Intelligent Transportation Systems (ITS)/ Operational Improvement Plan 2014

July 2014

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I. Introduction

The Caltrans District 3 Division of Transportation Planning and Division of Traffic Operations developed this **Intelligent Transportation Systems (ITS)/Operational Improvement Plan (PLAN)** to facilitate strategic deployment of ITS and operational improvement projects that optimize the State Highway System. The PLAN provides an investment strategy, to be developed in collaboration with Caltrans local and regional partners, to identify and prioritize ITS and operational improvements throughout District 3.

> ***"We need to prioritize ITS solutions and operational improvements, because they are the most cost-effective operational improvements we can make."***
>
> Caltrans Director,
> Malcolm Dougherty

The proposed value investments include cost-effective projects and strategies that provide a high benefit-cost ratio. These projects will improve mobility, safety, productivity, reliability, and air quality, reducing vehicle emissions and fuel consumption, at a relatively lower cost than other capital projects like widening. The PLAN focuses on the State Highway System and off-system parallel and connecting routes with linkages to the State Highway System.

The PLAN describes a project analysis and prioritization initiative undertaken by Caltrans District 3 Planning and Operations staff and should be of interest to other districts in the State. Recognizing the importance of ITS as part of an operations-centric future for Caltrans, the PLAN describes several significant accomplishments, including:

- Compiling all ITS related and operational improvement projects from various internal and external sources and developing one unified database,
- Organizing the ITS and operational improvement projects by system management function (e.g., ramp metering) and corridor, as opposed to by field device or technology type, and
- Analyzing and prioritizing the resulting investments by benefit cost ratio taking into account pollution and green-house-gas emission reductions as well as travel time and user costs.

The PLAN is the first step towards developing individual Plans for Operations for each corridor in the District. The PLAN details the process for developing the list of prioritized investments in the District, a process that can be emulated by other districts or tailored to other district needs and circumstances.

This PLAN is a tool for Caltrans, regional planners, operators, and decision-makers, particularly with regard to selecting the best projects for limited funding, to use technology that is here today. It is a tool

to make the best use of available funds that move travelers and goods where they need to go, safely and on time.

II. Why Focus on ITS and Operational Improvements?

The future of transportation includes an increase of smarter cars and an intelligent roadway system that helps meet transportation challenges. Data provide the base for good decision making to provide the most effective transportation investments to improve California's transportation system. Through the implementation of ITS and operational improvement strategies, we can better operate and manage the current transportation system, restore lost capacity by improving throughput, reduce congestion and delay, improve travel-time reliability, and improve air quality.

DISTRICT 3 BY THE NUMBERS

CCTV:	118
CMS:	69
HAR:	28
TMS:	291
Ramp meters:	189

Source: 2014 TMS Inventory

Small ITS improvements have a big impact

Some of the most common ITS elements are explained below:

CCTV – provides visual verification of the roadway conditions and incidents remotely, saving personnel, time, and resources for more effective system and incident management

CMS – alerts motorists on the roadway to real-time hazardous conditions, incidents, travel time and other vital information, reaching thousands of passing motorists

HAR – provides more detailed information regarding incidents and delays to the traveling public, helping travelers to make route decisions, saving valuable time, and reducing demand

TMS – collects real-time data that helps to operate the transportation system effectively

Ramp metering system – regulates vehicles entering the freeway to reduce platooning when the freeway congestion levels are high and helps to reduce merging/weaving impacts of the on-ramp

Weather Monitoring System – monitors real-time weather conditions for traveler information

The term "ITS" refers to advanced communications-based information and electronic technologies, used to manage the transportation network. These projects include a ramp metering system, traveler information system, and incident management system that utilize devices such as: Closed Circuit Television (CCTV) cameras, Changeable Message Signs (CMS), Highway Advisory Radios (HAR), Traffic Monitoring Stations (TMS), cable and fiber optic communications, etc. Operational improvements include projects such as auxiliary/transition lanes, ramp widening, ramp merge extensions, and others that reduce the impact of weaving, merging, and queuing. Combining these two types of improvements optimizes the State Highway System to improve mobility.

Focused operational improvements present real change

Some of the most common operational improvements are described below:

Auxiliary/transition lanes – provide additional time and space for traffic to merge/exit the state highway, making it operationally more efficient

Ramp widening – provides more storage for more effective ramp metering operations without impacting local streets and intersections

Ramp merge extensions – provide more time and space for ramp traffic to merge, to improve safety and operations

Interchange modifications – eliminate inefficient operations that cause traffic queuing onto the freeway, consecutive merges, excessive weaving, and poor circulation around the interchange

Intersection modifications – increase overall throughput, lessen or eliminate turning movement conflicts, and accommodate the wide range of vehicle sizes, in addition to bicycles and pedestrians

ITS and operational improvements deliver five key classes of benefits:

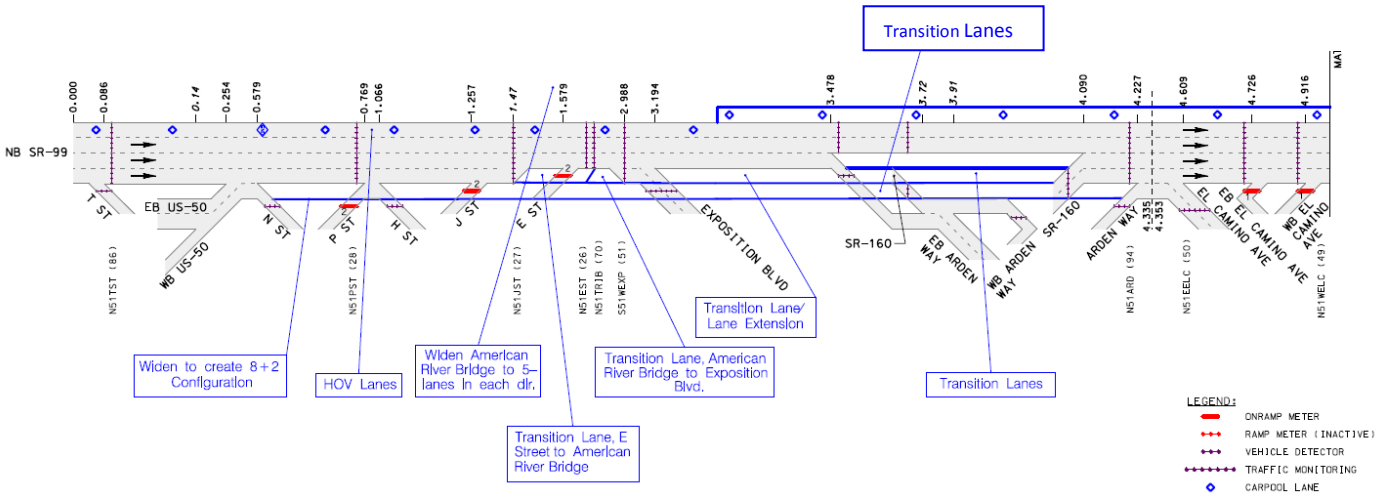
1. **Increased Safety** –*preventing or reducing accidents and improving emergency response*
2. **Improved Operational Performance** –*maximizing capacity by improving throughput*
3. **Enhanced Mobility and Convenience** –*reducing conges*tion
4. **Improved Environmental Outcomes** –*reducing fuel consumption and emissions*
5. **Boosted Productivity and Economic Growth** –*reducing travel times and fuel costs*

Increased safety – Whereas most developments in transportation safety over the past 50 years were designed to protect passengers in the event of a crash, fully-integrated ITS technologies are being designed to help motorists avoid accidents altogether. For example, the US Intellidrive system, which uses wireless communications to connect vehicles to the road infrastructure (V2I) as well as other vehicles (V2V), could potentially address 82 percent of vehicle crash scenarios involving unimpaired drivers, according to US Department of Transportation estimates.

Improved operational performance – ITS technologies maximize the capacity of infrastructure, reducing the need to build additional road capacity. For example, applying real-time traffic data to traffic signal lights can improve traffic flow significantly, reducing stops by as much as 40 percent and reducing travel time by 25 percent. This improved throughput can help transportation agencies avoid or postpone the need to add additional lanes to busy arterials.

Figure 1 provides an example of projects representing the optimal freeway design for a segment of SR 51. These types of projects improve the performance of the corridor and represent the design and planning effort involved in long-range transportation planning. These improvements provide consistent capacity through the corridor, and are developed in stages for maximum performance (optimization). The multi-modal strategy for demand management includes ITS, bus/carpool lanes, and other elements to improve transit. In addition, these improvements support future state system management planning and the corridor concept of operations, developed in stages.

Figure 1 SR 51 Corridor with Proposed Projects



Enhanced mobility and convenience – ITS technologies can contribute significantly to reducing congestion, which creates improved mobility options for drivers. Some estimate that improved ITS implementation could reduce congestion by 20 percent or more in most urban areas.

Improved environmental outcomes – The Information Technology and Innovation Foundation (ITIF) estimates that improving traffic flow by synchronizing traffic signals alone, can cut gas consumption by 10 percent and emissions by 22 percent. Other ITS efforts that reduce congestion and enable traffic to flow smoothly, such as ramp meters, also contribute to increased environmental benefits.

Boosted productivity and economic growth – According to the Texas Transportation Institute (TTI), congestion costs US commuters 4.2 billion hours and 2.8 billion gallons of fuel each year, costing the economy up to $200 billion per year. To the extent ITS applications reduce congestion, the overall productivity and economy can improve.

Declining Revenues

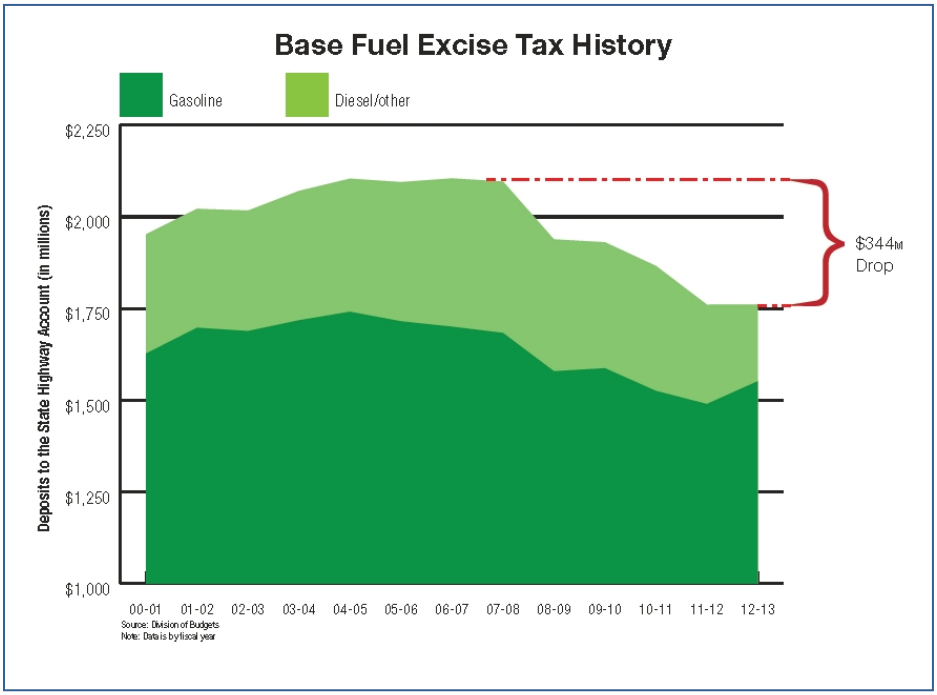
Revenues from the fuel excise tax have declined to levels not seen since 1996, and vehicle efficiency and emission standards are large factors behind the decline. Therefore, funding to programs for

transportation improvements is insufficient to meet the current demand for capital improvement projects.

In addition, new advancements in technology provide better overall system management through identifying congestion bottlenecks and focusing improvements where they have the most benefit to reduce delays and lost productivity.

Since capital projects often take precedence in the State Highway Operation and Protection Program (SHOPP), ITS projects can often be neglected. However, with the pressure of funding constraints mounting, the time to focus priorities on smaller, lower-cost investments into our transportation system is now. Figure 2, retrieved from *The Mile Marker, a Caltrans Performance Report* (2014), highlights the drop in deposits to the State Highway Account.

Figure 2 Base Fuel Excise Tax History

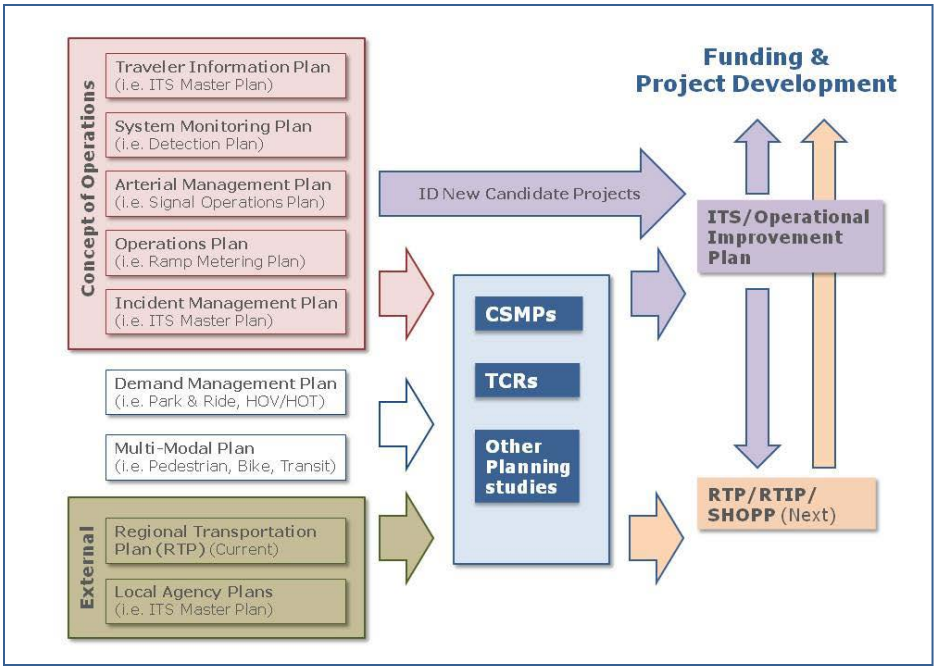


III. How the PLAN fits into the "Big Picture"

Typically, it takes years to identify, select, and fund transportation projects. Focused projects are easier to identify, select, and fund if they show a higher benefit compared with cost and are beneficial to the State, local agencies, and travelers.

The planning process in Figure 3 represents the systematic process to develop future projects versus a case-by-case methodology to address a certain issue—moving to a proactive rather than a reactive approach when considering transportation projects.

Figure 3 New Caltrans District 3 Systematic Planning Process for ITS and Operational Improvements



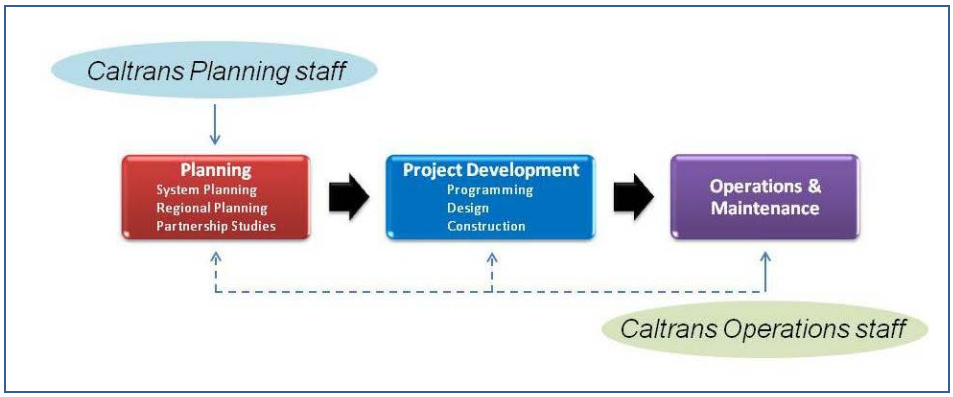
There can be multiple lead agencies to develop projects for a corridor or within a jurisdiction. Using this PLAN, we can move toward a process where the lead agencies are integrated with each other and reach for a common solution.

Planning for Operations

Bridging the gap between system operations and transportation planning requires the constant evaluation of projects, from the project identification process to the prioritization process. Successful funding and implementation of priority projects enables priority operations projects to be implemented while using scarce transportation funds efficiently. This will ensure that benefits can be realized every year, accumulatively, on every corridor.

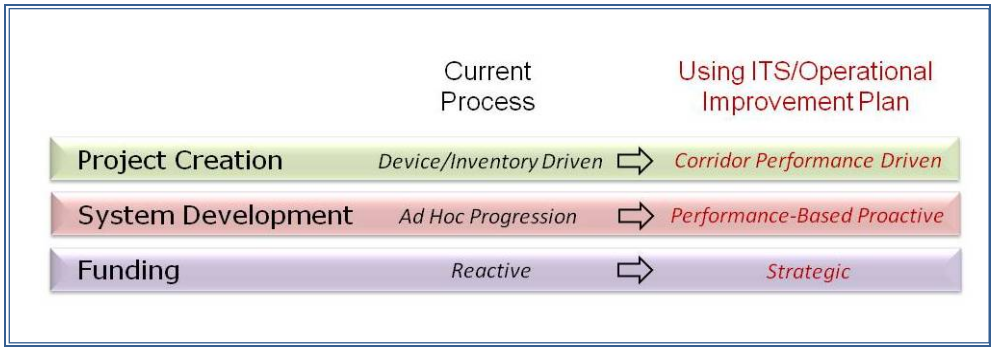
The District 3 Transportation Management Center (TMC) is the single focal point for all system management decisions on the State Highway System. The Office of Electrical Systems at the TMC provides support for system management devices.

Figure 4 Previous Caltrans Planning Process



While operations staff plays a crucial role in the day-to-day activities such as managing the TMC and understanding where the problem spots are located on some of the busiest freeways in the District, it is directly affected by planning decisions made years in advance. When planners and operators have a higher level of awareness and communication of the impact of their decisions on other functions in the long-term, better decisions are made in the present.

Figure 5 Planning for Operations



The focus is on improving the corridor's performance, and project development should anticipate the needs of the corridor. To be successful, a multi-agency partnership is necessary to work on strategic funding goals versus individual funding goals.

Project Creation

The current process to develop new projects is based on the current ITS and operational improvements inventory by determining what is needed to fill the gaps. The new process using the PLAN suggests utilizing corridor performance, regardless of inventory or technology devices or operational improvement elements.

System Development

The current process to develop ITS, transportation management, or operational systems is typically ad hoc reactionary to funding availability and inventory needs and ease of implementation. The new process using the PLAN suggests proactively developing the system from a performance-based plan yielding performance benefits.

Funding

The current process often involves planning projects for anticipated funding levels, developing projects for potential regional funding which may or may not be awarded, or reacting to unanticipated funding by developing projects that meet the specified funding criteria. The new process using the PLAN suggests more strategic funding investments through performance outcome-based results (benefit-cost analysis) and strategic prioritization in the District by working collaboratively with partner agencies.

Bridging the planning and operations functions provides a solution to one of many implementation challenges. When technical ITS and operations needs are identified and shared between the divisions, planning can use this information to support implementing these types of improvements during regional planning meetings and through formal grant applications for funding. In addition, when planning staff provides information regarding planning objectives and solutions being discussed with partner agencies, operations staff can look to the system approach and the implication of those decisions.

Moving from a project inventory to a project database, where projects are analyzed from a systems perspective and analysts are mindful of long-term needs, allows operations staff to hone in on specific needs consistent with desired performance measures.

When grant funding from regional agencies is available, the importance of low-cost, high-benefit investments should be conveyed and considered. Since planning typically administers the planning process for highway transportation projects, closing the gap between planning and operations will put planning for ITS and operational improvement projects at an advantage by including these types of projects in the planning process, rather than receiving consideration only as a supplement to larger projects.

Framework for a Multi-Agency Partnership

A multi-agency partnership is the best way to create, fund, and implement projects that optimize the transportation system. In the District, many partner agencies excel at identifying projects that work with multiple-jurisdictions and improve mobility for all travelers.

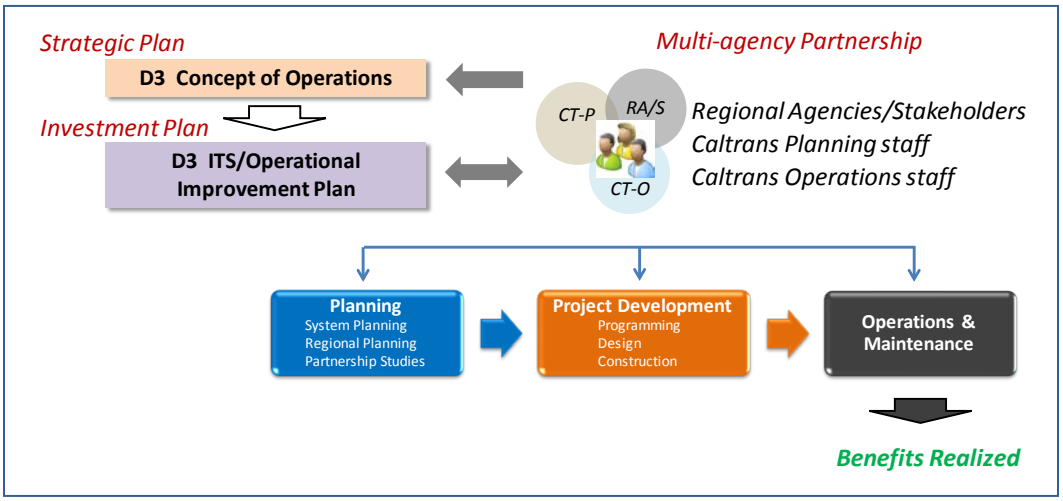
Multi-Agency Collaboration

A multi-agency collaboration is essential for successful project identification and implementation. Together, planning and operation staff can establish an internal project development and delivery process for ITS and operational improvement projects and put that process into regular practice.

- Interdisciplinary participation and collaboration of Caltrans planning and operations staff at district and regional planning and operations meetings
- Planning and project development process

The proper coordination of operators, project development, planning, and external regional planning agencies and their committees allows ITS infrastructure elements to be included in roadway construction projects rather than relying on them to be supplemented at a later time. These types of projects are the first to be cut when project cost overruns require adjustments to the project. As planners focus on administering the planning process for transportation projects, working with operators that have extensive knowledge of ITS technology and operational objectives is important to ensure that operational and ITS needs are not overlooked or minimalized during the selection process. The multi-agency partnership places operational needs among the other needs of the transportation system.

Figure 6 Planning for Operations with Local and Regional Partners



District 3 Concept of Operations

The newly created internal District 3 Concept of Operations is a strategic system management plan that provides guidance to the planning process for ITS and operational improvement project development, based on the Department goals and regional transportation needs. The District 3 Concept of Operations describes the District's objectives and approach to optimize the State Highway System by identifying ITS elements and operational improvement project needs to meet those objectives. It also provides a unified direction through shared objectives and performance measures and clarifies the roles and responsibilities of planners and operators. It is the foundation for all present and future system management deployment and operations, of which all District ITS and operational improvements should be an integrated piece of the puzzle.

External Plans

Regional Transportation Plans and other local agency plans are external documents that have their own policies and guidelines for transportation projects for their jurisdictions. Since these plans consist of projects on both local roads and state highways, incorporating ITS and operational improvement projects that are consistent with the District Concept of Operations will provide for projects that improve the transportation system and its performance.

Corridor System Management Plans (CSMPs)/Transportation Concept Reports (TCRs)

The CSMPs focus on urban corridors for selected routes in the District. These corridors often have a greater use and need for ITS and operational improvements than other corridors. By including focused improvements in these planning documents, it highlights the need for the improvement and shows the associated benefit to the corridor and the parallel road network by the proposed projects. Transportation Corridor Reports (TCRs) provide a 20-year concept for all routes in the District, including segment summaries with planned, programmed, and conceptual projects. Incorporating projects early in these planning documents provides a starting point to fund identified projects.

Future Regional Transportation Plans (RTPs), PLAN, and Funding

New candidate projects identified, using the process shown in the flow chart below in Figure 3, will feed into future RTPs and updates to the PLAN. These projects provide solutions using a systematic approach that is consistent with various policies, plans, and performance measures identified early in the process. Following this process focused improvements that improve the transportation system are identified and recommended for funding and implementation. Planning for the best use of limited funds and placing projects that improve system performance first is a win-win for the State, local and regional agencies, and travelers.

IV. Caltrans Priority Projects for Investment

Prioritized List of Projects with Benefit-Cost Ratios

The project list below reflects projects that Caltrans Planning and Operations staff identified as priorities for operations. Caltrans staff reviewed numerous planning documents, incorporated a composite database of Caltrans and partner agency ITS and operational improvement category of projects, and conducted qualitative analysis (see Appendix A) to determine those projects that have the best potential to address needs and issues, and produce the desired performance outcomes. The high-priority projects were then evaluated with subsequent quantitative valuation analysis using the California Life-Cycle Benefit/Cost Analysis Model (Cal-B/C) developed by Caltrans. The Cal-B/C shows the incremental benefit for the incremental cost for each project (see Appendix B for the analysis results). The priority projects are grouped and ranked within each county for ease of reference. Figure 7 below illustrates an example of a benefit/cost analysis result. As shown, the benefits are in 20-year life-cycle benefits that include itemized travel time savings, vehicle operating cost savings, accident cost savings, and emission cost savings. The emission saved shows the CO_2 but the analysis worksheet provides assessment of all of the air quality elements, in both tons and in dollars. The benefits are also presented in net present value, rate of return on investment, and the payback period for the cost recovery.

Figure 7 Project Valuation Using Benefit/Cost Analysis (Cal-B/C Model Result Example)

PROJECT: US50 Coloma Rd offramp to Placerville Dr offramp Auxiliary Lane PPNO:

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$13.0
Life-Cycle Benefits (mil. $)	$133.6
Net Present Value (mil. $)	$120.6
Benefit / Cost Ratio:	10.3
Rate of Return on Investment:	79.0%
Payback Period:	2 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$5.9	$117.9
Veh. Op. Cost Savings	$0.7	$14.1
Accident Cost Savings	-$0.0	-$0.0
Emission Cost Savings	$0.1	$1.5
TOTAL BENEFITS	$6.7	$133.6
Person-Hours of Time Saved	531,346	10,626,914
CO_2 Emissions Saved (tons)	3,334	66,676
CO_2 Emissions Saved (mil. $)	$0.1	$1.3

These projects reflect improvements that are considered mutually beneficial to Caltrans and local/regional jurisdictions. Funding these ITS and operational improvements provides focused and low-cost solutions to improve operations in the jurisdictions served by local roads and highways.

Tables in the following pages present the District 3 initial prioritized list of projects for investment.

Project No.	County	Route	Beg. Post Mile	End Post Mile	Project Type	Location	Description	Document	SHOPP Eligible	Sponsoring Agency	Proposed Completion Year	Funding - Estimated TOTAL Cost	Benefit/Cost Ratio
Butte County Association of Governments (BCAG)													
1	Butte	99	R29.37	R36.9	ITS	Between Southgate Ave. & JNO W. Eaton Rd.	Install & implement full range of ITS elements	SR99 CSMP (North)	Yes	Caltrans	2020	$6,728,800	5.1
2	Butte	99	29.367	29.367	Interchange construction & modification	Entler/Southgate Ave.	Costruct I/C & extend Otterson Dr., Entler Dr., Heagan Rd. & Speedway	BCAG MTP 2012, SR99 CSMP (North)	No	Butte Co/City of Chico	2025	$29,000,000	3.3
3	Butte	162	20.405	20.49	Intersection modification	Oro-Quincy Hwy & Oakvale Avenue	Safety & operational improvements at two closely spaced intersections	Butte Co 2030 General Plan	Yes	Caltrans	2020	$3,500,000	2.9

Project No.	County	Route	Beg. Post Mile	End Post Mile	Project Type	Location	Description	Document	SHOPP Eligible	Sponsoring Agency	Proposed Completion Year	Funding - Estimated TOTAL Cost	Benefit/Cost Ratio
El Dorado County Transportation Commission													
4	El Dorado	50	17.11	17.778	Auxiliary lane	From west of Coloma Rd. offramp to Placerville Dr. off-ramp	Construct auxiliary lane	Conceptual	Yes	Caltrans	2020	$13,000,000	10.3

Project No.	County	Route	Beg. Post Mile	End Post Mile	Project Type	Location	Description	Document	SHOPP Eligible	Sponsoring Agency	Proposed Completion Year	Funding - Estimated TOTAL Cost	Benefit/Cost Ratio
Tahoe Metropolitan Planning Organization													
5	El Dorado	50	71.48	71.48	Intersection modification	Pioneer Trail	Traffic signal mod. - dual left-turn from Pioneer Trail & two WB lanes on highway, through intersection & merging prior to Santa Fe Trail/Apache intersection	Conceptual	Yes	Caltrans	2025	$1,000,000	1.6
6	El Dorado	50	70.621	70.621	Roundabout	SR89 in Meyers	Construct flared 2-lane roundabout	Conceptual	Yes	Caltrans	2025	$5,000,000	0.6

Notes

** Typical benefit/cost ratio (from Caltrans TMS Master Plan)*

SVCP *- Small Value Capital Project Initiation Document*

SHOPP Eligible *- indicates if the project is eligible for SHOPP funding*

Project No.	County	Route	Beg. Post Mile	End Post Mile	Project Type	Location	Description	Document	SHOPP Eligible	Sponsoring Agency	Proposed Completion Year	Funding - Estimated TOTAL Cost	Benefit/Cost Ratio
Nevada County Transportation Commission													
7	Nevada	20	23.0	46.1	Improve/add turnouts	Between Five Mile House & I-80: Existing PM 25.15, 28.45, 35.6, 37.05; New PM 32.2, 41.6	Lengthen &/or widen six existing turnouts, & add four turnouts	Conceptual	Yes	Caltrans	2020	$1,500,000	8.6
8	Nevada	49	1.8	15.06	Traveler information system/Vehicle detection system	Various locations on SR49 in Placer & Nevada Counties	Install ITS components from Auburn to Grass Valley (NB & SB); Taffic monitioring and detection systems near key intersections	SR49 CSMP	Yes	Caltrans	2022	$2,500,000	6.9
9	Nevada	20	31.3	31.3	Intersection modification	Washington Road	Construct EB left-turn lane & improve intersection sight distance	Nevada Co RTP 2010	Yes	Caltrans	2015	$1,300,000	0.3

Project No.	County	Route	Beg. Post Mile	End Post Mile	Project Type	Location	Description	Document	SHOPP Eligible	Sponsoring Agency	Proposed Completion Year	Funding - Estimated TOTAL Cost	Benefit/Cost Ratio
Placer County Transportation Planning Agency													
10	Placer	80	0.55	2.203	Auxiliary lane	Douglas Blvd. to Riverside	Construct auxiliary lane	PCTPA, PID	Yes	PCTPA	2018	$11,000,000 ($7M programmed, $4M unfunded)	8.3
11	Placer	80	4.5	5.9	Auxiliary lane	SR65 to Rocklin Rd.	Construct auxiliary lane	PCTPA, PID	Yes	PCTPA	2018		2.0
12	Placer	49	6.38	7.427	Signal coordination	Install signal at Shale Ridge Rd., coordinate to the north on Dry Creek Rd. & to the south on Bell Rd.	Extend coordinated traffic signals	Conceptual	Yes	Caltrans	2025	$2,000,000	4.5
13	Placer	65	R11.921	R11.921	Interchange modification	Twelve Bridges Dr.	Upgrade to a full I/C with merge lane to SB SR65; widen Twelve Bridges from 2 to 4 lanes	SACOG MTIP	No	Placer Co/City of Lincoln	2015	$3,662,100 ($2,817,000 funded)	1.8
14	Placer	267	3.76	6.671	Truck climbing lane	Northstar Dr. to Brockway Summit	Extend the existing SB truck-climbing lane; shoulder widening	Conceptual	Yes	Caltrans	2025	$15,000,000	1.1

Project No.	County	Route	Beg. Post Mile	End Post Mile	Project Type	Location	Description	Document	SHOPP Eligible	Sponsoring Agency	Proposed Completion Year	Funding - Estimated TOTAL Cost	Benefit/Cost Ratio
Sacramento Area Council of Governments (SACOG)													
15	Sacramento	51	1.44	2.6	Transition lane	E. St. to American River Bridge	Construct transition lane	SACOG 2035 MTP, PSR/PDS in development	Yes	Caltrans	2020	$8,300,000 ($0.9M programmed, $7.4M unfunded)	19.0
16	Sacramento	5	20.53	23.57	Auxiliary lane	US50 connector ramp to Sutterville Rd. off-ramp	Construct auxiliary lane	SACOG 2035 MTP	Yes	Caltrans	2020	$4,746,000	16.4
17	Sacramento	5	25.369	25.526	Transition lane	Garden Hwy off-ramp to Garden Hwy on-ramp	Construct transition lane	SACOG 2035 MTP	Yes	Caltrans	2020	$4,000,000	12.7
18	Sacramento	5	31.751	32.487	Deceleration lane	To Airport Blvd.	Construct 3/4 mile deceleration lane	Conceptual	Yes	Caltrans	2020	$2,000,000	12.0
19	Sacramento	50	R7.729	R9.485	Auxiliary lane	Bradshaw Rd. to Mather Field Rd.	Construct auxiliary lanes (EB & WB)	SACOG 2035 MTP	Yes	Caltrans	2020	$6,000,000	10.7
20	Sacramento/ Placer/ Yolo/ El Dorado/ Nevada	Var	Var	Var	Traveler information system	18 locations: PLA80 (PM 53.3, 63.5), NEV80 (PM 5.1, 9.1, 19.3, 27.3), ELD50 (PM 66.8), PLA267 (PM 6.7), NEV267 (PM 0.4), YOL80 (PM 5.7, 8.9), SAC80 (PM 0.4), SAC51 (PM 3.0), YOL5 (PM 0.8), SAC5 (PM 24.8), SAC99 (PM 8.8), PLA89 (PM 10.4), PLA28 (PM 3.0)	Roadway Weather Information Systems (RWIS) upgrade	2016 SHOPP, SCVP PID	Yes	Caltrans	2022	$1,635,436	10.0*
21	Various	Var	Var	Var	ITS	25 locations: I-5, SR65, I-80, US50, SR51, SR89, & SR99	Higway Advisory Radio (HAR) upgrades	2016 SHOPP, SCVP PID	Yes	Caltrans	2018	$1,843,200	10.0*
22	Sacramento	Var	Var	Var	Traveler information system	110 locations	Travel time detection and notification	Conceptual	Yes	Caltrans	2020	$1,939,200	10.0*
23	Sacramento	5	16.141	17.171	Auxiliary lane	Pocket Rd. to Florin Rd.	Construct auxiliary lanes (SB & NB)	SACOG 2035 MTP	Yes	Caltrans	2020	$7,100,000	6.2
24	Sacramento	50	3.629	3.759	Transition lane	NB Howe Ave. on-ramp to SB Howe Ave. on-ramp	Construct transition lane	SACOG 2035 MTP, PSR	Yes	Caltrans	2020	$3,000,000	5.4
25	Sacramento/ Yolo	50, 51, 80	Var	Var	Ramp metering system	14 locations: SAC80 Antelope (PM 16.70), SAC80 Enterprise (PM 9.1), YOL80 Reed EB (PM R11.2), YOL80 Reed WB (PM R11.0), YOL80 W. Capital Ave (PM 9.08), SAC50 Harbor EB (PM 1.34), SAC50 Jefferson EB (PM 2.66), SAC50 S. River Rd. (PM 2.82), SAC50 Harbor WB (PM 1.07), SAC50 Rte 275 (PM 2.20), SAC50 Jefferson WB (PM 19.4), SAC51 Marconi (PM 5.37), SAC51 Arden WB (PM 4.07), SAC51 Arden EB (PM 4.07)	Install ramp meters	SACOG 2035 MTP	Yes	Caltrans	2020	$5,500,000	7.7

Project No.	County	Route	Beg. Post Mile	End Post Mile	Project Type	Location	Description	Document	SHOPP Eligible	Sponsoring Agency	Proposed Completion Year	Funding - Estimated TOTAL Cost	Benefit/Cost Ratio
Sacramento Area Council of Governments (SACOG)													
26	Sacramento/ Placer/ Yolo	5, 65, 99, 80	Var	Var	Ramp metering system	8 locations: SAC5 I St. (PM 23.6), SAC99 Elkhorn WB (PM 33.41), SAC99 Elkhorn EB (PM 33.18), SAC99 Laguna (PM 13.8), SAC99 Laguna (PM 13.6), PLA65 Stanford Ranch (PM R6.15), YOL80 Richards (PM 0.45), PLA80 NB65 Connector (PM 4.32)	Install ramp meters	SACOG 2035 MTP	Yes	Caltrans	2020	$4,800,000	5.0
27	Sacramento	50	R0.314	R0.595	Auxiliary lane	Stockton Blvd. offramp to SR51 connector onramp	Extend auxiliary lane on WB US50; realign and add acceleration taper	Conceptual	Yes	Caltrans	2020	$6,000,000	3.9
28	Sacramento	50	TMC	TMC	ITS	Transportation Management Center (Rancho Cordova)	Upgrade video wall at regional TMC	SACOG MTP/2016 SHOPP/PID in-progress	Yes	Caltrans	2020	$1,000,000	3.0*
29	Sacramento/ Placer/ Yolo	80, 51, 99	Var	Var	Ramp metering system	15 locations: YOL 80 Chiles Rd (PM 5.6), SAC51 H St. (PM 1.067), SAC51 N St. (PM 0.591), SAC51 T St. (PM 0.084), SAC99 Broadway (PM 23.852), SAC99 12th(14th) Ave. (PM 22.905), SAC99 Fruitridge (PM 21.832), SAC99 MLK Jr. Blvd. (PM 21.44), SAC99 Consumnes River (PM 16.313 & PM 16.124), SAC51 Arden Wy (PM 4.227), SAC99 WB 47th (PM 20.935), SAC99 EB47th (PM 20.734), SAC99 WB Florin (PM 19.71), SAC99 EB Florin (PM 19.479)	Install ramp meters	SACOG 2035 MTP, PID	Yes	Caltrans	2020	$22,286,400 ($11.5M programmed, $10.78M unfunded)	> 3.0 (partial funded)
30	Sacramento	5	Var	Var	Ramp metering system	8 locations on I-5 in Sacramento Co: Sutterville (PM 20.388), Seamas (PM 19.186), WB Florin (PM 17.26), EB Florin (PM 16.924), WB Pocket (PM 16.201), EB Pocket (PM 16.025), Laguna (PM 12.188), Elk Grove Blvd. (PM 10.882)	Install ramp meters	SACOG 2035 MTP	Yes	Caltrans	2020	Alt 1 $2,203,700, Alt 2 $10,861,900	Alt 1 (9.7); Alt 2 (2.0)
31	Yuba	20	R2.610	R2.940	Acceleration lane	17th St. and 22nd St.	Extend acceleration lane; construct median refuge	Conceptual	Yes	Caltrans	2020	$1,000,000	17.3
32	Yuba	20	7.9	9.4	Passing lane	Loma Rica Rd. to Kibbe Rd.	Install shoulders, left-turn channelization & passing lanes	SACOG 2035 MTP/ SR 20 TCR	Yes	Caltrans	2025	$2,500,000	1.3
33	Yuba	20	13.27	16.98	Safety/ operational improvement	Marysville Rd. to Sicard Flat Rd.	Standard shoulders, vertical & horizontal curve improvements, & EB & WB left-turn lanes	SACOG 2035 MTP/ SR 20 TCR	Yes	Caltrans	2025	$5,500,000	2.8*

Potential Portfolio Investments in Priority Order by Regional Jurisdiction

Butte County Association of Governments (BCAG)

Project 1: BUT 99 (29.37/36.9) – the benefit/cost ratio for this **ITS elements** project between Southgate Avenue and W. Eaton Road is 5.1 for a $6.72M project with completion in six years. We can expect a $34.6M benefit over the life of the project. This project supports system management for SR 99 and the region and is included in the SR 99 CSMP (North). This project can contribute towards system management, incident management, and traveler information, as well as collect and gather data for performance monitoring and analyses, providing additional benefits.

Project 2: BUT 99 (29.367) – the benefit/cost ratio for this **interchange reconstruction and modification** project at Entler/Southgate Avenue is 3.3, a very good value for an interchange improvement project. This project is identified as a key capital project in the SR 99 CSMP (North), and it is included in the BCAG MTP. The cost for this project is relatively higher because of the interchange and the analysis assumes various arterial improvements. This improvement is expected to improve circulation in the area as well as eliminating future congestion and slowing on the freeway at this location.

Project 3: BUT 162 (20.405/20.49) – this **intersection improvement** project at Oro-Quincy Highway and Oakvale Avenue to improve safety and operations, also identified in the Butte County General Plan, provides an estimated benefit/cost ratio of 2.9 to modify two intersections. This $3M investment provides an estimated benefit of $20M over a 20-year period.

EL Dorado Transportation Commission

Project 4: ELD 50 (17.11/17.778) – an **auxiliary lane** project from west of Coloma Road off-ramp to Placerville Drive off-ramp on US 50 provides a high value benefit/cost ratio of 10.3, with a $13M investment; the benefit is substantial in improving mobility and air quality along this corridor.

Tahoe Metropolitan Planning Organization

Project 5: ELD 50 (71.48) – this low-cost (under $1M) **intersection modification** project at Pioneer Trail provides several operational and safety improvements and has a benefit/cost ratio of 1.6. While the benefit/cost ratio is modest, the expected impact is significant.

Project 6: ELD 50 (70.621) – a **flared 2-lane roundabout** on SR 89 in Meyers that can handle peak demands at this location for a $5M investment, which provides a low benefit/cost ratio of 0.64, due to the higher cost of the construction of a roundabout.

Nevada County Transportation Commission

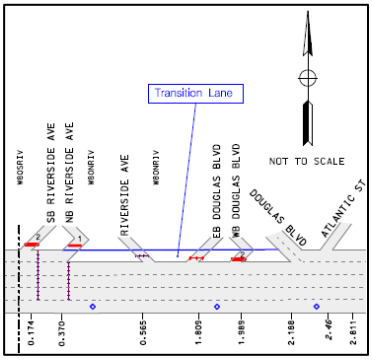
Project 7: NEV 20 (23.0/46.1) – a $1.5M investment in **turnouts** at several uphill grades on SR 20 between Five Mile House and I-80 provide an estimated benefit/cost ratio of 8.6, for a benefit of $12.9M over a 20-year period. This is a high value project with high return on investment.

Project 8: NEV 49 (1.8/15.06) – this **vehicle detection system and traveler information system** project on various locations on SR 49 in Placer and Nevada Counties is a high value project with a benefit/cost ratio of 6.9, for a $2.5M investment with an expected benefit of $17.3M over a 20-year period. This project is included in the SR 49 CSMP and is a vital component for the corridor system management.

Project 9: NEV 20 (31.3) – on this two-lane, downhill, portion of SR 20, a **left-turn lane and sight distance improvements** at Washington Road intersection provide safer turn movements; a $1.3M investment provides a 0.3 benefit/cost ratio. Although a modest B/C ratio, this project is expected to enhance safety at this location and maintain its low collision rates into the future.

Placer County Transportation Planning Agency

Project 10: PLA 80 (0.55-2.203) – an **auxiliary lane** from Douglas Boulevard to Riverside in Placer County provides traffic congestion relief and supports future economic development in the south part of the County. With $7M of this project and Project 11 (combined) already programmed and a Project Initiation Document (PID) complete, an additional $4M is necessary to complete this project and Project 11. This project alone provides a benefit/cost ratio of 8.3 for an estimated benefit of $45.9M over the life of this project. It is a high value project.



Project 11: PLA 80 (4.5-5.9) – an **auxiliary lane** from SR 65 to Rocklin Road in Placer County provides traffic congestion relief and supports future economic development in the south part of the County. With $7M of this project and Project 10 already programmed and a PID complete, an additional $4M is necessary to complete this project and Project 10 which provides a benefit/cost ratio of 2.0 for an estimated benefit of $10.8M over the life of this project.

Project 12: PLA 49 (6.38/7.427) – this $2M **signal installation** (at Shale Ridge Road) **and coordination** (Bell Road to Dry Creek Road) project on SR 49 improves conditions for travelers and improves service with a benefit/cost ratio of 4.5, providing a benefit of $9M over the life of the project.

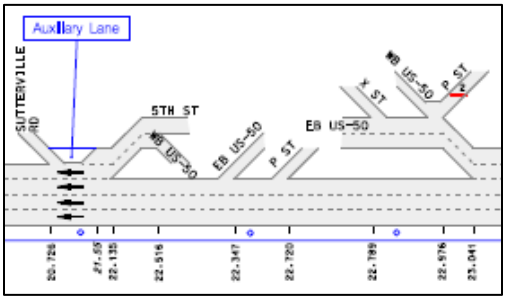
Project 13: PLA 65 (11.921) – an **upgrade to the Twelve Bridges interchange** included in the SACOG MTIP provides an estimated benefit/cost ratio of 1.8 for a $3.66M investment, which provides an estimated benefit of $6.59M over a 20-year period to a key interchange serving the Placer County region.

Project 14: PLA 267 (3.76/6.671) – constructing a **truck-climbing lane** in this rural and uphill terrain, from Northstar Drive to Brockway Summit, for an investment of $15M provides a benefit/cost ratio of 1.1 to assist truck travel connecting to I-80 and SR 89 near Truckee. The relatively lower B/C ratio is due to the higher construction cost.

Sacramento Area Council of Governments (SACOG)

Project 15: SAC 51 (1.44/2.6) – construction of a **transition lane** at this location, from E Street to American River Bridge, has a very high benefit/cost ratio of 19.0 with an investment of $8.3M. This very high value project is partially programmed for $0.9M and still needs $7.4M of funding that can provide a benefit of $157.9M over the life of the project. This project is included in the SACOG MTP and has a Project Study Report (PSR)/Project Development Study (PDS) in development.

Project 16: SAC 5 (20.53/23.57) – construction of this **auxiliary lane**, from US50 connector ramp to Sutterville Road off-ramp, provides congestion relief to existing traffic from downtown to the south of town for a $4.74M investment that yields a very high benefit/cost ratio of 16.4, resulting in benefit of $77.9M over the life of the project. This project is included in the SACOG MTP and the SR 51 CSMP. This project will significantly help reduce the impact of weaving and merging.



Project 17: SAC 5 (25.369/25.526) – building a **transition lane** project near this job center, between Garden Highway off-ramp to Garden Highway on-ramp, will provide traffic with more time/space, to merge to travel thru on I-5 or connect with I-80. For a $4M investment, the project yields a high benefit/cost ratio of 12.7, resulting in a benefit of $50.8M over the life of the project. This high value project is included in the SACOG MTP.

Project 18: SAC 5 (31.751/32.487) – this **deceleration lane** project is truly an operational improvement that provides a big impact for the single access point available to general travelers to one of the largest transportation hubs in the region, Sacramento International Airport. For $2M, the benefit for this investment is $24M for a 20-year period that yields a very high benefit/cost ratio of 12.0.

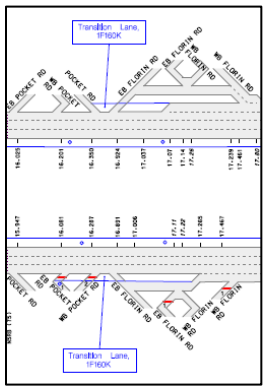
Project 19: SAC 50 (7.729/9.485) – constructing **eastbound and westbound auxiliary lanes**, between Bradshaw Road to Mather Field Road, near jobs and housing provides congestion relief for existing traffic. With a $6M investment, the expected benefit of this project is $64.2M over the life of the project, yielding a high benefit/cost ratio of 10.7. This high value project is included in the SACOG MTP.

Project 20: VAR (Var) – this project **upgrades Roadway Weather Information Systems (RWIS)** in five counties (Sacramento, Placer, Yolo, El Dorado, and Nevada) at 18 locations on seven routes. The existing RWIS have reached the end of their useful life, and a $1.63M investment will upgrade these

monitoring devices to provide quicker and more accurate weather information, which may help reduce congestion and collisions. The benefit/cost ratio could be as high as 10.0 (typical for traveler information system based on Caltrans TMS Master Plan) for a benefit of $16.35M. This project is included in the 2016 State Highway Operation and Protection Program (SHOPP) and has a completed SCVP.

Project 21: VAR (Var) – **Highway Advisory Radio** at various locations on I-5, SR 65, I-80, US 50, SR 51, SR 89, and SR 99 provides travelers with information regarding incidents and delays to make adjustments to their travel plans. For a $1.84M investment the estimated benefit could yield over $18M based on a 10.0 benefit/cost ratio (typical for traveler information system based on Caltrans TMS Master Plan). This project is included in the 2016 SHOPP and has a complete Small Capital Value Project Initiation Document (SCVP).

Project 22: SAC VAR (Var) – **travel time detection and notification** in 110 locations provides valuable travel data and information for an investment of approximately $1.93M the benefit is over $19M based on a 10.0 benefit/cost ratio (typical for traveler information system based on Caltrans TMS Master Plan). This project is needed to provide en-route traveler information to help motorists make route choices and distribute and balance the network demand. This tool can also be used during incidents and can lead to providing multi-modal travel time information.



Project 23: SAC 5 (16.141/17.171) – constructing **northbound and southbound auxiliary lanes**, between Pocket Road and Florin Road, with $7.1M in the Pocket area of Sacramento, where Florin Road provides an east/west connection between I-5 and SR 99, provides traffic relief on I-5 between downtown Sacramento and Elk Grove. The benefit/cost ratio for this project is estimated at 6.2, providing a $44.02M benefit over the life of the project. This high value project is included in the SACOG MTP.

Project 24: SAC 50 (3.629/3.759) – this project is a low-cost component of a comprehensive plan for **auxiliary and transition lanes** on the most congested freeway segments in the region, from northbound Howe Avenue on-ramp to southbound Howe Avenue on-ramp. A $3M investment provides a high benefit/cost ratio of 5.4, resulting in a $16.3M benefit over a 20-year period. This high value project is included in the SACOG MTP and has a completed PSR.

Project 25: SAC VAR (Var) – this project fills in the gaps in the **ramp metering system** on three freeways (US 50, SR 51, and I-80) at 14 locations throughout Sacramento and Yolo Counties. This project yields a high benefit /cost ratio of 7.7, collectively. This project is included in the SACOG MTP and Caltrans District 3 long term system management plans and the ramp metering development plan. This project can lead to the future integration with traffic signal operations for integrated corridor management (ICM) operations. These are vital tools to mitigate both recurrent and non-recurrent congestion.

Project 26: SAC VAR (Var) – this project fills in the gaps in the **ramp metering system** on three freeways (I-5, SR 65, SR 99, I-80) at 8 locations throughout Sacramento and Yolo Counties. This project yields a high benefit /cost ratio of 5.0, collectively. This project is included in the SACOG MTP and Caltrans District 3 long term system management plans and the ramp metering development plan. This project can lead to the future integration with traffic signal operations for integrated corridor management (ICM) operations. These ramp meters are vital tools to mitigate both recurrent and non-recurrent congestion. These ramp meters will allow for corridor operations and help reduce arterial congestion.

Project 27: SAC 50 (0.314/0.595) – traffic relief from the Stockton Blvd. off-ramp to the SR 51 connector on-ramp by extending an existing **auxiliary lane** on US 50 and other minor improvements at a cost of $6M provides a benefit/cost ratio of 3.9 and a benefit of $23.4M over the life of the project.

Project 28: SAC 50 (TMC) – upgrades to the technology at the **regional Transportation Management Center's video wall** provides an estimated benefit/cost ratio of 3.0 for an investment of $1M. This small investment provides local emergency responders and traffic operators with current technology to monitor and manage incidents for the region with a benefit of $3M over the life of the project. This project is included in the SACOG MTP, the 2016 SHOPP, and has a PID in progress.

Project 29: SAC/PLA/YOL 5/51/99/65 (Var) – installing **ramp meters** at the locations identified in this project improve merge/weave conditions at some of the most congested locations in the region with significant population and projected travel. This project has regional significance and affects multiple jurisdictions. With $11.5M of this $22.28M project funded by SACOG, funding the remaining portion of this project will reduce regional congested vehicle miles traveled, support goods movement, and reduce vehicle miles traveled. This project is included in the SACOG MTP and is the first part of a larger integrated ramp meter system. This project can lead to the future integration with traffic signal operations for integrated corridor management (ICM) operations.

Project 30: SAC/PLA/YOL 5 (Var) – this project fills in the gaps in the **ramp metering system** at 8 locations along I-5 throughout Sacramento, Placerville, and Yolo Counties. This project yields a high benefit /cost ratio of 9.7, collectively for the low cost alternative 1 and B/C ratio of 2.0 for the high cost alternative 2. This project is included in the SACOG MTP and Caltrans District 3 long term system management plans and the ramp metering development plan. This project can lead to the future integration with traffic signal operations for integrated corridor management (ICM) operations. These ramp meters are vital tools to mitigate both recurrent and non-recurrent congestion. These ramp meters will allow for corridor operations and help reduce arterial congestion.

Project 31: YUB 20 (2.610/2.940) – minor operational improvements of **acceleration lane and median refuge construction**, between 17th Street and 22nd Street, in Marysville for $1M provide a benefit/cost ratio of 17.3 for a benefit of $17.3M over a 20-year period. This is a high value project at very low cost improvement.

Project 32: YUB 20 (7.9/9.4) – passing lanes and left-turn channelization will improve operations on this rural two-lane facility connecting Browns Valley to Marysville for a cost of $2.5M. The benefit/cost ratio is 1.3 for a benefit of $3.2M over the life of the project. This project is included in the SACOG MTP and SR 20 TCR.

Project 33: YUB 20 (13.27/16.98) – safety and operational improvements of **constructing standard shoulders, vertical and horizontal curve corrections, and EB/WB left-turn lanes** for 3 ½ mile stretch of rural SR 20 to improve curves/shoulders in both directions for $5.5M provides an estimated benefit/cost ratio of 2.8 for an estimated benefit of $15.4M. This project is included in the SACOG MTP and the SR 20 TCR.

V. Next Steps (Multi-Agency Collaboration)

An initial process of valuation using benefit-cost ratios identifies prioritized projects by Caltrans staff. The next step is to work collaboratively with the local and regional partner agencies after they have had a chance to review the new process to reprioritize and adjust the prioritization of projects up or down in the list based on other intangible factors to develop the collective potential portfolio investments in ranking order.

From here, we can pull projects from this list, and from a database of additional projects when funding becomes available, to compete for limited funding opportunities. This showcases why ITS and operational improvements provide cost-effective improvements, and in many cases benefit multiple jurisdictions or an entire region.

Continuous monitoring and updating of these projects with partner agencies will provide the most current projects with accurate information to inform decision-makers of projects that have been analyzed and that are ready to be programmed based upon the results.

Specifically, the next critical step of the multiagency collaboration requires actions on two fronts. On the first, Caltrans will need to collaborate with local and regional partner agencies to reprioritize the current projects listed and summarized in Section III. This action is an immediate need for the current available funding sources. On the second, Caltrans will need to collaborate with local and regional partner agencies to develop a Concept of Operations for each major corridor and develop a specific, strategic plan for future operations for near-term, mid-term, and long-term corridor optimization and effective system management. This will ensure that all projects from this and all future ITS/Operational Improvement Plans that are implemented will produce the intended corridor performance outcomes. This collaboration process is depicted in Figure 6 above.

Multi-Agency Collaboration Action 1 (Investment Ranking)

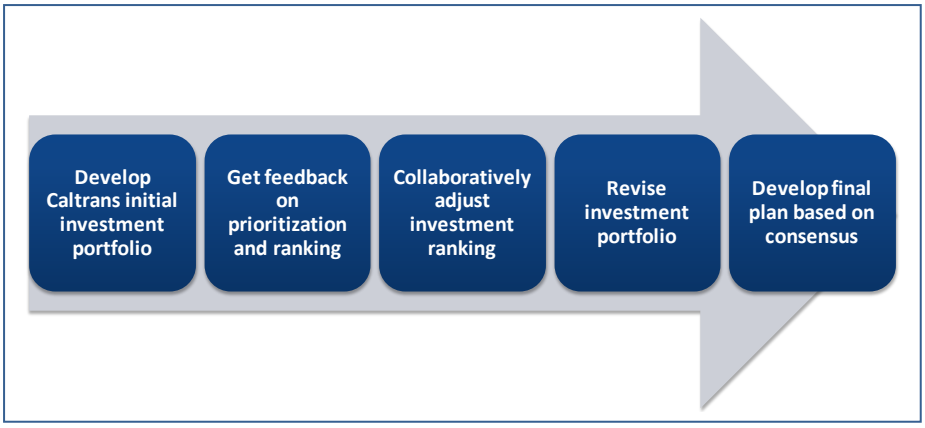
The initial Caltrans prioritized investment list is summarized and presented in Section III, primarily based on the quantitative benefit-cost analysis results. Some qualitative adjustments may have been made to take into account other intangible factors. This investment list represents ITS and operational improvement projects that Caltrans desires on various freeway corridors in District 3 limits for programming and implementation in the preferred order of ranking.

In general, while the projects as a whole will mutually benefit the entire region, Caltrans recognizes that local and regional partner agencies may have other factors to consider that may influence the order of ranking of these potential investments. Caltrans will work with its local and regional partner agencies collaboratively to re-rank the potential investments, taking into consideration other factors, including intangible ones that could impact their jurisdictions. This step requires qualitative adjustments, taking into account such factors including:

- Mobility & safety improvement amount (quantity gain versus benefit/cost ratio)
- Available funding (cutoff level)
- Funding leverage (previous partial funding, opportunity)
- Project sequencing (phases or prerequisites)
- Regional significance (equity, benefit/user, regional concerns)
- Sustainability/environment/complete streets elements or impacts
- Feasibility (constructability, operations & maintenance costs/resources)
- Intermodal integration (potential mode changes)
- Multi-jurisdictional improvement (improvement impacting multiple agencies)
- Politics (legal ramifications, community concerns, elected officials' input, support leverage)
- Other (e.g., efficiencies, customer satisfaction, system continuity, etc.)

This collaboration is a continuous and iterative process, as illustrated in Figure 8 below. These projects will make up the multi-agency partnership investment portfolio for potential programming as funding becomes available. As such, agencies should work together continuously to ensure that this portfolio is always current and ready.

Figure 8 Collaborative Process with Local and Regional Partners for Investment Portfolio



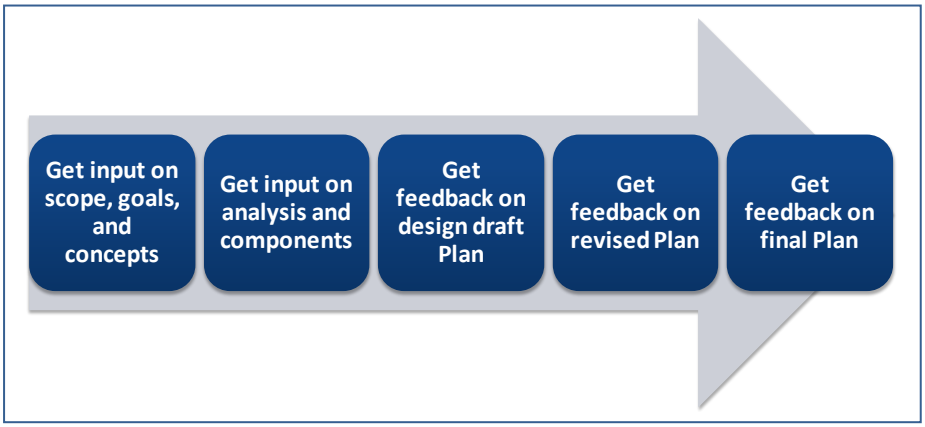
Multi-Agency Collaboration Action 2 (Concept of Operations)

After the initial investment list in preferred ranking order, agencies should then work together to build future lists of potential projects and build contingency plans (in the event that unexpected additional funding becomes available). This would require a strategic plan in place for each corridor in the Concept of Operations for guidance and reference.

To build future investment opportunities requires identifying new candidate projects. Rather than randomly identifying projects from a "bucket" of an inventory list or operational fixes to a problem, projects should be identified strategically based on desired corridor performance outcomes and system management capabilities to improve traffic management and incident management. A corridor Concept of Operations can provide the specific strategies and plan for operational enhancements that can achieve this goal.

As depicted in Figure 3 and Figure 6 above, the Concept of Operations can be used to continuously generate new candidate projects. Caltrans will collaborate with its local and regional partners to develop and update the Concept of Operations for specific freeway corridors.

Figure 9 Collaborative Process with Local and Regional Partners for Concept of Operations



APPENDIX

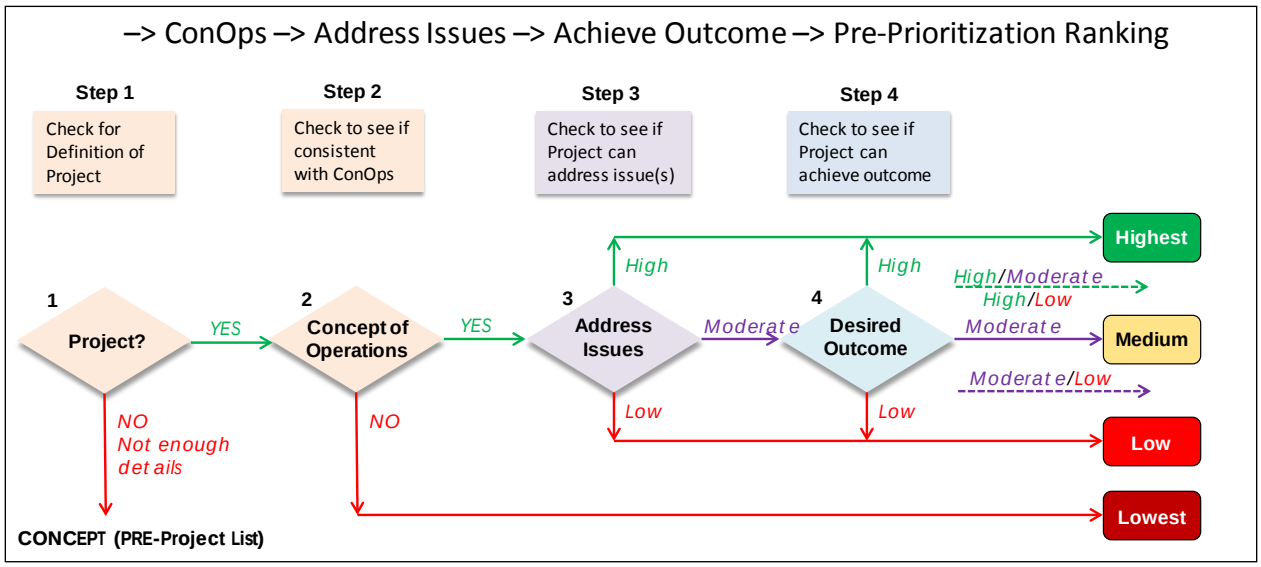
Appendix

A. Project Prioritization and Selection Process

The newly implemented process to identify and prioritize ITS and operational improvement projects uses the District 3 Concept of Operations and ITS/Operational Improvement PLAN. The process involves essentially three main levels: firstly, quantitative analysis for prioritization; secondly, qualitative valuation analysis to determine benefit/cost ratios for each high-priority project; and thirdly, selection ranking for potential investment order, taking into account the project value (benefit/cost ratio) and other tangible and intangible factors.

LEVEL 1: PROJECT PRIORITIZATION – QUALITATIVE ANALYSIS

The project prioritization qualitative analysis process follows Steps 1-4 below:



STEP 1:

The very first step is to verify that there is sufficient description and information to define a project. A project is a "planned set of interrelated tasks to be executed over a fixed period and within certain cost and other limitations." For the project inventory database as well as for prioritization purposes, a definition of a project in this case is the following:

> *Sufficient details of interrelated scope to describe specific physical changes to effect desired results, where costs can be estimated, timeline projected, and major limitations anticipated.*

If it does not meet this definition, then there is insufficient information to perform qualitative or quantitative analysis. Therefore, it cannot be prioritized and must be moved to a pre-project

(conceptual project) list. These concepts can later be considered within the District 3 Concept of Operations context for further development into projects. Those that meet the definition can go to the next step.

STEP 2:

It is unlikely that all projects added to the inventory database are developed or formulated strategically from the Concept of Operations. Every project should be reviewed and assessed for consistency with the District Concept of Operations. For projects that do not fit among the Concept of Operations yet that the District finds valuable, the District should revisit the Concept of Operations for possible adjustments or revisions. Otherwise, projects not consistent with the District Concept of Operations should be ranked among the lowest priority group of projects. Those that are consistent with the Concept of Operations can go to the next step.

STEP 3 and STEP 4:

Steps 3 and 4 can be conducted simultaneously. Step 3 involves the level to which the project is necessary and issues are addressed. Step 4 involves the level to which desired outcomes can potentially be achieved. While both of these qualitative steps require subjective assessment, they force the users to consider projects from a strategic standpoint to separate out the unimportant projects. If a project is assessed as needed and is able to address issues and achieve one or more desired outcomes, both at a high-level, then it should be ranked among the highest priority group of projects. If a project meets both criteria at a moderate level, then it should be ranked among the medium-priority group of projects. If a project meets both criteria at a low-level, then it should be ranked among the low-priority group of projects. If a project meets one criterion at a high-level and the other criterion at a moderate level, then it should be ranked somewhere between the highest and medium-priority group of projects. If a project meets one criterion at a moderate level and the other criterion at a low-level, then it should be ranked somewhere between the medium- and low-priority group of projects.

In some cases, there will be corridor improvements segregated into several phases or elements such as interchange modifications, ITS deployments, and auxiliary lanes. Each phase or element of the project in and of itself may rank very highly, but grouped together will rank highest. In these cases, these projects should be grouped and ranked together. Each phase project description needs to identify a "traceability path" so that all phases of the project can be connected.

LEVEL 2: PROJECT PRIORITIZATION – QUANTITATIVE VALUATION ANALYSIS

A benefit-cost analysis using the California Life-Cycle Benefit-Cost Analysis Model (Cal B/C) provides an estimate of the cost-effectiveness of a project and compares the user benefits of a project to the cost of providing those benefits. The analysis consists of:

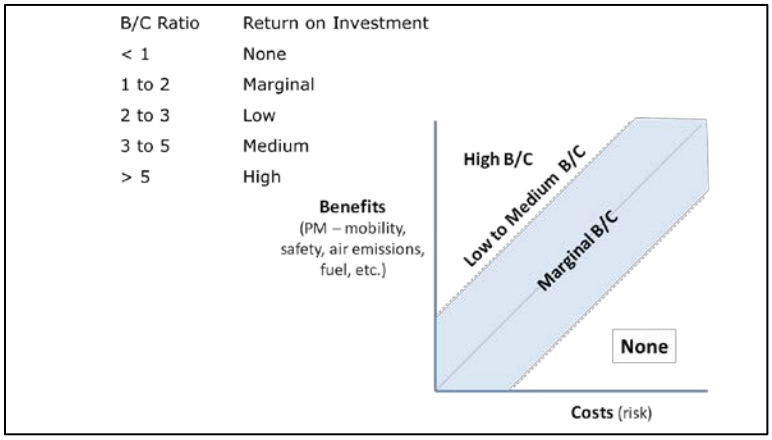
- Estimating the performance impacts of a project (i.e., delay reductions, safety improvements, etc.)

- Converting these impacts into dollar values (monetizing)
- Comparing these impacts to the life-cycle project costs (arriving at a benefit-cost ratio)

The benefits of using this type of quantitative analysis include:

- The Department has a well-defined process and often includes benefit-cost analysis in value engineering analysis
- Benefit-cost analysis is required for many funding sources (i.e., Corridor Mobility Improvement Account (CMIA) applications, Interregional Transportation Improvement Plan (ITIP) funding, and the SHOPP funding)
- The Federal government is becoming more interested in benefit-cost analysis (i.e., Transportation Investment Generating Economic Recovery (TIGER) grant applications), and the California Transportation Commission often requests the analysis

Costs refer to all potential agency costs (right-of-way, construction and equipment, project support, rehabilitation and mitigation, and operating and maintenance). Both costs and benefits are measured over a standard 20-year lifecycle. Performance results for this Plan are summarized using a benefit-cost ratio, which compares discounted benefits to discounted costs.



In the graphic above, high B/C ratios in the upper-left quadrant (high-benefits and low-cost) have the best return on investment. These projects are always good choices from a cost-effectiveness standpoint. Conversely, the marginal (low-benefits and low-cost and high-benefits and high-cost) to "minimal/no go" B/C ratio in the lower-right quadrant (low-benefits and high-cost) should be avoided whenever possible, unless there are intangible benefits to consider, such as equity, political inclusion, sustainability, multi-modal, or emergency response assurance. Projects with low-to-medium B/C ratios that fall just above the shaded band are not necessarily poor choices, but they are less cost-effective than the ones in the upper-left quadrant. Within the shaded band, for the lower-left projects, while benefits are nominal, the cost is also very low. These represent the "low hanging fruit" – projects that are easier to fund and program. While the cost is high for projects in the upper-right quadrant, the

benefits are also high. These are the high-risk, high-reward projects where significant mobility gains and improvements can be realized. However, they are much more difficult to fund and program due to their higher costs.

The benefit-cost analysis provides support for tradeoff analysis; it is not a substitute for micro-simulation modeling and analysis.

LEVEL 3: PROJECT RANKING FOR POTENTIAL INVESTMENT

Adjustment Factors to Consider

- Mobility and safety improvements (congestion level/safety concerns)
- Cost level (cutoff level)
- Funding leverage (previous partial funding, opportunity)
- Project sequencing (phases or prerequisites)
- Regional significance (equity/benefit-per user/regional concerns)
- Sustainability/environment/complete streets
- Feasibility (construction/operation and maintenance costs)
- Intermodal integration
- Multi-jurisdictional improvement
- Politics
- Other (i.e., efficiencies, customer satisfaction, system continuity, etc.)

SELECTION PROCESS

After all of the projects are ranked and prioritized, the selection process is the final prioritization step for future programming. Depending on the level of funding available, a threshold can be chosen using the costs of the project. As an example, for $100 million available, ten $10 million projects can be programmed, twenty $5 million projects can be programmed, or a mixture totaling $100 million in available funding can be programmed. Qualitative adjustments should be made to the prioritized list of projects to take into account, for programming selection, the following factors:

▪ Mobility & Safety	▪ Intermodal Integration
▪ Cost Level (cutoff)	▪ Multi-jurisdictional Improvement
▪ Funding Leverage	▪ Politics
▪ Project Sequencing	▪ Efficiencies, system performance
▪ Sustainability/Environment	▪ Regional Significance
▪ Feasibility (constructability/O&M)	

B. Benefit-Cost Analysis Results by Project

Project 1

PROJECT: Butte County SR99 Traveler Info (Various TOS Elements) PPNO:

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$6.7
Life-Cycle Benefits (mil. $)	$34.6
Net Present Value (mil. $)	$27.8
Benefit / Cost Ratio:	5.1
Rate of Return on Investment:	34.5%
Payback Period:	3 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$1.0	$20.0
Veh. Op. Cost Savings	$0.7	$14.2
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.3
TOTAL BENEFITS	$1.7	$34.6
Person-Hours of Time Saved	115,059	2,301,172
CO_2 Emissions Saved (tons)	-127	-2,548
CO_2 Emissions Saved (mil. $)	-$0.0	-$0.0

Project 2

PROJECT: BUT-99 Southgate IC PPNO:

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$25.8
Life-Cycle Benefits (mil. $)	$86.1
Net Present Value (mil. $)	$60.3
Benefit / Cost Ratio:	3.3
Rate of Return on Investment:	20.7%
Payback Period:	4 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$4.3	$86.1
Veh. Op. Cost Savings	$0.0	$0.0
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.0
TOTAL BENEFITS	$4.3	$86.1
Person-Hours of Time Saved	569,400	11,388,000
CO_2 Emissions Saved (tons)	1	20
CO_2 Emissions Saved (mil. $)	$0.0	$0.0

Notes

** Typical benefit/cost ratio (from Caltrans TMS Master Plan and Caltrans Safety Program Guidelines)*

SVCP *- Small Value Capital Project Initiation Document*

SHOPP Eligible *- indicates if the project is eligible for SHOPP funding*

Project 3

1. Project Information

Application ID	Butte 162 Orov[illegible]e-Quincy Hwy	Version	1

2. Countermeasures and Crash Data

Crash Data Time Period	01/01/2006	to	12/31/2010	Years	5

• Convert intersection to roundabout (from 2-way stop or yield control)

CM Number	Project Type	Crash Type	CRF	Life
NS4	Control	All	45	20

Crash Type	Fatality (Death)	Severe Injury	Injury – Other Visible	Injury – Complaint of Pain	Property Damage Only	Total
All	1	5	5	0	10	21

Annual Benefit	$ 500,211	Cost	$ 1,500,000
Life Benefit	$ 10,004,220	B/C Ratio	6.67

3. Benefit Cost Result

Total Benefit	$ 10,004,220
Total Cost	$ 1,500,000
B/C Ratio	6.67

Note: Estimation based on two intersection modifications to roundabouts; the inputs are limited to one roundabout; cost divided by two for both improvements to arrive at B/C. ratio for both. The cost estimate subsequently came in higher at $7 million for the two intersections. **B/C is then $10M benefit/$3.5M cost per I/S for a result of 2.9.**

Project 4

PROJECT: US50 Coloma Rd offramp to Placerville Dr offramp Auxiliary Lane PPNO:

3

INVESTMENT ANALYSIS

SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$13.0
Life-Cycle Benefits (mil. $)	$133.6
Net Present Value (mil. $)	$120.6
Benefit / Cost Ratio:	10.3
Rate of Return on Investment:	79.0%
Payback Period:	2 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$5.9	$117.9
Veh. Op. Cost Savings	$0.7	$14.1
Accident Cost Savings	-$0.0	-$0.0
Emission Cost Savings	$0.1	$1.5
TOTAL BENEFITS	$6.7	$133.6
Person-Hours of Time Saved	531,346	10,626,914
CO_2 Emissions Saved (tons)	3,334	66,676
CO_2 Emissions Saved (mil. $)	$0.1	$1.3

Project 5

PROJECT: ED-50 Pioneer Rd Intersection Improvements PPNO:

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$0.9
Life-Cycle Benefits (mil. $)	$1.5
Net Present Value (mil. $)	$0.6
Benefit / Cost Ratio:	1.6
Rate of Return on Investment:	10.4%
Payback Period:	9 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.1	$1.5
Veh. Op. Cost Savings	$0.0	$0.0
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.0
TOTAL BENEFITS	$0.1	$1.5
Person-Hours of Time Saved	9,062	181,248
CO_2 Emissions Saved (tons)	4	73
CO_2 Emissions Saved (mil. $)	$0.0	$0.0

Project 6

1. Project Information

Application ID	US-50/SR-89 Meyers	Version	1

2. Countermeasures and Crash Data

Crash Data Time Period	01/01/2006	to	12/31/2010	Years	5

• Convert intersection to roundabout (from 2-way stop or yield control)

CM Number	Project Type	Crash Type	CRF	Life
NS4	Control	All	45	20

Crash Type	Fatality (Death)	Severe Injury	Injury – Other Visible	Injury – Complaint of Pain	Property Damage Only	Total
All	0	6	5	0	12	23

Annual Benefit	$ 160,182	Cost	$ 5,000,000
Life Benefit	$ 3,203,640	B/C Ratio	0.64

3. Benefit Cost Result

Total Benefit	$ 3,203,640
Total Cost	$ 5,000,000
B/C Ratio	0.64

Project 7

1. Project Information

Application ID	NEV-20 Turnouts	Version	1

2. Countermeasures and Crash Data

Crash Data Time Period	01/01/2006	to	12/31/2010	Years	5

- Install climbing lane (where large difference between car and truck speed)

CM Number	Project Type	Crash Type	CRF	Life
R12	Geometric Mod.	All	20	20

Crash Type	Fatality (Death)	Severe Injury	Injury – Other Visible	Injury – Complaint of Pain	Property Damage Only	Total
All	4	50	61	0	87	202

Annual Benefit	$ 1,291,936	Cost	$ 1,500,000
Life Benefit	$ 25,838,720	B/C Ratio	17.23

3. Benefit Cost Result

Total Benefit	$ 25,838,720
Total Cost	$ 1,500,000
B/C Ratio	17.23

Note: Estimation based on assumption that turnouts every three miles for an uphill 20 mile segment are similar to a truck climbing lane, the input used in the analysis. **The benefits are therefore reduced by half for a more conservative B/C ratio of 8.6.**

Project 8

PROJECT: Nevada County SR49 Traveler Info (Various ITS Auburn - Grass Valley) PPNO:

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$2.5
Life-Cycle Benefits (mil. $)	$17.3
Net Present Value (mil. $)	$14.8
Benefit / Cost Ratio:	6.9
Rate of Return on Investment:	47.5%
Payback Period:	3 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.6	$12.6
Veh. Op. Cost Savings	$0.2	$4.0
Accident Cost Savings	$0.0	$0.4
Emission Cost Savings	$0.0	$0.3
TOTAL BENEFITS	$0.9	$17.3
Person-Hours of Time Saved	68,758	1,375,158
CO_2 Emissions Saved (tons)	514	10,279
CO_2 Emissions Saved (mil. $)	$0.0	$0.2

Project 9

1. Project Information

Application ID	NEV-20 Washington IS Mod	Version	1

2. Countermeasures and Crash Data

Crash Data Time Period	01/01/2006	to	12/31/2010	Years	5

- Install left-turn lane (where no left-turn lane exists)

CM Number	Project Type	Crash Type	CRF	Life
NS15	Geometric Mod.	All	35	20

Crash Type	Fatality (Death)	Severe Injury	Injury - Other Visible	Injury - Complaint of Pain	Property Damage Only	Total
All	0	1	0	0	3	4

Annual Benefit	$16,674	Cost	$650,000
Life Benefit	$333,480	B/C Ratio	0.51

- Improve sight distance to intersection (clear sight triangles)

CM Number	Project Type	Crash Type	CRF	Life
NS10	Operation / Warning	All	20	10

Crash Type	Fatality (Death)	Severe Injury	Injury - Other Visible	Injury - Complaint of Pain	Property Damage Only	Total
All	0	1	0	0	2	3

Annual Benefit	$9,232	Cost	$650,000
Life Benefit	$92,320	B/C Ratio	0.14

3. Benefit Cost Result

Total Benefit	$425,800
Total Cost	$1,300,000
B/C Ratio	0.33

Project 10

PROJECT: 1 of 2 Auxiliary lanes SR65 (Douglas Blvd. to Riverside PM0.55-2.203) PPNO:

3

INVESTMENT ANALYSIS

SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$5.5
Life-Cycle Benefits (mil. $)	$45.9
Net Present Value (mil. $)	$40.4
Benefit / Cost Ratio:	8.3
Rate of Return on Investment:	63.1%
Payback Period:	2 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$2.0	$39.5
Veh. Op. Cost Savings	$0.3	$5.8
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.6
TOTAL BENEFITS	$2.3	$45.9
Person-Hours of Time Saved	122,891	2,457,815
CO_2 Emissions Saved (tons)	1,263	25,268
CO_2 Emissions Saved (mil. $)	$0.0	$0.5

Project 11

PROJECT: 2nd Auxiliary lane in PLA project SR65 (SR65 to Rocklin Rd PM4.5-5.9) PPNO:

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$5.5
Life-Cycle Benefits (mil. $)	$10.8
Net Present Value (mil. $)	$5.3
Benefit / Cost Ratio:	2.0
Rate of Return on Investment:	9.0%
Payback Period:	14 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.5	$9.0
Veh. Op. Cost Savings	$0.1	$1.6
Accident Cost Savings	-$0.0	-$0.0
Emission Cost Savings	$0.0	$0.2
TOTAL BENEFITS	$0.5	$10.8
Person-Hours of Time Saved	36,896	737,914
CO_2 Emissions Saved (tons)	495	9,899
CO_2 Emissions Saved (mil. $)	$0.0	$0.2

Project 12

PLA-49 Signal installation and coordination (Shale Ridge Rd., Dry Creek Rd., & Bell Rd.)

B/C ratio for signal coordination type projects is: 4.5.

Source: Caltrans TMS Master Plan

Project 13

PROJECT: IC modification Twelve Bridge PLA65 IC modification w/Ramp merge lane PPNO:

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$3.7
Life-Cycle Benefits (mil. $)	$6.5
Net Present Value (mil. $)	$2.8
Benefit / Cost Ratio:	1.8
Rate of Return on Investment:	10.2%
Payback Period:	10 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.2	$4.6
Veh. Op. Cost Savings	$0.1	$1.4
Accident Cost Savings	$0.0	$0.3
Emission Cost Savings	$0.0	$0.1
TOTAL BENEFITS	$0.3	$6.5
Person-Hours of Time Saved	25,492	509,842
CO_2 Emissions Saved (tons)	249	4,976
CO_2 Emissions Saved (mil. $)	$0.0	$0.1

Project 14

PROJECT: SB Truck Climbing Lane with Shoulder Widening SR 267 PPNO:

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$15.0
Life-Cycle Benefits (mil. $)	$16.0
Net Present Value (mil. $)	$1.0
Benefit / Cost Ratio:	1.1
Rate of Return on Investment:	4.7%
Payback Period:	14 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.7	$13.5
Veh. Op. Cost Savings	-$0.1	-$2.3
Accident Cost Savings	$0.3	$5.1
Emission Cost Savings	-$0.0	-$0.3
TOTAL BENEFITS	$0.8	$16.0
Person-Hours of Time Saved	81,128	1,622,560
CO_2 Emissions Saved (tons)	-580	-11,592
CO_2 Emissions Saved (mil. $)	-$0.0	-$0.2

Project 15

PROJECT: SR 51 Transition Lane E St to American River Bridge NB PPNO:

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$8.3
Life-Cycle Benefits (mil. $)	$157.9
Net Present Value (mil. $)	$149.6
Benefit / Cost Ratio:	19.0
Rate of Return on Investment:	54.1%
Payback Period:	3 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$6.7	$134.0
Veh. Op. Cost Savings	$1.1	$21.5
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.1	$2.4
TOTAL BENEFITS	$7.9	$157.9
Person-Hours of Time Saved	891,239	17,824,775
CO_2 Emissions Saved (tons)	6,025	120,503
CO_2 Emissions Saved (mil. $)	$0.1	$2.1

Project 16

PROJECT: Sac I-5: SB Auxiliary Lane from US50 connector to Sutterville offramp PPNO:

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$4.7
Life-Cycle Benefits (mil. $)	$77.9
Net Present Value (mil. $)	$73.2
Benefit / Cost Ratio:	16.4
Rate of Return on Investment:	148.8%
Payback Period:	1 year

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$3.6	$72.0
Veh. Op. Cost Savings	$0.3	$5.4
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.6
TOTAL BENEFITS	$3.9	$77.9
Person-Hours of Time Saved	200,914	4,018,281
CO_2 Emissions Saved (tons)	1,161	23,228
CO_2 Emissions Saved (mil. $)	$0.0	$0.5

Project 17

PROJECT: I-5 Transition Lane Between Garden Hwy off-ramp to Garden Hwy on-ramp PPNO:

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$4.0
Life-Cycle Benefits (mil. $)	$50.8
Net Present Value (mil. $)	$46.8
Benefit / Cost Ratio:	12.7
Rate of Return on Investment:	69.5%
Payback Period:	2 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$2.2	$43.3
Veh. Op. Cost Savings	$0.3	$6.7
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.7
TOTAL BENEFITS	$2.5	$50.8
Person-Hours of Time Saved	244,472	4,889,446
CO_2 Emissions Saved (tons)	1,584	31,682
CO_2 Emissions Saved (mil. $)	$0.0	$0.6

Project 18

PROJECT: I-5 NB Deceleration Lane to Airport Blvd. PPNO:

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$2.0
Life-Cycle Benefits (mil. $)	$24.0
Net Present Value (mil. $)	$22.0
Benefit / Cost Ratio:	12.0
Rate of Return on Investment:	121.8%
Payback Period:	1 year

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$1.1	$22.4
Veh. Op. Cost Savings	$0.1	$1.5
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.2
TOTAL BENEFITS	$1.2	$24.0
Person-Hours of Time Saved	0	0
CO_2 Emissions Saved (tons)	311	6,225
CO_2 Emissions Saved (mil. $)	$0.0	$0.1

Project 19

PROJECT: US50 EB & WB Auxilary Lanes Bradshaw Rd to Mather Field Rd PPNO:

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$6.0
Life-Cycle Benefits (mil. $)	$64.2
Net Present Value (mil. $)	$58.2
Benefit / Cost Ratio:	10.7
Rate of Return on Investment:	111.3%
Payback Period:	1 year

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$3.1	$62.0
Veh. Op. Cost Savings	$0.1	$2.0
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.2
TOTAL BENEFITS	$3.2	$64.2
Person-Hours of Time Saved	222,614	4,452,272
CO_2 Emissions Saved (tons)	378	7,562
CO_2 Emissions Saved (mil. $)	$0.0	$0.2

Project 20

SAC/PLA/YOL/ELD/NEV – Var – Roadway Weather Information Systems (RWIS) upgrade at 18 locations for multiple corridors.

B/C ratio typical for traveler information type projects is: 10.0.

Source: Caltrans TMS Master Plan

Project 21

Various – Var – Highway Advisory Radio (HAR) at 25 locations

B/C ratio typical for traveler information type projects is: 10.0.

Source: Caltrans TMS Master Plan

Project 22

Various – Var – Travel time detection and notification at 110 locations

B/C ratio typical for traveler information type projects is: 10.0.

Source: Caltrans TMS Master Plan

Project 23

PROJECT: Aux lane I-5 NB and SB from Pocket to Florin EA03-1F160 PPNO:

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$7.1
Life-Cycle Benefits (mil. $)	$44.1
Net Present Value (mil. $)	$37.0
Benefit / Cost Ratio:	6.2
Rate of Return on Investment:	25.1%
Payback Period:	6 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$1.8	$36.3
Veh. Op. Cost Savings	$0.4	$7.0
Accident Cost Savings	-$0.0	-$0.0
Emission Cost Savings	$0.0	$0.8
TOTAL BENEFITS	$2.2	$44.1
Person-Hours of Time Saved	120,407	2,408,144
CO_2 Emissions Saved (tons)	2,069	41,385
CO_2 Emissions Saved (mil. $)	$0.0	$0.7

Project 24

PROJECT: US50: WB Transition Lane from NB Howe Ave onramp to SB Howe Ave onramp PPNO:

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$3.0
Life-Cycle Benefits (mil. $)	$16.3
Net Present Value (mil. $)	$13.3
Benefit / Cost Ratio:	5.4
Rate of Return on Investment:	20.2%
Payback Period:	8 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.7	$14.0
Veh. Op. Cost Savings	$0.1	$2.0
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.2
TOTAL BENEFITS	$0.8	$16.3
Person-Hours of Time Saved	93,210	1,864,193
CO_2 Emissions Saved (tons)	629	12,585
CO_2 Emissions Saved (mil. $)	$0.0	$0.2

Project 25

PRIORITY 1 PROJECTS COMBINED

INVESTMENT ANALYSIS

SUMMARY RESULTS FOR PRIORITY 1 PROJECT RAMPS

Life-Cycle Costs (mil. $)	$5.5
Life-Cycle Benefits (mil. $)	$42.5
Net Present Value (mil. $)	$37.0
Benefit / Cost Ratio:	7.7
Rate of Return on Investment:	#NUM!
Payback Period:	N/A

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.8	$16.4
Veh. Op. Cost Savings	$1.2	$24.9
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.1	$1.2
TOTAL BENEFITS	$2.1	$42.5
Person-Hours of Time Saved	92,861	1,857,229
CO_2 Emissions Saved (tons)	1,203	24,060
CO_2 Emissions Saved (mil. $)	$0.0	$0.5

EB I-80 at Antelope Rd RM (PM 99/100.4)

INVESTMENT ANALYSIS

SUMMARY RESULTS FOR PROJECT RAMPS (PRIORITY 1 RM_BCA1)

Life-Cycle Costs (mil. $)	$0.4
Life-Cycle Benefits (mil. $)	$1.2
Net Present Value (mil. $)	$0.8
Benefit / Cost Ratio:	3.0
Rate of Return on Investment:	#NUM!
Payback Period:	N/A

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.0	$0.5
Veh. Op. Cost Savings	$0.0	$0.7
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.0
TOTAL BENEFITS	$0.1	$1.2
Person-Hours of Time Saved	2,668	53,370
CO_2 Emissions Saved (tons)	30	592
CO_2 Emissions Saved (mil. $)	$0.0	$0.0

EB/WB I-80 at Reed Ave - Capital Ave (PM 80/83.4)

INVESTMENT ANALYSIS

SUMMARY RESULTS FOR PROJECT RAMPS (PRIORITY 1 RM_BCA2)

Life-Cycle Costs (mil. $)	$1.6
Life-Cycle Benefits (mil. $)	$15.4
Net Present Value (mil. $)	$13.9
Benefit / Cost Ratio:	9.8
Rate of Return on Investment:	#NUM!
Payback Period:	N/A

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.2	$5.0
Veh. Op. Cost Savings	$0.5	$9.9
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.6
TOTAL BENEFITS	$0.8	$15.4
Person-Hours of Time Saved	27,116	542,321
CO_2 Emissions Saved (tons)	742	14,848
CO_2 Emissions Saved (mil. $)	$0.0	$0.3

EB/WB SR 50 at Harbor - Rte 275 (PM 1.07/6.35)

3

INVESTMENT ANALYSIS

SUMMARY RESULTS FOR PROJECT RAMPS (PRIORITY 1 RM_BCA3)

Life-Cycle Costs (mil. $)	$2.4
Life-Cycle Benefits (mil. $)	$19.1
Net Present Value (mil. $)	$16.7
Benefit / Cost Ratio:	8.1
Rate of Return on Investment:	#NUM!
Payback Period:	N/A

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.4	$7.8
Veh. Op. Cost Savings	$0.5	$10.8
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.4
TOTAL BENEFITS	$1.0	$19.1
Person-Hours of Time Saved	44,930	898,605
CO_2 Emissions Saved (tons)	375	7,508
CO_2 Emissions Saved (mil. $)	$0.0	$0.1

EB/WB/SB SR 51 at Marconi Ave-Arden Way (PM 0.08/8.73)

3

INVESTMENT ANALYSIS

SUMMARY RESULTS FOR PROJECT RAMPS (PRIORITY 1 RM_BCA4)

Life-Cycle Costs (mil. $)	$1.2
Life-Cycle Benefits (mil. $)	$6.8
Net Present Value (mil. $)	$5.6
Benefit / Cost Ratio:	5.7
Rate of Return on Investment:	#NUM!
Payback Period:	N/A

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.2	$3.2
Veh. Op. Cost Savings	$0.2	$3.5
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.1
TOTAL BENEFITS	$0.3	$6.8
Person-Hours of Time Saved	18,147	362,934
CO_2 Emissions Saved (tons)	56	1,112
CO_2 Emissions Saved (mil. $)	$0.0	$0.0

Project 26

PRIORITY 2 PROJECTS COMBINED

3

INVESTMENT ANALYSIS

SUMMARY RESULTS FOR PRIORITY 2 PROJECT RAMPS

Life-Cycle Costs (mil. $)	$4.8
Life-Cycle Benefits (mil. $)	$23.8
Net Present Value (mil. $)	$19.0
Benefit / Cost Ratio:	5.0
Rate of Return on Investment:	#NUM!
Payback Period:	N/A

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.8	$15.5
Veh. Op. Cost Savings	$0.4	$8.0
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.3
TOTAL BENEFITS	$1.2	$23.8
Person-Hours of Time Saved	87,087	1,741,730
CO_2 Emissions Saved (tons)	135	2,702
CO_2 Emissions Saved (mil. $)	$0.0	$0.1

SB I-5 at I-Street & SR 99 at Elkhorn (PM 517.4/522.3)

3

INVESTMENT ANALYSIS

SUMMARY RESULTS FOR PROJECT RAMPS (PRIORITY 2 RM_BCA1)

Life-Cycle Costs (mil. $)	$1.8
Life-Cycle Benefits (mil. $)	$6.2
Net Present Value (mil. $)	$4.4
Benefit / Cost Ratio:	3.4
Rate of Return on Investment:	#NUM!
Payback Period:	N/A

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.2	$3.2
Veh. Op. Cost Savings	$0.1	$2.9
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.1
TOTAL BENEFITS	$0.3	$6.2
Person-Hours of Time Saved	17,913	358,256
CO_2 Emissions Saved (tons)	78	1,568
CO_2 Emissions Saved (mil. $)	$0.0	$0.0

SB SR99 at Laguna Ave (PM 288.1/292)

3

INVESTMENT ANALYSIS

SUMMARY RESULTS FOR PROJECT RAMPS (PRIORITY 2 RM_BCA2)

Life-Cycle Costs (mil. $)	$1.2
Life-Cycle Benefits (mil. $)	$2.6
Net Present Value (mil. $)	$1.4
Benefit / Cost Ratio:	2.1
Rate of Return on Investment:	#NUM!
Payback Period:	N/A

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.1	$1.2
Veh. Op. Cost Savings	$0.1	$1.3
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.1
TOTAL BENEFITS	$0.1	$2.6
Person-Hours of Time Saved	6,564	131,286
CO_2 Emissions Saved (tons)	35	699
CO_2 Emissions Saved (mil. $)	$0.0	$0.0

NB SR-65 at Stanford Ranch Rd (PM 64/68)

3

INVESTMENT ANALYSIS

SUMMARY RESULTS FOR PROJECT RAMPS (PRIORITY 2 RM_BCA3)

Life-Cycle Costs (mil. $)	$0.6
Life-Cycle Benefits (mil. $)	$7.8
Net Present Value (mil. $)	$7.2
Benefit / Cost Ratio:	13.0
Rate of Return on Investment:	#NUM!
Payback Period:	N/A

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.3	$6.1
Veh. Op. Cost Savings	$0.1	$1.6
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.1
TOTAL BENEFITS	$0.4	$7.8
Person-Hours of Time Saved	33,919	678,386
CO_2 Emissions Saved (tons)	81	1,625
CO_2 Emissions Saved (mil. $)	$0.0	$0.0

EB I-80 at Richards Blvd (PM 71.24/77.81)

3

INVESTMENT ANALYSIS

SUMMARY RESULTS FOR PROJECT RAMPS (PRIORITY 2 RM_BCA4)

Life-Cycle Costs (mil. $)	$0.6
Life-Cycle Benefits (mil. $)	$5.9
Net Present Value (mil. $)	$5.3
Benefit / Cost Ratio:	9.9
Rate of Return on Investment:	#NUM!
Payback Period:	N/A

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.2	$4.5
Veh. Op. Cost Savings	$0.1	$1.4
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.0
TOTAL BENEFITS	$0.3	$5.9
Person-Hours of Time Saved	25,872	517,445
CO_2 Emissions Saved (tons)	-91	-1,821
CO_2 Emissions Saved (mil. $)	-$0.0	-$0.0

WB I-80 at NB 65 Connector (PM 103.5/105.8)

3

INVESTMENT ANALYSIS

SUMMARY RESULTS FOR PROJECT RAMPS (PRIORITY 2 RM_BCA5)

Life-Cycle Costs (mil. $)	$0.6
Life-Cycle Benefits (mil. $)	$1.3
Net Present Value (mil. $)	$0.7
Benefit / Cost Ratio:	2.2
Rate of Return on Investment:	#NUM!
Payback Period:	N/A

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.0	$0.5
Veh. Op. Cost Savings	$0.0	$0.8
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.0
TOTAL BENEFITS	$0.1	$1.3
Person-Hours of Time Saved	2,818	56,357
CO_2 Emissions Saved (tons)	32	631
CO_2 Emissions Saved (mil. $)	$0.0	$0.0

Project 27

PROJECT: US50: Extend Auxilary Lane Stockton offramp to SR51and realign/add acceleration taper PPNO:

3

INVESTMENT ANALYSIS

SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$6.0
Life-Cycle Benefits (mil. $)	$23.6
Net Present Value (mil. $)	$17.6
Benefit / Cost Ratio:	3.9
Rate of Return on Investment:	21.1%
Payback Period:	6 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$1.2	$24.8
Veh. Op. Cost Savings	-$0.1	-$1.1
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	-$0.0	-$0.1
TOTAL BENEFITS	$1.2	$23.6
Person-Hours of Time Saved	147,691	2,953,821
CO_2 Emissions Saved (tons)	-174	-3,482
CO_2 Emissions Saved (mil. $)	-$0.0	-$0.1

Project 28

SAC-50 TMC – Upgrade video wall at Regional TMC

B/C ratio typical for ITS project is 3.0.

Source: Caltrans TMS Master Plan

Project 29

HOLD SAC/PLA/YOL Ramp Metering System

Project 30

PROJECT: Sacramento County I-5 Ramp Meters Alternative 1 PPNO:

3

INVESTMENT ANALYSIS

SUMMARY RESULTS FOR ENTIRE SEGMENT RAMP METERING SYSTEM

Life-Cycle Costs (mil. $)	$2.2
Life-Cycle Benefits (mil. $)	$21.4
Net Present Value (mil. $)	$19.2
Benefit / Cost Ratio:	9.7
Rate of Return on Investment:	67.1%
Payback Period:	2 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.4	$7.0
Veh. Op. Cost Savings	$0.7	$13.6
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.7
TOTAL BENEFITS	$1.1	$21.4
Person-Hours of Time Saved	35,947	718,931
CO_2 Emissions Saved (tons)	986	19,725
CO_2 Emissions Saved (mil. $)	$0.0	$0.4

3

INVESTMENT ANALYSIS

SUMMARY RESULTS FOR PROJECT RAMPS PROPORTIONATE

Total On-Ramps w/in Segment	8	Total Project On-Ramps	8

Life-Cycle Costs (mil. $)	$2.2
Life-Cycle Benefits (mil. $)	$21.4
Net Present Value (mil. $)	$19.2
Benefit / Cost Ratio:	9.7
Rate of Return on Investment:	67.1%
Payback Period:	2 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.4	$7.0
Veh. Op. Cost Savings	$0.7	$13.6
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.7
TOTAL BENEFITS	$1.1	$21.4
Person-Hours of Time Saved	35,947	718,931
CO_2 Emissions Saved (tons)	986	19,725
CO_2 Emissions Saved (mil. $)	$0.0	$0.4

PROJECT: Sacramento County I-5 Ramp Meters Alternative 2 PPNO:

3

INVESTMENT ANALYSIS

SUMMARY RESULTS FOR ENTIRE SEGMENT RAMP METERING SYSTEM

Life-Cycle Costs (mil. $)	$10.9
Life-Cycle Benefits (mil. $)	$21.4
Net Present Value (mil. $)	$10.5
Benefit / Cost Ratio:	2.0
Rate of Return on Investment:	12.9%
Payback Period:	8 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.4	$7.0
Veh. Op. Cost Savings	$0.7	$13.6
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.7
TOTAL BENEFITS	$1.1	$21.4
Person-Hours of Time Saved	35,947	718,931
CO_2 Emissions Saved (tons)	986	19,725
CO_2 Emissions Saved (mil. $)	$0.0	$0.4

3

INVESTMENT ANALYSIS

SUMMARY RESULTS FOR PROJECT RAMPS PROPORTIONATE

Total On-Ramps w/in Segment	8	Total Project On-Ramps	8

Life-Cycle Costs (mil. $)	$10.9
Life-Cycle Benefits (mil. $)	$21.4
Net Present Value (mil. $)	$10.5
Benefit / Cost Ratio:	2.0
Rate of Return on Investment:	12.9%
Payback Period:	8 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.4	$7.0
Veh. Op. Cost Savings	$0.7	$13.6
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.7
TOTAL BENEFITS	$1.1	$21.4
Person-Hours of Time Saved	35,947	718,931
CO_2 Emissions Saved (tons)	986	19,725
CO_2 Emissions Saved (mil. $)	$0.0	$0.4

Project 31

PROJECT: SR20 Acceleration Lane extend median/lane at 17th&22nd PPNO:

3

INVESTMENT ANALYSIS

SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$1.0
Life-Cycle Benefits (mil. $)	$17.3
Net Present Value (mil. $)	$16.3
Benefit / Cost Ratio:	17.3
Rate of Return on Investment:	60.6%
Payback Period:	2 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.7	$14.1
Veh. Op. Cost Savings	$0.1	$2.9
Accident Cost Savings	$0.0	$0.0
Emission Cost Savings	$0.0	$0.3
TOTAL BENEFITS	$0.9	$17.3
Person-Hours of Time Saved	55,317	1,106,341
CO_2 Emissions Saved (tons)	795	15,910
CO_2 Emissions Saved (mil. $)	$0.0	$0.3

Project 32

PROJECT: SR20 Passing Lane between Loma Rica Rd to Kibbe Rd PPNO:

3

INVESTMENT ANALYSIS
SUMMARY RESULTS

Life-Cycle Costs (mil. $)	$2.5
Life-Cycle Benefits (mil. $)	$3.2
Net Present Value (mil. $)	$0.7
Benefit / Cost Ratio:	1.3
Rate of Return on Investment:	6.8%
Payback Period:	12 years

ITEMIZED BENEFITS (mil. $)	Average Annual	Total Over 20 Years
Travel Time Savings	$0.2	$3.2
Veh. Op. Cost Savings	-$0.0	-$0.5
Accident Cost Savings	$0.0	$0.5
Emission Cost Savings	-$0.0	-$0.0
TOTAL BENEFITS	$0.2	$3.2
Person-Hours of Time Saved	19,364	387,276
CO_2 Emissions Saved (tons)	-110	-2,198
CO_2 Emissions Saved (mil. $)	-$0.0	-$0.0

Project 33

YUB-20 Safety/operational improvements

Shoulders, vertical/horizontal curve improvements & left-turn lanes

B/C ratio typical for this type of project: 2.8

Source: Safety Program guidelines on estimating B/C ratios

Notes

** Typical benefit/cost ratio (from Caltrans TMS Master Plan and Caltrans Safety Program Guidelines)*

SVCP *- Small Value Capital Project Initiation Document*

SHOPP Eligible *- indicates if the project is eligible for SHOPP funding*