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I. INTRODUCTION

Purpose

This study evaluates the traffic and circulation impacts associated with the proposed residential development located on Olive Drive just north of Interstate 80 in Davis (see Figure 1). The proposed project includes 122 apartments, 43 affordable housing units, and 3,500 square feet of commercial space. The affordable housing units would not initially be constructed with the rest of the project; however, this study assumes all three components in place. The traffic impacts of the proposed project are evaluated at key intersections in the vicinity of the site under existing and cumulative (2010) conditions. Two alternatives are evaluated: one with a high vehicular mode share and one with a low vehicular mode share. In the latter alternative, pedestrian, bicycle, and transit modes are assumed to be more heavily utilized. In addition, access to the project site, on-site circulation, and parking are evaluated. Where necessary, recommendations are provided to improve off-site traffic operations and on-site access and circulation.

Study Area

The potential off-site traffic impacts of the project were evaluated during the a.m. and p.m. peak hours at the following intersections:

- Richards Boulevard / First Street / E Street;
- Richards Boulevard / Olive Drive; and
- Olive Drive / Hickory Lane.

Analysis Methodology

To determine the operating conditions of an intersection or roadway, the concept of level of service (LOS) is commonly used. The LOS grading system is a rating scale ranging from LOS A to LOS F, where LOS A represents free-flow conditions and LOS F represents congested or jammed conditions. A unit of measure, such as vehicle delay, generally accompanies the LOS designation. For this study, the Transportation Research Board’s Highway Capacity Manual (2000) signalized and unsignalized methodologies were utilized. For each, operations are defined by the average control delay per vehicle (measured in seconds). This incorporates delay associated with deceleration and acceleration, stopping, and moving up in the queue. Tables 1 and 2 relate the average control delay with each level of service category. For signalized
Table 1
Signalized Intersection Level of Service Criteria

<table>
<thead>
<tr>
<th>Level of Service</th>
<th>Control Delay per Vehicle (sec/veh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>≤ 10</td>
</tr>
<tr>
<td>B</td>
<td>&gt;10-20</td>
</tr>
<tr>
<td>C</td>
<td>&gt;20-35</td>
</tr>
<tr>
<td>D</td>
<td>&gt;35-55</td>
</tr>
<tr>
<td>E</td>
<td>&gt;55-80</td>
</tr>
<tr>
<td>F</td>
<td>&gt; 80</td>
</tr>
</tbody>
</table>


Table 2
Unsignalized Intersection Level of Service Criteria

<table>
<thead>
<tr>
<th>Level of Service</th>
<th>Control Delay per Vehicle (sec/veh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0–10</td>
</tr>
<tr>
<td>B</td>
<td>&gt;10-15</td>
</tr>
<tr>
<td>C</td>
<td>&gt;15-25</td>
</tr>
<tr>
<td>D</td>
<td>&gt;25-35</td>
</tr>
<tr>
<td>E</td>
<td>&gt;35-50</td>
</tr>
<tr>
<td>F</td>
<td>&gt; 50</td>
</tr>
</tbody>
</table>


intersections, the delay is typically represented as an average per vehicle for the total intersection. For unsignalized intersections, the delay is typically represented for each movement from the minor approaches only. Throughout this report, the average control delay per vehicle will be referred to as average delay.
Level of Service Standards

According to General Plan Standard #0.2, operations during peak hours of LOS E or better are considered acceptable.
II. EXISTING CONDITIONS

This section describes the existing roadway system and analyzes existing intersection operations in the vicinity of the project site.

Roadway System

Figure 1 displays the major roadways in the vicinity of the project site. A brief description of the key facilities in the area is provided below.

- **Interstate 80 (I-80)** - is an east-west six- to eight-lane freeway that extends through the study area. I-80 provides access to the San Francisco Bay Area and the Sacramento Area and beyond. Through Davis, approximately 113,000 vehicles travel along I-80 during a typical weekday.

- **Richards Boulevard** - is a two- to four-lane arterial that provides access between downtown Davis, southern Davis, and I-80. South of First Street, Richards Boulevard is a narrow two-lane roadway that passes through a tunnel under the Union Pacific Railroad. South of Olive Drive, the roadway crosses over I-80 with two travel lanes in each direction. East of Research Park Drive, Richards Boulevard becomes Cowell Boulevard and narrows to one travel lane in each direction. Class II bicycle lanes are provided on both sides of Richards Boulevard south of Olive Drive. A Class I bicycle path is provided on the west side of the roadway between Olive Drive and First Street.

- **Olive Drive** – is a two-lane east-west roadway that intersects Richards Boulevard just south of the Union Pacific Railroad tracks. Olive Drive connects both commercial and residential land uses to Richards Boulevard and carries approximately 3,300 vehicles (east of Richards Boulevard) during a typical weekday. A westbound I-80 off-ramp terminates at the east end of Olive Drive east of the project site. Eastbound traffic is forced to turn around at this point and yield to exiting freeway traffic. Class II bicycle lanes are provided on both sides of Olive Drive.

---

1 Freeway volumes for I-80 (east of Richards Boulevard) from Caltrans’ 1999 Traffic Volumes on California State Highways.
• **Hickory Lane** – is a short two-lane unpaved residential street located directly across from the project site. This north-south roadway extends north of Olive Drive, connecting it to residential land uses.

• **First Street** – is a two-lane arterial extending from A Street to G Street along the southern boundary of downtown Davis. First Street provides access between the University of California and the Richards Boulevard corridor and I-80. On-street parking is provided on the north side of First Street west of E Street. A Class I bicycle path runs along the south side of the roadway, connecting the Richards Boulevard bicycle path to the University.

**Transit Service**

Unitrans is a student-owned and operated transit system providing bus service to both students and residents throughout Davis. All routes begin and end on the University campus and cover over 100 miles throughout the City. In the vicinity of the project site, the *W Line* and *M Line* provide service to the University. The *W Line* travels along Richards Boulevard, Cowell Boulevard, Drummond, Avenue, and Lillard Avenue. Service is provided in 10 to 20-minute headways on most weekdays. One-hour headways are maintained during University breaks, holidays, and finals. No Saturday service is provided along Richards Boulevard. The closest stop to the project site is on the west of Richards Boulevard, between Olive Drive and the I-80 westbound on-ramp. The *M Line* provides night service only (7:10 to 11:10 p.m.) and travels to the end of Olive Drive and returns to campus. However, this route is demand responsive, running only when requested by a rider at the Memorial Union (MU).

**Pedestrian and Bicycle Facilities**

Davis provides an extensive, connected network of bicycle and pedestrian facilities through the City. Due to the proximity of the project site to downtown Davis and the University, walking and bicycling are viable means of transportation. Class II bicycle lanes are provided on Olive Drive and connect to bicycle facilities along Richards Boulevard. A separate pedestrian/bicycle tunnel under the railroad tracks along the west side of Richards Boulevard allows for safe crossing towards downtown and the University. Bicycle lanes on Richards Boulevard south of Olive Drive provide a connection to south Davis.

Pedestrian sidewalks are provided along developed portions of Olive Drive. Signal-controlled
crosswalks are provided at the Richards Boulevard/Olive Drive intersection for crossing to the west side of Richards Boulevard, where the Unitrans bus stop is located. An at-grade private railroad crossing exists adjacent to the Amtrak/Greyhound Depot for UPRR’s use; however, due to its proximity to downtown Davis, this crossing is frequently used by the public.

On November 30, 2001, 23 pedestrians/bicyclists were observed crossing the tracks between 7:30 and 9:30 a.m. High speed freight locomotives and AMTRAK frequent this corridor. Limited visibility due to the track curvature and numerous trees and lack of at-grade crossing control devices make this location unsafe for crossing. According to City staff, UPRR previously installed a fence to deter public use of this crossing, but this prior effort was unsuccessful. City staff has met with the Public Utilities Commission and UPRR to discuss the possibilities of installing a safe crossing, although no funding for such an installation has been identified at this time. For more information on this issue, please refer to Pedestrian, Bicycle, and Transit Assessment for Olive Drive Apartments, written by The Hoyt Company (January, 2002).

Existing Traffic Volumes

Fehr & Peers Associates performed traffic counts at each study intersection during the a.m. peak period (7:00 to 9:00 a.m.) and p.m. peak period (4:00 to 6:00 p.m.) in March 2001. At the time of the counts, the University was in session under a normal schedule. Appendix A contains the peak period count sheets. Richards Boulevard/Olive Drive peak period intersection counts were reconducted in November 2001. It was determined that in November, some movements were higher and some were lower than the March counts. The overall amount of traffic at the intersection was virtually the same. Nevertheless, the movements affected by the proposed project were carefully reviewed to insure a conservative analysis of project impacts. The only changes made were for the westbound approach, where all movements showed higher volumes than in March for the a.m. peak hour only, and the southbound left turn for the p.m. peak hour. Therefore, the existing conditions analysis results provided in this report incorporate the higher a.m. peak hour volumes for the westbound approach.

Figure 2 displays the existing peak hour traffic volumes, lane configurations, and traffic control devices at each study intersection. The Olive Drive/Hickory Lane intersection is unsignalized, and the other two study intersections are signalized. As shown, a separate northbound right-turn

---

3 The peak hour volumes displayed in Figure 2 and used in the existing conditions analysis are slightly different than those contained in Appendix A because the volumes were balanced between intersections.
EXISTING CONDITIONS

PEAK HOUR TRAFFIC VOLUMES AND LANE CONFIGURATIONS

FIGURE 2
lane is included on Richards Boulevard at First Street, as was recently constructed.

**Existing Levels of Service**

As part of the *Richards Boulevard Corridor Alternatives Study*, Fehr & Peers Associates developed a CORSIM corridor simulation model for the Richards Boulevard/First Street corridor between D Street and Research Park Drive. Improved signal timing plans were developed as part of this study. The existing conditions analysis utilizes this model which assumes the improved timing plans and a separate northbound right-turn lane on Richards Boulevard at First Street. Because both of these improvements were recently implemented by the City, Fehr & Peers Associates revalidated the model using November 2001 queue length counts, and more detailed pedestrian crossing information, along with the volume adjustments at Richards Boulevard/Olive Drive mentioned in the previous section. Table 3 displays the existing peak hour service levels at each study intersection (see Appendix B for technical calculations).

<table>
<thead>
<tr>
<th>Intersection</th>
<th>AM Peak Hour</th>
<th>PM Peak Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Delay¹</td>
<td>Level of Service</td>
</tr>
<tr>
<td>Richards / First / E</td>
<td>21.1</td>
<td>C</td>
</tr>
<tr>
<td>Olive / Richards</td>
<td>19.6</td>
<td>B</td>
</tr>
<tr>
<td>Olive / Hickory²</td>
<td>10.0</td>
<td>A</td>
</tr>
</tbody>
</table>

**Notes:**
1. Average control delay calculated in seconds per vehicle.
2. Delay and level of service reported for the southbound Hickory Lane approach only.


As shown, all study intersections currently operate within the City’s threshold of LOS E or better.
Queues for Critical Movements

One of the key issues raised for this project is the impact of the added traffic at the Richards Boulevard/Olive Drive intersection, and specifically the queues for the affected movements. These movements include the southbound left-turn, the westbound left-turn, and the westbound right-turn. Table 4 displays maximum observed queue for each of these key movements based on field survey data collected in November of 2001. Currently, the southbound and westbound turn movements exceed the available storage capacity by two to six vehicles during at least one peak hour of the day.

It was observed that pedestrians crossing the north leg of the intersection delay westbound right-turning vehicles, and pedestrians crossing the south leg of the intersection delay westbound left-turning vehicles. The queues reported in Table 4 are created by a combination of delay incurred at the intersection during a red light and delay incurred by pedestrian crossings.

<table>
<thead>
<tr>
<th>Movement</th>
<th>Available Storage (No. Vehicles)</th>
<th>Existing Queues (No. Vehicles)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>AM Peak Hour</td>
</tr>
<tr>
<td>Southbound Left</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Westbound Left</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Westbound Through/Right</td>
<td>Not applicable</td>
<td>11</td>
</tr>
</tbody>
</table>

Three-Year Accident History

The City of Davis maintains a record of reported traffic accidents that occur throughout the City. A three-year summary of those reported within 100 feet of the Richards Boulevard/Olive Drive intersection or along Olive Drive (east of Richards Boulevard) are summarized in Table 5. Both the total number of accidents and the type of collision for each accident are provided.

During the first year of the three-year survey (April 1998 through March 1999), six accidents
occurred within the area studied. The total increased to 13 and 17 for the second and third years (April 1999 through March 2000 and April 2000 through March 2001, respectively). The majority of accidents, 20, during the three years were rear-end collisions. Four of the reported accidents involved a bicyclist and none involved a pedestrian. Of the 36 total accidents during the three-year period, 12 occurred north of the intersection, nine occurred in the intersection, and nine occurred south of the intersection. The remaining six occurred either east or west of the intersection.
<table>
<thead>
<tr>
<th>Year</th>
<th>Total Accidents Per Year</th>
<th>Location</th>
<th>Total Accidents By Location</th>
<th>Type of Accidents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Broadside</td>
<td>Head-On</td>
</tr>
<tr>
<td>4/98 - 3/99</td>
<td>6</td>
<td>Intersection</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>North</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>South</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>West</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4/99 - 3/00</td>
<td>13</td>
<td>Intersection</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>North</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>South</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>West</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4/00 - 3/01</td>
<td>17</td>
<td>Intersection</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>North</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>South</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>West</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td></td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes:
1. Study area includes the Richards Boulevard/Olive Drive intersection (within 100 feet) and Olive Drive (east of Richards Boulevard).
2. Accident locations are either at the intersection or within 100 feet of the intersection (unless indicated otherwise).
3. Accident(s) involves a bicycle.
4. One accident occurred 1,500 feet east of the Richards Boulevard/Olive Drive intersection.

Source: City of Davis, Department of Public Works, 2001.
III. EXISTING PLUS PROJECT CONDITIONS

This chapter evaluates the impacts of the proposed project on existing traffic operations in the vicinity of the project site. Two alternatives are evaluated - both of which are based on the same site plan. Alternative 1 assumes a high vehicular mode share (i.e. limited use of pedestrian, bicycle, and transit modes), and Alternative 2 assumes a low vehicular mode share (with a higher percentage of pedestrian, bicycle, and transit use).

Project Description

The project site is located east of Richards Boulevard and north of I-80 on Olive Drive in Davis, as illustrated by Figure 1. According to the site plan, shown on Figure 3 (Mogavero Notestine Associates, March 25, 2001), the proposed project consists of 122 apartment units, 43 affordable housing units, and 3,500 square feet of commercial space. Access to the site would be provided by four driveways on Olive Drive. Each driveway would provide left- and right-turn movements and is described in detail below:

- **Driveway 1** - is a 14-foot wide primary driveway near the western end of the project boundary. It provides access to the main aisle, which circles through the site to Driveway 4. Most parking spaces can be accessed from the main aisle. Driveway 1 also provides access to the parking spaces adjacent to the commercial land use.
- **Driveway 2** - is a 12-foot secondary driveway about 270 feet east of Driveway 1 and about 75 feet west of Hickory Lane. Driveway 2 provides access to nine parking spaces.
- **Driveway 3** - is a 12-foot secondary driveway about 140 feet east of Driveway 2 and about 65 feet east of Hickory Lane. Driveway 3 provides access to 24 parking spaces.
- **Driveway 4** - is a 14-foot wide primary driveway near the eastern end of the project boundary. It is located about 110 feet east of Driveway 3. It provides access to the main aisle, which circles through the site to Driveway 1.

In total, 389 parking spaces are shown on the site plan. Of the spaces shown, 370 are off-street spaces and 19 are on-street spaces. The main aisle, connecting Driveway 1 and Driveway 4, would accommodate two directions of flow and would include angled parking spaces, except for 16 perpendicular spaces near Driveway 1 adjacent to Building D. All other off-street parking would be perpendicular spaces. The on-street spaces are parallel to the curb.
SITE PLAN

FIGURE 3

Olive Drive Apartments

Source: Hallmark Properties, Mogavero Notestine Associates, March 2001

= Driveway Number

Olive Drive

Not to Scale

January 2002
1697-13a
Trip Generation

Trip generation for Alternatives 1 and 2 is presented in this section. Alternative 1 assumes a high vehicular mode share, and Alternative 2 assumes less travel assumed to occur by automobile and more by pedestrian, bicycle, and transit modes. Each is described in more detail below.

Alternative 1

The trip generation for Alternative 1 was computed based on two sources: the City of Davis General Plan and Trip Generation (Institute of Transportation Engineers, 6th Edition, 1997)4. Table 6 summarizes the daily and peak hour trip generation of Alternative 1. All assumptions were reviewed and approved by City staff. The results are summarized in Table 6.

To estimate the number of trips generated by the housing units, the multi-family housing trip generation rate published in the City of Davis General Plan (8.5 trips per unit per day) was used. This rate is somewhat higher than the daily rate published in the Institute of Transportation Engineer’s Trip Generation (6th Edition) (6.82 trips per day), but was developed as a more location-specific rate by the City during the development of the City-wide traffic model. Staff found this rate to be more consistent with the level of trip productions occurring within the City-wide model in the vicinity of multi-family developments in Davis.

To develop peak hour rates, the percent difference between the General Plan rate (8.5 trips per day) and the daily rate published in Trip Generation (6.82 trips per day) was applied to the peak hour rates published in Trip Generation. The rates were then adjusted by 5% to account for a non-vehicular mode share (e.g., pedestrian, bicycle, and transit trips). To estimate the number of trips generated by the 3,500 square feet of commercial space, shopping center average trip generation rates provided in Trip Generation were used and adjusted by 20 percent. An adjustment of 20 percent was applied to account for trip generation internal to the project and trip generation of walking trips from nearby housing. That is to say that an estimated 20 percent of the commercial trips would be generated by the housing units on-site. Shopping center trip generation rates were used because the actual use has not yet been determined. Due to the proximity of the project site, it was conservatively assumed that no pass-by trips would occur.

---

4 At the time that this study was initiated, the 1987 General Plan was the most recent adopted version. The 2001 General Plan has since been adopted but provides a less conservative trip rate for multi-family unit. Therefore, the more conservative rate provided in the 1987 Plan was used.
Table 6
Alternative 1 (High Vehicular Mode Share) Project Trip Generation

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Size</th>
<th>Trip Rates</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Daily</td>
<td>AM Peak Hour</td>
<td>PM Peak Hour</td>
<td>Daily</td>
<td>AM Peak Hour</td>
</tr>
<tr>
<td>Housing</td>
<td>165 Units</td>
<td>8.5&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.65&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.81&lt;sup&gt;2&lt;/sup&gt;</td>
<td>1,403</td>
<td>107</td>
</tr>
<tr>
<td>With 5% Adjustment&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,333</td>
<td>102</td>
</tr>
<tr>
<td>Commercial&lt;sup&gt;4&lt;/sup&gt;</td>
<td>3.5 ksf&lt;sup&gt;5&lt;/sup&gt;</td>
<td>42.92</td>
<td>1.03</td>
<td>3.74</td>
<td>150</td>
<td>4</td>
</tr>
<tr>
<td>With 20% Adjustment&lt;sup&gt;6&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>120</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Trips</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>1,453</strong></td>
<td><strong>105</strong></td>
</tr>
</tbody>
</table>

Notes:
1. Daily rate of 8.5 trips taken from the 1987 City of Davis General Plan. The 2001 General Plan was not yet approved at the time this study was initiated.
2. Peak hour rates formulated by comparing the percent difference between the General Plan daily rate to the daily rate published in Institute of Transportation Engineers' *Trip Generation* (6th Edition) and applying the difference to *Trip Generation* peak hour rates. Note that the *Trip Generation* rates were determined using the regression equations because all of the criteria (established in ITE’s *Trip Generation Handbook*) were met for using the equation rather than using the weighted average rate.
3. Trip generation rates provided in ITE’s *Trip Generation* typically do not account for transit usage or high pedestrian and bicycle traffic. An adjustment of 5% was applied to account for the non-vehicular usage common in Davis made possible by convenient transit service and extensive pedestrian and bicycle facilities.
4. Rates represent average trip generation rates per 1,000 square feet of Shopping Center in ITE’s *Trip Generation* (6th Edition). Average trip generation rates were used for estimating the commercial land use trip generation because not all of the criteria (established in ITE’s *Trip Generation Handbook*) were met for using the equation rather than using the weighted average rate.
5. Thousand square feet.
6. An adjustment of 20% was applied to the commercial trips to account for trip generation internal to the project and trip generation of walking trips from nearby housing.


As shown in Table 6, an estimated 1,453 daily, 105 a.m. peak hour, and 137 p.m. peak hour trips would be generated by the project. Based on inbound/outbound splits provided in *Trip Generation*, 19% of the a.m. trips would be inbound, and 65% of the p.m. trips would be inbound.

**Alternative 2**

In order to explore what level of operation could be achievable assuming lower trip generation
than published in the General Plan and assuming high usage of alternate modes of travel, Alternative 2 was developed. The trip generation for Alternative 2 was computed based on two sources: *Trip Generation* and *Pedestrian, Bicycle, Transit Assessment for Olive Drive Apartments*, written by The Hoyt Company (January 2002). Based on surveys conducted in cities throughout the United States, *Trip Generation* has a published daily trip generation rate of 6.81 trips per unit for multi-family dwelling units. A morning peak hour rate of 0.52 trips per unit and an evening trip generation rate of 0.65 trips per unit are also published in *Trip Generation* and assumed for Alternative 2. Table 7 summarizes the daily and peak hour trip generation of the proposed project. The assumptions yielding a higher non-auto mode share are based on the premise that the close proximity of the project site to the University, to downtown, and to Unitrans bus service would allow for convenient use of alternate modes, such as walking, bicycling, or bus transit. All assumptions were reviewed and approved by City staff.

### Table 7

**Alternative 2 (High Non-Vehicular Mode Share) Project Trip Generation**

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Size</th>
<th>Trip Rates</th>
<th>Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Daily</td>
<td>AM Peak Hour</td>
</tr>
<tr>
<td>Housing</td>
<td>165 Units</td>
<td>6.81(^1)</td>
<td>0.52(^1)</td>
</tr>
<tr>
<td></td>
<td>With 41%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adjustment(^2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td>3.5 ksf(^4)</td>
<td>42.92</td>
<td>1.03</td>
</tr>
<tr>
<td></td>
<td>With 38%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adjustment(^5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Trips</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
1. Daily and peak hour rates published in Institute of Transportation Engineers’ *Trip Generation* (6\(^{th}\) Edition). Note that the *Trip Generation* rates were determined using the regression equations because all of the criteria (established in ITE’s *Trip Generation Handbook*) were met for using the equation rather than using the weighted average rate.
2. As estimated in The Hoyt Company’s November 14, 2001 memorandum, an estimated 59 percent of the trips generated will utilize single occupancy vehicles. The remainder will either walk, bicycle, or take public transit.
3. Rates represent average trip generation rates per 1,000 square feet of Shopping Center in ITE’s *Trip Generation* (6\(^{th}\) Edition). Average trip generation rates were used for estimating the commercial land use trip generation because not all of the criteria (established in ITE’s *Trip Generation Handbook*) were met for using the equation rather than using the weighted average rate.
4. Thousand square feet.
5. As estimated in The Hoyt Company’s November 14, 2001 memorandum, an estimated 62 percent of the trips generated will utilize single occupancy vehicles. The remainder will either walk, bicycle, or take public transit.

**Source:** Fehr & Peers Associates, 2002.
As shown in Table 7, the Alternative 2 trip generation scenario results in a daily vehicle trip generation that is 48 percent less than Alternative 1.

**Trip Distribution and Assignment**

All inbound/outbound trips were assumed to come from/go to Richards Boulevard via Olive Drive. Trip distribution and assignment throughout the area was assumed proportional to existing traffic counts. Project trip distribution is shown in Figure 4 and was used for both Alternative 1 and Alternative 2. Project trip assignment through the study intersections is shown in Figures 5 and 6 for Alternatives 1 and 2, respectively. Figures 7 and 8 summarize existing plus project peak hour intersection counts for each alternative. Based on the layout of the project site, half of the project trips were assumed to use Driveways 1 and 2 and the remaining half were assumed to use Driveways 3 and 4. Therefore, half of the project trips would travel through the Olive Drive/Hickory Lane intersection.

**Level of Service Results**

Table 8 compares Alternative 1 and Alternative 2 peak hour levels of service at each study intersection under existing and existing plus project conditions (see Appendix B for technical calculations). This table shows that operations are still maintained at acceptable levels at each of the study intersections with average delays increasing by about 0-2 seconds. As expected, operations generally improve slightly under Alternative 2 as compared to Alternative 1 due to the reduced vehicle trip generation. The slight decrease (0.2 seconds) in average delay at Richards Boulevard/Olive Drive with addition of project traffic is an inherent result of the calculation methodology. Addition of trips to low-delay movements (particularly right turns) can result in the overall average delay decreasing. In reality, no difference in delay would be detected.

The additional pedestrian and bicycle trips are considered in the model. Additional crossings on the north leg of the intersection will increase delay for right-turning vehicles off of Olive Drive onto northbound Richards Boulevard. Additional crossings on the south leg of the intersection will increase delay for left-turning vehicles off of Olive Drive onto southbound Richards Boulevard. The impacts, however, will not deteriorate operations at the intersection to unacceptable levels, as shown in Table 8.
Figure 5

Key:
xx (yy) = AM (PM) Peak Hour Traffic Volumes
1 = Study Intersection

Olive Drive Apartments
Alternative 1
Project Trip Assignment

Transportation Consultants

January 2002
1687-15a
University of California at Davis

ALTERNATIVE 2
PROJECT TRIP ASSIGNMENT

FIGURE 6

KEY:
XX (YY) = AM (PM) Peak Hour Traffic Volumes
1 = Study Intersection

Olive Drive Apartments

January 2002
1687-112a

FEHR & PEERS ASSOCIATES, INC.
Transportation Consultants
ALTERNATIVE 1 - EXISTING PLUS PROJECT CONDITIONS

PEAK HOUR TRAFFIC VOLUMES AND LANE CONFIGURATIONS

FIGURE 7
ALTERNATIVE 2 - EXISTING PLUS PROJECT CONDITIONS
PEAK HOUR TRAFFIC VOLUMES AND LANE CONFIGURATIONS

FIGURE 8

University of California at Davis

Olive Drive Apartments

KEY:

XX (YY) = AM (PM) Peak Hour Traffic Volumes

= Signalized Intersection

= Stop Sign

= Study Intersection

Not to Scale
<table>
<thead>
<tr>
<th>Intersection</th>
<th>Existing AM Peak Hour</th>
<th>Existing PM Peak Hour</th>
<th>Alternative 1 AM Peak Hour</th>
<th>Alternative 1 PM Peak Hour</th>
<th>Alternative 2 AM Peak Hour</th>
<th>Alternative 2 PM Peak Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Delay</td>
<td>LOS</td>
<td>Delay</td>
<td>LOS</td>
<td>Delay</td>
<td>LOS</td>
</tr>
<tr>
<td>Richards / First / E</td>
<td>21.1</td>
<td>C</td>
<td>26.5</td>
<td>C</td>
<td>21.9</td>
<td>C</td>
</tr>
<tr>
<td>Olive / Richards</td>
<td>19.6</td>
<td>B</td>
<td>20.3</td>
<td>C</td>
<td>19.4</td>
<td>B</td>
</tr>
<tr>
<td>Olive / Hickory²</td>
<td>10.0</td>
<td>A</td>
<td>9.3</td>
<td>A</td>
<td>10.3</td>
<td>B</td>
</tr>
</tbody>
</table>

Notes:
1. Average control delay calculated in seconds per vehicle.
2. Delay and level of service reported for the southbound Hickory Lane approach only.

Queue Length Impacts

A queue length for a turning movement that exceeds the turn pocket length is of concern because vehicles can potentially block through vehicles from proceeding during a green light. Existing queue length data was collected in November 2001 and the model was updated to more accurately represent these queue lengths. Table 9 compares the existing queue lengths collected in the field to expected queue lengths for Alternative 1 and Alternative 2 for the critical movements affected by the project at the Richards Boulevard/Olive Drive intersection. Queues typically increase by one to three vehicles. The maximum left-turn queues for the southbound and westbound approaches would be nine and 11 vehicles, respectively, under Alternative 1 during the evening peak hour. Queues longer than the available storage capacity would periodically block through traffic throughout the peak hour. The software used for the level of service analysis accounts for vehicle delay that results from these blockages.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM Peak Hour</td>
<td>PM Peak Hour</td>
<td>AM Peak Hour</td>
</tr>
<tr>
<td>Southbound Richards left-turn onto Olive²</td>
<td>2</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Westbound Olive left-turn onto Richards³</td>
<td>6</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Westbound Olive Through/Right</td>
<td>11</td>
<td>10</td>
<td>13</td>
</tr>
</tbody>
</table>

Note:
1. Project queue lengths calculated by applying the incremental difference between the model queues (existing versus project) to existing field observations.
2. Available storage is for three vehicles.
3. Available storage is for four vehicles.


Transit Impacts

The project would result in an increase in transit trips. Unless new service is added, those
accessing Unitrans would cross Richards Boulevard at the signalized crossing with Olive Drive and board the W Line traveling southbound on Richards Boulevard or board the M Line on Olive Drive during the evening hours only. For more information on this issue, please refer to Pedestrian, Bicycle, and Transit Assessment for Olive Drive Apartments, written by The Hoyt Company (January, 2002).

Bicycle and Pedestrian Impacts

The proposed project would increase bicycle and pedestrian trips along Olive Drive and across the railroad tracks to/from downtown. Currently, bicycle lanes are provided on both sides of Olive Drive and would be maintained. Sidewalks would be provided in front of the project site, connecting existing sidewalks to the east and west of the site. The sidewalk installation would also include bulb-outs on both sides of each driveway. This would improve pedestrian safety by shortening the crossing distance across Olive Drive. The existing at-grade railroad crossing adjacent to the railroad station does not meet formal standards, but is used regularly. The project would add pedestrian trips to this crossing. Pursuant to the Gateway/Olive Drive Specific Plan City staff has recently investigated the installation of a formal crossing, but no funding has been identified, nor is the improvement included in the City’s capital improvement program. For more information on this issue, please refer to Pedestrian, Bicycle, and Transit Assessment for Olive Drive Apartments, written by The Hoyt Company (January, 2002).
IV. CUMULATIVE CONDITIONS ANALYSIS

This chapter documents an analysis of the proposed project under 2010 cumulative conditions. First, a trip generation comparison between the proposed land uses and the designated land uses set forth in the Gateway/Olive Drive Specific Plan is presented. Next, the results of a traffic impact analysis at the three study intersections for Alternative 1 and Alternative 2 are provided. Finally, a review of potential long-term roadway improvements is given.

Trip Generation Comparison

The Gateway/Olive Drive Specific Plan documents the designated land uses for the project site (referred to as the Youmans Property in the plan). Based on this document and consultation with City planning staff, the following land use designations are assumed:

- 8,000 square feet of restaurant;
- 5,000 square feet of retail;
- 39,272 square feet of office; and
- 81 multi-family units.

The resulting trip generation is provided in Table 10 along with a comparison of Alternative 1 and Alternative 2. The designated land uses would generate an estimated 2,179 daily, 185 a.m. peak hour, and 246 p.m. peak hour trips. Daily trip generation for the proposed project would be 33% to 65% percent less under Alternative 1 and Alternative 2 trip generation scenarios, respectively.

Traffic Impact Analysis

The percent growth between existing conditions and 2010 General Plan conditions for daily traffic was applied to existing peak hour traffic to estimate 2010 peak hour conditions. Project traffic was then added to develop the cumulative volumes shown in Figures 9 and 10 for Alternatives 1 and 2, respectively. Table 11 presents the LOS results for the study intersections under cumulative conditions for both Alternative 1 and Alternative 2.

---

5 City of Davis, Gateway/Olive Drive Specific Plan EIR, May 1996.
6 City of Davis, Executive Summary Gateway Olive Drive Specific Plan, March 1996, pp. 5 and 7.
### Table 10
Trip Generation Based on Current Land Use Designation

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Size</th>
<th>Trip Rates</th>
<th></th>
<th></th>
<th>Trips</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Daily</td>
<td>AM Peak Hour</td>
<td>PM Peak Hour</td>
<td>Daily</td>
<td>AM Peak Hour</td>
<td>PM Peak Hour</td>
</tr>
<tr>
<td>Commercial</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restaurant(^1)</td>
<td>8 ksf(^2)</td>
<td>130.34</td>
<td>9.27</td>
<td>10.86</td>
<td>1,043</td>
<td>74</td>
<td>87</td>
</tr>
<tr>
<td>Retail(^3)</td>
<td>5 ksf(^2)</td>
<td>42.92</td>
<td>1.03</td>
<td>3.74</td>
<td>215</td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td>Office(^4)</td>
<td>39,272 ksf(^2)</td>
<td>16.47</td>
<td>2.27</td>
<td>3.13</td>
<td>647</td>
<td>89</td>
<td>123</td>
</tr>
<tr>
<td>Commercial Total with 20% Adjustment(^5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,524</td>
<td>134</td>
<td>183</td>
</tr>
<tr>
<td>Housing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multi-Family</td>
<td>81 Units</td>
<td>8.5(^6)</td>
<td>0.65(^7)</td>
<td>0.81(^7)</td>
<td>689</td>
<td>53</td>
<td>66</td>
</tr>
<tr>
<td>Housing Total with 5% Adjustment(^8)</td>
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<td></td>
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<td>655</td>
<td>51</td>
<td>63</td>
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<td>Total Trips</td>
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<td>2,179</td>
<td>185</td>
<td>246</td>
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<tr>
<td>Proposed Project – Alternative 1</td>
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<td></td>
<td></td>
<td>1,453</td>
<td>105</td>
<td>137</td>
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<tr>
<td>Proposed Project – Alternative 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>757</td>
<td>54</td>
<td>73</td>
</tr>
</tbody>
</table>

Notes:
1. Rates represent average trip generation rates per 1,000 square feet of High-Turnover (Sit Down) Restaurant in Institute of Transportation Engineers’ (ITE) Trip Generation (6\(^{th}\) Edition).
2. Thousand square feet.
3. Rates represent average trip generation rates per 1,000 square feet of Shopping Center in ITE’s Trip Generation (6\(^{th}\) Edition). Average trip generation rates were used for estimating the retail trip generation because not all of the criteria (established in ITE’s Trip Generation Handbook) were met for using the equation rather than using the weighted average rate.
4. Number of trips estimated using the ITE’s Trip Generation (6\(^{th}\) Edition) regression equations for General Office Building. The regression equation was used for estimating the office trip generation because all of the criteria (established in ITE’s Trip Generation Handbook) were met for using the equation rather than using the weighted average rate.
5. An adjustment of 20% was applied to the commercial trips to account for trip generation internal to the project and trip generation of walking trips from near-by housing.
6. Daily rate of 8.5 trips taken from the existing City of Davis General Plan.
7. Peak hour rates formulated by comparing the percent difference between the General Plan daily rate to the daily rate published in ITE’s Generation (6\(^{th}\) Edition) and applying the difference to Trip Generation peak hour rates. Note that the Trip Generation rates were determined using the regression equations because all of the criteria (established in ITE’s Trip Generation Handbook) were met for using the equation rather than using the weighted average rate.
8. Trip generation rates provided in ITE’s Trip Generation typically do not account for transit usage or high pedestrian and bicycle traffic. An adjustment of 5% was applied to account for the non-vehicular usage common in Davis made possible by convenient transit service and extensive pedestrian and bicycle facilities.
ALTERNATIVE 1 - CUMULATIVE CONDITIONS

PEAK HOUR TRAFFIC VOLUMES AND LANE CONFIGURATIONS

FIGURE 9

KEY:

XX (YY) = AM (PM) Peak Hour Traffic Volumes

= Signalized Intersection

= Stop Sign

= Study Intersection

Olive Drive Apartments

Feihr & Peers Associates, Inc. Transportation Consultants

January 2002
1697-18a
Table 11
Peak Hour Intersection Level of Service Results
Existing and Cumulative Conditions

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Existing AM Peak Hour Delay</th>
<th>Existing PM Peak Hour Delay</th>
<th>Cumulative - Alternative 1 AM Peak Hour Delay</th>
<th>Cumulative - Alternative 1 PM Peak Hour Delay</th>
<th>Cumulative - Alternative 2 AM Peak Hour Delay</th>
<th>Cumulative - Alternative 2 PM Peak Hour Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Richards / First / E</td>
<td>21.1</td>
<td>26.5</td>
<td>42.9</td>
<td>44.6</td>
<td>36.6</td>
<td>43.8</td>
</tr>
<tr>
<td>Olive / Richards</td>
<td>19.6</td>
<td>20.3</td>
<td>34.4</td>
<td>31.4</td>
<td>21.9</td>
<td>32.8</td>
</tr>
<tr>
<td>Olive / Hickory²</td>
<td>10.0</td>
<td>9.3</td>
<td>10.7</td>
<td>9.6</td>
<td>10.5</td>
<td>9.5</td>
</tr>
</tbody>
</table>

Notes:
1. Average delay calculated in seconds per vehicle.
2. Delay and level of service reported for the southbound Hickory Lane approach only.

As shown in Table 11, operations could still be maintained at acceptable levels (LOS E or better) under either the Alternative 1 or Alternative 2 trip generation scenario. At Richards Boulevard/First Street, worst-case operations would be during the evening peak hour assuming Alternative 1 trip generation with an average vehicle delay of 45 seconds. At Richards Boulevard/Olive Drive, worst-case operations would be during the morning peak hour assuming Alternative 1 trip generation or during the evening peak hour assuming Alternative 2 trip generation each with an average vehicle delay of about 43 seconds.

**Queue Length Impacts**

Table 12 compares the existing queue lengths for critical movements at Richards Boulevard/Olive Drive to expected queue lengths for Alternative 1 and Alternative 2 under cumulative conditions. The maximum left-turn queues for the southbound and westbound approaches would be nine and 11 vehicles, respectively, under Alternative 1 during the evening peak hour. Queues longer than the available storage capacity would periodically block through traffic throughout the peak hour. The software used for the level of service analysis accounts for vehicle delay that results from these blockages.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM Peak Hour</td>
<td>PM Peak Hour</td>
<td>AM Peak Hour</td>
</tr>
<tr>
<td>Southbound Richards left-turn onto Olive&lt;sup&gt;2&lt;/sup&gt;</td>
<td>2</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Westbound Olive left-turn onto Richards&lt;sup&gt;3&lt;/sup&gt;</td>
<td>6</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Westbound Olive Through/Right</td>
<td>11</td>
<td>10</td>
<td>16</td>
</tr>
</tbody>
</table>

Note:
1. Cumulative queue lengths calculated by applying the incremental difference between the model queues (existing versus cumulative) to existing field observations.
2. Available storage is for three vehicles.
3. Available storage is for four vehicles.

Future Roadway Improvements

Richards Boulevard, a key gateway into the City of Davis, is constrained to one lane in each direction under the Union Pacific Railroad Bridge. Several studies, including the City’s 1993 General Plan Circulation Element, have concluded that Richards Boulevard needed to be widened to four lanes to accommodate future demand. In March 1997, the City of Davis electorate approved a referendum to preclude the addition of lanes to Richards Boulevard north of I-80. In response, the City Council directed Public Works staff to evaluate opportunities to improve the capacity and safety of this two-lane segment of Richards Boulevard. Consequently, the Richards Boulevard Corridor Alternatives Study was conducted by Fehr & Peers Associates and completed in June 2000. The study examined various transportation improvement options for the Richards Boulevard corridor. Several final recommendations were made that could either be implemented independently or in phases, as described below.

- Modified signal timings for the entire corridor from First Street/D Street to Richards Boulevard/Research Park Drive were recommended to better coordinate the system and to help alleviate congestion through the tunnel. This option required that the City take control of the Richards Boulevard/I-80 eastbound ramps intersection, which was operated by Caltrans. Since the publication of the report, the City has taken control of the intersection and implemented the modified timing plan for the corridor.

- Installation of a right-turn pocket on northbound Richards Boulevard at First Street was also recommended to help reduce congestion through the tunnel. This option has also been implemented since publication of the report and improved operations have occurred, specifically a reduced northbound queue length.

- The Putah Creek bike route, including a tunnel under I-80 (west of Richards Boulevard), is currently completed up to Olive Drive. Connection to the UC Davis Arboretum and Davis Commons is expected for completion in Fall 2002.

- To improve connectivity between the Putah Creek bike route and downtown, a new pathway was proposed in the Alternatives Study that parallels the north side of the railroad tracks connecting to the First Street/F Street intersection. Further investigation is budgeted in the current Davis CIP.

- An additional new path, recommended to be evaluated after the Putah Creek tunnel opens, would tunnel under the railroad tracks on the east side of Richards Boulevard. It would connect the Richards Boulevard/Olive Drive intersection to First Street at F Street. This
would allow bicyclists and pedestrians the same access on the east side of Richards Boulevard as is currently available on the west side. These path improvements would help provide safe alternatives for bicyclists and pedestrians from the proposed project as well as existing south Davis and Olive Drive residents. In addition, the number of Richards Boulevard crossings would be reduced.

- Finally, the study recommended the conversion of the westbound I-80 cloverleaf-type ramps to diamond on- and off-ramps. This would require installation of a signalized intersection that would control all movements onto and off of westbound I-80. The study analyzed operations under future conditions and determined that operations at the Olive Drive intersection could be maintained at LOS B and LOS C during the morning and evening peak hours, respectively. Improved operations would benefit current and future Olive Drive residents. In addition, the available right-of-way after the conversion could be used for a northbound Richards Boulevard bus stop or new bicycle/pedestrian connections.
V. ANALYSIS OF PROJECT SITE

This section analyzes driveway width, location and spacing, minimum required throat depths, on-site circulation, project frontage issues, and parking requirements. Recommendations are provided for the issues related to the public system, while suggestions are made for the internal site access issues (see Figure 11). In addition, trip reduction measures proposed by the project applicant are described. Please note that this chapter is based entirely on the trip generation assumptions of Alternative 1, which is more conservative from a trip generation perspective.

**Driveway Width**

As shown in Figure 3, four driveways would provide access from the project to Olive Drive. Davis Municipal Code Section 40.25.070 identifies the following driveway width standards (for two-way traffic):

1. Serving seven to twenty parking spaces, sixteen feet, except for high-turnover uses (less than one hour), where twenty feet is required.
2. Serving twenty-one or more parking spaces, twenty feet.

As discussed earlier, Driveways 1 and 4 are 14 feet wide and Driveways 2 and 3 are 12 feet wide. Driveways 1, 3 and 4 each serve more than twenty parking spaces and should be 20 feet wide. Driveway 2 serves ten parking spaces and should be a minimum of 16 feet wide. Therefore, none of the driveways meet the minimum width requirements set forth in the City’s code. It is recommended that the driveways be widened to meet City requirements.

**Driveway Spacing**

The distance between driveways is an important consideration because short spacing can lead to capacity and safety concerns caused by increased conflicts between vehicles, bicyclists, and pedestrians. A standard for minimum distances between driveways is not set forth in City code. However, ITE’s *Transportation and Land Development* (1988) provides guidelines for minimum driveway spacing. For through-traffic speeds of 35 mph, a minimum distance of 240 feet should be provided between driveways so that the speed differential of a vehicle turning out and a through vehicle is not more than 15 mph. In order to maintain a speed differential of 10 mph, a minimum of 300 feet between driveways is recommended. The distance between Driveways 1 and 2 is 270 feet, which meets the requirement for the 15 mph differential.
Recommendation: Remove first two parking spaces

Suggestion: Widen internal driveways to 16 feet

Suggestion: Convert all angled parking to perpendicular parking

Recommendation: Remove on-street parking or widen bike lane and install “No U-Turn” signs

Recommendation: Widen Driveway 1 to 20 feet

Recommendation: Remove Driveways 2 and 3, and provide alternate access on site

Recommendation: Widen Driveway 4 to 20 feet

Recommendation: Remove on-street parking or widen bike lane and install “No U-Turn” signs

Recommendation: Remove Driveways 2 and 3, and provide alternate access on site

Recommendation: Remove on-street parking or widen bike lane and install “No U-Turn” signs

= Driveway Number

Source: Hallmark Properties, Mogavero Notestine Associates, March 2001
However, the distance between Driveways 2 and 3 is 140 feet, and the distance between Driveways 3 and 4 is 110 feet. Therefore, these driveways are spaced too close based on ITE recommendations. In addition, the Hickory Lane intersection is located between Driveways 2 and 3, adding more conflict. It is therefore recommended that Driveways 2 and 3 be removed and access to the parking spaces previously provided by these two driveways be provided on-site.

**Project Driveway Throat Depth**

The minimum required throat depth (MRTD) was computed at project driveways based on the expected driveway volume and cumulative adjacent street traffic volumes (presented in the previous chapter). An adequate MRTD is necessary to provide enough stacking distance for egressing vehicles so that the first drive aisle or parking spaces on the site are not blocked. This minimizes the possibility of incoming vehicles queuing back onto the adjacent street.

Table 13 displays the minimum required throat depths at project driveways (see Appendix C for technical calculations). Because of the recommended removal of Driveways 2 and 3, only Driveways 1 and 4 are included in the analysis. This table also displays the throat depths provided at both of these driveway based on the project site plan.

According to Table 13, sufficient throat depth is provided at both Driveways 1 and 4 to prevent blockage of the first parking spaces. However, vehicles making parking maneuvers within the first two stalls would likely encroach into this area. It is therefore recommended that the first two parking spaces on each side of the aisle be removed.

<table>
<thead>
<tr>
<th>Driveway</th>
<th>Minimum Required Throat Depth</th>
<th>Throat Depth Provided&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driveway 1</td>
<td>25 feet</td>
<td>36 feet</td>
</tr>
<tr>
<td>Driveway 4</td>
<td>25 feet</td>
<td>38 feet</td>
</tr>
</tbody>
</table>

**Note:**
1. Based on the site plan (March 2001) provided by Mogavero Notestine Associates.

On-Site Circulation

Fehr & Peers Associates reviewed the project site plan to identify potential on-site circulation problems. Although the site plan generally provides for adequate access and on-site circulation, a couple of issues were identified, described below, and illustrated on Figure 11.

- **Issue:** Most of the parking spaces along the main aisle are angled. This will potentially lead to vehicles making a U-turn to park on the opposite side of the aisle.

  *Suggestion:* Reconfigure the parking spaces so that all are perpendicular to the aisle.

- **Issue:** Internal driveways provide access to covered parking spaces, each serve 20 or fewer parking spaces and should be 16 feet wide (according to Davis Municipal Code Section 40.25.070). All meet this requirement, except for three (see Figure 11).

  *Suggestion:* Widen the three internal driveways that are currently less than 16 feet wide.

Frontage Issues

Fehr & Peers Associates reviewed the project frontage to identify potential problems and one issue was identified as described below and illustrated on Figure 11.

- **Issue:** Safety concerns with on-street parallel parking adjacent to bicycle lanes include conflict due to cars backing into the spaces, driver-side car doors opening, and/or midblock U-turning movements.

  *Recommendation:* Either remove on-street parking or widen the bicycle lane by two feet. Also install “No U-Turn” signs.

Parking Requirements

Davis Municipal Code Section 40.25.090 outlines parking supply requirements for various land uses. The specified standards for the proposed land uses and total supply requirements are
summarized in Table 14. For 65 two-bedroom apartments, 100 three- or more-bedroom apartments, and 3,500 square feet of retail space, 326 parking spaces are required. The site plan shows a total of 389 spaces.

<table>
<thead>
<tr>
<th>Land Use</th>
<th>City Requirement</th>
<th>Project Size</th>
<th>Spaces Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-Family Dwellings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 2 bedroom units</td>
<td>1.75 per unit</td>
<td>65 units</td>
<td>114</td>
</tr>
<tr>
<td>- 3+ bedroom units</td>
<td>2 per unit</td>
<td>100 units</td>
<td>200</td>
</tr>
<tr>
<td>Commercial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Retail</td>
<td>1 per 300 sf</td>
<td>3,500 sf</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>326</strong></td>
</tr>
</tbody>
</table>

Source: Davis Municipal Code Section 40.25.090.

Other Trip Reduction Measures

The project applicant proposes to include several features to the site that, if effective, could further reduce project vehicle trip generation. These features include:

- DSL lines in all of the housing units;
- More than 500 bicycle parking spaces;
- Bicycle maintenance and purchase discount agreement with a local bicycle shop;
- “Site-Bike” bicycle-sharing program;
- Board to display ridesharing announcements to the Bay Area and beyond; and
- AMTRAK discount tickets (purchased in bulk).
VI. TRAFFIC CALMING MEASURES

Olive Drive not only provides access to both residential and commercial uses, but it also serves the off-ramp for westbound traffic from I-80. Consequently, excessive vehicle speeds are a concern on Olive Drive between I-80 and Richards Boulevard. In fact, the Gateway/Olive Drive Specific Plan (March 1996) identifies the need to implement traffic calming measures to reduce travel speeds. This chapter discusses possible measures and provides recommendations to safely reduce travel speeds for the Olive Drive corridor.

Existing Travel Speeds

In June, the City of Davis conducted a speed survey at two locations on Olive Drive during the a.m. peak period, p.m. peak period, and mid-morning period. The survey captured existing travel speeds for vehicles in both the eastbound and westbound directions (combined) just west of the off-ramp (adjacent to 1502 Olive Drive) and near the Richards Boulevard intersection (adjacent to 1056 Olive Drive). The results for average speeds and 85th percentile speeds are shown in Table 15. The 85th percentile speed represents the speed at which 85 percent of the vehicles are traveling at or below. The posted speed limit on Olive Drive is 30 mph.

<table>
<thead>
<tr>
<th>Time Period</th>
<th>East of Richards Boulevard</th>
<th>West of I-80 Off-Ramp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average Speed (mph)</td>
<td>85th Percentile Speed (mph)</td>
</tr>
<tr>
<td>AM Peak</td>
<td>35</td>
<td>39</td>
</tr>
<tr>
<td>Mid-Morning</td>
<td>33</td>
<td>38</td>
</tr>
<tr>
<td>PM Peak</td>
<td>33</td>
<td>37</td>
</tr>
</tbody>
</table>

Note:
1. Speeds, representing both eastbound and westbound traffic, were collected on June 8 and June 13, 2001.
2. Collected adjacent to 1056 Olive Drive.
3. Collected adjacent to 1502 Olive Drive.

Source: City of Davis, Department of Public Works.
Traffic Calming Objectives

The proposed project would bring an increase in bicycle and pedestrian traffic, as well as vehicle traffic entering and exiting the project driveways. Concerns regarding speeding vehicles on Olive Drive already exist among residents in the area. Consequently, consideration of traffic calming measures is required for any proposed development on the project site, as outlined in the Gateway/Olive Drive Specific Plan. The Specific Plan Advisory Committee decided to implement traffic calming measures, after which traffic speeds would be monitored. Several types of measures were identified and evaluated that could potentially accomplish the following goals:

- Reduce speeds on Olive Drive;
- Accommodate bicyclists and pedestrians;
- Accommodate existing traffic volumes and traffic generated by the proposed apartment complex;
- Accommodate large vehicles; and
- Maintain compatibility with existing infrastructure and adjacent land uses.

Evaluation of Alternatives

Traffic calming devices should be designed to create a safe environment for the specific roadway segment being studied. Olive Drive is unique in that it accommodates vehicles exiting I-80 and provides access to both residential and commercial land uses. The advantages and disadvantages of several potential traffic calming measures are summarized in Table 16. Note that installation of speed bumps was not considered because they are not recommended for public roadways. Speeds of 5 mph or less are required to traverse them. Such a low speed could delay emergency vehicles causing serious injury or loss of life. Furthermore, if a speed bump is traversed at a speed higher than designed for, serious injury could result to the vehicle and the motorist.

Recommendations

Each device listed in Table 16 was evaluated with respect to the unique nature of the Olive Drive corridor and the following recommendations are made. The recommended traffic calming measures are illustrated in Figure 12. Figure 13 through Figure 16 demonstrates each of the

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<table>
<thead>
<tr>
<th>Device</th>
<th>Description</th>
<th>Positive Attributes</th>
<th>Negative Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed Tables</td>
<td>10-foot length of raised area (3-4” high) with 6-foot ramps on each approach.</td>
<td>• Very effective in slowing vehicles to moderate speeds.</td>
<td>• Appearance (varies).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Relatively friendly to bicyclists.</td>
<td>• Substantially slows larger vehicles, including emergency vehicles.</td>
</tr>
<tr>
<td>Raised Crosswalks</td>
<td>Same as Speed Tables with striping for a crosswalk.</td>
<td>• Same positive attributes as Speed Tables.</td>
<td>• Same negative attributes as Speed Tables.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Increases visibility of pedestrians.</td>
<td></td>
</tr>
<tr>
<td>Lateral Shifts</td>
<td>Travel lanes are shifted by 4-12’, (e.g., by shifting parking from one side to the other). Medians are sometimes used in the transition area to separate travel lanes.</td>
<td>• Friendly to large vehicles.</td>
<td>• Some parking would be shifted to the opposite side of the road from the major adjacent land uses. Not as effective as vertical measures in reducing speeds.</td>
</tr>
<tr>
<td>Center Island Narrowings/ Pedestrian Refuges</td>
<td>10- to 50-foot-long raised, landscaped center island that forces vehicle path deflection.</td>
<td>• Friendly to large vehicles.</td>
<td>• Not as effective as vertical measures in reducing speeds.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Can be combined with crosswalks, creating a pedestrian refuge.</td>
<td></td>
</tr>
<tr>
<td>Chicanes</td>
<td>Raised, landscaped midblock curb extensions on alternating sides of a roadway that create a reverse-curving travel lane; can be designed with bike bypass lanes.</td>
<td>• Friendly to large vehicles.</td>
<td>• Risk of vehicles crossing centerline – can be mitigated by combining with center island narrowings.</td>
</tr>
</tbody>
</table>

Olive Drive Student Housing

Center Island Narrowing

Pedestrian Islands

Chicane Combined With Bicycle Bypass Lanes

Lateral Shifts Using Alternating On-Street Parking

OLIVE DRIVE STUDENT HOUSING
City of Davis HALLMARK PROPERTIES

RECOMMENDED TRAFFIC CALMING MEASURES
FIGURE 12
recommendations in detail. City staff has reviewed and approved the following recommendations; however, the recommendations provide only a conceptual layout of the measures and further design is required before implementation.

**Speed Tables and Raised Crosswalks**

Neither the speed tables nor the raised crosswalks are recommended for this corridor because it requires vehicles to travel at very slow speeds. Considering the high speeds that currently exist along the roadway, this type of measure is not feasible, even if vehicles are already slowed to the speed limit using other calming devices. Requiring vehicles to significantly slow down can particularly be a hazard with large trucks, which do utilize Olive Drive to access commercial uses and the self-storage facility. Devices such as speed tables and raised crosswalks can also create concern for emergency vehicles, which need to respond to emergencies in a timely manner.

**Lateral Shifts**

Lateral shifts were found to be appropriate along the easternmost segment of Olive Drive (between the westbound I-80 off-ramp and the Olive Drive curve east of the project site) due to the high travel speeds of traffic leaving I-80. Of the traffic calming measures listed in Table 16, lateral shifts have seen the widest application on collectors and arterial streets, according to *Traffic Calming: State of the Practice* (Reid Ewing, Institute of Transportation Studies, August 1999), primarily because large vehicles (including emergency response vehicles) can easily negotiate them. Also, the design speed for lateral shifts is higher than for other measures, at approximately 35 miles per hour. The higher design speed makes this measure more compatible with the I-80 off-ramp, since drivers have had less distance over which to slow down at this point than they will at the other measures described below. This measure, however, is far enough away from the off-ramp to allow for sufficient deceleration off of the freeway as required by Caltrans. A conceptual layout of a lateral shift is provided in Figure 13.

To minimize loss of parking, the lateral shifts would be created by alternating parking between each side of the road. On the transition areas, parking would be removed completely and raised islands would be installed to guide through traffic along the lane shift. The length of the lane shift

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9 American Association of State Highway and Transportation Officials, *A Policy on Geometric Design of Highways and Streets*, 1990. Approximately 200 feet is required for a motorist to decelerate from 65 mph to 35 mph. The length of the off-ramp is almost 600 feet, providing more than sufficient distance for motorists to slow down to 35 mph. The lateral shift is proposed to begin approximately 500 feet beyond the off-ramp on Olive Drive.
Install Warning Signs: W1-4

Optional Pavement Markers
Along Centerline

1-2' Drainage Channel

1-2' Drainage Channel
Object Marker

Existing Edge of Pavement

8' 10' 5' 12'

12'

12' 4' 12' 5'

50' 100' 50'

LEGEND:

= Existing Striping

= Proposed Striping Changes

Oliver Drive Student Housing
shift would be determined in accordance with the taper length standards contained in the Manual for Uniform Traffic Control Devices (MUTCD, Federal Highway Administration, December 2000). Depending on this length, each transition area would require the removal of approximately two parking spaces. If the lateral shift were designed with two individual shifts (e.g., if the center third of the parking spaces were shifted to the north side of Olive Drive), then four parking spaces would be lost.

Chicane

A chicane was selected for Olive Drive between the project site and the curve because like lateral shifts, it would be compatible with large vehicles. Also, they can be designed with bicycle bypass lanes, eliminating the problem of bicyclists being forced into the travel lane with motorists. This measure would require on-street parking to be prohibited over the entire length of the chicane. Consequently, the chicane is recommended to be located in front of the existing self-storage facility, which creates negligible on-street parking demand. Impacts on the existing apartment complex east of the self-storage facility should be minimized by modifying the lengths or numbers of islands and curb extensions in the chicane. The chicanes would be created using stand-alone islands on alternating sides of the street, leaving a gap between the islands and the curb for drainage and bicyclists to pass through. A conceptual layout of a chicane is provided in Figure 14.

Pedestrian Islands

Pedestrian islands are appropriate at crosswalks, especially at the intersection of a side street. These circumstances only exist at the Olive Drive/Hickory Lane intersection. These would cause some vehicle deflection from the centerline approaching this intersection, while providing pedestrians with a protected waiting area between crossing each direction of Olive Drive. Since parking on the south side of Olive Drive opposite Hickory Lane will be prohibited with the proposed project, only two additional spaces would need to be eliminated at the tapers approaching each pedestrian island. A conceptual layout of pedestrian islands is provided in Figure 15.

Center Island Narrowing

A center island narrowing (on Olive Drive near the western edge of the project site) would cause some vehicle deflection from the centerline and serve as a visual transition point between
Install Chicane Warning Signs

Pavement Markers Along Centerline

8’ min. Extension

Object Marker

Object Marker

Object Marker

Object Marker

Object Marker

Object Marker

Object Marker

24'

20’ min.

Pavement Markers

Taper Length per MUTCD

8:1 min. (typ.)

LEGEND:

Existing Striping

Proposed Striping Changes

Olive Drive Student Housing

FEHR & PEERS ASSOCIATES, INC.
Transportation Consultants

January 2002
1687-02

CHICANE

FIGURE 14
Planned Crosswalk and Wheelchair Ramps

LEGEND:

- = Existing Striping
- = Proposed Striping Changes
R4-7 = "Keep Right" Sign

Olive Drive Student Housing

FIGURE 15
residential areas and nearby commercial or industrial areas. For these reasons, installation of a center island narrowing is recommended on Olive Drive west of the project site at the transition point between the highway commercial uses, which generate large amounts of traffic, and the residential area east of those uses.

A conceptual layout of a center island narrowing is provided in Figure 16. Taper lengths in advance of the island would conform to MUTCD. This measure would require on-street parking to be prohibited along the length of the island and its approach tapers. In this case, approximately four total parking spaces would need to be eliminated for a 50-foot long island.

**Summary of Impacts**

Based on previous experience with traffic calming measures in other locations, it is expected that the lateral shifts on the eastern segment of Olive Drive would result in 85th percentile speeds of approximately 35 mph (where there currently exists 85th percentile speeds of between 42 and 46 mph during the time periods surveyed, as shown in Table 15). The chicane, pedestrian islands, and center island narrowing on the western segment of Olive Drive would result in 85th percentile speeds of approximately 30 miles per hour (where there currently exists 85th percentile speeds of between 37 and 39 mph during the time periods surveyed, as shown in Table 15). However, local conditions vary widely when installing traffic calming measures, and data for other similar measures is limited. After implementing traffic calming measures on Olive Drive, the prevailing speeds should be monitored closely for a period of at least three months, and feedback should be gathered from local residents to assess and potentially refine the measures. The initial assessment of on-street parking space losses is that approximately 22 total parking spaces would be lost along the entire length of Olive Drive as a combined result of the traffic calming measures described above. However, this number will need to be refined as detailed designs for each measure are developed.

To determine the number of vehicles that would divert from the Olive Drive off-ramp to the Richards Boulevard off-ramp with implementation of the traffic calming measures, the 2001 General Plan Travel Demand Model was utilized. The model was run with a 10-mph reduction of the eastern segment (nearest the off-ramp) and a 5-mph reduction of the western segment of Olive Drive (nearest Richards Boulevard). The results showed a diversion of about 3,800 vehicles per day, which represented 89 percent of the daily traffic.

The traffic calming measures described above are particularly intended to address the high speeds of existing traffic in front of the proposed apartment complex site and the potential for
LEGEND:

--- Existing Striping
--- Proposed Striping Changes
R4-7 = "Keep Right" Sign

Taper Length per MUTCD
8:1 min. (typ.)

20' min.

R4-7

6' min.

R=4'

11'

10'

R=250'

Existing Edge of Pavement

Centerline

Markings

Pavement Markers

Existing Curbline

Olive Drive Student Housing

CENTER ISLAND NARROWING

FIGURE 16
excessive speeds associated with trips generated by the apartment complex. However, additional measures may be needed to address other issues on Olive Drive unrelated to the proposed apartment complex. Further study may be required to identify traffic problems as observed by local residents and businesses and to develop appropriate solutions along the entire length of Olive Drive.