
Orange County Managed Lanes Network Study

Summary of Findings and Implementation Plan



Prepared for



Prepared by



6 Hutton Centre Drive, Suite 700
Santa Ana, CA 92707

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Managed lanes present the motorist with travel choices. In addition to mobility, managed lanes are consistent with other goals and objectives of Caltrans, District 12 and the Federal Highway Administration (FHWA), including safety, stewardship of the environment, and prudent financial management of public funds.

Managed lanes are implemented with tools to manage demand, such as pricing, eligibility based on occupancy and vehicle type, and physical access via striping or barriers. Ideally, the demand for the managed lane can be reduced to match the capacity and thereby ensure free-flow conditions. Priced managed lanes are a form of congestion pricing, where tolls allow operating agencies to manage excess demand during peak periods. The economic basis is that when users are forced to pay for negative impacts they create, they will be more likely to change to their behavior, thereby reducing congestion.

Orange County has extensive experience with managed facilities on the HOV network, Express Lanes and toll roads. HOV lanes first opened in Orange County in 1985, on State Route (SR) 55. The HOV lanes on Interstate 5 (I-5), SR 57, SR 91, and I-405 also have all been open for more than 20 years, and have been highly successful. All lanes operate all hours of the day with HOV-2+ requirements (vehicles with two or more occupants, including the driver, are allowed to use the lanes). There are several HOV direct connectors, direct access ramps (DARs), as well as a short two-lane section south of the El Toro “Y” on I-5, and on I-405 between SR 22 and I-605.

Orange County’s HOV network has 216 lane-miles of existing HOV lanes, more than in any other California county except Los Angeles. District 12 is also unique in that nearly all of the non-toll freeways in the County have HOV lanes. The southern end of I-5 is the longest section without HOV lanes, and most of that section is either currently under construction or in planning/design to add an HOV lane. There is a mix of limited-access and continuous striping.

Orange County has only one of seven priced managed lanes (Express Lanes) currently operating in California, on SR 91. The SR 91 Express Lanes provide two lanes in each direction for 10 miles between the SR 91/SR 55 interchange in Anaheim and the Orange/Riverside County Line. The other Express Lanes in the state are I-15 in San Diego County, I-110 and I-10 in Los Angeles County I-580, I-680, and SR 237/I-880 in the Bay Area as shown in Table 1.

Caltrans Highway Design Manual definitions:

Managed lanes are proactively managed in response to changing operating conditions in efforts to achieve improved efficiency and performance. Typically employed on highways with increasing recurrent traffic congestion and limited resources.

(a) **High-Occupancy Vehicle (HOV) Lanes**--An exclusive lane for vehicles carrying the posted number of minimum occupants or carpools, either part time or full time.

(b) **High Occupancy Toll (HOT) Lanes**—An HOV lane that allows vehicles qualified as carpools to use the facility without a fee, while vehicles containing less than the required number of occupants to pay a toll. Tolls may change based on real time conditions (dynamic) or according to a schedule (static).

(c) **Express Toll Lanes**--Facilities in which all users are required to pay a toll, although HOVs may be offered a discount. Tolls may be dynamic or static.

TABLE 1
Express Lanes Operating in California

Express Lanes	County	Length (miles)	Number of Lanes	Free Travel Eligibility
SR-91	Orange	10	2 lanes per direction	HOV-3+*
I-15	San Diego	20	2 lanes per direction	HOV-2+
I-10	Los Angeles	14	2 lanes per direction	HOV-3+
I-110	Los Angeles	11	2 lanes per direction	HOV-2+
I-580	Alameda	12	2 lanes eastbound and 1 lane westbound	HOV-2+
I-680	Alameda	14	1 lane southbound	HOV-2+
SR 237/I-880	Santa Clara	4	1 lane per direction	HOV-2+

* Half price on Monday-Friday 4:00 PM to 6:00 PM in the eastbound direction

The network study area is shown in Exhibit 2; it highlights the various study segments. All of Orange County's freeways are included in the Managed Lanes Network Study, except for the toll roads and Express Lanes (the current lanes on SR 91 and the future I-405 Express Lanes, OCTA's M2 project that will open in approximately 2023). The Express Lanes are managed by the Orange County Transportation Authority (OCTA).

There is also a network of toll roads in Orange County, consisting of SR 241, SR 73, SR 133, and SR 261, operated by the Transportation Corridor Agencies (TCA). Tolls on these facilities vary by time of day, but the tolling is not dynamic, or responsive to demand. There are four defined tolling periods: peak hour, pre-/post-peak, non-peak, and weekend, each of which is tolled at a predefined rate. These toll roads are managed lane facilities, because variable tolling is used to address variations in the demand. The toll roads are somewhat different, however, in that all lanes are tolled and the tolls are the same regardless of occupancy. Therefore, this study is focused on the existing HOV system and the potential for conversion or construction of managed lanes facilities, and does not identify or propose toll road expansion.

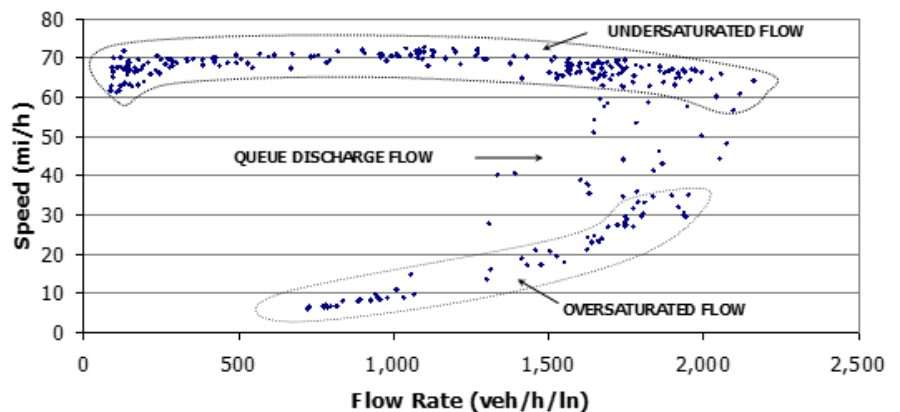


Toll roads and HOT lanes are different. Toll roads charge all drivers on all lanes, and carpools do not get a discount. HOT lanes are similar to HOV lanes, but require tolls (except for carpools, which are free or discounted). HOT lanes are only on the one or two left lanes.

While HOV lanes have been successful in Orange County (and across California and the U.S.) for many years, their effectiveness is beginning to wane as demand increases. Once demand exceeds capacity, the lane becomes congested. Once this occurs, the HOV lanes is deemed "degraded", which is addressed by a federal requirement. Degradation is defined as when the average traffic speed during the morning or evening weekday peak hour is less than 45 miles per hour (mph) for more than 10 percent of the time over a consecutive 180-day period. In other words, the HOV lane's average traffic speed cannot drop below 45 mph for an average of more than two weekdays each month.

EXHIBIT 2**Study Area Network****EXHIBIT 3****Speed-Flow Relationship**

Exhibit 3 helps explain the goals behind managing flow. On the top of the graph, as flows (demand) increase towards the maximum (approximately 2000 vehicles/hour/lane), speeds are generally maintained. However, as demand increases beyond the maximum, the system breaks down (the lower part of the graph). With higher demand, both flows



Source: Highway Capacity Manual, 6th Edition (data from Caltrans, I-405, 2008)

and speed decrease as congestion sets in. Speeds around 45 mph are the break point between free-flow operations and congestion.

Federal guidelines, including MAP-21 (the Moving Ahead for Progress in the 21st Century Act, 2012) and the FAST Act (Fixing America's Surface Transportation Act, 2015), require monitoring and remediation strategies when HOV lanes are degraded. In response, Caltrans prepares the annual *California High-Occupancy Vehicle Lane Degradation Determination Report* (the latest is 2014) to assess current performance.

Most of the HOV lanes in Orange County are degraded (see Table 2 and Exhibit 4). Based on federal guidelines, District 12 (Orange County) had approximately 20 percent of the degraded HOV lane miles statewide in 2014. Degradation in Orange County has increased from 139 lane-miles to 146 lane-miles between the first and second halves of 2014. Specifics on peak period operations and specific locations are available in the *Degradation Determination Report*. Of course, managed lane degradation is not limited to Orange County, and there are operational issues at the boundaries with other counties (particularly Los Angeles). However, the focus here is on Orange County facilities.



The status quo is not a viable option. The investment in HOV lanes in Orange County requires improvements to the system to reduce congestion and improve reliability. Those potential improvements to managed lanes are the subject of this study.

TABLE 2

Orange County HOV Segments Identified as Operationally Degraded (Extremely, Very, or Slightly)

Freeway	Direction	Begin (Interchange)	End (Interchange)	2014 Degradation*
I-5	Northbound	Junipero Serra Rd.	Oso Pkwy.	Slightly
		Bake Parkway	SR 57-SR 22	Extremely
	Southbound	Lincoln Ave.	Jeffrey Rd.	Extremely
		Bake Parkway	Junipero Serra Rd.	Slightly
SR 22	Eastbound	Magnolia St	Glassell St.	Slightly
	Westbound	Magnolia St.	I-405	Very
SR 55	Northbound	I-405	SR-91	Extremely
	Southbound	SR-91	I-5	Extremely
SR 57	Northbound	Lincoln Ave.	LA County	Very
	Southbound	LA County	I-5	Very
SR 91	Eastbound	LA County	SR 55	Extremely
	Westbound	SR 55	LA County	Extremely
I-405	Northbound	I-5	LA County	Extremely
	Southbound	LA County	I-5	Extremely

Source: http://www.dot.ca.gov/hq/traffops/trafmgmt/hov/files/degrd_rept/2014-HOV-degradation-report.pdf

*Levels of degradation: slightly (10 to 49%), very (50 to 74%) or extremely degraded (74 to 100%) of days when the average traffic speed during the morning or evening weekday peak hour is less than 45 mph

EXHIBIT 4

Orange County HOV Lanes Identified as Operationally Degraded (Either Direction, 2014 Data)



Source: http://www.dot.ca.gov/hq/traffops/trafmgmt/hov/files/degrd_rept/2014-HOV-degradation-report.pdf

2. General Benefits of Express Lanes

Caltrans' mission is to provide a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability. Managed lanes, including priced managed lanes, are consistent with the fulfillment of this mission. Per DD-43-R1, Caltrans uses managed lanes as a "sustainable transportation system management strategy". Express Lanes address regional growth and provide long-term congestion relief. Caltrans must focus on efficient lane management due to limited opportunities for current and future freeway expansion, as well as the need to minimize right of way impacts.

Express Lanes enhance California's sustainability and livability as follows:

- **Travel times and reliability are improved across the system.** With Express Lanes, travel times in the managed lanes will be reduced, and speed variations will become less common. Since some solo drivers will shift to Express Lanes, even drivers who stay in the free lanes can benefit.
- **Travelers have more choices.** Solo drivers can also use these lanes, allowing for the option to pay for faster trips and more reliable travel.
- **Transit use, new transit services, and carpooling are all encouraged.** Travelers are incentivized to use transit or carpools, maximizing people throughput and not just vehicle throughput. Express Lanes make the transit mode choice more attractive, encouraging the modal shift to vanpools, carpools, and buses. Toll revenue can also be used to support these strategies, encouraging the expansion of the transit system. These benefits have already been realized in San Diego County, where transit ridership has increased significantly along I-15 corridor, and new Bus Rapid Transit (BRT) service has been instituted.
- **Express Lanes help Caltrans address federal guidelines.** Degradation is nearly ubiquitous in the Orange County HOV system. The federal guidelines require monitoring and remediation strategies, and Express Lanes are an effective tool for addressing degradation.
- **The managed lanes system is more sustainable.** A priced managed lanes system is more sustainable. There were great investments into the HOV system when they were first introduced. Decades later, they have become so successful that more innovative ways are needed to sustain their effectiveness. Express lanes allow for the flexibility necessary to make the system more sustainable, and they provide for long-term mobility benefits by preserving a portion of the roadway for assured free-flow operation.
- **Caltrans and other agencies can better manage the freeway system.** With Express Lanes, Caltrans and other agencies can manage traffic volumes better and limit congestion. HOV lanes alone are not flexible enough to be an effective tool for active management.
- **Safety is enhanced.** Harmonizing speeds across lanes by reducing stop/starts in the managed lanes and minimizing mainline bottlenecks can significantly reduce the number and frequency of incidents during peak periods. This has been demonstrated in managed lane facilities across the nation.¹
- **There are environmental benefits.** Less congestion means reduced vehicle emissions as speeds are higher and more consistent. Decreases in idling and stop-and-go driving also help improve air quality. Potential benefits include reductions in particular matter (PM), carbon monoxide (CO) and greenhouse gas (GHG) emissions.

¹ FHWA (<http://www.ops.fhwa.dot.gov/freewaymgmt/faq.htm>) notes that "studies have shown that HOV lanes are frequently as safe as, and in many cases safer than, unrestricted lanes".

- **Express Lanes are consistent with regional planning goals.** Express Lanes are in alignment with goals of the Southern California Association of Governments (SCAG) Regional Transportation Plan (RTP) and Senate Bill 375 requirements. They also close the gaps in interconnectivity, providing better mobility for the entire region.
- **Express Lanes improve quality of life.** Travel time savings allow for more time spent with families, businesses to operate more efficiently, and the safe and reliable movement of goods and services, including those services from emergency responders.

3. Approach for Analyzing Managed Lanes

This study is the culmination of a series of efforts conducted by Caltrans and the Southern California Association of Governments (SCAG). Exhibit 5 illustrates the connection between this study and other relevant planning efforts.

The Managed Lanes Network Study is a companion to the Managed Lanes Feasibility Study, and it is a more region-specific assessment of managed lanes in Orange County from the SCAG Express Travel Choices Study, which examined Express Lanes throughout the SCAG region (Ventura, Los Angeles, Orange, Riverside, San Bernardino, and Imperial Counties). Exhibit 6 illustrates that the Managed Lanes Network Study is more comprehensive than the other two studies; it includes an evaluation of added priced managed lanes (not included in the SCAG study) and traffic analysis (not included in the Managed Lanes Feasibility Study).

Similar to the Managed Lanes Feasibility Study, the primary goal of the Managed Lanes Network Study is to identify specific projects to move forward in the project development process. With this report, Caltrans is also putting policies (like DD-43-R1) into practice.

EXHIBIT 5

Relevant Recent Studies (State, Regional, and District 12)

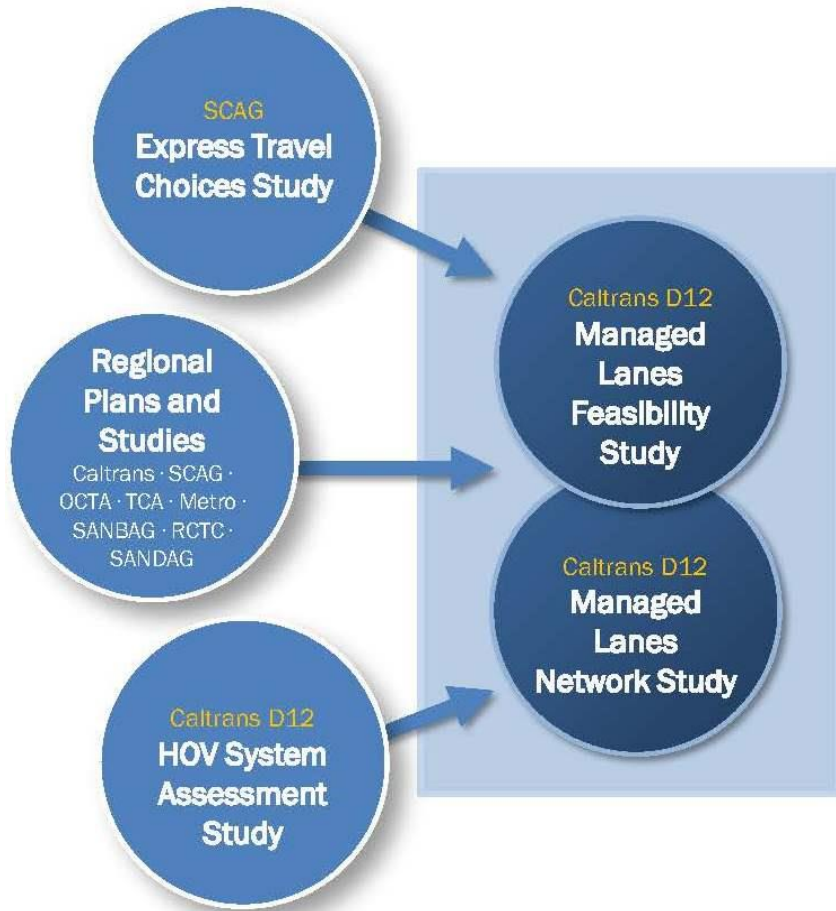
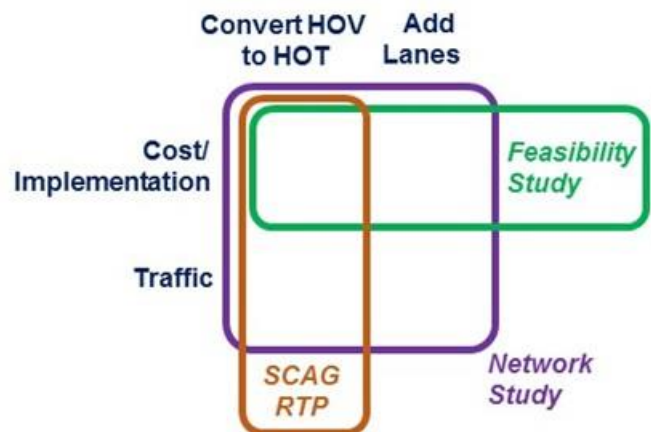


EXHIBIT 6

Comparison of Managed Lanes Studies





The ultimate goal of this study is to identify specific implementation priorities for moving forward with managed lanes projects. Both policy and current operations drive the need for improvements to the managed lanes system.

To do so, technical analysis was needed to support the recommendations. This section outlines the types of analysis that were conducted. Section 4 is a summary of the results, and Section 5 identifies the implementation plan priorities.

3.1 Evaluation Scenarios

All of the freeways in Orange County were evaluated to determine how well they would work with priced managed lanes (Express Lanes) instead of HOV lanes. Each freeway was evaluated with two scenarios², customized for each freeway:

- **Scenario 1:** Convert existing HOV lanes (2+ occupancy) to Express Lanes (vehicles with 3+ occupancy would remain free to encourage carpooling and transit). Implement limited physical/capital improvements, except for toll equipment.
- **Scenario 2:** Add lanes, as needed, to create two managed lanes in each direction. Convert new and existing HOV lanes to Express Lanes (the analysis baseline was that vehicles with 2+ or 3+ occupancy would be free³, to encourage carpooling and transit, although those details have not yet been determined.

These scenarios were compared to a future baseline network that included all programmed future projects (e.g., all of the OCTA Measure M2 projects), plus additional projects identified by stakeholders. Technical Reference 3 is a summary of the stakeholders and Technical Reference 4 is a summary of the formal modeling request. The project definitions were the result of a collaborative process among technical stakeholders from OCTA, SCAG, TCA, FHWA, Caltrans Headquarters and neighboring Districts.

The future Express Lanes on I-405 were included as a baseline project, for all scenarios including No-Build. The I-405 Express Lanes project will improve 16 miles of I-405 between the SR 73 freeway in Costa Mesa and I-605 near the L.A. County line. The project includes adding one General Purpose (GP) lane in each direction from Euclid Street to I-605, and the construction of the 405 Express Lanes (two lanes in each direction from SR-73 to I-605). The project is financially committed, and expected to be completed by 2023. It is funded with a combination of federal, state, local, and toll revenues⁴.

An HOV-2 to HOV-3 conversion scenario was considered but not included in the analysis. With this scenario, no pricing would be implemented. The only change would be to modify the occupancy requirements for carpools from HOV-2 to HOV-3. While this scenario would improve managed lanes operations, it would result in increased congestion on the GP lanes, with associated degradation of reliability, safety, and air quality. An HOV-3 scenario would also likely create “empty lane syndrome”, where drivers in the congested GP lanes would see the adjacent HOV lane with mostly available capacity.

² It is possible that both scenarios could occur on the same freeway, as part of a phased implementation plan. A project built on one freeway would have effects (positive and negative) on other freeways in the system. Individual project plans will need to address these effects, as project timing is better known.

³ A scenario with a reduced toll for HOV-2 vehicles (and free for HOV-3+) scenarios is feasible but was not explicitly analyzed. The performance of this scenario would be between the HOT-2 and the HOT-3 scenarios. The decision on tolling HOV-2s would depend on future financial plans, so further future evaluation would be needed.

⁴ More details on toll revenue can be found in Section 6.4 of Technical Reference 6.

Conversions of GP or HOV-2+ lanes to HOV-3+ facilities have rarely been implemented. FHWA guidance⁵ notes that HOV-2+ to HOV-3+ may “result in underutilization of the HOV lanes ... It is very likely that prevailing traffic congestion on general purpose lane will worsen.” One GP lane on the Santa Monica Freeway (I-10) was converted to HOV-3+ in 1976⁶. The increased congestion in the other GP lanes was not well-received by the public and the media. Eventually, a lawsuit was initiated and the lanes were restored to GP by court order. Another example that demonstrates the inefficiencies of HOV3+ conversions is the I-10 (Katy) HOV Lane⁷. The Katy HOV lanes were opened in October 1984 and only buses and vanpools were initially allowed. There were only a total of 86 vehicles using the facility during the morning peak hour. To address this low use, the lane was open to authorized HOV-4+ in 1985. The occupancy requirement was dropped to HOV-3+ later in 1985 and to HOV-2+ in 1986.

3.2 Evaluation Measures

There are many different evaluation measures that can be used for assessing priced managed lanes. For this study, six measures were used, as summarized in Table 3. A balanced set of evaluation measures is important, because not all potential improvements will address every measure. The evaluation measures are generally consistent with those used in the regional Express Travel Choices Study. Technical Reference 5 is a comprehensive assessment of performance measures for managed lanes that provides more details on evaluation.

TABLE 3
Evaluation Measures

Measure	Purpose	Measured By
Managed lanes operations	Address degradation of HOV lanes and ensure performance of Express Lanes	Predicted speed improvement in managed lanes
Speed and delay (GP lanes)	Improve operations for all freeway users; improve air quality	Speed change and delay reduction in GP lanes
Funding (revenue vs. cost)	Develop financially feasible projects that can help improve corridor operations	Preliminary toll revenue and cost estimates
Connectivity and planning	Identify projects that are consistent with regional planning priorities	Evaluation of countywide network, considering other projects
Stakeholders and policy	Identify potential conflicts with key stakeholders and their policies	Assessment of other agencies (SCAG, OCTA, TCA) and their programs
Independent function	Identify projects that can be developed independently prior to network completion	Consideration of corridor alignment and existing connectors

⁵ http://ops.fhwa.dot.gov/publications/fhwahop08034/hot1_0.htm

⁶ <http://next10.org/sites/next10.org/files/10%20High-Occupancy%20Vehicle%20Lanes.pdf>

⁷ <http://ops.fhwa.dot.gov/docs/houston/houstoncasestudy.pdf>

3.3 Evaluation Tools

The first three measures listed in Table 3 required detailed technical analysis, using advanced modeling software. Exhibit 7 is an overview of the approach for conducting the planning-level traffic forecasting and economic analysis.

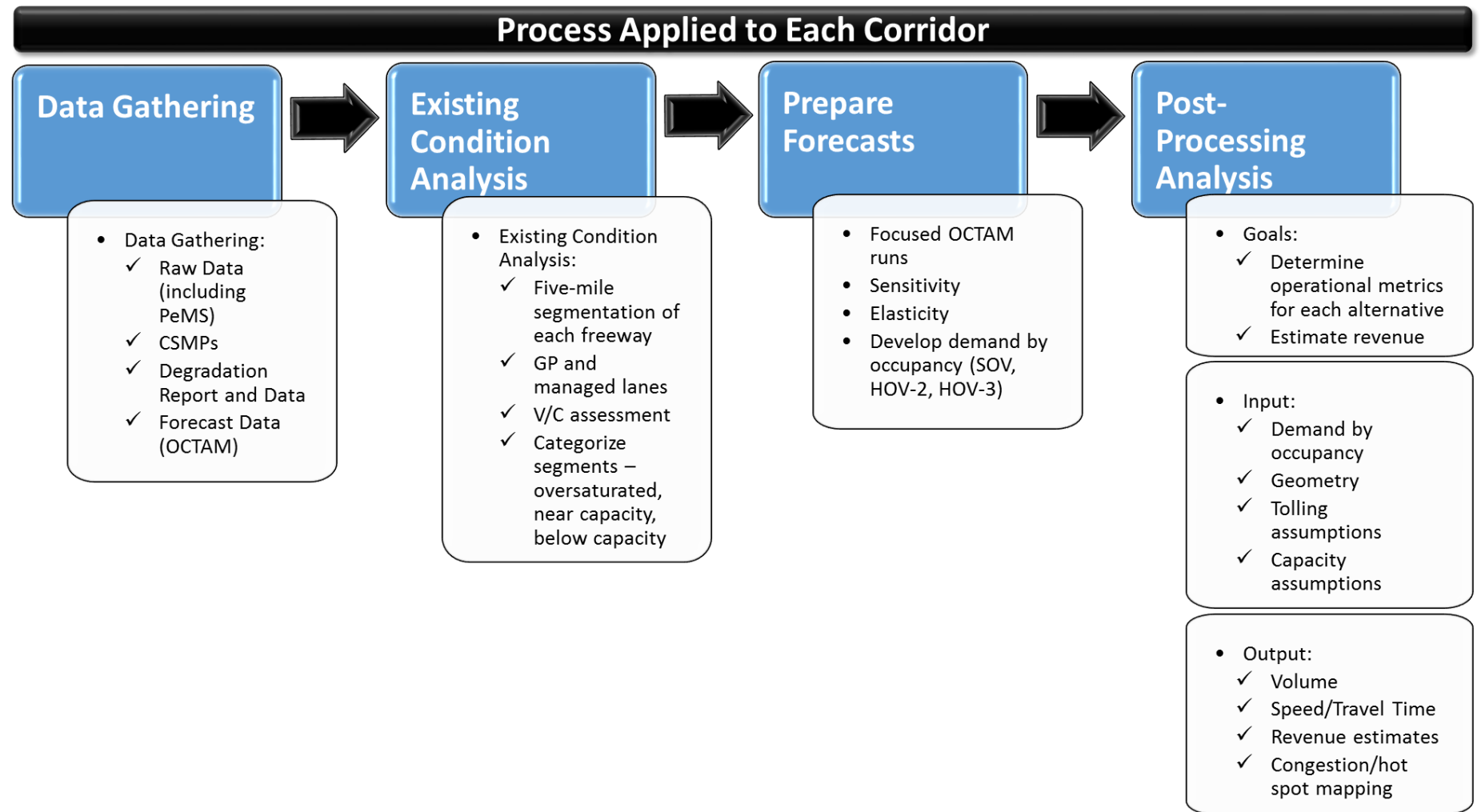
A suite of tools was used to conduct the technical evaluation. The general strategy was to apply a modeling tool that integrates and extends available models and leverages current data. The Orange County Transportation Analysis Model (OCTAM), supplemented by current data from Caltrans' Performance Monitoring System (PeMS), was the primary resource for the evaluation. The key steps were:

1. Data collection – gather information from available sources.
2. Existing conditions analysis – assess current operations as a baseline to validate the model.
3. Traffic forecasting – extract data from the OCTAM model (year 2040) for the baseline analysis (without new priced managed lanes).
4. Post-processing analysis - assess the operational metrics for each alternative and estimate demand, traffic operations, and revenue on each corridor. Key outputs include volume, speed/travel time and delay, congestion mapping, and revenue. The CH2M Desktop Traffic and Revenue Analysis Model for Managed Lanes (DTRAM-ML) was used for the analysis.

Technical Reference 6 is a summary of these technical details.

EXHIBIT 7

Planning-Level Toll Demand and Revenue Analysis Modeling Approach Flow Diagram



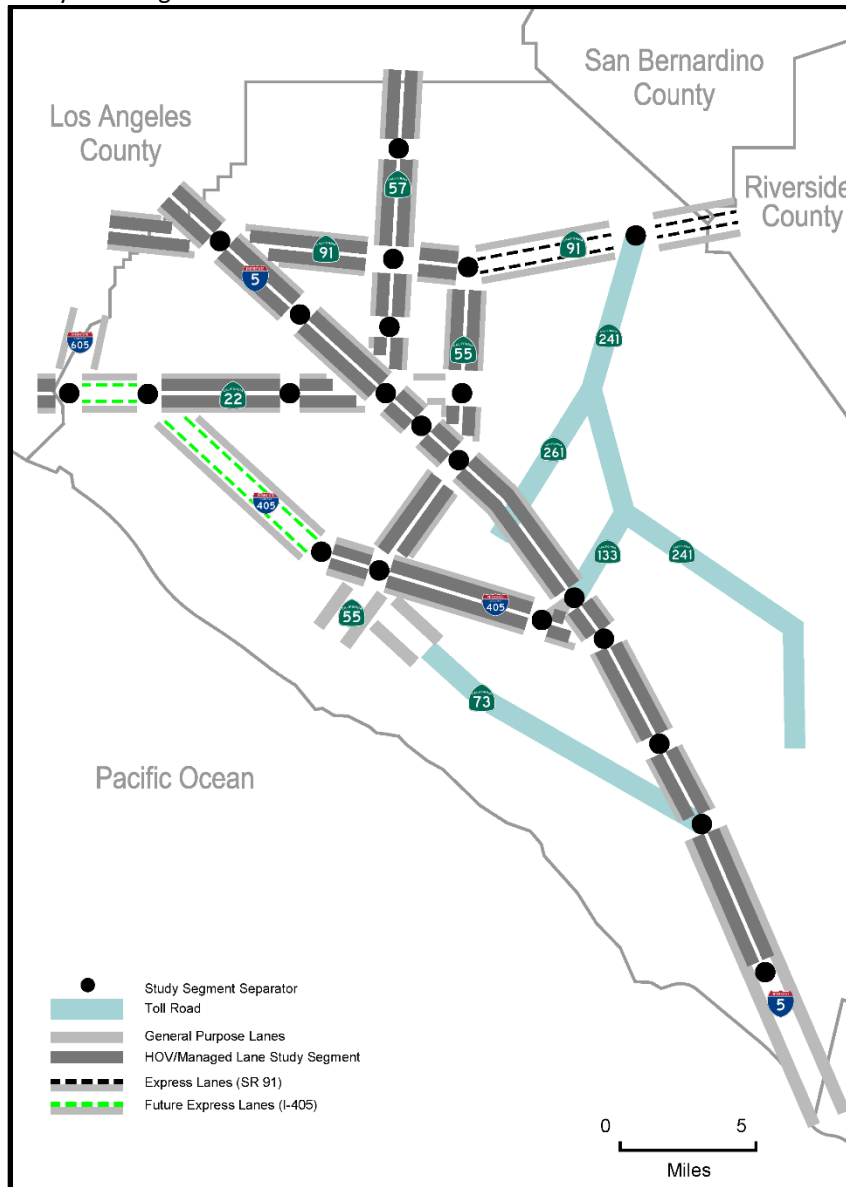
4. Evaluation Results

The DTRAM-ML analysis of managed lanes scenarios resulted in an extensive data set. Variables in the analysis are as follows:

- Segments: up to 11 segments, depending on the freeway, as illustrated in Exhibit 8.
- Directions: northbound/southbound, or eastbound/westbound
- Study periods: AM, midday, PM, and night-time
- Year: 2010 to 2075 (2035 was used as the typical horizon year)
- Freeway element: Managed and GP lanes
- Mode: Single-occupancy vehicle (SOV), HOV-2, HOV-3+, and truck

EXHIBIT 8

Study Area Segmentation



For a single scenario, the demand, volume/capacity (V/C), and speed were calculated. For I-5 alone, the calculations resulted in over 46,000 individual base calculations (not including iterations), or well over one million calculations for all scenarios. The resulting database, which totaled approximately 500 megabytes of data, was summarized by corridor and scenario.

Note that the existing Express Lanes on SR 91 (east of SR 55), and the financially committed future Express Lanes on I-405 (from SR 73 to I-605) are included in the baseline analysis. Therefore, the benefits of these Express Lanes are not part of the assessment of additional Express Lanes in these corridors. In short, the results below reflect the benefits of Express Lanes on SR 91 only west of SR 55, and on I-405 only south of SR 73.

Exhibit 9 is a summary of the delay reduction benefits, which include delay savings on both the managed and GP lanes. The graph includes data for the peak period (either AM or PM) for the entire corridor. Higher numbers indicate where Express Lanes will reduce delay the most, for all drivers (Express and GP). The delay savings are much greater for Scenario 2, where a second managed lane is added, providing substantial additional capacity. Technical details can be found on pages TR-92 to TR-262 in Technical Reference 7.

EXHIBIT 9

Analysis Summary: Delay Improvements

Delay: Throughout the peak periods, how much less time will vehicles be stuck in traffic?

Priced managed lanes will reduce overall delay for the aggregate of all vehicles, on all freeways in Orange County. The biggest reductions will be on the congested I-5 and I-405 freeways. More congestion reduction is projected when a second managed lane can be added.

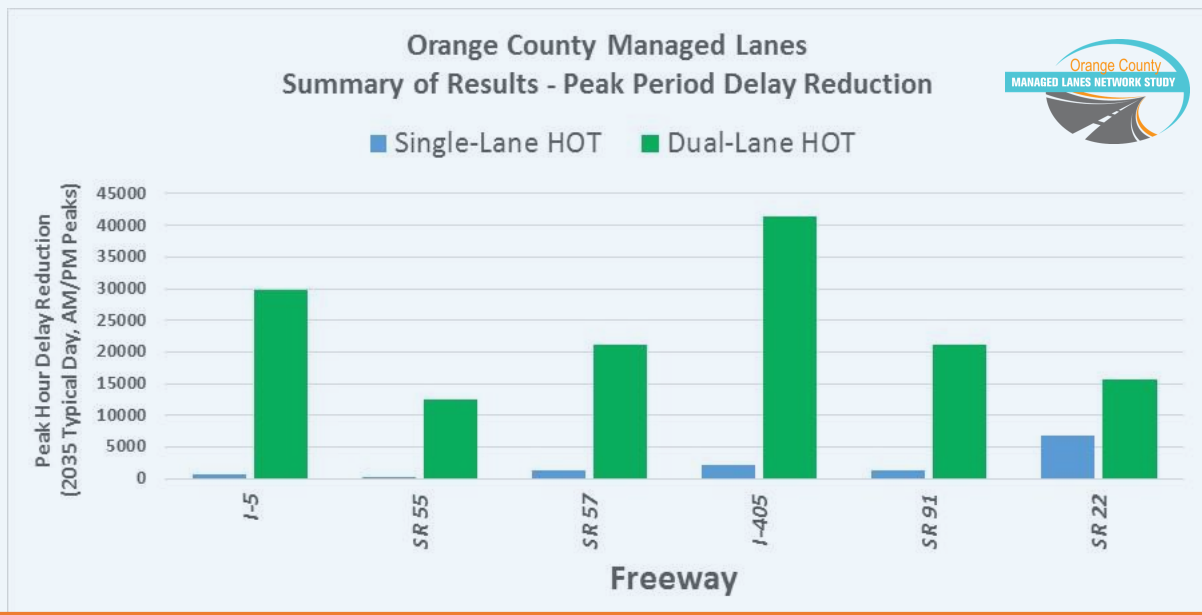


Exhibit 10 is a summary of how well the managed lanes will achieve the primary goal of addressing degradation. The graph includes a proxy estimate of the reduction in degradation in the two peak periods (AM and PM) for managed lanes in each corridor. The differences reflect how well Express Lanes can address degradation in the often-congested HOV lanes. Higher numbers indicate where Express Lanes will reduce degradation the most. The benefits are somewhat greater for Scenario 2, where a second managed lane is added, although the change from HOV-2 to HOT-3 in Scenario 1 still provides substantial benefits. On I-5, the degradation benefits are comparable to those of Scenario 1, primarily because of the high vehicle occupancy on that freeway. Technical details can be found on pages TR-92 to TR-262 in Technical Reference 7.

EXHIBIT 10

Analysis Summary: Managed Lane Improvements

ML Operations: How much will Express lanes eliminate degradation on the managed lanes?

Priced managed lanes will eliminate future degradation on the congested HOV lanes on the I-5, SR 57 and I-405 freeways the most. For both scenarios, speeds will get better with pricing, so managed lanes drivers will have more reliable trips. Adding the second managed lane will improve speeds even more.

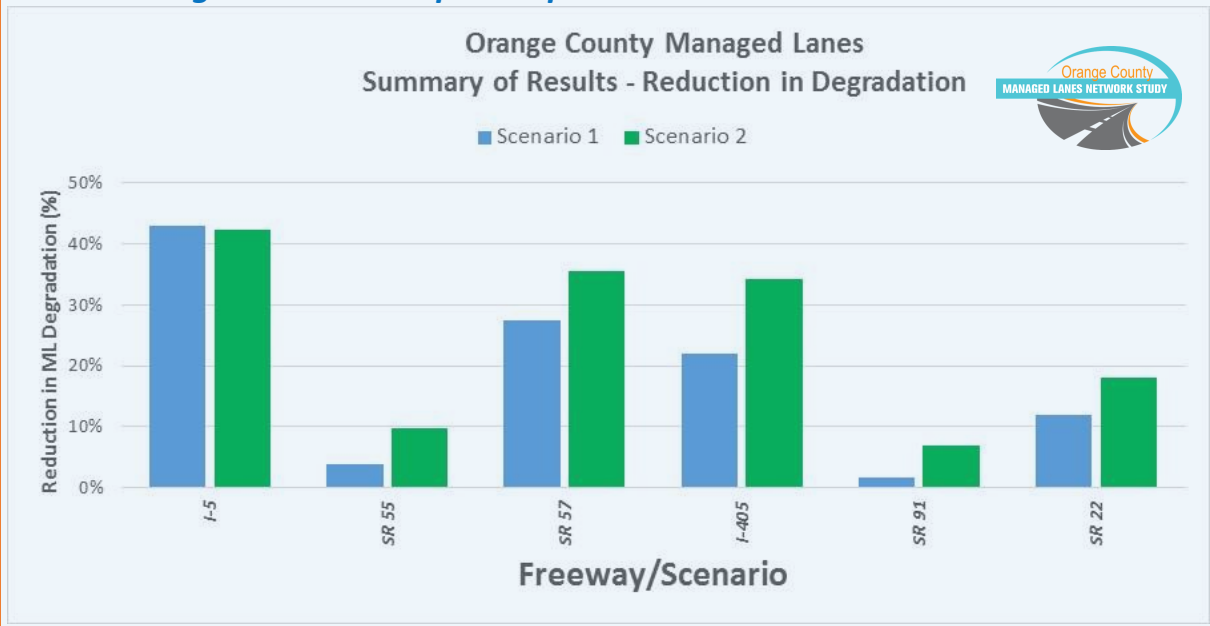


Exhibit 11 is a summary of the speed benefits for the GP lanes. The graph includes data for the peak periods (both AM and PM) for the entire corridor. Higher numbers indicate where Express Lanes will increase speed the most for the GP lanes. There are generally only speed benefits for Scenario 2, where a second managed lane is added, providing substantial additional capacity. Technical details can be found on pages TR-92 to TR-262 in Technical Reference 7.

EXHIBIT 11

Analysis Summary: GP Speed Improvements

Speed: How will speeds change for General Purpose (GP) lanes users?

Priced managed lanes will have a modest effect on GP speeds unless a second managed lane is added (Scenario 2). Scenario 1 speed changes are near zero because some HOVs shift to the GP lanes (counterbalancing paying SOVs shifting to the managed lanes). GP speeds in Scenario 2 are markedly higher.

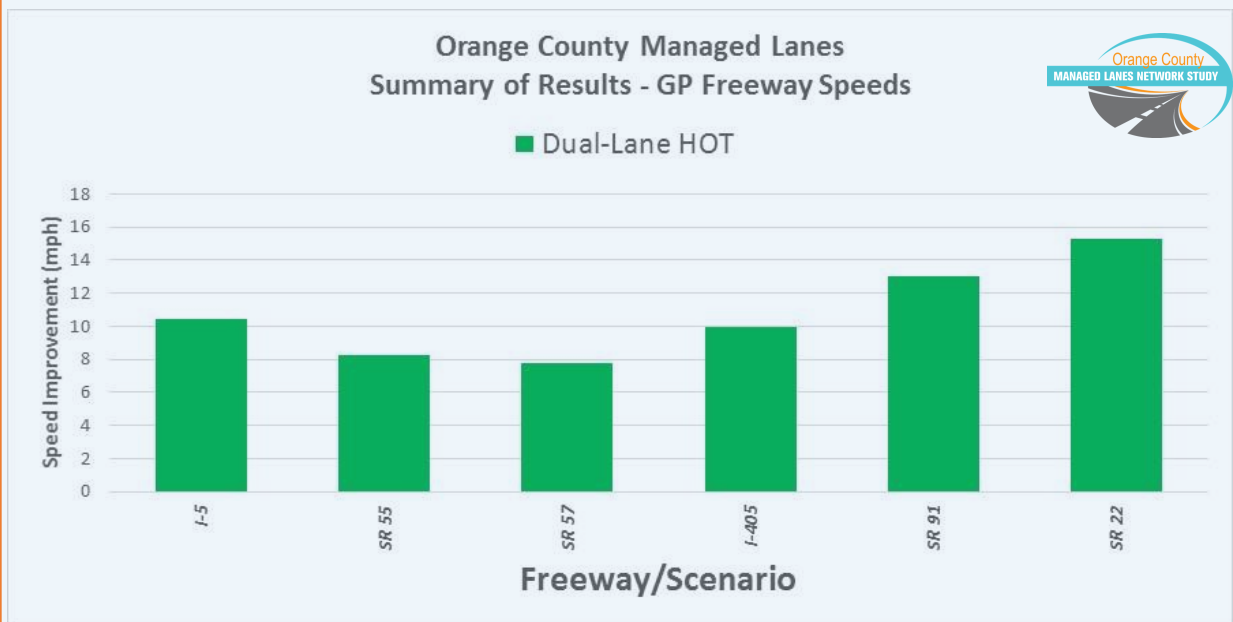


Exhibit 12 is a summary of the expected toll revenue benefits. The graph includes an assessment of annual revenue for each freeway. The DTRAM-ML model includes a toll estimation module, but the projections are less detailed than typical projections with a Traffic and Revenue (T&R) Study. However, DTRAM-ML is accurate for comparing revenues between scenarios because the assumptions are consistent in each analysis. Those revenue projections are presented in Exhibit 12 on the vertical axis (from low to high).

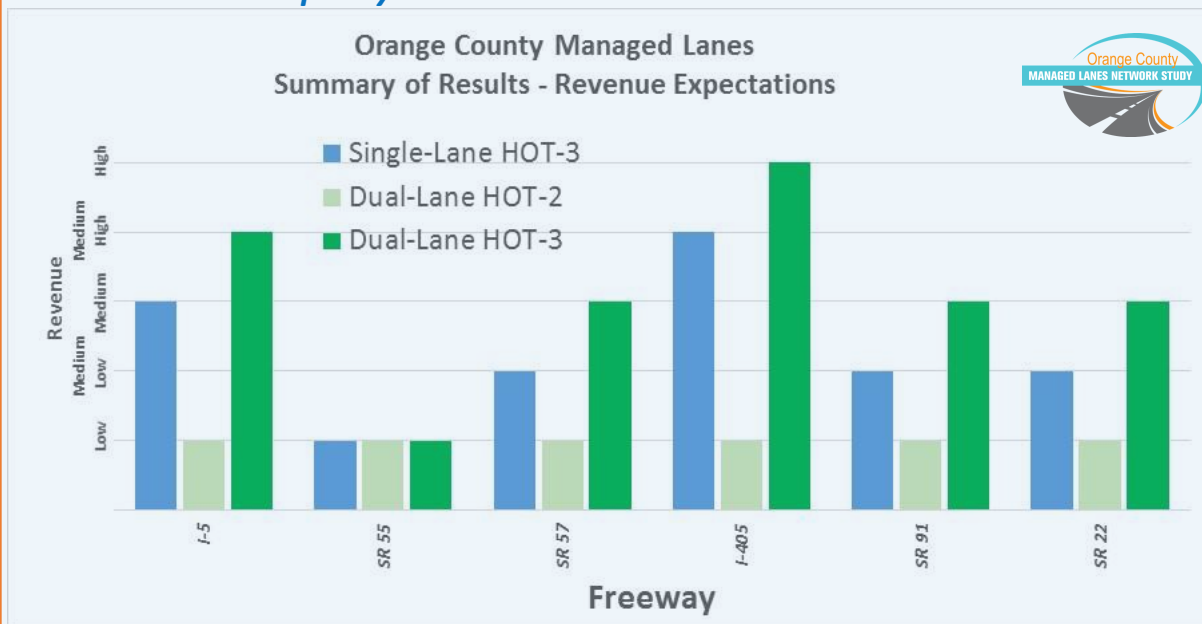
Scenario 1 is shown in blue, and the two Scenario 2 options are shown in green. The Scenario 2 HOT-2 option (light green) has the lowest expected revenue because the available capacity in the Express Lanes will serve more free HOV-2s. The Scenario 2 HOT-3 option (dark green) has the highest expected revenue because of the number of vehicles (SOV and HOV-2) who will pay to use the available capacity in the managed lanes. Technical details can be found on pages TR-92 to TR-262 in Technical Reference 7.

EXHIBIT 12

Analysis Summary: Toll Revenue Benefits

Revenue: What toll revenue is expected?

Priced managed lanes will provide additional funding to operate and maintain the existing freeway and support transit services in the corridors that they serve. Scenario 2 revenue is highest when HOV-3+ occupancy is used.



5. Implementation Priorities

The goal of this study is to determine which freeways will do best overall, and make those a priority when implementing priced managed lanes. The results in Section 4 indicate that some freeways under certain scenarios will perform better for some (but not all) of these measures.

Exhibit 13 highlights results from a combined rating and ranking exercise. Each of the performance measures described in Section 4 was evaluated on a 1-100 scale, and then combined for each freeway and scenario. From there, the ratings were converted to a *Consumer Reports*-style assessment.

The freeway corridors were assessed for the Scenario 1 (conversion) and Scenario 2 (added managed lane) evaluations. The technical (modeling) results were very different for Scenario 1 and Scenario 2, so the two separate evaluations were conducted. The technical comparisons between the two evaluations in Exhibit 13 were independent. A “best” performance rating for Scenario 1 may not be as good as a “good” or “fair” performance rating for Scenario 2, because of the additional capacity as part of Scenario 2. The approach was to compare corridors with similar investments.

EXHIBIT 13

Summary Evaluation

Summary by Freeway

Scenario 1: HOV->HOT Conversion Only

	I-5	SR 55	SR 57	I-405	SR 91	SR 22
Managed Lanes Operations	●	●	●	●	●	●
Speed and Delay	●	●	●	●	●	●
Funding (Revenue vs. Cost)	●	●	●	●	●	●
Connectivity and Planning	●	●	●	●	●	●
Stakeholders and Policy	●	●	●	●	●	●
Independent Function	●	●	●	●	●	●

Scenario 2: Added Managed Lane, for Two HOT Lanes

	I-5	SR 55	SR 57	I-405	SR 91	SR 22
Managed Lanes Operations	●	●	●	●	●	●
Speed and Delay	●	●	●	●	●	●
Funding (Revenue vs. Cost)	●	●	●	●	●	●
Connectivity and Planning	●	●	●	●	●	●
Stakeholders and Policy	●	●	●	●	●	●
Independent Function	●	●	●	●	●	●

●	Best performance/fewest challenges
●	Good performance/minor challenges
●	Fair performance/some challenges
●	Poor performance/major challenges

The last step was to translate the evaluation into implementation priorities. The timeline for project development (from project initiation through environmental documentation through final design through construction) can be several years, and securing funding may add even more time. Therefore, 15-year time periods were used to prioritize improvements. Therefore, implementing managed lanes on the highest priority corridors should be initiated as soon as practical, to complete construction before 2030. The second tier of projects would likely not be considered until after 2030.

Exhibit 14 is the final summary of implementation priorities (primary and secondary) for the corridors in Orange County. The table was developed by considering the technical analysis and input from stakeholders. The assessment of these implementation priorities was based on the assessment in Exhibit 13, comparing across freeways and between the two scenarios. Then, synergies among corridors were considered, to get to a package of corridors for each set of priorities.

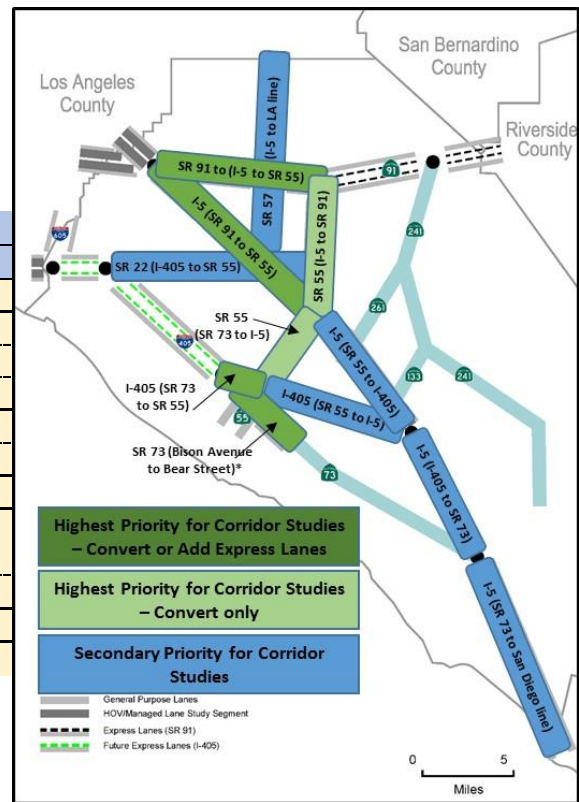
There are different priorities for SR 55 for the convert vs. add lanes scenarios, due to differences in the performance from the modeling findings. For all of the other corridors, the findings are consistent.

EXHIBIT 14

Managed Lane Implementation Priorities

Segment	Convert		Add Lanes	
	Priority		Priority	
	1	2	1	2
I-5: SR 91 to SR 55	☑		☑	
I-5: SR 55 to SR 73		☑		☑
I-5: SR 73 to San Diego line		☑		☑
SR 55: SR 73 to I-5	☑			☑
SR 55: I-5 to SR 91	☑			☑
SR 57: I-5 to LA line		☑		☑
I-405: SR 73 to SR 55 and SR 73: Bison to Bear*	☑		☑	
I-405: SR 55 to I-5		☑		☑
SR 91: SR 55 to I-5	☑		☑	
SR 22: I-405 to SR 55		☑		☑

*Include consideration of SR 73 north (Bison Avenue to Bear Street) in future project development studies and plans



The end result is a set of recommended corridors to prioritize in the next phase of the project development process. I-5, SR 91, SR 55, and I-405 should be strongly considered for moving forward in the project development process, with a goal of completed construction by 2030 or earlier. Conversion to Express Lanes, including a second lane where feasible, are recommended on:

- I-5 north of SR 55
- SR 91 from the existing Express Lanes, west to I-5
- SR 55 from SR-73 to SR 91
- I-405 from SR 73 to SR 55 (potentially including SR 73 from Bison Avenue to Bear Street)



All of the recommended corridors result in clear benefits with the implementation of Express Lanes, for both the system and individually. As a system, the corridors will form a north-south connection between the existing SR 91 Express Lanes and the new I-405 Express Lanes that will be built by 2023. Proceeding forward, the intent is that the findings of the study will serve as one of the various sources that will help drive the region's planning documents, including but not limited to future RTP and Long

Range Transportation Plan (LRTP) amendments/revisions. Individually, the key reasons for recommending each corridor for moving forward to the next stage of the project development process are:

- **I-5** ranks very high on improving operations (by reducing speed and delay) on both the managed and GP lanes. As the longest corridor in Orange County, it will also function well as a stand-alone Express Lane corridor, while also connecting to SR 55 and SR 91.
- **SR 91** is the logical extension to the existing Express Lanes to the east (which are being extended into Riverside County). The operations benefits are clear, and it should be well-received by stakeholders because of the existing Express Lanes.
- **SR 55** will see clear benefits for all users if Express Lanes are implemented. As the central spine freeway in the County, SR 55 is an essential piece of the puzzle, and will connect to several other Express Lanes corridors (I-405, I-5, and SR 91).
- **I-405** is the logical extension to the upcoming Express Lanes to the north, which are expected to be completed by 2023. Like SR 91, extending these Express Lanes (and connecting them to SR 55, where there are already managed lanes connectors at the system interchange) is a logical next step. The north end of SR 73 does not have managed lanes, although the freeway was built with sufficient pavement width for HOV or other managed lanes in the median. With the connection to I-405, SR 55, and the SR 73 toll road, Caltrans and the other stakeholders have identified this section as a high priority for Express Lanes consideration. Coupling it with the segment of I-405 (from SR 73 to SR 55) would be a natural fit for a corridor study.

To support the managed lanes network concept, an initial concept of operations (ConOps) has been developed. While it is the first ConOps and covers a broad range, it can serve as the starting point for corridor-specific ConOps throughout the County. The initial ConOps is attached as Technical Reference 8.

Other projects should be considered for implementation in the 2030 to 2045 timeline. While there are benefits in these corridors, the operations, connectivity, and policy issues suggest that they should be a lower priority. Also, regardless of the priority for implementation, all priced managed lanes projects should include monitoring and enforcement programs. Partnership meetings and public workshops should also be included.

In summary, there are clear benefits associated with improving the managed lanes system in Orange County. Converting to Express Lanes (HOT lanes) will help ensure that the investment in HOV lanes can be used as intended: to provide travel time benefits for carpools and transit users. Caltrans and other agencies will be able to better manage the freeway system, and travel time/reliability will be markedly improved. With the implementation of a more robust managed lanes network, travelers will have more choices. As transit use and carpooling become more attractive, they will be encouraged. With improvements in traffic flow, safety and the environment will be enhanced. Finally, Express Lanes will help Caltrans address federal guidelines for degradation. Moving towards two Express Lanes in each direction is ideal, but intermediate projects to convert lanes will also provide noticeable benefits.



New and expanded Express Lanes in the I-5, SR 91, SR 55, and I-405 corridors will help address degradation, improve corridor operations, advance network connectivity, and will be fiscally responsible. Project Initiation Documents (PIDs) should be started to further develop and refinement improvements in these corridors, and move toward implementation.

Technical Reference 1: Literature Survey

Technical Reference 2: Caltrans Deputy Directive DD-43-R1

Technical Reference 3: Stakeholders

Technical Reference 4: OCTAM Modeling Request

Technical Reference 5: Performance Measures for Managed Lanes

Technical Reference 6: Approach for Analyzing Managed Lanes

Technical Reference 7: DTRAM-ML Results

Technical Reference 8: Concept of Operations

All technical references are provided as separate attachments.