	0	2	0	23	15	10	15	7	2
	Link08	19	25	23	10	19	26	15	20	14	0	3	0	27	19	18	22	10	2
	Link09	24	28	23	10	23	24	14	22	12	0	2	0	32	25	26	28	13	2
	Link10	24	29	22	11	26	22	14	23	13	0	3	0	31	26	27	30	14	1
	Link11	25	30	22	9	29	22	16	23	12	0	3	0	31	26	28	29	13	1
	Link12	20	26	16	9	26	21	14	24	11	0	3	0	29	21	24	24	11	1

Travel Time Estimate Results by Link, 2019

Table 25. Yearly Transit Time Estimates, 2019.

Year	Both Directions						Southbound Trips						Northbound Trips					
	Link Number	Average Transit Time (hours)	Std Dev (hours)	25th Pctl. (hours)	50th Pctl. (hours)	75th Pctl. (hours)	Sample Size	Link Number	Average Transit Time (hours)	25th Pctl. (hours)	Median Transit Time (hours)	75th Pctl. (hours)	Sample Size	Link Number	Average Transit Time (hours)	25th Pctl. (hours)	Median Transit Time (hours)	75th Pctl. (hours)	Sample Size
2019	Link01	6.2	5.2	3.5	4.6	6.9	931	6.5	5.4	3.4	4.6	7.4	463	5.9	4.9	3.6	4.5	6.5	468
	Link02	1.9	1.3	1.3	1.6	2.0	934	1.5	1.2	1.3	1.3	1.5	469	2.3	1.4	1.8	2.0	2.3	465
	Link03	4.8	4.5	3.2	3.9	5.3	929	4.6	4.0	3.1	3.7	4.9	461	5.1	5.0	3.4	4.1	5.7	468
	Link04	4.2	3.5	2.2	3.4	4.4	756	4.0	4.2	1.9	2.2	3.3	370	4.5	2.5	3.3	3.8	4.6	386
	Link05	4.9	3.5	3.3	4.0	5.6	725	4.8	3.7	3.2	3.8	5.2	364	5.0	3.2	3.4	4.2	5.8	361
	Link06	4.6	2.4	3.2	4.0	5.1	555	3.9	2.5	2.8	3.2	3.6	264	5.3	2.2	4.1	4.7	5.8	291
	Link07	1.0	1.0	0.6	0.7	0.8	662	1.1	1.3	0.5	0.6	0.7	282	1.0	0.9	0.7	0.8	0.8	380
	Link08	1.2	0.6	1.0	1.1	1.3	799	1.0	0.4	0.9	1.0	1.1	347	1.4	0.7	1.1	1.3	1.5	452
	Link09	0.7	0.5	0.5	0.6	0.7	952	0.6	0.2	0.5	0.6	0.7	457	0.7	0.6	0.6	0.7	0.8	495
	Link10	3.7	2.8	2.5	3.0	3.9	1015	3.8	3.2	2.4	3.0	4.0	482	3.7	2.4	2.6	3.0	3.9	533
	Link11	2.0	1.5	1.3	1.7	2.2	990	1.7	1.9	1.2	1.3	1.4	468	2.3	1.0	1.8	2.0	2.4	522
	Link12	5.5	4.6	3.5	4.4	6.3	946	5.4	5.3	3.3	4.1	6.2	454	5.6	3.7	3.8	4.6	6.5	492

Table 26. Monthly Average Transit Time Estimates (Hours), 2019.

Year	Link Number	Both Directions								Southbound Trips								Northbound Trips							
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
2019	Link01	0.00	6.48	7.32	6.33	5.84	6.00	8.09	4.64	0.00	11.83	10.96	6.38	6.08	6.55	7.97	4.82	0.00	4.47	5.42	6.28	5.59	5.44	8.20	4.42
	Link02	0.00	2.53	1.84	1.76	1.93	2.01	2.17	1.69	0.00	1.29	1.35	1.45	1.48	1.56	1.64	1.46	0.00	2.88	2.01	2.07	2.42	2.48	2.70	1.96
	Link03	0.00	11.04	3.71	4.52	5.51	4.54	5.82	3.82	0.00	7.50	2.82	4.18	6.03	4.37	4.85	4.03	0.00	12.22	4.05	4.86	5.00	4.73	6.77	3.59
	Link04	0.00	3.05	3.32	4.25	4.90	3.93	4.50	3.94	0.00	1.92	2.31	3.78	5.70	3.62	4.02	3.65	0.00	3.43	3.54	4.80	4.25	4.25	4.93	4.27
	Link05	0.00	3.56	5.33	5.32	5.19	4.71	4.97	4.83	0.00	2.29	0.00	4.45	4.69	4.50	4.69	5.73	0.00	4.19	5.33	6.55	5.62	4.92	5.22	3.78
	Link06	0.00	5.90	4.50	4.60	4.82	4.75	4.34	4.67	0.00	3.13	3.83	3.91	3.64	4.15	3.66	3.97	0.00	7.75	4.63	5.57	5.68	5.24	4.92	5.45
	Link07	0.00	0.75	1.06	0.99	1.00	0.94	1.27	1.00	0.00	0.67	0.51	0.97	1.26	1.02	1.44	0.89	0.00	0.76	1.22	1.02	0.83	0.89	1.17	1.10
	Link08	1.25	1.21	1.30	1.16	1.21	1.25	1.25	1.21	0.00	0.79	0.98	0.95	1.07	1.03	1.04	1.00	1.25	1.27	1.43	1.34	1.31	1.43	1.39	1.42
	Link09	0.62	0.68	0.80	0.66	0.71	0.70	0.64	0.62	0.50	0.44	0.55	0.55	0.68	0.65	0.53	0.59	0.65	0.72	0.89	0.77	0.74	0.76	0.73	0.65
	Link10	2.97	4.39	3.26	3.39	3.83	4.42	3.56	3.74	5.00	2.10	2.55	3.51	4.09	4.67	3.24	3.96	2.46	4.93	3.52	3.26	3.63	4.18	3.82	3.47
	Link11	1.83	1.88	1.98	1.78	2.24	2.63	2.01	1.67	1.33	1.03	1.41	1.38	1.96	2.59	1.67	1.38	2.00	2.04	2.20	2.17	2.47	2.67	2.29	2.03
	Link12	8.60	7.48	6.38	5.16	6.45	6.20	4.76	4.79	2.17	15.08	3.71	4.74	6.21	7.33	3.87	4.99	10.75	6.53	7.21	5.55	6.67	4.96	5.47	4.54

Table 27. Monthly Link Transit Count, 2019.

Year	Link Number	Both Directions								Southbound Trips								Northbound Trips							
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
2019	Link01	0	11	38	199	151	207	154	171	0	3	13	99	76	105	73	94	0	8	25	100	75	102	81	77
	Link02	0	9	34	196	150	196	167	182	0	2	9	98	78	100	84	98	0	7	25	98	72	96	83	84
	Link03	0	8	29	206	140	187	182	177	0	2	8	102	70	95	90	94	0	6	21	104	70	92	92	83
	Link04	0	8	17	114	121	177	177	142	0	2	3	61	54	90	85	75	0	6	14	53	67	87	92	67
	Link05	0	6	4	65	132	179	184	155	0	2	0	38	61	91	89	83	0	4	4	27	71	88	95	72
	Link06	0	5	6	55	78	146	136	129	0	2	1	32	33	66	62	68	0	3	5	23	45	80	74	61
	Link07	0	10	27	163	73	141	120	128	0	1	6	77	28	62	46	62	0	9	21	86	45	79	74	66
	Link08	1	15	35	189	78	165	147	169	0	2	10	86	33	73	60	83	1	13	25	103	45	92	87	86
	Link09	5	19	41	232	91	174	167	223	1	3	11	116	43	86	75	122	4	16	30	116	48	88	92	101
	Link10	5	21	41	235	157	170	167	219	1	4	11	116	70	83	76	121	4	17	30	119	87	87	91	98
	Link11	4	19	40	226	155	169	169	208	1	3	11	110	72	81	76	114	3	16	29	116	83	88	93	94
	Link12	4	18	38	212	148	165	157	204	1	2	9	102	72	86	70	112	3	16	29	110	76	79	87	92

Table 28. Weekly Average Transit Time Estimates (Hours): Both Directions, Week 69–Week 87, 2019.

Start Date		4/22/19	5/13/19	5/20/19	6/17/19	6/24/19	7/1/19	7/8/19	7/15/19	7/22/19	7/29/19	8/5/19	8/12/19	8/19/19	8/26/19
End Date		4/28/19	5/19/19	5/26/19	6/23/19	6/30/19	7/7/19	7/14/19	7/21/19	7/28/19	8/4/19	8/11/19	8/18/19	8/25/19	9/1/19
Year	Link Number	Week 69	Week 72	Week 73	Week 77	Week 78	Week 79	Week 80	Week 81	Week 82	Week 83	Week 84	Week 85	Week 86	Week 87
2019	Link01	0.00	6.48	0.00	7.21	7.34	6.74	6.02	5.82	5.60	7.05	5.27	5.33	6.39	5.93
	Link02	0.00	2.53	0.00	2.00	1.80	1.70	1.74	1.80	1.82	1.77	2.00	1.68	1.83	2.24
	Link03	0.00	11.04	0.00	4.02	3.65	3.88	4.39	4.29	5.43	4.94	4.95	15.10	4.41	4.85
	Link04	0.00	2.93	3.42	3.79	3.26	3.18	4.30	5.12	5.14	4.55	5.27	5.88	4.40	4.17
	Link05	0.00	3.56	0.00	0.00	5.33	5.83	3.49	3.88	7.96	5.65	5.41	4.93	4.81	4.01
	Link06	0.00	5.90	0.00	0.00	4.50	3.00	4.14	3.50	5.65	4.34	5.17	0.00	5.34	4.60
	Link07	0.00	0.67	0.88	0.67	1.11	0.99	0.99	1.04	1.18	1.00	0.73	0.00	0.82	0.98
	Link08	1.25	1.12	1.38	1.22	1.31	1.11	1.16	1.28	1.14	1.10	1.26	0.00	1.19	1.30
	Link09	0.62	0.64	0.76	0.60	0.83	0.63	0.62	0.58	0.85	0.61	1.00	0.00	0.68	0.65
	Link10	2.97	2.88	8.15	2.73	3.33	3.39	3.34	3.53	3.53	3.11	3.74	3.71	4.36	3.43
	Link11	1.83	1.88	0.00	1.75	2.01	1.77	1.75	1.82	1.81	1.83	2.04	2.19	2.29	2.80
	Link12	8.60	7.48	0.00	4.56	6.54	5.05	4.92	5.02	5.77	5.13	6.57	6.16	6.60	7.08

Table 29. Weekly Average Transit Time Estimates (Hours): Both Directions, Week 88–Week 100, 2019.

Start Date		9/2/19	9/9/19	9/16/19	9/23/19	9/30/19	10/7/19	10/14/19	10/21/19	10/28/19	11/4/19	11/11/19	11/18/19	11/25/19
End Date		9/8/19	9/15/19	9/22/19	9/29/19	10/6/19	10/13/19	10/20/19	10/27/19	11/3/19	11/10/19	11/17/19	11/24/19	12/1/19
Year	Link Number	Week 88	Week 89	Week 90	Week 91	Week 92	Week 93	Week 94	Week 95	Week 96	Week 97	Week 98	Week 99	Week 100
2019	Link01	5.08	4.96	7.81	6.02	6.74	4.97	16.68	9.41	4.87	4.77	4.87	5.61	3.33
	Link02	2.09	2.23	1.88	1.94	1.89	1.76	3.33	2.21	1.94	1.67	1.64	2.05	1.44
	Link03	4.27	4.31	4.25	5.37	5.18	3.82	10.34	5.73	5.18	4.14	3.46	3.35	3.09
	Link04	4.32	3.26	3.78	4.18	4.19	4.03	5.78	4.07	4.63	3.73	3.90	2.33	4.21
	Link05	4.78	4.27	4.78	4.97	5.05	4.10	6.26	5.06	4.82	4.96	3.98	0.00	5.49
	Link06	4.88	4.54	4.82	4.46	4.40	4.39	3.80	4.87	4.72	4.26	4.83	0.00	4.57
	Link07	1.28	0.84	0.84	0.85	1.05	1.20	0.89	1.43	1.58	0.94	1.02	1.14	0.76
	Link08	1.18	1.23	1.26	1.35	1.16	1.24	1.45	1.13	1.36	1.21	1.14	1.54	1.09
	Link09	0.63	0.69	0.65	0.87	0.66	0.67	0.61	0.62	0.61	0.61	0.60	0.69	0.58
	Link10	4.44	6.63	3.99	4.09	3.70	4.23	2.84	3.59	3.69	3.42	3.45	3.70	4.13
	Link11	4.05	3.01	2.24	1.78	1.76	1.87	1.66	1.80	2.43	1.90	1.59	1.68	1.55
	Link12	11.31	4.71	4.46	4.20	4.12	4.00	5.52	4.87	5.71	5.18	4.28	4.62	4.87

Table 30. Weekly Link Transit Count: Both Directions, Week 69–Week 87, 2019.

Start Date		4/22/19	5/13/19	5/20/19	6/17/19	6/24/19	7/1/19	7/8/19	7/15/19	7/22/19	7/29/19	8/5/19	8/12/19	8/19/19	8/26/19
End Date		4/28/19	5/19/19	5/26/19	6/23/19	6/30/19	7/7/19	7/14/19	7/21/19	7/28/19	8/4/19	8/11/19	8/18/19	8/25/19	9/1/19
Year	Link Number	Week 69	Week 72	Week 73	Week 77	Week 78	Week 79	Week 80	Week 81	Week 82	Week 83	Week 84	Week 85	Week 86	Week 87
2019	Link01	0	11	0	7	31	42	51	44	38	49	46	10	42	35
	Link02	0	9	0	6	28	44	50	43	37	50	46	12	41	29
	Link03	0	8	0	5	24	45	49	50	37	53	41	10	36	31
	Link04	0	6	2	2	15	20	30	22	18	52	34	5	31	26
	Link05	0	6	0	0	4	2	14	5	14	58	40	6	39	26
	Link06	0	5	0	0	6	2	11	4	15	43	20	0	22	21
	Link07	0	6	4	3	24	23	39	40	38	42	15	0	23	21
	Link08	1	10	5	3	32	33	41	47	41	51	13	0	23	27
	Link09	5	13	6	5	36	46	55	48	53	57	14	0	26	32
	Link10	5	15	6	5	36	46	55	52	51	58	43	16	50	29
	Link11	4	19	0	4	36	44	51	51	51	57	46	16	47	27
	Link12	4	18	0	3	35	42	51	49	43	54	45	15	43	26

Table 31. Weekly Link Transit Count: Both Directions, Week 88–Week 100, 2019.

Start Date		9/2/19	9/9/19	9/16/19	9/23/19	9/30/19	10/7/19	10/14/19	10/21/19	10/28/19	11/4/19	11/11/19	11/18/19	11/25/19
End Date		9/8/19	9/15/19	9/22/19	9/29/19	10/6/19	10/13/19	10/20/19	10/27/19	11/3/19	11/10/19	11/17/19	11/24/19	12/1/19
Year	Link Number	Week 88	Week 89	Week 90	Week 91	Week 92	Week 93	Week 94	Week 95	Week 96	Week 97	Week 98	Week 99	Week 100
2019	Link01	51	39	56	48	48	34	20	34	53	45	48	23	26
	Link02	49	38	55	42	48	41	21	38	56	48	50	26	27
	Link03	48	33	53	43	50	41	28	41	54	49	46	25	29
	Link04	48	26	54	38	50	43	24	43	53	48	36	1	29
	Link05	46	25	53	39	55	43	23	50	51	52	37	0	37
	Link06	36	22	48	25	48	31	20	34	44	34	34	0	30
	Link07	33	26	47	23	38	27	17	29	33	34	35	15	27
	Link08	38	27	48	35	44	32	21	39	40	44	44	21	39
	Link09	39	27	51	41	44	35	24	47	55	54	51	36	52
	Link10	41	22	52	39	42	36	22	50	54	53	51	35	51
	Link11	39	21	54	39	42	36	20	50	55	48	53	34	46
	Link12	41	19	51	39	39	37	18	48	49	46	53	34	44

Table 32. Weekly Average Transit Time Estimates (Hours): Southbound, Week 69–Week 87, 2019.

Start Date		4/22/19	5/13/19	6/17/19	6/24/19	7/1/19	7/8/19	7/15/19	7/22/19	7/29/19	8/5/19	8/12/19	8/19/19	8/26/19
End Date		4/28/19	5/19/19	6/23/19	6/30/19	7/7/19	7/14/19	7/21/19	7/28/19	8/4/19	8/11/19	8/18/19	8/25/19	9/1/19
Year	Link Number	Week 69	Week 72	Week 77	Week 78	Week 79	Week 80	Week 81	Week 82	Week 83	Week 84	Week 85	Week 86	Week 87
2019	Link01	0.00	11.83	21.42	10.09	4.04	6.31	5.80	5.59	8.30	5.59	5.17	6.41	6.77
	Link02	0.00	1.29	1.25	1.36	1.28	1.51	1.32	1.69	1.34	1.50	1.55	1.54	1.49
	Link03	0.00	7.50	3.17	2.77	3.27	4.31	4.30	4.04	5.00	4.87	21.06	4.17	3.99
	Link04	0.00	1.92	0.00	2.31	2.07	4.40	4.13	6.41	4.20	6.61	14.42	4.88	3.37
	Link05	0.00	2.29	0.00	0.00	5.83	3.29	3.42	7.88	5.08	4.38	2.08	4.43	3.50
	Link06	0.00	3.13	0.00	3.83	3.00	3.48	2.71	6.42	3.78	3.19	0.00	3.35	4.00
	Link07	0.00	0.67	0.50	0.52	0.70	1.02	0.74	1.52	0.98	0.58	0.00	1.12	1.35
	Link08	0.00	0.79	0.96	0.99	0.92	0.93	0.96	1.01	0.96	1.17	0.00	1.07	1.11
	Link09	0.50	0.44	0.44	0.59	0.57	0.53	0.50	0.60	0.56	0.69	0.00	0.77	0.65
	Link10	5.00	2.10	2.42	2.59	3.25	3.47	4.23	3.79	2.83	4.11	3.35	4.98	3.65
	Link11	1.33	1.03	1.19	1.49	1.22	1.49	1.27	1.47	1.31	1.43	1.98	1.97	3.93
	Link12	2.17	15.08	4.00	3.63	4.49	3.88	4.40	5.80	5.24	6.03	7.05	6.48	7.05

Table 33. Weekly Average Transit Time Estimates (Hours): Southbound, Week 88–Week 100, 2019.

Start Date		9/2/19	9/9/19	9/16/19	9/23/19	9/30/19	10/7/19	10/14/19	10/21/19	10/28/19	11/4/19	11/11/19	11/18/19	11/25/19
End Date		9/8/19	9/15/19	9/22/19	9/29/19	10/6/19	10/13/19	10/20/19	10/27/19	11/3/19	11/10/19	11/17/19	11/24/19	12/1/19
Year	Link Number	Week 88	Week 89	Week 90	Week 91	Week 92	Week 93	Week 94	Week 95	Week 96	Week 97	Week 98	Week 99	Week 100
2019	Link01	5.37	4.16	9.35	6.20	6.64	5.61	12.60	9.74	5.73	4.64	5.16	5.78	3.97
	Link02	1.61	2.20	1.35	1.30	1.27	1.26	1.24	2.05	1.86	1.31	1.33	2.38	1.35
	Link03	4.15	4.87	4.04	4.86	4.35	3.37	4.52	6.81	5.03	4.23	3.76	3.82	3.63
	Link04	4.13	2.87	3.43	3.68	3.52	3.78	3.20	4.53	4.24	3.17	3.76	2.33	4.29
	Link05	4.82	4.22	4.42	4.59	4.28	3.84	5.70	5.38	4.73	5.71	4.85	0.00	6.96
	Link06	4.13	3.58	4.64	3.92	3.23	3.59	2.85	5.03	3.41	3.28	4.55	0.00	4.38
	Link07	1.34	0.69	0.97	0.86	1.34	1.71	0.99	1.50	1.21	0.78	0.81	1.47	0.72
	Link08	1.07	1.18	0.99	0.98	0.93	0.92	1.70	0.97	0.96	0.95	0.99	0.99	1.06
	Link09	0.61	0.73	0.58	0.75	0.56	0.54	0.48	0.52	0.57	0.54	0.58	0.62	0.61
	Link10	4.82	8.96	4.16	4.08	3.68	3.83	2.59	3.00	4.03	3.31	3.60	3.59	4.59
	Link11	5.42	1.85	1.77	1.33	1.25	1.20	1.14	1.45	2.25	1.49	1.22	1.62	1.32
	Link12	15.31	5.38	4.44	3.42	3.62	4.02	2.80	4.50	4.68	5.13	4.24	4.69	5.55

Table 34. Weekly Link Transit Count: Southbound, Week 69–Week 87, 2019.

Start Date		4/22/19	5/13/19	6/17/19	6/24/19	7/1/19	7/8/19	7/15/19	7/22/19	7/29/19	8/5/19	8/12/19	8/19/19	8/26/19
End Date		4/28/19	5/19/19	6/23/19	6/30/19	7/7/19	7/14/19	7/21/19	7/28/19	8/4/19	8/11/19	8/18/19	8/25/19	9/1/19
Year	Link Number	Week 69	Week 72	Week 77	Week 78	Week 79	Week 80	Week 81	Week 82	Week 83	Week 84	Week 85	Week 86	Week 87
2019	Link01	0	3	1	12	13	32	20	20	29	23	6	20	14
	Link02	0	2	1	8	15	31	20	20	28	24	8	21	10
	Link03	0	2	1	7	15	28	23	21	30	20	6	19	11
	Link04	0	2	0	3	8	19	10	9	30	14	1	16	9
	Link05	0	2	0	0	2	11	2	5	33	18	2	20	9
	Link06	0	2	0	1	2	8	2	4	28	7	0	7	9
	Link07	0	1	2	4	8	24	12	18	26	4	0	7	8
	Link08	0	2	2	8	12	22	16	20	30	2	0	11	10
	Link09	1	3	3	8	16	34	19	28	35	3	0	13	14
	Link10	1	4	3	8	17	33	21	26	33	17	8	24	9
	Link11	1	3	3	8	17	29	21	26	31	21	7	22	10
	Link12	1	2	2	7	17	30	15	24	31	22	5	22	10

Table 35. Weekly Link Transit Count: Southbound, Week 88–Week 100, 2019.

Start Date		9/2/19	9/9/19	9/16/19	9/23/19	9/30/19	10/7/19	10/14/19	10/21/19	10/28/19	11/4/19	11/11/19	11/18/19	11/25/19
End Date		9/8/19	9/15/19	9/22/19	9/29/19	10/6/19	10/13/19	10/20/19	10/27/19	11/3/19	11/10/19	11/17/19	11/24/19	12/1/19
Year	Link Number	Week 88	Week 89	Week 90	Week 91	Week 92	Week 93	Week 94	Week 95	Week 96	Week 97	Week 98	Week 99	Week 100
2019	Link01	29	17	32	22	23	16	11	12	30	22	26	13	17
	Link02	29	17	30	20	26	17	13	16	33	23	27	13	17
	Link03	30	13	28	21	26	18	14	19	31	23	24	13	18
	Link04	28	12	28	19	24	19	11	20	30	22	16	1	19
	Link05	27	11	27	22	26	18	10	23	29	26	17	0	24
	Link06	19	9	23	11	23	12	9	15	22	15	16	0	20
	Link07	17	10	22	9	17	10	7	9	15	15	14	6	17
	Link08	21	9	21	16	19	11	8	15	19	21	20	8	24
	Link09	23	10	27	21	21	14	11	19	30	26	24	21	33
	Link10	25	6	28	20	20	15	10	22	30	27	24	19	32
	Link11	21	7	28	21	19	16	9	21	30	25	25	19	28
	Link12	24	8	28	21	18	16	7	20	28	23	27	18	28

Table 36. Weekly Average Transit Time Estimates (Hours): Northbound, Week 69–Week 87, 2019.

Start Date		4/22/19	5/13/19	5/20/19	6/17/19	6/24/19	7/1/19	7/8/19	7/15/19	7/22/19	7/29/19	8/5/19	8/12/19	8/19/19	8/26/19
End Date		4/28/19	5/19/19	5/26/19	6/23/19	6/30/19	7/7/19	7/14/19	7/21/19	7/28/19	8/4/19	8/11/19	8/18/19	8/25/19	9/1/19
Year	Link Number	Week 69	Week 72	Week 73	Week 77	Week 78	Week 79	Week 80	Week 81	Week 82	Week 83	Week 84	Week 85	Week 86	Week 87
2019	Link01	0.00	4.47	0.00	4.85	5.60	7.95	5.55	5.85	5.60	5.24	4.94	5.56	6.38	5.37
	Link02	0.00	2.88	0.00	2.15	1.98	1.91	2.13	2.21	1.97	2.31	2.55	1.94	2.13	2.63
	Link03	0.00	12.22	0.00	4.23	4.01	4.19	4.50	4.28	7.25	4.86	5.02	6.17	4.69	5.32
	Link04	0.00	3.44	3.42	3.79	3.49	3.91	4.12	5.94	3.88	5.04	4.33	3.75	3.88	4.59
	Link05	0.00	4.19	0.00	0.00	5.33	0.00	4.22	4.19	8.00	6.40	6.25	6.35	5.21	4.28
	Link06	0.00	7.75	0.00	0.00	4.63	0.00	5.89	4.29	5.37	5.38	6.23	0.00	6.28	5.06
	Link07	0.00	0.67	0.88	1.00	1.23	1.15	0.93	1.16	0.86	1.05	0.78	0.00	0.69	0.74
	Link08	1.25	1.20	1.38	1.75	1.41	1.21	1.42	1.44	1.27	1.29	1.27	0.00	1.30	1.42
	Link09	0.65	0.70	0.76	0.83	0.90	0.66	0.77	0.63	1.13	0.68	1.08	0.00	0.60	0.65
	Link10	2.46	3.17	8.15	3.21	3.54	3.48	3.16	3.05	3.27	3.48	3.49	4.07	3.78	3.33
	Link11	2.00	2.04	0.00	3.42	2.15	2.11	2.09	2.20	2.15	2.46	2.55	2.36	2.57	2.14
	Link12	10.75	6.53	0.00	5.67	7.26	5.43	6.41	5.29	5.73	4.98	7.10	5.71	6.73	7.10

Table 37. Weekly Average Transit Time Estimates (Hours): Northbound, Week 88–Week 100, 2019.

Start Date		9/2/19	9/9/19	9/16/19	9/23/19	9/30/19	10/7/19	10/14/19	10/21/19	10/28/19	11/4/19	11/11/19	11/18/19	11/25/19
End Date		9/8/19	9/15/19	9/22/19	9/29/19	10/6/19	10/13/19	10/20/19	10/27/19	11/3/19	11/10/19	11/17/19	11/24/19	12/1/19
Year	Link Number	Week 88	Week 89	Week 90	Week 91	Week 92	Week 93	Week 94	Week 95	Week 96	Week 97	Week 98	Week 99	Week 100
2019	Link01	4.70	5.57	5.76	5.87	6.83	4.40	21.68	9.23	3.76	4.89	4.52	5.38	2.11
	Link02	2.77	2.25	2.52	2.52	2.62	2.11	6.72	2.33	2.06	2.00	2.01	1.73	1.58
	Link03	4.46	3.95	4.49	5.86	6.08	4.17	16.16	4.80	5.39	4.06	3.14	2.84	2.20
	Link04	4.60	3.60	4.15	4.69	4.81	4.23	7.96	3.66	5.14	4.20	4.02	0.00	4.07
	Link05	4.72	4.30	5.16	5.45	5.74	4.28	6.70	4.79	4.94	4.20	3.23	0.00	2.76
	Link06	5.71	5.20	4.98	4.89	5.48	4.90	4.58	4.74	6.03	5.04	5.08	0.00	4.95
	Link07	1.21	0.93	0.73	0.84	0.81	0.90	0.82	1.39	1.88	1.07	1.16	0.92	0.84
	Link08	1.30	1.25	1.47	1.66	1.34	1.40	1.30	1.24	1.73	1.44	1.26	1.87	1.14
	Link09	0.66	0.67	0.73	0.99	0.76	0.76	0.72	0.69	0.67	0.67	0.63	0.80	0.54
	Link10	3.85	5.75	3.78	4.11	3.72	4.51	3.05	4.05	3.27	3.54	3.31	3.83	3.34
	Link11	2.46	3.59	2.74	2.30	2.18	2.40	2.09	2.05	2.65	2.34	1.91	1.76	1.92
	Link12	5.67	4.23	4.49	5.10	4.55	3.99	7.25	5.13	7.10	5.22	4.33	4.53	3.68

Table 38. Weekly Link Transit Count: Northbound, Week 69–Week 87, 2019.

Start Date		4/22/19	5/13/19	5/20/19	6/17/19	6/24/19	7/1/19	7/8/19	7/15/19	7/22/19	7/29/19	8/5/19	8/12/19	8/19/19	8/26/19
End Date		4/28/19	5/19/19	5/26/19	6/23/19	6/30/19	7/7/19	7/14/19	7/21/19	7/28/19	8/4/19	8/11/19	8/18/19	8/25/19	9/1/19
Year	Link Number	Week 69	Week 72	Week 73	Week 77	Week 78	Week 79	Week 80	Week 81	Week 82	Week 83	Week 84	Week 85	Week 86	Week 87
2019	Link01	0	8	0	6	19	29	19	24	18	20	23	4	22	21
	Link02	0	7	0	5	20	29	19	23	17	22	22	4	20	19
	Link03	0	6	0	4	17	30	21	27	16	23	21	4	17	20
	Link04	0	4	2	2	12	12	11	12	9	22	20	4	15	17
	Link05	0	4	0	0	4	0	3	3	9	25	22	4	19	17
	Link06	0	3	0	0	5	0	3	2	11	15	13	0	15	12
	Link07	0	5	4	1	20	15	15	28	20	16	11	0	16	13
	Link08	1	8	5	1	24	21	19	31	21	21	11	0	12	17
	Link09	4	10	6	2	28	30	21	29	25	22	11	0	13	18
	Link10	4	11	6	2	28	29	22	31	25	25	26	8	26	20
	Link11	3	16	0	1	28	27	22	30	25	26	25	9	25	17
	Link12	3	16	0	1	28	25	21	34	19	23	23	10	21	16

Table 39. Weekly Link Transit Count: Northbound, Week 88–Week 100, 2019.

Start Date		9/2/19	9/9/19	9/16/19	9/23/19	9/30/19	10/7/19	10/14/19	10/21/19	10/28/19	11/4/19	11/11/19	11/18/19	11/25/19
End Date		9/8/19	9/15/19	9/22/19	9/29/19	10/6/19	10/13/19	10/20/19	10/27/19	11/3/19	11/10/19	11/17/19	11/24/19	12/1/19
Year	Link Number	Week 88	Week 89	Week 90	Week 91	Week 92	Week 93	Week 94	Week 95	Week 96	Week 97	Week 98	Week 99	Week 100
2019	Link01	22	22	24	26	25	18	9	22	23	23	22	10	9
	Link02	20	21	25	22	22	24	8	22	23	25	23	13	10
	Link03	18	20	25	22	24	23	14	22	23	26	22	12	11
	Link04	20	14	26	19	26	24	13	23	23	26	20	0	10
	Link05	19	14	26	17	29	25	13	27	22	26	20	0	13
	Link06	17	13	25	14	25	19	11	19	22	19	18	0	10
	Link07	16	16	25	14	21	17	10	20	18	19	21	9	10
	Link08	17	18	27	19	25	21	13	24	21	23	24	13	15
	Link09	16	17	24	20	23	21	13	28	25	28	27	15	19
	Link10	16	16	24	19	22	21	12	28	24	26	27	16	19
	Link11	18	14	26	18	23	20	11	29	25	23	28	15	18
	Link12	17	11	23	18	21	21	11	28	21	23	26	16	16

Travel Time Estimate Results by Link, 2020

Table 40. Yearly Transit Time Estimates, 2020.

Year	Link Number	Both Directions						Southbound Trips						Northbound Trips					
		Average Transit Time (hours)	Std Dev (hours)	25th Pctl. (hours)	50th Pctl. (hours)	75th Pctl. (hours)	Sample Size	Link Number	Average Transit Time (hours)	25th Pctl. (hours)	Median Transit Time (hours)	75th Pctl. (hours)	Sample Size	Link Number	Average Transit Time (hours)	25th Pctl. (hours)	Median Transit Time (hours)	75th Pctl. (hours)	Sample Size
2020	Link01	5.4	4.7	3.3	4.2	5.8	1558	5.6	5.5	3.3	4.1	6.0	762	5.2	3.8	3.5	4.2	5.8	796
	Link02	1.9	1.1	1.4	1.7	2.1	1530	1.6	0.7	1.3	1.5	1.7	750	2.3	1.2	1.8	2.0	2.5	780
	Link03	4.4	2.5	3.3	3.8	5.1	1495	4.4	2.3	3.3	3.8	5.2	723	4.4	2.6	3.3	3.8	5.0	772
	Link04	3.9	2.4	2.4	3.2	4.3	1454	3.5	2.9	2.2	2.4	3.0	705	4.2	1.8	3.2	3.8	4.6	749
	Link05	4.6	2.5	3.3	3.9	5.3	1578	4.4	2.4	3.3	3.8	5.0	774	4.7	2.7	3.4	4.1	5.5	804
	Link06	4.5	2.2	3.3	3.9	4.9	1227	4.1	2.5	3.0	3.4	3.8	574	4.9	1.9	3.8	4.5	5.4	653
	Link07	1.0	1.0	0.6	0.7	0.8	1160	0.9	1.0	0.6	0.6	0.8	522	1.1	1.0	0.7	0.8	0.8	638
	Link08	1.2	0.6	1.0	1.1	1.3	1392	1.1	0.2	0.9	1.1	1.2	643	1.4	0.8	1.0	1.2	1.4	749
	Link09	0.7	0.6	0.5	0.6	0.8	1676	0.6	0.2	0.5	0.6	0.7	821	0.8	0.7	0.5	0.7	0.8	855
	Link10	3.7	2.0	2.6	3.1	4.1	1726	3.8	2.2	2.6	3.1	4.3	847	3.6	1.8	2.7	3.1	3.9	879
	Link11	2.1	1.5	1.3	1.7	2.1	1740	1.7	1.6	1.3	1.4	1.6	847	2.4	1.3	1.8	2.0	2.5	893
	Link12	5.9	3.6	3.7	4.8	7.2	1673	6.0	4.2	3.7	5.0	7.5	805	5.7	3.0	3.8	4.7	6.9	868

Table 41. Monthly Average Transit Time Estimates (Hours), 2020.

Year	Link Number	Both Directions								Southbound Trips								Northbound Trips							
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
2020	Link01	5.98	4.58	5.58	6.16	5.88	5.20	4.89	4.67	6.14	4.27	5.47	6.52	6.33	5.28	5.25	5.09	5.86	4.87	5.68	5.80	5.45	5.10	4.55	4.21
	Link02	1.92	1.86	1.79	2.03	1.98	2.10	1.94	1.81	1.52	1.42	1.46	1.65	1.55	1.59	1.63	1.56	2.23	2.26	2.11	2.38	2.38	2.66	2.24	2.09
	Link03	4.55	4.15	4.51	4.75	4.88	4.31	4.10	3.69	3.11	4.20	4.65	4.68	5.09	4.57	4.28	3.84	5.52	4.11	4.38	4.81	4.67	4.04	3.91	3.52
	Link04	3.90	3.64	3.88	4.42	3.88	3.91	3.95	3.40	3.68	2.99	3.56	4.27	3.43	3.39	3.81	3.07	4.03	4.24	4.16	4.56	4.35	4.42	4.10	3.76
	Link05	4.59	4.11	4.74	4.98	4.84	4.72	4.47	4.20	3.78	3.70	5.07	5.02	4.77	4.53	4.15	4.08	5.20	4.47	4.43	4.94	4.91	4.90	4.79	4.34
	Link06	4.48	4.28	4.33	4.36	4.45	4.68	4.63	4.97	4.50	4.04	3.60	3.84	3.78	4.21	4.08	4.69	4.47	4.52	4.96	4.81	5.10	5.16	5.04	5.24
	Link07	1.20	1.03	0.98	0.93	0.97	0.86	1.16	0.91	1.12	0.97	0.78	0.83	0.85	0.84	1.15	0.77	1.25	1.08	1.14	1.03	1.08	0.87	1.17	1.04
	Link08	1.21	1.19	1.16	1.21	1.26	1.29	1.37	1.17	0.92	0.99	0.99	1.03	1.11	1.15	1.15	1.11	1.37	1.35	1.30	1.37	1.40	1.42	1.57	1.23
	Link09	0.63	0.69	0.67	0.68	0.75	0.74	0.72	0.67	0.53	0.57	0.56	0.62	0.65	0.66	0.69	0.67	0.69	0.80	0.76	0.73	0.86	0.82	0.75	0.67
	Link10	3.01	3.40	3.52	4.16	4.14	3.58	3.96	3.74	2.85	3.45	3.54	4.24	4.35	3.58	4.14	3.92	3.12	3.34	3.49	4.08	3.92	3.59	3.78	3.55
	Link11	1.80	1.79	1.90	2.16	2.57	2.04	2.20	1.89	1.34	1.36	1.41	1.76	2.73	1.71	1.94	1.48	2.10	2.21	2.34	2.55	2.42	2.39	2.48	2.33
	Link12	4.03	4.90	5.84	6.99	7.97	5.34	6.40	4.58	3.47	4.65	6.01	7.42	8.52	5.34	6.58	4.83	4.35	5.14	5.68	6.62	7.38	5.34	6.24	4.31

Table 42. Monthly Link Transit Count, 2020.

Year	Link Number	Both Directions								Southbound Trips								Northbound Trips							
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
2020	Link01	135	164	189	262	220	183	215	190	56	78	91	131	107	96	104	99	79	86	98	131	113	87	111	91
	Link02	127	172	188	267	216	168	212	180	56	83	92	129	105	88	104	93	71	89	96	138	111	80	108	87
	Link03	141	176	179	259	206	160	202	172	57	83	85	124	101	83	101	89	84	93	94	135	105	77	101	83
	Link04	134	171	175	234	205	160	195	180	51	82	81	115	105	79	98	94	83	89	94	119	100	81	97	86
	Link05	157	193	202	239	209	173	211	194	67	90	98	119	104	87	104	105	90	103	104	120	105	86	107	89
	Link06	113	149	134	217	180	136	146	152	44	74	62	100	89	68	62	75	69	75	72	117	91	68	84	77
	Link07	109	137	121	219	183	132	131	128	41	63	52	100	89	61	53	63	68	74	69	119	94	71	78	65
	Link08	138	171	144	248	213	156	176	146	50	77	65	114	104	75	82	76	88	94	79	134	109	81	94	70
	Link09	172	207	175	281	238	180	222	201	71	100	83	134	122	92	111	108	101	107	92	147	116	88	111	93
	Link10	184	206	209	284	231	188	224	200	76	102	97	139	118	97	113	105	108	104	112	145	113	91	111	95
	Link11	184	211	216	277	228	184	226	214	72	104	102	135	115	93	115	111	112	107	114	142	113	91	111	103
	Link12	170	209	207	257	220	173	220	217	62	101	100	120	114	88	108	112	108	108	107	137	106	85	112	105

Table 43. Weekly Average Transit Time Estimates (Hours): Both Directions, Week 118–Week 135, 2020.

Start Date		3/30/20	4/6/20	4/13/20	4/20/20	4/27/20	5/4/20	5/11/20	5/18/20	5/25/20	6/1/20	6/8/20	6/15/20	6/22/20	6/29/20	7/6/20	7/13/20	7/20/20	7/27/20
End Date		4/5/20	4/12/20	4/19/20	4/26/20	5/3/20	5/10/20	5/17/20	5/24/20	5/31/20	6/7/20	6/14/20	6/21/20	6/28/20	7/5/20	7/12/20	7/19/20	7/26/20	8/2/20
Year	Link Number	Week 118	Week 119	Week 120	Week 121	Week 122	Week 123	Week 124	Week 125	Week 126	Week 127	Week 128	Week 129	Week 130	Week 131	Week 132	Week 133	Week 134	Week 135
2020	Link01	5.14	3.49	10.01	4.97	4.80	5.48	4.06	4.75	4.29	5.55	5.15	4.60	6.04	6.84	5.78	6.38	6.12	6.22
	Link02	1.99	2.35	2.64	1.57	1.60	1.91	1.87	1.67	1.97	1.70	1.80	1.76	1.78	1.84	1.95	2.26	2.00	2.23
	Link03	3.57	3.55	7.52	3.49	3.78	3.78	4.89	4.65	3.68	4.77	5.05	3.64	4.22	4.46	4.35	5.04	4.74	5.24
	Link04	3.35	3.85	3.62	4.01	3.99	3.99	4.02	3.23	3.49	3.85	3.61	3.76	3.90	4.55	4.52	3.90	5.14	4.23
	Link05	3.90	3.33	6.82	4.89	3.63	4.29	4.06	4.43	4.02	4.88	4.40	4.65	4.51	5.23	4.84	5.53	5.22	4.64
	Link06	4.61	4.54	4.61	4.89	3.83	4.38	4.46	3.70	4.49	3.94	4.47	4.49	4.45	4.37	4.23	4.53	4.51	4.29
	Link07	1.20	1.01	1.11	1.08	1.25	1.21	1.03	0.88	1.13	0.91	1.08	1.11	0.74	1.01	1.00	0.87	0.97	0.88
	Link08	1.14	1.06	1.28	1.12	1.39	1.10	1.26	1.28	1.14	1.21	1.16	1.15	1.17	1.21	1.17	1.26	1.20	1.22
	Link09	0.63	0.60	0.62	0.69	0.58	0.78	0.62	0.71	0.67	0.69	0.60	0.67	0.82	0.66	0.71	0.66	0.62	0.78
	Link10	2.51	3.32	3.26	2.95	3.20	3.94	3.07	3.21	3.28	3.02	3.37	3.46	3.54	4.52	4.13	3.90	4.07	4.42
	Link11	1.64	1.66	2.09	1.86	1.70	1.86	1.52	1.98	1.81	1.70	1.83	1.99	1.97	2.22	1.83	2.63	1.97	2.23
	Link12	3.38	3.47	5.16	3.75	4.87	4.54	4.67	5.37	4.90	5.20	5.84	6.71	6.10	5.80	5.65	9.45	6.08	7.88

Table 44. Weekly Average Transit Time Estimates (Hours): Both Directions, Week 136–Week 153, 2020.

Start Date		8/3/20	8/10/20	8/17/20	8/24/20	8/31/20	9/7/20	9/14/20	9/21/20	9/28/20	10/5/20	10/12/20	10/19/20	10/26/20	11/2/20	11/9/20	11/16/20	11/23/20	11/30/20
End Date		8/9/20	8/16/20	8/23/20	8/30/20	9/6/20	9/13/20	9/20/20	9/27/20	10/4/20	10/11/20	10/18/20	10/25/20	11/1/20	11/8/20	11/15/20	11/22/20	11/29/20	12/6/20
Year	Link Number	Week 136	Week 137	Week 138	Week 139	Week 140	Week 141	Week 142	Week 143	Week 144	Week 145	Week 146	Week 147	Week 148	Week 149	Week 150	Week 151	Week 152	Week 153
2020	Link01	5.70	7.10	5.12	5.65	5.29	4.67	4.96	5.09	5.59	4.66	4.60	4.34	5.71	5.01	4.60	3.79	5.31	4.29
	Link02	1.81	1.89	1.97	2.02	2.05	2.02	2.16	1.85	2.16	2.00	2.04	2.03	1.72	1.84	1.93	1.68	1.85	1.54
	Link03	4.96	4.81	4.73	4.92	5.80	3.89	4.18	3.54	4.32	3.73	4.75	3.76	3.75	4.13	3.85	3.40	3.28	3.90
	Link04	3.54	4.24	3.95	4.04	4.46	3.60	3.75	3.65	4.10	4.38	4.18	4.10	3.13	3.97	3.28	2.87	3.32	3.45
	Link05	4.64	5.03	4.97	4.53	4.80	4.20	4.93	5.09	4.97	4.30	4.48	4.06	4.61	4.79	4.57	3.38	3.33	7.35
	Link06	4.60	4.50	4.53	4.24	4.97	4.15	4.64	5.18	4.50	5.08	4.43	4.91	4.80	5.05	5.72	4.65	4.21	3.65
	Link07	1.22	0.91	0.92	0.77	0.98	0.95	0.69	0.71	0.84	1.79	0.99	1.14	0.94	0.78	1.00	0.70	1.21	0.56
	Link08	1.27	1.24	1.27	1.21	1.25	1.20	1.21	1.20	1.49	1.46	1.25	1.74	1.12	1.22	1.14	1.13	1.19	1.03
	Link09	0.71	0.75	0.80	0.69	0.89	0.69	0.78	0.67	0.64	0.74	0.78	0.77	0.62	0.63	0.66	0.71	0.63	1.18
	Link10	4.49	4.45	3.82	3.54	3.70	3.67	3.46	3.57	3.98	3.90	4.01	3.60	3.95	4.03	4.09	3.63	3.21	4.81
	Link11	2.15	2.00	3.72	2.35	2.17	1.90	2.06	2.03	2.05	2.16	2.68	2.01	2.03	1.89	2.06	1.91	1.79	1.40
	Link12	6.39	5.54	10.80	8.11	7.12	5.05	4.12	5.66	5.65	5.58	8.23	6.85	4.83	4.37	4.20	5.09	3.92	9.68

Table 45. Weekly Link Transit Count: Both Directions, Week 118–Week 135, 2020.

Start Date		3/30/20	4/6/20	4/13/20	4/20/20	4/27/20	5/4/20	5/11/20	5/18/20	5/25/20	6/1/20	6/8/20	6/15/20	6/22/20	6/29/20	7/6/20	7/13/20	7/20/20	7/27/20
End Date		4/5/20	4/12/20	4/19/20	4/26/20	5/3/20	5/10/20	5/17/20	5/24/20	5/31/20	6/7/20	6/14/20	6/21/20	6/28/20	7/5/20	7/12/20	7/19/20	7/26/20	8/2/20
Year	Link Number	Week 118	Week 119	Week 120	Week 121	Week 122	Week 123	Week 124	Week 125	Week 126	Week 127	Week 128	Week 129	Week 130	Week 131	Week 132	Week 133	Week 134	Week 135
2020	Link01	14	14	30	51	42	36	40	28	44	47	53	19	55	49	63	66	50	71
	Link02	15	20	22	44	42	38	36	32	50	45	50	23	56	55	65	64	48	73
	Link03	15	21	35	44	44	37	38	30	53	46	43	21	54	55	64	58	47	70
	Link04	15	23	33	38	41	36	38	32	49	43	42	20	53	56	54	57	35	68
	Link05	17	37	31	44	45	42	38	35	61	51	54	24	55	47	55	65	41	74
	Link06	16	21	22	30	38	31	28	26	50	40	44	18	20	43	60	48	36	64
	Link07	20	19	21	32	33	28	25	25	43	34	42	17	15	44	58	50	38	63
	Link08	21	30	27	40	38	35	30	34	54	39	51	22	17	54	56	59	48	66
	Link09	24	37	34	50	47	45	38	40	64	51	57	29	20	57	64	70	59	70
	Link10	32	39	37	50	47	43	37	40	65	49	57	32	50	62	65	71	55	73
	Link11	35	37	39	47	48	43	38	41	67	48	62	31	57	58	59	73	55	69
	Link12	32	36	36	42	44	41	43	39	66	47	61	26	55	55	52	59	59	66

Table 46. Weekly Link Transit Count: Both Directions, Week 118–Week 153, 2020.

Start Date		3/30/20	8/10/20	8/17/20	8/24/20	8/31/20	9/7/20	9/14/20	9/21/20	9/28/20	10/5/20	10/12/20	10/19/20	10/26/20	11/2/20	11/9/20	11/16/20	11/23/20	11/30/20
End Date		4/5/20	8/16/20	8/23/20	8/30/20	9/6/20	9/13/20	9/20/20	9/27/20	10/4/20	10/11/20	10/18/20	10/25/20	11/1/20	11/8/20	11/15/20	11/22/20	11/29/20	12/6/20
Year	Link Number	Week 118	Week 137	Week 138	Week 139	Week 140	Week 141	Week 142	Week 143	Week 144	Week 145	Week 146	Week 147	Week 148	Week 149	Week 150	Week 151	Week 152	Week 153
2020	Link01	14	41	62	25	39	49	42	39	52	45	49	45	50	47	45	41	46	4
	Link02	15	43	61	26	33	45	40	40	48	43	54	41	46	46	39	39	45	4
	Link03	15	40	54	26	31	44	37	38	49	38	51	38	46	49	34	35	43	5
	Link04	15	39	54	26	31	45	38	36	47	37	48	39	44	52	39	36	42	5
	Link05	17	40	62	26	37	49	39	34	46	47	53	42	48	51	46	37	45	6
	Link06	16	37	54	21	33	37	33	24	35	27	35	33	36	40	33	30	36	5
	Link07	20	43	51	22	31	36	29	27	35	29	28	29	26	34	26	29	33	3
	Link08	21	51	59	26	30	45	33	36	43	41	38	37	36	40	28	34	38	3
	Link09	24	56	64	27	37	50	37	40	54	47	51	48	50	54	42	41	48	8
	Link10	32	50	61	27	42	51	39	41	54	49	51	48	49	53	41	44	48	7
	Link11	35	52	57	27	42	50	40	39	54	49	52	46	50	51	50	48	52	7
	Link12	32	50	66	26	40	49	37	30	53	51	50	42	50	54	50	47	51	8

Table 47. Weekly Average Transit Time Estimates (Hours): Southbound, Week 118–Week 135, 2020.

Start Date		3/30/20	4/6/20	4/13/20	4/20/20	4/27/20	5/4/20	5/11/20	5/18/20	5/25/20	6/1/20	6/8/20	6/15/20	6/22/20	6/29/20	7/6/20	7/13/20	7/20/20	7/27/20
End Date		4/5/20	4/12/20	4/19/20	4/26/20	5/3/20	5/10/20	5/17/20	5/24/20	5/31/20	6/7/20	6/14/20	6/21/20	6/28/20	7/5/20	7/12/20	7/19/20	7/26/20	8/2/20
Year	Link Number	Week 118	Week 119	Week 120	Week 121	Week 122	Week 123	Week 124	Week 125	Week 126	Week 127	Week 128	Week 129	Week 130	Week 131	Week 132	Week 133	Week 134	Week 135
2020	Link01	22.00	2.25	12.11	5.56	4.09	4.17	4.31	4.70	4.11	5.96	4.18	4.92	5.53	8.46	5.43	6.26	6.80	6.24
	Link02	1.00	2.81	1.22	1.30	1.41	1.37	1.37	1.41	1.51	1.41	1.50	1.49	1.47	1.46	1.47	2.04	1.45	1.68
	Link03	2.75	2.28	4.10	2.96	3.35	3.44	5.57	4.36	3.52	5.18	4.73	3.15	4.42	4.60	4.40	4.85	4.42	5.39
	Link04	1.75	3.90	3.01	4.34	3.12	2.75	3.80	3.14	2.60	3.79	3.04	2.91	3.38	4.97	4.10	3.61	4.96	3.92
	Link05	1.71	2.98	3.57	4.70	3.32	3.41	3.84	4.15	3.75	5.03	4.54	5.36	4.87	5.45	4.86	6.25	4.73	4.45
	Link06	2.42	4.92	5.22	5.29	3.51	3.82	4.69	3.01	4.41	3.10	4.21	4.10	3.32	3.43	3.65	4.13	4.43	3.42
	Link07	0.42	0.92	1.46	1.08	1.07	1.59	0.59	0.57	1.30	0.82	0.83	0.86	0.58	0.72	1.18	0.69	0.64	0.62
	Link08	0.77	0.92	0.88	0.95	0.99	0.97	1.00	0.96	1.00	1.00	0.98	0.99	1.25	1.00	0.97	1.05	1.04	1.11
	Link09	0.43	0.57	0.52	0.53	0.56	0.59	0.57	0.55	0.57	0.58	0.55	0.54	0.47	0.66	0.59	0.61	0.63	0.65
	Link10	1.67	3.52	3.23	2.66	3.16	4.22	3.02	3.36	3.27	2.80	3.45	3.46	3.42	4.92	4.04	4.15	4.33	4.26
	Link11	1.07	1.18	1.17	1.56	1.36	1.51	1.27	1.26	1.46	1.35	1.20	1.75	1.53	1.52	1.60	2.27	1.43	2.03
	Link12	1.75	2.64	3.97	3.50	4.67	3.78	4.36	5.83	4.42	4.79	6.15	7.53	6.45	6.16	6.00	10.17	6.18	8.41

Table 48. Weekly Average Transit Time Estimates (Hours): Southbound, Week 136–Week 153, 2020.

Start Date		8/3/20	8/10/20	8/17/20	8/24/20	8/31/20	9/7/20	9/14/20	9/21/20	9/28/20	10/5/20	10/12/20	10/19/20	10/26/20	11/2/20	11/9/20	11/16/20	11/23/20	11/30/20
End Date		8/9/20	8/16/20	8/23/20	8/30/20	9/6/20	9/13/20	9/20/20	9/27/20	10/4/20	10/11/20	10/18/20	10/25/20	11/1/20	11/8/20	11/15/20	11/22/20	11/29/20	12/6/20
Year	Link Number	Week 136	Week 137	Week 138	Week 139	Week 140	Week 141	Week 142	Week 143	Week 144	Week 145	Week 146	Week 147	Week 148	Week 149	Week 150	Week 151	Week 152	Week 153
2020	Link01	5.58	7.76	5.99	6.72	5.65	4.09	5.77	4.09	6.82	5.32	5.15	4.50	5.36	5.66	4.61	4.32	6.04	4.00
	Link02	1.45	1.62	1.53	1.73	1.63	1.48	1.63	1.59	1.64	1.71	1.72	1.58	1.51	1.54	1.53	1.57	1.58	1.54
	Link03	5.29	4.77	4.80	5.70	6.29	3.77	4.40	3.67	4.17	3.89	5.30	4.04	3.76	3.81	4.24	3.98	3.56	3.39
	Link04	2.86	3.68	3.75	3.91	3.67	2.78	3.86	3.09	3.78	4.66	3.96	4.32	2.64	3.98	2.81	2.57	3.06	2.33
	Link05	4.12	4.85	5.37	4.67	4.85	3.51	4.96	6.04	4.40	3.83	4.43	4.13	3.87	4.61	4.01	3.49	3.26	7.35
	Link06	3.57	3.85	4.17	3.68	4.92	3.37	3.69	5.79	3.93	4.97	3.91	4.56	4.39	4.27	5.71	4.40	4.08	3.40
	Link07	1.15	0.64	1.04	0.67	0.85	0.98	0.68	0.71	0.71	1.73	1.02	1.26	1.01	0.79	0.85	0.66	0.83	0.54
	Link08	1.04	1.11	1.13	1.19	1.17	1.12	1.12	1.17	1.16	1.19	1.14	1.14	1.10	1.14	1.13	1.10	1.11	1.00
	Link09	0.64	0.65	0.64	0.69	0.69	0.62	0.64	0.70	0.67	0.73	0.70	0.66	0.63	0.66	0.70	0.78	0.63	0.56
	Link10	4.73	4.33	4.42	3.46	3.54	3.61	3.46	4.03	3.96	4.16	4.17	3.44	4.14	4.00	4.01	4.08	3.49	5.22
	Link11	1.59	1.92	6.67	2.03	1.88	1.60	1.61	1.61	1.78	1.86	2.63	1.58	1.49	1.51	1.60	1.52	1.38	1.33
	Link12	5.91	5.58	14.75	7.88	7.28	4.84	3.84	5.67	5.59	5.34	8.64	7.27	4.86	4.43	4.17	5.13	4.10	10.58

Table 49. Weekly Link Transit Count: Southbound, Week 118–Week 135, 2020.

Start Date		3/30/20	4/6/20	4/13/20	4/20/20	4/27/20	5/4/20	5/11/20	5/18/20	5/25/20	6/1/20	6/8/20	6/15/20	6/22/20	6/29/20	7/6/20	7/13/20	7/20/20	7/27/20
End Date		4/5/20	4/12/20	4/19/20	4/26/20	5/3/20	5/10/20	5/17/20	5/24/20	5/31/20	6/7/20	6/14/20	6/21/20	6/28/20	7/5/20	7/12/20	7/19/20	7/26/20	8/2/20
Year	Link Number	Week 118	Week 119	Week 120	Week 121	Week 122	Week 123	Week 124	Week 125	Week 126	Week 127	Week 128	Week 129	Week 130	Week 131	Week 132	Week 133	Week 134	Week 135
2020	Link01	1	7	9	25	21	15	22	14	20	24	28	9	22	29	29	32	27	34
	Link02	1	8	10	22	21	16	20	18	23	23	27	11	23	30	29	31	25	35
	Link03	1	8	12	21	22	16	19	17	24	23	23	9	21	30	28	27	25	33
	Link04	1	7	12	15	23	16	20	18	21	21	22	9	19	32	25	27	19	33
	Link05	2	14	9	24	26	19	19	17	27	28	28	11	20	27	25	32	22	37
	Link06	2	9	5	15	21	12	16	14	24	21	19	9	5	24	28	22	18	28
	Link07	4	10	4	15	17	11	13	11	19	17	16	9	3	24	28	21	17	27
	Link08	4	11	7	18	20	13	17	14	23	20	22	10	3	30	26	26	23	29
	Link09	5	14	11	24	27	19	23	20	28	29	26	13	5	29	30	35	30	31
	Link10	8	16	12	24	27	18	22	22	29	27	27	15	18	31	30	36	28	34
	Link11	8	15	12	21	27	18	23	23	29	26	28	17	23	28	29	37	27	31
	Link12	5	15	9	18	23	18	24	23	28	26	28	15	23	25	23	28	31	30

Table 50. Weekly Link Transit Count: Southbound, Week 136–Week 153, 2020.

Start Date		8/3/20	8/10/20	8/17/20	8/24/20	8/31/20	9/7/20	9/14/20	9/21/20	9/28/20	10/5/20	10/12/20	10/19/20	10/26/20	11/2/20	11/9/20	11/16/20	11/23/20	11/30/20
End Date		8/9/20	8/16/20	8/23/20	8/30/20	9/6/20	9/13/20	9/20/20	9/27/20	10/4/20	10/11/20	10/18/20	10/25/20	11/1/20	11/8/20	11/15/20	11/22/20	11/29/20	12/6/20
Year	Link Number	Week 136	Week 137	Week 138	Week 139	Week 140	Week 141	Week 142	Week 143	Week 144	Week 145	Week 146	Week 147	Week 148	Week 149	Week 150	Week 151	Week 152	Week 153
2020	Link01	34	24	23	12	25	27	15	17	26	23	28	17	28	22	22	24	25	2
	Link02	32	26	22	11	22	25	14	18	24	22	30	15	27	21	19	22	25	2
	Link03	33	25	20	11	20	24	13	17	25	21	29	14	25	23	17	20	24	3
	Link04	34	26	20	12	17	25	14	15	23	20	28	14	25	23	22	21	22	4
	Link05	30	26	23	11	22	26	14	14	23	24	31	14	28	23	28	20	24	6
	Link06	23	22	21	9	19	21	13	7	18	10	20	8	19	18	17	14	19	4
	Link07	22	24	19	11	17	20	11	7	17	10	15	8	14	17	11	15	16	2
	Link08	27	29	23	12	17	25	12	14	20	21	20	13	20	20	14	17	21	2
	Link09	38	34	24	12	22	29	15	16	27	24	31	19	28	25	23	22	26	7
	Link10	40	30	23	12	26	29	16	16	27	25	31	19	28	25	19	25	26	6
	Link11	39	30	20	13	25	28	17	15	27	25	32	19	28	24	22	26	29	6
	Link12	34	29	28	13	22	28	15	12	26	26	28	17	27	26	23	26	26	7

Table 51. Weekly Average Transit Time Estimates (Hours): Northbound, Week 118–Week 135, 2020.

Start Date		3/30/20	4/6/20	4/13/20	4/20/20	4/27/20	5/4/20	5/11/20	5/18/20	5/25/20	6/1/20	6/8/20	6/15/20	6/22/20	6/29/20	7/6/20	7/13/20	7/20/20	7/27/20
End Date		4/5/20	4/12/20	4/19/20	4/26/20	5/3/20	5/10/20	5/17/20	5/24/20	5/31/20	6/7/20	6/14/20	6/21/20	6/28/20	7/5/20	7/12/20	7/19/20	7/26/20	8/2/20
Year	Link Number	Week 118	Week 119	Week 120	Week 121	Week 122	Week 123	Week 124	Week 125	Week 126	Week 127	Week 128	Week 129	Week 130	Week 131	Week 132	Week 133	Week 134	Week 135
2020	Link01	3.84	4.74	9.11	4.41	5.52	6.42	3.75	4.80	4.44	5.13	6.23	4.32	6.39	4.48	6.08	6.49	5.33	6.20
	Link02	2.07	2.03	3.83	1.85	1.79	2.30	2.51	2.01	2.35	2.02	2.14	2.00	2.00	2.30	2.34	2.47	2.61	2.74
	Link03	3.63	4.33	9.30	3.98	4.20	4.03	4.22	5.03	3.82	4.36	5.41	4.01	4.09	4.30	4.31	5.20	5.10	5.11
	Link04	3.46	3.82	3.96	3.80	5.09	4.98	4.27	3.35	4.17	3.92	4.23	4.46	4.19	4.00	4.88	4.16	5.36	4.52
	Link05	4.19	3.55	8.15	5.11	4.06	5.02	4.28	4.69	4.24	4.69	4.25	4.06	4.30	4.93	4.82	4.84	5.79	4.83
	Link06	4.93	4.26	4.44	4.50	4.23	4.74	4.15	4.51	4.57	4.86	4.66	4.88	4.83	5.55	4.73	4.87	4.58	4.96
	Link07	1.39	1.12	1.03	1.07	1.44	0.97	1.51	1.12	0.99	1.00	1.22	1.40	0.78	1.36	0.84	0.99	1.23	1.07
	Link08	1.23	1.13	1.43	1.26	1.84	1.18	1.60	1.50	1.25	1.42	1.30	1.28	1.15	1.48	1.33	1.42	1.36	1.30
	Link09	0.68	0.62	0.67	0.84	0.62	0.92	0.69	0.86	0.74	0.83	0.64	0.77	0.93	0.65	0.81	0.70	0.61	0.88
	Link10	2.80	3.18	3.27	3.22	3.25	3.73	3.16	3.04	3.29	3.30	3.31	3.47	3.61	4.11	4.21	3.65	3.81	4.57
	Link11	1.80	1.99	2.50	2.10	2.13	2.10	1.91	2.90	2.08	2.11	2.36	2.27	2.27	2.87	2.06	3.00	2.49	2.39
	Link12	3.68	4.06	5.56	3.93	5.09	5.14	5.06	4.71	5.25	5.71	5.57	5.59	5.85	5.50	5.37	8.80	5.97	7.45

Table 52. Weekly Average Transit Time Estimates (Hours): Northbound, Week 136–Week 153, 2020.

Start Date		8/3/20	8/10/20	8/17/20	8/24/20	8/31/20	9/7/20	9/14/20	9/21/20	9/28/20	10/5/20	10/12/20	10/19/20	10/26/20	11/2/20	11/9/20	11/16/20	11/23/20	11/30/20
End Date		8/9/20	8/16/20	8/23/20	8/30/20	9/6/20	9/13/20	9/20/20	9/27/20	10/4/20	10/11/20	10/18/20	10/25/20	11/1/20	11/8/20	11/15/20	11/22/20	11/29/20	12/6/20
Year	Link Number	Week 136	Week 137	Week 138	Week 139	Week 140	Week 141	Week 142	Week 143	Week 144	Week 145	Week 146	Week 147	Week 148	Week 149	Week 150	Week 151	Week 152	Week 153
2020	Link01	5.83	6.17	4.60	4.65	4.67	5.39	4.52	5.87	4.36	3.98	3.87	4.24	6.16	4.45	4.58	3.05	4.43	4.58
	Link02	2.25	2.29	2.22	2.23	2.90	2.69	2.45	2.07	2.68	2.30	2.44	2.29	2.02	2.09	2.30	1.83	2.18	1.54
	Link03	4.59	4.87	4.68	4.34	4.92	4.04	4.06	3.43	4.48	3.53	4.01	3.59	3.73	4.41	3.46	2.62	2.92	4.67
	Link04	4.33	5.37	4.07	4.16	5.42	4.62	3.68	4.04	4.41	4.06	4.50	3.97	3.76	3.97	3.89	3.29	3.60	7.92
	Link05	5.30	5.35	4.73	4.42	4.73	4.97	4.92	4.43	5.54	4.79	4.55	4.02	5.64	4.93	5.44	3.26	3.42	0.00
	Link06	5.79	5.45	4.76	4.67	5.05	5.18	5.26	4.94	5.09	5.15	5.13	5.02	5.26	5.68	5.74	4.87	4.36	4.67
	Link07	1.29	1.24	0.84	0.87	1.14	0.92	0.69	0.71	0.95	1.82	0.94	1.10	0.85	0.76	1.11	0.74	1.56	0.58
	Link08	1.51	1.40	1.36	1.23	1.36	1.30	1.26	1.22	1.77	1.73	1.38	2.07	1.14	1.30	1.15	1.17	1.29	1.08
	Link09	0.79	0.89	0.90	0.69	1.18	0.79	0.88	0.65	0.61	0.76	0.91	0.84	0.60	0.60	0.61	0.64	0.62	5.50
	Link10	4.14	4.61	3.46	3.61	3.96	3.75	3.46	3.27	4.01	3.62	3.77	3.70	3.69	4.06	4.15	3.04	2.88	2.33
	Link11	2.92	2.10	2.12	2.64	2.59	2.29	2.39	2.29	2.31	2.48	2.77	2.32	2.72	2.23	2.41	2.39	2.31	1.83
	Link12	7.03	5.48	7.89	8.33	6.93	5.33	4.31	5.65	5.70	5.84	7.69	6.56	4.78	4.31	4.22	5.05	3.74	3.33

Table 53. Weekly Link Transit Count: Northbound, Week 118–Week 135, 2020.

Start Date		3/30/20	4/6/20	4/13/20	4/20/20	4/27/20	5/4/20	5/11/20	5/18/20	5/25/20	6/1/20	6/8/20	6/15/20	6/22/20	6/29/20	7/6/20	7/13/20	7/20/20	7/27/20
End Date		4/5/20	4/12/20	4/19/20	4/26/20	5/3/20	5/10/20	5/17/20	5/24/20	5/31/20	6/7/20	6/14/20	6/21/20	6/28/20	7/5/20	7/12/20	7/19/20	7/26/20	8/2/20
Year	Link Number	Week 118	Week 119	Week 120	Week 121	Week 122	Week 123	Week 124	Week 125	Week 126	Week 127	Week 128	Week 129	Week 130	Week 131	Week 132	Week 133	Week 134	Week 135
2020	Link01	13	7	21	26	21	21	18	14	24	23	25	10	33	20	34	34	23	37
	Link02	14	12	12	22	21	22	16	14	27	22	23	12	33	25	36	33	23	38
	Link03	14	13	23	23	22	21	19	13	29	23	20	12	33	25	36	31	22	37
	Link04	14	16	21	23	18	20	18	14	28	22	20	11	34	24	29	30	16	35
	Link05	15	23	22	20	19	23	19	18	34	23	26	13	35	20	30	33	19	37
	Link06	14	12	17	15	17	19	12	12	26	19	25	9	15	19	32	26	18	36
	Link07	16	9	17	17	16	17	12	14	24	17	26	8	12	20	30	29	21	36
	Link08	17	19	20	22	18	22	13	20	31	19	29	12	14	24	30	33	25	37
	Link09	19	23	23	26	20	26	15	20	36	22	31	16	15	28	34	35	29	39
	Link10	24	23	25	26	20	25	15	18	36	22	30	17	32	31	35	35	27	39
	Link11	27	22	27	26	21	25	15	18	38	22	34	14	34	30	30	36	28	38
	Link12	27	21	27	24	21	23	19	16	38	21	33	11	32	30	29	31	28	36

Table 54. Weekly Link Transit Count: Northbound, Week 136–Week 153, 2020.

Start Date		8/3/20	8/10/20	8/17/20	8/24/20	8/31/20	9/7/20	9/14/20	9/21/20	9/28/20	10/5/20	10/12/20	10/19/20	10/26/20	11/2/20	11/9/20	11/16/20	11/23/20	11/30/20
End Date		8/9/20	8/16/20	8/23/20	8/30/20	9/6/20	9/13/20	9/20/20	9/27/20	10/4/20	10/11/20	10/18/20	10/25/20	11/1/20	11/8/20	11/15/20	11/22/20	11/29/20	12/6/20
Year	Link Number	Week 136	Week 137	Week 138	Week 139	Week 140	Week 141	Week 142	Week 143	Week 144	Week 145	Week 146	Week 147	Week 148	Week 149	Week 150	Week 151	Week 152	Week 153
2020	Link01	31	17	39	13	14	22	27	22	26	22	21	28	22	25	23	17	21	2
	Link02	27	17	39	15	11	20	26	22	24	21	24	26	19	25	20	17	20	2
	Link03	29	15	34	15	11	20	24	21	24	17	22	24	21	26	17	15	19	2
	Link04	29	13	34	14	14	20	24	21	24	17	20	25	19	29	17	15	20	1
	Link05	24	14	39	15	15	23	25	20	23	23	22	28	20	28	18	17	21	0
	Link06	20	15	33	12	14	16	20	17	17	17	15	25	17	22	16	16	17	1
	Link07	20	19	32	11	14	16	18	20	18	19	13	21	12	17	15	14	17	1
	Link08	26	22	36	14	13	20	21	22	23	20	18	24	16	20	14	17	17	1
	Link09	28	22	40	15	15	21	22	24	27	23	20	29	22	29	19	19	22	1
	Link10	27	20	38	15	16	22	23	25	27	24	20	29	21	28	22	19	22	1
	Link11	28	22	37	14	17	22	23	24	27	24	20	27	22	27	28	22	23	1
	Link12	26	21	38	13	18	21	22	18	27	25	22	25	23	28	27	21	25	1

APPENDIX C: LINK TRAVEL TIME HISTOGRAMS BY YEAR BY DIRECTION

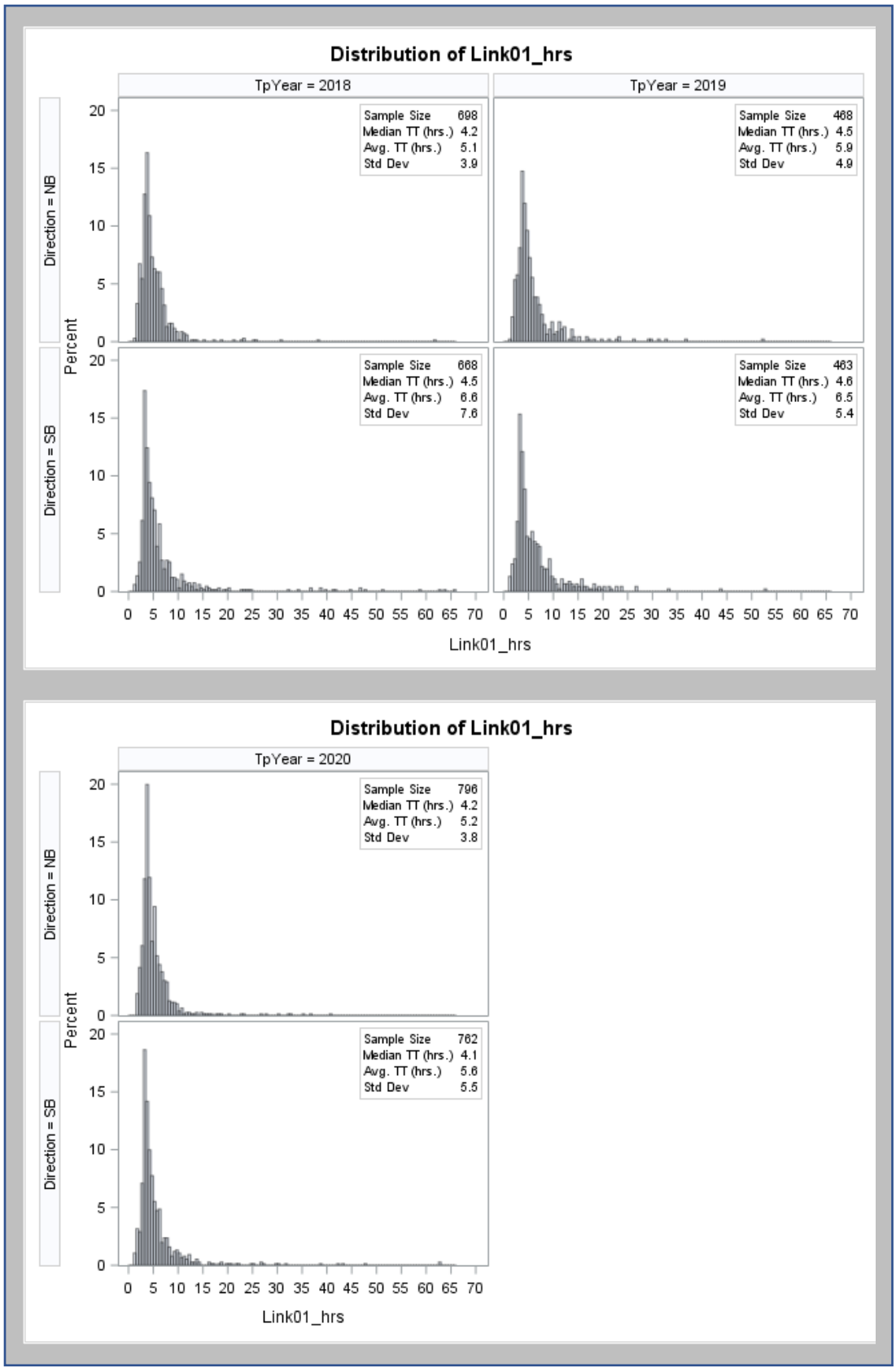


Figure 39. Link 1 Travel Time Histograms by Year by Direction.

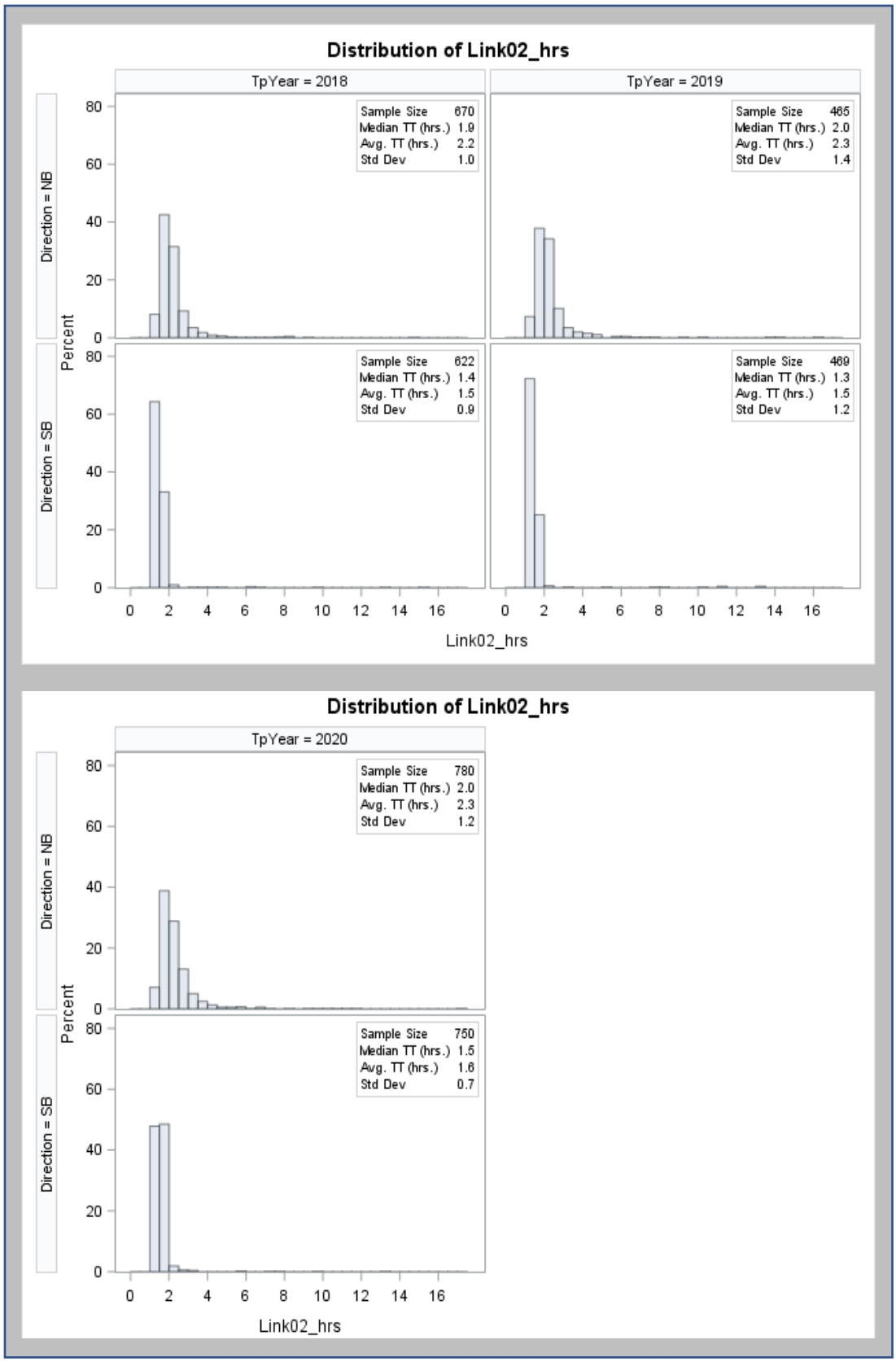


Figure 40. Link 2 Travel Time Histograms by Year by Direction.

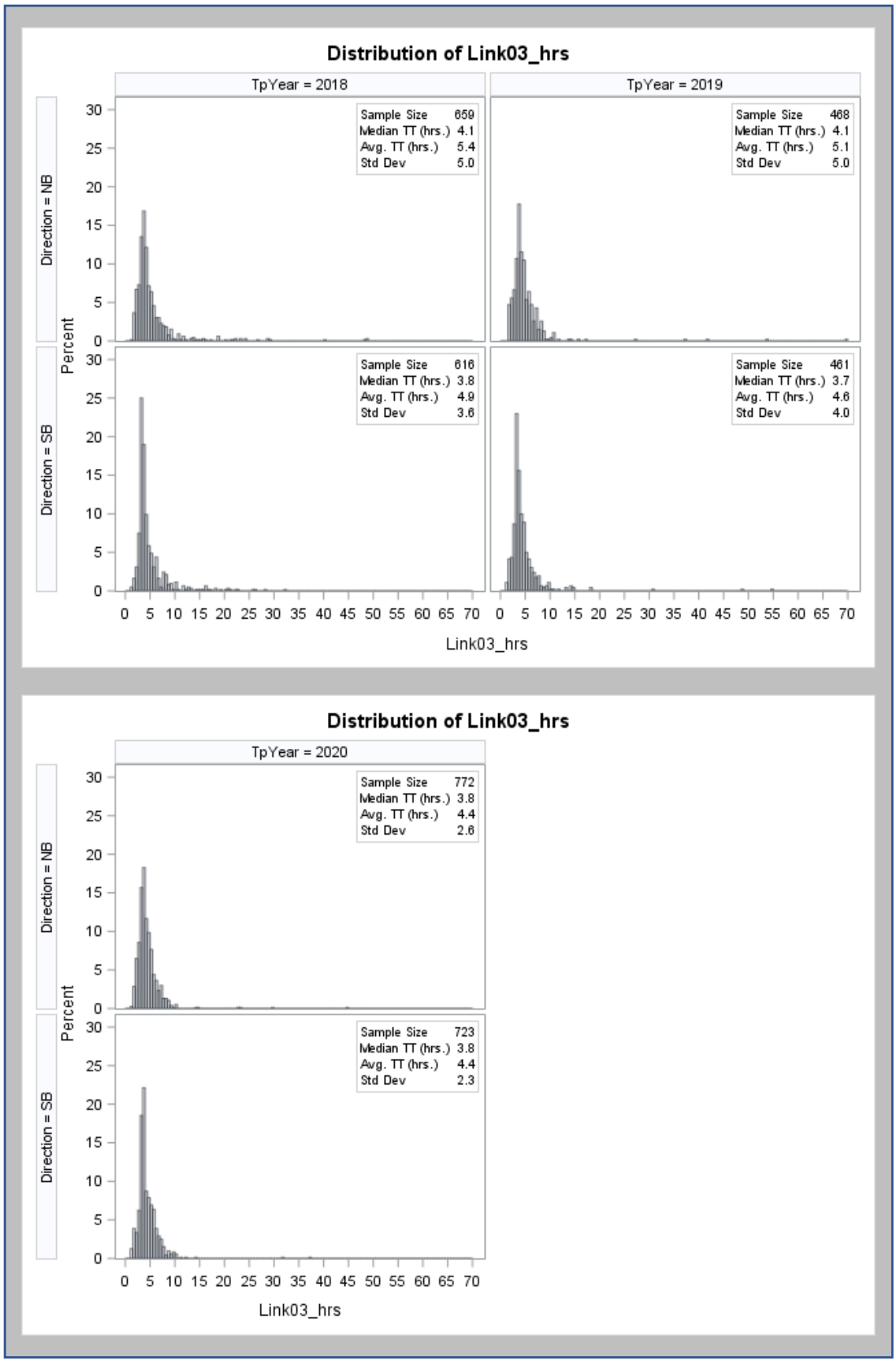


Figure 41. Link 3 Travel Time Histograms by Year by Direction.

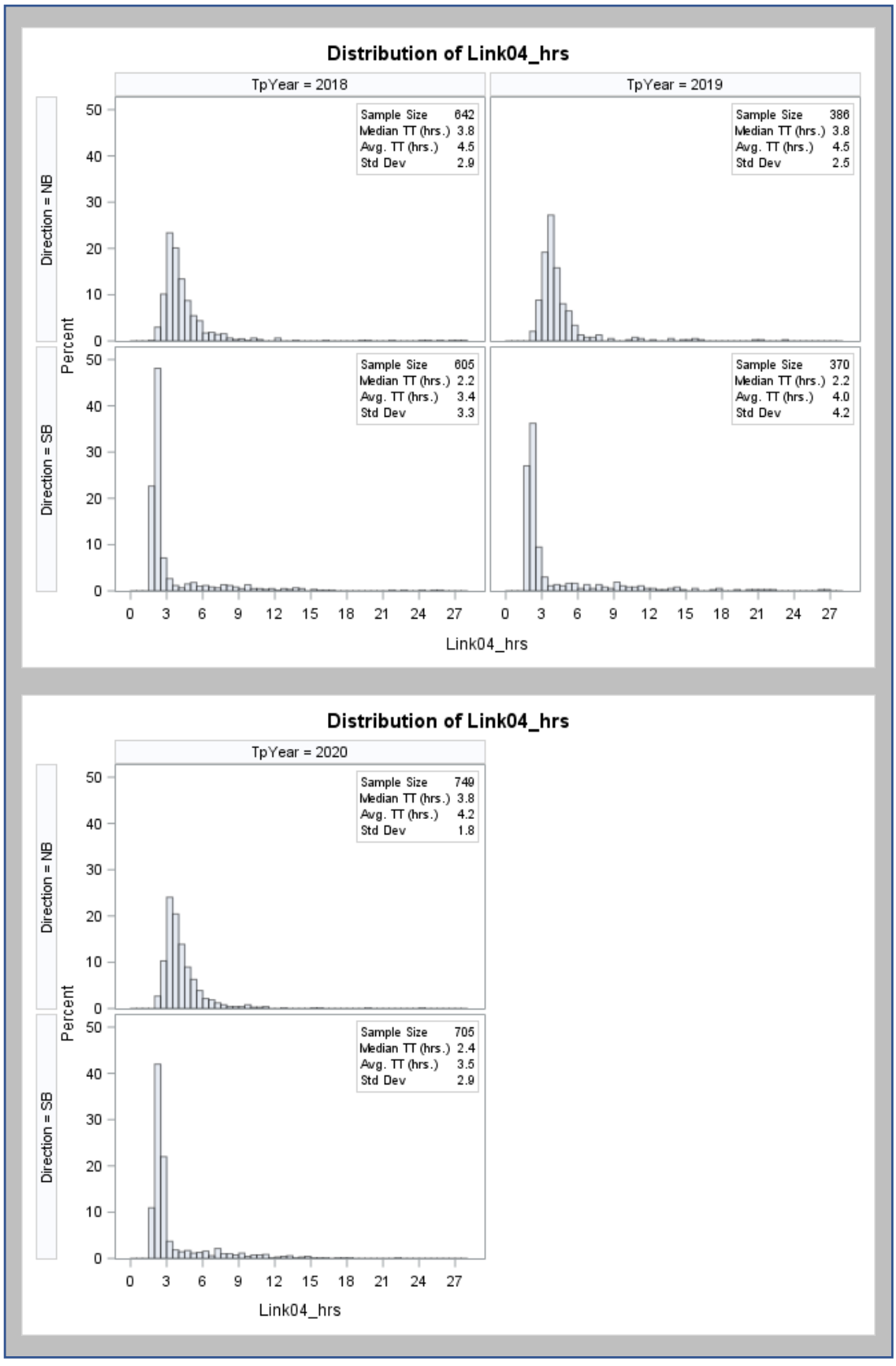


Figure 42. Link 4 Travel Time Histograms by Year by Direction.

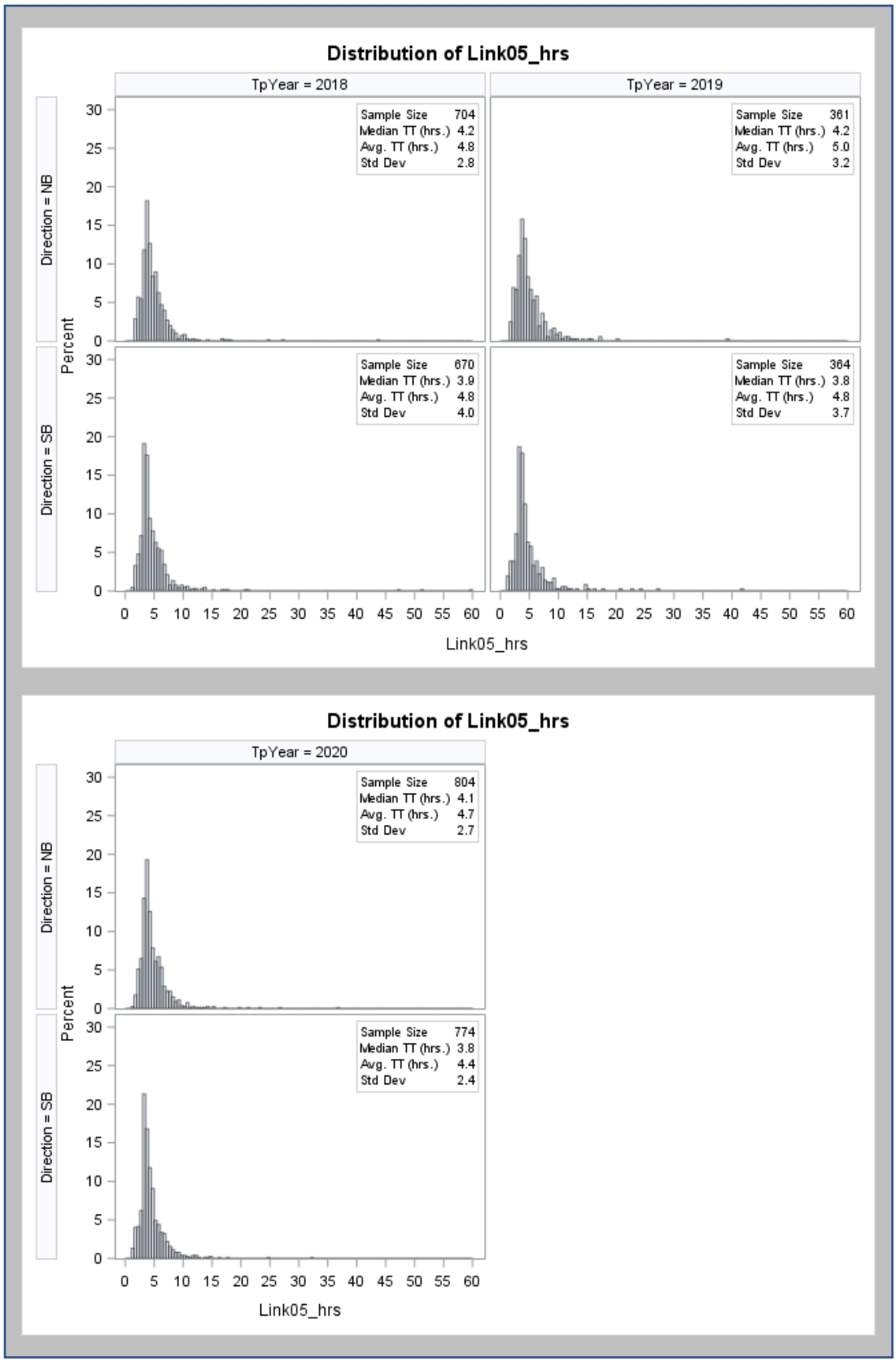


Figure 43. Link 5 Travel Time Histograms by Year by Direction.

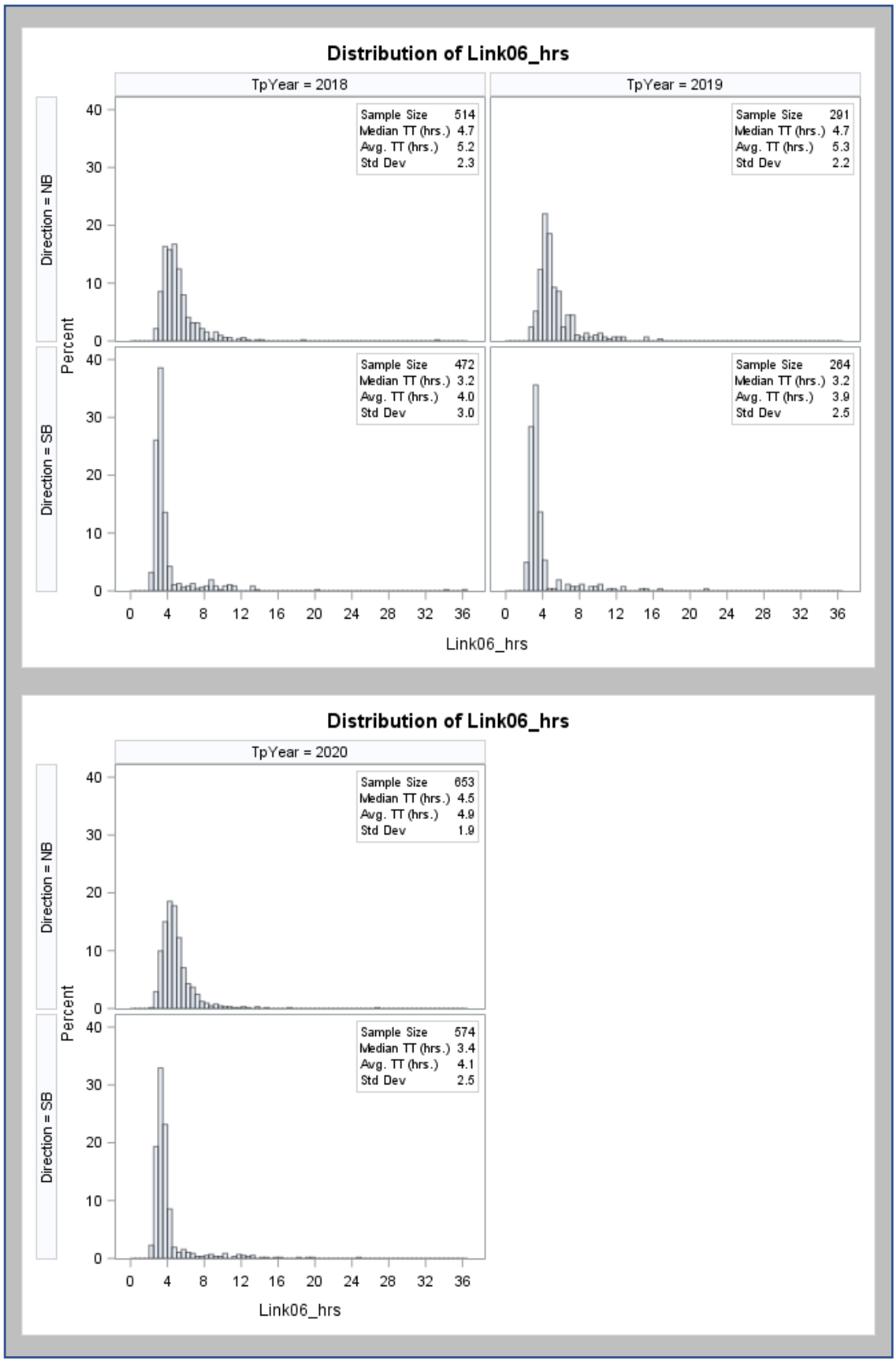


Figure 44. Link 6 Travel Time Histograms by Year by Direction.

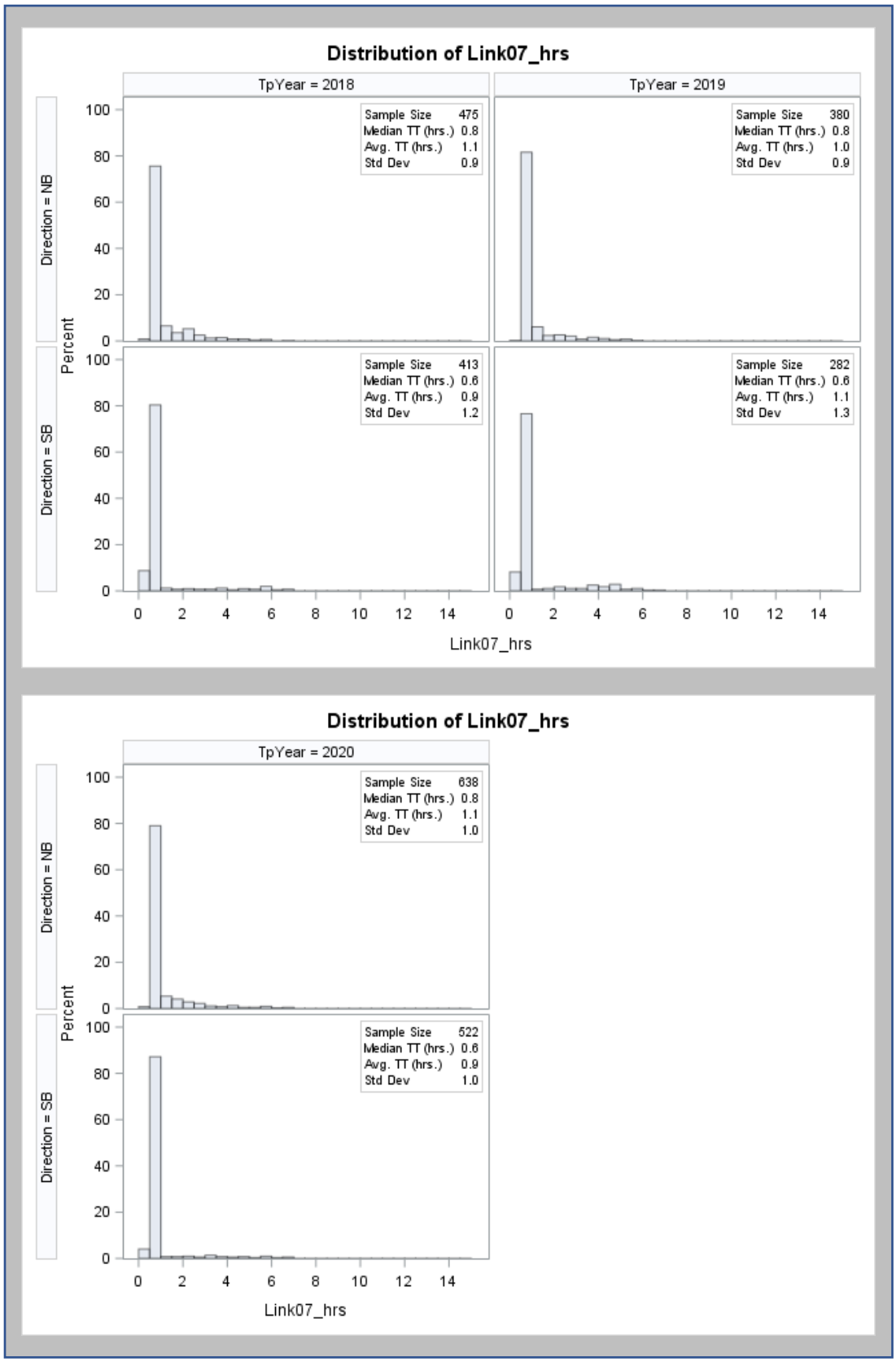


Figure 45. Link 7 Travel Time Histograms by Year by Direction.

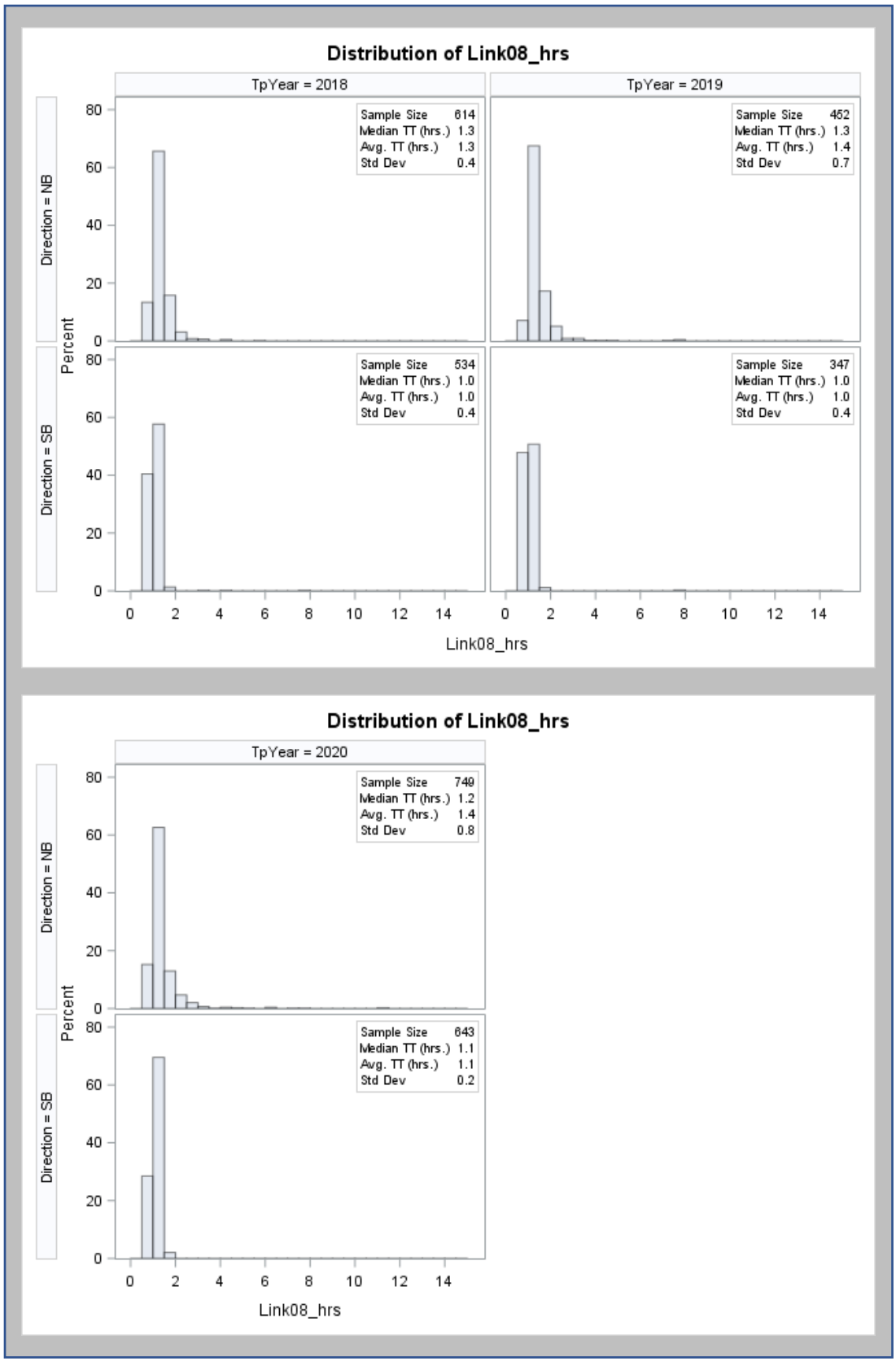


Figure 46. Link 8 Travel Time Histograms by Year by Direction.

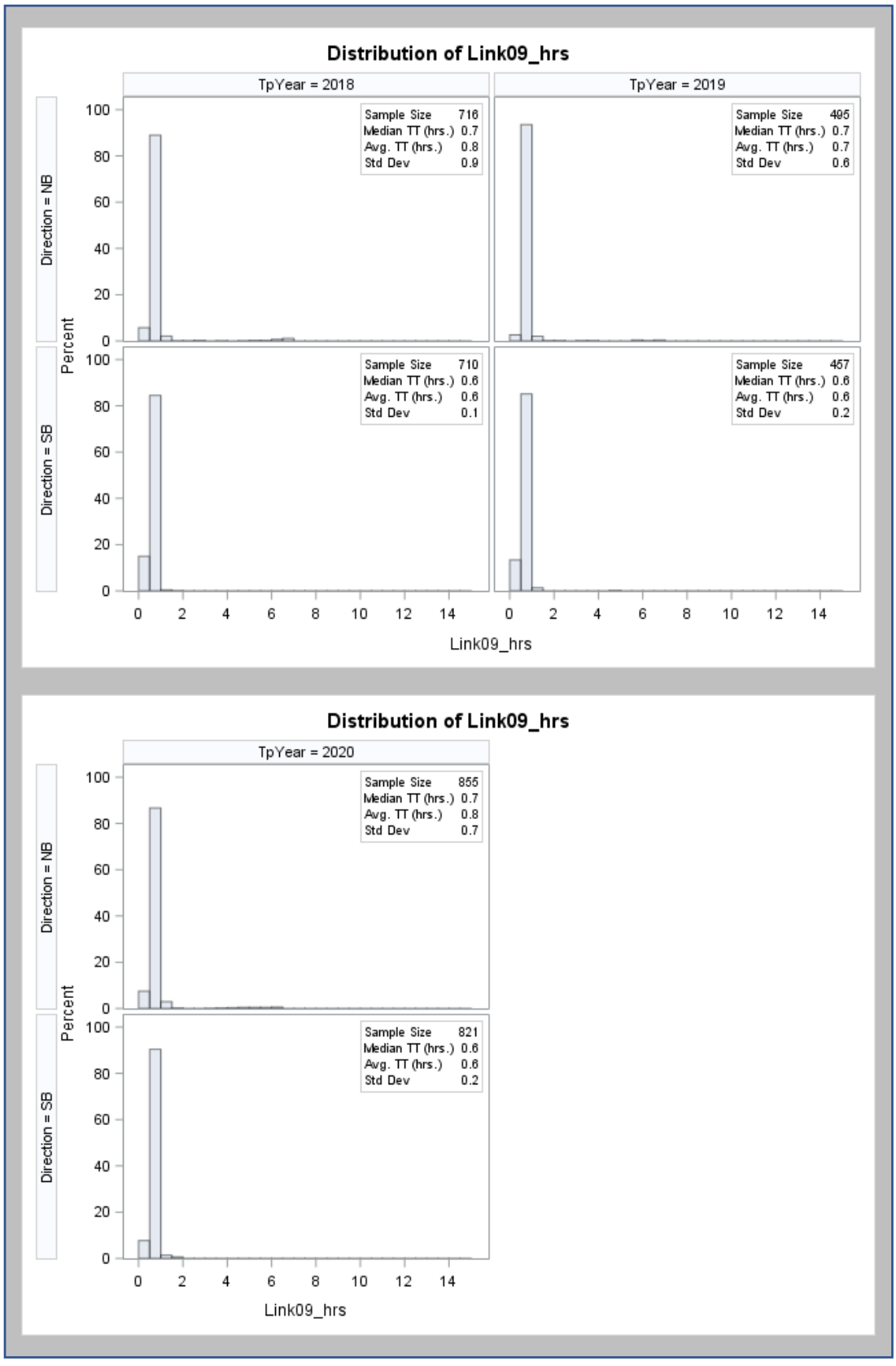


Figure 47. Link 9 Travel Time Histograms by Year by Direction.

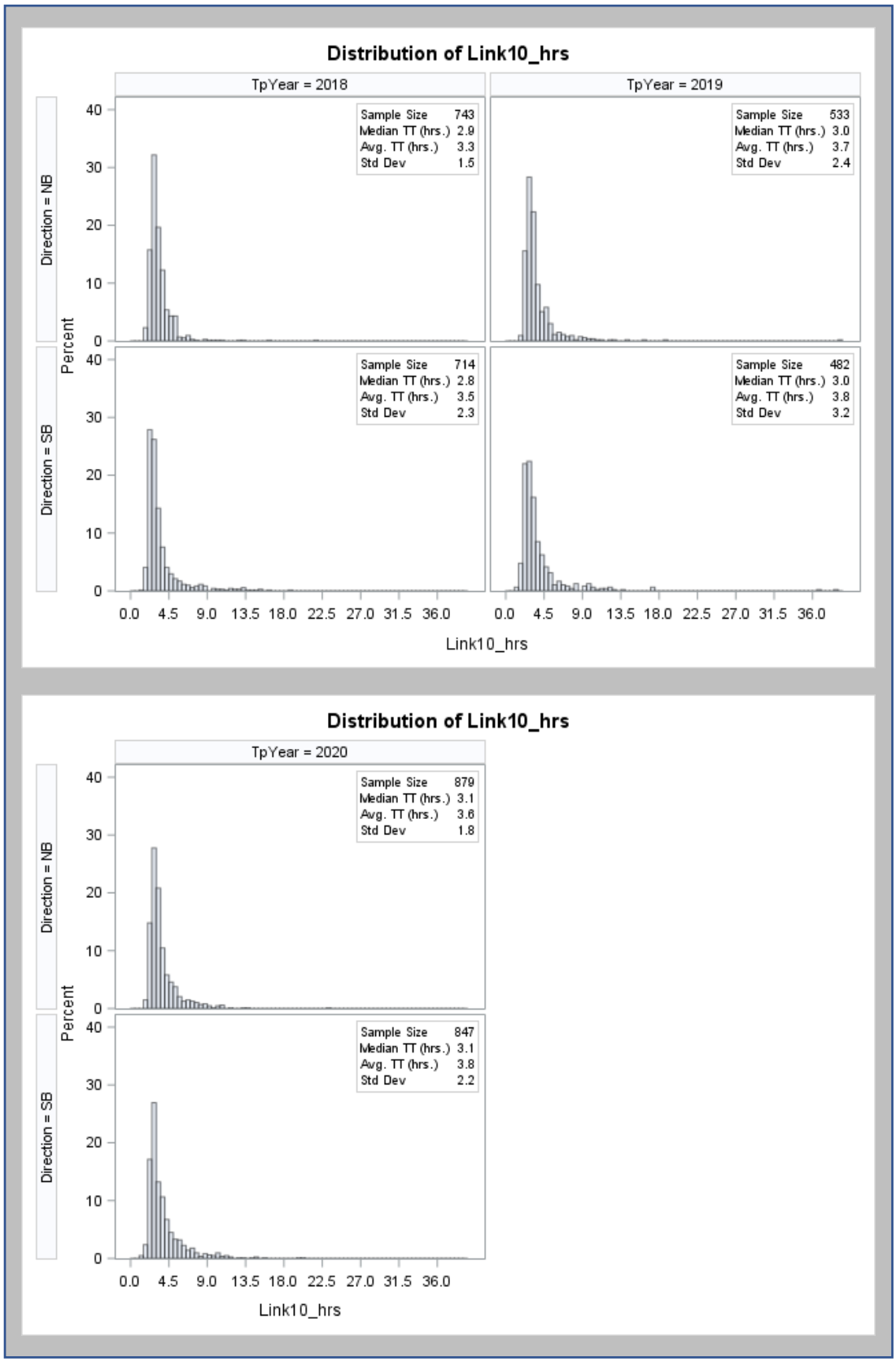


Figure 48. Link 10 Travel Time Histograms by Year by Direction.

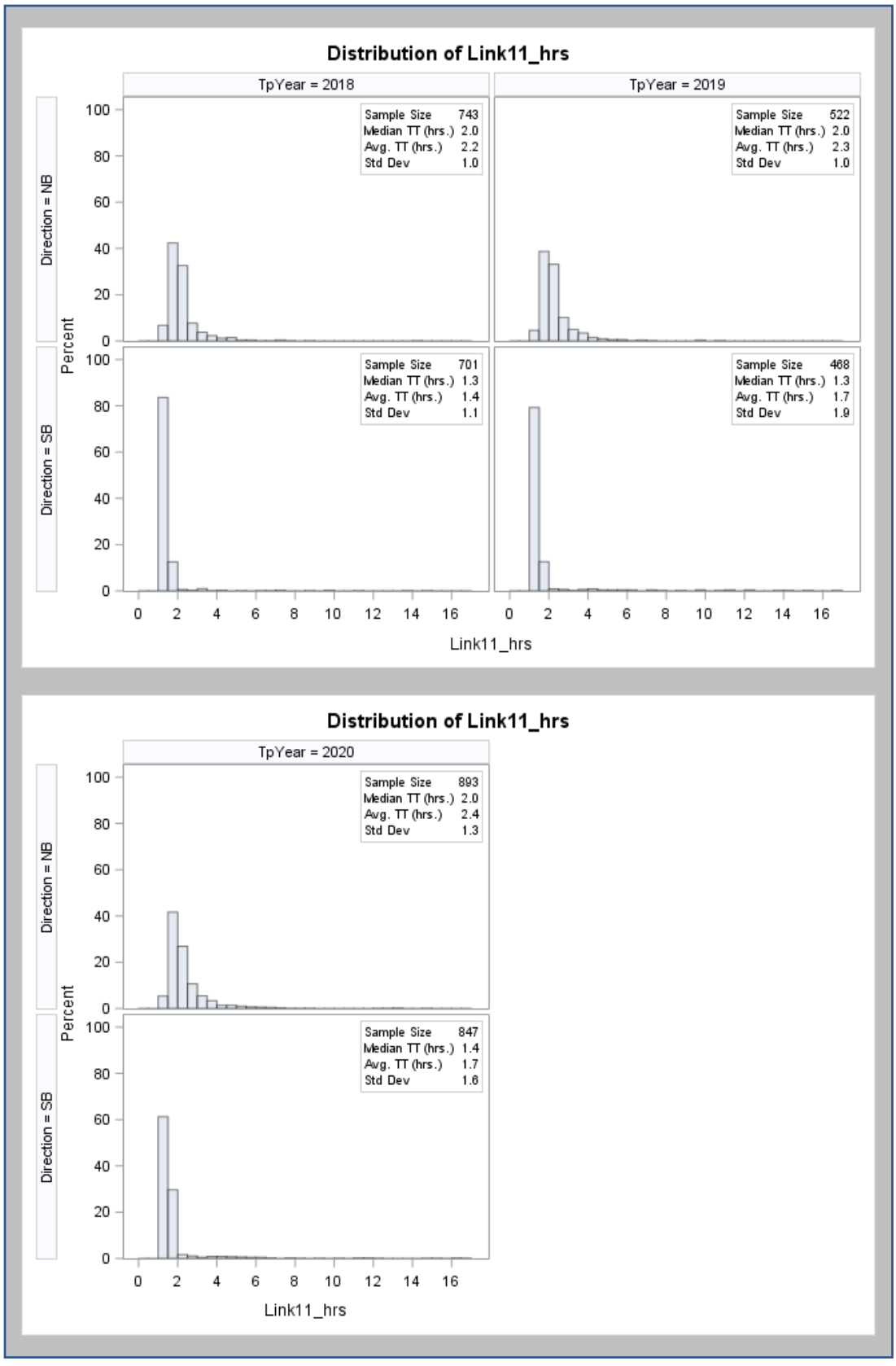


Figure 49. Link 11 Travel Time Histograms by Year by Direction.

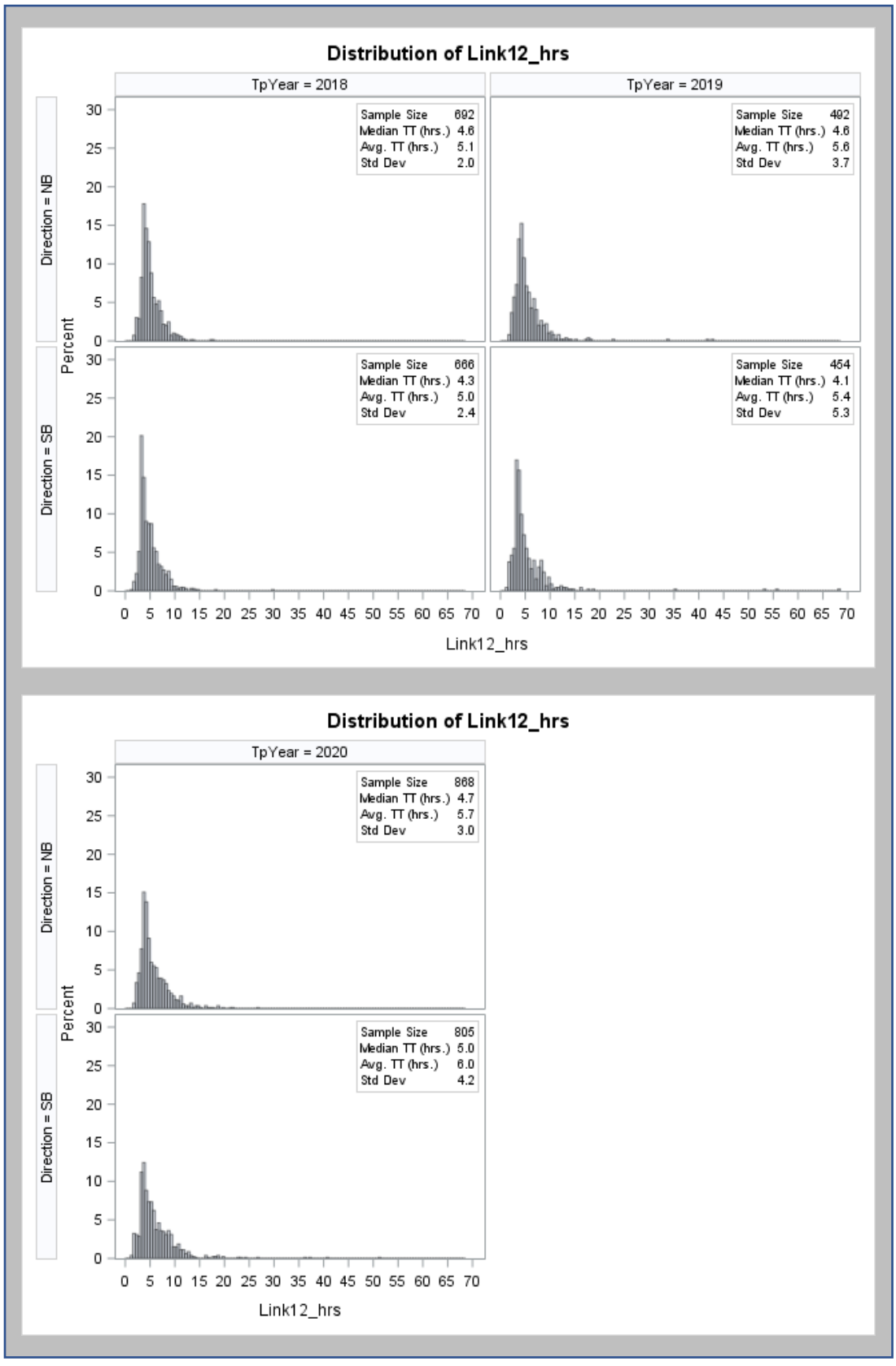


Figure 50. Link 12 Travel Time Histograms by Year by Direction.

APPENDIX D: TRAVEL TIMES BETWEEN ORIGINS AND DESTINATIONS

Table 55. Three-Year Average Travel Times between O-Ds (Hours).

	Origin \ Destination	North End of Study Segment	Hall Towing Segment	Hendricks River Logistics Segment	South End of Study Segment
2018	North End of Study Segment	-	18.69	20.67	26.21
	Hall Towing Segment	22.00	-	1.03	6.57
	Hendricks River Logistics Segment	24.39	1.30	-	4.97
	South End of Study Segment	30.71	7.61	5.51	-
2019	North End of Study Segment	-	18.86	20.92	27.07
	Hall Towing Segment	22.17	-	1.01	7.15
	Hendricks River Logistics Segment	24.57	1.38	-	5.56
	South End of Study Segment	31.27	8.08	5.96	-
2020	North End of Study Segment	-	17.98	19.94	26.14
	Hall Towing Segment	20.58	-	1.07	7.26
	Hendricks River Logistics Segment	23.04	1.38	-	5.57
	South End of Study Segment	29.79	8.13	5.99	-

APPENDIX E: GRAPHS OF SPEED VERSUS WATER LEVEL (STAGE) BY SUBLINK

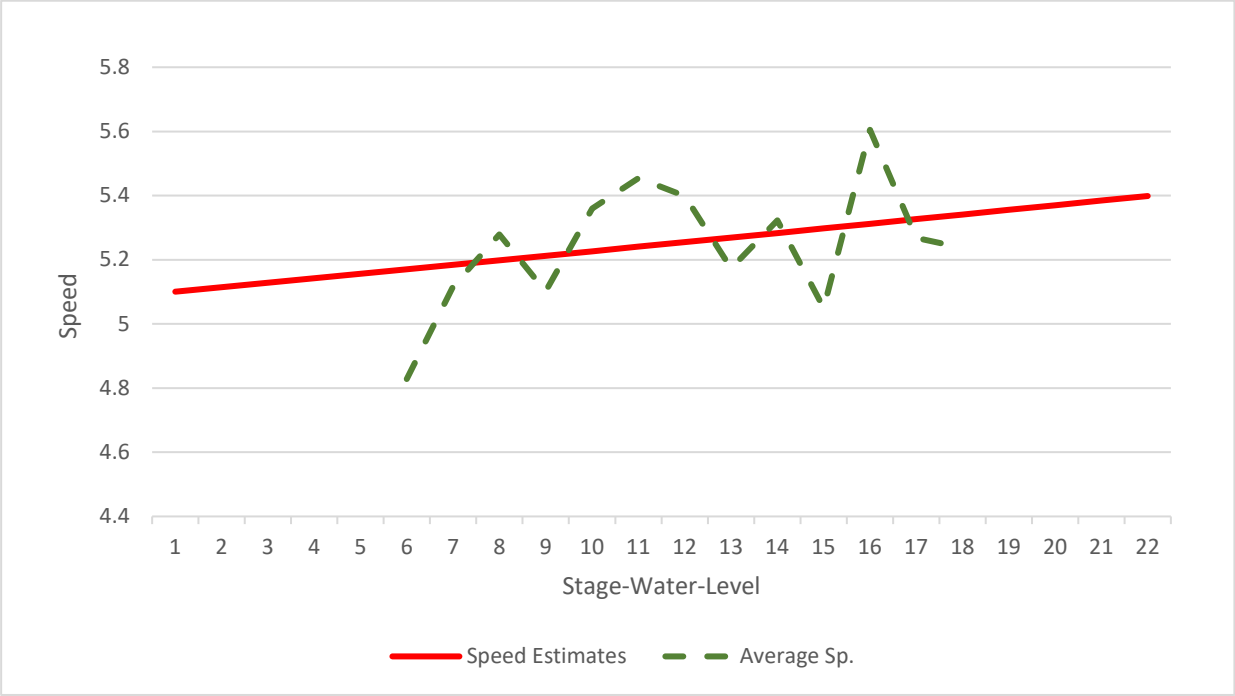


Figure 51. Sublink 1U Speed versus Water Level (Stage).

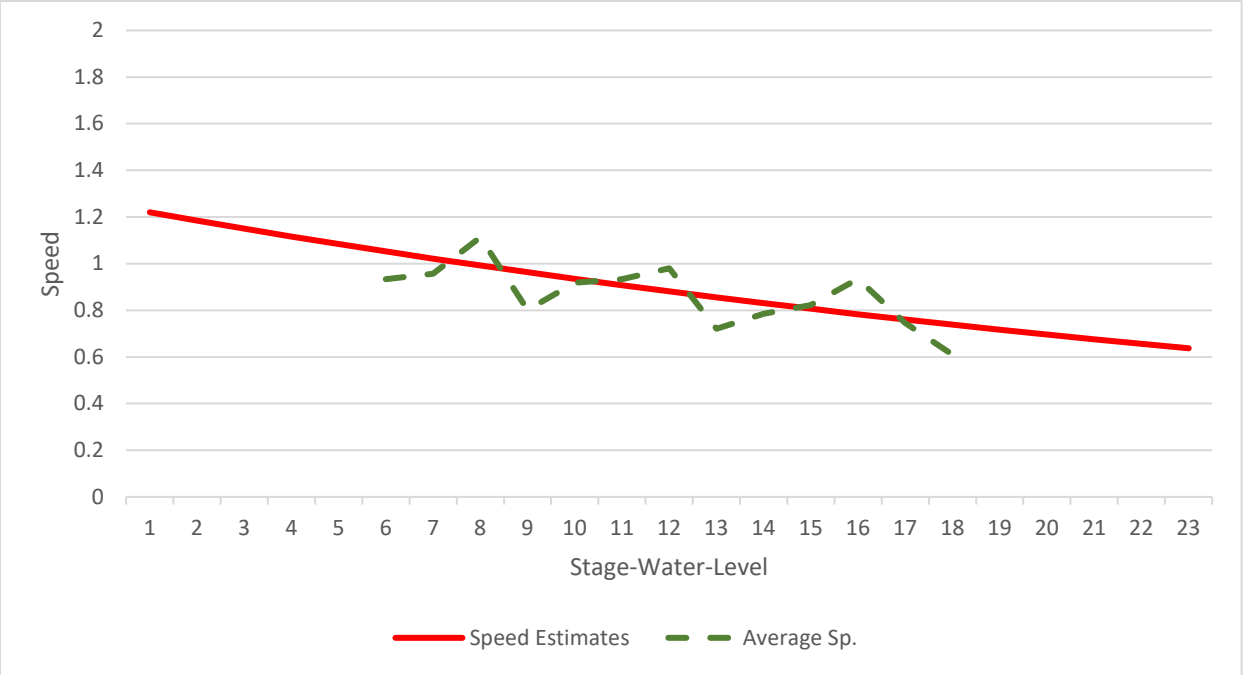


Figure 52. Sublink LD16 Speed versus Water Level (Stage).

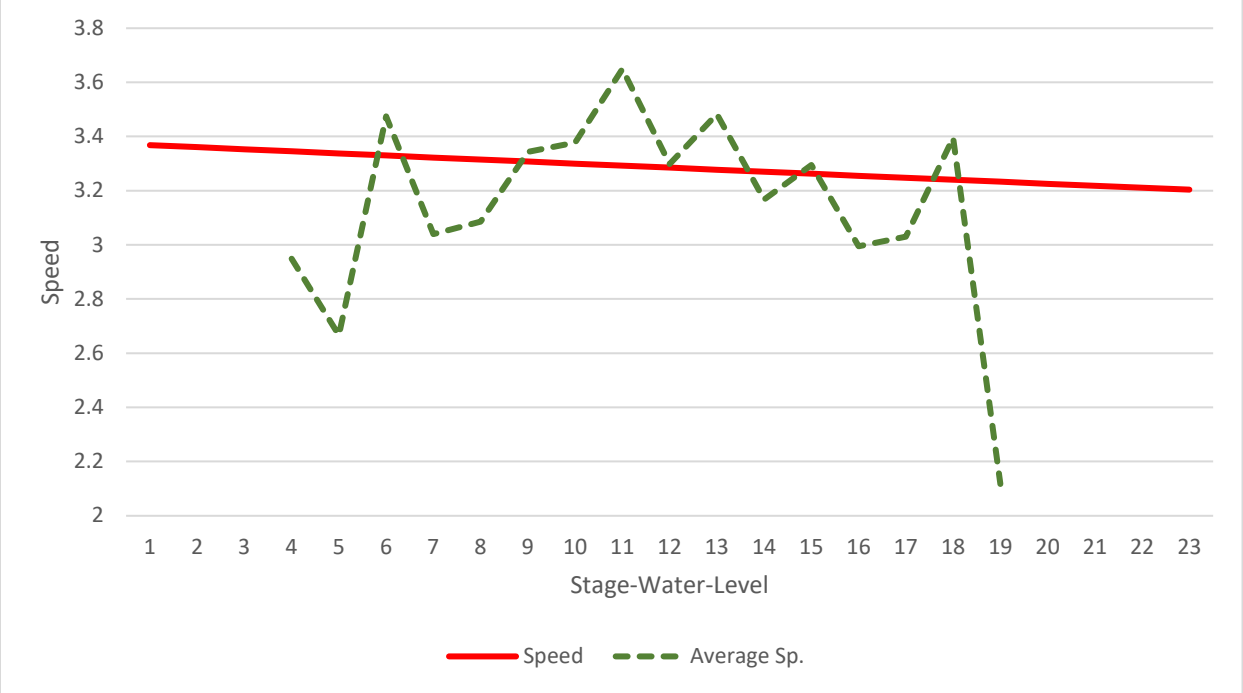


Figure 53. Sublink 1D Speed versus Water Level (Stage).

Figure 54. Link 2 Speed versus Water Level (Stage).

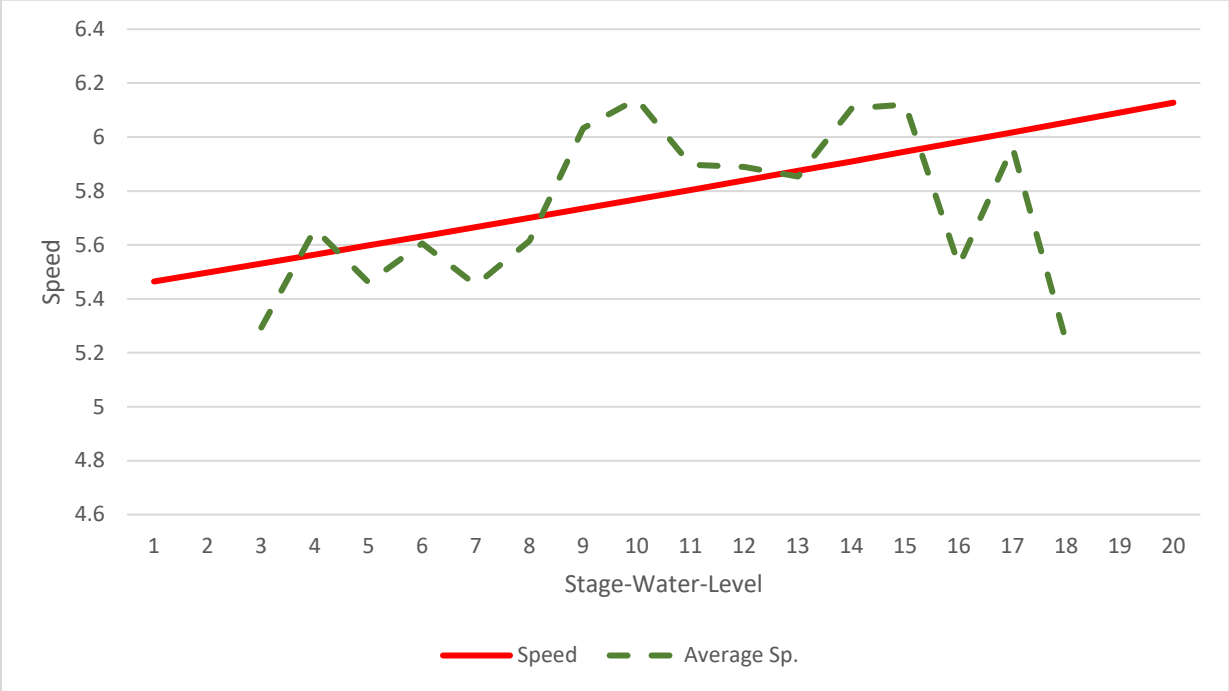


Figure 55. Sublink 3U Speed versus Water Level (Stage).

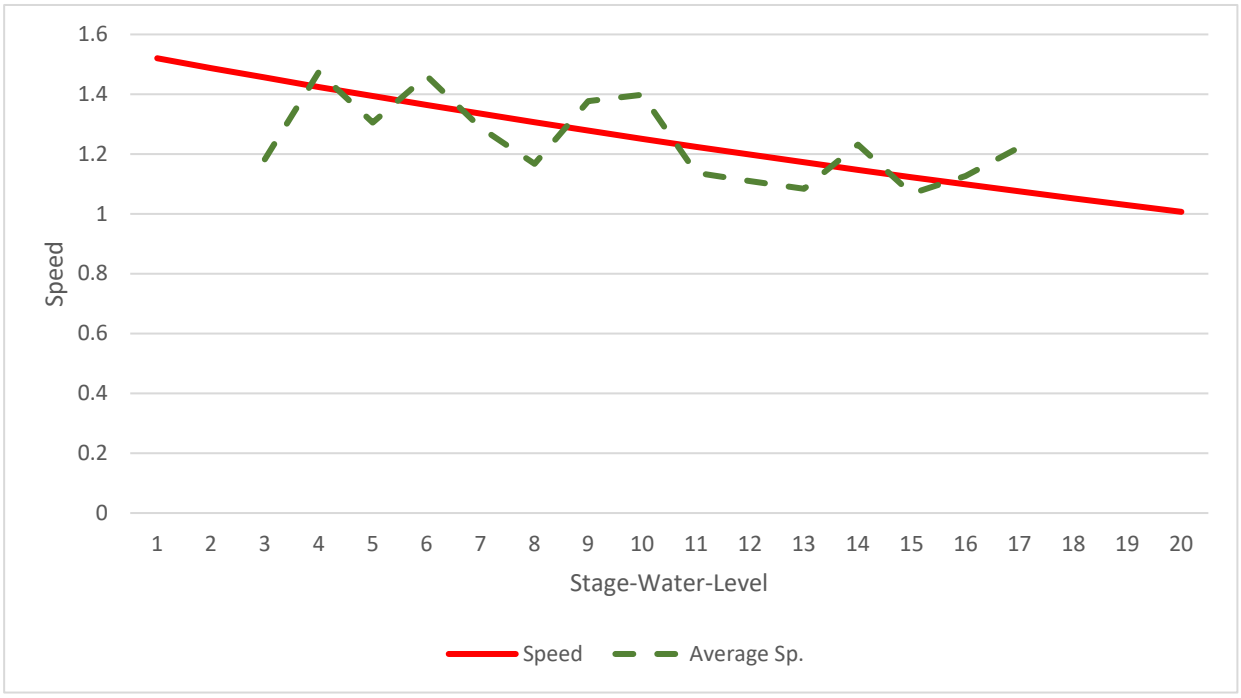


Figure 56. Sublink LD17 Speed versus Water Level (Stage).

Figure 57. Sublink 3D Speed versus Water Level (Stage).

Figure 58. Link 4 Speed versus Water Level (Stage).

Figure 59. Sublink 5U Speed versus Water Level (Stage).

Figure 60. Sublink LD18 Speed versus Water Level (Stage).

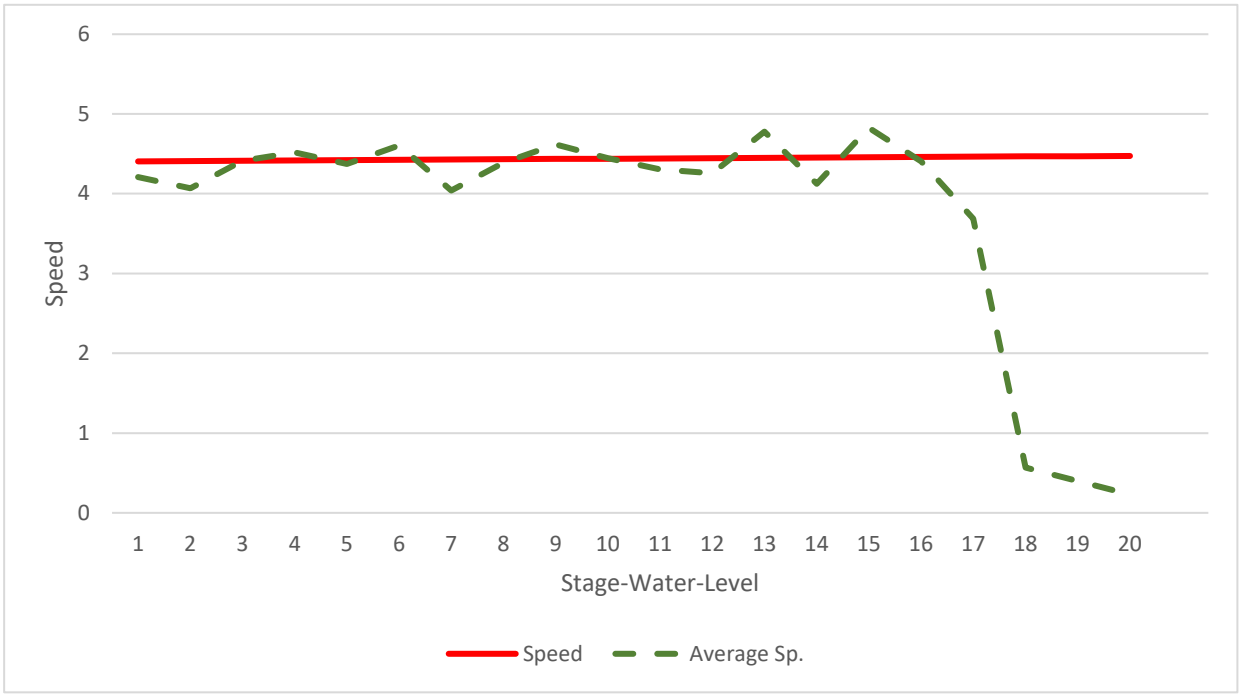


Figure 61. Sublink 5D Speed versus Water Level (Stage).

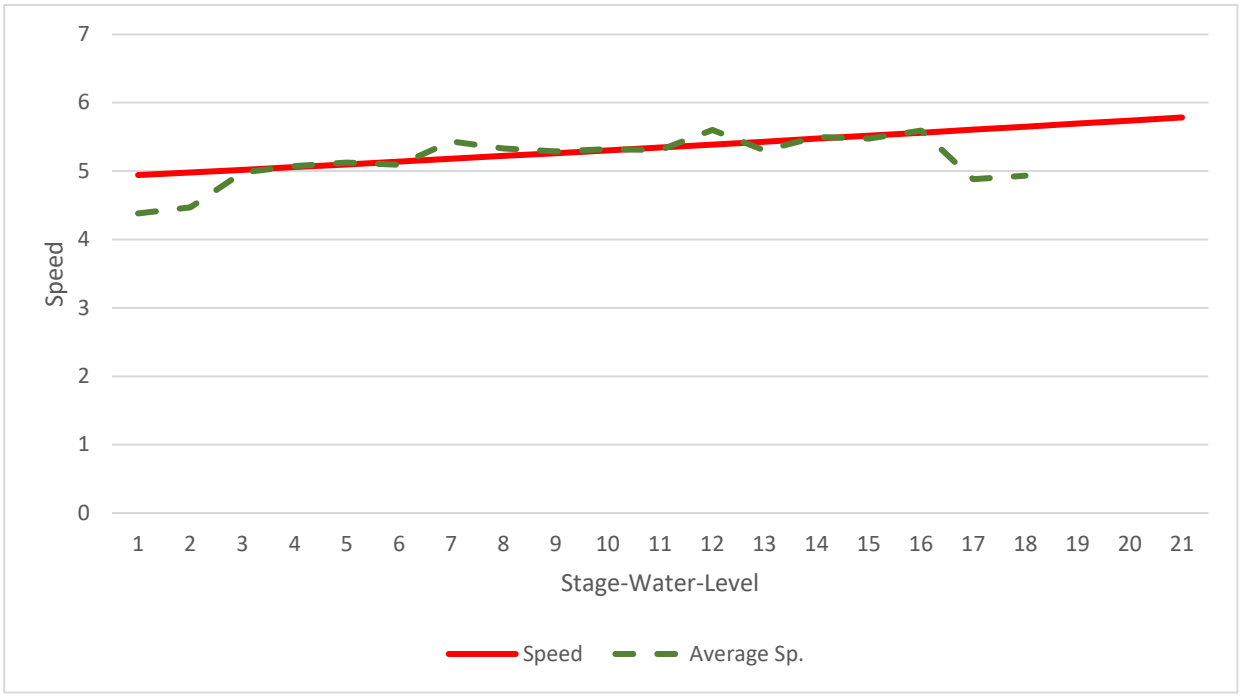


Figure 62. Link 6 Speed versus Water Level (Stage).

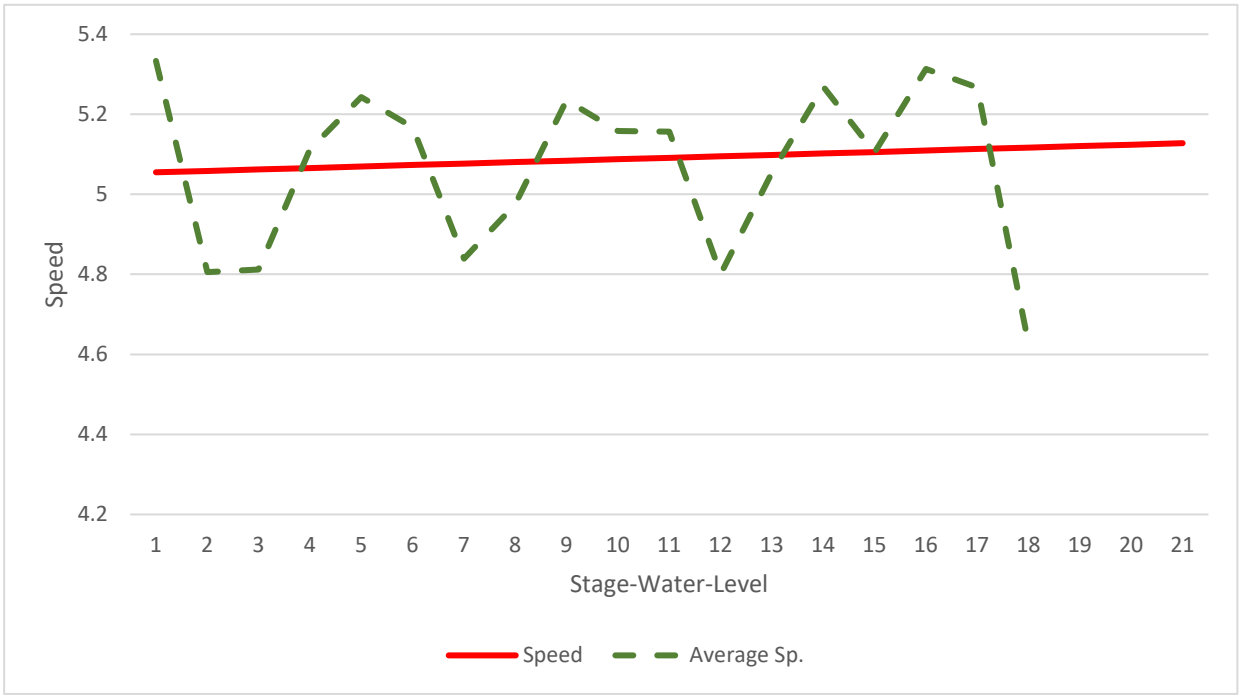


Figure 63. Link 7 Speed versus Water Level (Stage).

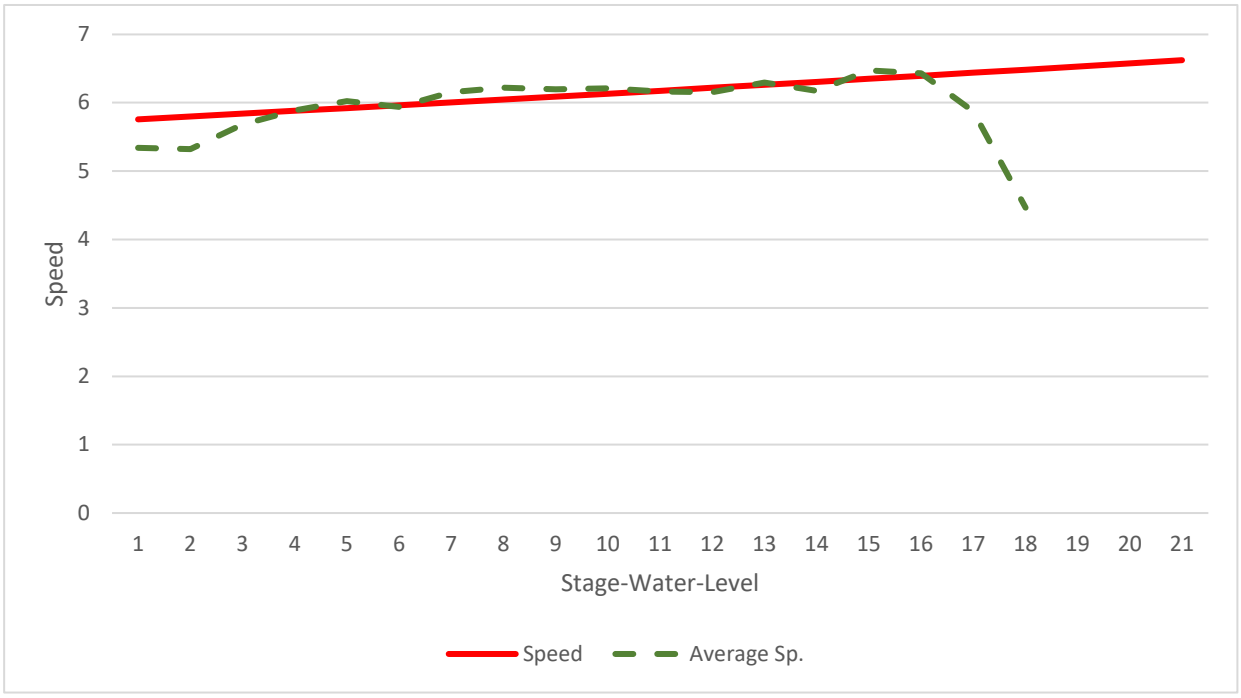


Figure 64. Link 8 Speed versus Water Level (Stage).

Figure 65. Link 9 Speed versus Water Level (Stage).

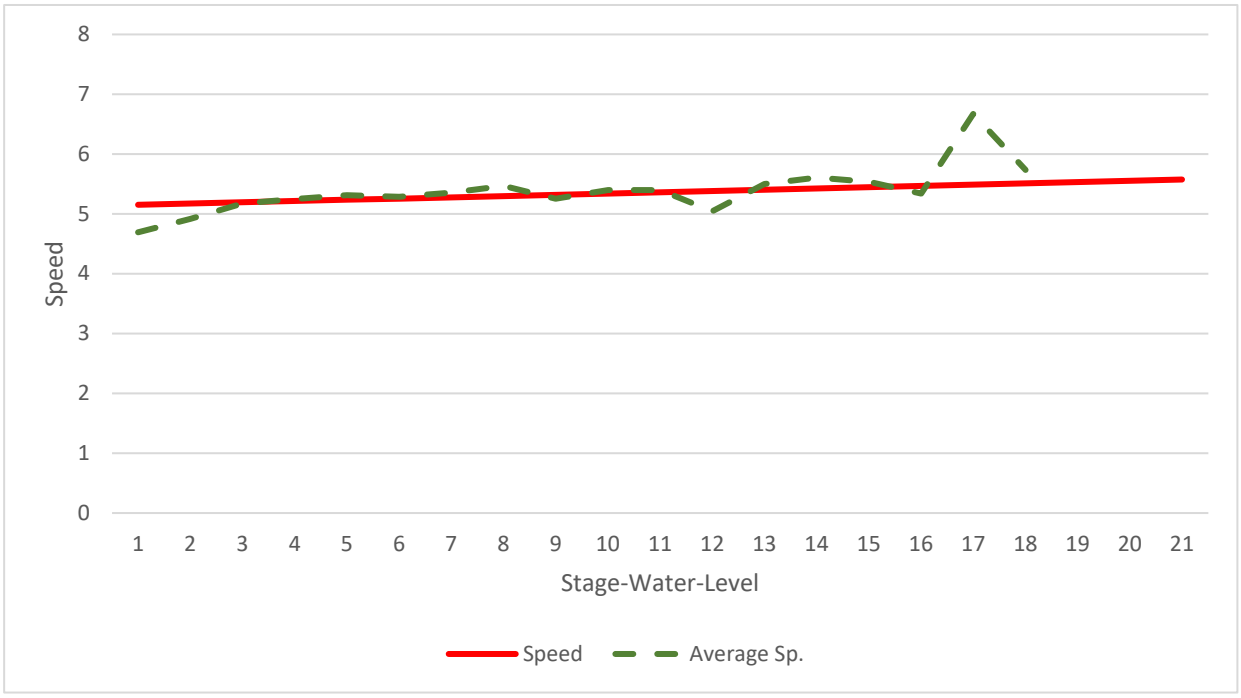


Figure 66. Sublink 10U Speed versus Water Level (Stage).

Figure 67. Sublink LD19 Speed versus Water Level (Stage).

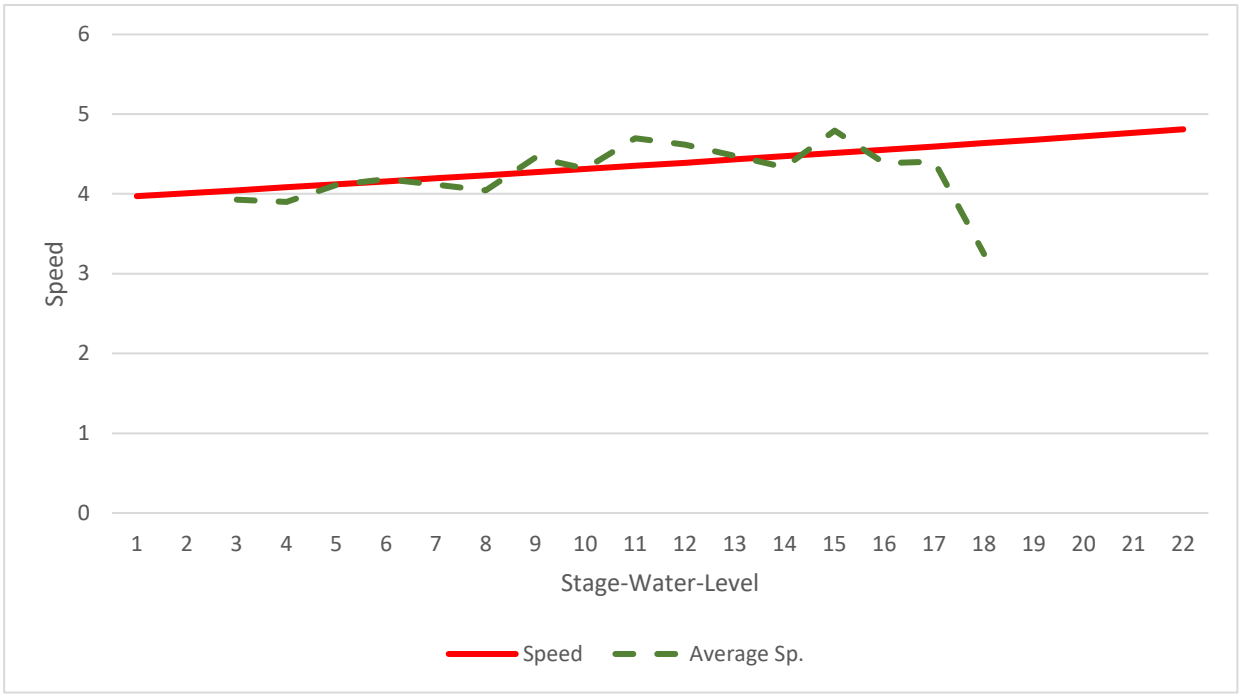


Figure 68. Sublink 10D Speed versus Water Level (Stage).

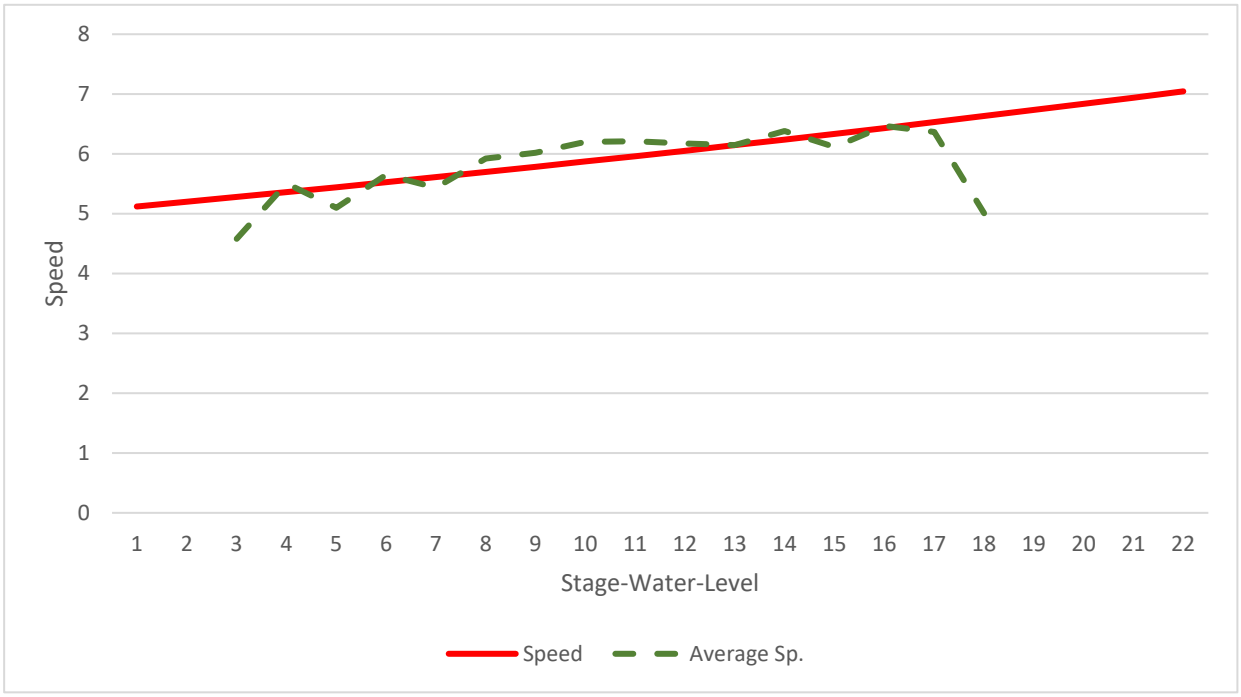


Figure 69. Link 11 Speed versus Water Level (Stage).

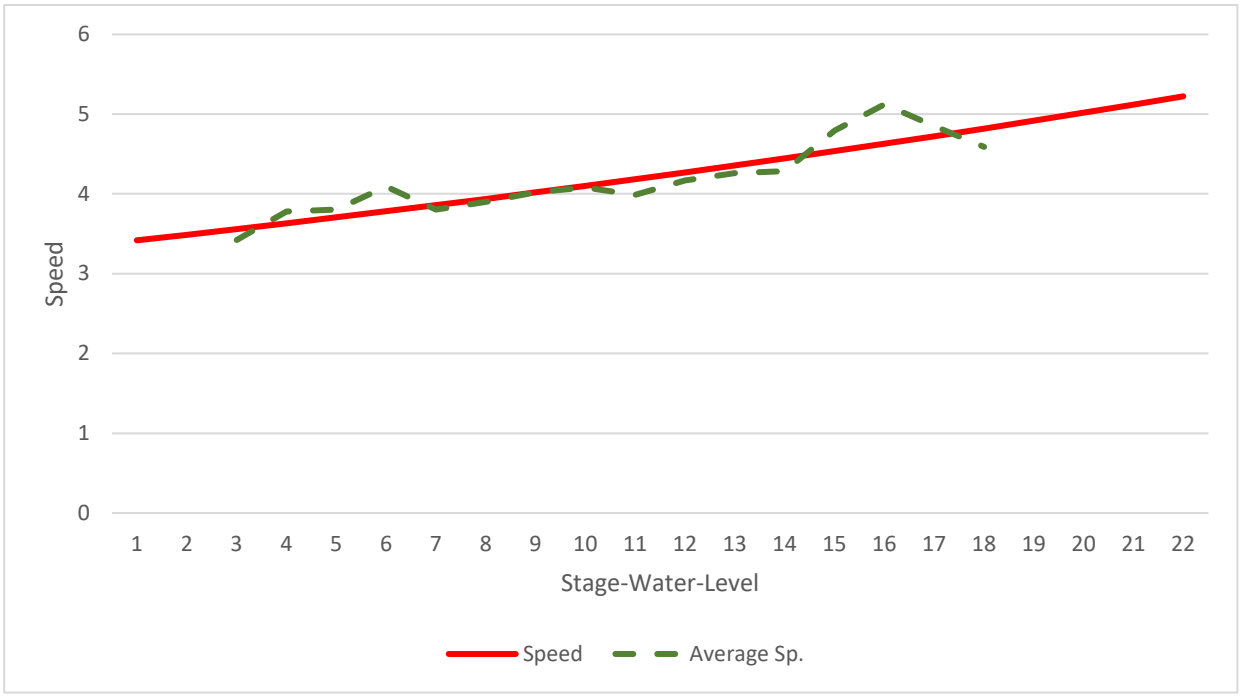


Figure 70. Sublink 12U Speed versus Water Level (Stage).

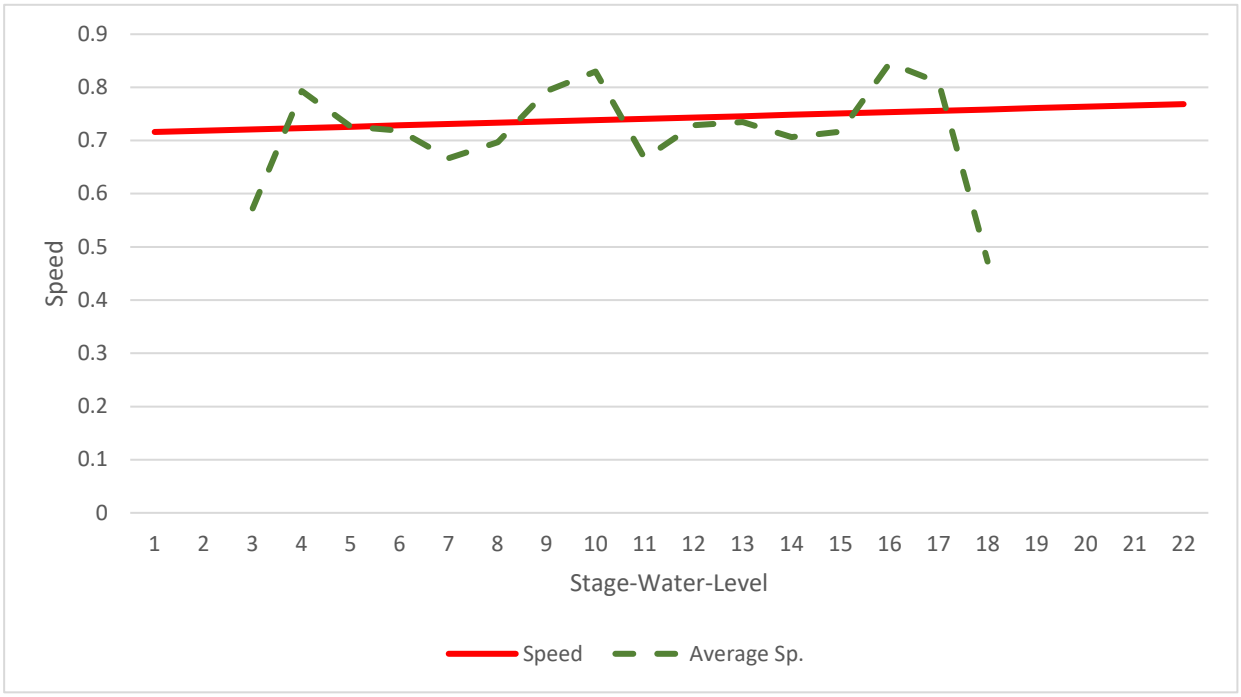


Figure 71. Sublink LD20 Speed versus Water Level (Stage).

APPENDIX F: GRAPHS OF SPEED VERSUS TRAFFIC (SAMPLE SIZE) BY SUBLINK

Figure 72. Sublink 1U Speed versus Traffic (Sample Size).

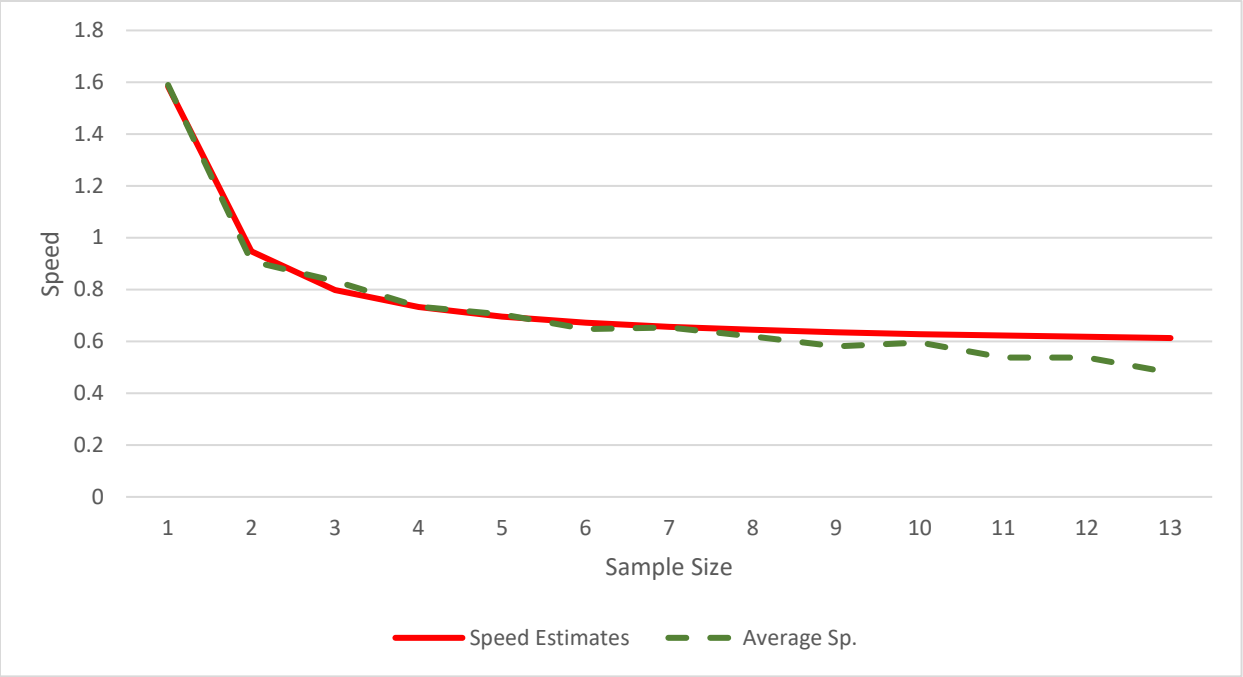


Figure 73. Sublink LD16 Speed versus Traffic (Sample Size).

Figure 74. Sublink 1D Speed versus Traffic (Sample Size).

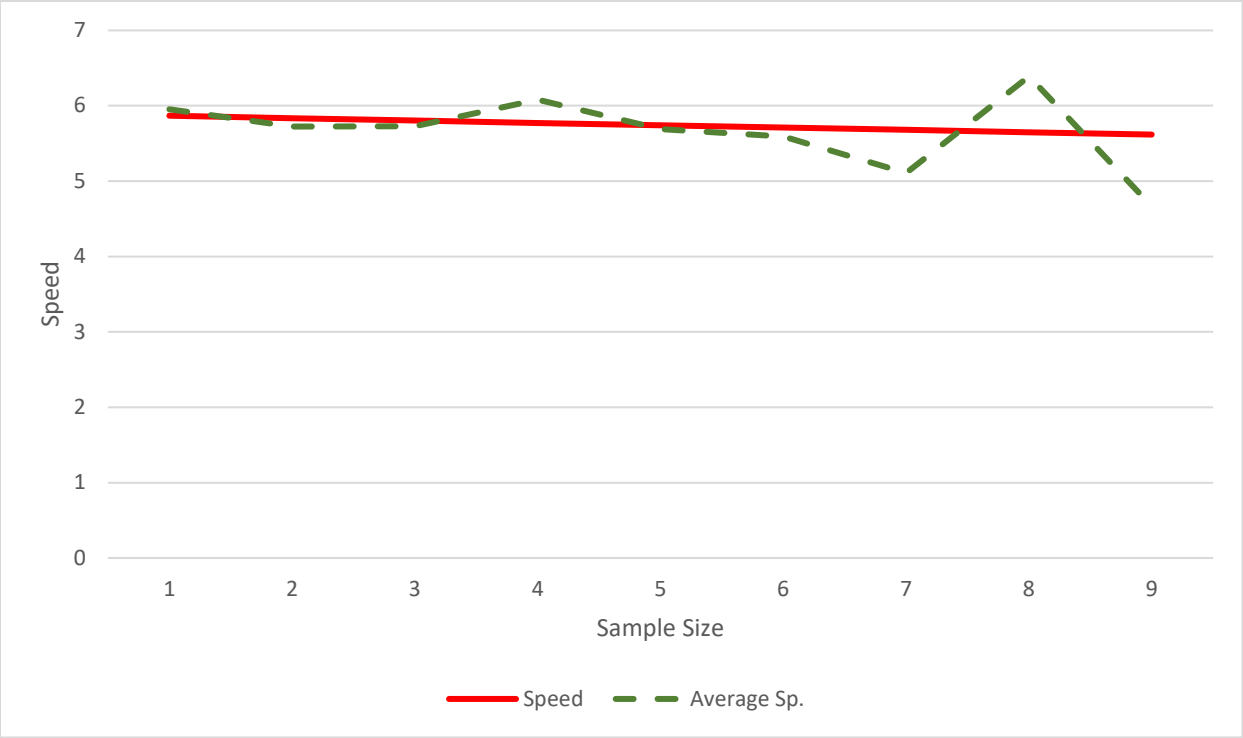


Figure 75. Link 2 Speed versus Traffic (Sample Size).

Figure 76. Sublink 3U Speed versus Traffic (Sample Size).

Figure 77. Sublink LD17 Speed versus Traffic (Sample Size).

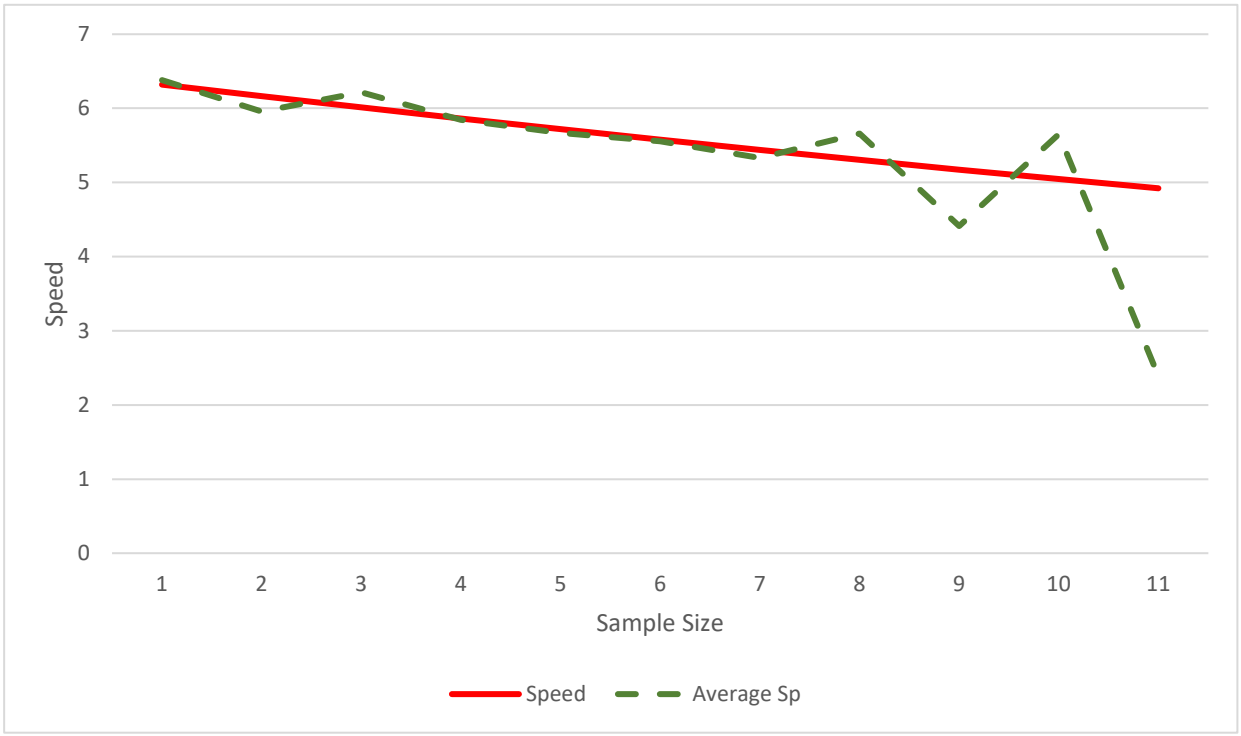


Figure 78. Sublink 3D Speed versus Traffic (Sample Size).

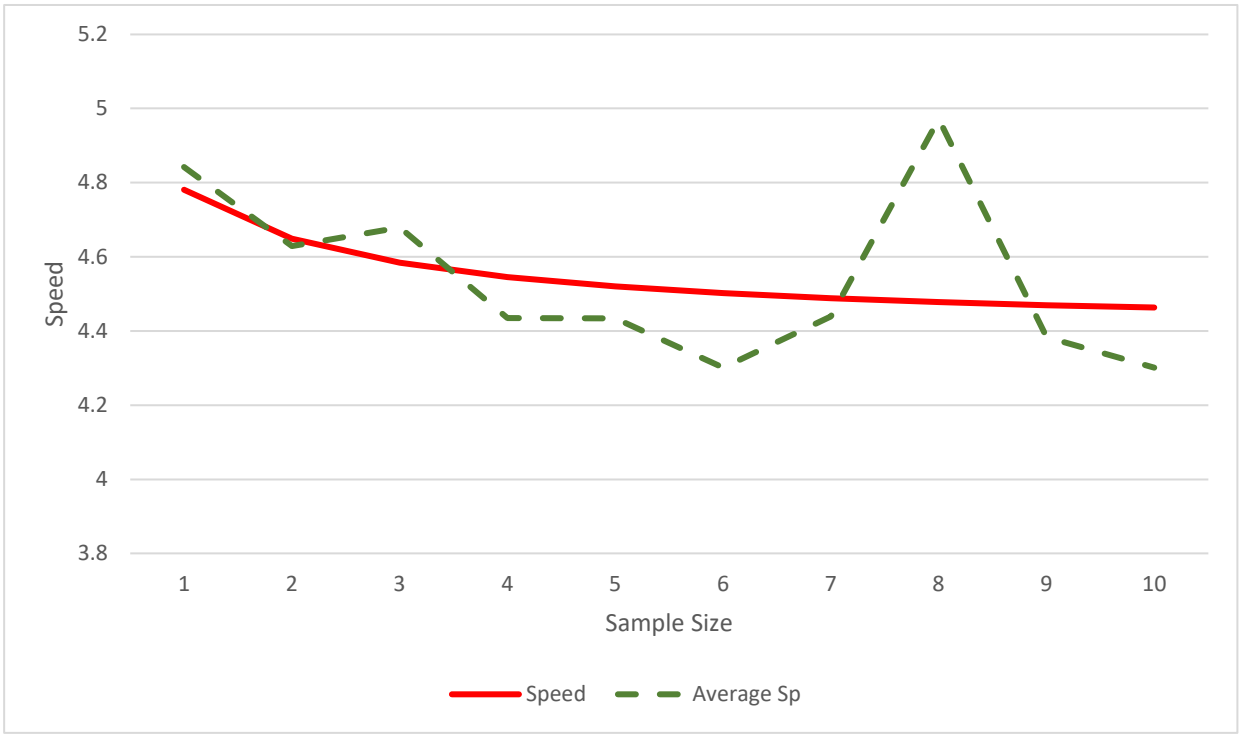


Figure 79. Link 4 Speed versus Traffic (Sample Size).

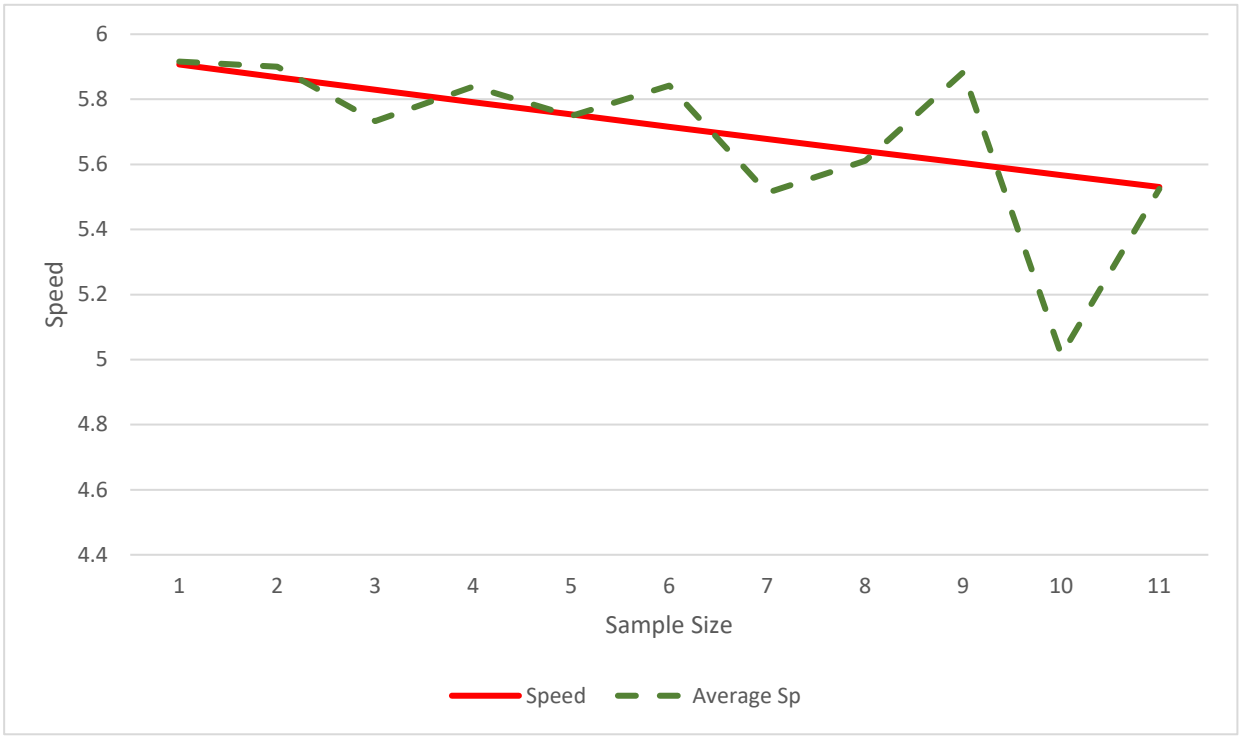


Figure 80. Sublink 5U Speed versus Traffic (Sample Size).

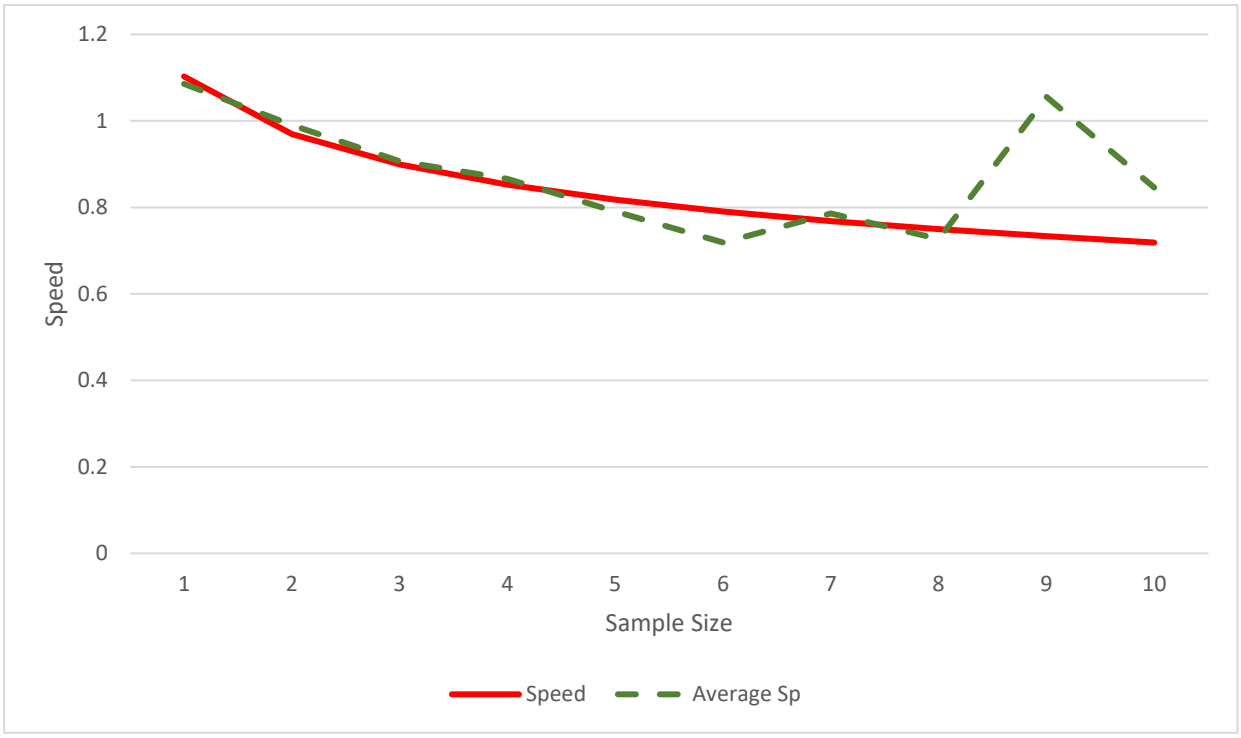


Figure 81. Sublink LD18 Speed versus Traffic (Sample Size).

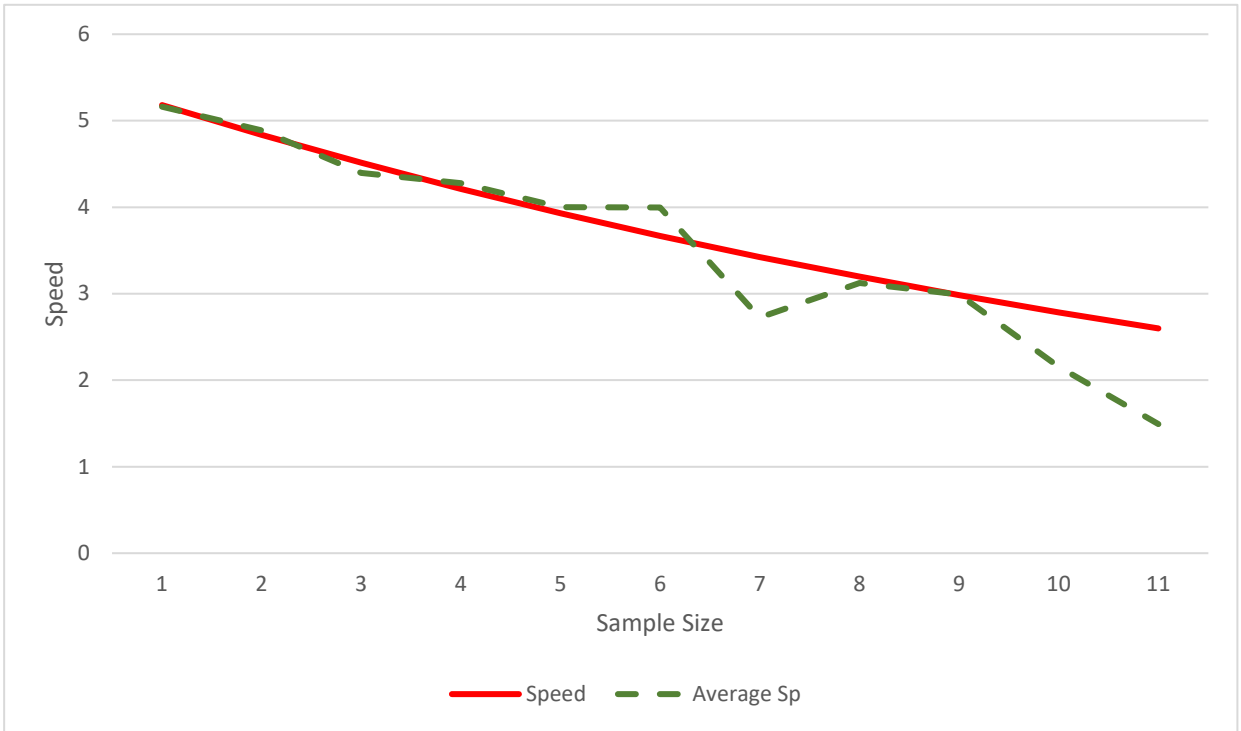


Figure 82. Sublink 5D Speed versus Traffic (Sample Size).

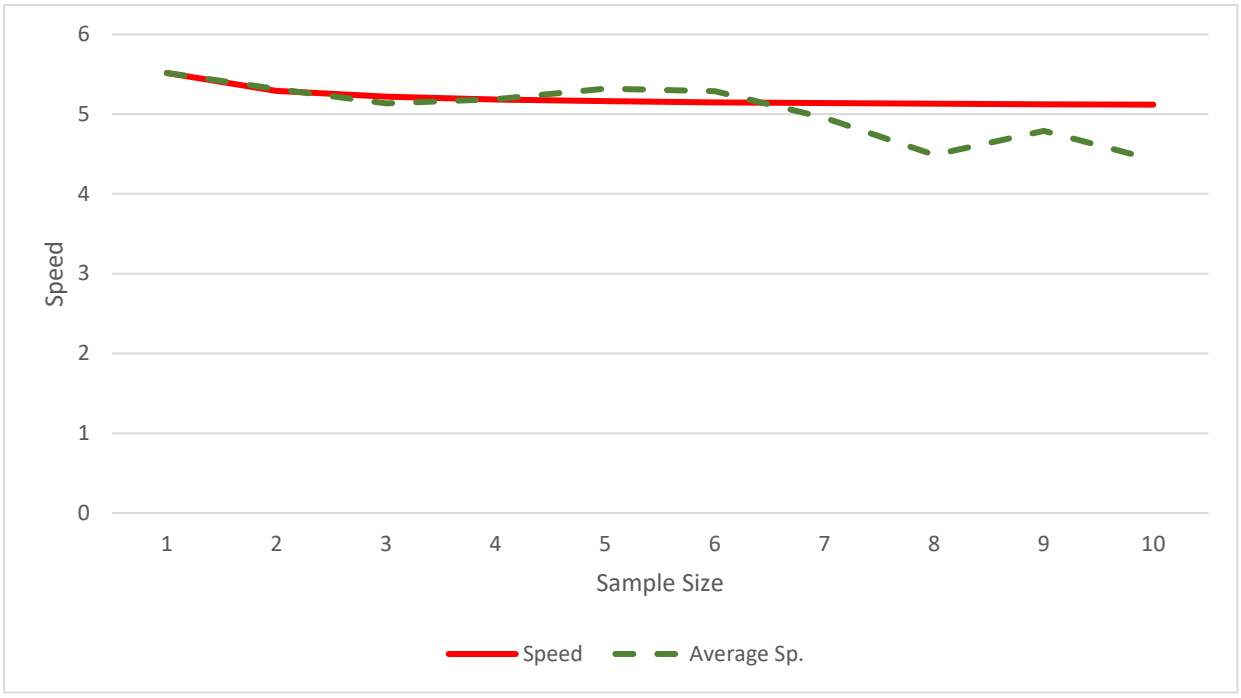


Figure 83. Link 6 Speed versus Traffic (Sample Size).

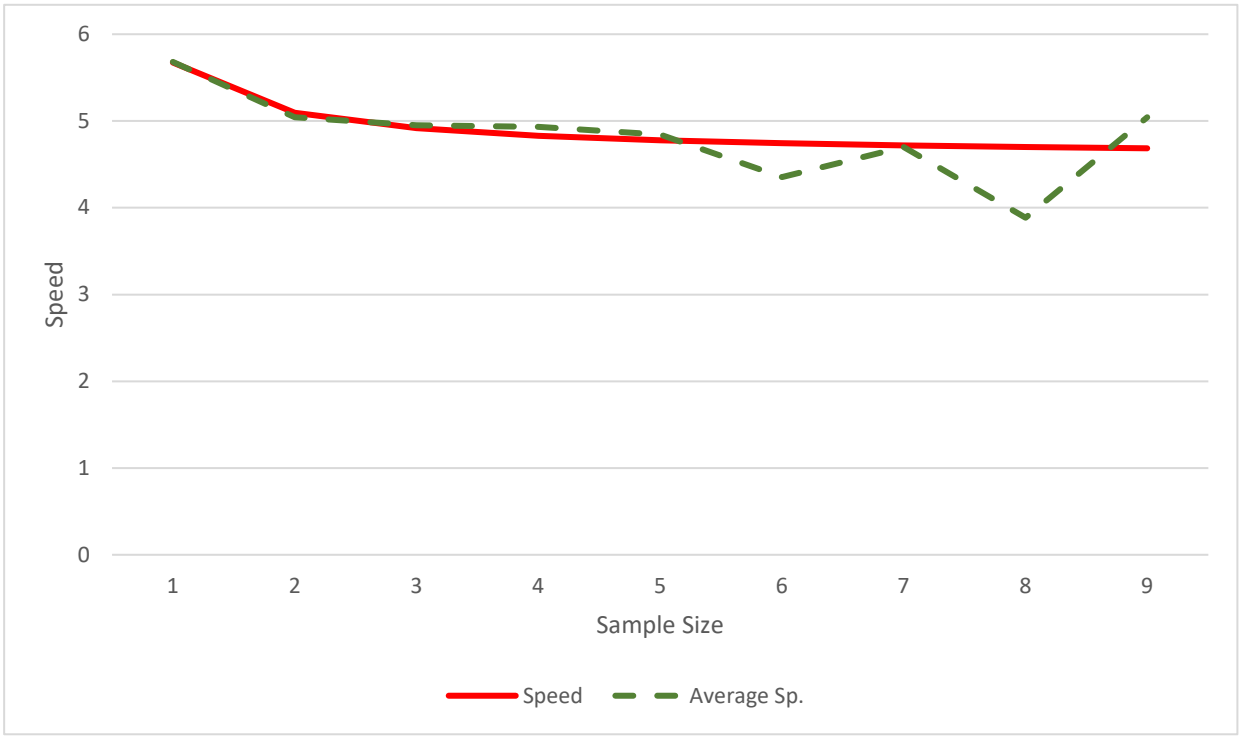


Figure 84. Link 7 Speed versus Traffic (Sample Size).

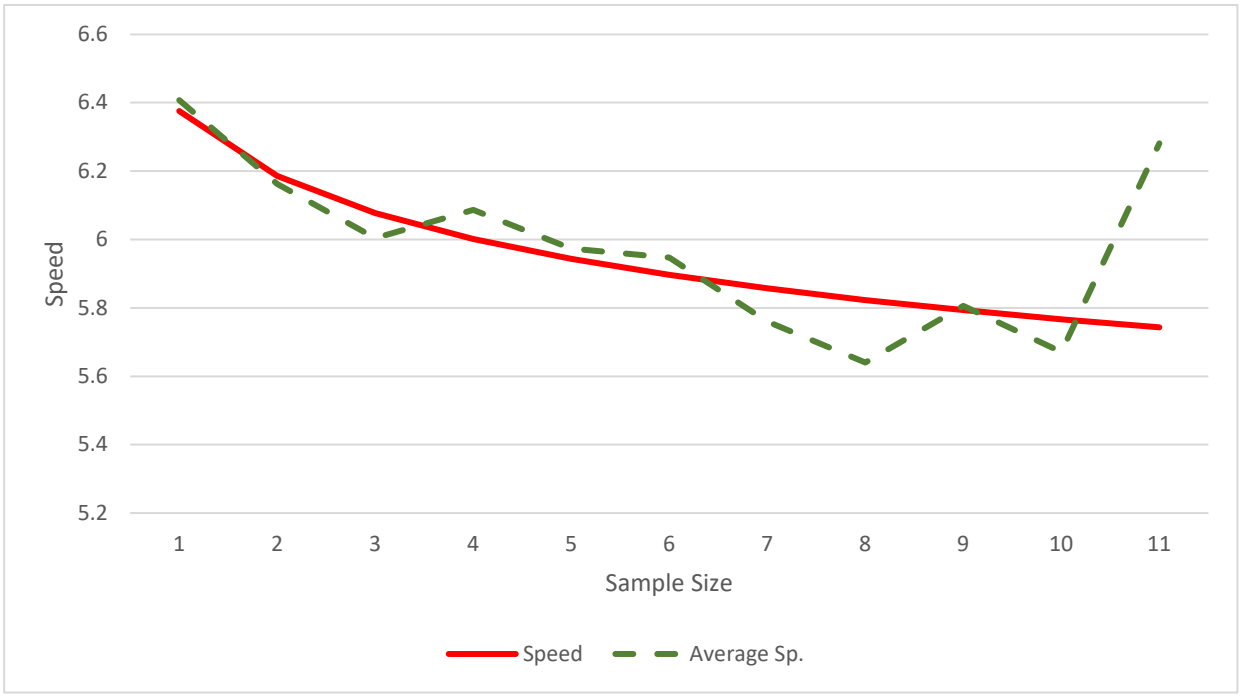


Figure 85.Link 8 Speed versus Traffic (Sample Size).

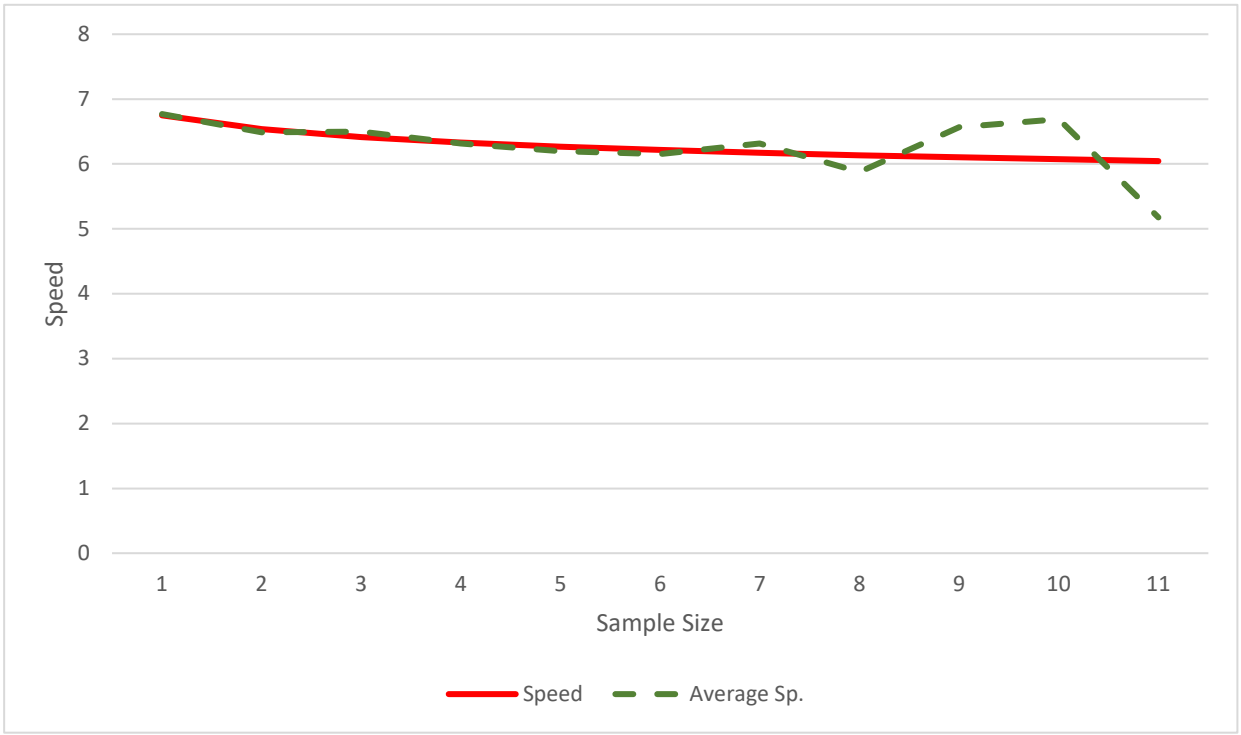


Figure 86. Link 9 Speed versus Traffic (Sample Size).

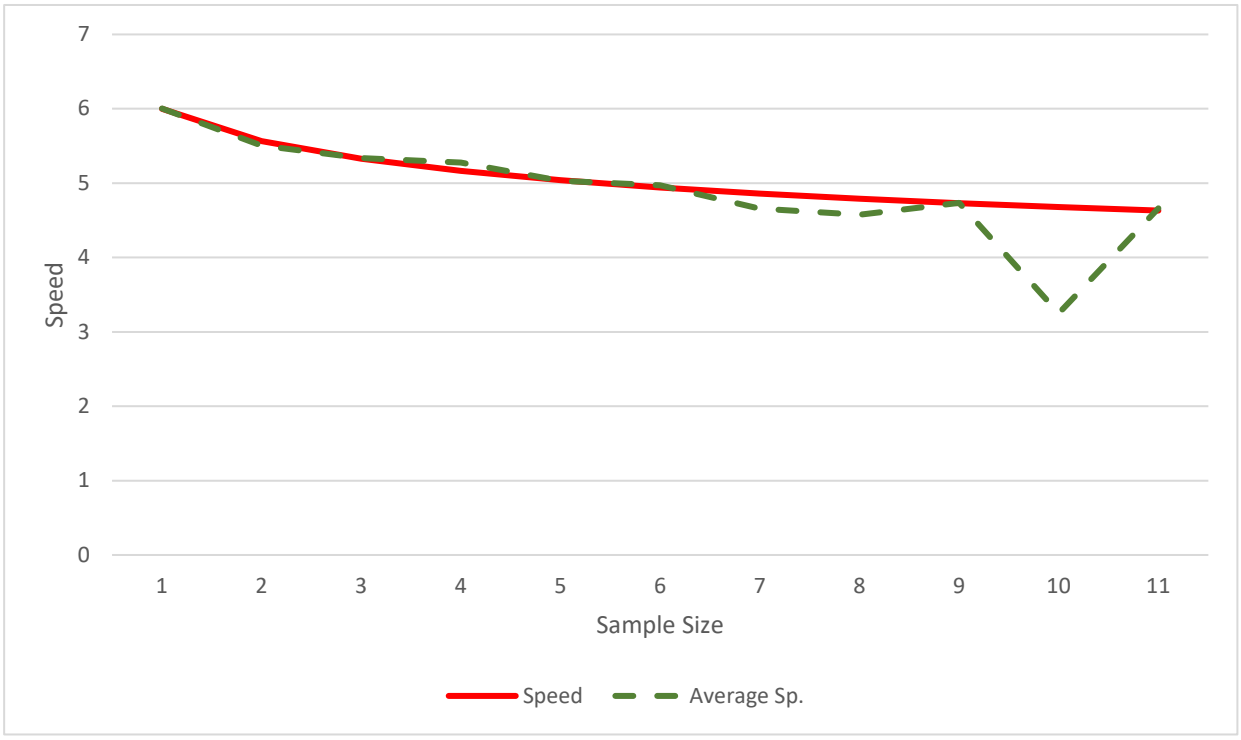


Figure 87. Sublink 10U Speed versus Traffic (Sample Size).

Figure 88. Sublink LD19 Speed versus Traffic (Sample Size).

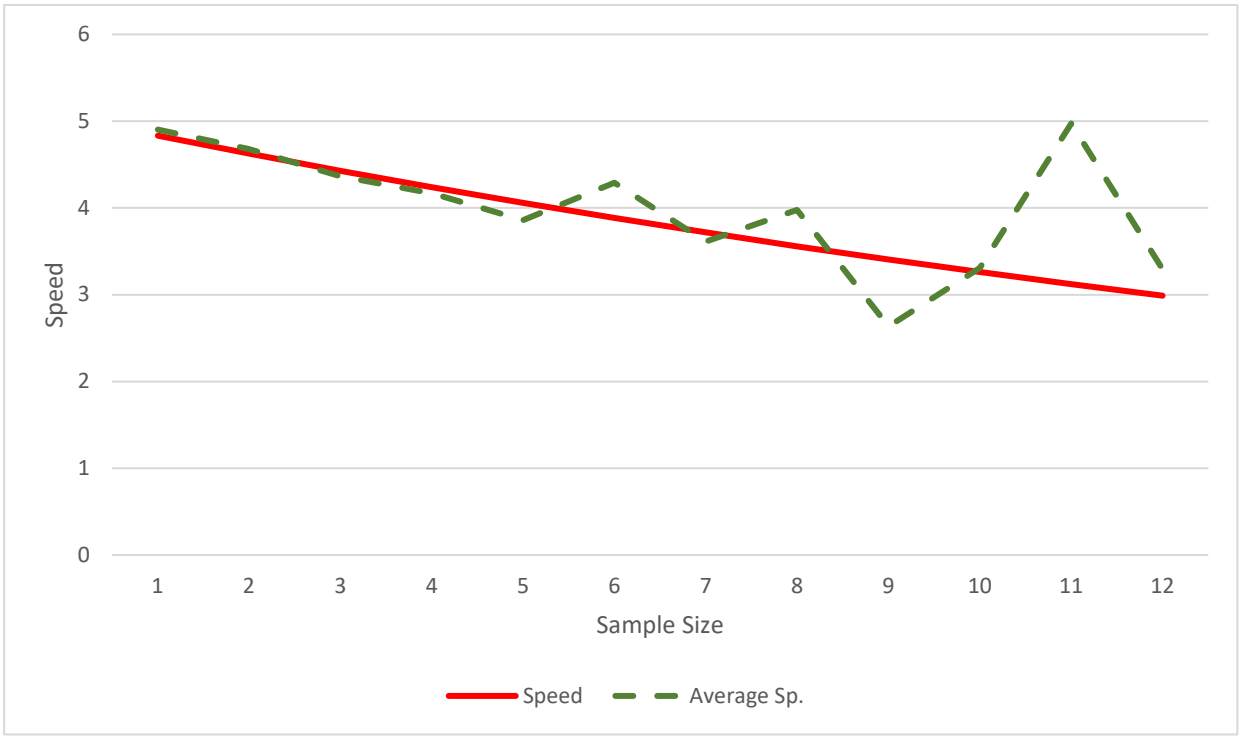


Figure 89. Sublink 10D Speed versus Traffic (Sample Size).

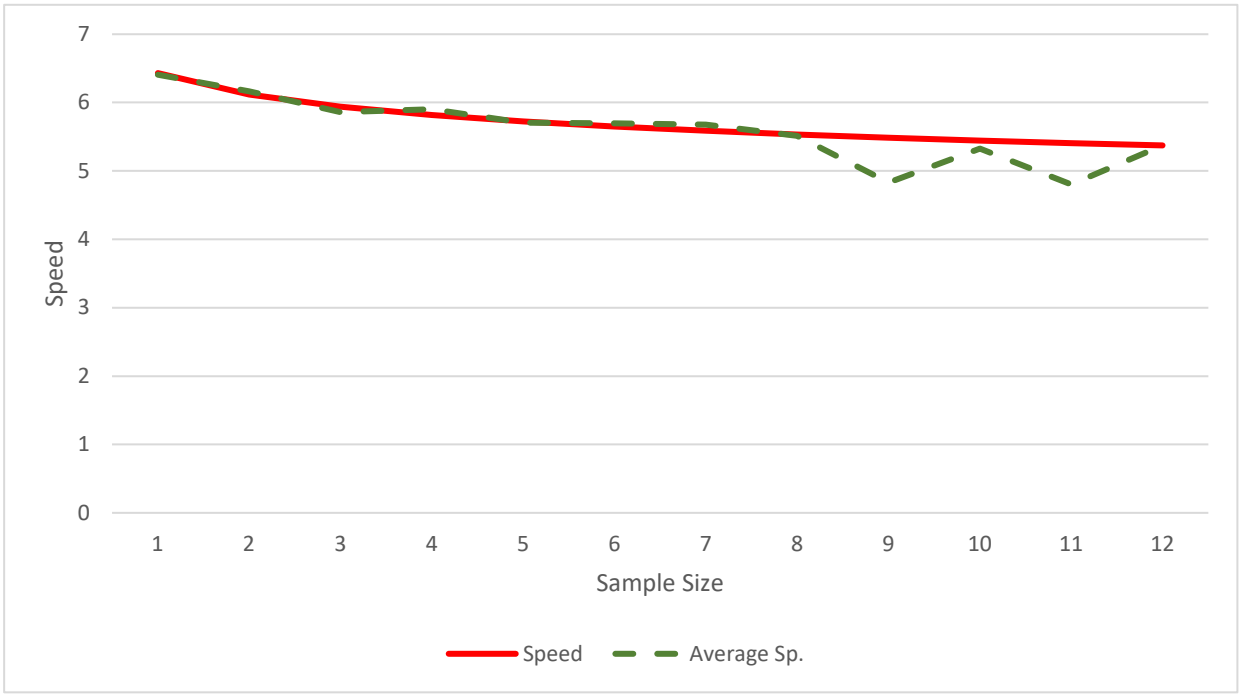


Figure 90. Link 11 Speed versus Traffic (Sample Size).

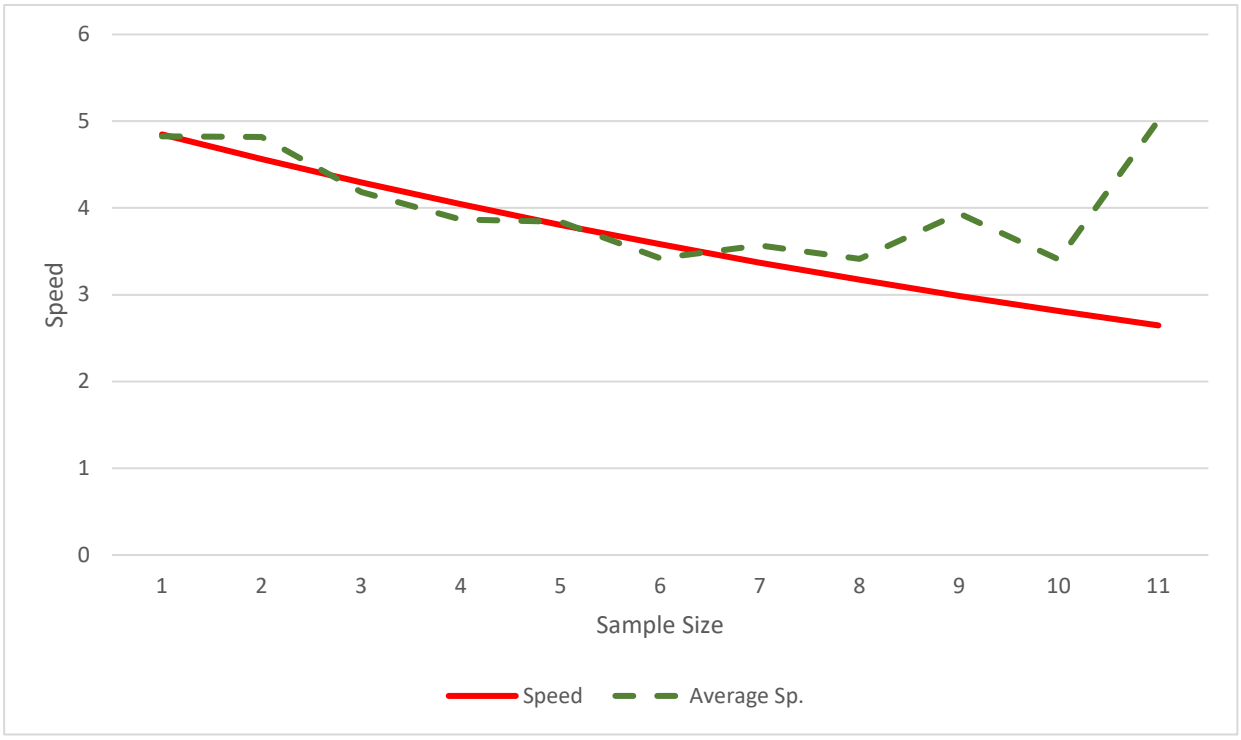


Figure 91. Sublink 12U Speed versus Traffic (Sample Size).

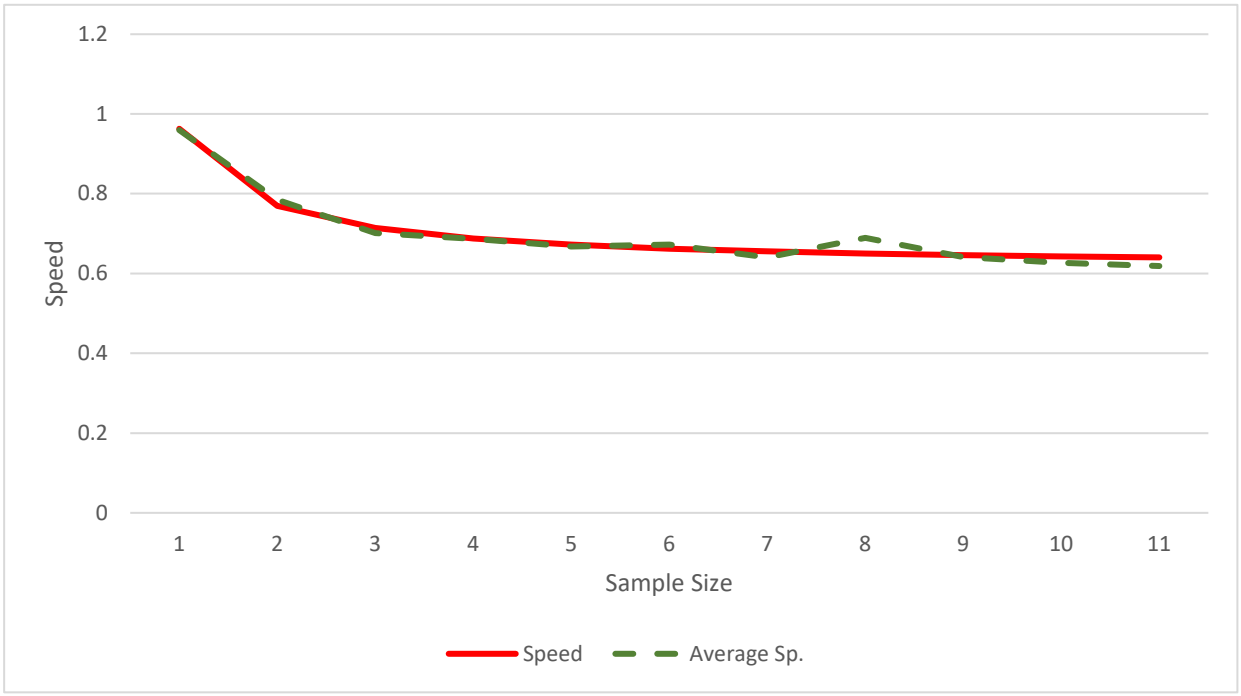


Figure 92. Sublink LD20 Speed versus Traffic (Sample Size).

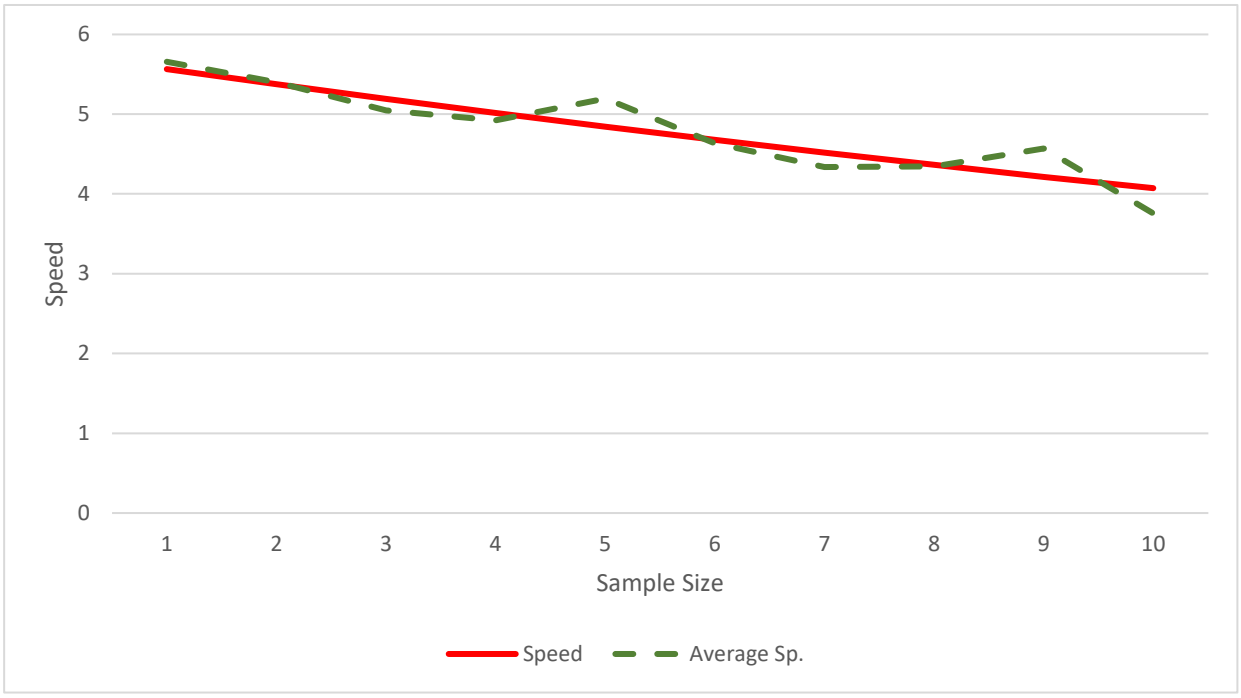


Figure 93. Sublink 12D Speed versus Traffic (Exponential).

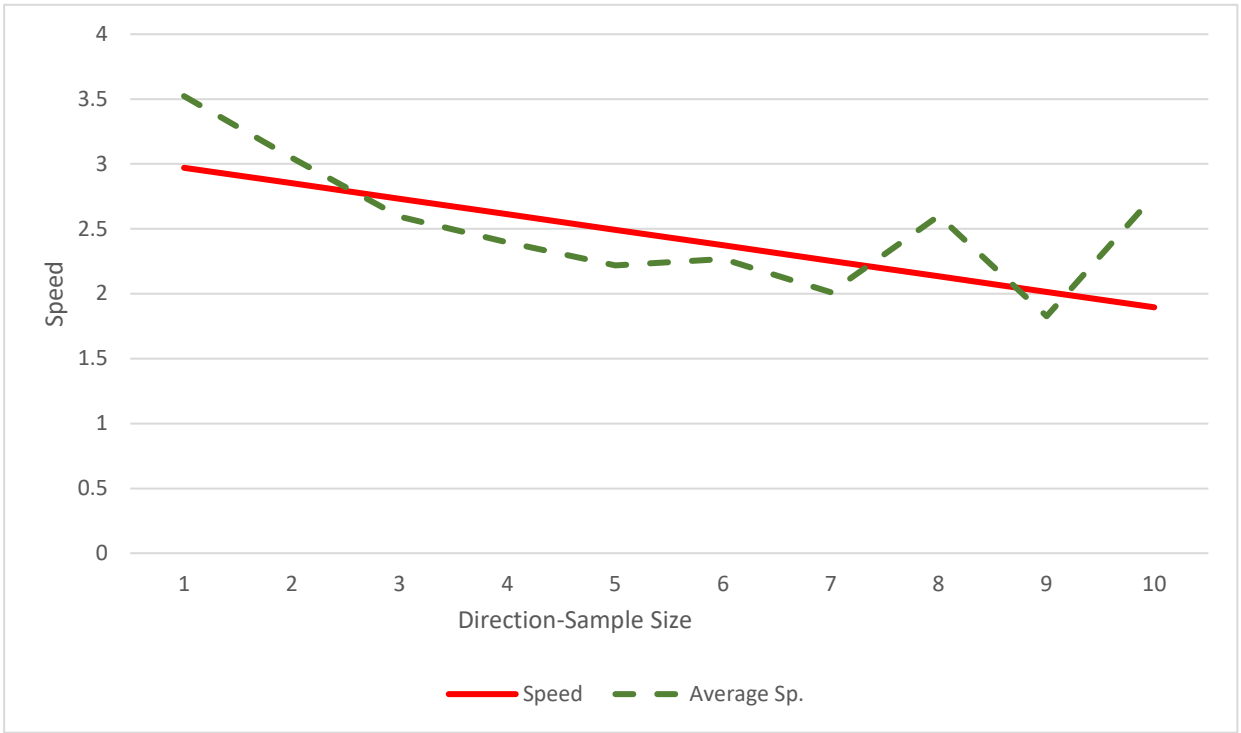


Figure 94. Sublink 12D Speed versus Traffic (Linear Northbound).

APPENDIX G: STATISTICAL RESULTS FOR SELECTED MODELS

Table 56. Statistical Results for Selected Models.

					Coefficients					p-values			
DepVar	Predictor	Model	R2	AR2	a	b	c	Linear	Constant	a	b	c	Linear
SPL1U	SSL1U	Power curve	0.9373	0.9372	6.076773	-0.14177	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL1U	Stage16	Exponential	0.931	0.9309	5.086978	0.002706	N/A	N/A	N/A	0.000	0.240	N/A	N/A
SPLD16	SSLD16	Log reciprocal	0.676	0.6755	0.566912	1.026872	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPLD16	Stage16	Exponential	0.6167	0.6161	1.256211	-0.02954	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL1D	SSL1D	Power curve	0.6941	0.6936	4.416791	-0.26297	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL1D	Stage17	Exponential	0.6772	0.6767	3.375661	-0.00228	N/A	N/A	N/A	0.000	0.655	N/A	N/A
SPL2	SSL2	Exponential	0.9375	0.9374	5.930383	-0.00541	N/A	N/A	N/A	0.000	0.200	N/A	N/A
SPL2	Stage17	Exponential	0.9383	0.9382	5.321526	0.00809	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL3U	SSL3U	Exponential	0.9486	0.9486	6.115123	-0.0172	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL3U	Stage17	Exponential	0.9483	0.9482	5.399178	0.006023	N/A	N/A	N/A	0.000	0.001	N/A	N/A
SPL17	SSL17	Power curve	0.7979	0.7976	1.625604	-0.26782	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL17	Stage17	Exponential	0.7829	0.7825	1.58695	-0.02165	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL3D	SSL3D	Exponential	0.9254	0.9252	6.480266	-0.02503	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL3D	Stage18	Exponential	0.9239	0.9237	5.770254	0.004338	N/A	N/A	N/A	0.000	0.085	N/A	N/A
SPL4	SSL4	Log reciprocal	0.8754	0.8752	4.395159	0.168274	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL4	Stage18	Exponential	0.8736	0.8734	4.517287	0.006273	N/A	N/A	N/A	0.000	0.059	N/A	N/A
SPL5U	SSL5U	Exponential	0.967	0.9669	5.945262	-0.00657	N/A	N/A	N/A	0.000	0.030	N/A	N/A
SPL5U	Stage18	Exponential	0.9691	0.9691	5.19711	0.014411	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL18	SSL18	Power curve	0.7742	0.7738	1.102271	-0.18556	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL18	Stage18	Exponential	0.7656	0.7652	0.995476	-0.01166	N/A	N/A	N/A	0.000	0.016	N/A	N/A
SPL5D	SSL5D	Exponential	0.7716	0.7712	5.55104	-0.069	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL5D	Stage19	Exponential	0.7609	0.7604	4.403148	0.000801	N/A	N/A	N/A	0.000	0.843	N/A	N/A
SPL6	SSL6	Log reciprocal	0.9254	0.9253	5.076908	0.082704	N/A	N/A	N/A	0.000	0.005	N/A	N/A
SPL6	Stage19	Exponential	0.9259	0.9257	4.90227	0.007875	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL7	SSL7	Log reciprocal	0.8767	0.8765	4.575667	0.214726	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL7	Stage19	Exponential	0.8732	0.873	5.051174	0.000714	N/A	N/A	N/A	0.000	0.798	N/A	N/A
SPL8	SSL8	Power curve	0.9601	0.9601	6.375534	-0.04358	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL8	Stage19	Exponential	0.9603	0.9602	5.718774	0.006972	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL9	SSL9	Power curve	0.9597	0.9596	6.746896	-0.04581	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL9	Stage19	Exponential	0.96	0.96	5.937211	0.008116	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL10U	SSL10U	Power curve	0.89	0.8898	5.997997	-0.10805	N/A	N/A	N/A	0.000	0.000	N/A	N/A

Table 56. Statistical Results for Selected Models (Continued).

DepVar	Predictor	Model	R2	AR2	a	b	c	Linear	Constant	a	b	c	Linear
SPL10U	Stage19	Exponential	0.8867	0.8865	5.132555	0.003933	N/A	N/A	N/A	0.000	0.114	N/A	N/A
SPLD19	SSLD19	Log reciprocal	0.9656	0.9656	1.049395	0.137519	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPLD19	Stage19	Exponential	0.9657	0.9657	1.012342	0.009511	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL10D	SSL10D	Exponential	0.7931	0.7928	5.047438	-0.04371	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL10D	Stage20	Exponential	0.7895	0.7892	3.936803	0.009096	N/A	N/A	N/A	0.000	0.014	N/A	N/A
SPL11	SSL11	Power curve	0.9168	0.9167	6.430634	-0.07229	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL11	Stage20	Exponential	0.9185	0.9184	5.042694	0.015205	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL12U	SSL12U	Exponential	0.8412	0.841	5.150804	-0.06059	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPL12U	Stage20	Exponential	0.8368	0.8365	3.350023	0.020202	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPLD20	SSLD20	Log reciprocal	0.7519	0.7515	0.614705	0.448641	N/A	N/A	N/A	0.000	0.000	N/A	N/A
SPLD20	Stage20	Exponential	0.7389	0.7385	0.713867	0.003363	N/A	N/A	N/A	0.000	0.428	N/A	N/A
SPL12	SSL12 Dir	Linear	0.803	0.8027	-0.11945	N/A	N/A	-4.91845	8.008267	0.000	N/A	N/A	0.000
SPL12	SSL12	Exponential	0.777	0.7766	5.76233	-0.03477	N/A	N/A	N/A	0.000	0.000	N/A	N/A

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