

TECHNICAL MEMORANDUM

August 23, 2024

Project# 30086

To: Denise Vo, Susan Hernandez, Kimiko Lizardi
Rincon Consultants, Inc.

From: Mike Aronson, P.E; Grace Carsky; Allison Woodworth

RE: Chino Hills Safety Element: Evacuation Analysis

Introduction

Kittelison & Associates, Inc. (Kittelison) has prepared an evacuation analysis for the City of Chino Hills, California in support of the city's General Plan Safety Element update. The evaluation considers three (3) representative evacuation scenarios and provides the city with estimates of roadway capacity constraints and travel time considerations during evacuations. The analysis helps identify locations where there is a greater potential for traffic congestion and need for additional control measures in the event of an evacuation.

This evacuation evaluation is consistent with requirements outlined in Assembly Bill (AB) 747¹ and Senate Bill (SB) 99². These laws require agencies to evaluate the resiliency of their transportation system, the capacity of evacuation routes, and identify key routes for community areas with only one access point.

The memorandum includes the following sections:

- Introduction including legislative requirements and analysis scenarios
- Methodology
- Single access neighborhoods
- Evacuation scenario findings
- Evacuation planning considerations and recommendations.

LEGISLATIVE REQUIREMENTS

Recent California legislation, including Assembly Bill (AB) 747 and Senate Bill (SB) 99, requires local agencies to review accessibility and evacuation routes when specific elements within the General Plan or other emergency planning documents are completed or updated.

¹ <https://openstates.org/ca/bills/20192020/AB747/>

² <https://openstates.org/ca/bills/20192020/SB99/>

- **Senate Bill 99** requires review and update of the Safety Element to include information to identify residential developments in hazard areas that do not have at least two emergency evacuation routes. This is intended to assist the city in identifying opportunities to improve the connectivity and resiliency of the transportation system.
- **Assembly Bill 747** requires that the Safety Element be reviewed and updated to identify evacuation routes and their capacity, safety, and viability under a range of emergency scenarios. This is a requirement for all Safety Elements or updates to Hazard Mitigation Plans completed after January 2022.

ROADWAY NETWORK

The City of Chino Hills is located in southwest San Bernardino County, California (Figure 1). It is bounded by the cities of Yorba Linda to the southwest, Pomona to the north, Diamond Bar and Brea to the west and Chino to the east.

State Routes

State Route 71 (SR 71) is an access-controlled state highway that runs north-south and has five ramp access points on the eastern side of the city.

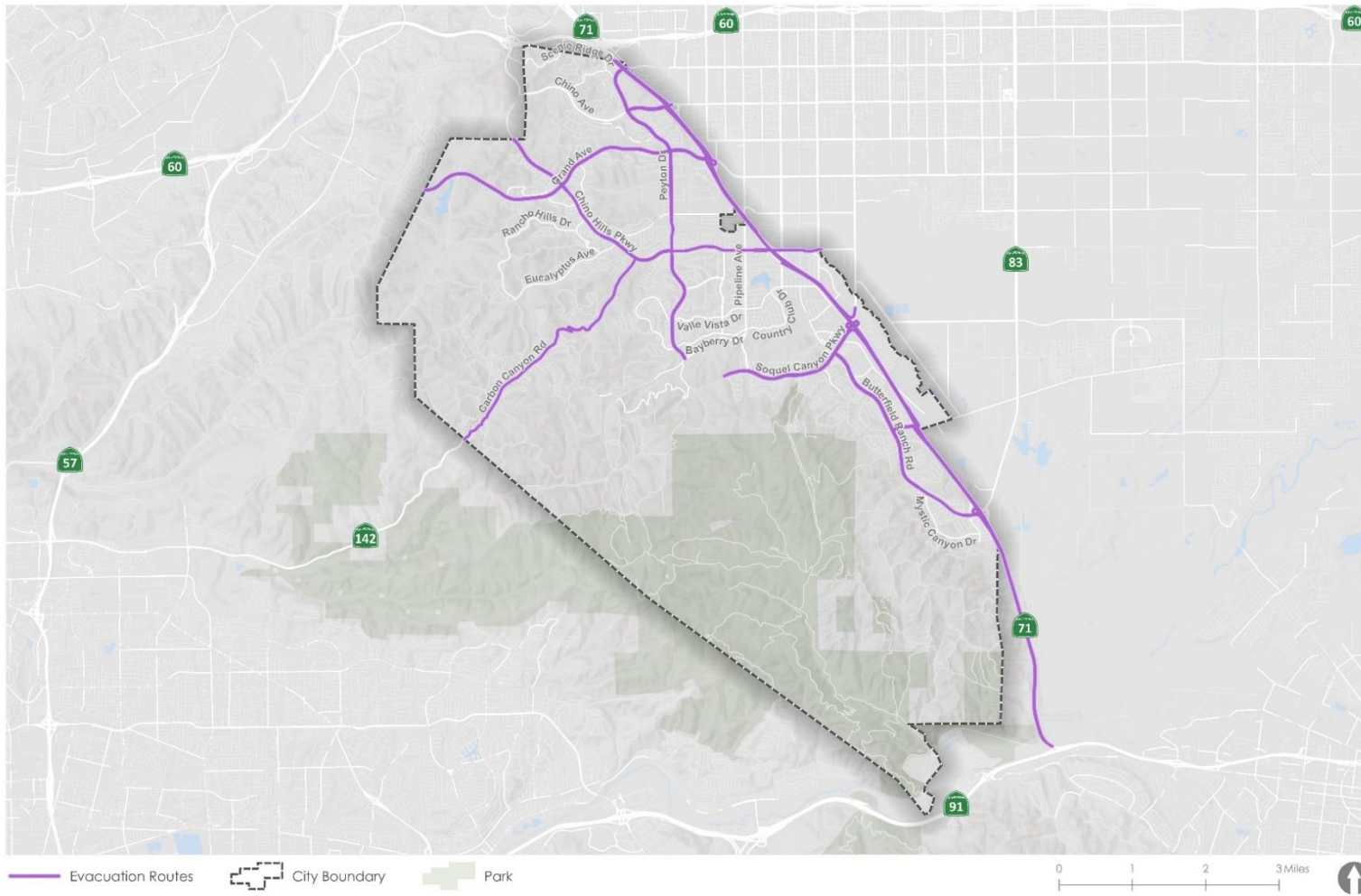
State Route 142 (SR 142) runs east-west, connecting Chino Hills to SR 71 in the east and Brea in the west. The western part of SR 142, also named Carbon Canyon Road, is a two-lane highway that runs at grade with no access control through the city. Residential communities abut Carbon Canyon Road for much of its alignment. The eastern portion of SR 142, Chino Hills Parkway, is a four-lane arterial which serves residential neighborhoods and a commercial area near SR 71.

Local Roads

There are several local routes that complement the state highways and are also likely to be used for evacuation purposes, depending on the evacuation area, including:

- Peyton Drive
- Chino Avenue
- Grand Avenue
- Chino Hills Parkway
- Soquel Canyon Parkway
- Butterfield Ranch Road

Figure 1: Chino Hills Roadway Network and Evacuation Routes



Roadway Network and Evacuation Routes
Chino Hills Safety Element Update
Chino Hills, CA



Source: Kittelson & Associates, 2024

ANALYSIS SCENARIOS

The evacuation analysis considers the following three representative evacuation scenarios:

- **Wildfire Scenario #1** – Wildfire ignites in Carbon Canyon
- **Wildfire Scenario #2** – Wildfire ignites outside Carbon Canyon and spreads towards Chino Hills
- **Earthquake Scenario #3** – Earthquake along Chino Fault in southeast area of Chino Hills

These scenarios do not represent every possible emergency that could affect Chino Hills, but they do represent the highest likelihood emergencies that may stress different parts of the road system.

Time Frames

Each evacuation scenario is compared to weekday PM peak hour traffic conditions for two time frames, base year and future year.

BASE YEAR

The base year evaluation is representative of evacuations with existing traffic levels. The available San Bernardino County travel model uses a base year of 2016. The California Department of Finance official population statistics report that 2016 population in Chino Hills (77,900) was actually higher than the current 2024 population (76,400). Therefore, the 2016 demographics are able to be used to represent current base year traffic levels.

FUTURE YEAR

The future year traffic levels include development allowable under the proposed Chino Hills General Plan, consistent with the analysis of other elements of the General Plan including the Housing Element and Circulation Element. Outside of Chino Hills, the traffic forecasts include travel that would be generated by the 2040 demographic forecasts for the entire region provided by the San Bernardino Council of Governments (SBCOG) for travel forecasting.

Methodology

Assumptions regarding travel patterns for evacuees were developed based on recent research. The following sections describe the tools and inputs used for the evacuation analysis.

EVACUATION MODELING

Travel Modeling Tools

The evacuation analysis uses the San Bernardino County Transportation Analysis Model (SBTAM) maintained by SBCOG. The current travel model was calibrated and validated for a 2016 base year and includes a 2040 future scenario with 2040 land use forecasts and transportation improvement assumptions.

The model represents all land uses in the five-county Southern California Association of Governments (SCAG) region grouped into transportation analysis zones (TAZs). The model includes a representative roadway network (generally all streets except for very local residential streets). Each road segment is coded with functional classification, number of lanes, uncongested speed, and an estimate of the typical hourly capacity. The model estimates vehicle trips generated by each land use, distributes the trips to a variety of likely destinations, and assigns each origin-destination pair to the best route. The model also assesses congestion and iteratively diverts traffic to alternative routes until congestion is balanced between all available routes.

Affected Areas

The areas that would be affected by each emergency scenario were identified based on the California Department of Forestry and Fire Protection (CAL FIRE) Fire Hazard Severity Zones mapping and consultation with Chino Hills emergency responders. The affected areas were overlaid with the SBTAM TAZs to identify the numbers of people that would need to be evacuated.

Time Period

Transportation activity was modeled for one worst-case time period, based on the weekday PM peak hour when non-evacuation traffic and congestion would be at its highest levels. Peak evacuation traffic was assumed to occur during this period involving the specified area within the city.

Number of Evacuation Trips

If a fire occurs during the night, most residents would be home but most employees would not be at their workplace. If a fire occurs during the workday, most employees would be at their workplace but many

residents would not be at their homes. The evacuation analysis conservatively assumes that 75 percent of residents and 75 percent of employees would need to evacuate during a fire event.

Depending on the order received, a proportion of residents, employees, and visitors will choose to evacuate. When a zone is assigned an Evacuation Order, it is assumed that 90 percent of residents, employees, and visitors will evacuate and approximately 10 percent will remain behind. When a zone is assigned an Evacuation Warning, it is assumed that 25% of residents, employees, and visitors will evacuate. The estimated factors are based on survey results from people impacted by prior fires in California in UC Berkeley's Review of California Wildfire Evacuations from 2017 to 2019.³

Based on vehicle ownership data from the United States Census American Community Survey (ACS)⁴, there are an average of 2.3 vehicles per household in Chino Hills. Therefore, the number of evacuating households is multiplied by 2.3 to estimate residential vehicles. Each evacuating employee is assumed to use one vehicle.

Evacuation Destinations

Likely evacuation destinations were identified in consultation with city staff:

- The Chino Hills Community Center is a designated evacuation center during emergency events.
- Locations in Diamond Bar (Diamond Bar High School) and Brea (Brea Community Center) were also used to estimate evacuation trips leaving Chino Hills towards the west and south.

The percentage of trips heading for each evacuation destinations were assigned based on the location and direction of the evacuation. The majority of trips were typically assigned to the nearest destination if the evacuation route would not cross the affected fire or earthquake area. However, a smaller percentage of trips from each neighborhood were assumed to want to travel in the other directions, particularly if they could reach shelter with family or friends.

The distribution of the destinations is not intended to represent a precise distribution of the routes that would be taken during an evacuation.

Roadway Capacity

Traffic congestion as measured by the demand volume-to-capacity ratio was modeled using the default average capacities for each roadway. The scenarios conservatively represent conditions without

³ This assumption is based in knowledge that there is a certain contingent of people who will not evacuate, even when under official notice. See Wong, S., Broader, J. and Shaheen, P., 2022. *Review of California Wildfire Evacuations from 2017 to 2019*. [online] Escholarship.org. Available at: <<https://escholarship.org/uc/item/5w85z07q>>

⁴ U.S. Census Bureau. "Household Size by Vehicles Available." American Community Survey, ACS 5-Year Estimates Detailed Tables, Table B08201, 2022, <https://data.census.gov/table/ACSDT5Y2022.B08201?q=b08201&g=160XX00US0613214&moe=false>. Accessed on May 2, 2024.

implementation of any evacuation strategies, such as manual traffic control or contraflow lanes, which could increase roadway capacity in one direction versus the other.

Travel Times

The travel model includes formulas which estimate how much travel speeds decrease based on the demand volume versus the capacity and the type of road. These formulas are based on the standard travel forecasting practice. Travel times for evacuation trips are estimated by identifying the best route between origins and destinations with the congested speeds, and summing the congested travel times on each road segment along the route.

LIMITATIONS

The results of this evaluation are intended to identify potential congested locations during modeled representative evacuation scenarios. These scenarios were developed based on conservative assumptions and modeling techniques that reflect current understanding of evacuation analysis. These scenarios are intended to model a potential range of different evacuation scenarios but not all possible scenarios.

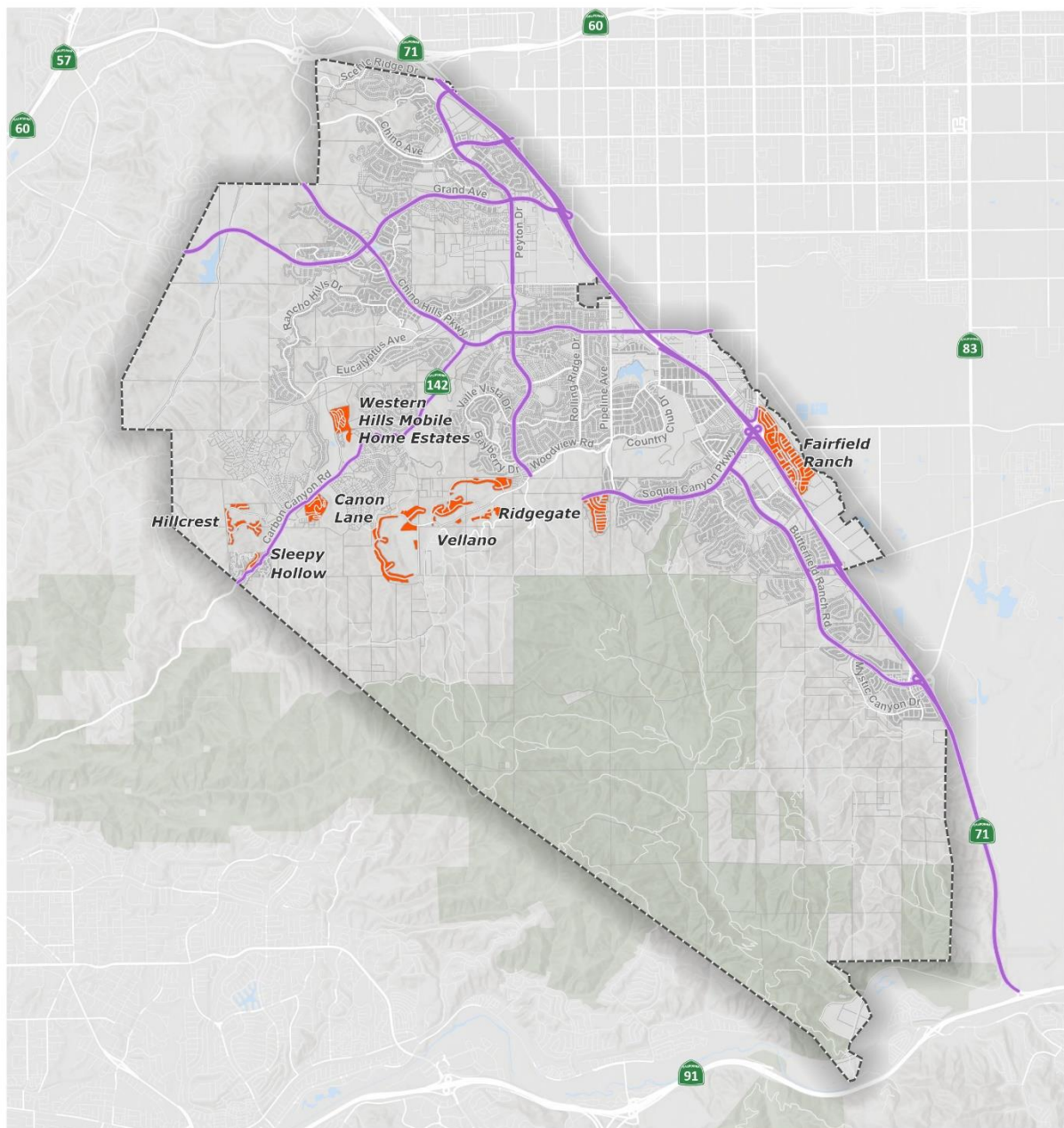
The scenarios represent potential emergencies occurring in portions of the City of Chino Hills. Actual emergencies may occur at other locations in and around the city and the specific conditions of an emergency evacuation could result in evacuation behavior that diverges from the definitions and assumptions used for this analysis. As a result, the identified scenarios and evacuation constraints represent informed estimates of the most likely potential evacuation scenario footprints and capacity constraints based on available data.





Single Access Neighborhoods

In compliance with SB 99 (Government Code Section 65302), residential neighborhoods have been identified with less than two evacuation routes located within any hazard zone defined in the General Plan Safety Element. There are seven neighborhoods in the city that have been identified as having only a single access route (Figure 2).

The city has also identified communities with private access and locked gates (Figure 3). These communities require additional considerations for emergency access and evacuation.

Figure 2: Neighborhoods with Single Access Points



-  Evacuation Routes
-  Parcels with One Egress Route
-  Parcels with Two or More Egress Routes
-  City Boundary

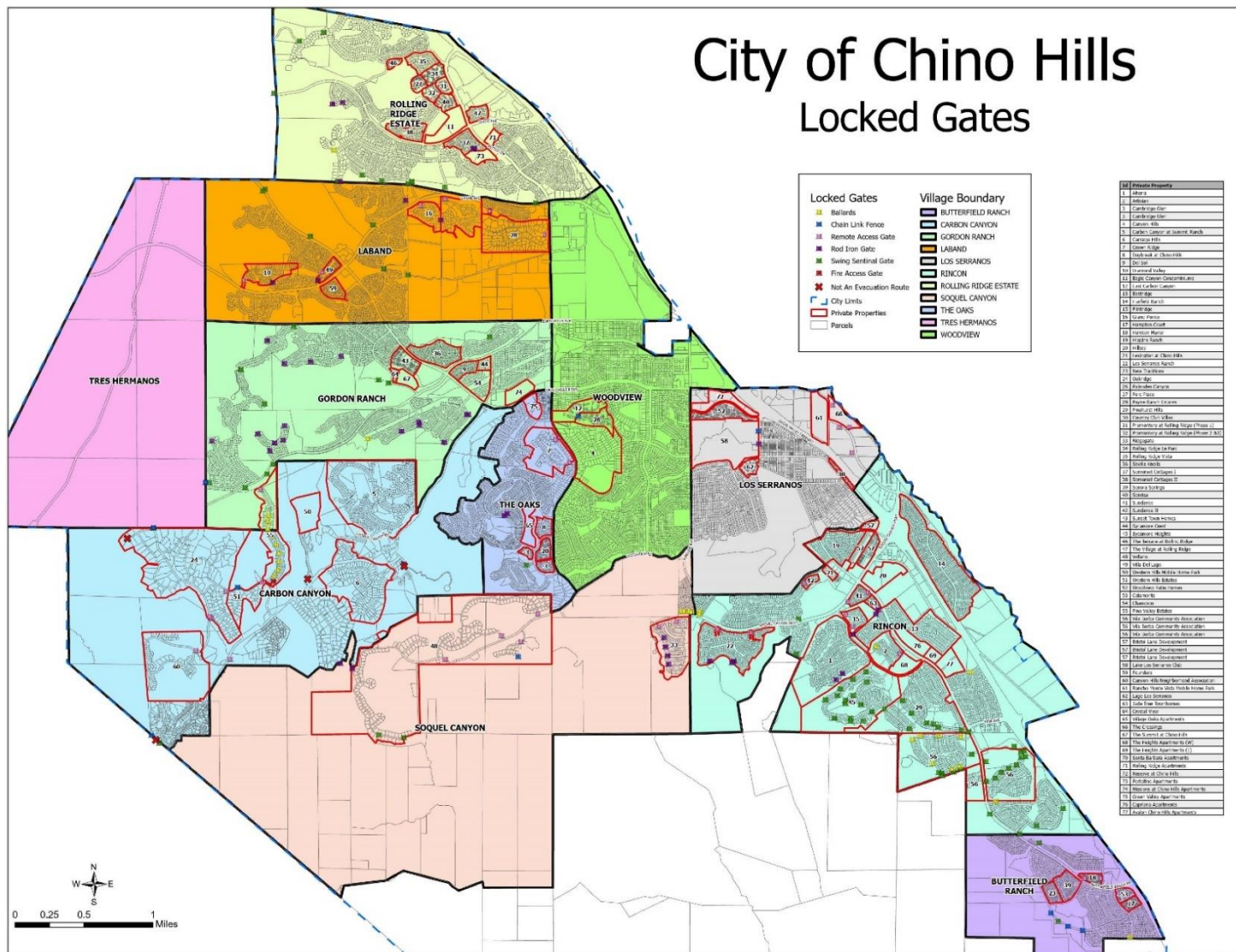
0 1 2 Miles 



Neighborhoods with Single Access Points
Chino Hills Safety Element Update
Chino Hills, CA

Source: Kittelson & Associates, 2024

Figure 3: Chino Hills Villages and Locked Gates



Source: City of Chino Hills, 2024

Evacuation Analysis Results

Evacuation analysis was conducted for the analysis peak hour for conditions with no evacuation and for the three (3) different evacuation scenarios. The analysis is presented for the base year and future year.

BASELINE NO EVACUATION CONDITIONS

The PM peak analysis hour volumes were compared to road capacities for weekday conditions without an emergency evacuation event. These congestion conditions can be compared to the congestion conditions with an evacuation event to determine where additional traffic management may be needed during an emergency.

Base Year

The PM peak hour modeling for the base year without an evacuation event indicates congestion in the following locations (Figure 4):

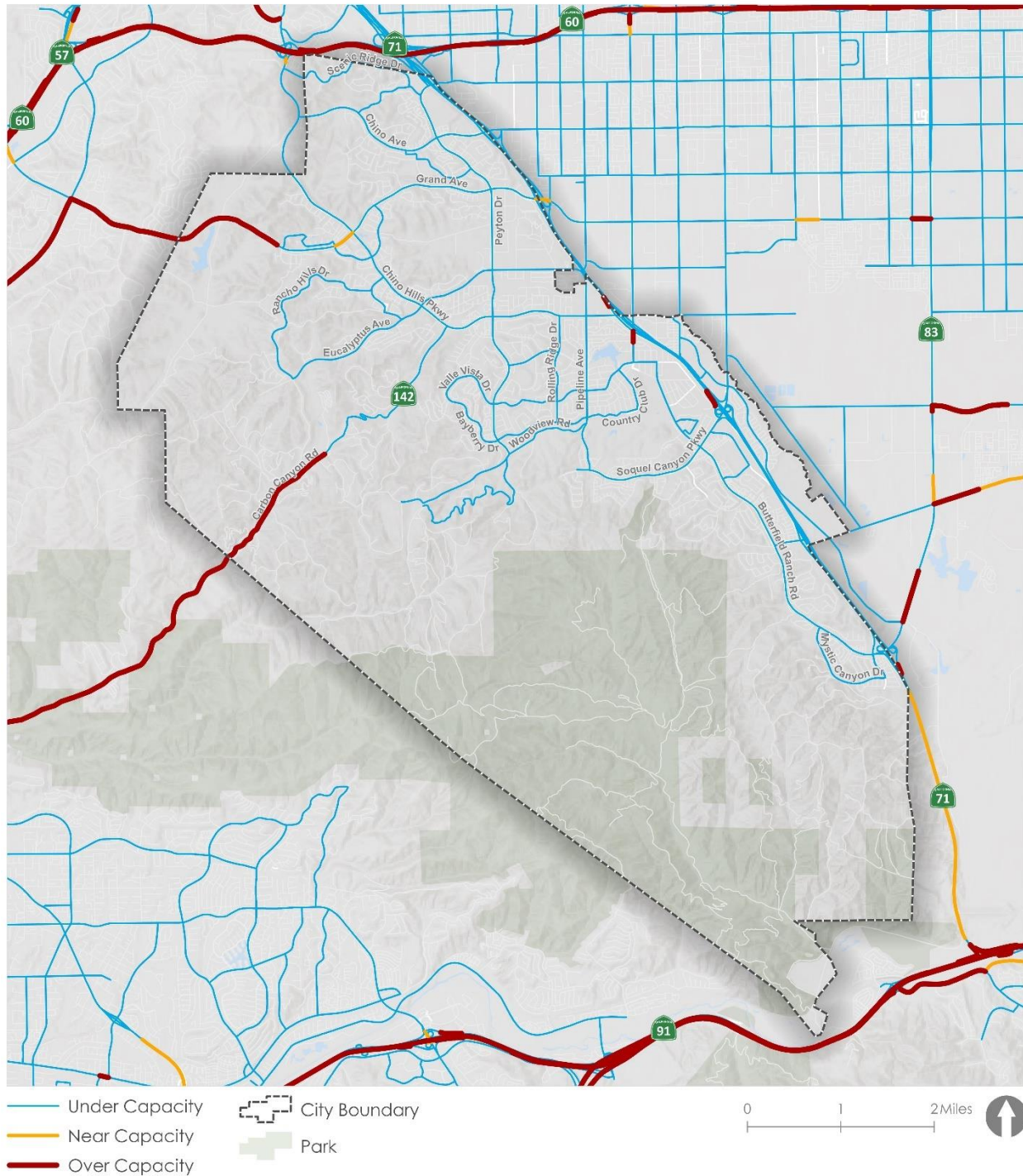
- Grand Avenue between Diamond Bar and Pleasant Hill Drive and west of Chino Hills Parkway
- Carbon Canyon Road between Brea and the Western Hills Country Club
- Several off-ramps from SR 71

Future Year

The PM peak hour modeling for the future year with the proposed General Plan and without an evacuation event forecasts congestion in the following locations (Figure 5):

- Grand Avenue between Diamond Bar and Chino Hills Parkway
- Carbon Canyon Road between Brea and the Western Hills Country Club
- Chino Hills Parkway east of Carbon Canyon Road
- Several off-ramps from SR 71

Figure 4: Base Year PM Peak Hour Congestion Locations, No Evacuation

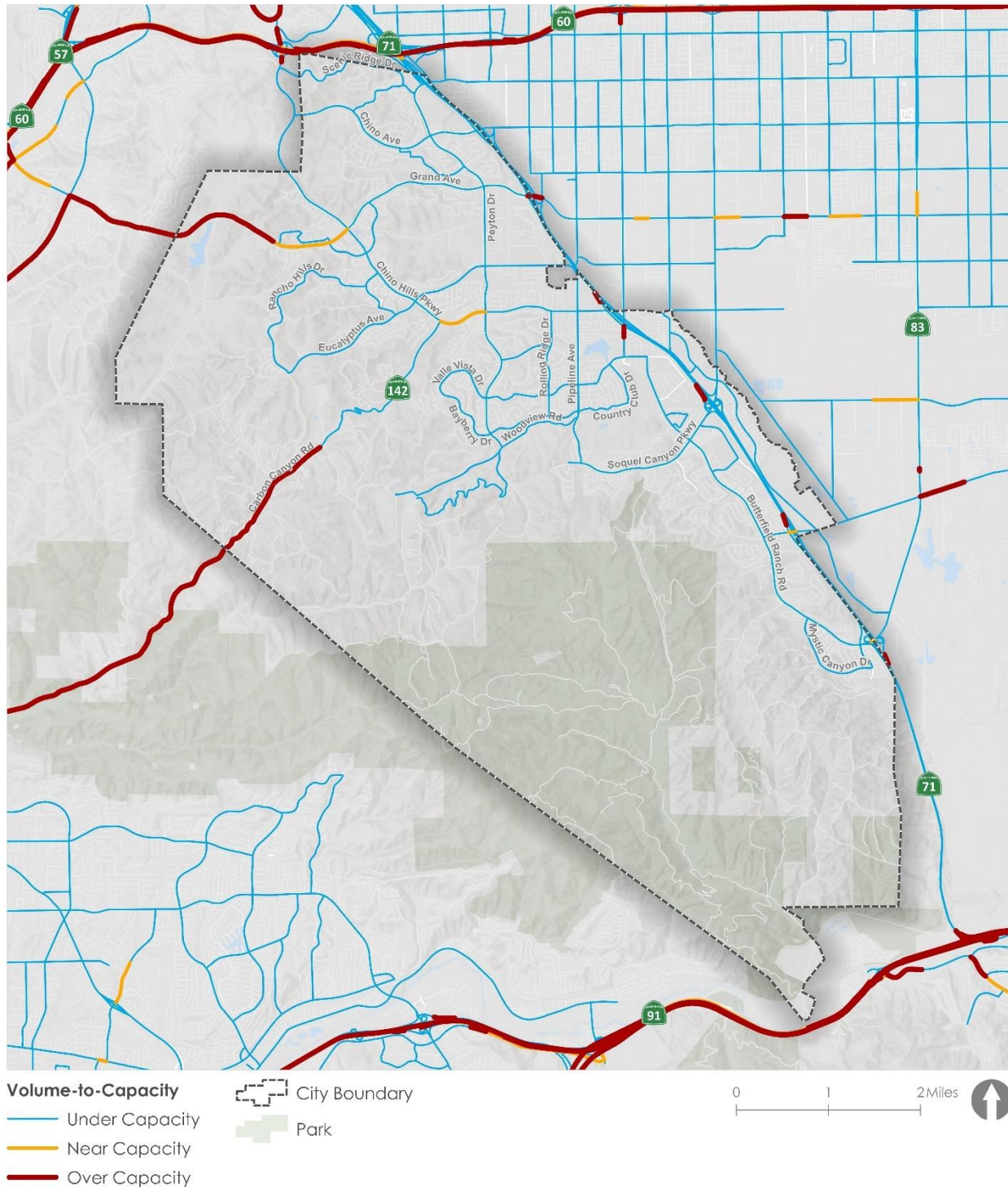


**Base Year Congestion Locations (No Evacuation)
Chino Hills Safety Element Update
Chino Hills, CA**



Source: Kittelson & Associates using SBTAM travel model, 2024

Figure 5: Future Year PM Peak Hour Congestion Locations, No Evacuation



**Future Year Congestion Locations (No Evacuation)
Chino Hills Safety Element Update
Chino Hills, CA**



Source: Kittelson & Associates using SBTAM travel model as updated by LLG Transportation Engineers and Planners, 2024

SCENARIO 1: WILDFIRE IN CARBON CANYON

Under this scenario, a fire ignites in Carbon Canyon and spreads west, initiating an evacuation order for communities in the western half of Chino Hills, communities to the south of Carbon Canyon Road in Brea, and neighborhoods west of Chino Hills State Park in Yorba Linda (Figure 6). Table 1 shows the number of households and employees in the affected area by transportation analysis zone (TAZ) as well as the total estimated evacuation trips for this scenario.

Base Year

With peak evacuation from a wildfire in Carbon Canyon in the base year, the analysis indicates over-capacity conditions on several roadways in the city as shown in Figure 7. Specifically, the roadways where demand volumes are projected to be at or exceed road capacity include:

- Grand Avenue west of Chino Hills Parkway (similar to no evacuation conditions)
- Grand Avenue west of SR 71
- Chino Hills Parkway south of SR 60
- Chino Hills Parkway west and east of Carbon Canyon Road
- Carbon Canyon Road between Brea and Chino Hills Parkway
- Peyton Drive north of Chino Hills Parkway
- Woodview Road west of Peyton Drive
- Butterfield Ranch Road

Future Year

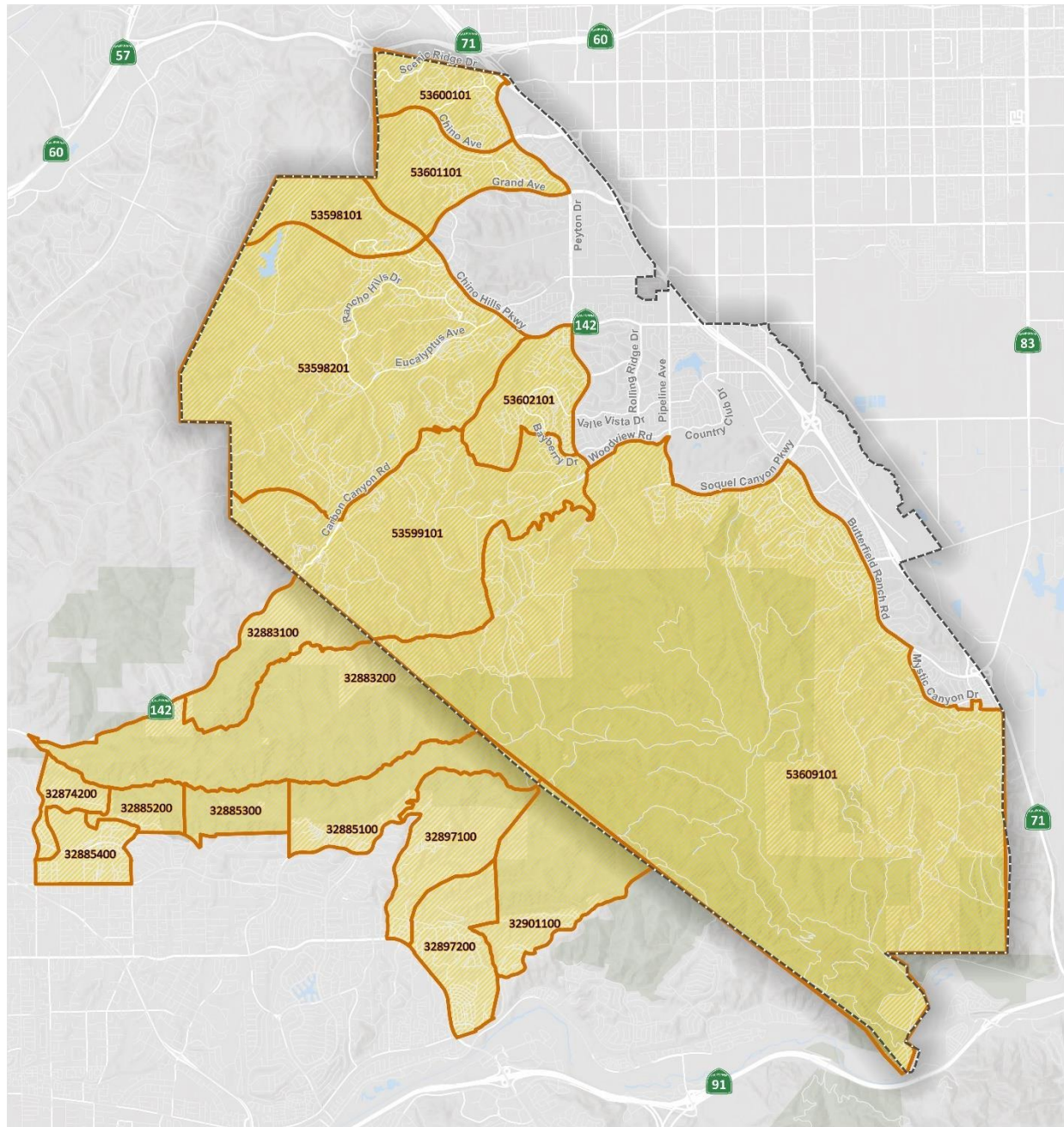
With peak evacuation from a wildfire in Carbon Canyon in the future year, the analysis predicts over-capacity conditions on several roadways in the city as shown in Figure 8. In addition to the locations listed for the base year, the roadways where demand volumes are projected to be at or exceed road capacity include:

- Additional length of Grand Avenue west of SR 71
- Eucalyptus Avenue
- Soquel Canyon Parkway near SR 71
- Additional length of Butterfield Ranch Road

Travel Times

Travel times between Chino Hills neighborhoods and various evacuation destinations are listed in Table 2. With base year traffic levels, an evacuation event would add up to six minutes to the time to reach the Chino Hills Community Center, up to 18 minutes to reach safety in Diamond Bar, and up to 10 minutes to Brea. With future year traffic levels, an evacuation event would add up to 17 minutes to the time to the Chino Hills Community Center, up to 31 minutes to Diamond Bar, and up to 17 minutes to Brea.

Figure 6: Evacuating Area, Scenario 1 Carbon Canyon Wildfire



-  TAZs
-  Evacuating Areas
-  City Boundary
-  Park



Evacuation Scenario - Carbon Canyon Wildfire #1
Chino Hills Safety Element Update
Chino Hills, CA

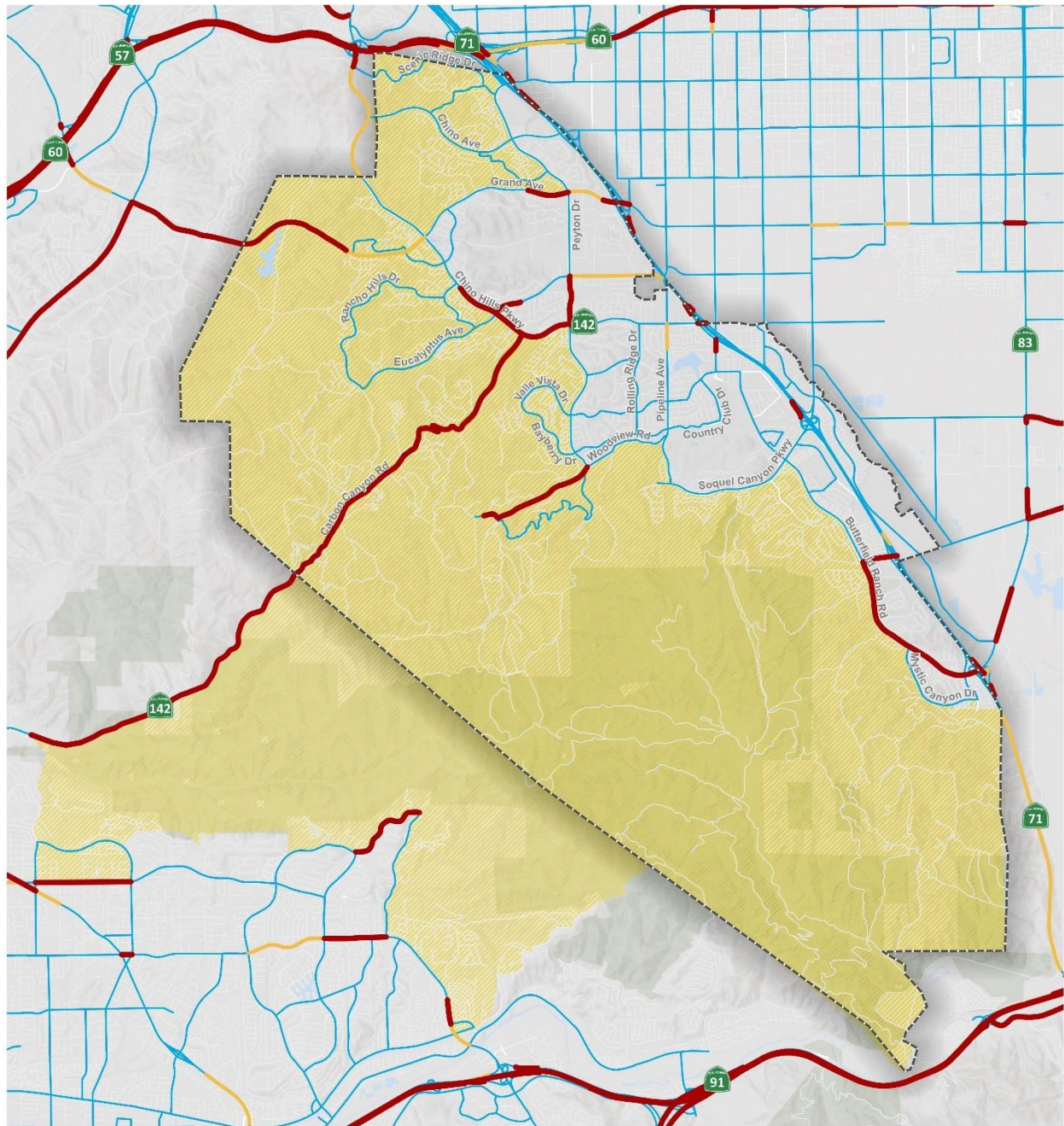
Source: Kittelson & Associates, 2024

Table 1: Affected Population and Peak Hour Evacuation Trips, Scenario 1 Carbon Canyon Wildfire

Evacuating TAZ	Base Year Households	Base Year Employment	Base Year Evacuation Trips	Future Households	Future Employment	Future Evacuation Trips
53609101	2,276	389	3,796	3,715	1,537	6,805
53599101	808	366	1,501	1,249	992	2,609
53598201	3,166	926	5,540	4,323	1,618	7,804
53602101	1,831	244	3,007	1,907	147	3,060
32901100	131	51	238	147	51	263
32897200	800	679	1,700	900	974	2,055
32874200	75	31	137	77	185	244
32885200	0	0	0	0	46	31
32885300	0	0	0	0	0	0
32885400	451	217	847	452	399	971
32883200	123	48	223	168	48	293
32883100	3	2	6	4	2	8
32885100	298	75	513	335	75	571
32897100	300	166	578	338	166	637
53598101	542	102	910	659	176	1,142
53600101	1,440	345	2,468	1,370	208	2,267
53601101	1,380	937	2,775	1,360	509	2,455

Source: San Bernardino Transportation Analysis Model; Kittelson & Associates, Inc., 2024

Figure 7: Congestion Locations, Scenario 1 Carbon Canyon Wildfire, Base Year



- | | |
|---------------------------------|------------------|
| Volume-to-Capacity Ratio | Evacuating Areas |
| Under Capacity | City Boundary |
| Near Capacity | Park |
| Over Capacity | |

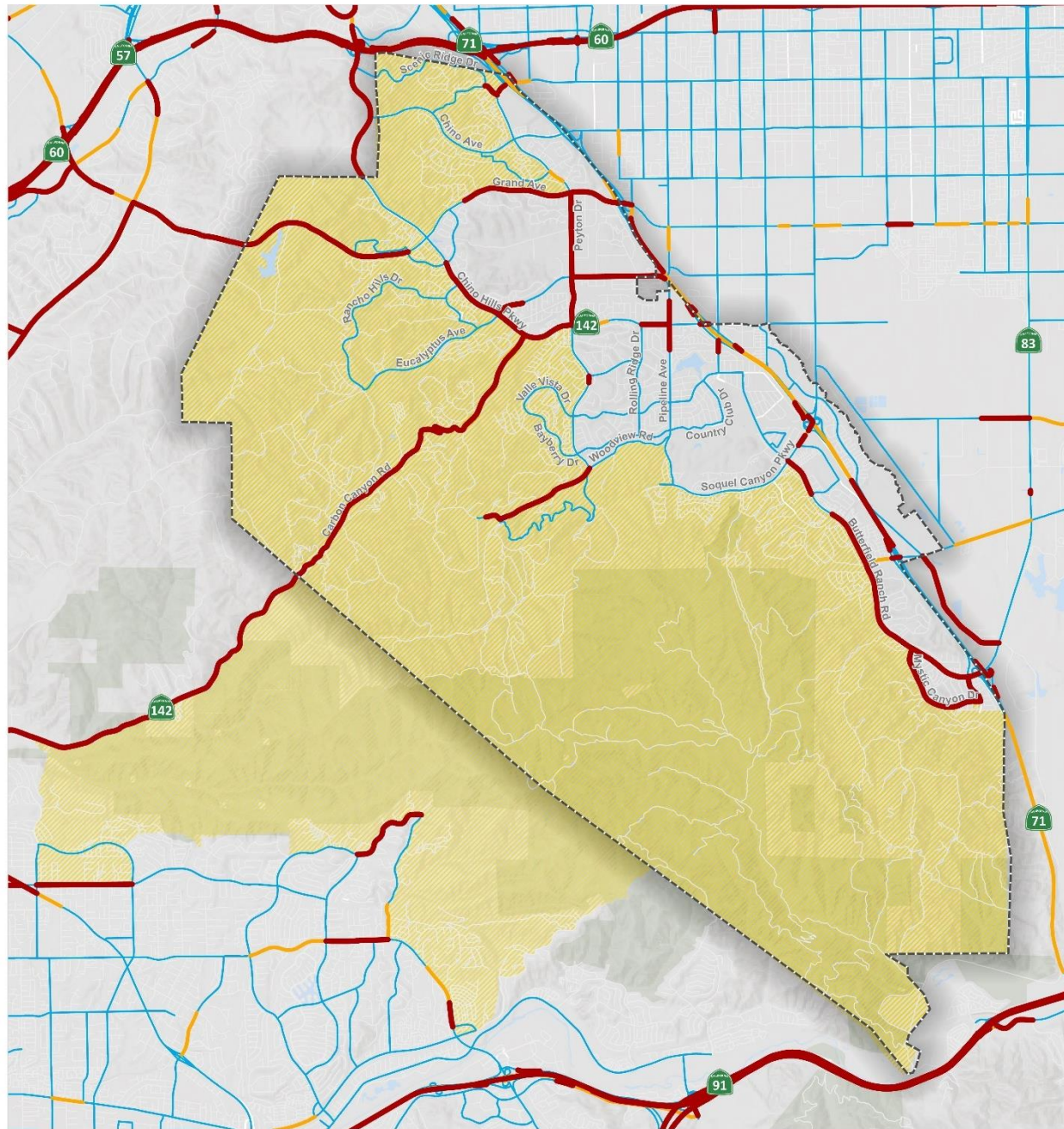
0 1 2 Miles

Congestion Locations
Scenario 1 Carbon Canyon Wildfire, Base Year
 Chino Hills Safety Element Update
 Chino Hills, CA



Source: Kittelson & Associates using SBTAM travel model, 2024

Figure 8: Congestion Locations, Scenario 1 Carbon Canyon Wildfire, Future Year



- | | |
|---------------------------------|------------------|
| Volume-to-Capacity Ratio | Evacuating Areas |
| Under Capacity | City Boundary |
| Near Capacity | Park |
| Over Capacity | |

0 1 Miles

Congestion Locations
Scenario 1 Carbon Canyon Wildfire, Future Year
 Chino Hills Safety Element Update
 Chino Hills, CA



Source: Kittelson & Associates using SBTAM travel model as updated by LLG Transportation Engineers and Planners, 2024

Table 2: Travel Times (Minutes), Scenario 1 Carbon Canyon Wildfire

Origin and Destination	Base Year No Evacuation	Base Year Scenario 1	Future Year No Evacuation	Future Year Scenario 1
From Rolling Ridge Estates				
To Chino Hills Community Center	5.2	6.2	5.2	6.8
To Diamond Bar	9.0	16.2	9.4	20.7
To Brea	19.2	29.6	20.7	37.3
From Laband				
To Chino Hills Community Center	4.7	5.0	4.7	5.3
To Diamond Bar	4.7	17.2	5.0	24.0
To Brea	17.3	27.8	18.3	35.6
From Gordon Ranch				
To Chino Hills Community Center	5.1	5.1	5.1	5.1
To Diamond Bar	6.6	19.6	6.9	27.2
To Brea	17.4	23.2	17.8	29.1
From The Oaks				
To Chino Hills Community Center	4.4	7.4	4.4	7.8
To Diamond Bar	8.8	23.4	9.2	28.4
To Brea	19.4	25.8	20.1	33.2
From Carbon Canyon				
To Chino Hills Community Center	6.9	13.0	7.4	23.9
To Diamond Bar	11.4	29.0	12.2	43.4
To Brea	16.4	22.2	17.0	29.7

Source: Kittelson & Associates using SBTAM travel model, 2024

SCENARIO 2: WILDFIRE OUTSIDE CARBON CANYON

Under this scenario, a fire ignites outside Carbon Canyon and spreads east which is presumed to necessitate the evacuation order for people in northwest Chino Hills, eastern Diamond Bar, and in Brea (**Figure 9**). Table 3 shows the number of households and employees in the affected area as well as the total estimated evacuation trips for this scenario.

Base Year

With peak evacuation from a wildfire outside Carbon Canyon in the base year, the analysis indicates over-capacity conditions on several roadways in the city as shown in Figure 10. Specifically, the roadways where demand volumes are projected to be at or exceed road capacity include:

- Grand Avenue west of Chino Hills Parkway (similar to no evacuation conditions)
- Grand Avenue west of Peyton Drive
- Chino Hills Parkway between Grand Avenue and Peyton Drive
- Carbon Canyon Road between Brea and Chino Hills Parkway
- Peyton Drive north of Chino Hills Parkway
- Eucalyptus Avenue
- Woodview Road west of Peyton Drive

Future Year

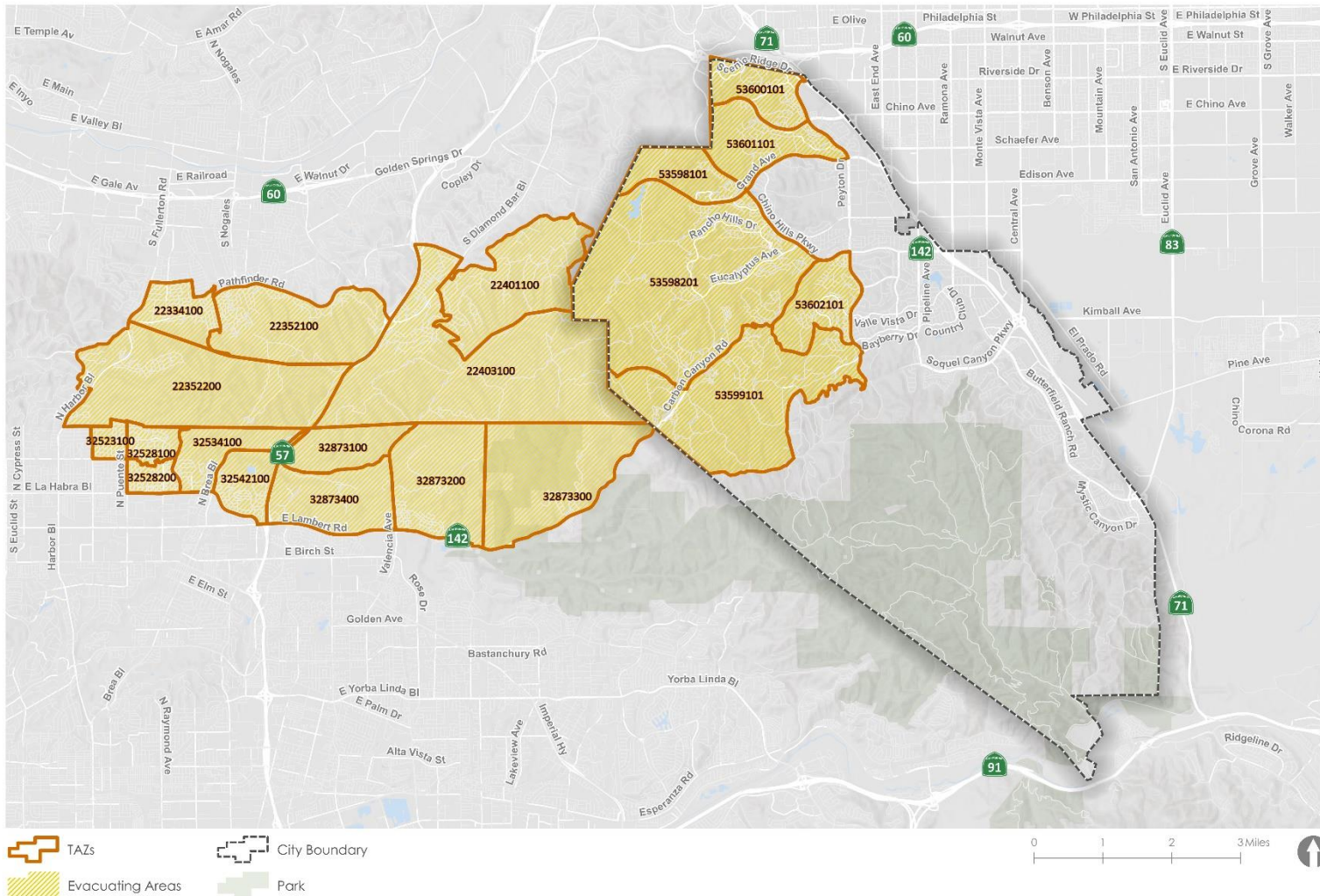
With peak evacuation from a wildfire outside Carbon Canyon in the future year, the analysis predicts over-capacity conditions on several roadways in the city as shown in Figure 11. Most congestion locations would be the same as those identified for the base year. In addition to the locations listed for the base year, the roadways where demand volumes are projected to be at or exceed road capacity include:

- Additional length of Peyton Drive north of Chino Hills Parkway

Travel Times

Travel times between Chino Hills neighborhoods and various evacuation destinations are listed in Table 2. With base year traffic levels, an evacuation event would add up to nine minutes to the time to reach the Chino Hills Community Center, up to 13 minutes to reach safety in Diamond Bar, and up to 14 minutes to Brea. With future year traffic levels, an evacuation event would add up to 29 minutes to the time from Carbon Canyon neighborhoods to the Chino Hills Community Center, up to 36 minutes to Diamond Bar, and up to 22 minutes to Brea. The travel times from other Chino Hills neighborhoods to the Community Center would not be as impacted as Carbon Canyon neighborhoods under this wildfire scenario.

Figure 9: Evacuating Area, Scenario 2 Wildfire Outside Carbon Canyon



Evacuation Scenario - Carbon Canyon Wildfire #2
Chino Hills Safety Element Update
Chino Hills, CA

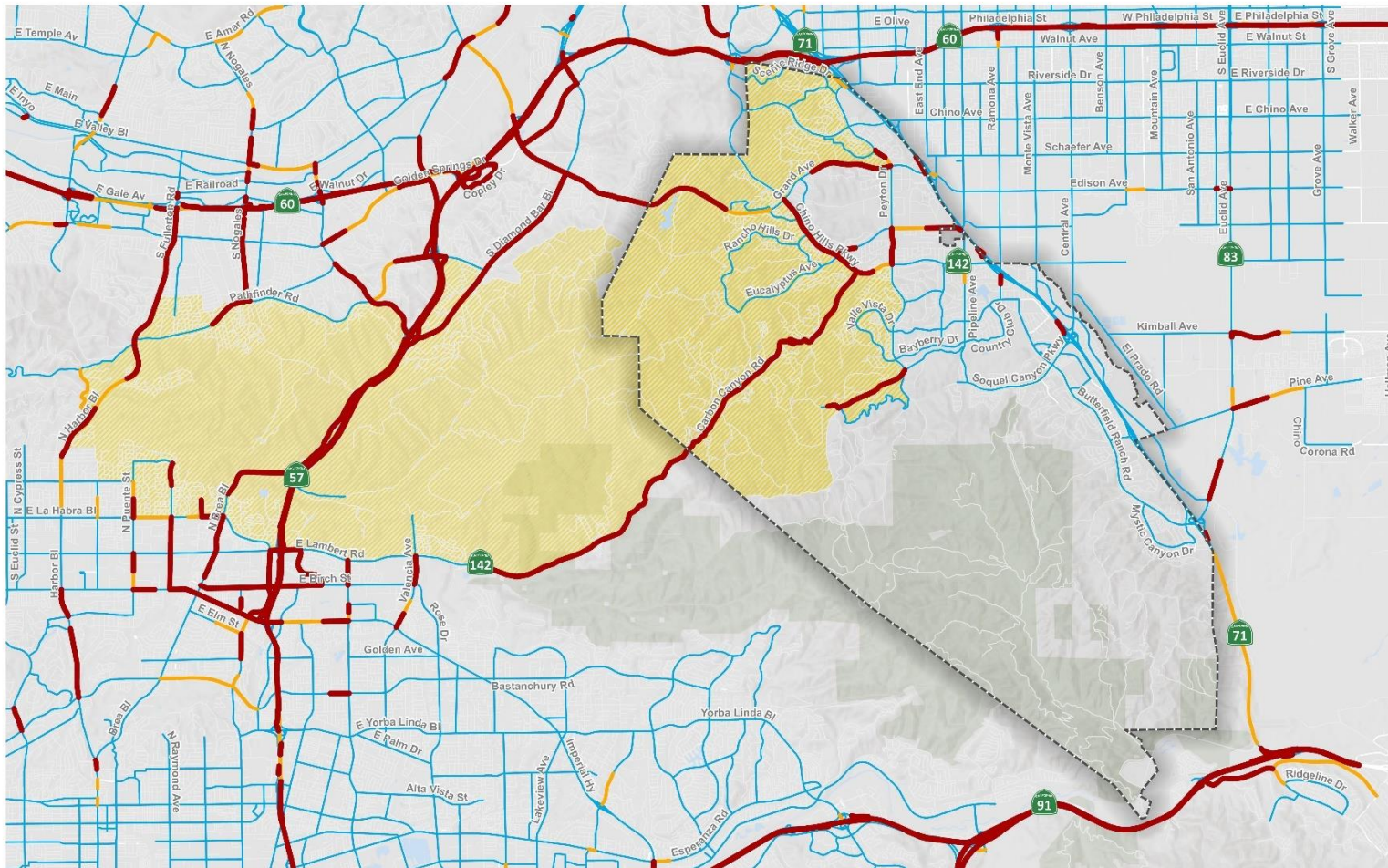
Source: Kittelson & Associates, 2024

Table 3: Affected Population and Peak Hour Evacuation Trips, Scenario 2 Wildfire Outside Carbon Canyon

Evacuating TAZs	Base Year Households	Base Year Employment	Base Year Evacuation Trips	Future Households	Future Employment	Future Evacuation Trips
53599101	808	366	1,501	1,249	992	2,609
22403100	1,514	1,305	3,231	1,832	1,801	4,060
22352200	666	77	1,086	698	102	1,152
22334100	1,262	221	2,108	1,282	229	2,145
22352100	1,287	248	2,165	1,346	260	2,265
53598201	3,166	926	5,540	4,323	1,618	7,804
53598101	542	102	910	659	176	1,142
53601101	1,380	937	2,775	1,360	509	2,455
53600101	1,440	345	2,468	1,370	208	2,267
53602101	1,831	244	3,007	1,907	147	3,060
22401100	643	148	1,098	749	148	1,263
32523100	446	233	850	529	247	988
32528100	646	190	1,131	882	190	1,498
32528200	849	237	1,478	1,089	237	1,851
32542100	750	231	1,320	1,024	390	1,853
32873400	348	8,721	6,427	475	8,725	6,627
32534100	866	417	1,626	1,183	685	2,299
32873200	650	318	1,224	887	610	1,789
32873100	0	0	0	0	0	0
32873300	147	109	302	201	315	525

Source: San Bernardino Transportation Analysis Model; Kittelson & Associates, Inc., 2024

Figure 10: Congestion Locations, Scenario 2 Wildfire Outside Carbon Canyon, Base Year



Volume-to-Capacity Ratio
 Under Capacity
 Near Capacity
 Over Capacity

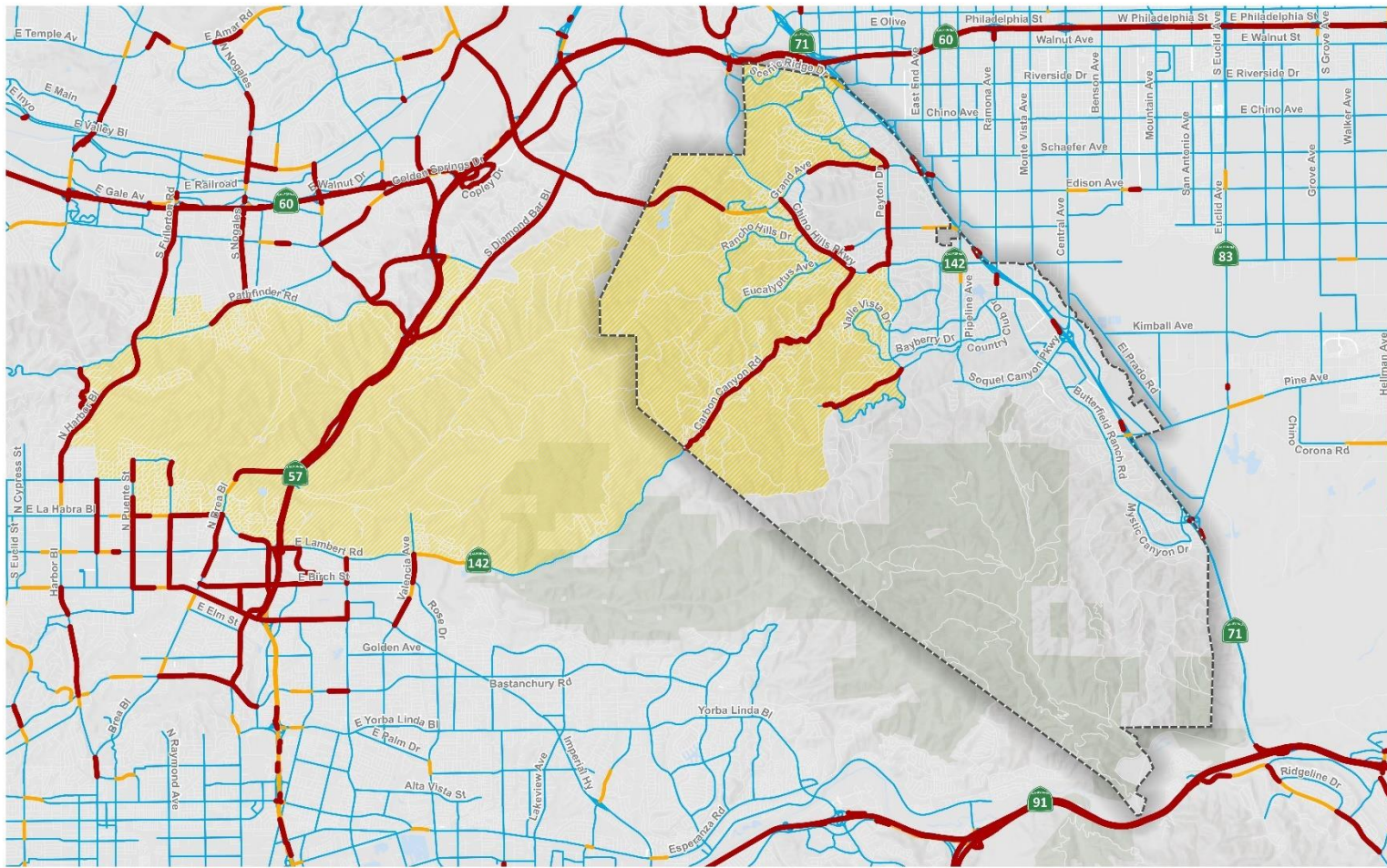
Evacuating Areas
 City Boundary
 Park



Congestion Locations
 Scenario 2 Wildfire Outside Carbon Canyon, Base Year
 Chino Hills Safety Element Update
 Chino Hills, CA

Source: Kittelson & Associates using SBTAM travel model, 2024

Figure 11: Congestion Locations, Scenario 2 Wildfire Outside Carbon Canyon, Future Year



Congestion Locations
Scenario 2 Wildfire Outside Carbon Canyon, Future Year
 Chino Hills Safety Element Update
 Chino Hills, CA

Source: Kittelson & Associates using SBAM travel model as updated by LLG Transportation Engineers and Planners, 2024

Table 4: Travel Times (Minutes), Scenario 2 Wildfire Outside Carbon Canyon

Origin and Destination	Base Year No Evacuation	Base Year Scenario 2	Future Year No Evacuation	Future Year Scenario 2
From Rolling Ridge Estates				
To Chino Hills Community Center	5.2	6.5	5.2	6.8
To Diamond Bar	9.0	13.4	9.4	16.7
To Brea	19.2	28.4	20.7	36.9
From Laband				
To Chino Hills Community Center	4.7	7.2	4.7	7.6
To Diamond Bar	4.7	9.1	5.0	12.3
To Brea	17.3	28.4	18.3	36.9
From Gordon Ranch				
To Chino Hills Community Center	5.1	5.1	5.1	5.1
To Diamond Bar	6.6	11.0	6.9	14.2
To Brea	17.4	30.9	17.8	40.3
From The Oaks				
To Chino Hills Community Center	4.4	9.4	4.4	9.4
To Diamond Bar	8.8	18.1	9.2	21.4
To Brea	19.4	33.7	20.1	42.5
From Carbon Canyon				
To Chino Hills Community Center	6.9	15.8	7.4	36.0
To Diamond Bar	11.4	24.7	12.2	47.8
To Brea	16.4	30.2	17.0	39.4

Source: Kittelson & Associates using SBTAM travel model, 2024

SCENARIO 3: EARTHQUAKE

Under this scenario, an earthquake occurs along the Chino Fault (part of the Elsinore Fault Zone) necessitating the evacuation of the Los Serranos and Butterfield Ranch communities and Chino Hills State Park (Figure 12). The Southern California Earthquake Data Center states that there is no recorded recent history of an earthquake specifically on the Chino Fault, but the probable magnitude of an earthquake on the Chino Fault would be a seismic moment magnitude (similar to but not identical to the Richter scale) of 6.0 to 7.0.

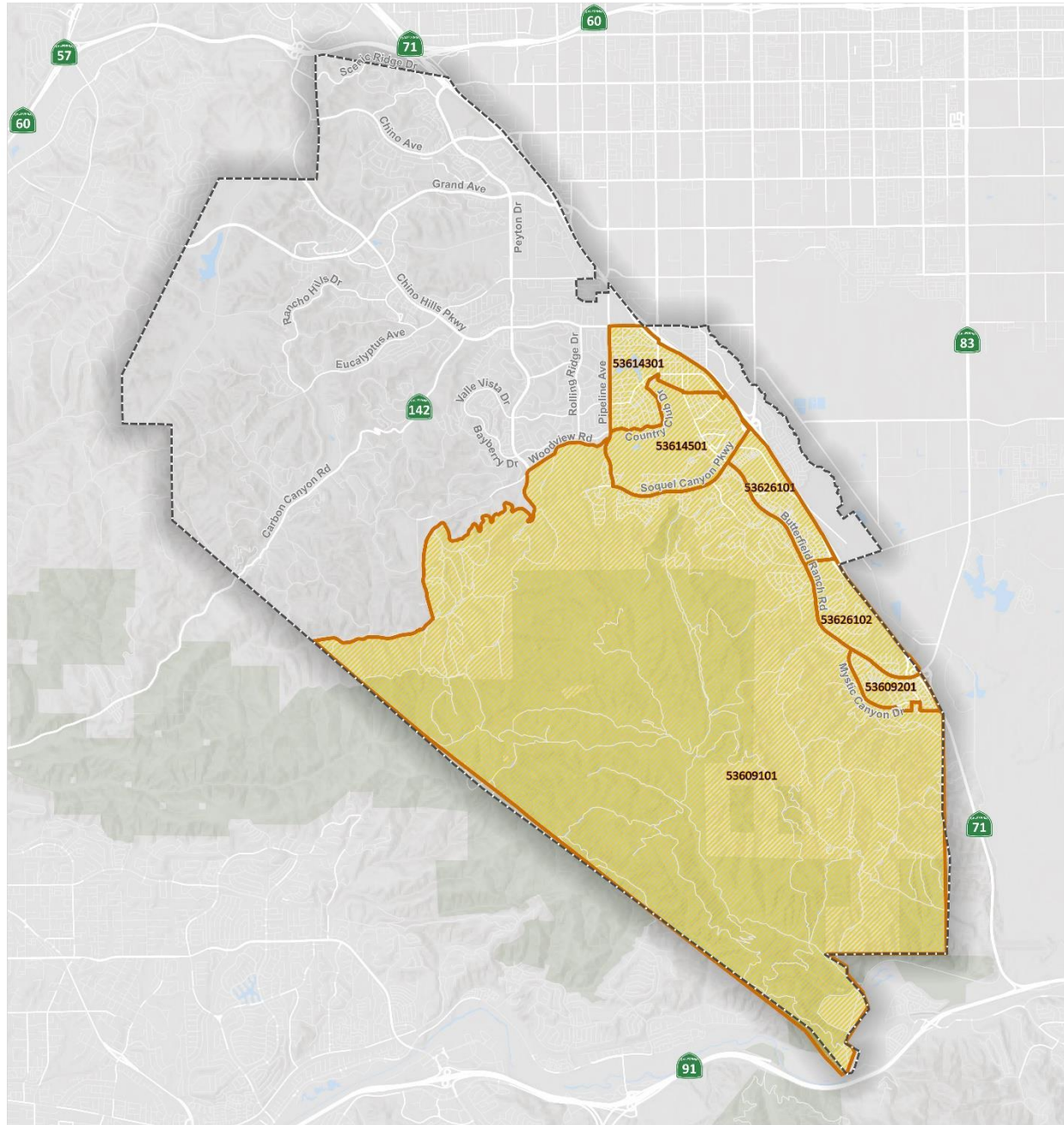
Table 5 shows the number of households and employees in the affected area as well as the total estimated evacuation trips for this scenario.

Table 5: Affected Population and Peak Hour Evacuation Trips, Scenario 3 Earthquake

Evacuating TAZs	Base Year Households	Base Year Employment	Base Year Evacuation Trips	Future Households	Future Employment	Future Evacuation Trips
53609101	2,276	389	3,796	3,715	1,537	6,805
53614501	1,044	765	2,137	1,840	954	3,501
53614301	2,214	578	3,827	2,614	213	4,202
53609201	1,171	108	1,891	1,171	91	1,879
53626101	740	419	1,432	1,667	879	3,181
53626102	607	604	1,350	961	554	1,866

Source: San Bernardino Transportation Analysis Model; Kittelson & Associates, Inc., 2024

Figure 12: Evacuating Area, Scenario 3 Earthquake



- TAZs
- Evacuating Areas
- City Boundary
- Park



Evacuation Scenario - Chino Fault Earthquake
Chino Hills Safety Element Update
Chino Hills, CA

Source: Kittelson & Associates, 2024

Base Year

With peak evacuation from an earthquake along the Chino Fault in the base year, the analysis indicates over-capacity conditions on several roadways in the city as shown in Figure 13. Specifically, the roadways where demand volumes are projected to be at or exceed road capacity include:

- Grand Avenue west of Chino Hills Parkway (similar to no evacuation conditions)
- Carbon Canyon Road between Brea and the Western Hills Country Club (similar to no evacuation conditions)
- Chino Hills Parkway, most segments within Chino Hills
- Peyton Drive, most segments within Chino Hills
- Eucalyptus Avenue
- Woodview Road east of Peyton Drive
- Soquel Canyon Parkway near SR 71
- Rolling Ridge Drive
- Pipeline Avenue
- Butterfield Ranch Road

Future Year

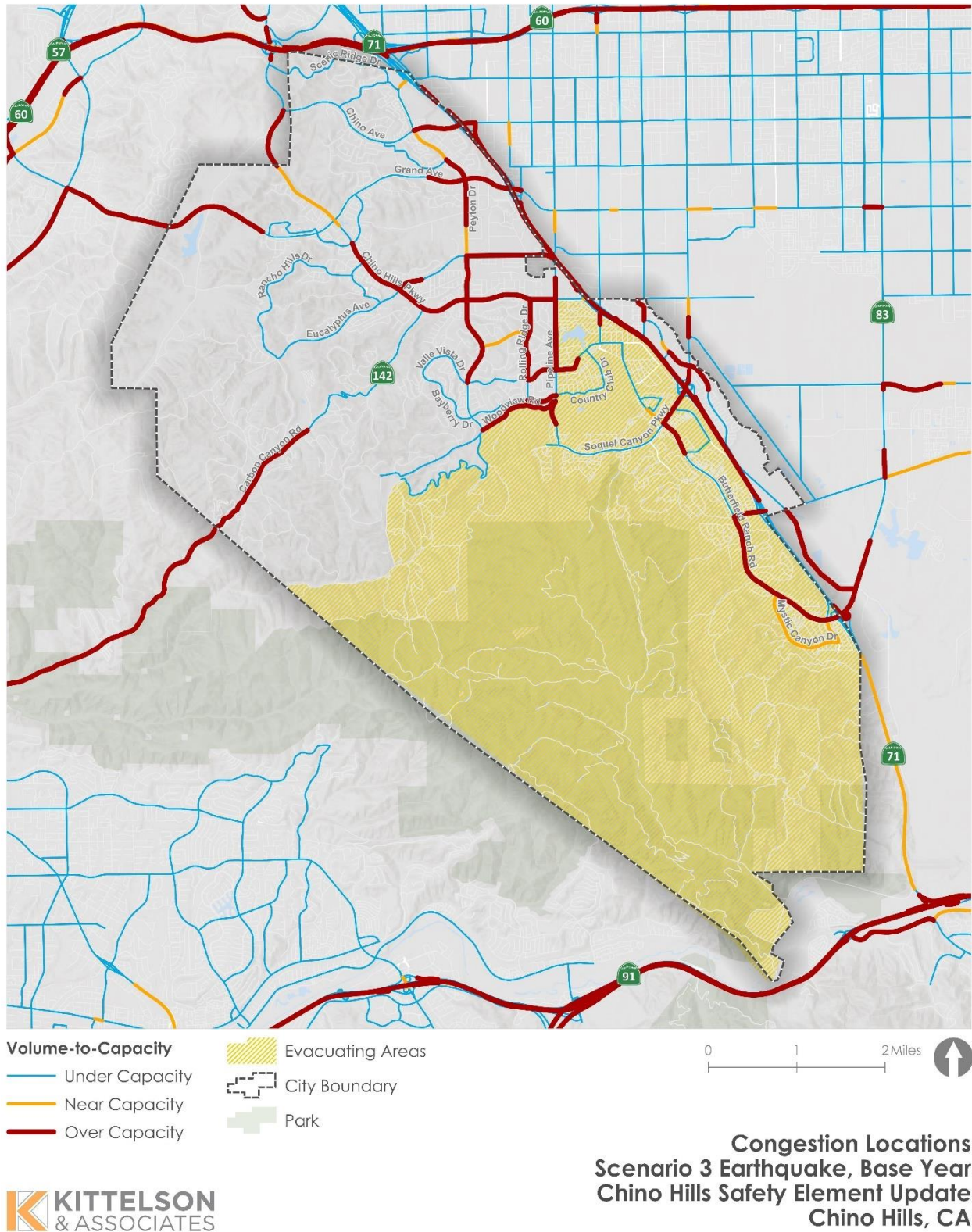
With peak evacuation from an earthquake along the Chino Fault in the future year, the analysis predicts over-capacity conditions on several roadways in the city as shown in Figure 14. Most congestion locations would be the same as those identified for the base year. In addition to the locations listed for the base year, the roadways where demand volumes are projected to be at or exceed road capacity include:

- Additional congestion on Glen Ridge Drive
- Additional congestion on Mystic Canyon Drive

Travel Times

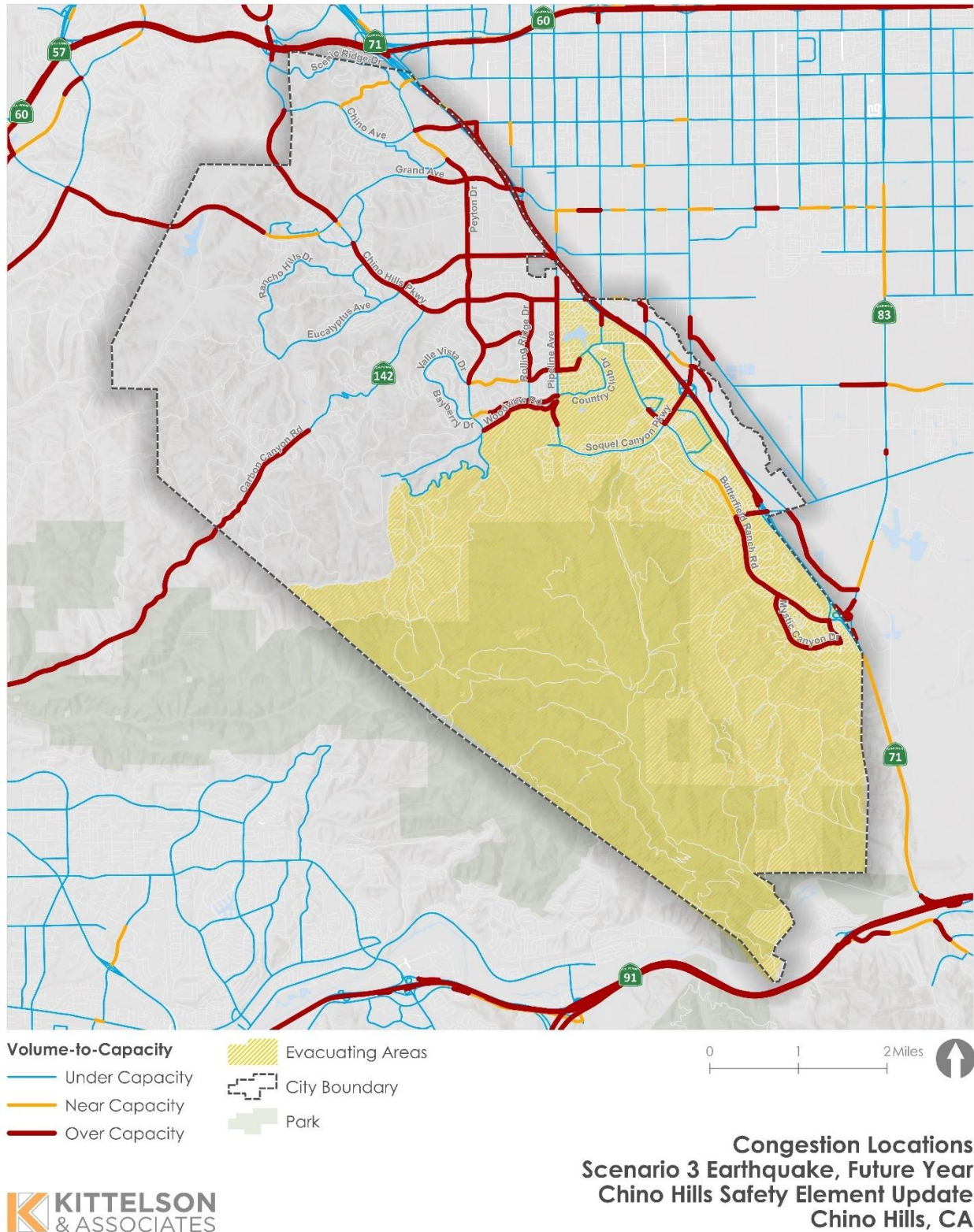
Travel times between Chino Hills neighborhoods and various evacuation destinations are listed in Table 6. With base year traffic levels, an evacuation event would add up to 39 minutes to the time to reach the Chino Hills Community Center and up to 37 minutes to reach safety in Diamond Bar. With future year traffic levels, an evacuation event would add up to 68 minutes to the time from the Butterfield Ranch area to the Chino Hills Community Center and up to 67 minutes to Diamond Bar.

Figure 13: Congestion Locations, Scenario 3 Earthquake, Base Year



Source: Kittelson & Associates using SBTAM travel model, 2024

Figure 14: Congestion Locations, Scenario 3 Earthquake, Future Year



Source: Kittelson & Associates using SBTAM travel model as updated by LLG Transportation Engineers and Planners, 2024

Table 6: Travel Times (Minutes), Scenario 3 Earthquake

Origin and Destination	Base Year No Evacuation	Base Year Scenario 3	Future Year No Evacuation	Future Year Scenario 3
From Los Serranos North				
To Chino Hills Community Center	5.9	23.5	6.0	29.4
To Diamond Bar	11.9	29.9	12.4	36.0
From Los Serranos South				
To Chino Hills Community Center	8.5	25.3	8.6	30.8
To Diamond Bar	14.5	30.3	15.0	36.2
From Rincon				
To Chino Hills Community Center	13.6	52.2	13.8	81.6
To Diamond Bar	19.8	56.8	20.7	87.0
From Butterfield Ranch North				
To Chino Hills Community Center	9.9	48.4	10.0	77.8
To Diamond Bar	16.0	53.0	17.0	83.3
From Butterfield Ranch South				
To Chino Hills Community Center	9.7	46.1	9.8	63.6
To Diamond Bar	15.9	50.4	16.7	69.0

Source: Kittelson & Associates using SBTAM travel model, 2024

Evacuation Planning Considerations

This section describes evacuation projects and strategies that may be considered to improve the capacity and resilience of the city’s roadway network to support future evacuation events. The projects and strategies were identified based on previous congestion and evacuation studies, review of recent evacuation efforts, and effective evacuation planning practices identified by US Department of Transportation (USDOT) and Federal Highway Administration (FHWA). The strategies are organized into five categories:

1. Roadway Management
2. Communications
3. Vulnerable Populations
4. Public Education
5. Resource Management

ROADWAY MANAGEMENT

This section includes infrastructure-related strategies that will aid in improving the capacity of the evacuation roadway network, which can be a challenging element in a successful evacuation. For each infrastructure-related treatment, it is necessary to consider downstream capacity limitations and identify if those limits nullify the potential benefits of the treatment as well as other competing roadway design needs to serve other functions and goals. Table 7 outlines each of these strategies and provides a brief description of the strategy and desired outcomes.

Of these strategies, the most effective for increasing evacuation capacity would be those that involve manual control of traffic combined with contra flow operations that allow evacuation on both inbound and outbound lanes of streets, combined with maintaining clear passages for emergency vehicles.

Table 7: Roadway and Intersection Capacity and Resilience Related Strategies

Strategy	Action Items
Limited contra flow on highways	Reverse one or more lanes of highway to accommodate an increased flow of traffic in one direction.
Unlimited contra flow on highways	Redirect all lanes of a designated evacuation route to accommodate rapid evacuation from a city or region.
Limited/unlimited contra flow on unlimited access arterials	Temporarily close inbound travel lanes on selected unlimited access arterials (such as parkways and boulevards) to allow outbound traffic to utilize these lanes during evacuation.

Strategy	Action Items
Closure of inbound lanes on selected roads and highways	Close inbound lanes on highways utilized for evacuation routes to prevent drivers on these routes from entering the city while evacuation is underway.
Restrict left-turn movements	Minimize left-turn movements along evacuation routes and on roads leading to evacuation routes.
Stage tow trucks	Consider how to stage tow trucks at bottleneck locations along evacuation routes to help detect and clear minor crashes and maintain traffic flows.
Adjust signal timing	Increase the green time and/or progression band for through movements leading out of an evacuation zone.
Signal operation during power outage	Install signal battery backups in case signal operations need to be maintained during a power outage. Consider using channeling devices, static signs, and coning strategies to manage intersection flow during power outage if the signals lack power.
Additional access routes	Identify and communicate with communities that have at least two access points. Prioritize adding additional access to communities which are currently served by only one or two access points.
Public Transit	Develop transportation solutions such as the use of a bus system for evacuating individuals with special needs (such as those with mobility limitations) and/or evacuating larger groups of people in fewer vehicles.
Traffic control points	Establish traffic control points (i.e., locations along designated evacuation routes with emergency management personnel) to maintain a greater degree of evacuation management. These locations could enhance the efficiency of an evacuation, reduce public confusion, and allow increased operational flexibility during an evacuation.
Vegetation clearing/management	Maintain evacuation roadways and shoulders to clear them of trees, vegetation, and debris that would block travel lanes and shoulders for evacuating and emergency operation vehicles.

COMMUNICATIONS

This section describes communication strategies that address how information may be shared among agencies, organizations, and the general public for evacuations. During an emergency evacuation event, two types of communication take place: (1) communication among entities involved in the management of response, and (2) communication between the City and the general public. Table 8 outlines each of these strategies and provides a brief description of the strategy and desired outcomes.

Table 8. Communication Strategies for Evacuations

Strategy	Description and Outcome
Establish and maintain communications	Strengthen and maintain communication among coordinating emergency event agencies. This could be achieved through systems such as the Public Information Emergency System and Emergency Satellite Communications.
Variable/Dynamic Message Signage	Use variable message board equipment and targeted installation of permanent dynamic message signs on evacuation routes to improve communication and reduce public confusion.
Traffic Control Center	Implement a traffic control center which would have up to the minute reports on traffic patterns and can communicate directly with emergency officers via broadcast media, social media, and other emergency communications channels (e.g., County Telephone Emergency Notification System and San Bernardino Ready App) to let drivers know about roadway congestion and conditions and direct them to alternate routes.
Traffic counters/CCTV cameras	Install traffic counters and/or CCTV cameras on freeways, which can help assess traffic flow, volume of vehicles evacuating, and monitor incidents during emergency evacuation events.
Highway Advisory Radio	Implement highway advisory radio to provide information regarding primary and secondary evacuation routes and incidents to the public.
Pre-defined evacuation zones	The city could consider implementing a system of pre-defined evacuation zones. Pre-defined evacuation zones can provide a common reference system for first responders and the community.

VULNERABLE POPULATIONS

This section identifies strategies specifically for evacuation of vulnerable populations.⁵ The city can use demographic data and U.S. Census data to identify vulnerable population locations and communities. City staff and emergency response teams may work with specialized organizations such as hospitals, medical associations, public service organizations, public health staff, and other providers or community groups to identify and locate relevant population segments and the types of assistance needed. Table 9 outlines considerations by need.

Table 9: Additional Steps for Evacuation of Vulnerable Populations

Special Need	Action Items/Considerations
Visually impaired	May be reluctant to leave familiar surroundings when the request for evacuation comes from a stranger. People who are blind or partially sighted may have to depend on their guide dogs and/or others to lead them to safety.
Hearing impaired	May need to make special arrangements to receive evacuation warnings. Include visual aids such as pictures or maps to reinforce key messages.
Mobility impaired	May need special assistance such as paratransit. Partner with neighboring cities/private/non-profit agencies to provide adequate paratransit services.
People without vehicles	Emphasize the importance of carpooling with neighbors or other community members. Provide information on transit routes and transit stops.
Non-English-speaking persons	Provide bilingual or multilingual materials to support communication with non-English speaking populations during evacuation.
People with medical conditions	Communicate in advance the location and availability of hospitals or facilities with emergency/life-sustaining medical equipment such as a dialysis machine.
Unhoused (Homeless) population	Arrange for food, shelter, and transportation for unhoused (homeless) population. Offer age-appropriate emergency and evacuation information to homeless children.

⁵ *Using Highways for No-Notice Evacuations: Five Planning Considerations*, FHWA, Accessed August 2022.

PUBLIC EDUCATION

Sharing information is a critical element to help educate the general public on how to prepare in advance for an evacuation. The public education strategies the city may consider include:

- Defining the meaning of different types of evacuation orders;
- Sharing how evacuation orders are declared and communicated to the public;
- Providing information on preparations to carry out in advance (such as emergency “go” kits or family evacuation plans);
- Conducting a public affair campaign(s) to distribute easy-to-read evacuation maps with alternate routes;
- Providing information on available transportation options, including for vulnerable populations; and
- Providing information on evacuation shelters and support services offered during evacuation.
- Providing regular emergency preparedness trainings in multiple languages at convenient, accessible locations.
- Building capacity of resilience hubs, CBOs, and other community groups to support community-based disaster preparedness efforts through direct or passthrough funding, grant writing support, information sharing, etc.

RESOURCE MANAGEMENT

Evacuations are resource-intensive events that require significant personnel, facilities, and equipment to implement successfully. The City should determine what resources are available as well as what resources will be needed for staff to perform their responsibilities during an evacuation successfully, which can include the following:

- Clarity on staff roles and expertise available;
- Facilities available (e.g., traffic operations center, shelters, etc.);
- Available information systems to support the evacuation (e.g., ITS, computer networks, ancillary hardware such as cameras, road sensor loops, etc.);
- Communication systems (e.g., landline, mobile phones, radio system, email, sirens);
- Vehicles/transport (e.g., staff transport, tow trucks, transit vehicles, heavy equipment); and
- Miscellaneous materials to support implementation of evacuation strategies (e.g., traffic cones, channeling devices, static signs).

If critical resource gaps are identified, the City may look to work with other evacuation entities to determine additional resources and needs. The City may also work with private sector entities to expand the resource base. For example, utilities companies may keep cell and internet services running in vulnerable communities during public safety power shutoffs. Private service companies such as ambulance operators and towing companies can provide additional assets during evacuation. These companies can clarify what is expected of them during a potential evacuation event to ensure their services are available, when needed.

Next Steps

This memorandum describes the results of the evacuation analysis as well as evacuation planning considerations and strategies to help improve the capacity and resilience of the City of Chino Hills' roadway network to support future evacuation events. This information will be used to frame supportive policies for the Safety Element update. These strategies and policies can be used to identify potential evacuation resiliency improvements throughout the City.