

Memorandum

Date: October 19, 2022
To: Jeremy Dennis, Town of Portola Valley
From: Bob Grandy and Natalie Daugherty
Subject: **Portola Valley Housing Element-Evacuation Time Estimates**

SF21-1185

The purpose of this memorandum is to document Evacuation Time Estimates (ETE's) that reflect the additional evacuation trips generated by approximately 300 additional residential units, that have been identified in the Housing Element Update, when compared to the ETE forecasts developed for the *Portola Valley Wildfire Traffic Evacuation Capacity Study*.

The evacuation time estimates are prepared for the following three scenarios that were also evaluated in the aforementioned capacity study.

- Scenario 1 – All Evacuation Routes Open
- Scenario 2 – North Evacuation Routes Open (i.e., Portola Road-Woodside Road, Sand Hill Road, Whisky Hill Road)
- Scenario 3 – South Evacuation Routes Open (i.e., Alpine Road, Arastradero Road)

Summary of Results

This study provides evacuation time estimate (ETE) ranges and average evacuation times for three population groups (residents, employees, and equestrian trailers) for the three study scenarios based on a 6:00 am evacuation notice. The evacuation time estimate ranges are provided for two evacuation level scenarios (90 and 100 percent) and two road network capacity scenarios (normal roadway capacity and 40% reduced roadway capacity). **Table 1** provides a summary of the ETE ranges for residents.

The following is a summary of the effect of the approximately 300 additional residential units identified in the Housing Element Update on Evacuation Time Estimates identified in the *Wildfire Traffic Evacuation Capacity Study*.



The new residential households at the Housing Element Update sites are forecast to generate a total of 401 additional vehicle trips during a full town-wide evacuation. Existing households in Portola Valley and surrounding unincorporated areas are forecast to generate a total of about 4,760 evacuation trips: 3,160 trips from Portola Valley households and 1,600 from surrounding unincorporated households¹.

- For Scenario 1 (all routes open), the change in ETE’s due to added housing element trips is less than the 15-minute study intervals and thus does not change the previous ETE ranges. This is true for other scenarios with the exception of those listed below.
- For both Scenarios 2 and 3, the added housing element trips result in an increase of ETE’s for the reduced capacity condition of one 15-minute interval for both the 90 and 100 percent evacuation levels.
- For Scenario 2 (north routes open), the added housing element trips result in an ETE increase for the baseline (100%) road capacity condition of one 15-minute interval for the 90 percent evacuation level.

Table 1: Evacuation Time Estimate Ranges for Residents

EVACUATION LEVEL	SCENARIO 1 (ALL EVACUATION ROUTES OPEN)	SCENARIO 2 (NORTH EVACUATION ROUTES OPEN)	SCENARIO 3 (SOUTH EVACUATION ROUTES OPEN)
90% OF RESIDENTS EVACUATED WITHIN:			
Wildfire Traffic Evacuation Capacity Study	1 hr, 15 min – 1 hr, 30 min	2 hr, 45 min – 3 hr, 45 min	2 hr – 2 hr, 45 min
with New Housing Element Units	1 hr, 15 mins – 1hr, 30 mins	3 hr – 4 hr	2 hr – 3 hr
100% OF RESIDENTS EVACUATED WITHIN:			
Wildfire Traffic Evacuation Capacity Study	3 hr, 15 min	3 hr, 30 min – 4 hr, 45 min	3 hr, 15 min – 3 hr, 30 min
with New Housing Element Units	3 hr, 15 mins	3 hr, 30 mins – 5 hr	3 hr, 15 mins – 3 hr, 45 mins

Notes:
 6:00 am evacuation notice.
 First time in range is ETE for baseline road capacity scenario.
 Second time in range is ETE for 40% below baseline road capacity scenario.

Source: Fehr & Peers, 2022.

¹ Portola Valley Wildfire Traffic Evacuation Capacity Study, July 2022, Fehr & Peers.



Purpose of Wildfire Traffic Evacuation Capacity Study

The intent of this study is not to estimate disaster behavior nor is it to evaluate every disaster that is possible in the Town; rather it is to help the Town understand the amount of time potentially needed under “stress test” scenarios for a wildfire evacuation, understand the most vulnerable areas where evacuations would occur (e.g. those with the least amount of redundant access and those areas furthest from evacuation gateways), and look for strategies to improve emergency egress during these events.

Housing Element Update Inventory

The Portola Valley Housing Element Update has identified the capacity to accommodate 293 additional housing units. This includes a total of 39 single family units, 162 multi-family units, and 92 accessory dwelling units (ADU’s). The single-family units are located in the Stanford Wedge site and the opt-in-rezoning program sites. The multi-family units are located in the Stanford Wedge, Willow Commons, Dorothy Ford Field, 4394 Alpine Road, Glen Oaks Housing, 4370 Alpine Road, Sequoias Affiliated Housing, Christ Church Affiliated Housing, and Ladera Church Affiliated Housing sites.

This includes a total of 88 units affordable to very low-income households, 51 units affordable to low-income households, 47 units affordable to moderate income households, and 107 units affordable to above moderate-income households.

Evacuation Trips for Housing Element Sites

The number of evacuation trips generated by new residential households at the Housing Element sites varies by housing type based on the relative home size, household income, household population, and number of vehicles. A summary of the evacuation trip generation methodology for the single-family, multi-family, and ADU housing is provided below.

New single-family homes are forecast to have similar characteristics to existing homes in Portola Valley. The number of evacuation trips for single-family homes is informed by the most recent available data from the US Census Bureau and the California Department of Finance. The household census data is used to estimate evacuation vehicle trips based on the number of households, persons per household, auto-ownership information, population, and other factors that could affect the number of vehicles per household used during an evacuation event.

For the multi-family households, there are few comparable complexes in Portola Valley that would have similar affordability levels as the planned projects in the Housing Element Update. About 50 percent of the new units would be for very low-income or low-income households. To identify household characteristics for areas with similar household size and vehicle ownership levels, a review of land use data in the San Mateo C/CAG travel demand model was conducted. This review



indicated that several areas in the City of Palo Alto currently have characteristics similar to the planned multi-family households. Census data was extracted for two Palo Alto census tracts and relevant demographic data used to inform the number of evacuation trips.

For new ADU housing, current Town of Portola Valley standards were considered. This includes requirements that a parcel must be at least one acre in size, have a main house on it, and be located in a residential zoning district to have an external/attached ADU. ADU housing may range in size from 1,000 to 1,500 square feet depending on parcel size. One parking space is required.

The new residential households at the Housing Element Update sites described above are forecast to generate a total of 401 additional vehicle trips during a full town-wide evacuation. For reference as described in the *Portola Valley Wildfire Traffic Evacuation Capacity Study*, existing households in Portola Valley and surrounding unincorporated areas are forecast to generate a total of about 4,760 evacuation trips including about 3,160 trips from Portola Valley households and 1,600 from surrounding unincorporated households.

Evacuation Scenario Analysis for Housing Element Update

The results of the macroscopic trip assignment by time interval, using PTV Visum, are shown in the following pages for the three evacuation scenarios.

Evacuation time estimates (ETE's) are provided for each scenario for two network capacity levels and two evacuation levels as summarized below.

Evacuation Capacity Levels

- Baseline road capacity
- 40 percent below baseline road capacity

Evacuation Levels

- 90 percent of population evacuated
- 100 percent of population evacuated

For the purpose of the evacuation time assessment, population groups are considered to be evacuated when they have either accessed gateways to the north or south on I-280 or traveled east of I-280. The evacuation time estimate ranges provided are thus when 90 or 100 percent of all evacuees in each population group would clear the evacuation area and routes. The evacuation times include time spent traveling on major evacuation routes such as Alpine Road, Portola Road, and Westridge Road, as well as the time vehicles would wait while in queues on local connecting streets to access the evacuation routes.



Average evacuation times are also provided for residents, based on the start time of the resident evacuation trip by 15-minute interval, for each scenario. The average evacuation times shown in the tables and histograms are average times of evacuees from all zones. Residents living closer to I-280 would experience shorter evacuation times and residents living farther from I-280 would experience longer evacuation times.

The evacuation time estimates are based on existing lane configurations in place throughout the evacuation and no change to provide contraflow lane operations. The evacuation assessment is based on no major traffic incidents that would impede egress in the study area.

Scenario 1

Table 2 shows a range of evacuation travel times by population group for Scenario 1 where all routes are open. With reduced capacity levels, 90 percent of employees would be evacuated within one hour, 90 percent of residents within one hour and 30 minutes, and 90 percent of equestrian trailers within two hours and 30 minutes. Full evacuation times with reduced capacity levels are about one hour and 30 minutes to one hour and 45 minutes longer for each group, in part because the evacuation start times for the last five percent of evacuees in these population groups significantly lag the assumed start times of most others.

Table 2: Scenario 1 Evacuation Time Estimates – with Housing Element Units

POPULATION GROUP	90% EVACUATED WITHIN	100% EVACUATED WITHIN
Residents	1 hr, 15 mins – 1 hr, 30 mins [1 hr, 15 min – 1 hr, 30 min]	3 hr, 15 mins [3 hr, 15 min]
Employees	45 mins – 1 hr [45 min – 1 hr]	1 hr, 45 mins – 2 hr, 30 mins [1 hr, 45 min – 2 hr, 30 min]
Equestrian Trailers	2 hr, 30 mins [2 hr, 30 min]	4 hr, 15 mins [4 hr, 15 min]

Notes:

The above travel times are the estimated duration of time starting with a 6:00 am evacuation notice, after which 90 and 100 percent of the three population groups are evacuated.

First time in range is ETE for baseline road capacity scenario.

Second time in range is ETE for 40% below baseline road capacity scenario.

The ETE values shown in [brackets] on the 2nd row of each population group above are from the Portola Valley Wildfire Traffic Evacuation Capacity Study.

Source: Fehr & Peers, 2022.

To provide additional detail on the evacuation characteristics for Scenario 1, the average evacuation travel times for residents was extracted from the model by 15-minute time interval. The average evacuation travel times are identified for the baseline road capacity and reduced road capacity levels. It should be noted that these are the average of all evacuation times and that



residents located closer to I-280 would experience lower travel times while residents located farther away would experience higher travel times.

Table 3 shows the average evacuation travel times for Scenario 1. Average evacuation times under reduced road capacity levels range from about 30 to 45 minutes for resident trips that start in the 6:30 to 8:00 am window when travel times are at their greatest for Scenario 1. The added trips generated by the housing element units are estimated to increase average evacuation travel times under reduced capacity levels by two to five minutes for trips that start in the 6:30 to 8:00 am window.

Table 3: Scenario 1: Average Resident Evacuation Travel Time (Minutes) by Time Interval – with Housing Element Units

TIME INTERVAL RESIDENT TRIP STARTED	AVERAGE EVACUATION TIME [BASELINE ROAD CAPACITY]	AVERAGE EVACUATION TIME [40 PERCENT BELOW BASELINE ROAD CAPACITY]
6:00-6:14	10.3 [10.3]	10.8 [11.0]
6:15-6:29	21.2 [19.4]	31.1 [28.8]
6:30-6:44	25.6 [22.7]	43.5 [39.8]
6:45-6:59	22.5 [19.8]	42.1 [38.5]
7:00-7:14	17.6 [15.5]	37.0 [34.7]
7:15-7:29	15.2 [14.1]	37.5 [36.2]
7:30-7:44	12.7 [11.2]	42.4 [43.3]
7:45-7:59	9.2 [9.5]	29.9 [27.2]
8:00-8:14	8.7 [9.2]	23.5 [21.1]
8:15-8:29	8.9 [8.8]	17.7 [15.3]
8:30-8:44	7.3 [7.3]	14.5 [10.3]
8:45-8:59	7.3 [7.3]	8.3 [7.7]

Notes:

6:00 am evacuation notice.

The average evacuation time values shown in [brackets] to the right above are from the Portola Valley Wildfire Traffic Evacuation Capacity Study.

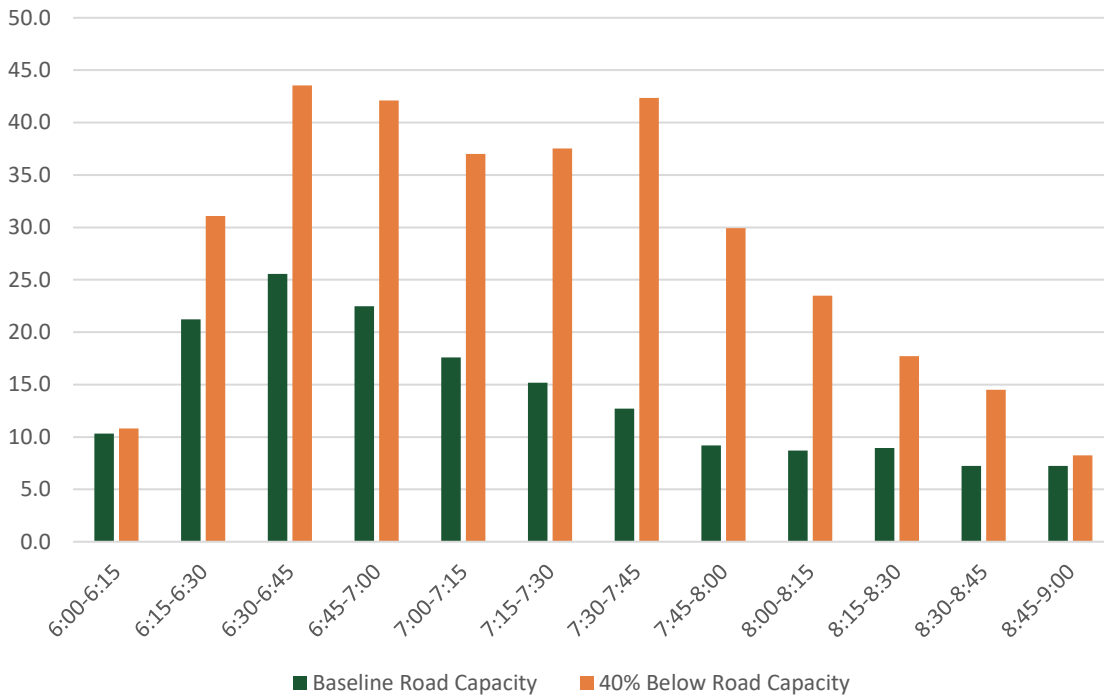
Source: Fehr & Peers, 2022.

The average evacuation travel times by time interval for Scenario 1 – with added trips generated by new Housing Element units - are illustrated in the histogram on Figure 1 below. As noted, the



evacuation travel times shown in Table 3 and Figure 1 are averages of evacuation travel times from zones throughout the study area. Residents living closer to I-280 would experience shorter evacuation times and residents living farther from I-280 would experience longer evacuation times.

**Figure 1: Scenario 1 with New Housing Units (All Routes Open)
Average Evacuation Travel Time (Minutes)**





Scenario 2

Table 4 shows a range of evacuation travel times by population group for Scenario 2 where only the north routes are open. With reduced capacity levels, 90 percent of employees would be evacuated within two hours and 15 minutes, 90 percent of residents within four hours, and 90 percent of equestrian trailers within three hours and 45 minutes. Full evacuation times with reduced capacity levels are about one hour to two hours and 45 minutes longer for each group, in part because the evacuation start times for the last five percent of evacuees in these population groups significantly lag the assumed start times of most others.

Table 4: Scenario 2 Evacuation Time Estimates – with Housing Element Units

POPULATION GROUP	90% EVACUATED WITHIN	100% EVACUATED WITHIN
Residents	3 hr – 4 hr [2 hr, 45 min – 3 hr, 45 min]	3 hr, 30 mins – 5 hr [3 hr, 30 min – 4 hr, 45 min]
Employees	1 hr, 30 mins – 2 hr, 15 mins [1 hr, 30 min – 2 hr]	3 hr, 30 mins – 5 hr [3 hr, 30 min – 4 hr, 30 min]
Equestrian Trailers	3 hr – 3 hr, 45 mins [3 hr – 3 hr, 30 min]	4 hr, 15 mins – 5 hr [4 hr, 15 min – 4 hr, 45 min]

Notes:

The above travel times are the estimated duration of time starting with a 6:00 am evacuation notice, after which 90 and 100 percent of the three population groups are evacuated.

First time in range is ETE for baseline road capacity scenario.

Second time in range is ETE for 40% below baseline road capacity scenario.

The ETE values shown in [brackets] on the 2nd row of each population group above are from the Portola Valley Wildfire Traffic Evacuation Capacity Study.

Source: Fehr & Peers, 2022.

To provide additional detail on the evacuation characteristics for Scenario 2, the average evacuation travel times for residents was extracted from the model by 15-minute time interval. The average evacuation travel times are identified for the baseline road capacity and reduced road capacity levels. It should be noted that these are the average of all evacuation travel times and that residents located closer to I-280 would experience lower travel times while residents located farther away would experience higher travel times.

Table 5 shows the average evacuation travel times for Scenario 2. Average evacuation travel times under reduced road capacity levels range from about 115 to 175 minutes for resident trips that start in the 6:30 to 8:00 am window when travel times are at their greatest for Scenario 2. The added trips generated by the housing element units are estimated to increase average evacuation travel times under reduced capacity levels by 10 to 40 minutes in the 6:30 to 8:00 am window, with the higher increases in average evacuation travel times occurring for those who begin their trip after 7:30 am.



Table 5: Scenario 2: Average Resident Evacuation Travel Time (Minutes) by Time Interval – with Housing Element Units

TIME INTERVAL RESIDENT TRIP STARTED	AVERAGE EVACUATION TIME [BASELINE ROAD CAPACITY]	AVERAGE EVACUATION TIME [40 PERCENT BELOW BASELINE ROAD CAPACITY]
6:00-6:14	17.1 [17.1]	23.3 [23.0]
6:15-6:29	68.4 [61.9]	106.3 [98.9]
6:30-6:44	88.2 [78.6]	127.9 [116.7]
6:45-6:59	85.6 [76.0]	125.5 [114.6]
7:00-7:14	77.6 [66.7]	116.8 [104.2]
7:15-7:29	82.3 [72.4]	134.6 [121.5]
7:30-7:44	93.2 [67.2]	175.4 [134.3]
7:45-7:59	66.8 [54.6]	161.0 [121.4]
8:00-8:14	61.4 [42.6]	126.9 [96.1]
8:15-8:29	50.8 [33.9]	131.4 [96.3]
8:30-8:44	37.6 [34.3]	118.0 [102.3]
8:45-8:59	33.2 [29.3]	103.0 [87.3]

Notes:

6:00 am evacuation notice.

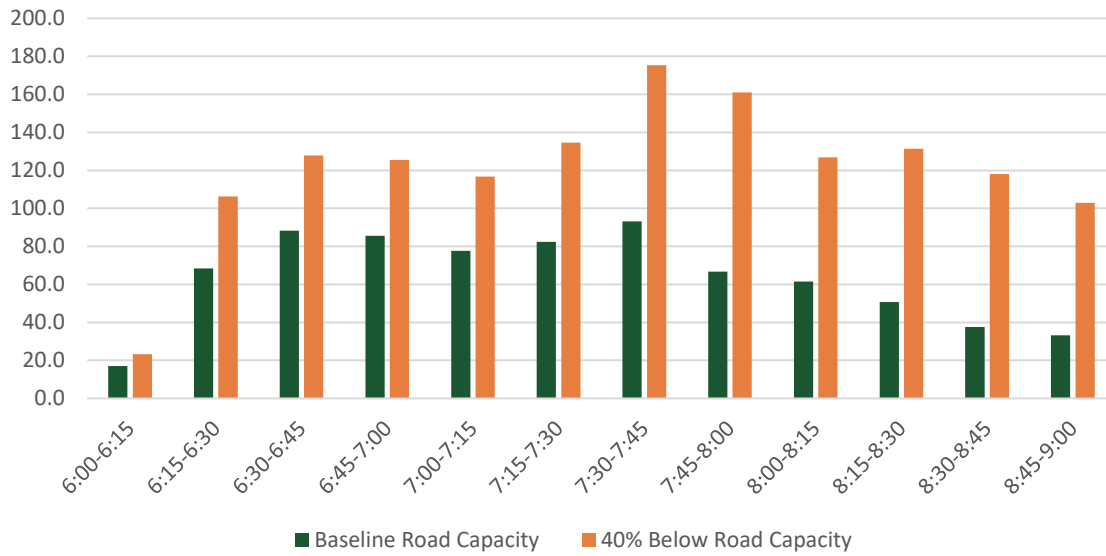
The average evacuation time values shown in [brackets] to the right above are from the Portola Valley Wildfire Traffic Evacuation Capacity Study.

Source: Fehr & Peers, 2022.

The average evacuation travel times by time interval for Scenario 2 – with added trips generated by new Housing Element units - are illustrated in the histogram on Figure 2 below. As noted, the evacuation travel times shown in Table 5 and Figure 2 are averages of evacuation travel times from zones throughout the study area. Residents living closer to I-280 would experience shorter evacuation times and residents living farther from I-280 would experience longer evacuation travel times.



**Figure 2: Scenario 2 with New Housing Units (North Routes Only)
Average Evacuation Travel Time (Minutes)**





Scenario 3

Table 6 shows a range of evacuation travel times by population group for Scenario 3 where only the south routes are open. With reduced capacity levels, 90 percent of employees would be evacuated within two hours, 90 percent of residents within three hours, and 90 percent of equestrian trailers within three hours. Full evacuation travel times with reduced capacity levels are at 45 minutes to one hour and 45 minutes longer for each group, in part because the evacuation start times for the last five percent of evacuees in these population groups significantly lag the assumed start times of most others.

Table 6: Scenario 3 Evacuation Time Estimates – with Housing Element Units

POPULATION GROUP	90% EVACUATED WITHIN	100% EVACUATED WITHIN
Residents	2 hr – 3 hr [2 hr – 2 hr, 45 min]	3 hr, 15 mins – 3 hr, 45 mins [3 hr, 15 min – 3 hr, 30 min]
Employees	1 hr, 15 mins – 2 hr [1 hr, 15 min – 1 hr, 45 min]	2 hr, 45 mins – 3 hr, 45 mins [2 hr, 45 min – 3 hr, 30 min]
Equestrian Trailers	2 hr, 30 mins – 3 hr [2 hr, 30 min – 3 hr]	4 hr, 15 mins [2 hr, 45 min – 3 hr, 30 min]

Notes:

The above times are the estimated duration of travel time starting with a 6:00 am evacuation notice, after which 90 and 100 percent of the three population groups are evacuated.

First time in range is ETE for baseline road capacity scenario.

Second time in range is ETE for 40% below baseline road capacity scenario.

The ETE values shown in [brackets] on the 2nd row of each population group above are from the Portola Valley Wildfire Traffic Evacuation Capacity Study.

Source: Fehr & Peers, 2022.

To provide additional detail on the evacuation characteristics for Scenario 3, the average evacuation travel times for residents was extracted from the model by 15-minute time interval. The average evacuation travel times are identified for the baseline road capacity and reduced road capacity levels. It should be noted that these are the average of all evacuation times and that residents located closer to I-280 would experience lower travel times while residents located farther away would experience higher travel times.

Table 7 shows the average evacuation travel times for Scenario 3. Average evacuation travel times under reduced road capacity levels range from about 75 to 90 minutes for resident trips that start in the 6:30 to 8:00 am window when travel times are at their greatest for Scenario 3. The added trips generated by the housing element units are estimated to increase average evacuation travel times under reduced capacity levels by five to ten minutes in the 6:30 to 8:00 am window.



Table 7: Scenario 3: Average Resident Evacuation Travel Time (Minutes) by Time Interval – with Housing Element Uses

TIME INTERVAL RESIDENT TRIP STARTED	AVERAGE EVACUATION TIME [BASELINE ROAD CAPACITY]	AVERAGE EVACUATION TIME [40 PERCENT BELOW BASELINE ROAD CAPACITY]
6:00-6:14	12.8 [12.3]	14.9 [14.7]
6:15-6:29	43.1 [42.3]	68.1 [59.7]
6:30-6:44	59.8 [59.8]	94.9 [84.0]
6:45-6:59	56.9 [60.1]	91.1 [81.9]
7:00-7:14	48.5 [51.2]	82.3 [72.4]
7:15-7:29	41.7 [44.1]	78.0 [70.7]
7:30-7:44	33.6 [43.0]	83.9 [79.3]
7:45-7:59	22.5 [28.8]	68.7 [60.5]
8:00-8:14	17.1 [18.5]	56.9 [51.8]
8:15-8:29	12.7 [14.2]	44.4 [35.3]
8:30-8:44	7.7 [9.0]	11.3 [9.0]
8:45-8:59	8.3 [7.3]	8.0 [8.3]

Notes:

6:00 am evacuation notice.

The average evacuation time values shown in [brackets] to the right above are from the Portola Valley Wildfire Traffic Evacuation Capacity Study.

Source: Fehr & Peers, 2022.

The average evacuation travel times by time interval for Scenario 3 – with added trips generated by new Housing Element units - are illustrated in the histogram on Figure 3 below. As noted, the evacuation travel times shown in Table 7 and Figure 3 are averages of evacuation travel times from zones throughout the study area. Residents living closer to I-280 would experience shorter evacuation times and residents living farther from I-280 would experience longer evacuation travel times.



**Figure 3: Scenario 3 with New Housing Units (South Routes Only)
Average Evacuation Travel Time (Minutes)**

