2021 California High Occupancy Vehicle Facilities Degradation Report

Prepared by

California Department of Transportation
Division of Traffic Operations
Office of Mobility Programs

Submitted to

Federal Highway Administration
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1. OVERVIEW

As required by Title 23 of the United States Code, section 166 (23 U.S.C. § 166), the California Department of Transportation (Caltrans) has prepared the *2021 California High Occupancy Vehicle Facilities Degradation Report*. This is the annual report on the performance of the high occupancy vehicle (HOV) facilities on the State Highway System (SHS) in California. It includes remediation strategies to bring degraded HOV lanes into compliance with the federal performance standard outlined in 23 U.S.C. § 166.

2. HIGH OCCUPANCY VEHICLE FACILITIES IN CALIFORNIA

In 2021, there were approximately 1,487 lane-miles of HOV lanes and about 424 lane-miles of high occupancy toll (HOT) lanes on the SHS. HOV facilities are in Caltrans District 3 (Sacramento, El Dorado, Placer Counties), District 4 (Alameda, Contra Costa, Marin, San Mateo, Santa Clara, Solano, and Sonoma Counties), District 5 (Santa Barbara County), District 7 (Los Angeles and Ventura Counties), District 8 (San Bernardino and Riverside Counties), District 10 (San Joaquin County), District 11 (San Diego County), and District 12 (Orange County). HOT facilities are in Districts 4, 7, 8, 11, and 12. A complete list of all the HOV and HOT lanes on the SHS may be found in **Attachment A**.

There were several changes to the State's HOV facilities in 2021.

- Approximately six (6) lane-miles of HOV lanes on Interstate 5 (I-5) in Southbound direction were partially opened in Sacramento County from Meadowview to South of Elk Grove Blvd in October 2021, and the rest will be opened in 2022.

- Approximately fifty (50) lane-miles of the express lanes on I-15 were opened in Riverside County from Cajalco Road to State Route 60 (SR-60) in April 2021.

- Approximately eleven (11) lane-miles of HOV lanes were opened in both directions of I-10 in Los Angeles County between Azusa Avenue and SR-57 in April 2021. This closed a gap in the HOV facilities on I-10 in Los Angeles County. With this gap closure, there are now continuous HOV and HOT facilities for forty (40) miles along I-10 in Los Angeles and San Bernardino Counties, starting in downtown Los Angeles and extending to I-15.

- Approximately four (4) lane-miles of HOV lanes were opened on I-5 in Los Angeles County in April 2021. The new lanes are located between SR-134 and Magnolia Avenue and are part of a larger project that will result in HOV facilities on I-5 between SR-134 and SR-14. The full project will be completed in 2022.

- Approximately three (3) lane-miles of HOV lanes were opened on United States Route 101 (US-101) in Sonoma County between SR-116 and Old Redwood Highway in December 2021.

3. EXEMPT VEHICLE ACCESS ON HOV FACILITIES IN CALIFORNIA

Title 23 U.S.C. § 166 includes a provision for states to allow inherently low-emission vehicles (ILEVs), certain gasoline/electric plug-in hybrid vehicles, and toll-paying vehicles to use HOV facilities without meeting occupancy requirements. States that allow these exempted vehicles to access these facilities must monitor and report the performance of those facilities.

California allows certain ILEVs and plug-in hybrid electric vehicles displaying valid Clean Air Vehicle (CAV) decals to access HOV facilities without meeting occupancy requirements.[1] California also allows toll-paying vehicles not meeting occupancy requirements to access certain HOV facilities, known as HOT lanes.[2]

3.1. CLEAN AIR VEHICLE ACCESS

California's CAV decal program was first established in 2004. It is managed by the California Department of Motor Vehicles (DMV) in partnership with the California Air Resources Board (CARB). CARB establishes the official list of eligible vehicles based on specified emissions standards. The program was established by the California State Legislature to promote the purchase and lease of the cleanest models of vehicles and has been amended over the years to allow more drivers to participate, incorporate vehicles with the newest technologies, and retire other vehicle technologies that had become commonplace. Each year, a different colored decal is issued to qualifying vehicles, with its own expiration dates and the decals cannot be renewed. In 2021 there were four (4) different colored decals in use:

[1] Refer to Vehicle Code sections 5205.5 and 21655.9
[2] Refer to Streets and Highways Code sections 149.1 and 149.4 through 149.10

- Vehicles that registered in 2018 received a red decal that was valid through January 1, 2022
- Vehicles that registered in 2019 received a purple decal that is valid through January 1, 2023
- Vehicles that registered in 2020 received an orange decal that is valid through January 1, 2024
- Vehicles that registered in 2021 received a blue decal that is valid through January 1, 2025

At the beginning of 2020, there were 235,006 vehicles with a CAV decal. At the end of 2020, there were 296,182 vehicles with a decal. As of December 31, 2021, there were 386,340 vehicles with a decal. Most of these vehicles were registered in counties with a significant number of HOV facilities. Table 1 below shows the counties with the largest number of vehicles with decals. High percentage decals were registered in Los Angeles, Orange, and Santa Clara Counties.

TABLE 1. DECAL REGISTRATION AND COUNTIES

Counties That Have Majority Decals	2021	2020	2019	2018	Total	Percentage
Alameda	7,048	5,628	9,683	13,205	35,564	9%
Contra Costa	4,364	2,971	4,775	6,031	18,141	5%
Los Angeles	23,855	15,337	23,469	34,325	96,986	25%
Orange	15,046	9,033	15,437	18,756	58,272	15%
San Diego	6,408	4,277	6,646	9,055	26,386	7%
Santa Clara	8,875	7,795	15,475	21,721	53,866	14%

3.2. HIGH OCCUPANCY/TOLL LANES

There were ten (10) HOT facilities in operation on the SHS in 2021. While these facilities are on State highways, the authority to collect the tolls has been granted to regional transportation agencies through legislation. These agencies are responsible for setting the tolls and establishing eligibility requirements, subject to other provisions in State and Federal law. All HOT facilities use congestion pricing, and all facilities except for the HOT lanes on SR-91 use dynamic pricing based on real-time traffic conditions. The HOT lanes on SR-91 are priced based on the time of day. HOV traveling in the eastbound direction during the weekday afternoon peak period pays a discounted toll.

Vehicles with two (2) or more occupants (HOV 2+) may travel toll-free on all HOT facilities in California, except for the facilities on SR-91, SR-237, I-10, I-15 in Riverside County, and I-880. On the SR-91 facility, vehicles with three (3) or more occupants (HOV 3+) are eligible to travel toll-free (or at a discount, as noted above). The SR-237 and I-880 facilities offer toll-free travel to HOV 3+ and discounted travel to HOV 2+. The I-10 facility offers toll-free travel to HOV 3+ during peak periods and to HOV 2+ at all other times. On the I-15 facility, vehicles with three (3) or more occupants (HOV 3+) travel toll-free.

Decaled CAVs are charged a toll on five (5) HOT lanes in California. On the HOT lanes on I-10, I-110, and I-15 in Riverside County, these vehicles pay 85 percent of the posted toll. On SR-237 and I-880, decaled CAVs pay 50 percent of the posted toll. Zero-emission vehicles pay a discounted toll on the SR-91 facility when traveling in the EB direction during weekday afternoon peak periods but travel toll-free at all other times.

Whenever the average vehicle speed begins to fall below 45 miles per hour (mph) on a segment of a HOT facility, it will operate in an "HOV Only" status, precluding toll-paying vehicles from entering the lanes to help alleviate the congestion.[3] If ineligible vehicles enter the HOT lanes while they are operating in "HOV Only" mode, they are charged the maximum toll rate as well as additional fines.

All HOT facilities require all users to have a FasTrak electronic toll collection transponder except for the I-680 facility in Alameda and Santa Clara Counties and I-15 in San Diego County, which only require single occupant vehicles to have a transponder. On those facilities which require all vehicles to have a transponder, HOVs must have a FasTrak Flex transponder to travel toll-free; this transponder includes a switch that the driver can set prior to travel to indicate how many people are in the vehicle. (The HOT facility on SR-91 has separate "declaration lanes" for HOVs at the tolling points, and a FasTrak Flex transponder is not required for toll-free travel on this facility.) Requiring all users to carry a transponder is one of the main strategies for reducing violations on HOT facilities. A violation of the transponder requirement usually results in a toll evasion notice issued by the agency that has the legislative authority to collect the toll.

[3] This strategy is not used on the SR-91 HOT facility or on I-15 in Riverside County.

The California Highway Patrol (CHP) enforces the vehicle occupancy requirements. All HOT facilities use indicator signals at the tolling points to indicate whether a vehicle has a transponder, and on facilities that require a FasTrak Flex transponder for toll-free or discounted travel; these indicator signals also report the setting on the FasTrak Flex transponder. CHP uses the indicator lights and a visual check on the vehicle to determine if a violation has occurred.

4. PROCESS FOR DETERMINING DEGRADATION

Subsection (d) of 23 U.S.C. § 166 states that an HOV facility is considered degraded if the average traffic speed during the morning or evening weekday peak hour period is less than 45 mph for more than 10 percent of the time over a consecutive 180-day period. FHWA has not developed specific procedures or methodologies for states to follow when determining if the operational performance of an HOV facility is degraded. This is primarily because each state has different characteristics, and each agency responsible for operations has different resources to collect and analyze data. However, Caltrans has developed a comprehensive methodology to provide consistent and frequent data collection of HOV lane operations. This process is outlined in the following sections.

4.1. PERFORMANCE MONITORING

Caltrans uses its Performance Measurement System (PeMS) to monitor and analyze the operational performance of State highways. PeMS serves as a central repository to collect, store, and analyze traffic data from vehicle detection stations and traffic census stations. Traffic data is collected automatically from sensors located on or adjacent to freeways throughout the State. Detector stations are usually located where there are existing metering lights on freeway entrance-ramps (the sensors are used to control the ramp metering signals). In facilities with lower traffic volumes and less congestion, there may be fewer detector stations. Each detector station covers a set length of the freeway, with data available for each individual lane, including the HOV facilities located on those freeways. This data is collected every 30 seconds and transmitted to a centrally located database where it is reviewed for consistency and aggregated to 5-minute intervals. These 5-minute data sets can then be further aggregated into hourly time blocks. PeMS was used to collect the speed data for all HOV facilities except those facilities in District 11. Facilities in District 11 are analyzed using the Ramp Metering Information System since PeMS is not

able to properly calculate speeds for the I-15 HOT facility, which has reversible lanes.

The HOT facility on SR-91 in Orange County is not included in this report. This facility was constructed as a set of toll lanes in the median of the freeway, which HOVs could use for free or at a discounted rate and as such they are not subject to the monitoring and reporting requirements of 23 U.S.C. § 166. The Riverside County portion of the SR-91 HOT facility was originally constructed as an HOV lane and is subject to the monitoring and reporting requirements and is included in this report.

4.2. PERIOD FOR ANALYSIS

Caltrans collects data for HOV facilities 24 hours a day, seven (7) days a week. However, since traffic volumes tend to be higher in the second half of each calendar year, Caltrans and FHWA have agreed to use data collected in the latter half of a calendar year to perform the annual degradation analysis. From July 1 to December 31 in 2021, there were 132 weekdays and 52 weekend days, including seven (7) holidays.

The morning peak hour period is 6 a.m. to 9 a.m., and the afternoon peak hour period is 3 p.m. to 6 p.m. Most HOV facilities in California operate during both time blocks.

4.3. DATA COLLECTION

Data was collected on approximately 1,186 lane-miles of HOV facilities. This is about 65 percent of the 1,833 lane-miles of HOV facilities that were subject to monitoring and analysis as required by 23 U.S.C. § 166.[4] Table 2 shows the number of HOV lane-miles in each Caltrans district and the number of lane-miles for which data was collected.

Reasons for a lack of data include defective sensors, incorrectly transmitted data, or no detection along that segment. Data that was imputed or estimated by PeMS was eliminated from the analysis. This ensures that only actual and not estimated data is used for the analysis. Any faulty or inaccurate data was also removed from the analysis. As part of its asset management efforts, Caltrans is

[4] The lane-miles monitored as required by Title 23 U.S.C. § 166 include 1,375 lane-miles of HOV lanes, and all but 41 lane-miles of the 414 lane-miles of HOT lanes (SR-91 in Orange County is excluded as noted in Section 4.1). Numbers do not add up exactly due to rounding.

continuously focusing on the health of the detector stations and has a process in place for replacing detector stations that have reached the end of their service life cycle or are beyond repair.

TABLE 2. OPERATING VS. MONITORED HOV LANE MILES BY DISTRICT

District	Lane-Miles Operating	Lane- Miles Monitored
3	117	105
4	510	252
5	3	3
7	559	303
8	276	213
10	14	4
11	119	120
12	235	187
TOTAL	**1833**	**1186**

4.4. CALCULATING DEGRADATION

The vehicle miles traveled (VMT) and vehicle hours traveled (VHT) during the peak hour periods were calculated from the PeMS data for each detector station. The VMT and the VHT were then used to determine the average speed for each peak hour period for each day for the entire six (6) months.

- The average peak hour period speed for each day was determined by dividing the total VMT for the peak hour period by the total VHT for the peak hour period (miles traveled / hours traveled = mph).[5]

- The average peak hour period speed for the entire six (6) months was determined by taking the total VMT and the total VHT for the peak period for the entire six (6) months and then dividing that VMT by that VHT. [6]

[5] For facilities in District 11, the average speed for the morning and afternoon three-hour time blocks was provided directly from the Ramp Metering Information System.

[6] For facilities in District 11, the average peak hour period speed for the six (6) month period was calculated by determining the average of the daily speeds provided by RMIS.

For all stations from which data was collected, a count was taken of the number of weekdays where the average speed at the detector station was less than 45 mph. The total number of weekdays with data was also counted for each sensor. The number of weekdays where the speed was less than 45 mph was then divided by the number of weekdays for which data was available. If this value exceeded ten percent, that portion of the HOV facility covered by that detector station was deemed degraded (each detector station covers a predetermined length of the facility, as previously noted in Section 4.1). The lane-miles for each detector station with data were added up to determine the total number of lane-miles with data available as well as the total number of lane-miles that were degraded. Graphs were then developed for each HOV facility showing the average weekday speed at these detector stations for each peak hour period as well as the percentage of time where the average speed at the detector stations was less than 45 mph.

4.5. DEGRADATION CATEGORY

While the federal standard distinguishes HOV facilities' performance as degraded or not degraded, Caltrans further classifies degradation into three (3) categories based on how frequently it occurs. The three classes are defined as follows:

- Slightly Degraded—degradation occurs from 10 to 49 percent of the time.
- Very Degraded—degradation occurs from 50 to 74 percent of the time.
- Extremely Degraded—degradation occurs 75 percent or more of the time.

5. STATEWIDE DEGRADATION SUMMARY

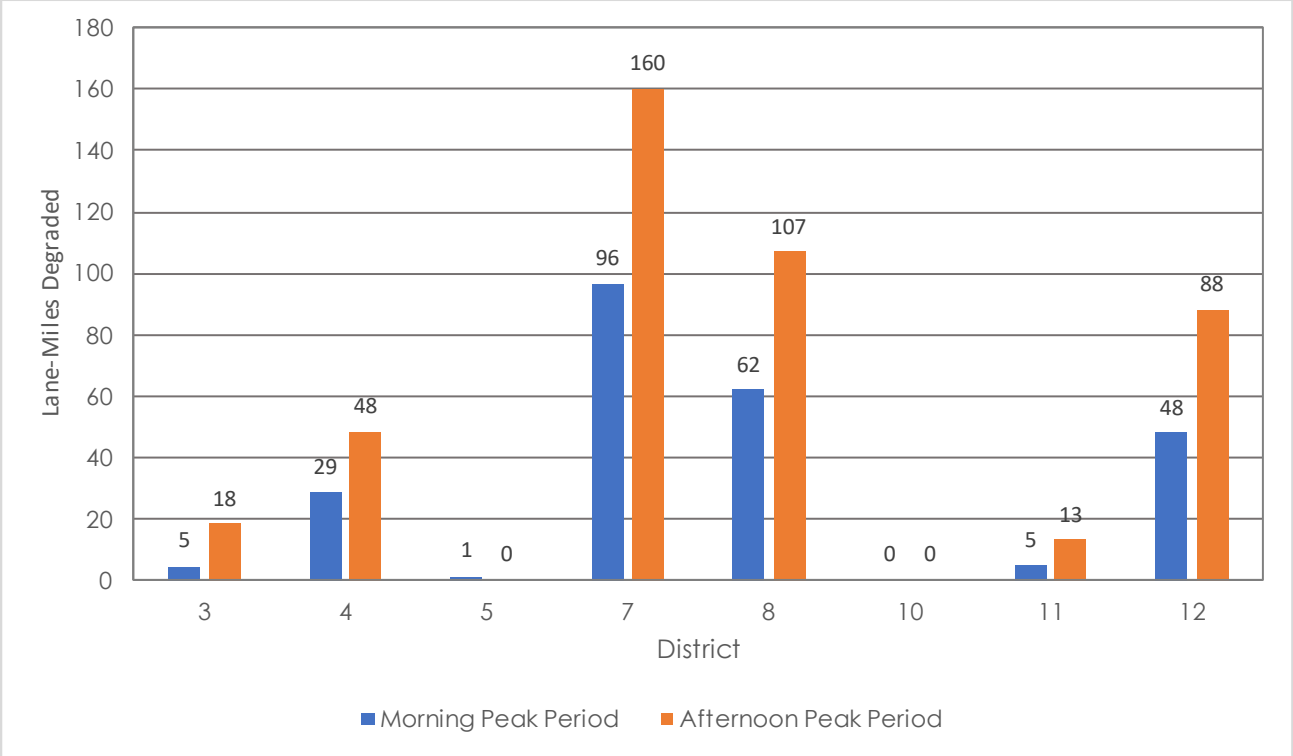
Table 3 summarizes the statewide HOV facilities degradation monitoring in 2021. Of the 1,186 lane-miles monitored during the morning peak hour period, about 21 percent (245 lane-miles) were degraded. Of the 1,185 lane-miles monitored during the afternoon peak hour period, approximately 37 percent (435 lane-miles) were degraded. Figure 1 shows the lane-miles of degraded HOV facilities by district. District 7 (Los Angeles area) and District 8 (Riverside and San Bernardino Counties) had the most degradation. Approximately 40 percent of District 7 and District 8 HOV facilities that operated in both peak hour periods

experienced degradation in both peak hour periods. District 10 experienced no degradation.

TABLE 3. 2021 STATEWIDE DEGRADATED LANE MILES SUMMARY

Peak Hour Period	Category	Lane-Miles
Morning	Degraded	245
Morning	Not Degraded	941
Afternoon	Degraded	435
Afternoon	Not Degraded	750

FIGURE 1. DEGRADATION BY DISTRICT



Figures 2 and 3 show statewide degradation categorized by frequency; as slightly degraded, very degraded, and extremely degraded. Degradation occurred more frequently in the afternoon, with approximately 41 percent of the degraded facilities in that period experiencing extreme levels of degradation.

FIGURE 2. STATEWIDE DEGRADATION BY FREQUENCY (MORNING PEAK HOUR PERIOD)

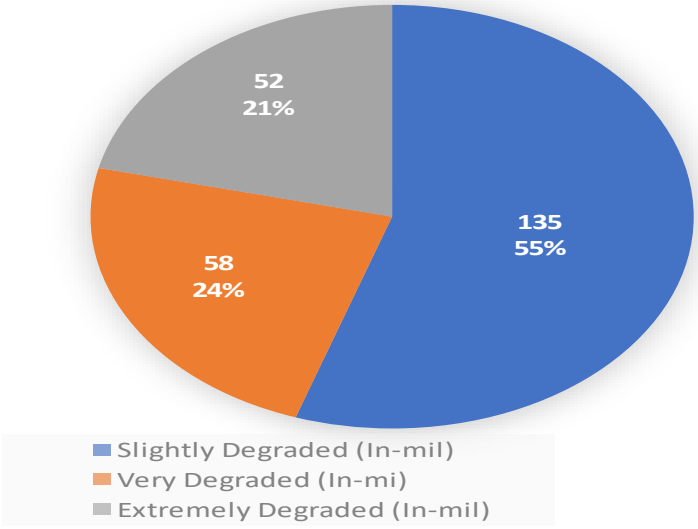
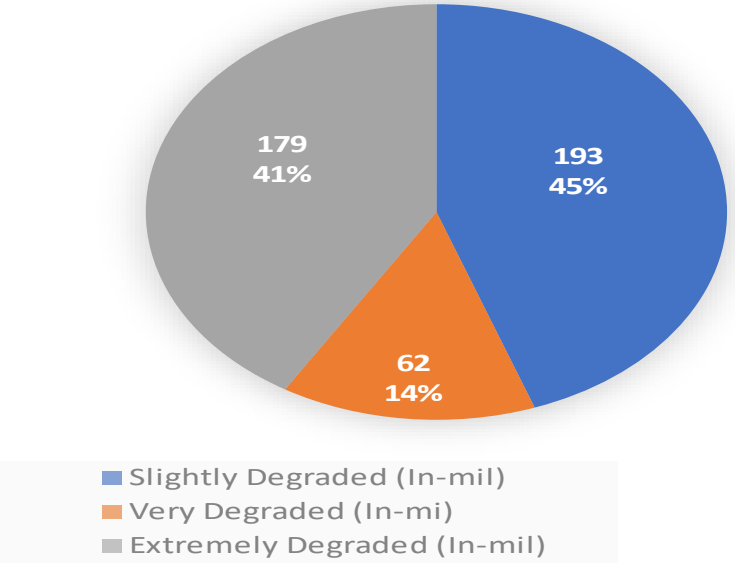


FIGURE 3. STATEWIDE DEGRADATION BY FREQUENCY (AFTERNOON PEAK HOUR PERIOD)



Analysis of degraded facilities indicates that the following factors contributing to degradation include:

- HOV demand exceeding the capacity of the facility.
- Recurrent congestion on the freeway.

- Disruptions to the traffic flow from vehicles entering or exiting the HOV facility.

- Congestion at the downstream end of the HOV facility backing up traffic into the HOV facility.

The results of the degradation analysis for each district's HOV facilities are provided in **Attachment B**. The degraded stations can be accessed through web browsers and mobile devices at the link below: **Click Here** https://caltrans.maps.arcgis.com/apps/webappviewer/index.html?id=85604a36aa4e411fb4d00bab29edd4fc.

5.1. IMPACTS OF COVID-19 PANDEMIC ON DEGRADATION

Since California Governor Gavin Newsom declared a statewide state of emergency due to concerns about the rapid spread of the COVID-19 on March 2, 2020, and California entered several stay-at-home orders, the stay-at-home orders had a marked effect on traffic congestion on California's highways. Overall, the traffic volumes on the SHS during the morning and afternoon peak periods from March 2020 through December 2020 were 10 to 50 percent less compared to the same period in 2019. VMT on the SHS during this period was down about 10 to 50 percent from the same time in 2019, while average speeds went up as much as 15 percent. The State's HOV lanes were not exempted from the impacts of the pandemic. Table 4 compares the percentage of facilities degraded in 2020 compared to 2019. There was an approximately 50 to 80 percent drop in degradation in 2020.

As of April 2021, more people became eligible for the COVID-19 vaccine, and Governor Gavin Newsom took actions to lift pandemic executive orders on June 15, 2021. That included terminating the Stay-at-Home Order that was implemented early in the pandemic to protect Californians. The vaccine and stay-at-Home termination gradually allowed people to resume a more normal routine, which resulted in noticeable impacts on traffic congestion on California's highways. Figure 4 compares the percentages of statewide facilities degraded in 2021 to 2019. Figure 5 provides a side-by-side comparison of degradation in each district in the morning and afternoon peak hour periods in 2019, 2020 and 2021. HOV degradation levels in 2021 were about 8 to 21 percent below 2019 levels.

FIGURE 4. STATEWIDE PERCENTAGE OF HOV LAND-MILES DEGRADED IN THE LAST THREE YEARS

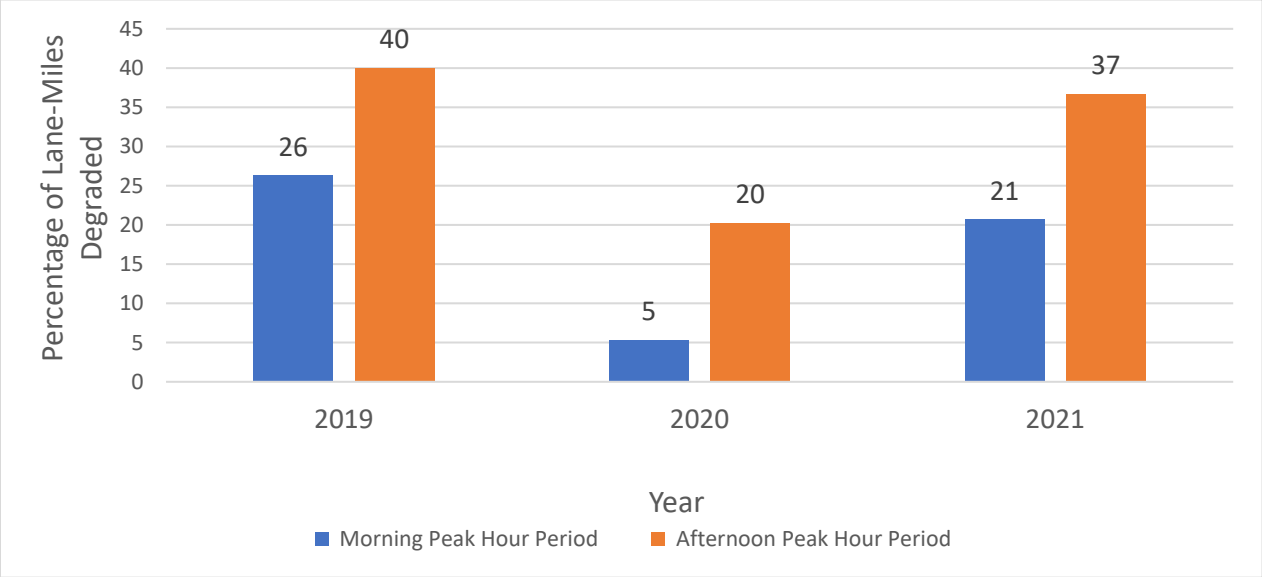
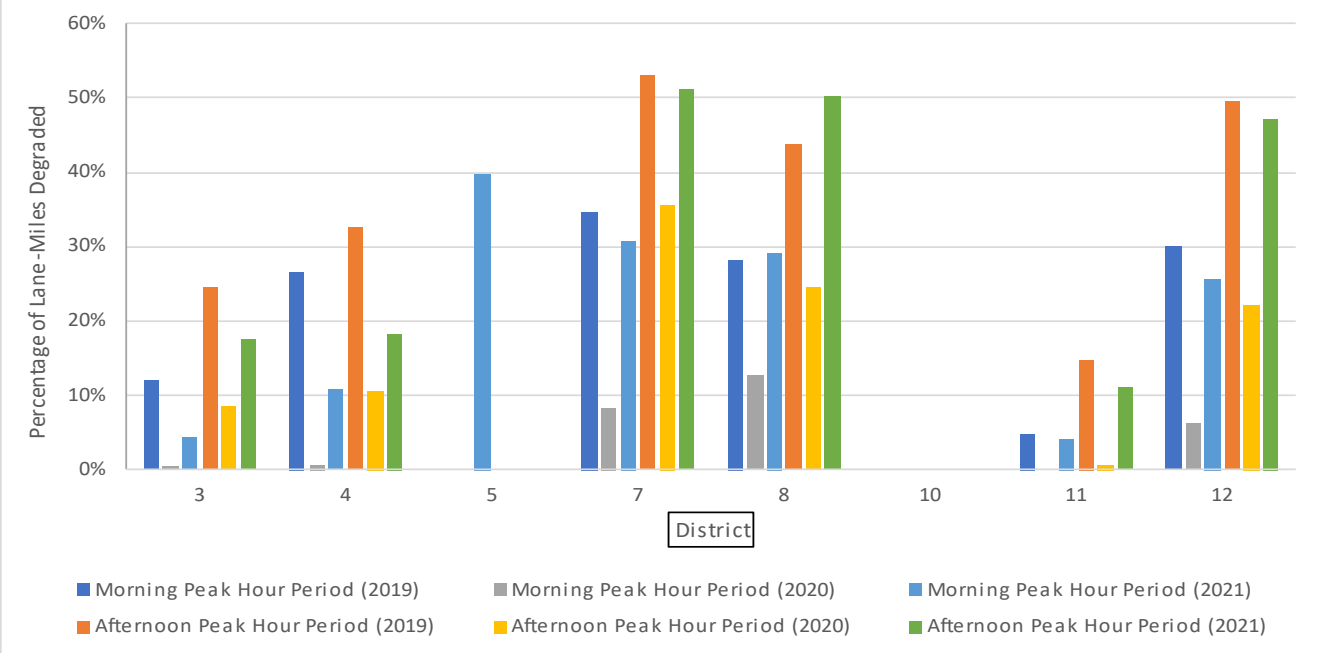


FIGURE 5. PERCENTAGE OF LANE-MILES DEGRADED BY DISTRICT IN THE LAST THREE YEARS



6. CONCLUSIONS

The tables in Attachment B summarize the degraded HOV facilities. There were approximately 37 facilities degraded in 2021. Listed below are some general observations from the 2021 degradation analysis:

- Degradation was more prevalent in the afternoon peak hour period, versus the morning peak hour period, as noted in Table 4.
- Comparing degradation in the years 2019, 2020 and 2021, District 5 has a high percentage of degradation during the morning peak period in 2021 while there was no degradation in the years 2019 and 2020. However, the significant increase in degradation was due to ongoing construction downstream at the end of multiple HOV segments. District 5 has several segments of US-101 currently under construction. The US-101 HOV Project that is being constructed in phases is tying into the HOV lanes constructed by District 7 that cross into District 5. Since the issue is expected to go away once construction is completed, a potential waiver request is expected to be submitted to FHWA.
- Districts 7, 8, and 12 had the highest amounts of degradation. All three districts experienced degradation in the morning and afternoon peak hour periods. The levels of degradation for Districts 7 and 12 in the morning were about 11 to 15 percent less than the levels seen in 2019 and levels of degradation in the afternoon decreased by 3 to 5 percent.
- The percentage of lane-mile degraded in the morning peak hour period in District 8 was 28 percent in 2019 and increased to 29 percent in 2021. The percentage of lane-mile degraded in the afternoon peak hour period was 44 percent in 2019 and increased to 50 percent in 2021. The level of degradation in District 8 was about 3 percent during the morning peak period and 15 percent in the afternoon peak period, more than the levels seen in 2019.

7. NEXT STEPS

The degradation analysis data including speed plots has been separately sent to the districts to help them with their analyses. Caltrans continues to work towards implementing a more strategic and programmatic approach to addressing degradation, including dedicated funding to addressing

performance issues in the SHS, including degradation. In February 2022, the Division of Traffic Operations issued a new policy that requires all districts with degraded HOV facilities to perform traffic investigations on those facilities. This new policy should result in a more thorough analysis of the causes of degradation and actions that will more directly address those causes. It should be noted that some of the operational changes that were highlighted in Section 2 of this report are expected to have addressed the degradation of those facilities and will be reflected in the action plans. Caltrans will provide FHWA a draft degradation action plan by September 30, 2022, and the final version will be submitted by November 30, 2022.

8. ATTACHMENTS

A. LIST OF HOV FACILITIES ON THE STATE HIGHWAY SYSTEM IN 2021 (8)
B. SUMMARY OF 2021 DEGRADATION ON HOV FACILITIES (11)