System Metrics Group, Inc.

Metro

The Los Angeles County Metropolitan Transportation Authority

Metro Arterial Performance Measurement Tool (APMT)

Methodology and User's Guide

September 18, 2017

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This document details the methodology used to develop an arterial performance measurement tool (APMT) to establish baseline performance conditions for selected subregional arterial corridors in Los Angeles County.

The documentation also serves as a User's Guide and describes how to use various features of the APMT and describes how the APMT is to be updated. The APMT contains traffic data inputs and automated analytical tools to produce arterial performance results.

1. Background

The Los Angeles County Metropolitan Transportation Authority (Metro) has been closely collaborating with its local partner agencies to implement a wide range of arterial improvements including signal synchronization, ITS investments, and bus speed improvements to improve mobility and reliability in the County. Understanding how well a transportation system performs would greatly help target the right projects to address local and regional mobility and reliability needs.

In 2014, Metro launched a performance monitoring initiative to assess the feasibility of developing a countywide Arterial Performance Measurement Program. The study demonstrated that the concept of a countywide Arterial Performance Measurement Program is feasible, and a framework was developed.

In 2015, Metro completed an initial deployment of a Baseline Conditions Analysis for the South Bay Cities subregion that provided a summary of how the regional arterial network was performing. The first generation APMT developed as part of that effort fused together speed and traffic volume data to produce travel demand, mobility, system reliability, and productivity measures. To ensure that the tool could be applied countywide, Metro developed a Methodology and User's Guide to support the APMT.

In late 2015, Metro completed the Arterial Performance Measurement Framework and developed the Concept of Operations. Subsequently, Metro initiated the Countywide Arterial Performance Measurement Baseline Conditions Analysis study to develop the APMT for all nine subregions in Los Angeles County. The resulting APMT is the second generation APMT that included enhancements and improvements to the initial APMT developed for the South Bay.

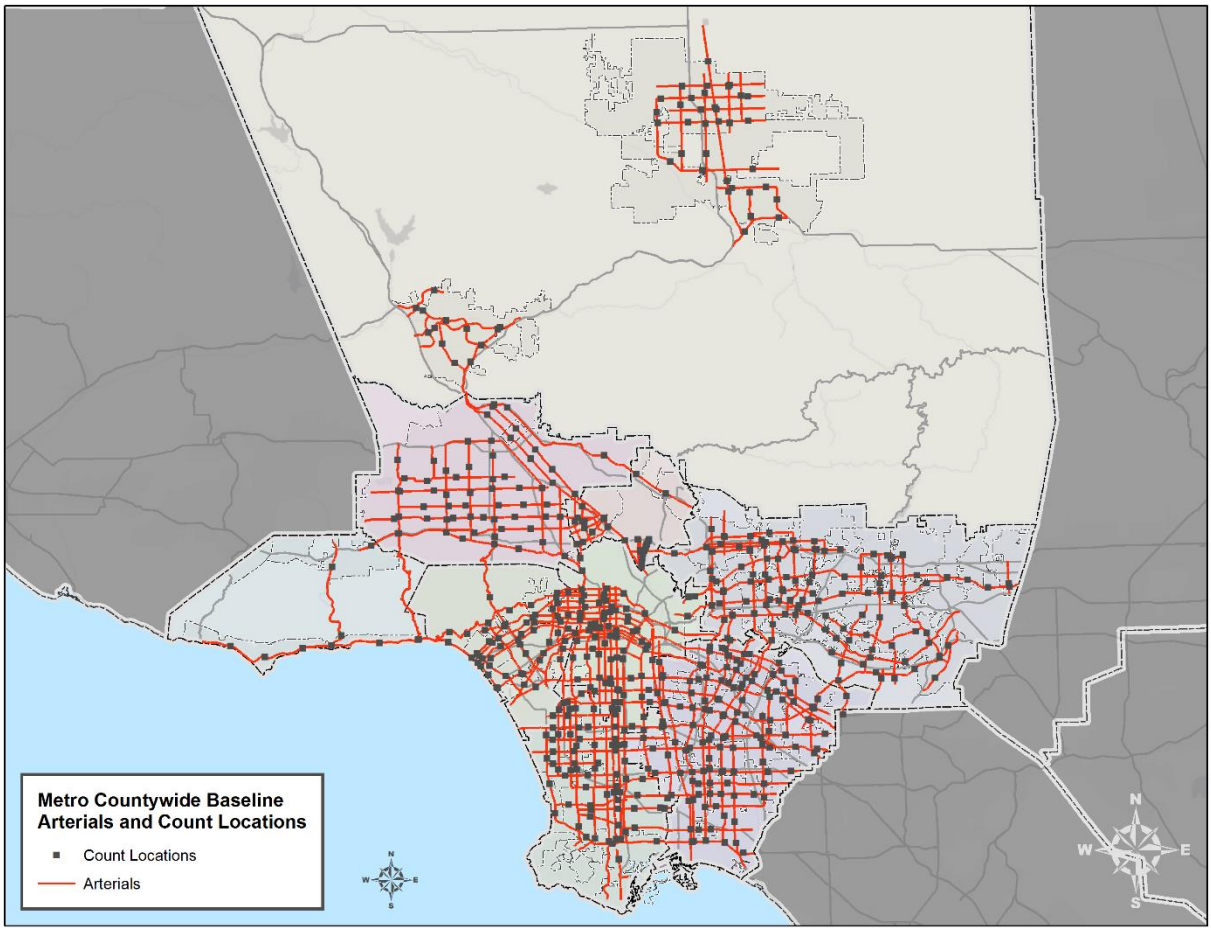
The subregional APMTs speed data comes from INRIX®, Inc. (http://inrix.com/) and traffic volume data was collected from various sources, including manual traffic counts conducted from February to May 2017, counts from public agency sources, and purchased data from private data collection vendors.

This document details the methodology behind the data analysis in the subregional APMTs and provides a User's Guide on how to use the tool. Following a description in Section 2 of how arterial corridors were selected and defined for the tool, an overview of the performance measures is provided in Section 3. Section 4 describes features of the APMT, how data was integrated into the tool, and how to update the tool in the future.

2. Overview of Arterial Corridors

The map in Exhibit 2-1, below, shows the county arterials that have been analyzed in the subregional APMTs. The map also shows the locations where vehicle traffic volume data was collected for this study. Appendix A of this methodology presents the complete list of arterials included in the tools.

Exhibit 2-1: Los Angeles County Evaluation Arterials



The arterial corridors in the APMTs were selected using both quantitative and qualitative factors with the final corridors being approved by Metro's regional partners. Metro's Recommended Framework Network (RFN) arterials were used as the source for the arterial selection process, which was developed as part of the Arterial Performance Measurement Framework. The RFN includes the Metro Countywide Significant Arterial Network (CSAN) and the Countywide Significant Truck Arterial Network (CSTAN). From the RFN, an initial list of corridors was selected based on the following quantitative and qualitative criteria:

- Corridor identified as a Priority Route by Metro's subregional partners
- Corridor carries high traffic volumes (typically exceeding 40,000 average daily traffic)
- Corridor is multi-jurisdictional that provides intercity/subregional connectivity
- Corridor has unique regional operational characteristic such as being an Integrated Corridor Management (ICM) project facility or directly parallel to a proposed future ICM corridor
- Corridor has programmed or planned ITS projects along the corridor.

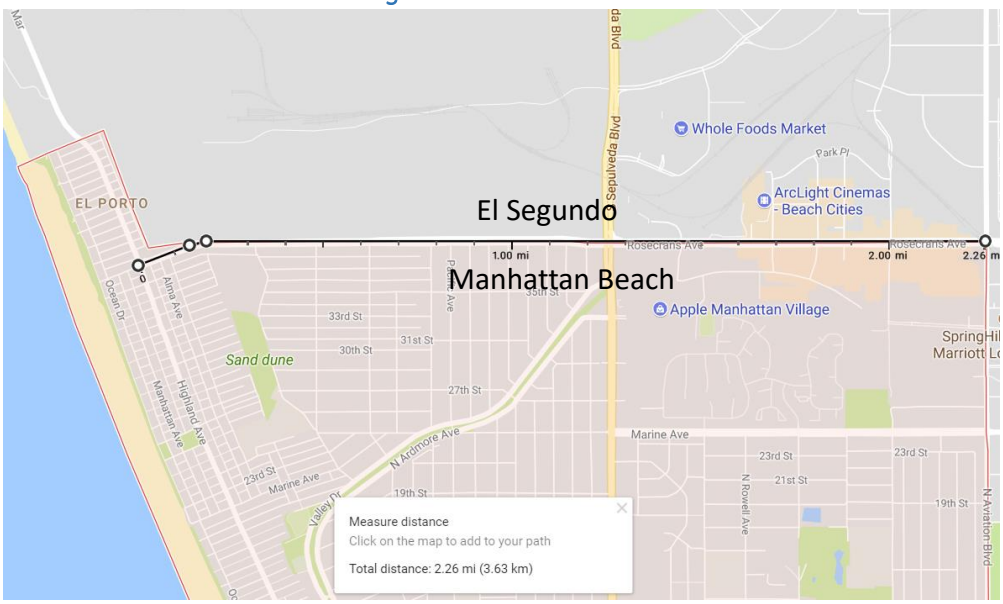
This draft list was provided to Metro's partners for review in January 2017. Follow-up outreach meetings were conducted in January and February 2017. Metro received feedback from regional partners, which resulted in arterial corridors being added, extents being modified, and in some cases arterials being removed. The comments were incorporated and the final list of arterials was developed.

2.1 Arterial Corridor Segmentation

In the APMT, an arterial corridor is defined as a roadway segment that runs within or adjacent to a jurisdiction. A jurisdiction is a Metro subregion (e.g., Gateway Cities), a city (e.g., Duarte), or county unincorporated sub-area (e.g., unincorporated Westwood).

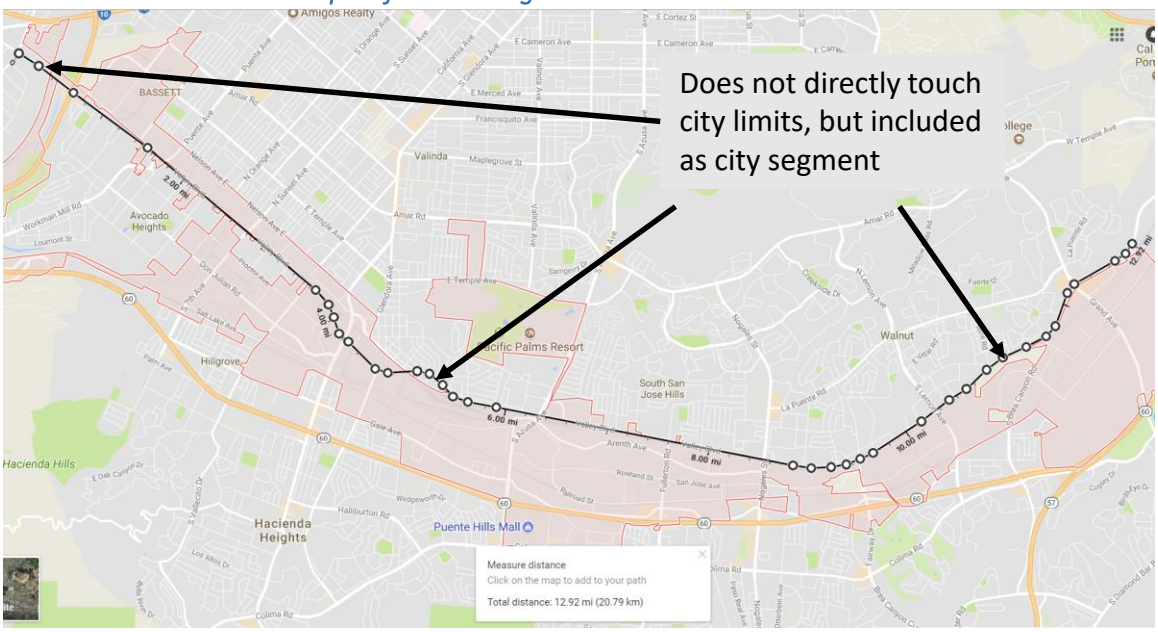
Segmenting the corridors by jurisdiction was done using Geographic Information System (GIS) software. The segmentation was fairly straightforward for arterials that traverse through a jurisdiction. In some cases, where two or more jurisdictions "share" an arterial, manual adjustments were made. Exhibit 2-2, below provides an example of how jurisdictions share an arterial using Rosecrans Avenue in the South Bay Cities subregion where El Segundo and Manhattan Beach lie on either side of the street. In the analysis worksheet of the APMT there will be two rows of identical directional data for this same section of Rosecrans Avenue for these two cities (eastbound Rosecrans will be presented for El Segundo as well as for Manhattan Beach even though El Segundo lies on the westbound side of the street).

Exhibit 2-2: Illustrative Arterial Segmentation



The example above, however, is an atypical case when there is a straight jurisdictional boundary along an entire APMT arterial segment. Many jurisdictional boundaries tend to be more irregular, which makes defining the arterial segments more challenging. In such cases, judgments were made concerning whether an arterial segment was assigned to a particular jurisdiction. Exhibit 2-3 on the following page illustrates such a case showing Valley Boulevard running approximately 12.9 miles from east to west in the vicinity of the City of Industry. There are short segments of Valley Boulevard that do not pass through the city or pass along the city limits. However, these short segment distances were included as part of the continuous segment assigned to the city.

Exhibit 2-3: Illustrative Example of Arterial Segmentation



3 Performance Measures Overview

Exhibit 3-1 is a table that summarizes the performance outcomes and measures evaluated in the APMT. The following sections describe each of these performance measures in more detail and explain how they are estimated in the tool.

Exhibit 3-1: Metro Arterials Performance Measures

Performance Outcome	Performance Measure	Definition	Data Source
Travel Demand	Vehicle Miles Traveled (VMT)	Number of vehicles multiplied by the distance traveled over a corridor.	• 24-hour traffic count data
Productivity	Flow in Vehicles per Hour (VPH)	Number of vehicles traveling along a corridor.	• 24-hour traffic count data
Mobility	Speed (MPH)	Corridor distance divided by travel time in hours.	• INRIX speed data
	Travel Time (minutes)	Time to traverse a corridor segment in minutes	• INRIX speed data
	Delay in Vehicle-Hours of Delay (VHD)	Difference in actual travel time compared to a threshold travel time (typically at the free-flow speed) along a segment. VHD is calculated as the delayed travel time multiplied by the number of vehicles experiencing that delay.	• 24-hour traffic count data • INRIX speed data
	Delay per Mile (VHD/Mile)	Ratio of VHD divided by corridor distance. A measure of congestion intensity.	• 24-hour traffic count data • INRIX speed data
	Peak Period Spreading	Average duration of peak period VHD in hours	• VHD
Reliability	Travel Time Index	Ratio of the average travel time divided by the threshold travel time (i.e., free-flow)	• INRIX speed data
	Planning Time Index	Ratio of the 95th percentile travel time divided by the average travel time. The 95th percentile travel time is the 95th slowest day out of 100 days (approx. 1 day per month).	• INRIX speed data

3.1 Travel Demand

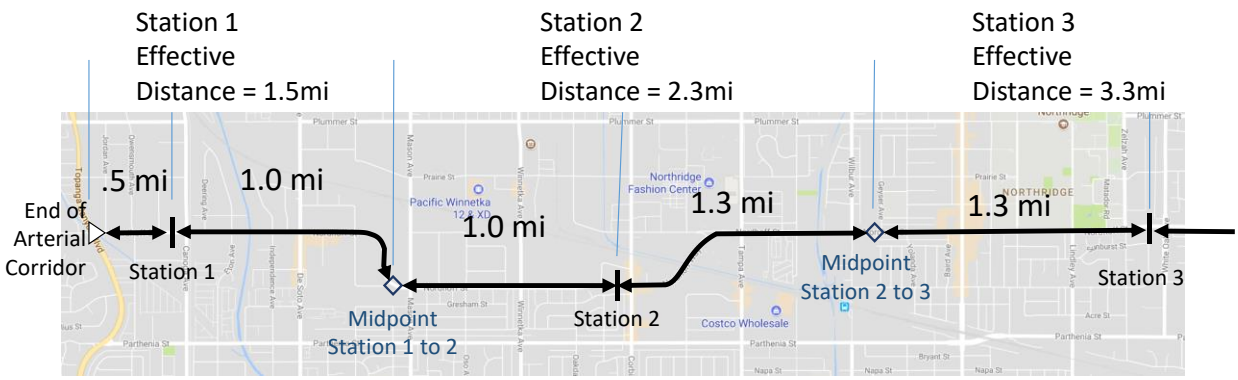
Vehicle-Miles Traveled (VMT) is the measure used to identify the demand for travel along an arterial corridor. VMT is calculated in the APMT by multiplying the traffic volume from a specific count location by the "effective distance" of that segment.

An example of how the effective distance is calculated is illustrated in Exhibit 3-2. For a given count location that distance is measured between the midpoints of the nearest upstream and downstream count locations. In the case where there is a subregional boundary or a road terminates, the effective distance is measured as the full distance between the boundary and one-half the distance between the specified count location and the nearest count location.

In the effective distance exhibit (Exhibit 3-2) described uses Nordhoff Street in the San Fernando Valley as an example. The western end of the corridor is at Topanga Canyon Boulevard (SR-27). The first count station is located just east of Canoga Avenue approximately ½ mile from SR-27. The next count station on the corridor (station 2 in our example) is located just west of Corbin Avenue, which is approximately two miles from station 1. The effective distance for station 1 is 1.5 miles – the full 0.5 mile distance to SR-27 and ½ the distance to station 2 (1.0 mile). The effective distance for Station 2 is 2.3 miles (½ the distance between Station 1 and Station 2 and ½ the distance between Station 2 and Station 3).

Estimating corridor level VMT in this way allows the tool to calculate VMT for a jurisdiction along an arterial even if that jurisdiction did not have any count stations by adjusting the VMT by taking the proportion of the corridor distance in that city to the total corridor distance. For example, if the actual distance of a corridor in a given city is 3.2 miles, but the distance over which the VMT was estimated is 4.0 miles, then the VMT for that city is increased by a ratio of 3.2/4.0.

Exhibit 3-2: Count Station Effective Distance Example



3.1.1 Productivity

Throughput or flow is the measure used to evaluate productivity and is defined as the average number of vehicles that move along a corridor per unit of time. In the APMT, productivity is reported as vehicles per hour (VPH). Arterial productivity for a jurisdiction or subregion is calculated by summing hourly VMT and the effective distances for all the count stations associated with that jurisdiction along that arterial, then dividing by the total VMT by the total effective distances.

3.1.2 Mobility

Mobility is evaluated using five measures of traffic performance: average speed, travel time, vehicle-hours of delay (VHD), VHD per mile, and peak period spreading.

The average annual non-holiday, weekday ***speed*** (in miles-per-hour or mph) over a corridor is calculated using the INRIX data by estimating the average travel time along the corridor and dividing that time by the distance for each arterial corridor and dividing by the average travel time to traverse that distance. Low speeds are indicative of congestion, but speeds depend on other characteristics of the roadway such as geometrics (e.g., shoulder widths or curvature) or other speed restrictions (e.g., school zones).

Average ***travel times*** are reported in the APMT in minutes and average travel times in minutes over a year (current year is 2016) computed using INRIX speed data described above. Since travel times vary by the distance of a corridor, they are best used to compare a corridor's performance over time rather than to compare performance across corridors.

Delay is reported as vehicle-hours of delay (VHD) and measures the overall congestion levels on a corridor. The measure is computed by identifying a reference or threshold travel time against which to determine if vehicles were delayed. This time is defined as the free-flow time that is determined by reviewing the fastest constrained and is determined by reviewing the fastest average INRIX speeds during an off-peak period, typically during the middle of the night. Delay is the corridor VMT multiplied by the difference in travel time along the corridor from the actual travel time compared against the threshold travel time. When the actual travel time is equal to or less than the threshold travel time, then the delay is equal to zero.

Delay per Mile or VHD/mile is a measure of congestion intensity and is measured by taking VHD and dividing that number by the directional miles of corridor. Since VHD can vary by both the demand and the length of the corridor, VHT/mile allows for a comparison across corridors that reflects an individual driver's experience of congestion along a corridor.

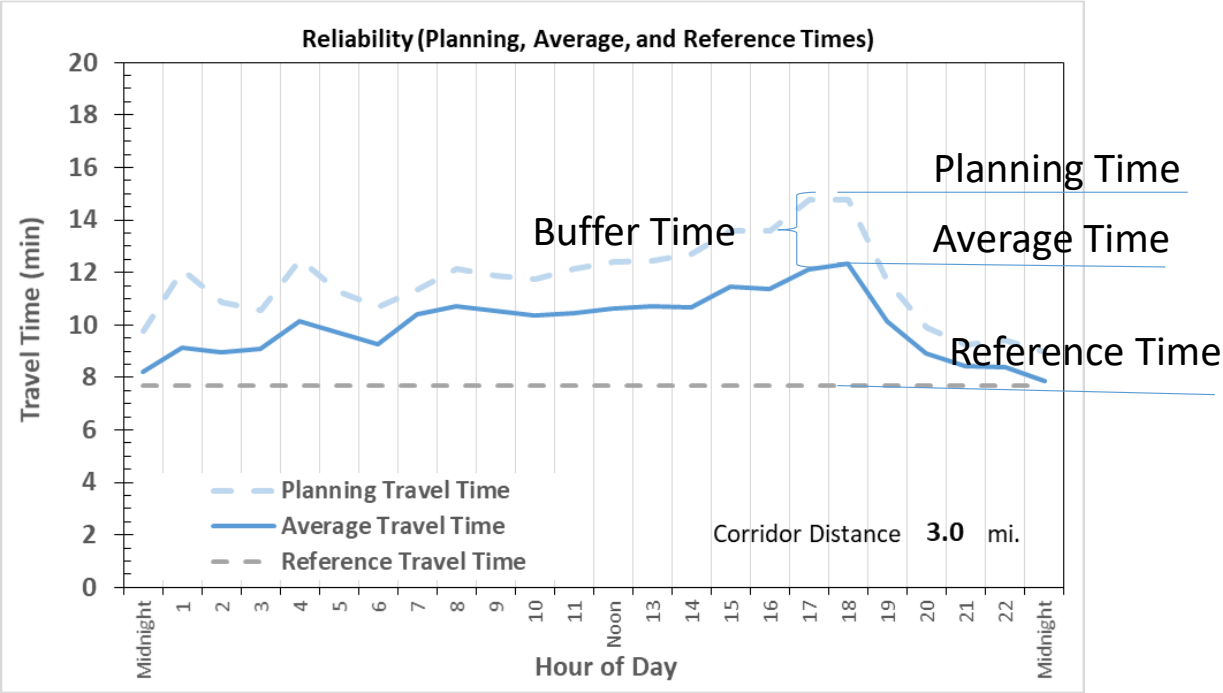
Peak Period Spreading measures the change in the congested time period for a corridor over time and is measure in hours. That is, it attempts to answer whether the duration of the congestion expanding (or contracting) from one year to the next.

3.1.3 Reliability

Travel time reliability attempts to capture the extent of unexpected delays that can occur from day to day. While average travel times can give an indication of how bad congestion can be, reliability metrics quantify the impact of those really bad days that travelers remember. The APMT uses the ***Travel Time Index*** to evaluate the intensity of congestion. The travel time index is calculated by taking the ratio of the average travel over the free-flow travel time.

The ***Planning Time Index*** is a measure of reliability and is the ratio of the 95th percentile travel time as compared to the free-flow travel time. The 95th percentile time is the time at which 95 percent of the travel times are faster. As an example, out of 100 weekdays, travel times on 95 of the weekdays will be slower than the 95th percentile travel time. Conversely, five days will take longer. If a commuter wants to get to work on time 95 days out of 100, that person should allow the 95th percentile travel time to get to work. The difference between the planning time and the average travel time is called the buffer time. Exhibit 3-3, below, illustrates these concepts.

Exhibit 3-3: Travel Time Reliability Example



4 Arterial Performance Measures Tool Overview

This section presents the APMT, describes its features, and discusses how the Metro arterial performance measures are calculated and reported.

APMT users must have basic familiarity with Microsoft Excel™ workbooks and should be comfortable navigating within and among worksheets. The APMT is designed to be transparent using basic Excel features and formulas that can be traced to the source data without more sophisticated features such as macros. Once the user has a basic knowledge of the Excel functions used in the tool and an understanding of the approaches used in processing the data, the user will be able to update the tool when updated data becomes available.

The APMT workbook is presented in Exhibit 4-1, below. The sections below describe the workbook in more detail. The workbook has 12 color-coded worksheet tabs. At the left of the workbook, are four **blue**-colored tabs containing tables and charts that summarize the arterial performance measurement results.

Exhibit 4-1: Overview of the APMT

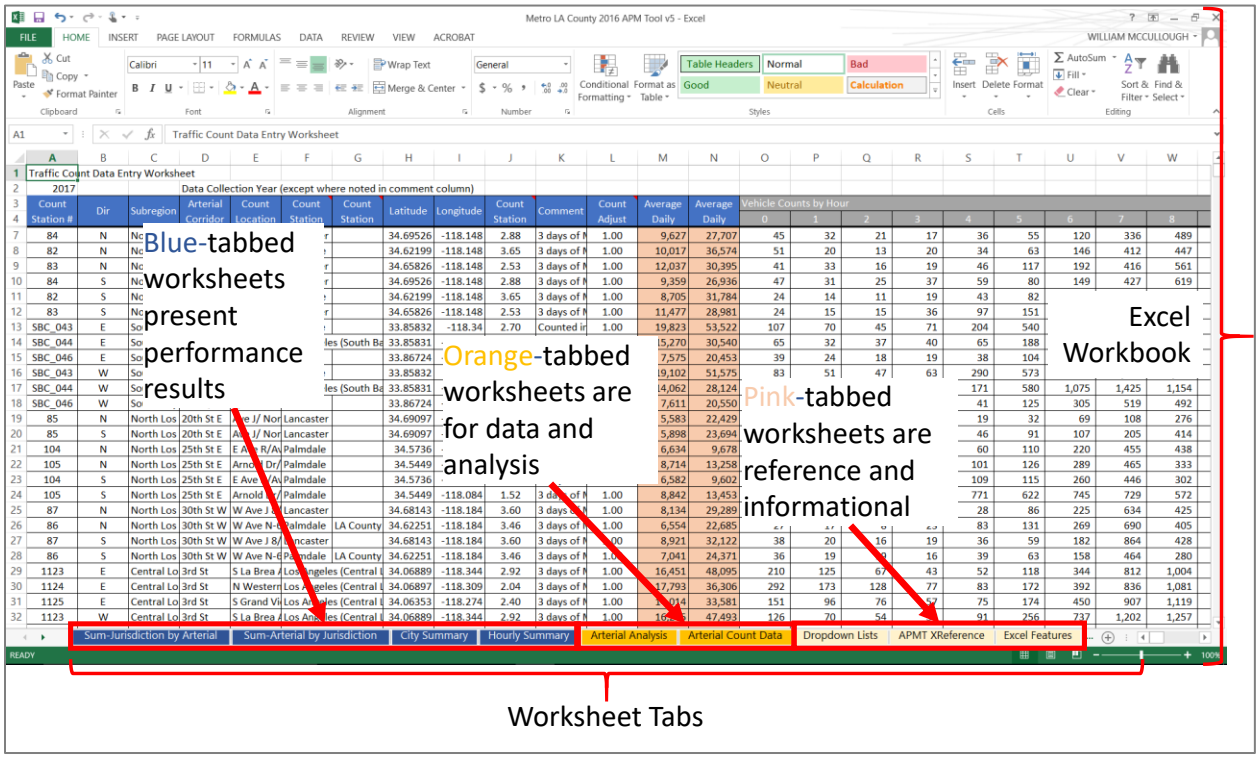


Exhibit 4-2 on the following page lists the four results worksheet and describes the performance measures reported in each one. The results worksheets reference data contained in-colored analysis worksheets that contain the speed and volume data used to calculate the results and perform the analysis. Finally, the two lighter gold-tabbed sheets at the far right provide reference information and resources to assist the user in learning more about the Excel functions and features used to present the results.

Exhibit 4-2: Performance Measures in the Results Worksheets

Worksheet Tab	Travel Demand	Productivity	Mobility			Reliability	
	Vehicle Miles Traveled (VMT)	Throughput (Vehicles per Hour)	Speed	Travel Time	Delay	Travel Time Variance	Planning Time Index
City Summary	◆				◆		
Arterial by Jurisdiction	◆	◆	◆		◆	◆	◆
Jurisdiction by Arterial	◆	◆		◆	◆	◆	◆
Hourly Summaries		◆		◆	◆	◆	◆

The following bullets briefly summarize each worksheet tab in the APMT (each tab is discussed in more detail in the following sections):

- ***Performance Measure Definitions*** – provides the definitions as presented in the performance measures summary table presented above in Exhibit 3-1.
- ***City Summary*** – reports measures that can be aggregated to the jurisdictional level (e.g., subregions, individual cities, county sub-areas). This can be used to compare overall performance among jurisdictions.
- ***Sum-Jurisdiction by Arterial*** – presents arterial specific performance measures that can be aggregated to the jurisdictional level. This can be used to compare performance for a single arterial corridor across multiple jurisdictions.
- ***Sum-Arterial by Jurisdiction*** – presents arterial corridor performance results for all jurisdictions and arterial corridors. For each jurisdiction, the performance results for each arterial in that jurisdiction are provided.
- ***Hourly Summaries*** – details hourly performance results for individual arterial corridors in a user-specified jurisdiction. Charts provide hour-of-day results for a number of performance metrics.
- ***Arterial Analysis*** - This worksheet is where the arterial performance measures are calculated. It also includes the hourly travel time, speed, and 95th percentile travel time inputs (i.e., the INRIX XD data). This worksheet is referenced by all the previously described results sheets.
- ***Arterial Count Data*** – Worksheet for the input of hourly arterial count data. This sheet also calculates the VMT for each hour of the day for individual count stations and calculates average daily traffic (ADT) and average daily VMT for each count station. This worksheet is also referenced by all the previously described results sheets.
- ***Dropdown Lists*** – Several worksheets use dropdown menu options to reference information. This worksheet contains the jurisdictional and arterial information used by the dropdown options.
- ***Excel Features*** – This worksheet provides details on key Microsoft Excel features that are used in this workbook. It also provides online references for additional information.

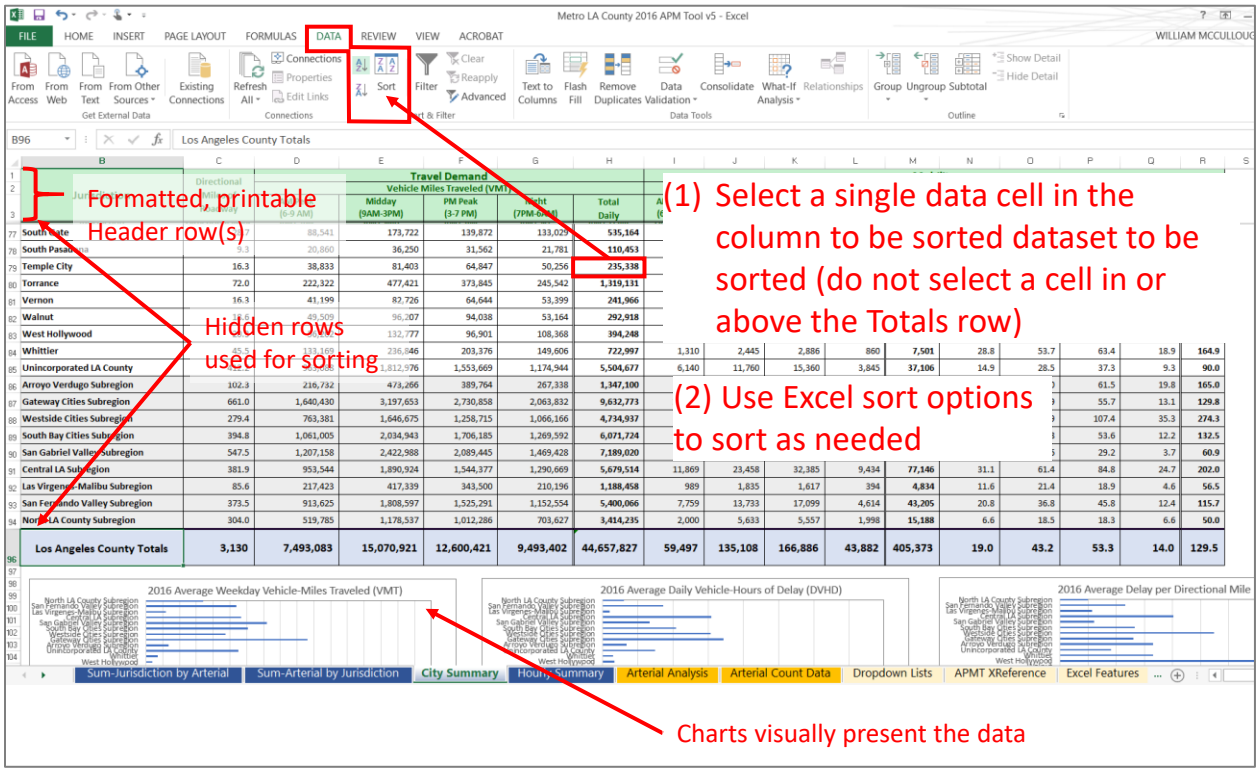
4.1 City Summary

This worksheet summarizes travel demand (i.e., VMT), delay and delay per directional mile indicators at the jurisdictional level. Other performance measures cannot be aggregated to the jurisdiction in a way that provides meaningful results, so they are not included in this worksheet.

Exhibit 4-3 shows the *City Summary* table and charts. Formulas in the data cells reference results from the *Arterial Analysis* worksheet. Cells shown in dark gray represent jurisdictions for which there is no data available to calculate the performance metrics. Below the table in Exhibit 4-3 are bar charts to visually present the performance measures. Users can modify or even add additional charts as needed for their analysis.

A feature of the *City Summary* and other worksheets in the APMT allows for the data portion of the tables to be sorted or filtered for analysis. This is also illustrated in Exhibit 4-3.

Exhibit 4-3: City Summary Table Example



At the top of each table are formatted, printable header rows that contain merged cells for ease of reading. Below this header row there are two additional rows that are set to a row height of "1" to make them invisible to the eye when printed. Excel does not allow the user to sort on merged cells, so the purpose of these two additional rows is to allow for sorting of the data in the table.

To sort the data for any column or combination of columns containing data, the user simply clicks on a single cell in the dataset below the header rows and hidden rows. Then the user can use the Excel sort features to sort the data as needed. Exhibit 4-4 on the following page show how the bar charts change based on the sorting performed on the table. The user can select the type of sorting needed for analysis.

Exhibit 4-4: Jurisdiction Summary Bar Chart Example

Table sorted by Total Delay column in descending order…

Produces chart sorted by delay…

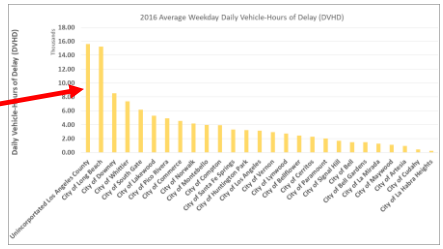
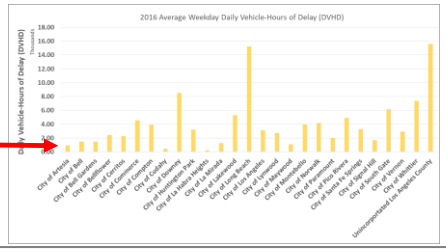


Table sorted by Jurisdiction column in ascending order…

Produces chart sorted by jurisdiction…



It should be pointed out that the APMT is designed to be as transparent as possible, using the most basic formulas and Excel features available to calculate and present results. One of the most commonly used formulas in the APMT is the Excel SUMIFS function. This function is used in the *City Summary* worksheet and all others to reference results in the *Arterial Analysis* worksheet. The function can use multiple matching criteria (e.g., jurisdiction, direction) to sum up the values in a column. Exhibit 4-5 briefly describes this formula. The *Excel Features* worksheet contains references to online resources to assist the user with data sorting features.

Exhibit 4-5: Excel SUMIF Function Example

Sum all the values in column "M" (PM Peak VMT) from row 5 to row 298 of the *Arterial Analysis* worksheet

where…

all the values in column "D" (jurisdiction) from row 5 to row 298 of the *Arterial Analysis* worksheet

match…

the value in cell "A8" (jurisdiction) from this current worksheet

=SUMIFS('Arterial Analysis'!M$5:M$298,'Arterial Analysis'!$D$5:$D$298,$A8)

4.2 Sum-Jurisdiction by Arterial

This worksheet, illustrated in Exhibit 4-6, summarizes all the performance measures for a single, user-selected arterial for all jurisdictions through which that arterial traverses. The arterial is selected by a dropdown menu which is located on the top left. The data in the table and charts will update automatically.

Exhibit 4-6: Arterial Performance Summary by Jurisdiction Example

Uses Excel "Data Validation" drop-down menu.
(See discussion of "Dropdown Lists" worksheet for more details

Arrow Hwy — Select the Arterial Corridor

Jurisdiction	Dir	Arterial Length	Travel Demand: Vehicle Miles Traveled (VMT)					Productivity: Average Hourly Flow During Period (VPH)			Mobility: Weekday Vehicle-Hours of Delay (VHD)					Mobility: V		
			AM Peak (6-9 AM)	Midday (9AM - 3PM)	PM Peak (3-7 PM)	Night (7PM-6AM)	Total Daily VMT	AM Peak (6-9 AM)	Midday (9AM - 3PM)	PM Peak (3-7 PM)	AM Peak (6-9 AM)	Midday (9AM - 3PM)	PM Peak (3-7 PM)	Night (7PM-6AM)	Total Daily VHD	AM Peak (6-9 AM)	Midday (9AM - 3PM)	P
San Gabriel Valley Subregion	E	16.8	28,594	77,434	89,231	45,039	240,298	567	768	1,328	99	361	769	63	1,292	5.9	21.5	
	W	16.8	62,179	75,878	51,171	44,324	233,551	1,234	753	761	274	409	300	85	1,068	16.3	24.4	
City of Alhambra	E	-																
	W	-																
City of Arcadia	E	-																
	W	-																
City of Azusa	E	2.2	4,036	11,523	[illegible]											4.5	19.4	
	W	2.2	7,512	10,532	[illegible]											28.9	23.8	
City of Baldwin Park	E	-																
	W	-																
City of Claremont	E	2.3	2,547	8,238	9,579	3,707	24,072	366	592	1,032	9	36	75	9	129	3.9	15.5	
	W	2.3	4,633	6,843	5,269	3,969	20,714	666	492	568	18	39	30	11	98	7.6	16.7	
City of Covina	E	2.7	4,595	12,445	14,341	7,238	38,619	567	768	1,328	7	55	123	12	196	2.7	20.2	
	W	2.7	9,993	12,195	8,224	7,123	37,535	1,234	753	761	61	65	48	14	187	22.4	23.9	
City of Diamond Bar	E	-																
	W	-																
City of Duarte	E	-																
	W	-																
City of El Monte	E	-																
	W	-																
City of Glendora	E	2.7	3,895	11,963	12,028	6,102	33,988	483	741	1,118	11	58	67	13	149	4.0	21.7	
	W	2.7	10,424	12,361	8,659	8,285	39,728	1,292	766	805	30	69	47	18	164	11.2	25.8	
City of Industry	E	-																
	W	-																
City of Irwindale	E	4.0	10,813	27,356	28,900	16,097	83,166	[illegible]	1,148	1,820	51	143	397	21	611	12.7	35.9	
	W	4.0	26,108	27,292	14,988	14,759	83,148	2,192										
City of Los Angeles	E	-																
	W	-																
City of La Puente	E	-																

City Summary | Sum-Jurisdiction by Arterial | Sum-Arterial by Jurisdiction | Hourly Summ

Arterials do not traverse these jurisdictions or data not available for performance measure shown in gray

Uses Excel "Conditional Formatting" feature to highlight high/low measures

Cells shown in dark gray indicate that the arterial does not run through or traverse the boundary of that jurisdiction or that results could not be calculated because no data was available to compute the metric. This worksheet uses the Excel dropdown list feature as well as conditional formatting. These two features are discussed below starting on the following page.

Unlike the *City Summary* worksheet from above, the data table in this worksheet cannot be sorted. This is because the jurisdiction column has merged cells to enhance readability. Microsoft Excel cannot sort data in data ranges containing merged cells.

As with the *City Summary* worksheet, there are a series of bar charts that visually show the data represented in the table. An example of a bar chart is shown in Exhibit 4-7 on the following page.

Exhibit 4-7: Arterial Performance Summary by Jurisdiction Bar Chart Example

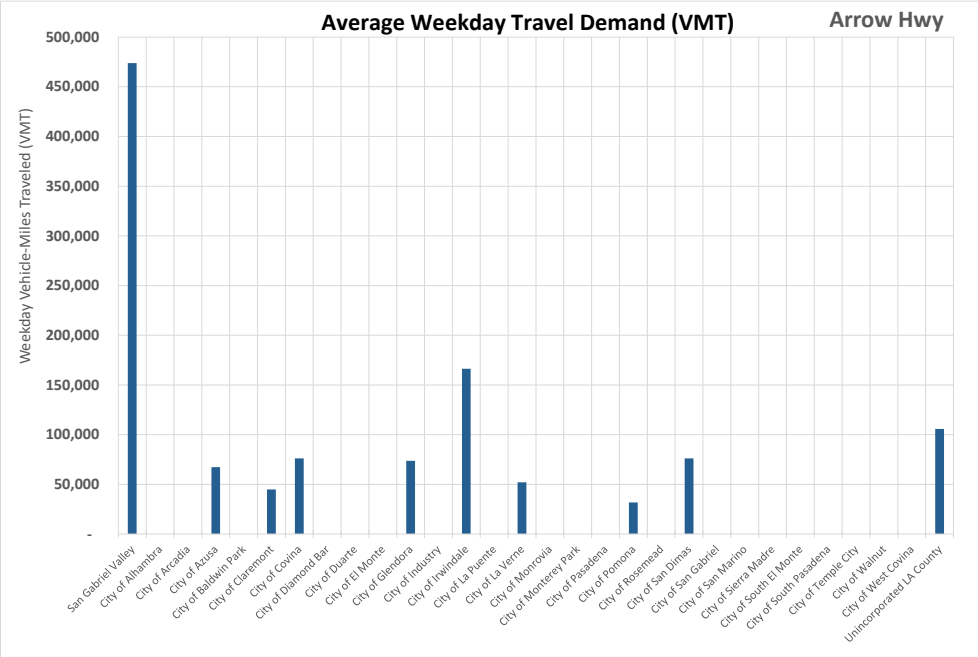


Exhibit 4-8, below, shows an example of Excel dropdown lists, and Exhibit 4-9 shows an example of Excel's conditional formatting.

The dropdown list example in Exhibit 4-8 shows how the tool uses the data validation feature to develop the dropdown menu that is used to select an arterial. Under the *Data* ribbon, selecting the *Data Validation-Data Validation* option brings up a window. To create the dropdown menu, the APMT uses the *List* option and identifies as the source of this list as the "Dropdown Lists" worksheet tab (described in more detail in a section below).

Exhibit 4-8: Excel Dropdown Lists Illustrated

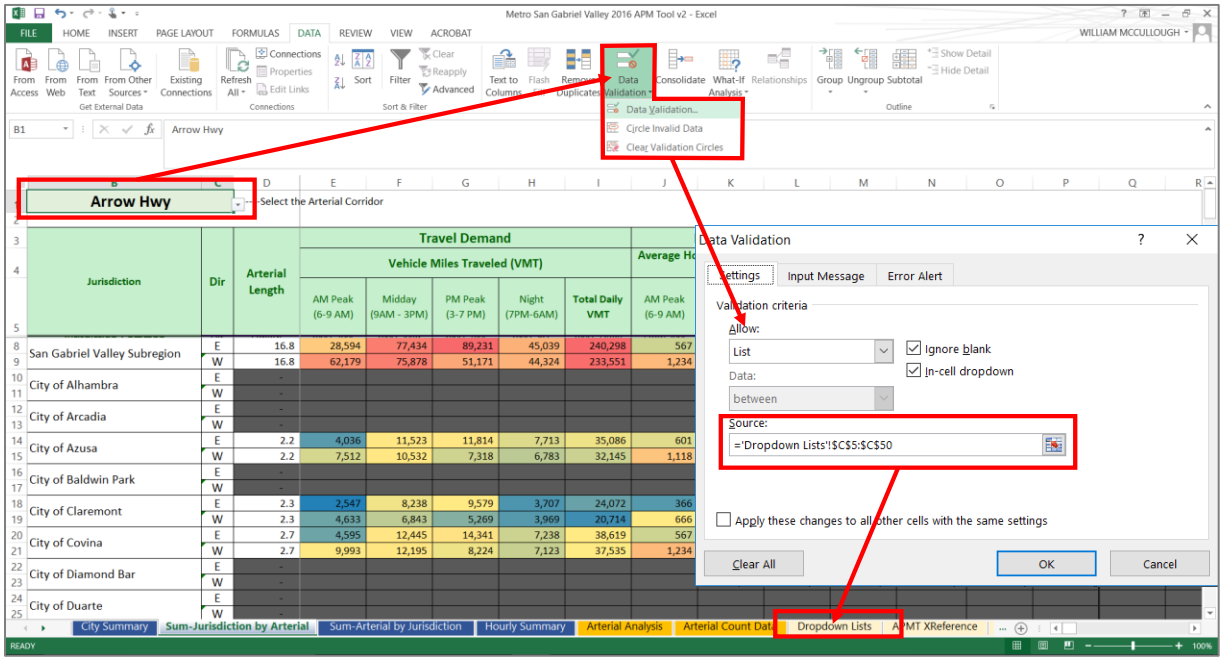
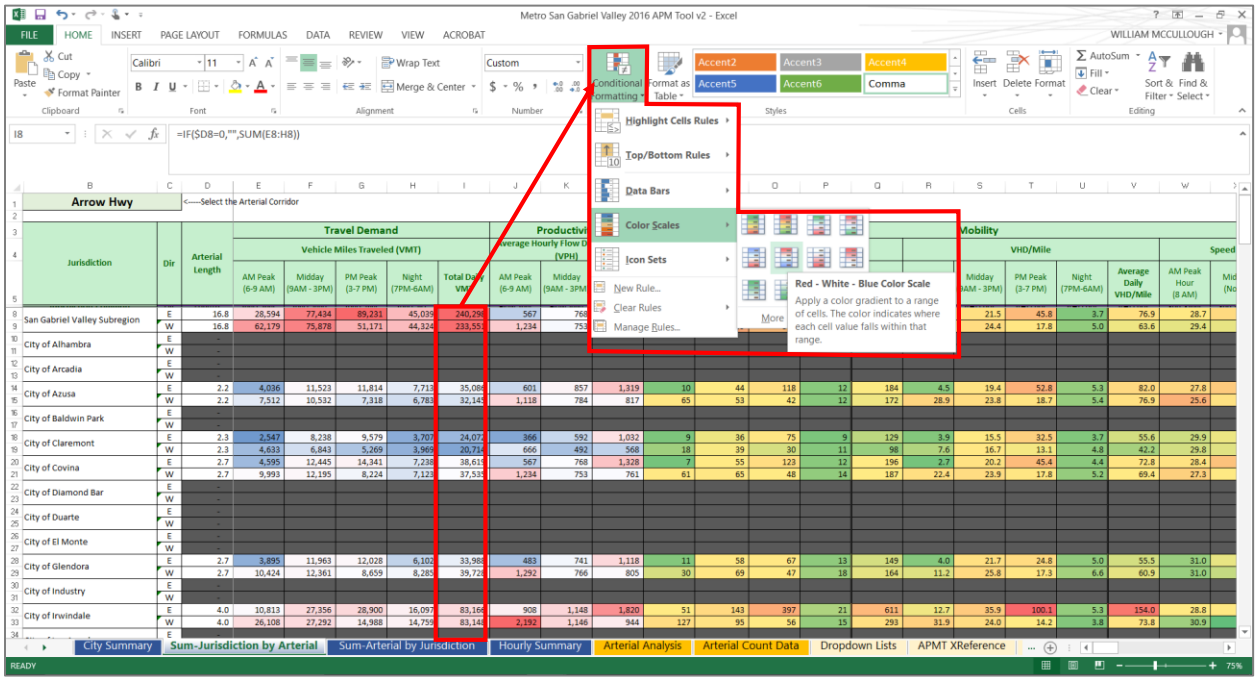


Exhibit 4-9 on the following page illustrates the *conditional formatting* option that is used to color-code the various performance measures in the tool. The purpose of using conditional formatting is to quickly highlight extreme values and allow the user to visually see performance ranges.

The tool uses the default color-palettes for Excel. However, users can change the conditional formatting as needed to meet their needs. In the default APMT, gray is used to denote a cell that does not have any data. Data may be missing because the selected arterial does not traverse through the jurisdiction. It could also be that there was no data available for that arterial. There are some arterials in Los Angeles County for which there is no INRIX data available.

The default APMT uses blue to red color palette to denote demand values (e.g., blue = lowest demand, red=highest demand). A red to green palette is used to denote speed, and reliability ranges (e.g., red = slowest speed, green = highest speed). Finally, a green to red palette is used to denote delay ranges (e.g., green = lowest delay, red = highest delay). The standard Excel palettes used in the APMT Excel use a "3-color" scheme to create the range with the lowest value, median, and highest value of the data in the range used to denote the three primary colors in the palette.

Exhibit 4-9: Excel Conditional Formatting Example



4.3 Sum-Arterial by Jurisdiction

This worksheet, shown in Exhibit 4-10 summarizes performance results by arterial, direction, and by jurisdiction. In contrast to the previously discussed *Sum-Jurisdiction by Arterial* worksheet, which summarizes results for a specified arterial for all jurisdictions, this worksheet summarizes all arterial results for a specific jurisdiction.

The *Sum-Jurisdiction by Arterial* worksheet has separate data tables for each jurisdiction. These tables can be sorted (see the *City Summary* worksheet discussion in Section 4.1 above for details on sorting), and they are color-coded using the Excel conditional formatting features (described above in Section 4.2) to make them easier to identify trends.

Exhibit 4-10: Sum-Arterial by Jurisdiction Example

City of Azusa

Arterial Corridor	Dir	Jurisdiction	Arterial Length	Travel Demand					Average Daily Traffic (ADT)	Peak	
				Vehicle Miles Traveled (VMT)							
				AM Peak (6-9 AM)	Midday (9AM - 3PM)	PM Peak (3-7PM)	Night (7PM - 6AM)	Total Daily		AM Peak (6-9 AM)	Midd (9AM - 3
Arrow Hwy	E	Azusa	2.2	4,036	11,523	11,814	7,713	35,086	15,663	778	
Arrow Hwy	W	Azusa	2.2	7,512	10,532	7,318	6,783	32,145	14,350	1,302	
Azusa Av	N	Azusa	2.9	5,811	16,148	12,785	13,580	48,324	16,606	848	
Azusa Av	S	Azusa	2.9	8,645	17,853	12,780	13,123	52,402	18,007	1,163	
Citrus Av	N	Azusa	1.4	3,375	7,312	4,843	3,948	19,477	14,217	1,156	
Citrus Av	S	Azusa	1.4	1,913	6,841	5,721	5,303	19,778	14,436	582	
Foothill Bl/Alosta Av	E	Azusa	2.9	2,536	10,027	11,538	6,325	30,426	10,564	362	
Foothill Bl/Alosta Av	W	Azusa	2.9	6,752	9,910	5,777	5,588	28,027	9,732	952	
Irwindale Av	N	Azusa	0.5	1,509	2,473	1,659	1,379	7,020	13,766	1,071	
Irwindale Av	S	Azusa	0.5	1,029	2,359	2,240	1,510	7,138	13,997	872	
City of Azusa Totals			**19.8**	**43,118**	**94,978**	**76,475**	**65,252**	**279,823**	**141,339**		

City of Baldwin Park

Arterial Corridor	Dir	Jurisdiction	Arterial Length	Travel Demand					Average Daily Traffic (ADT)	Peak	
				Vehicle Miles Traveled (VMT)							
				AM Peak (6-9 AM)	Midday (9AM - 3PM)	PM Peak (3-7PM)	Night (7PM - 6AM)	Total Daily		AM Peak (6-9 AM)	Midd (9AM - 3
Ramona Bl/Badillo St	E	Baldwin Park	3.4	5,717	15,704	19,092	12,114	52,628	15,710	714	
Ramona Bl/Badillo St	W	Baldwin Park	3.4	10,620	14,714	9,999	9,931	45,264	13,512	1,218	
City of Baldwin Park Totals			**6.7**	**16,337**	**30,419**	**29,091**	**22,045**	**97,892**			

City of Claremont

City Summary | Sum-Jurisdiction by Arterial | Sum-Arterial by Jurisdiction | Hourly Summary | Arterial Analysis | Arterial Count Data

4.4 Hourly Summaries

This worksheet presents hourly performance results based on a user selected jurisdiction and arterial using the dropdown menus at the top left of the worksheet as shown in Exhibit 4-11 on the following page. The corridor distance is automatically generated and the directional performance results are shown in the tables below the dropdown menus (these tables are not sortable).

Exhibit 4-11: Hourly Summary Worksheet Table Example

Analysis Jurisdiction	SBCCOG	---Select the Jurisdiction
Analysis Corridor	Imperial Hwy	<-----Select the Arterial Corridor
Corridor Distance	8.5	

Dir	Vehicles per Hour (VPH) for Imperial Hwy through SBCCOG														
	Midnight	1	2	3	4	5	6	7	8	9	10	11	Noon	13	14
EB	144	97	66	58	88	175	318	586	676	615	685	802	855	906	1,198
WB	131	96	77	117	235	472	1,146	1,764	1,553	975	719	751	784	794	792

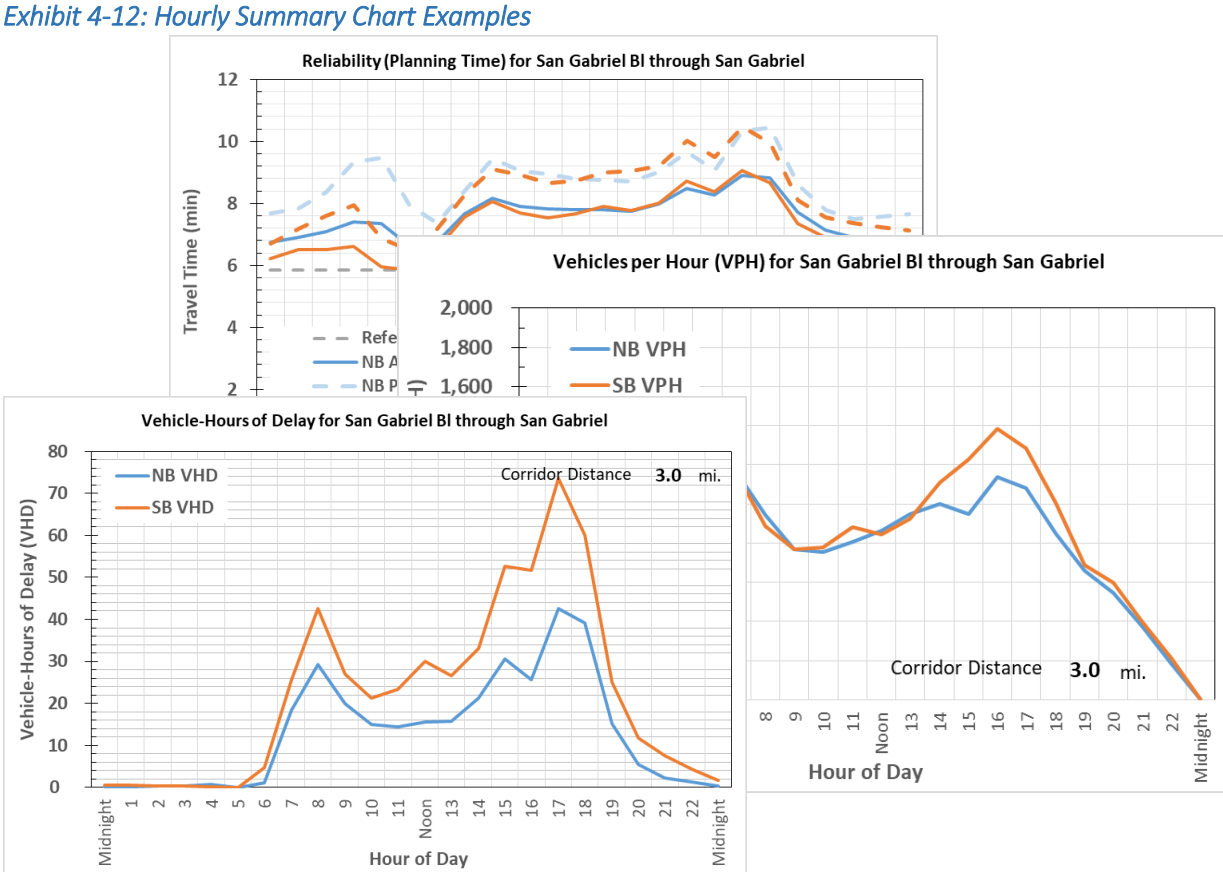
Dir	Travel Time for Imperial Hwy through SBCCOG														
	Midnight	1	2	3	4	5	6	7	8	9	10	11	Noon	13	14
EB	19.6	19.6	19.7	19.6	16.6	17.6	18.1	18.5	19.0	18.7	18.8	19.0	19.1	19.1	19.1
WB	18.7	18.8	18.8	18.7	16.3	17.1	17.8	19.5	19.7	18.9	19.0	19.2	19.4	19.3	19.3
Reference Travel Time	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6

Dir	Vehicle-Hours of Delay for Imperial Hwy through SBCCOG														
	Midnight	1	2	3	4	5	6	7	8	9	10	11	Noon	13	14
EB	7	5	3	3	-	3	8	19	28	21	26	33	36	38	52
WB	5	4	3	5	-	6	29	94	89	42	32	36	40	40	39

Dir	Reliability (Planning Time) for Imperial Hwy through SBCCOG														
	Midnight	1	2	3	4	5	6	7	8	9	10	11	Noon	13	14
EB- Average Travel Time	19.6	19.6	19.7	19.6	16.6	17.6	18.1	18.5	19.0	18.7	18.8	19.0	19.1	19.1	19.1
EB- Planning Time	20.1	20.0	19.9	19.9	17.5	19.1	19.9	21.0	21.6	21.0	21.2	21.4	21.5	21.5	21.6
WB- Average Travel Time	18.7	18.8	18.8	18.7	16.3	17.1	17.8	19.5	19.7	18.9	19.0	19.2	19.4	19.3	19.3
WB- Planning Time	19.0	19.3	19.0	18.9	17.2	18.7	20.2	23.1	23.3	21.6	21.4	21.6	21.7	21.6	21.7
Reference Travel Time	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6

As with other results worksheets, there are line charts below the tables that visually present the results. The chart titles automatically update when the user selects the jurisdiction and arterial corridor from the dropdown menus at the top of the worksheet as shown in Exhibit 4-12, below.

Exhibit 4-12: Hourly Summary Chart Examples

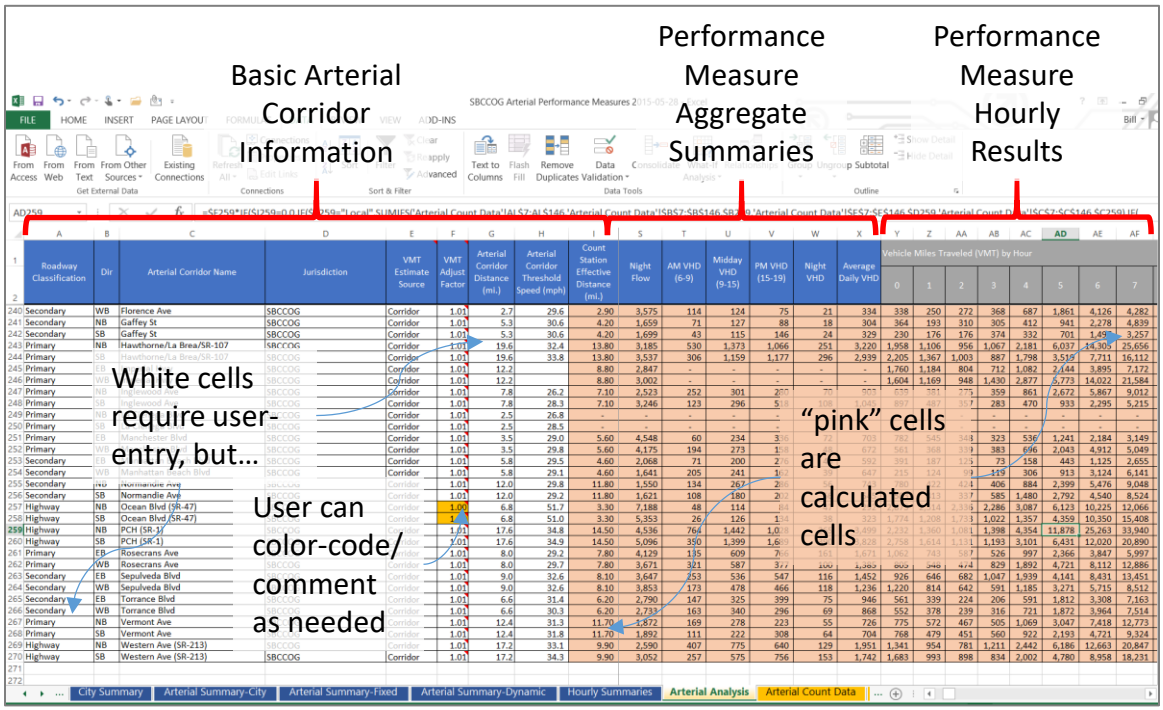


4.5 Arterial Analysis

The previous worksheets presented the arterial performance measurement results. The *Arterial Analysis* sheet is the heart of the APMT and is where the arterial performance results are calculated.

Exhibit 4-13 provides an overview of some of the key features of this worksheet. The unfilled or "white" cells require user entry. The pink cells contain formulas that calculate results or reference other information. As with other tables in the APMT, this table can be sorted by clicking on a single cell and using the Excel sort feature. The user can also make edits and color-code any cell as needed.

Exhibit 4-13: Arterial Analysis Worksheet



The worksheet is divided into three general sections. At the far left, general arterial information is provided that describes each arterial corridor. Each row in the sheet represents a single directional arterial corridor in a single jurisdiction. For example, Vermont Avenue in the South Bay Cities subregional tool has eight data rows, two directions for four jurisdictions: Gardena, City of Los Angeles City, Los Angeles County, and for the entire South Bay Cities subregion.

Next to the basic arterial information are the performance measure aggregates. This section essentially sums up various hourly results located in the 192 data items located to the right of the sheet (i.e., 24-hours for 8 different performance items: VMT, VHT, delay, speed, travel time, 95th percentile travel time, travel time index, and planning time index). The discussion below describes each of these parts of the worksheet in more detail.

4.5.1 Basic Arterial Corridor Information

This section contains the following columns:

- Dir – Direction of travel (E, N, S, W). The directionality must match the arterial directionality in the *Dropdown List* worksheet to ensure that references in the results worksheets correctly read the data.
- Arterial Corridor Name – The arterial corridor names must be consistent from one jurisdiction to the next (e.g., Pacific Coast Highway and Sepulveda share the same physical roadway in some cities). To ensure consistent results the roadway name must be consistent along the entire physical roadway). As with directionality, the street name must be consistent with those in the *Dropdown List* worksheet.
- Jurisdiction – This is the city name, Los Angeles County area, or the subregion as a whole. As with other corridor information, naming consistency is required to ensure references work throughout the tool.
- Jurisdiction (For Aggregation) – This is similar to the jurisdiction, but this allows the user to aggregate sub-areas in jurisdictions to larger areas. For example, in the APMT, the Los Angeles County sub areas are aggregated to "LA County" in the *City Summary* results worksheet.
- Comment – This column allows for the user to input comments regarding each arterial corridor.
- Volume Estimator – This section contains two columns. The *Volume Estimate Source* requires user-input to determine which traffic volume data to use to develop VMT estimates since VMT is used to calculate the throughput and delay performance measures.
    - Each cell in the *Volume Estimate Source* column contains a dropdown list that restricts user input to two options: "Local" or "Corridor". It is recommended to use the local option if there is a count station on a given arterial in that city (or LA County). It is required to use the "Corridor" option if there is no local count station available. Other adjustments to the VMT can be performed in the next column.
    - The *Adj Factor* (for "adjustment factor"), allows for additional adjustments to the VMT estimates as needed. If no adjustment is required, then this number should be 1.0.
    - An adjustment may be needed to account for different years of data. For example, if speed and travel time data is from a different year than the count data, then other sources can be used to identify a traffic growth rate to adjust the VMT to match speed and travel time data.
    - One recommendation to identify if an adjustment is needed is to examine the "Average Daily Traffic (ADT)" column. Since it is common to report ADT in General Plans or other arterial planning documents, this column can be compared to other sources to verify if the VMT estimate used is appropriate for the arterial. Changing the value in the VMT Adjust Factor column will change the ADT value.

- Arterial Corridor Threshold Speed (mph) – reference or threshold speed used to calculate delay and the travel time and planning time indices. It is important to establish a threshold speed that is appropriate for the corridor. For the APMT, the maximum average hourly INRIX speed was used to as the basis for the threshold speed. Typically, these maximum speeds occur during early morning hours (e.g., 3AM).
- Count Station Effective Distance (mi.) – used in the *Arterial Count Data* worksheet to convert screenline traffic counts into VMT. This is reported in this worksheet to further assist the user in

determining if a VMT adjustment is warranted. A VMT adjustment may be warranted if the count station effective distance is significantly different from the actual arterial corridor distance.

- Arterial Corridor Distance (mi.) – actual distance along the arterial corridor. Arterial corridor segmentation is discussed in more detail above in Section2.

4.5.2 Performance Measure Aggregate Summaries

This section of the *Arterial Analysis* worksheet simply aggregates the hourly performance results to various time periods (AM, Midday, PM, and Night) for those measures that can be readily aggregated: VMT, ADT (which is VMT/Arterial Corridor Distance), and delay in Vehicle-Hours (VHD). If desired, users with Excel experience can add columns as needed to produce aggregated results as needed.

4.5.3 Performance Measure Hourly Results

The hourly results are calculated in a 192 grey columns extending to the right of the worksheet (24 hours x 8 performance measures). These performance results are discussed below:

- Vehicle Miles Traveled (VMT) – is estimated by using a local or corridor VMT estimate from the *Arterial Count Data*, which is then adjusted first by the ratio of the Count Station Effective Distance divided by the Actual Corridor Distance. The second adjustment is done by multiplying the VMT by the VMT adjustment factor described previously.
- Vehicle Hours Traveled (VHT) – is simply calculated by multiplying VMT from above to the average travel time.
- Vehicle-Hours of Delay (VHD) - is calculated by multiplying the adjusted VMT from above by the difference between the average travel time and the travel time based on the threshold speed (if the average travel time is greater than the threshold travel time. If not, then the delay is zero.)
- Travel Time Index – is calculated by taking the average travel time and dividing by the travel time along the corridor based on the threshold speed.
- Planning Time Index – is calculated by taking the planning travel time (i.e., the 95th percentile travel time and dividing by the travel time along the corridor based on the threshold speed.

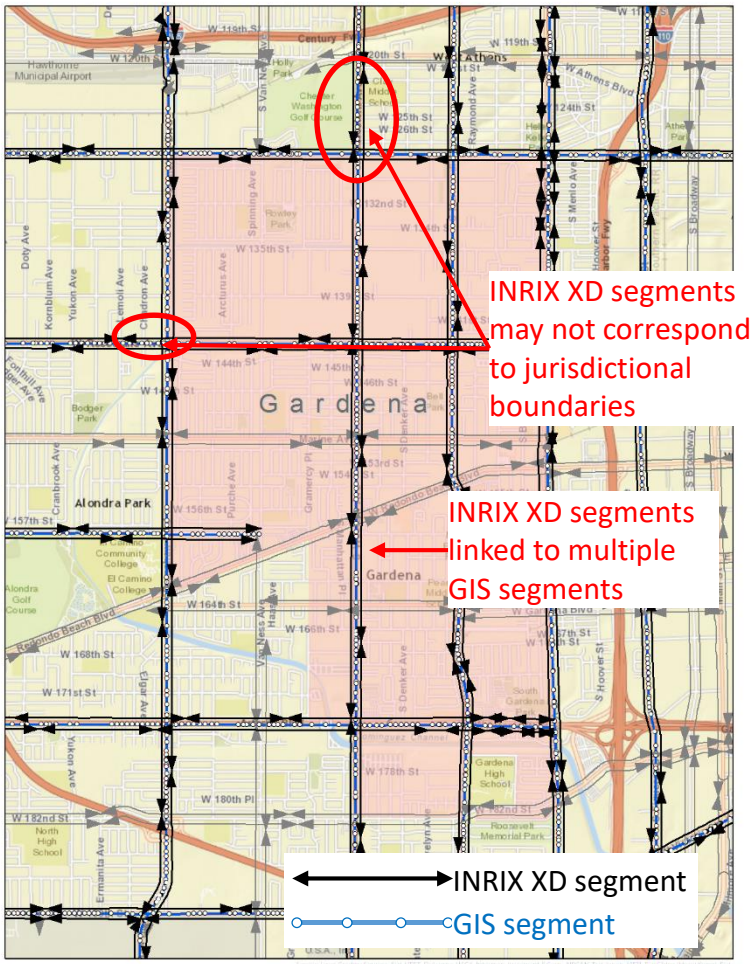
4.5.4 INRIX XD Data Processing

Metro has purchased INRIX, Inc. speed and travel time traffic data for each day of 2016 at the one-minute interval. For the APMT, the INRIX data processing followed three general steps: (1) link INRIX XD segments to arterial segments, (2) pull appropriate one-minute INRIX data corresponding to INRIX XD segments that lie on an APMT arterial corridor and aggregate INRIX XD data to hourly (i.e., 60-minute) intervals for non-holiday weekdays, (3) Calculate average hourly travel times and 95th percentile travel times for APMT corridors. The following sections describe these steps in more detail.

4.5.5 Link INRIX XD Segments to APMT Arterial Corridors

Given the very large size of the INRIX XD 30-second data, the XD segments were linked to APMT arterial corridor segments in order to extract only the data required for the tool development. The INRIX XD segment identification codes were linked to a more detailed GIS network shapefile. This linkage was done because the INRIX XD segments tend to be relatively long; averaging nearly ¾ miles long with some arterial XD segments up to nearly 1.6 miles. Because of these distances, XD segments often do not align with jurisdictional boundaries as illustrated in Exhibit 4-14, below.

Exhibit 4-14: INRIX XD Segmentation Illustrative Example



4.5.6 Pull and Aggregate INRIX XD Data

Once the appropriate XD segments were identified and linked to a specific arterial corridor and jurisdiction or all subregions, the one minute data was extracted for all non-holiday weekdays for the entire year. The following fields are included in the one minute data:

- **Date Time** - Date and time in zone of machine originating/generating this report.
- **Segment ID** - The associated INRIX XD unique identification code. This code was linked to arterial GIS segments.
- **UTC Date Time** - Date and time in UTC.
- **Speed(miles/hour)** - The current estimated harmonic mean speed for the roadway segment in miles per hour.
- **Hist Av Speed(miles/hour)** - The historical average speed for the roadway segment for that hour of the day and day of the week in miles per hour.
- **Ref Speed(miles/hour)** - The calculated "free flow" mean speed for the roadway segment in miles per hour.
- **Travel Time(Minutes)** - The time it will take to traverse the roadway segment in minutes.

- **CValue** - Indicates confidence value, probability the current probe reading represents the actual roadway conditions based on recent and historic trends. This value is only used when the confidence score is 30. - (0= low probability, 100 = high probability)
- **Pct Score30** – High confidence data. The percentage of observations where score = 30 (Real Time).
- **Pct Score20** - Medium confidence data, based on real-time data across multiple segments and/or based on a combination of expected and real-time data. Percentage of observations where score = 20 (National Average Speeds).
- **Pct Score10** – Low confidence data. Percentage of observations where score = 10 (Free Flow or historical average speeds).

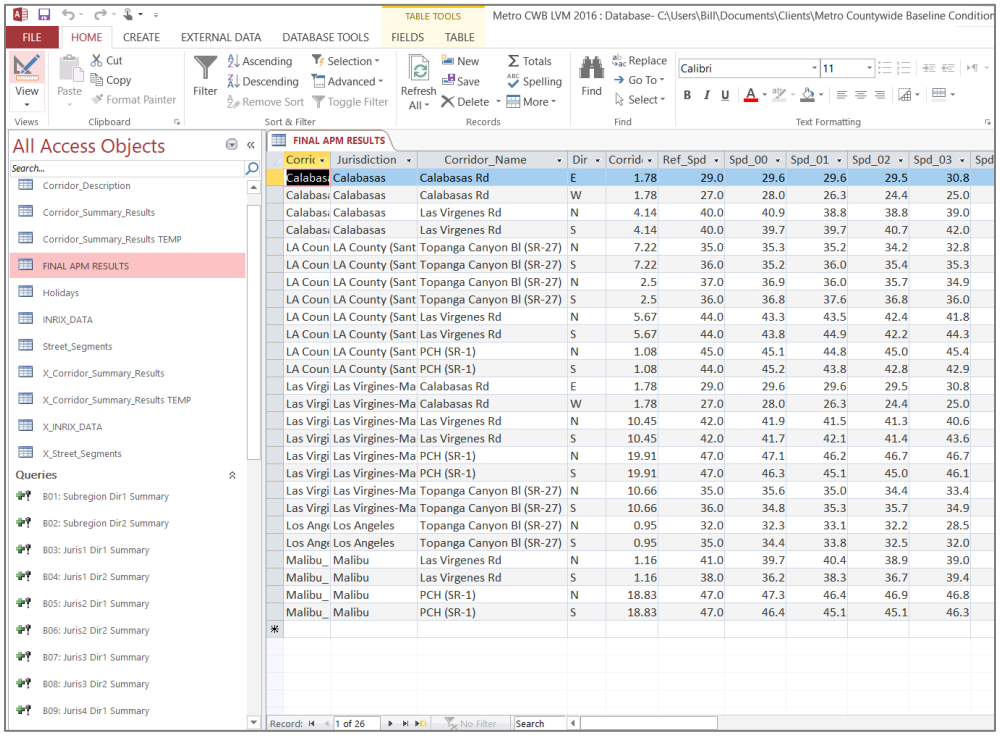
This data was then aggregated to hourly intervals by taking a straight average of the speeds (i.e., for each INRIX XD segment for each weekday of the year for each hour there will be 60 intervals). This was done using a combination of the open-source programming language Python and the PostgresSQL object-relational database system.

Python was used to decompress and extract the INRIX XD data and for file handling. The PostgresSQL database was used to pull only the APMT XD segments and to aggregate each XD segment into hourly intervals. This process produced a data file that was greatly reduced by 1/60 of the original size.

4.5.7 Calculate Average Travel Times, 95th Percentile Travel Times, and Average Speeds

Once these segments were linked, INRIX XD data extracted, and the data aggregated to hourly intervals, the data was imported into a Microsoft Access database for the final processing as illustrated in Exhibit 4-15. Access was selected for ease of use and because it is a commonly used database so that the processed hourly data could be made accessible to Metro.

Exhibit 4-15: Example Access Database



Corrid	Jurisdiction	Corridor_Name	Dir	Corrid	Ref_Spd	Spd_00	Spd_01	Spd_02	Spd_03	Spd
Calabas	Calabasas	Calabasas Rd	E	1.78	29.0	29.6	29.6	29.5	30.8	
Calabas	Calabasas	Calabasas Rd	W	1.78	27.0	28.0	26.3	24.4	25.0	
Calabas	Calabasas	Las Virgenes Rd	N	4.14	40.0	40.9	38.8	38.8	39.0	
Calabas	Calabasas	Las Virgenes Rd	S	4.14	40.0	39.7	39.7	40.7	42.0	
LA Coun	LA County (Sant	Topanga Canyon Bl (SR-27)	N	7.22	35.0	35.3	35.2	34.2	32.8	
LA Coun	LA County (Sant	Topanga Canyon Bl (SR-27)	S	7.22	36.0	35.2	36.0	35.4	35.3	
LA Coun	LA County (Sant	Topanga Canyon Bl (SR-27)	N	2.5	37.0	36.9	36.0	35.7	34.9	
LA Coun	LA County (Sant	Topanga Canyon Bl (SR-27)	S	2.5	36.0	36.8	37.6	36.8	36.0	
LA Coun	LA County (Sant	Las Virgenes Rd	N	5.67	44.0	43.3	43.5	42.4	41.8	
LA Coun	LA County (Sant	Las Virgenes Rd	S	5.67	44.0	43.8	44.9	42.2	44.3	
LA Coun	LA County (Sant	PCH (SR-1)	N	1.08	45.0	45.1	44.8	45.0	45.4	
LA Coun	LA County (Sant	PCH (SR-1)	S	1.08	44.0	45.2	43.8	42.8	42.9	
Las Virgi	Las Virgines-Ma	Calabasas Rd	E	1.78	29.0	29.6	29.6	29.5	30.8	
Las Virgi	Las Virgines-Ma	Calabasas Rd	W	1.78	27.0	28.0	26.3	24.4	25.0	
Las Virgi	Las Virgines-Ma	Las Virgenes Rd	N	10.45	42.0	41.9	41.5	41.3	40.6	
Las Virgi	Las Virgines-Ma	Las Virgenes Rd	S	10.45	42.0	41.7	42.1	41.4	43.6	
Las Virgi	Las Virgines-Ma	PCH (SR-1)	N	19.91	47.0	47.1	46.2	46.7	46.7	
Las Virgi	Las Virgines-Ma	PCH (SR-1)	S	19.91	47.0	46.3	45.1	45.0	46.1	
Las Virgi	Las Virgines-Ma	Topanga Canyon Bl (SR-27)	N	10.66	35.0	35.6	35.0	34.4	33.4	
Las Virgi	Las Virgines-Ma	Topanga Canyon Bl (SR-27)	S	10.66	36.0	34.8	35.3	35.7	34.9	
Los Ange	Los Angeles	Topanga Canyon Bl (SR-27)	N	0.95	32.0	32.3	33.1	32.2	28.5	
Los Ange	Los Angeles	Topanga Canyon Bl (SR-27)	S	0.95	35.0	34.4	33.8	32.5	32.0	
Malibu_	Malibu	Las Virgenes Rd	N	1.16	41.0	39.7	40.4	38.9	39.0	
Malibu_	Malibu	Las Virgenes Rd	S	1.16	38.0	36.2	38.3	36.7	39.4	
Malibu_	Malibu	PCH (SR-1)	N	18.83	47.0	47.3	46.4	46.9	46.8	
Malibu_	Malibu	PCH (SR-1)	S	18.83	47.0	46.4	45.1	45.1	46.3	

In the Access database, the data first underwent a data quality check. The data quality check only accepted an hour of data if the "CValue" and the sum of the "PctScore30" and "PctScore20" fields were greater than 67%. This was done to ensure that the best data was available to compute the average travel times and speeds.

The INRIX XD speeds that were assigned to GIS segments were then used to calculate the travel time along that GIS segment, where travel time is equal to the GIS segment distance divided by the INRIX XD speed assigned to the segment.

Since an arterial corridor in a jurisdiction is comprised of many smaller GIS segments (illustrated by the blue lines in Exhibit 4-14 above that shows how arterials were segmented for the INRIX XD data), the travel times along the segments were summed to obtain the travel time along a directional corridor for the jurisdiction for a single hour of a single day (e.g., Northbound Normandie Avenue through the City of Gardena at 8:00 AM on September 21, 2016).

Once the hourly travel times have been calculated for each jurisdictional directional corridor, the average travel time is calculated for all non-holiday weekdays. Another data quality check is performed at this stage that compares the distance covered by segments with available INRIX XD data to the total directional arterial corridor distance for that jurisdiction for a given date and hour. If the INRIX XD available segments covers less than ½ the total corridor, then that day is rejected from the analysis. The average speed is then calculated for the corridor by taking the average travel time and dividing that by the jurisdictional arterial corridor distance to get the average travel time for that segment.

The 95th percentile travel time calculation is more involved technically. In short, the 95th percentile, as defined in Section 2 above, is the travel time on the 95th day out of 100 days of data when sorted in ascending order from the fastest travel time to the longest travel time. That approach picks the element of the data that corresponds to the 95th percentile value. If an exact 95th percentile element does not exist, the Access database is designed to interpolate the 95th percentile based on the 95th value and the 96th value. There are several commonly accepted approaches used to estimate the 95th percentile, and the approach selected for this analysis is the same approach used in used in Microsoft Excel.

4.6 Arterial Count Data

This worksheet is the repository for hourly traffic count data for each arterial location with a count station. The worksheet is shown in Exhibit 4-16, below.

Exhibit 4-16: Arterial Count Data Worksheet

A1 | Traffic Count Data Entry Worksheet

Traffic Count Data Entry Worksheet

2017 | Data Collection Year (except where noted in comment column)

Count Station #	Dir	Subregion	Arterial Corridor Name	Count Location	Count Station Jurisdiction 1	Count Station Jurisdiction 2	Latitude	Longitude	Count Station Effective Distance (mi.)	Comment
46	E	South Bay Cities	190th/Victoria	b/n Avalon Blvd & Central Ave	Carson		33.8672385	-118.257498	2.70	Counted in Spring 2015 as part of SBCCOG APM Tool
46	W	South Bay Cities	190th/Victoria	b/n Avalon Blvd & Central Ave	Carson		33.8672385	-118.257498	2.70	Counted in Spring 2015 as part of SBCCOG APM Tool
44	E	South Bay Cities	190th/Victoria	b/n Normandie Ave & Vermont Ave	Los Angeles		33.858307	-118.295286	2.00	Counted in Spring 2015 as part of SBCCOG APM Tool
44	W	South Bay Cities	190th/Victoria	b/n Normandie Ave & Vermont Ave	Los Angeles		33.858307	-118.295286	2.00	Counted in Spring 2015 as part of SBCCOG APM Tool
43	E	South Bay Cities	190th/Victoria	b/n Hawthorne Blvd & Crenshaw Blvd	Torrance		33.858318	-118.339843	2.70	Counted in Spring 2015 as part of SBCCOG APM Tool
43	W	South Bay Cities	190th/Victoria	b/n Hawthorne Blvd & Crenshaw Blvd	Torrance		33.858318	-118.339843	2.70	Counted in Spring 2015 as part of SBCCOG APM Tool
38	E	South Bay Cities	Artesia Blvd	b/n Normandie Ave & Vermont Ave	Gardena		33.8729684	-118.295118	1.30	Counted in Spring 2015 as part of SBCCOG APM Tool
38	W	South Bay Cities	Artesia Blvd	b/n Normandie Ave & Vermont Ave	Gardena		33.8729684	-118.295118	1.30	Counted in Spring 2015 as part of SBCCOG APM Tool
40	E	South Bay Cities	Artesia Blvd	b/n Aviation Blvd & Inglewood Ave	Redondo Beach		33.872841	-118.369931	2.55	Counted in Spring 2015 as part of SBCCOG APM Tool
40	W	South Bay Cities	Artesia Blvd	b/n Aviation Blvd & Inglewood Ave	Redondo Beach		33.872841	-118.369931	2.55	Counted in Spring 2015 as part of SBCCOG APM Tool
39	E	South Bay Cities	Artesia Blvd	b/n Hawthorne Blvd & Crenshaw Blvd	Torrance		33.872901	-118.336996	2.15	Counted in Spring 2015 as part of SBCCOG APM Tool
39	W	South Bay Cities	Artesia Blvd	b/n Hawthorne Blvd & Crenshaw Blvd	Torrance		33.872901	-118.336996	2.15	Counted in Spring 2015 as part of SBCCOG APM Tool
18	N	South Bay Cities	Aviation Blvd	b/n El Segundo Blvd & Imperial Hwy	El Segundo	LA County (Del Aire)	33.9228163	-118.378492	2.70	Counted in Spring 2015 as part of SBCCOG APM Tool
18	S	South Bay Cities	Aviation Blvd	b/n El Segundo Blvd & Imperial Hwy	El Segundo	LA County (Del Aire)	33.9228163	-118.378492	2.70	Counted in Spring 2015 as part of SBCCOG APM Tool
4	N	South Bay Cities	Aviation Blvd	b/n Manchester Ave & Century Blvd	Los Angeles	Inglewood	33.952643	-118.377019	1.35	Counted in Spring 2015 as part of SBCCOG APM Tool
4	S	South Bay Cities	Aviation Blvd	b/n Manchester Ave & Century Blvd	Los Angeles	Inglewood	33.952643	-118.377019	1.35	Counted in Spring 2015 as part of SBCCOG APM Tool
41	N	South Bay Cities	Aviation Blvd	b/n Manhattan Bch Blvd & Artesia Blvd	Manhattan Beach	Redondo Beach	33.880367	-118.379806	2.05	Counted in Spring 2015 as part of SBCCOG APM Tool
41	S	South Bay Cities	Aviation Blvd	b/n Manhattan Bch Blvd & Artesia Blvd	Manhattan Beach	Redondo Beach	33.880367	-118.379806	2.05	Counted in Spring 2015 as part of SBCCOG APM Tool
57	E	South Bay Cities	Carson St	b/n Main St & Avalon Blvd	Carson		33.8316415	-118.270189	1.80	Counted in Spring 2015 as part of SBCCOG APM Tool
57	W	South Bay Cities	Carson St	b/n Main St & Avalon Blvd	Carson		33.8316415	-118.270189	1.80	Counted in Spring 2015 as part of SBCCOG APM Tool
58	E	South Bay Cities	Carson St	b/n Wilmington Ave & Alameda St	Carson		33.831786	-118.232218	2.40	Counted in Spring 2015 as part of SBCCOG APM Tool

The worksheet has the following columns:

- Count Station # - is a unique identifying code used to identify the count location. The code varies by count vendor or public agency source of the data.
- Dir – Direction of travel (E, N, S, W). The directionality must match the directionality in the *Dropdown List* and in the *Arterial Analysis* worksheets to ensure that references in the results worksheets correctly read the data.
- Arterial Corridor Name – Referenced by other worksheets so this must be consistent from one jurisdiction to the next (e.g., Pacific Coast Highway and Sepulveda share the same roadway in some cities. To ensure consistent results the roadway name must be consistent along the entire physical roadway in the subregion).
- Count Location – is a text description that indicates where the count station is located or the manual count was conducted. This information is not referenced by other worksheets, but is provided for informational purposes.
- Count Station Jurisdiction 1 and 2- These two columns represent the jurisdiction name (i.e., city, Los Angeles County area, or subregion). As with other corridor information, spelling consistency is required to ensure references work throughout the APMT. The APMT allows for a single count location to represent two locations. For example, in Exhibit 2-2 from above that shows above that shows Rosecrans Avenue splitting El Segundo and Manhattan Beach, a count station on that arterial can have "El Segundo" as jurisdiction 1 and "Manhattan Beach" as jurisdiction 2. This way each of those jurisdictions can have a "local" count location as a volume estimate source in the *Arterial Analysis* worksheet. This helps to ensure that each jurisdiction has the most accurate volume estimate possible.
- Latitude and Longitude- provides the location of the count stations for mapping purposes.
- Count Station Effective Distance (mi.) – used in the *Arterial Count Data* worksheet to convert screenline traffic counts into VMT. This is reported in this worksheet to further assist the user in

determining if a VMT adjustment is warranted. A VMT adjustment may be warranted if the count station effective distance is significantly different that the actual arterial corridor distance.

- Comment – allows for the user to add comments about each count location. It is current used to provide details on the count data including the data collection dates, count vendor/public agency, and original data file name.
- Count Adjust Ratio – this allows the user to adjust volumes based on a ratio, which is useful for applying growth factors to data that was collected in the past. For example, if a count location had data collected a few years in the past and the user estimates that traffic has grown by 3 percent between the count date and the current analysis date, 1.03 can be entered in this location and average daily traffic and VMT will be increased by a factor of 1.03 (i.e., 3%).
- Average Daily Volume - is the summation of the hourly counts. This column can be used to verify the screenline counts against other data sources, if needed.
- Average Daily VMT Over Effective Distance – is the summation of the VMT by hour.
- Vehicle Counts by Hour - is input from any traffic count source.
- Estimated Count Station Vehicle Miles Traveled (VMT) by Hour – is the hourly count multiplied by the count station effective distance.

4.7 Dropdown Lists

This worksheet contains the drop down lists used by the following worksheets:

- Arterial Count Data
- Hourly Summaries
- Arterial Summary-Dynamic
- City Summary.

There are two dropdown lists used referenced in this worksheet that are also presented in Exhibit 4-17, below: One for the jurisdictions, and one for the arterial names. Note that the jurisdiction and street names in this list must exactly match those used in the *Arterial Analysis* and *Arterial Count Data* worksheets. The reason is that the dropdown menus in the analysis results worksheets (the ones with the blue tabs) reference both the lists shown below and the jurisdictions and streets in the analysis worksheets (the sheets with the orange tabs).

Exhibit 4-17: Dropdown Lists for Jurisdictions and Arterial Corridors

This worksheet provides reference information for drop-down menus for the "Hourly Summaries" and "Sum-Jurisdiction by Arterial" worksheets. It is also used for data validation in the count data and analysis worksheets.
For more information on drop-down menus, please see: https://support.office.com/en-us/article/Create-a-drop-down-list-7693307a-59ef-400a-b769-c5402dce407b

Jurisdiction	Arterial Corridor	Dir1	Dir2
Artesia	7th St	E	W
Bell	Alameda St	N	S
Bell Gardens	Artesia Bl	E	W
Bellflower	Atlantic Av	N	S
Cerritos	Bellflower Bl	N	S
Commerce	Beverly Bl	E	W
Compton	Carson St	E	W
Cudahy	Central Av	N	S
Downey	Colima Rd/Golden Springs	E	W
Gateway Cities Subregion	Del Amo Bl	E	W
Huntington Park	Eastern Av	N	S
LA County (Compton)	El Segundo Bl	E	W
LA County (East Compton)	Figueroa St	N	S
LA County (East Los Angeles)	Florence Av/Mills Av	E	W
LA County (Florence-Graham-Walnut Park)	Garfield/Cherry Av	N	S
LA County (South Whittier-East La Mirada)	Hacienda Bl/Glendora	N	S
LA County (West Compton-Willowbrook)	Imperial Hwy	E	W
LA County (West Whittier-Los Nietos)	La Mirada Bl	N	S
La Habra Heights	Lakewood Bl/Rosemead Bl	N	S
La Mirada	Lambert Rd	E	W

4.8 APMT XReference Features

Since there are nine subregions in Los Angeles County, a cross-reference worksheet is provided to show where each jurisdiction's results can be found. This is shown in Exhibit 4-18, below.

Exhibit 4-18: APMT Cross Reference Example

Jurisdiction	Arroyo Verdugo	Central Los Angeles	Gateway Cities	Las Virgenes/Malibu	North Los Angeles County	San Fernando Valley	San Gabriel Valley	South Bay Cities	Westside Cities
Alhambra							■		
Arcadia							■		
Artesia			■						
Azusa							■		
Baldwin Park							■		
Bell			■						
Bell Gardens			■						
Bellflower			■						
Beverly Hills									■
Burbank	■								
Calabasas				■					
Carson								■	
Cerritos			■						
Claremont							■		
Commerce			■						

4.9 Excel Features

This final worksheet, as shown below in Exhibit 4-19, is a table that summarizes commonly used Microsoft Excel functions used in the APMT (e.g., "SUMIF", "VLOOKUP") and other key Excel features used in the tool (e.g., charts and data validation). The worksheet also provides links to internet resources that explain these functions and features in more detail.

Exhibit 4-19: Excel References Example

Excel Function	Description	Where to get more information
=B7*B8	Multiplies the numbers in two cells.	http://office.microsoft.com/en-us/excel-help/multiply-numbers-HP010070516.aspx?CTT=1
=B7/B8	Divides the number in one cell into the number from another cell	http://office.microsoft.com/en-us/excel-help/divide-numbers-HP010342450.aspx?CTT=5&origin=HP010342486
=B7+B8	Adds the numbers in two cells	http://office.microsoft.com/en-us/excel-help/add-numbers-HP010342146.aspx?CTT=1#_Toc262647455
=OR(Y254="",DQ254="")	In this tool, used primarily to determine if a cell is blank.	http://www.techonthenet.com/excel/formulas/or.php
=IF(K7<=3,1,K3)	IF/THEN statement. A logical statement. IF the first condition is true, then perform the second condition, else do something else. For example, if Weekday=Saturday, then classify as "Weekend".)	http://office.microsoft.com/en-us/performancepoint-server/entering-if-then-else-statements-in-management-repo
=ISERROR(N7)	If cell being referenced has an error, then this returns "NA"	http://office.microsoft.com/en-us/excel-help/information-functions-reference-HP010342611.aspx?CTT=1
=SUM(J3:J14) or SUM(BU254:BZ254,CN254:CR254)	Sums or adds up all the numbers in a range of cells. Used in various worksheets to add up total annual values (e.g., VMT, Delay)	http://office.microsoft.com/en-us/excel-help/sum-function-HP010342931.aspx?CTT=1

This document presented the Los Angeles Metro Arterial Performance Measurement Tools. The documentation includes a brief history and background to the APMT. It also provided a summary of the performance measures used in the tools and described the data and methods used to develop the tools. Finally, it describes each worksheet in the APMT and provides information on how to effectively use the tool.