TRAFFIC OPERATIONS PLAN

SAN DIEGO INTERSTATE 15 MANAGED LANES VALUE PRICING PROJECT

FINAL

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I-15 MANAGED LANES
VALUE PRICING PLANNING PROJECT

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Purpose

This report presents an overview of the operational requirements to be considered in the development of the proposed Managed Lanes on I-15. This plan addresses the major components of the Managed Lanes system, including:

- Signing
- Striping
- Types and locations of control features
- Moveable Barrier System
- AM/PM Peak/Off Peak Operations
- Safety Issues
- Incident Management

Discussion of each of the components is provided in the following sections of this report.

Background

The preparation of this Traffic Operations Plan is based on the assumption that value pricing will be utilized to allow and control the volume of SOV's within the Managed Lanes. It also has been assumed that a moveable barrier system will be used to adjust the configuration of the lanes to favor traffic in the peak direction of flow. If these criteria are not supported by other studies being conducted as part of this project, the operations plan for the Managed Lanes system will need to be revised. The Managed Lanes will also make use of some of the existing I-15 infrastructure, including Changeable Message Signs (TRS) for incident management, the existing communications backbone, CCTV cameras, etc.

The geometric layout of the Managed Lanes, including striping, mainline access locations and direct access locations, weaving distances, normal HOV signing (directions to HOV exit points to I-15 ramp locations), etc. are based on plans prepared by Caltrans District 11 engineers. Some modifications to the original Caltrans plans have been made based upon recommendations made by the project team, and are incorporated into the reference documents used to prepare this plan.

Project Description

The I-15 Managed Lanes project includes construction of a 4-lane, barrier separated facility in the median area of the freeway, from SR 163 north to SR 78. The project begins at the south end at the interchange with SR 163, and will include replacing the existing reversible two-lane barrier-separated Managed Lane facility. This existing

facility was constructed in the median of I-15 from SR 163 north to Ted Williams Parkway (SR 56). The Managed Lanes will consist of four lanes, barrier separated from the general purpose lanes, from SR-163 north to approximately 740 meters south of Citracado Parkway. At that location, the Managed Lanes are configured as two lanes in each direction, and operate as standard HOV lanes adjacent to the northbound and southbound mixed flow lanes. One of the northbound lanes drops as a direct connector to Hale Avenue, and the remaining HOV lane ends and becomes a general purpose lane. In the southbound direction, one HOV lane begins adjacent to the general purpose lanes approximately 400 meters north of Hale Avenue, and the second HOV lane begins as a direct connector from Hale Avenue.

Stage 1 of the project, from SR 56 to Centre City Parkway, will need to operate in the interim condition with the existing two-lane barrier-separated Managed Lanes to the south, and the existing general purpose lanes to the north. During operations after Stage 1 construction, the moveable barrier system will be configured to allow a fixed two travel lanes in each direction, and will require operational adjustments only at the south end at the interface with the existing two-lane section.

Traveling in the southbound direction, there are ten locations for vehicles to enter the Managed Lanes, and nine locations to exit the Managed Lanes. Traveling in the northbound direction, there are eleven locations for vehicles to enter the Managed Lanes, and eight locations to exit the Managed Lanes. These entry and exit points are depicted in the attached Exhibits and identified in Tables 1 and 2.

Major Components

- **Signing**

  There are two general types of signing associated with the Managed Lanes system: 1) normal regulatory, guide and warning signs, and 2) signs specifically required for operations of the Managed Lanes. The regulatory, guide and warning signs will be included in the construction plans prepared by Caltrans District 11 for the project. These include signs such as the R87-1, which identifies the entrance locations and specifies the number of persons required for classification as a carpool, and the G85 and G86 signs, which notify motorists which Managed Lane exit to use to access specific I-15 ramp locations.

  The signs required specifically for the Managed Lanes will notify drivers in the general purpose lanes of the tolls for SOV's using the Managed Lanes. A series of Toll Rate Signs (TRS) have been located to provide this information to the drivers. Generally located on the barrier between the general purpose lanes and the Managed Lanes, these signs will inform drivers of the current toll per mile, as well as the minimum toll charged for using the Managed Lanes. These signs will be placed far enough in advance of the entry locations to give drivers the opportunity to decide whether or not to use the Managed Lanes. The proposed locations for the TRS toll signs are shown on the attached Exhibits.

TABLE 1
I-15 MANAGED LANES
VEHICLE IDENTIFICATION LOCATIONS
SOUTHBOUND DIRECTION

ENTER	STATION	TOLL RATE SIGN	TOLL ZONE LOCATION
S/B Mainline (Project Beginning)	513+00	513+00	490+00
S/B Mainline	479+00	489+00	466+00
S/B Mainline	466+60	N/A	466+00
S/B Del Lago D.A.	443+00	N/A	396+80
S/B Mainline	399+20	408+40	396+80
S/B Rancho Bernardo D.A.	379+00	N/A	341+65
S/B Mainline	364+60	364+60	341+65
S/B Mainline	314+00	317+70	308+00
S/B Ted Williams D.A.	317+60	N/A	308+00
S/B Mainline	293+20	300+40	291+00
S/B Mainline	278+00	286+60	241+80
S/B Mainline	261+80	263+62	241+80
S/B Hillery Drive D.A.	261+20	N/A	241+80

TABLE 2
I-15 MANAGED LANES
VEHICLE IDENTIFICATION LOCATIONS
NORTHBOUND DIRECTION

ENTER	STATION	TOLL RATE SIGN	TOLL ZONE LOCATION
N/B Mainline (Project Beginning)	191+00	191+00	226+20
N/B Hwy. 163		181+00	226+20
N/B Mainline	238+60	227+00	241+40
N/B Mainline	261+20	259+00	291+00
N/B Hillery Drive D.A.	272+00	N/A	291+00
N/B Ted Williams D.A.	325+50	N/A	327+00
N/B Mainline	335+00	328+00	341+40
N/B Mainline	368+60	360+00	371+80
N/B Rancho Bernardo D.A.	389+80	N/A	429+10
N/B Mainline	419+80	410+60	429+10
N/B Del Lago D.A.	455+00	N/A	466+00
N/B End Moveable Barrier	466+00	N/A	466+00

- **Striping**

  Striping plans for the Managed Lanes project, including lane designations, ingress/egress and weaving sections, and striping on the reconstructed portions of the general purpose lanes will be prepared by Caltrans District 11. The typical section for the project includes four 4.2 meter lanes, with 3.0 meter shoulders and fixed concrete barriers between the Managed Lanes and the general purpose lanes. As envisioned, a moveable concrete barrier system, with a base width of 0.6 meters, will be placed over a lane line to provide separation between opposing vehicles within the Managed Lanes. At the mainline ingress/egress locations, the fixed concrete barrier is eliminated, and a striped transition between the Managed Lanes and the general purpose lanes in proposed. The striped transition includes a 1,000 meter long weaving section adjacent to the general purpose lanes to allow for transitions to and from the general purpose lanes.

- **Types and Locations of Control Features**

  The main controls for operation of the Managed Lanes will be the fixed concrete barriers which provide separation from the general purpose lanes, and the moveable barrier system which provides separation between opposing vehicles within the Managed Lanes. The purpose of the moveable barrier system is to provide a means for increasing capacity within the lanes in the peak flow direction. Generally, traffic is heavier in the southbound direction in the morning rush hour, and heavier in the northbound direction in the evening rush hour. During the mid-day period, traffic tends to be fairly uniform in both directions.

  The proposed moveable barrier system will allow the Managed Lanes to be operated in three distinct configurations during normal operations:

  - Three southbound lanes, one northbound lane
  - Two southbound lanes, two northbound lanes
  - One southbound lane, three northbound lanes

  During serious emergencies or long-lasting incidents, it may become necessary to operate the Managed Lanes with all four lanes being available in one direction. Under this scenario, the moveable barrier system would be moved up against the fixed concrete barrier to the left side of the travel direction. This will still allow for ingress and egress to the general purpose lanes in the direction of travel, while restricting entrance of vehicles from the wrong direction.

  The four-lane, barrier separated portion of the Managed Lanes project is approximately 27 kilometers (16.8 miles). The vehicles which are used to relocate the moveable barriers have a maximum travel speed of 7 to 10 miles per hour, which would mean each cycle of barrier relocations would take up to 2.5 hours. Assuming a morning rush hour of 6:30 a.m. to 9:30 a.m., and an evening

rush hour of 3:30 p.m. to 6:30 p.m., it would be possible to have a mid-day period when two lanes could be provided in each direction. If the time for the two relocations required to provide the two lane split at mid-day becomes excessive, it may be necessary to transition directly from a three lane southbound to a three lane northbound scenario. This could be accomplished either through use of one large barrier relocation vehicle, or through a pair of smaller machines operating in tandem.

One other feature which will control the operations of the Managed Lanes will be assessing tolls on SOV's using the lanes. As proposed, the tolls will vary depending upon utilization of the lanes. In order to provide the capacity service level required for High Occupancy Vehicles (HOV's), tolls will be increased as volume increases to discourage use by toll-paying SOV's. The exact mechanism for determination of the tolling schedule and thresholds for increasing or decreasing the tolls is covered in other portions of this project.

As shown in Tables 1 and 2, a Vehicle ID Location has been established at each location where a vehicle can enter the Managed Lanes. These Vehicle ID Location are also shown on the attached Exhibits. Every SOV using the Managed Lanes is required to have a transponder mounted in the vehicle. At the indicated Vehicle ID Locations, an antenna will read and write information to the transponder which identifies the vehicle, it's entry location, and the toll in effect at the time the vehicle enters the Managed Lanes. The toll per unit of distance traveled that is charged to a vehicle will remain constant, even though vehicles entering at a different location or time may be charged a different toll. The data required for proper management of the capacity and the service level through the use of variable tolling will be sent to the centralized control center utilizing the I-15 fiber optics network. At each Vehicle ID Location identified in the tables, a vehicle passing by the antenna will be charged from that point to the next exit. If a vehicle leaves the Managed Lanes and is not detected by the next Vehicle ID Location, it's tolling sequence is stopped.

- **AM/PM Peak/Off Peak Operations**

As discussed in the section above (Types and Locations of Control Features), traffic volumes in opposing directions may be unbalanced (ie: southbound traffic may be heavier than northbound during the a.m. peak, and northbound traffic may be heavier during the p.m. peak). Additional studies being completed for this project will define the magnitude of the unbalanced nature of the traffic flow. If it is determined that future traffic flows in both northbound and southbound directions is nearly balanced, it may become desirable to eliminate the moveable barrier system and install a fixed barrier in the middle of the Managed Lanes section.

- **Safety Issues**

  A number of potential safety issues concerning the construction and operation of the Managed Lanes project have been identified. Among the possible concerns with the project as currently envisioned are:

  - The moveable barrier system may pose a visual distraction hazard for drivers within the Managed Lanes and within the general purpose lanes. The large machines used to relocate the moveable barriers, while physically protected from vehicular traffic at all times during their operation, are nonetheless a large, unexpected vehicle positioned in the middle of the travel lanes. Drivers may tend to "rubberneck" to see what the machines are doing, thus creating a possibility of accidents due to inattention.
  - The 305 meter long weave section at the ingress/egress locations meets current design standards, but may become a safety issue at locations where a large volume of traffic is both entering and exiting the Managed Lanes. The vehicles exiting the Managed Lanes will be required to merge into the high speed, #1 lane of the general purpose lanes, at the same time interacting with vehicles using the weave section to enter the Managed Lanes.
  - The California Highway Patrol (CHP) has expressed a concern regarding the ability of their officers to pull over vehicles within the Managed Lanes to issue violation citations. For most of the length of the project, there is only a 3.0 meter right shoulder, which immediately adjacent to a fixed concrete barrier. Using this narrow shoulder to stop vehicles may pose a concern to both the CHP officers and the occupants of the vehicles being stopped.

- **Incident Management Program**

  As part of the Regional Intelligent Transportation System architecture Caltrans District 11 operates an Incident Management System (IMS) for the detection, verification, and resolution of traffic incidents occurring along I-15 in San Diego County. This system is currently used to manage incidents occurring along the southern region of I-15 including the existing HOV / Toll Lanes. The District 11 IMS program was developed, implemented, and is being operated as defined in the Caltrans statewide IMS standards of operation practice and is operating efficiently. Although some of the individual operating requirements of this system may appear to be minor or administrative where others are considered critical, failure to perform any requirement will effect the overall incident management program. Two of the most critical components are the ability to detect and verify incidents, for these are the initial building blocks leading toward effect response and resolution activities. The IMS system tools employed by District 11 includes a closed circuit television (CCTV) system which provides video images of the

freeway system and a congestion reporting system which collects and reports in "real time" traffic congestion conditions. Both systems are components of the Caltrans Advanced Transportation Management System (ATMS) will eventually be installed along I-15 to the northern end of San Diego County. The existing CCTV and congestion systems are utilized by the District 11 Transportation Management Center (TMC) operators to:

- Detect incidents by viewing video images and/or congestion data
- Verify and assess incidents either simultaneous with detection or reported via the 911 emergency reporting system
- Continually monitor recovery efforts to assist in restoration of services

The other components of the District 11 IMS operating practice deals with incident management operating practices and procedures and includes:

- Receive and document incident reports
- Verify, assess, and categorize incidents
- Coordinate and dispatch support personnel and services
- Provide information to motorists / public service providers
- Monitor, control, and document resolution efforts

As the existing Caltrans District 11 IMS program is a Caltrans standard operating practice and has been proven to be efficient and effective, this same program can and most certainly should be applied to the proposed new sections of the HOV / Toll lanes. This should also include any Freeway Service Patrol support.

Although the same IMS practices can be applied to the proposed HOV / Toll lanes there are some unique characteristics of its' design and operation that may require slight modifications to the practices and management systems. These are discussed in the following sections of this report.

Although the existing HOV/Toll lane segment and proposed managed lane system share the same basic barrier wall design features, there are some significant differences. Unlike the HOV/Toll lanes, the proposed managed lane system design will include deployment of numerous electronic signs, vehicle tolling detectors, and CCTV cameras along the facility. Although these devices / systems are dedicated to the toll collection operation, they can and where practical should be used for reporting "real time" congestion information and when necessary for incident management activities. To support this, the operating system component of the electronic sign and CCTV systems and the vehicle count output data of the detector system needs to be integrated with the existing ATMS system being operated by the District 11 TMC personnel. At the time of writing this report it is understood Caltrans is redesigning elements of the existing HOV/Toll lane control systems to support full integration with the District 11 ATMS.

The ability to use the proposed electronic toll signs to display incident related messages to alert and advise motorists are an advantage. Messages could be displayed to divert traffic into or from the HOV / Toll lanes and to warn motorists of traffic conditions to possibly mitigate follow-on collisions. For these reasons the design of the electronic tolling signs should include the ability to display numerous lines of text to support motorist information.

Other significant design features of the proposed HOV Toll lanes, which are most likely to have a large impact on incident management, include the requirement for a moveable barrier system and numerous access and egress locations. These design elements are either a benefit or a challenge as described below:

Benefits

1. Having numerous access and egress locations along the system will help when diverting traffic into or from the managed lanes and main line system for the purpose of incident management.
2. More access locations should reduce travel time for vehicles responding to incidents.
3. By design, more electronic tolling message signs are required that can used to alert / advise motorists of incidents both on the main line and HOV / toll lanes.
4. More vehicle detectors results in larger area for reporting congestion
5. By design there will be numerous strategically placed CCTV cameras to verify and/or assess incidents and assist in resolution efforts

Challenges

1. An incident in the single lane segment of the HOV / Toll lanes could easily result in a closure of the lane or entire segment including any shoulder. This may require pre-positioning service support vehicles
2. Having adequate lane and shoulder width in all segments of the HOV / Toll lanes for disabled vehicles, incident support vehicles, e.g. tow trucks, ambulances, fire trucks, or for CHP to pull over motorists.
3. Developing a methodology for incident management practices to remove / replace a disabled barrier wall truck should it break down during operation.

As these Incident Management Program requirements and issues are being developed very early in the overall project schedule it is recommend they be reviewed and reevaluated during the design phase of the project.