THE MILE MARKER

A CALTRANS PERFORMANCE REPORT

2016 Second Quarter Issue

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Caltrans

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On The Cover

The MSC Toronto is docked at the Port of Los Angeles, North America's leading seaport. In May, the Port of Los Angeles and Caltrans completed a $46 million project to ease traffic congestion and improve safety at key access points near the port on northbound Interstate 110 (Harbor Freeway). The project came in on time and under budget.

Back Cover

A Caltrans employee attends the Maintenance Equipment Training Academy in Sacramento.

Message from the Director

Our recent data-sharing agreement with Waze is adding millions of observations daily to the traffic data Caltrans already gathers through its intelligent transportation network of sensors and cameras.

Waze is a mobile app that provides real-time road and traffic information gathered from its users. Caltrans and Waze both know that information is key to success in transportation. For Waze, the more information its users share among themselves, the more accurate a picture it can deliver. For Caltrans, information means more precision in day-to-day operations as well as in long-term planning.

It's impossible to overstate the role of accurate information in achieving our mission of providing a safe, sustainable, integrated and efficient transportation system that enhances the economy and livability of the state.

Information is the core of our maturing Asset Management Program. We are right now gathering and cataloging an unprecedented volume of detail about California's vast transportation system, which was built in fits and starts over an entire century.

What's equally exciting is the way we are merging those details in a comprehensive, full-spectrum view of our many components. We will no longer have to consider our bridge assets separately from other asset classifications such as drainage systems. The condition of our pavement will be analyzed alongside the number of crosswalks, or the miles of bike lanes, or traffic sensors. In short, by seeing the system as a whole rather than a collection of its parts, we will be able to maximize the benefits of every project.

We are moving in that direction. A robust implementation of our Asset Management Program will be well underway by 2020. And the effects are already evident in the latest four-year State Highway Operation and Protection Program, which is featured on page 6.

That's why I want Caltrans to have as much data as possible. The Waze agreement is unlikely to be our last. We want more data coming in, and we want more data going out so it can be used in productive ways we may not yet have imagined.

That's the notion behind the Mile Marker quarterly report: sharing information brings positive change.

Malcolm Dougherty
Director of Caltrans

Caltrans' Mission

is to provide a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability.

CALTRANS MILE MARKERS
Performance Goals

Safety and Health

Worker Fatalities in Work Zones

0

Goal: 0 per calendar year

Auto Fatalities per 100 million Vehicle Miles Traveled

2012	2013
0.67	0.67

Goal: Less than 0.5

Pedestrian Fatalities

2012	2013
187	257

Goal: Reduce by 10% annually

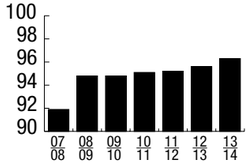
Bicycle Fatalities

2012	2013
26	30

Goal: Reduce by 10% annually

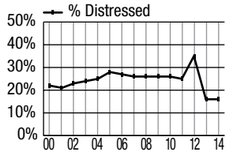
Stewardship and Efficiency

Bridge Health Index
FY 2007-08 — FY 2013-14



Goal: Better than 95 rating by 2020

Pavement Health Index
2000 — 2014



Goal: Better than 90% by FY 2024-25

Percentage of ITS in Working Order

65.6%

Goal: 90% by 2020

*Signal, ramp meter, electric signs, etc.

Planned Projects Delivered in Fiscal Year 2014-15

98%

Goal: 100% annually

Sustainability, Livability and Economy

Percentage of Commutes by

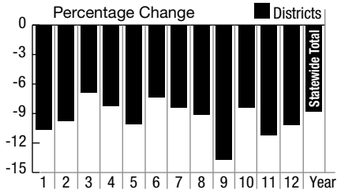
Bicycle	Pedestrian	Transit
1.5%	16.6%	4.4%
Goal by 2020: 4.5%	33.2%	8.8%

Greenhouse Gas Emissions from Caltrans Operations

2010: 217,485
2015: 164,173
2020: 73,988

metric tons

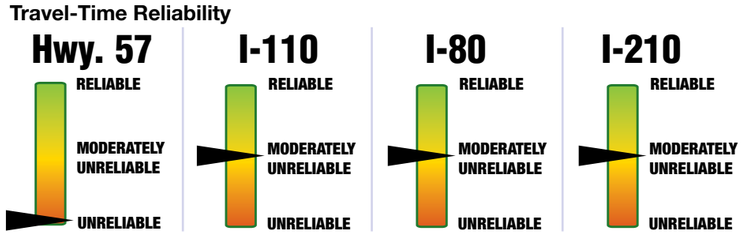
Vehicle Miles Traveled per Capita



Goal: 15% reduction by 2020

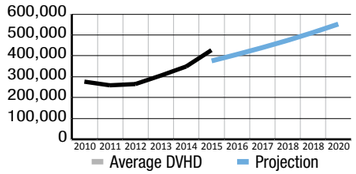
System Performance

Travel-Time Reliability



Goal: By 2020 one-tier improvement from established baseline.

Annual Growth in Daily Vehicle Hours of Delay



Goal: Reduce to an 8% rate of growth by 2020

Additional performance metrics on page 7

Asset Management Directs $250M to Key Projects

When Asset Management is up and running in 2020, Caltrans and its partners expect to be able to select projects based on their overall contribution toward an integrated and sustainable system, rather than on their benefit to a single asset class such as culverts or bridges, as is currently the case. This will allow Caltrans to get the most out of its limited highway funds.

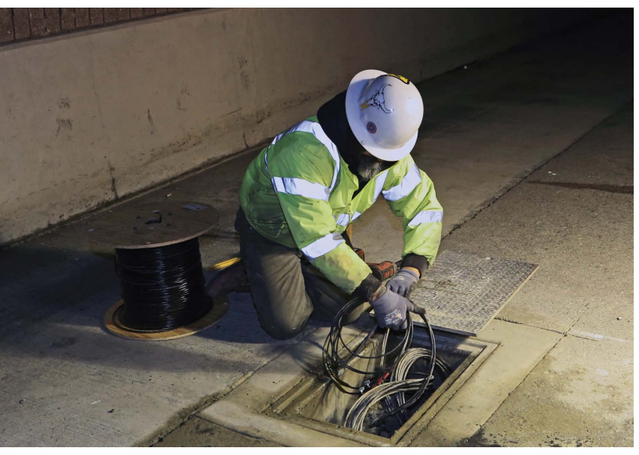
Although the Asset Management effort, initiated in 2015, is still in its infancy, it has already had an impact on the State Highway Operation and Protection Program (SHOPP), the state's "fix-it-first" program that funds the repair and preservation of the state highway system, safety improvements and some highway operational improvements (see story, page 6).

The 2016 Asset Management Report, presented to the California Transportation Commission (CTC) in March, zeroed in on the growing culvert inventory needs and lagging condition of the Intelligent Transportation System (ITS), which resulted in a $250 million reserve in the 2016 SHOPP to improve performance in these two areas.

With SHOPP funding expected to be relatively level through 2020 for pavement and bridges, it is instructive to take a closer look at the culverts and ITS programs to see how Asset Management planning works.

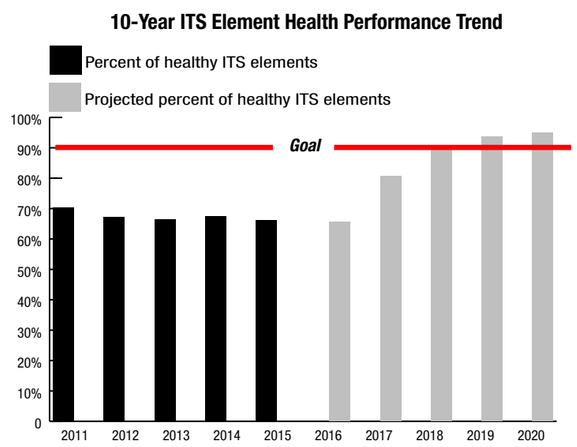
Intelligent Transportation System

ITS elements increase the efficiency of the existing highway system by improving the flow of traffic as congestion increases. The system's most effective tools are Caltrans' 2,802 ramp meters, 834 changeable message signs and more than 43,200 highway loop detectors. The problem in this area is that thousands of these loop detectors no longer work. The loops are integrated with the ramp meters to control how fast vehicles are allowed onto the highway. If the loops are not functioning, then the ramp meters are not as effective as they could be and congestion on the highway increases.



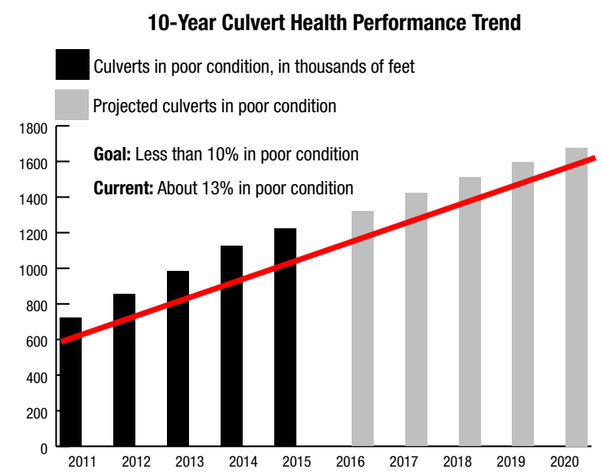
In recognition, the department has proposed reserving $150 million more to allow additional ITS projects to be planned and included in the later years of the 2016 SHOPP (through 2020). This reaction to lagging performance reflects an adjustment of the investment strategy to achieve a desired future performance goal. This is asset management.

The department will also evaluate improved technology and alternative means to capture the necessary information in addition to conventional loop detection approaches (see story on Bluetooth travel-time readers page 18).



The 2016 SHOPP includes rehabilitation or replacement of 1,600 existing ITS elements and the addition of 1,100 ITS elements. The total 2016 SHOPP investment in ITS elements statewide is $260 million from July 2016 to June 2020. As a result of Asset Management's recognition of lagging performance, Caltrans is proposing an additional $150 million SHOPP reservation to allow more ITS projects to be planned and included through 2020.

A new drainage culvert is added to Highway 89 in the Lake Tahoe area.



Culverts

Among the four asset classes, highway culverts are unique in that the inventory is still growing – with the total now at about 105,000. Ongoing culvert inspections are adding approximately 10,000 each year, with about 13 percent of the known inventory currently in poor condition.

Failure to address deteriorating culvert conditions increases the risk of potential mobility disruptions during periods of heavy water runoff. Maintaining these culverts is no small task. If one were to line the entire culvert inventory end to end, the length would reach from San Francisco to Illinois.

The 2016 SHOPP project portfolio includes 37 culvert rehabilitation or replacement projects valued at $150 million, which will address about 64,000 feet of poor-condition culverts. To keep up with the growing culvert needs, shown in the chart above, the department is proposing spending an additional $100 million over the next four years to improve the performance of culverts statewide.

As reported in the 2016 Asset Management Report, 2015 was marked with many activities related to the implementation of asset management in California. These activities include:

- Completion of an updated automated pavement condition survey of state highway pavement.
- Rollout of new condition assessment methods for pavement and bridges.
- Refinement of SHOPP project prioritization methodology through an asset management pilot program.
- CTC adoption of the four core asset classes: pavement, bridges, culverts and ITS elements.
- Adoption of performance measures for all four asset classes (pavement and bridges pending final federal rulemaking).
- Collection of risk management information required by the Moving Ahead for Progress in the 21st Century (MAP-21) and continued in the Fix America's Surface Transportation (FAST) Act.
- Implementation of the SHOPP Management Tool.
- Evaluation of several commercially available asset management software programs.
- External outreach to transportation partners through workshops and the formation of the Transportation Asset Management Advisory Committee.
- Initiation of contracts to provide consultant assistance with Transportation Asset Management Plan development and project prioritization efforts.

The recently released 2016 Asset Management Performance Report relies on information available at the time of writing and asset management tools already in place. The expectation is that this performance report will be a building block that can be improved through implementation efforts and feedback as Caltrans moves closer to full implementation in 2020.

Source: Engineer Michael B. Johnson, State Asset Management, 2016 Asset Management Report

Roadway Preservation Tops Four-Year Spending Plan

The California Transportation Commission (CTC) in March formally adopted Caltrans' program to invest $10 billion of federal and state gas tax revenue in highway upkeep over the next four years. Roadway preservation, the largest single category, received more than $3.1 billion.

Known as the "SHOPP," the State Highway Operation and Protection Program identifies specific rehabilitation and reconstruction projects, and includes reserves for emergency repairs. It is formally updated every two years, though adjustments occur more frequently. Highlights of the 2016 SHOPP include:

- $2.8 billion to improve 4,876 lane miles of pavement.
- $2.4 billion for 299 collision-prevention projects.
- $1.9 billion for major damage repairs and emergency needs.
- $1.4 billion to improve 178 distressed bridges.
- $260 million to add or repair more than 2,700 Intelligent Transportation Systems (ITS) components.
- $150 million to fix or replace 723 culverts.

2016 SHOPP, by Program Category

Program Categories	2016 SHOPP Total (in millions)
Major Damage Restoration	$1,000
Collision Reduction	$2,422
Mandates	$635
Bridge Preservation	$1,439
Roadway Preservation	$3,124
Mobility	$652
Roadside Preservation	$97
Facilities	$80
Minor Program	$610
Total	$10,060

Source: 2016 SHOPP

NOTE: Figures are in unescalated dollars and exclude Proposition 1B bond funds.

The 2016 SHOPP moves toward performance-based asset management methods (see story, page 4) required by state and federal statutes. Under state law, Caltrans has until 2020 to adopt a robust system of measuring and managing asset classes.

2016 SHOPP Asset Improvements

Asset	Performance
Pavement	4,875 lane miles
Bridge	163 bridges rehabilitated
Culverts	723 culverts rehabilitated
Intelligent Transportation Systems	1,600 replaced 1,100 installed (new)

For the 2016 SHOPP, the CTC approved the first phase of the transition to the Asset Management Plan: pavement, bridges, culverts and ITS components.

The 2016 SHOPP, as in previous years, is divided by eight major program categories (major damage restoration; collision reduction; mandates; bridge preservation; roadway preservation; mobility; roadside preservation and facilities) and lists the total dollars directed to each category.

But, as part of the transition to asset management, it also identifies specific outcomes anticipated in four primary CTC-approved asset categories (pavement, bridge, culvert, ITS). Together, those asset classes account for 69 percent of the SHOPP.

Of the proposed SHOPP document's 392 pages, 336 are devoted to a project-by-project list, divided by county and sorted into eight categories. It reflects an increased commitment to seek input from local partners. It includes letters and comments from counties as well as regional transportation partners, and notes that the CTC urges Caltrans to expand and institutionalize outreach to metropolitan planning organizations, regional transportation planning agencies and self-help county coalitions several months before submitting the next four-year SHOPP.

Contributors: Bruce de Terra, Donna Berry, Division of Transportation Programming

Commission Cuts $754M from STIP

The California Transportation Commission (CTC) in May agreed to cut $754 million from a five-year funding plan for new transportation projects and delay an additional $755 million in funding for three years. This marks the largest scaling back since the current funding structure for these projects was established nearly 20 years ago.

The CTC, anticipating a funding shortfall from fuel taxes, recommended the cuts to the State Transportation Improvement Program (STIP), which is the main source of funding for highway, rail, transit and other transportation improvements, including those for bicycles and pedestrians, throughout California.

Almost $200 million of those cuts are in interregional projects, with Contra Costa, Los Angeles, San Bernardino and San Diego counties each seeing cuts of more than $40 million.

Based on the amended 2016 Fund Estimate, the STIP is over-programmed in the first three years of the 2014 STIP by $1.5 billion and there is no capacity to add new projects. As a result, project funding was cut by $754 million for those three years, with an additional $755 million delayed to 2019-21.

As CTC Executive Director Susan Bransen explained in an April 22 letter to the state Legislature, "the Commission is required by law to estimate the amount of funding to be available over the five-year STIP period." Staff pinned the blame for the $1.5 billion shortfall on the "price-based excise tax," the STIP's primary funding source established by the Legislature. This tax is paid by motorists every time they fill up their tank.

This tax, Bransen explained, "originally established at 17.3 cents in 2010, has been adjusted annually and will be adjusted down by the State Board of Equalization to 9.8 cents on July 1, 2016. This decrease will result in a severe reduction in funding estimated to be available for the STIP."

> ***...every $1 billion in highway and transit investments supports 13,000 jobs...***

This tax figure is adjusted annually, by law, to remain revenue neutral with what sales tax on gasoline would have generated. Increasing vehicle fuel economy as well as lower costs for fuel translate directly into decreased funding derived from fuel taxes, even as more motorists than ever are using California's transportation infrastructure – a key component of the California economy.

Typically, transportation projects are funded with multiple revenue sources. CTC staff predict that the total impact of defunding projects will likely run into the billions. At the same time, the cuts in the five-year STIP will likely have a very real impact beyond just meeting the transportation needs of Californians, as every $1 billion in highway and transit investments supports 13,000 jobs, not to mention higher costs associated with project delays.

Source: California Transportation Commission, 2016 State Transportation Improvement Program Commission Staff Recommendations

Previously Reported Performance Measures Pending New Data

Percentage of active transportation funds programmed
Current period - 77.2%
Next reporting period - Sept. '16

Percentage of active transportation projects awarded within six months
Current period - 95.7%
Next reporting period - Sept. '16

On-time performance for intercity rail trips
Current period - 86.5%
Next reporting period - Sept. '16

Employees who say that they work in a positive environment
Current period - 50%
Next reporting period - Dec. '16

Employees who agree that innovation is encouraged at Caltrans
Current period - 40%
Next reporting period - Dec. '16

Stakeholders who say Caltrans meets their needs
Current period - 40%
Next reporting period - Dec. '16

Partners who view Caltrans as a collaborative partner
Current period - 40%
Next reporting period - Dec. '16

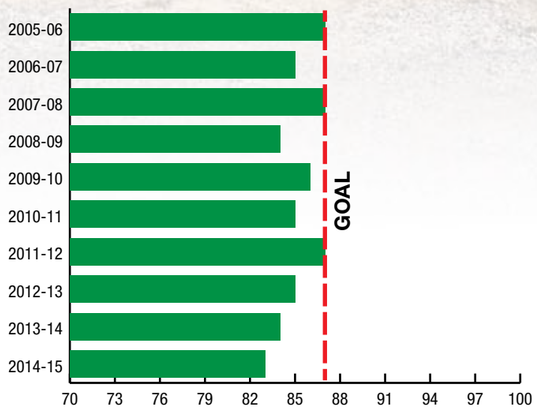
Stakeholders who say Caltrans' communication, professionalism, and service levels have improved
Current period - 36%
Next reporting period - Dec. '16

Stakeholders who give positive feedback on *The Mile Marker*
Current period - 43%
Next reporting period - Dec. 16

See Performance Goals, page 3.

New Guardrail Inspection Rules Bring Down Maintenance Scores

Overall Level of Service



Caltrans maintenance crews put down 33,000 miles of lane striping, eliminated enough graffiti to cover 127 football fields and replaced or repaired 67 miles of guardrail in fiscal year 2014-15. That made California's highways safer and cleaner, but it did not reach the overall service goal Caltrans set for itself.

Caltrans annually assigns performance scores to almost three dozen categories of maintenance activity. Those scores, from 0 as worst to 100 as best, are combined in a weighted average to establish a maintenance level of service (LOS) for its Statewide Report Executive Summary. Only three of these categories – striping, guardrail and litter – have been designated *Mile Marker* performance measures by the Caltrans Strategic Management Plan and receive a higher level of scrutiny in this publication.

Overall, Caltrans gave itself a score of 83 in fiscal year 2014-15, short of its goal of 87, which it last met in 2011-12.

To determine these scores, Caltrans divides California's approximately 15,000 highway centerline miles into one-mile segments and randomly selects 20 percent, which is about 3,000 miles for evaluation. These segments are seen as statistically viable snapshots of the overall health of the state's roadways. Scores that are within five points from the previous year are considered stable. The level of service scores for striping and litter, for example, would fall into the stable category in 2014-15 (see charts).

However, a change in how guardrails were scored in 2014-15 resulted in a dramatic drop to 64 – that's 27 points below its score the year before. It's important to note that the lower score is due to a change in six new inspection points for guardrail end treatments and not necessarily due to any change in the condition of the guardrails themselves.

Guardrails evaluation had previously been scored, for the most part, on whether guardrails required replacement after they had been hit by a vehicle and, in more rare instances, when posts were not aligned properly or had deteriorated over time. With the new inspection guidelines, personnel are now also grading anchor cables, bolts, washers and bearing plates. In response to this expanded task, Caltrans has assigned additional crews to the work.

In fiscal year 2014-2015, the department spent $12.1 million repairing and replacing 67 miles of guardrail, compared to $10.2 million to repair and replace 58 miles of guardrail in 2014.

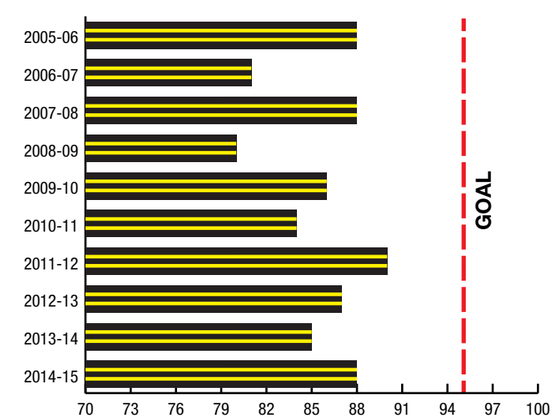
In fiscal year 2014–15, Caltrans spent about $9.7 million on restriping for 33,000 miles. Although its statewide score for striping was 88 – 3 points higher than the year before – Caltrans did not meet its goal of 95. Scores in this category have ranged from 80 to 90 since 2005.

Level of service has been particularly good for litter and debris in the past decade, with scores ranging from 72 to 85 and meeting its goal of 80 in each of the past seven years, including fiscal year 2014-15, with a score of 84.

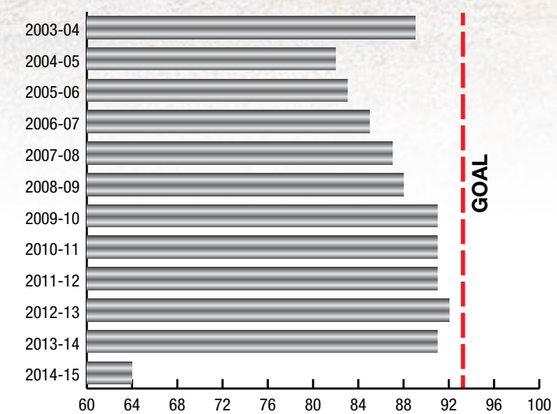
According to the report, Caltrans crews spent $39.1 million removing litter and debris, as well as performing sweeping activities. In total, including non-state employees, Caltrans spent more than $76 million on this task. That is $4.6 million less than what was spent in the prior year. Adopt-A-Highway program volunteers' collection efforts were valued at an additional $20 million. Combined, crews collected more than 13,000 cubic yards. Crews also removed 7.3 million square feet of graffiti, compared to 8.7 million square feet in the prior year.

Source: Division of Maintenance

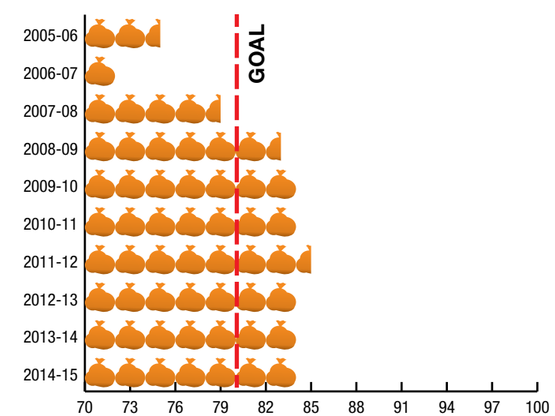
Striping Level of Service



Guardrail Level of Service



Litter/Debris Level of Service



Bicyclist, Pedestrian Deaths Continue to Rise

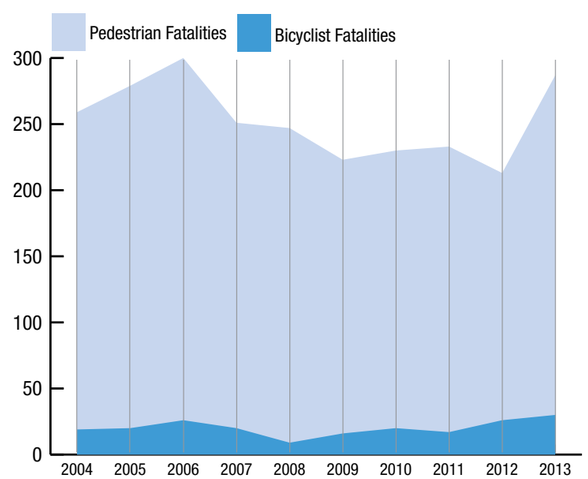
Highway Fatality Rate Holds Steady

Caltrans has a goal to annually reduce, by 10 percent, pedestrian and bicyclist deaths on the state's highway system. While overall highway deaths have not increased, bicyclist and pedestrian deaths have.

In 2012, across the state, 26 bicyclists and 187 pedestrians were killed on the state highway system. In 2013, bicyclist deaths increased to 30 for the year, while pedestrian deaths jumped to 257. Safety is Caltrans' No. 1 goal, and the department is concerned about the recent increase in deaths for these travelers. Caltrans and its partners are engaged in ongoing research to identify the reasons for this increase and solutions that they can implement.

Caltrans is working toward zero highway deaths and has a current goal of less than 0.5 highway fatalities for every 100 million vehicle miles traveled on the state highway system. In 2012, highway fatalities were 0.67 and remained the same in 2013, the most recent year data is available.

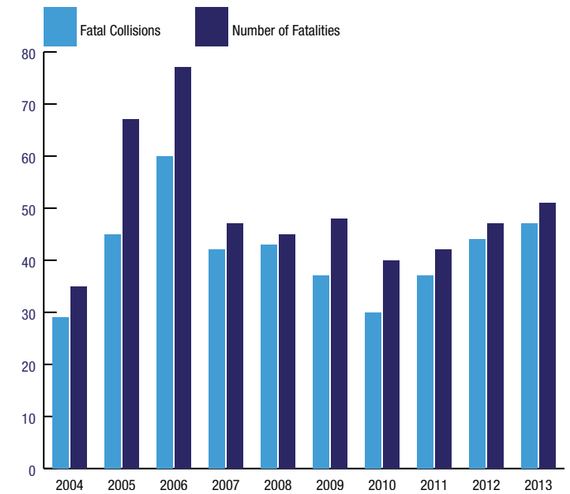
Bike and Pedestrian Highway Fatalities



Between 2012 and 2013, bicycle and pedestrian deaths on the state's highways have increased.

Since 1921, 184 Caltrans employees have been killed on the job. One of the biggest hazards to Caltrans workers and motorists alike is from drivers who do not exercise caution while driving in highway work zones. Caltrans' safety campaigns, such as its nationally recognized "Be Work Zone Alert," which feature the children of Caltrans employees, are a reminder that can also protect motorists. In 2013, 5,874 collisions happened in state highway work zones. Of those, 47 were fatal collisions, killing 51 people, all who were highway travelers.

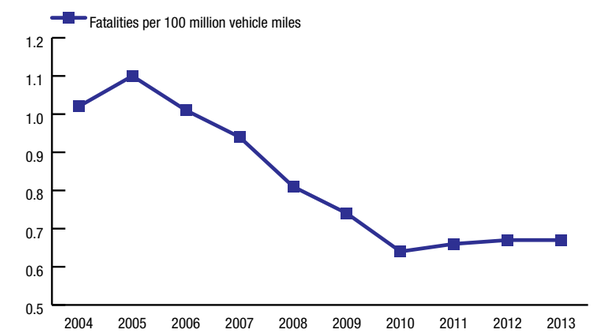
Fatal Collisions in Work Zones



Fatal collisions in work zones and deaths from those collisions have been rising since 2011. Fatal collisions can result in more than one death.

In 2014, Caltrans reported that the department did not lose any highway workers while on the job. But sadly, in 2015, Oscar Vargas, a Caltrans transportation civil engineer who worked in the San Diego area was killed when he lost control of his Caltrans work truck along Interstate 8 near Imperial County on July 14, 2015.

Fatalities Per 100M Vehicles Miles Traveled



Caltrans is working to improve the safety and efficiency of the highway system for all users. Future issues of *The Mile Marker* will provide updates on research findings and Caltrans' strategies to improve safety for people who choose to choose to use active transportation.

Source: Division of Research, Innovation and System Information, Division of Traffic Operations

Iconic S.F. Parkway Features Innovative Design That No One Will See

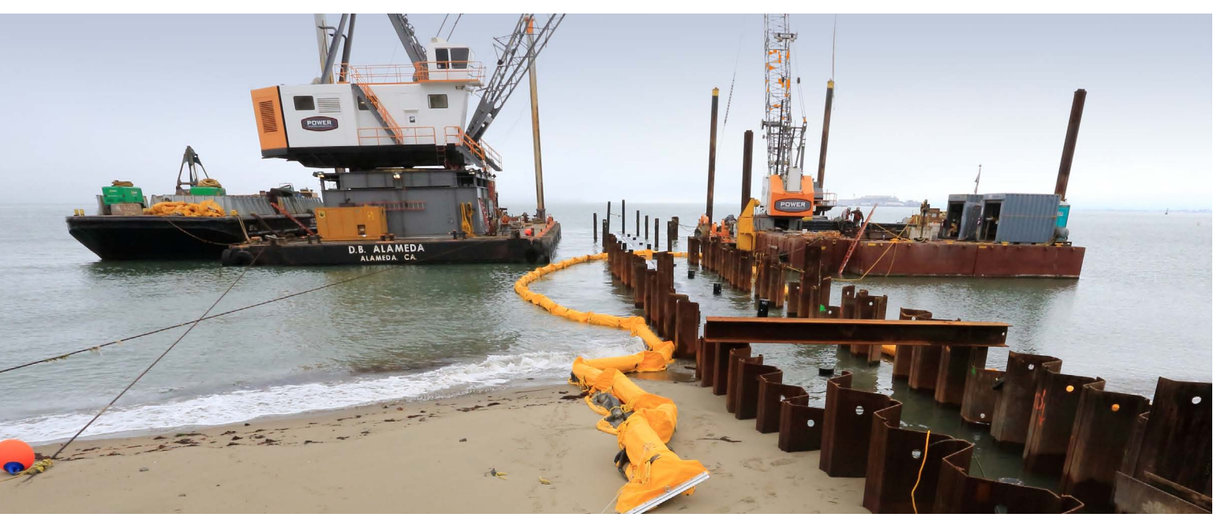
Sustainability was the byword for the Presidio Parkway project from conception to completion, defining everything from the native plants above its tunnels to the innovative drainage system below.

That drainage system was no small matter. This new parkway at the southern end of the Golden Gate Bridge in San Francisco produced 8 percent more runoff than the old route, which was already straining the existing drainage system.

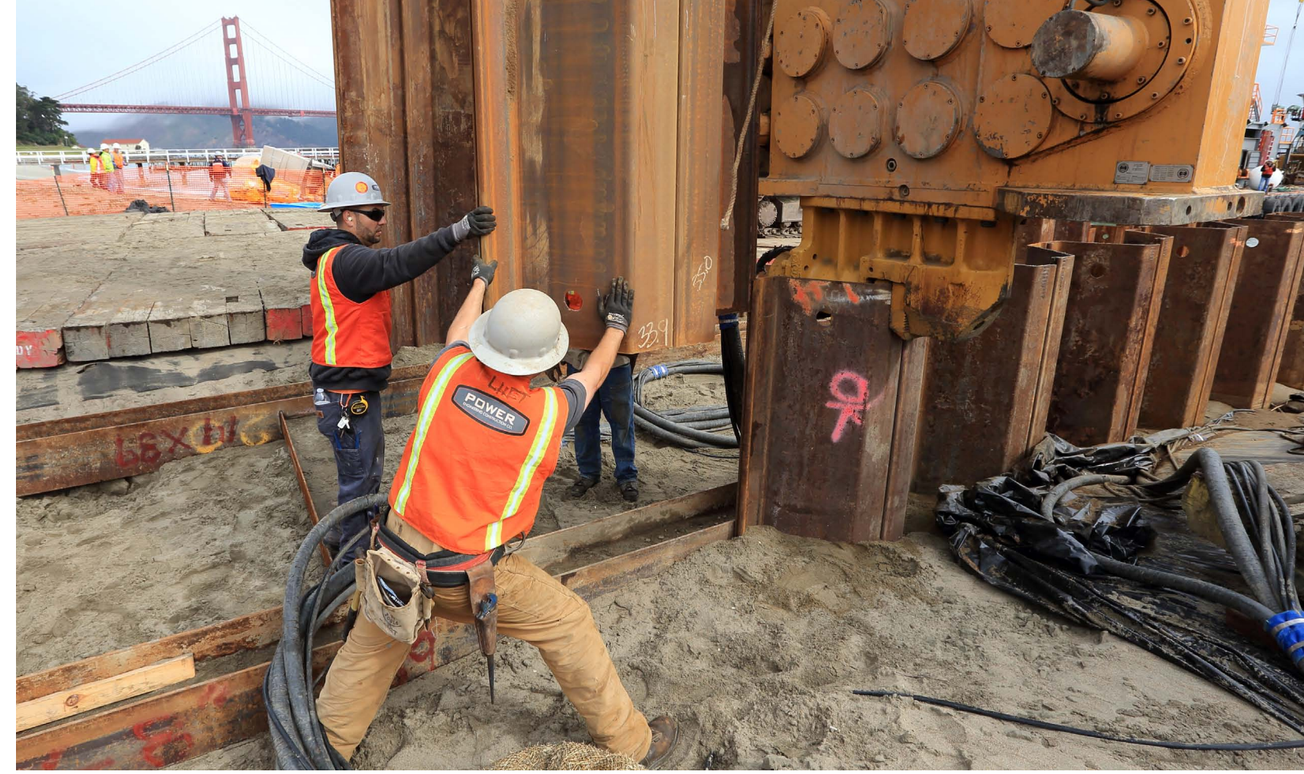
One drain, running from Mason Street to the bay, was a particular problem. Originally, a set of four drains – alphabetically listed as I, J, K and L – were merged into a single drain in the late 1990s. But continuous tidal action eventually buried the pipe outlet under 6 feet of beach sand and with every storm, San Francisco Public Works would have to excavate the pipe outlet and create a drainage trench into San Francisco Bay. Tidal action, however, would fill the trench within hours and the outlet would clog, leading to flooding along Mason Street and Crissy Field, a recreational area along the San Francisco Bay waterfront.

Enlarging and extending the so-called "IJKL" drain into the San Francisco Bay beyond Crissy Field Beach was more than an engineering challenge. Crissy Field is a popular tourist location and home to several protected plant and animal species. Moving forward required approval from a range of stakeholders and regulatory agencies. Among them: Presidio Trust, the National Park Service, the U.S. Coast Guard, the San Francisco County Transportation Authority, the Regional Water Quality Control Board, the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service and the Bay Conservation and Development Commission.

Caltrans designers settled on a 54-inch, high-density polyethylene pipe, which would be buried deeper than the original to obscure the pipe even at low tide. The pipe would rest on piles of recycled plastic that would resist corrosion, protect water quality and last a long time.



The yellow, plastic "Ruffwater" turbidity curtain was custom-designed for the parkway drainage contract. It prevented fine sediment raised during excavation from spreading in the bay.



Workers maneuver the pile driver as they install vertical sheet piles in the sand, creating an open trench to place the 54-inch pipe.

Meeting Environmental Challenges

After the design was complete, the project team faced new challenges when the scheduled opening was moved from 2016 to 2015.

"Our main challenge was to get all of the environmental permits and clearances one year ahead of the original schedule," said Co-Project Manager Joon Kang.

They obtained the permits, which came with a list of restrictions to ensure the project made the least possible impact on its environment. One of the permit conditions was protection of the western snowy plover, a small bird local to the Crissy Field area.

"The western snowy plover is an endangered species due to its habitat loss resulting from human disturbance," said District 4 Biologist Ryan Graybehl. "The plover has come to the point where there is not enough population to sustain itself."

To avoid disturbing the species, Caltrans had to limit the work window to eight weeks between May and July 2015. Native vegetation was carefully moved and later replanted, biological monitors were installed on both dry ground and in the bay. Timber mats helped prevent damage to the sand dunes. The pipe sections themselves were fused at a workshop on the other side of the bay, then floated to the site via two tugboats.

One of the tougher problems resulted in an innovative solution that could have long-lasting dividends. Excavating loose, sandy soil causes "turbidity," the muddying of the waters. Normally, the problem is solved by installing cofferdams. But traditional cofferdams require a long construction time, which wasn't possible on this project. Caltrans engineers considered a "turbidity curtain," but the available models could not handle the high wind and wave velocities of the Crissy Field area.

Caltrans turned to a manufacturer, Elastec Inc., which designed a turbidity curtain specifically for this project that could handle the high winds and waves – the "Ruffwater" curtain. Once installed, both the contractor and Caltrans took water samples upstream and downstream every two hours. Not once did the water reach the threshold limits.

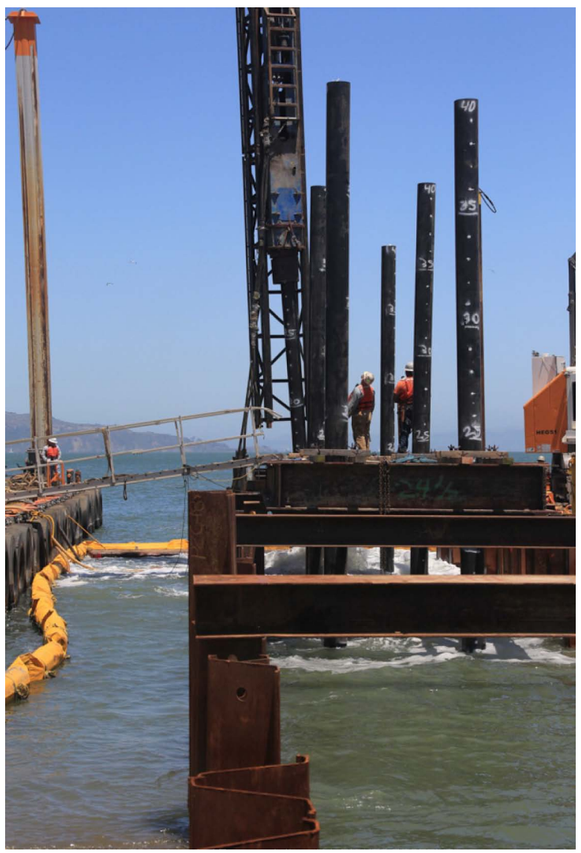
While the overall Presidio Parkway project was required to provide a permanent treatment system for runoff, the Crissy Field project was tasked simply with providing sufficient drainage. Eventually, onsite treatment will rely in large part on bioswales – landscape elements often filled with vegetation, compost and rocks – to filter the water before it goes into the bay.

Noise Reduction

When construction began, Caltrans' biggest concern was the pile-driving noise. If it were too loud, the local wildlife could be harmed and the pile driving would have to be halted – which would not work with an already short work window.

So, instead of normal pile materials – wood, steel, or concrete – the team used piles made of recycled plastic reinforced with fiberglass, known as Seapile. The combination of recycled plastic and fiberglass significantly dampened the noise. Not only that, it was far less corrosive than steel, and therefore better for the environment. Caltrans engineers combined the new plastic/fiberglass piles with a bubble curtain – the same technique used on last year's implosion of an old Bay Bridge pier. The combination worked extremely well. The only time the work had to be halted was when some curious seals ventured a little too close to the work site.

The air bubble curtain was operational during all pile-driving activities to ensure maximum sound level reduction. State Project Engineer Peter Aguilera estimates it achieved a 10 percent reduction in sounds levels.



The casing for the hydraulic impact hammer was placed around the support pile.

With the piles driven into place, Caltrans and the contractor headed into the home stretch. Tugboats floated the 453-foot-long fused sections of drain pipe from the other side of the Bay to Crissy Field Beach. Divers wrangled the pipe into place and secured it to the piles. After that, the cleanup and demobilization got underway.

The seals were not the only species to visit the construction site. Over the course of the project, the team counted 32 California sea lions, 27 Pacific harbor seals, three porpoises, seven humpback whales and a dolphin. Fortunately, the one species that caused the most worry, the endangered western snowy plover, was nowhere to be seen. But on the last day of the project, one of the marine biologists spotted a visitor that might have given pause to the dive teams – a thresher shark.

Despite the visitors, the project ended ahead of schedule and under budget. "It took a lot of teamwork and effort to design and deliver this unique and challenging project," said Caltrans District 4 Director Bijan Sartipi.

When the first of the El Niño rainstorms arrived in December 2015, the new drains worked flawlessly. The Crissy Field area is now free of chronic flooding, and the local wildlife thrives, as if no construction had ever taken place.

Contributor: Bob Haus, District 4 Public Information Officer

Value Analysis Saves Taxpayers $4.3 Billion

Value analysis, a systematic approach to project engineering dating back to World War II, is so dependably productive that adopting even half of the recommendations gleaned during the process yields an average 100-to-1 return on investment.

Caltrans, which conducted its first eight-step value analysis in 1969, does even better, achieving $240 in cost savings for every $1 it spends on the process. Since 1999, Caltrans has saved California taxpayers almost $4.3 billion by putting more than 800 projects through the value analysis process before breaking ground.

Caltrans Exceeds FHWA 2015 Value Analysis Goals

Project Metrics	Caltrans Actual	National Goal
Implementation Rate	62%	50%
Return on Investment	240:1	100:1
Savings	7%	5%

For every dollar Caltrans spends on a value analysis study, it receives an average of $240 back in project cost savings. Those savings are then returned to fund other capital projects. The implementation rate is based on the percentage of recommendations by the Value Analysis team that are implemented.

Saving money, although the measurable result of value analysis, is not its only benefit. The goal is not only to reduce the cost of a project, but to improve its overall value, which may not have an immediate cost savings.

The system was pioneered by General Electric engineers while building propulsion systems for battleships during WWII. The U.S. Navy adopted the practice in the 1950s, and over time all Department of Defense programs benefited. As the process evolved, it was applied to other areas of federal spending and is now required on highway projects costing more than $50 million.

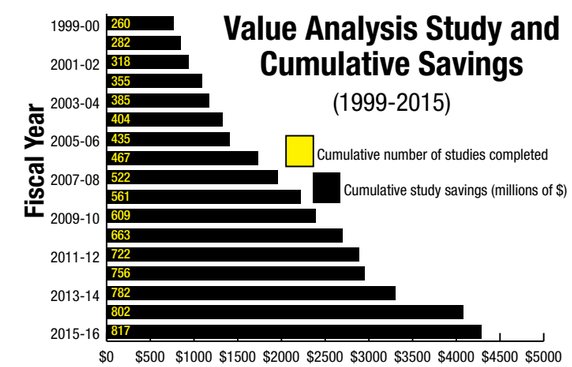
Since 2000, the Value Analysis Program at Caltrans has used standardized metrics to deliver performance-based practical designs. Projects are complex and have to balance hundreds of competing interests from public stakeholders. Project Development Teams (PDTs) strive to balance these competing interests to build the best project on time on budget and within schedule that meets the needs of the competing stakeholders.

During the value analysis study, a team of experts will recommend alternatives to consider all aspects of the project. Considerations could include stakeholder interest, lifecycle cost of pavement, environmental impacts, ride quality, delivering the project early to the traveling public, innovative solutions to complicated problems, design speed, sight distance, lane and shoulder widths and bicycle and pedestrian access at the safest level possible.

Maintenance considerations include the overall durability, longevity and maintainability of pavements, structures and systems, ease of maintenance and safety considerations for maintenance personnel.

An analysis also looks at impacts to the public, including traffic disruptions, detours and delays; noise; reduced access to business districts and neighborhoods; and potential effects on air quality, soil erosion and local plants and wildlife. The permanent environmental impacts to all of the above – as well as cultural, recreational and historic resources – are also assessed.

The recommendations by the value analysis team help build consensus with stakeholders, mitigate risk, increase communication, document decision making, balance interest, and improve the overall value of the project.



Value analysis helped District 11 on the State Route 138 rehabilitation projects in Imperial County. Three large projects were studied together to coordinate construction activities, traffic management and environmental impacts. These projects required coordination with the Bureau of Land Management, California State Highway Patrol, Arizona Department of Transportation, the Agricultural Inspection Facility, California Border Patrol, and Imperial County officials. Community members wanted Caltrans to contain construction in its right-of-way. The value analysis team recommended five alternatives that eliminated the use of local street detours and streamlined the construction by building temporary median crossovers to divert traffic to a single side.

In the end, good value is achieved when the necessary system performance can be accurately defined and delivered at the lowest lifecycle cost.

Source: Troy Tusup, Caltrans Value Analysis Program Manager

Project Initiation Documents Prevent Delays, Cost Overruns

In its annual report to the Legislature, the Project Initiation Document Program showed a $3 billion gap between initial cost predictions for hundreds of highway projects and the more detailed estimates that result from its analyses.

That difference was discovered as Caltrans put more than 480 projects in fiscal year 2014-15 through a rigorous process designed to give them a more predictable path through the planning process into project programming and delivery.

These project initiation documents (PIDs) provide engineering details that document the scope, cost and schedule of a project for programming transportation funds. PIDs are essential to successful project delivery because they optimize transportation funds by ensuring only feasible projects move forward into capital project development.

According to the Project Initiation Document Program Report for fiscal year 2014-15, Caltrans delivered 526 PIDs at a cost of $51.5 million. Of those, 482 PIDs were for projects that will be funded through the State Highway Operation Protection Program (SHOPP) and 44 for state-sponsored and local-sponsored projects for the State Transportation Improvement Program (STIP) and other non-SHOPP funding sources

Prior to PID development, total capital project costs for the 482 PIDs were estimated at $3.41 billion. The total project costs identified in the completed PIDs were estimated at $6.48 billion, as noted in the table below. These differences validate the importance of PIDs. The consequences of moving forward with these planned projects without a PID or reliable scope, schedule and cost estimates would be potential scope changes, schedule delays and project overruns, ultimately leading to projects being delayed or removed from the SHOPP.

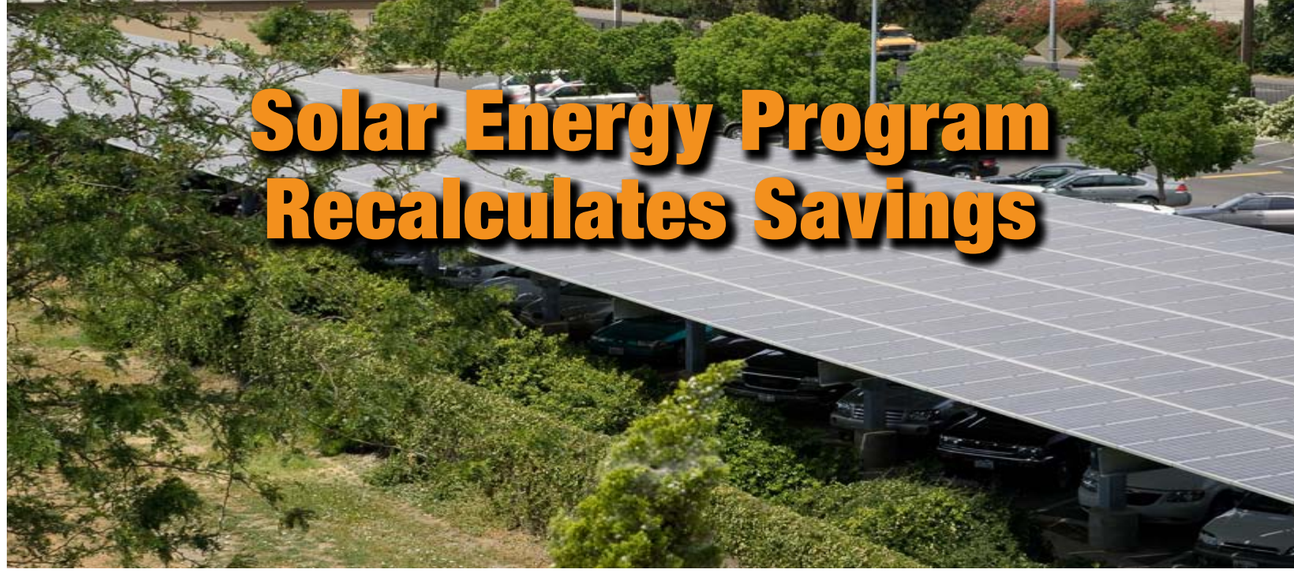
The most notable innovation since the last report is the pilot project to improve SHOPP PIDs. In FY 2013–14, the concept for the Project Initiation Report was developed to create more consistency and autonomous decision-making in the process to develop SHOPP PIDs.

Completed SHOPP PIDs, by Program (FY 2014-15)

SHOPP Program	PIDs Completed in FY 2014-15	Estimated Total Project Cost at Pre-PID (in millions)	Total Cost for Programming in Completed PID (in millions)
Bridge	80	$499	$1,417
Collision Reduction	141	$631	$1,021
Mandates	55	$286	$402
Mobility	35	$219	$356
Roadway/Roadside	132	$1,600	$3,085
Emergency	36	$146	$171
Facilities	3	$25	$23
Total	**482**	**$3,406**	**$6,475**

For details, visit *http://www.dot.ca.gov/docs/2016_Project_Initiation_Document.pdf.*

Solar Energy Program Recalculates Savings



A solar parking canopy was erected in 2007 next to the District 10 administration building in Stockton. It is one of 70 Caltrans photovoltaic projects funded by the Clean Energy Renewable Bonds Program administered by the IRS.

Ten years into a federally funded solar power program, Caltrans reports that installation costs were lower than expected, but so was energy generation. The result, according to a recent report, is that although 48 maintenance stations get their power from the sun, it will take six years longer than predicted for $14 million worth of solar panels to pay for themselves.

The Clean Energy Renewable Bonds (CREBs) Program is administered by the Internal Revenue Service. CREBs are a type of tax credit bond in which interest on the bonds is paid in the form of tax credits by the U.S. government. The proceeds for the issuance of the CREBs are available to finance renewable energy and clean coal facilities projects.

By January 2013, seven years after getting tax-credit bonds approved by the IRS, Caltrans had 70 photovoltaic projects up and running through CREBs, with a handful of significant solar projects outside of the program. Lower-than-expected construction costs and rebates enabled Caltrans to make a prepayment on outstanding CREBs, reducing its bond debt service from about $22.8 million to $12.4 million, according to the CREBs Program 2016 Annual Report released in April.

Despite that savings, after reassessing its actual electricity generation, Caltrans now estimates it will take 21 years, instead of 15, to fund the bond debt service and cost associated with the photovoltaic systems.

Since startup, the department upgraded its monitoring system from monthly manual readings to real-time online monitoring, allowing Caltrans to see that the intensity of light on a surface varies throughout the day, as well as day to day, affecting the output of the photovoltaic energy systems. To obtain a more realistic expectation of the overall system output and economic benefits, calculations were adjusted to consider factors such as standard test conditions, dirt and dust, temperature, sun angle and building orientation.

The original calculations were based on an average of eight hours of sunlight each day. But by following the guidelines of a California Energy Commission report, the average time of sunlight each day, used to calculate future energy production, was revised to approximately five hours each day.

Still, at peak usage, the 70 sites are expected to produce 2.4 megawatts of solar power, enough to power about 500 homes per year. Put another way, it takes 2.1MW to power 344 Caltrans maintenance stations and sand/salt storage sheds throughout the state. It just so happens that 46 of the 70 solar installations are at those maintenance stations.

For the life of the system, it is projected that Caltrans will save approximately $5.3 million. But the program does more than simply save money. It also helps Caltrans meet energy conservation goals and reduce greenhouse gas emissions as outlined in executive orders set by Gov. Edmund G. Brown Jr. Additionally, they support the state's renewable power statutes, "green power," electric grid demand, energy conservation, Leadership in Energy and Environmental Design (LEED) and climate change mandates.

Source: Clean Renewable Energy Bonds Program 2016 Annual Report

Bluetooth Readers

Wirelessly Track Travel Times

The City of South Lake Tahoe had a simple question: Could Caltrans post estimated travel times on its changeable message signs to let travelers know how long it would take them to get back to the Sacramento area?

That's a question with economic implications for the local tourism economy. Visitors faced with a longer-than-usual trip might choose to stay for dinner or even overnight. It is also seen as a key piece to helping Caltrans meet its goal of improving travel time reliability and reducing peak-period travel times and delays – not just in the Sierra Nevada, but statewide. In order to improve travel time reliability, it must first be measured.

The answer was not so straightforward, at least not at first. Like many rural highways, U.S. Highway 50 in the Sierra Nevada lacks the wire loops embedded in pavement that capture travel speeds – a system common in urban areas.

The solution was Bluetooth readers, a technology first devised in Europe and used in the private sector to estimate travel times – and advanced by the Caltrans Division of Research, Innovation, and System Information (DRISI), Division of Traffic Operations, and District 3. Travelers' mobile devices and navigation systems emit signals as they travel along a highway. By capturing these signals anonymously, Caltrans can estimate travel times and post the information on the electronic changeable message signs and on QuickMap, the Caltrans mobile app that provides motorists with real-time travel conditions.

Contrary to a common misconception, Caltrans is not listening to or recording conversations and/or music transmitted over Bluetooth communications devices. The signal is picked up by a small electronic box installed at the roadside and is immediately encrypted at the site and time-stamped then sent to the host server. No personally traceable information is stored on the field unit. The host server resides within Caltrans' secure network.

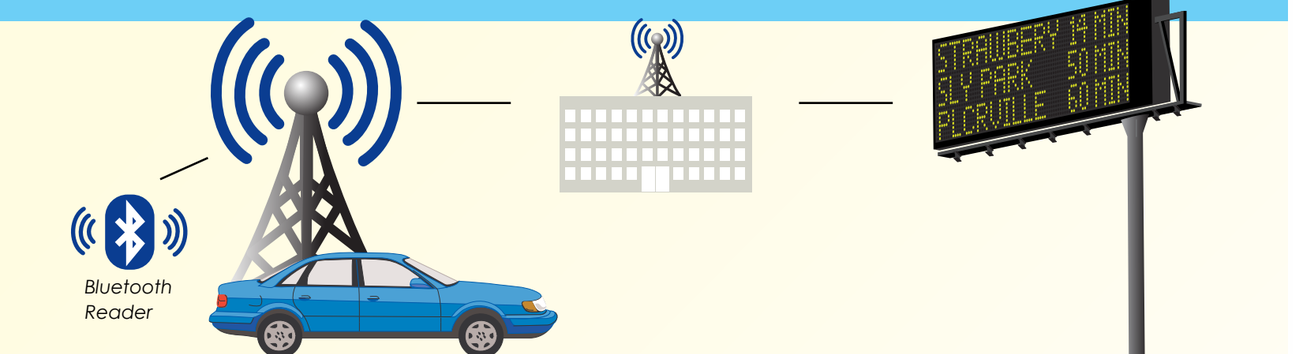
The time it takes for the matching signal to travel from the first field unit to other field units miles down the road is the travel time that is then averaged with the times provided by other vehicles.

For the South Lake Tahoe test project, Bluetooth-sensing equipment was installed at multiple locations along U.S. 50 and software was created to push the information out to QuickMap and the electronic changeable message signs. The test has been successfully running since the Fourth of July weekend in 2015. In fact, an overturned truck that weekend immediately showed the value of the system, which broadcast real-time traffic time of more than three hours between Stateline to Placerville – a distance of 60 miles — while the truck was down.

A Bluetooth listening device assigns a unique address to a passing vehicle and sends an encrypted signal to the traffic management center.

Further down, the vehicle exits the monitored section of highway and the unique address is now matched with the previous signal and a travel time calculation is made.

This information is broadcast on a changeable message sign, which can inform motorists of expected travel times.



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The locations for the Bluetooth equipment were selected based on the availability of existing power, communications, and nearby distance to roadway. Existing Intelligent Transportation System equipment cabinets were used to host the readers. The readers were initially installed by drilling a hole into the top of the cabinet to route the antenna cable, but it was feared the hole would leak over time and would cause severe damage to the electrical equipment in the cabinet. District 3 engineer Gurdeep Sidhu solved that problem by designing a side-mounted bracket that uses the existing cabinet hardware to secure the new bracket, reducing the chance for leakage and reducing the materials and time required to mount the antenna from two hours to 20 minutes.

Quantifying the Benefits

It is difficult to quantify the benefits of posting travel times on changeable message signs, as it is challenging to determine what decisions drivers make when they view them. Qualitatively, on corridors that drivers travel regularly, seeing the posted travel time gives them "peace of mind" that their trip will be reliable. For example, if the posted travel time on the corridor is normally 19 minutes, but today it is 38 minutes, then drivers can be sure that something unusual has occurred.

On corridors where there are alternative routes or modes, drivers could decide to change their travel plans. They could also decide to stop their trip and wait until traffic conditions improve. With these options, drivers help to self-manage the demand on the transportation system, which helps the system operate better. An informed traveler can be a safer and more efficient traveler.

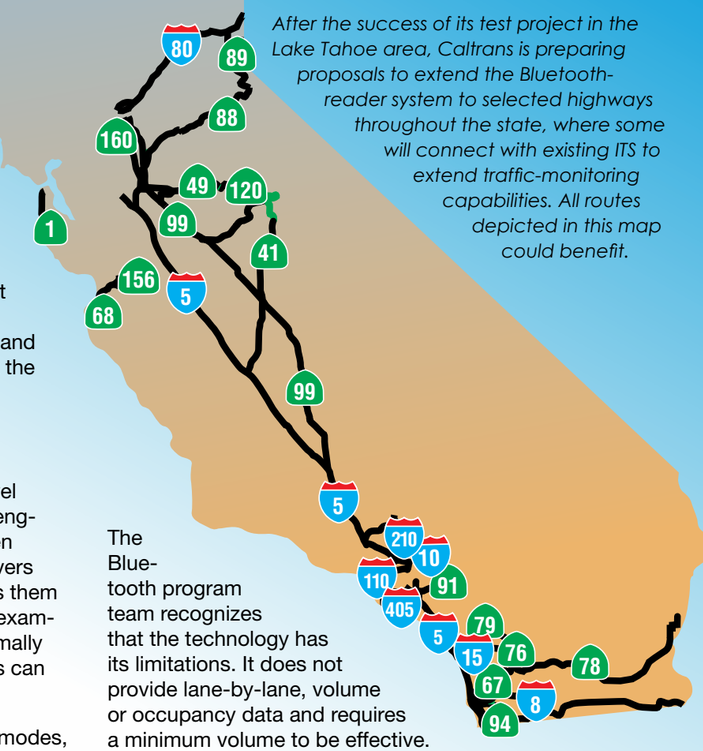
What's Next?

Caltrans thinks the system shows promise. It helps motorists, improves system performance and costs relatively little. Total cost for the U.S. 50 test project was about $150,000, including labor and materials. Initial deployment around the state is estimated to cost about $20 million. Money would come from the State Highway Operation and Protection Program. Proposals are already being prepared.

The Tahoe project, for example, would eventually be connected to State Route 89 north to Interstate 80, then west toward the Bay Area. Various routes through the Central Valley would also be connected, all the way down through southern California and along Interstate 8 near the Mexican border.

Possible Routes for Bluetooth Readers

After the success of its test project in the Lake Tahoe area, Caltrans is preparing proposals to extend the Bluetooth-reader system to selected highways throughout the state, where some will connect with existing ITS to extend traffic-monitoring capabilities. All routes depicted in this map could benefit.



The Bluetooth program team recognizes that the technology has its limitations. It does not provide lane-by-lane, volume or occupancy data and requires a minimum volume to be effective. Also, some devices might be able to block Bluetooth transmissions or can simply be turned off by its user.

Research is now being conducted to determine whether Wi-Fi might be an effective work-around. It is acknowledged that future technologies might make both obsolete, but proving that travel-time data could be obtained wirelessly would ensure that the program will have lasting value.

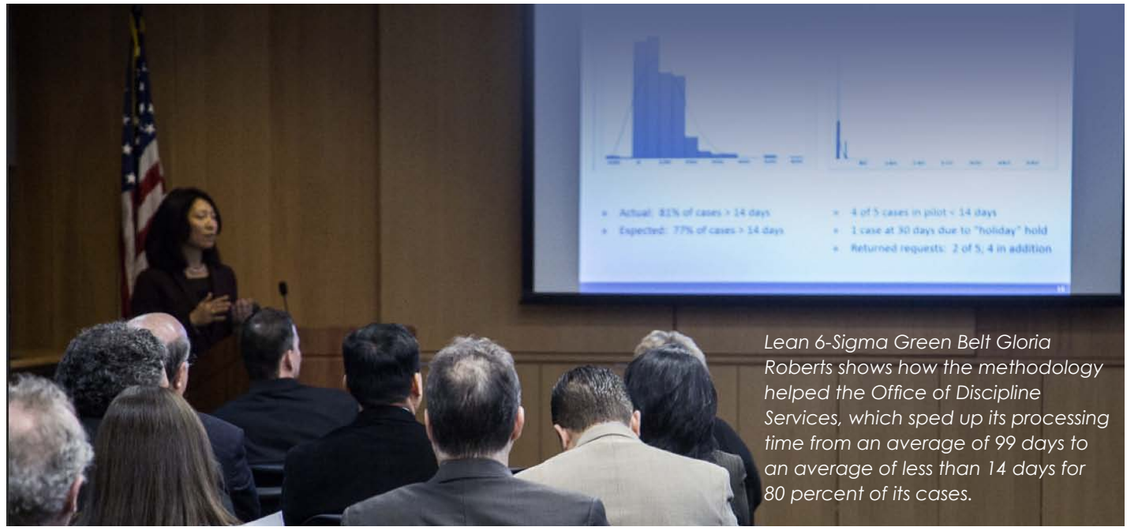
South Lake Tahoe is Already Reaping the Rewards

"We are thrilled with the posted times and information provided to the traveling public," said South Lake Tahoe City Manager Nancy Kerry. "We have encouraged the lodging properties to link to the posting signs and times on the Caltrans website (www.TahoeRoads.com). Now it's a matter of getting the information to the traveling public to encourage them to stay longer, or leave earlier or watch the traffic and adjust their stay accordingly."

Source: Caltrans Division of Traffic Operations and Division of Research, Innovation and System Information

Lean 6-Sigma Helps Projects Exceed Goals

Early use of methodology improves systems, avoids waste



Lean 6-Sigma Green Belt Gloria Roberts shows how the methodology helped the Office of Discipline Services, which sped up its processing time from an average of 99 days to an average of less than 14 days for 80 percent of its cases.

Caltrans was one of the first state departments in California to adopt Lean 6-Sigma, a corporate methodology for improving systems and avoiding waste. Its first projects completed in February already are showing improvements that meet or exceed stated project goals. For example:

- **Reduce the time to develop the scope of work for architectural and engineering (A&E) contracts.** The time from the A&E planning stage to completion of a scope of work and supporting contract documents averaged 111 days and ranged up to 180 days. The process was re-engineered, moving contracts from the planning stage to completing scope of work and other supporting documents in just 29 days.
- **Reduce the time to process A&E contracts.** The time from the date Caltrans' Division of Procurement and Contracts approves a completed scope of work and supporting contract documents to the date the contract is executed averaged 125 days and ranged up to 180 days. The process was simplified and the new estimated time is 45 days.
- **Streamline the safety review process for Caltrans District 12 (Orange County) capital projects.** The safety review process averaged 28.1 working days and has ranged to over 100 working days. This project used many Lean 6-Sigma techniques to streamline the process, and now the process is down to 8.7 days – representing a 69 percent time savings.
- **Improve the quality control practice of documents before they are circulated for approvals.** Project reports can contain an unacceptable number of errors and defects before their circulation for approval. Defects often require numerous resubmittals that waste resources. A sampling of project reports revealed a baseline capability of 12.7 defects per page. The project team focused on reducing the most frequent defects, such as formatting and spelling, and the most critical, such as missing or incorrect data. With the process improvements, defects will be reduced by over 75 percent to less than three defects per page.
- **Reduce the time to process disciplinary actions.** The average processing time of formal disciplinary actions was 99 days, resulting in perceptions of ineffectiveness and unaccountability. Failure to address employee issues also affects morale and disrupts the workplace. Under the reworked process, 80 percent of cases now take less than 14 days.
- **Reduce unreported labor expenses.** In the past, Caltrans had been unable to capture all of its personnel service costs due to employee timesheets that were not submitted or approved. This becomes a problem because Caltrans does not recover costs reimbursed to its programs by federal and local governments for unrecorded personnel service costs. The first stage of implementation showed a 69 percent reduction in unsubmitted timesheets statewide.
- **Reduce time to process "Relocation Agreements" for outdoor advertising displays.** Relocation agreements can take an extremely long time to execute and they did not follow a standard process. This resulted in the average time of more than two years from the date of the request to an initial offer and ranged to four years. The process was standardized, simplified and re-engineered, and the new estimated time to process a relocation agreement is three months.
- **Reduce the time to hire field Maintenance employees.** The hiring process for field maintenance staff was cumbersome and the process could take four to six months. Applying Lean 6-Sigma methodologies reduced the time between a hiring request and an offer of employment to eight weeks.
- **Improve the fleet vehicle and equipment use, replacement and procurement process.** The time from identifying the need for replacement to final replacement approval averaged 243 days and ranged up to 400 days. This process was completely re-engineered, and the time from when the need was identified to the replacement approval was reduced by 95 percent—less than 90 days.

Source: Julie Dunning, Lean 6-Sigma program manager

Caltrans Picks Up Pace in Discrimination Investigations

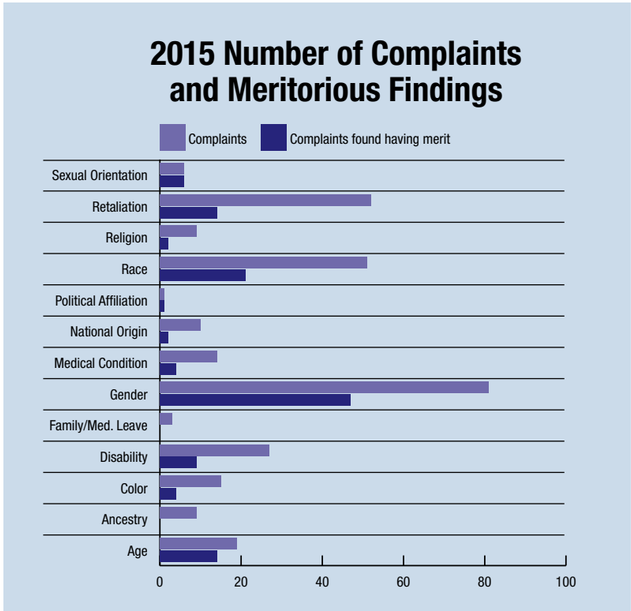
After participating in the Lean 6-Sigma effort, the Equal Employment Opportunity Program (EEOP) showed a 47-percent increase in the number of discrimination complaints it processed, completing 276 investigations in 2015, compared to 188 cases in 2014.

Moreover, investigations that previously took an average of nine to 18 months to complete were being completed within three to six months after opening. Once the program eliminates a backlog of investigations – which is estimated to happen this summer – 95 percent of all complaints are expected to be investigated within 45 business days.

The unit's participation in the Governor's Office of Business and Economic Development (Go-Biz) 2015 Lean 6-Sigma program is being credited for much of that improvement.

By implementing improvements identified through the Lean 6-Sigma process, the DCIU standardized its investigative process and removed multiple steps, thus eliminating inefficiency and saving time. It also devised a new Discrimination Complaint Questionnaire form that serves as a guide for EEO officers, supervisors, managers and employees when filing an EEO complaint. The form also gathers more complete information up front, eliminating unnecessary rework.

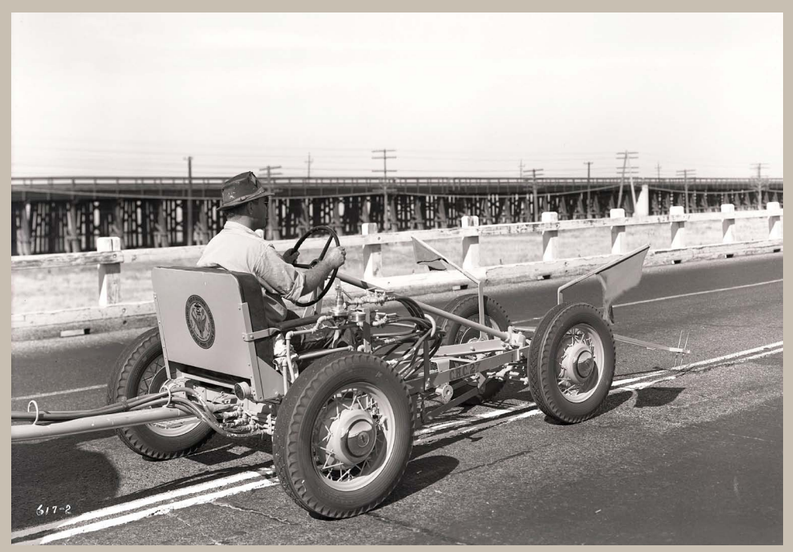
Caltrans, like all state departments, does not discriminate when it comes to legally protected classes such as age, ancestry, color, disability, marital status, medical condition, national or ethnic origin, political affiliation, race, religion, sex or sexual orientation. Caltrans encourages employees to report activity that may violate that policy. In 2015, Caltrans received 202 such complaints.



A single complaint can contain multiple protected groups, Of the 276 completed investigations, 85 concerned violations of the department's EEO policy.

Source: Equal Employment Opportunity Program Review, 2015 (released April 2016)

From the Caltrans Archives



A crew refreshes lane striping on the Yolo Causeway in 1939. When the causeway was completed in 1916, it allowed year-round travel for the first time between the state capital and San Francisco despite the area's regular floods. This causeway, which became part of Interstate 80, was California's first highway project financed by the sale of highway bonds.

Caltrans Districts

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Mile Marker Archives
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QuickMap
http://quickmap.dot.ca.gov

Mission, Vision, Goals
http://www.dot.ca.gov/hq/paffairs/about/mission.htm

Caltrans Social Media
http://www.dot.ca.gov/socialmedia

Reports to the California Legislature
http://www.dot.ca.gov/reports-legislature.htm

2013 10-Year SHOPP Plan
http://www.dot.ca.gov/hq/transprog/SHOPP/prior_shopp_documents/10yr_SHOPP_Plan/2013_Ten_Year_SHOPP_Plan.pdf

Division of Maintenance
http://www.dot.ca.gov/hq/maint

Complete Streets Program
http://www.dot.ca.gov/hq/tpp/offices/ocp/complete_streets.html

Smart Mobility Framework
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