Construction Analysis for Pavement Rehabilitation Strategies

CA4PRS Peer–Exchange Workshop

September 22, 2010

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Institute of Transportation Studies
Univ. of Cal. - Berkeley

AGENDA

CA4PRS Introduction

Schedule Module

Traffic Module

Cost Module

Challenge

AASHTO President (MO-DOT) Transconomy:

- No Transportation=> No Economy

AASHTO Report: “Unlocking Freight” Demand-Supply unbalance (’80-’06)

- 150% more traffic vs 15% highway capacity up
- $63 billion of yearly user delay cost

Freight: Trucks carry 74% of loads

- In 10 years: 1.8 mil more trucks
- In 20 years: 50% trucks than NOW

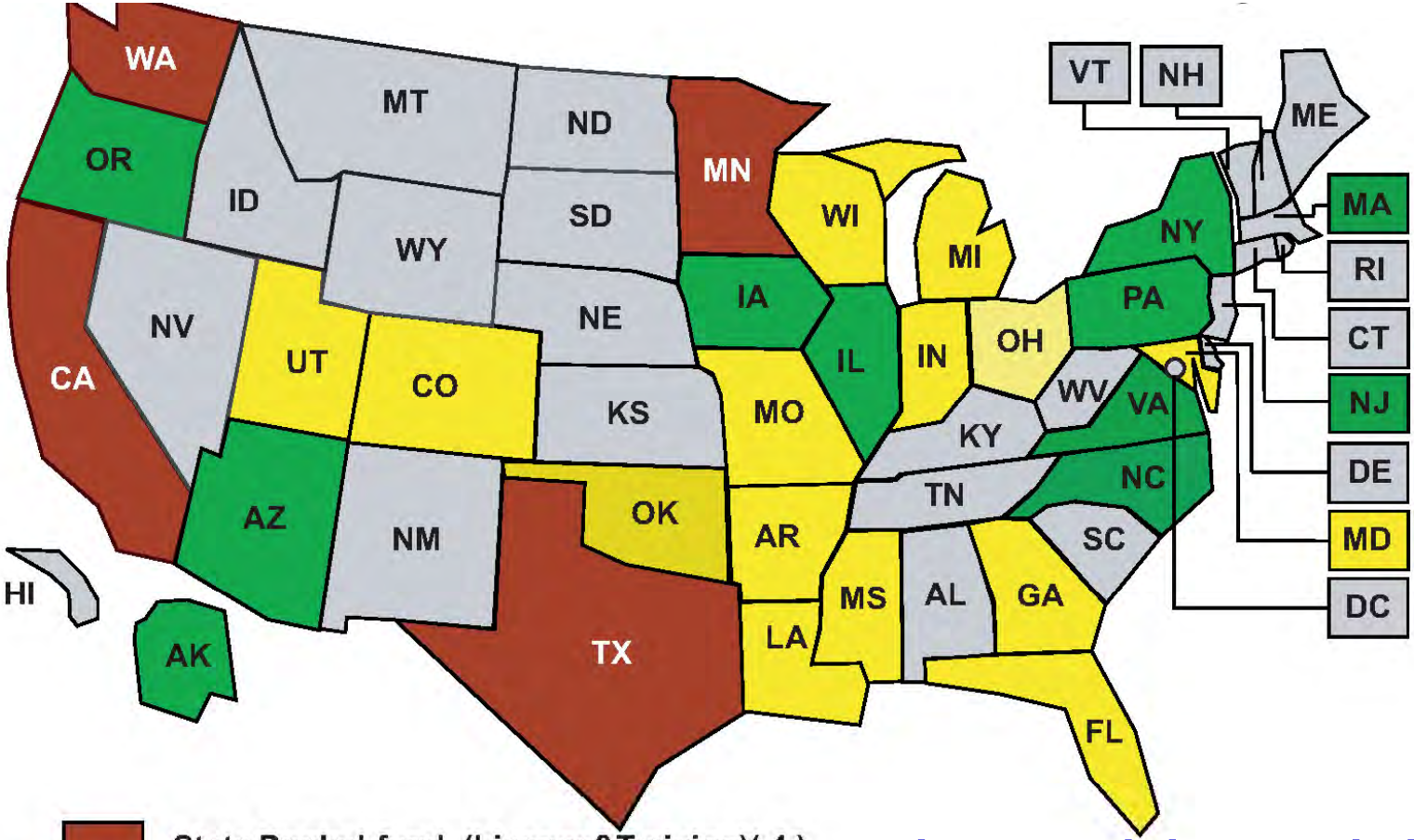
Highway Infrastructure Renewal & Impacts

- **Aging highway infrastructure needs renewal**
  - State DOT 4-R projects; Renewal research-SHRP2
- **How to minimize the Impacts of WZ lane closures?**
  - Quantify impacts to motorists and local businesses
  - FHWA 2008 WZ regulation: 23 CFR Part 630 Subpart J
  - Work-zone mobility and safety
  - State-wide process & project-level procedure: TMP
- **Integration approach: analysis tools to balance**
  - Tolerable traffic delays in WZ
  - Faster construction delivery
  - Longer lasting pavements
  - Affordable agency budget
  - TRB: “Get-in, Get-out & Stay-out”

CA4PRS Software Development and Nationwide Implementation

- CA4PRS software development
  - Pooled-fund (CA, MN, TX, WA): UCB-FHWA-Caltrans
  - Help develop optimum construction-staging plans and TMP
  - Multi-discipline collaboration and teamwork building
- FHWA Outreach
  - 2009 Market-ready Innovation and Technology Product
  - Arranged Free-group License for all 50 State DOTs
  - Trainings: 1,000 Engineers in 20 states, 10 universities
- AASHTO Promotion
  - CAST: WZ Traffic Tools: 2007-2009
  - Exhibit, Presentation: AASHTO Committee, Conference
- 2007 International Road Federation Award

CA4PRS Nationwide Promotion (2010)



State Pooled-fund (License&Training)(4)

State with License&Training (14)

State Wants License&Training (12)

Hands-on Training Workshops:

Caltrans + 20 DOTs => 1,100 engineers

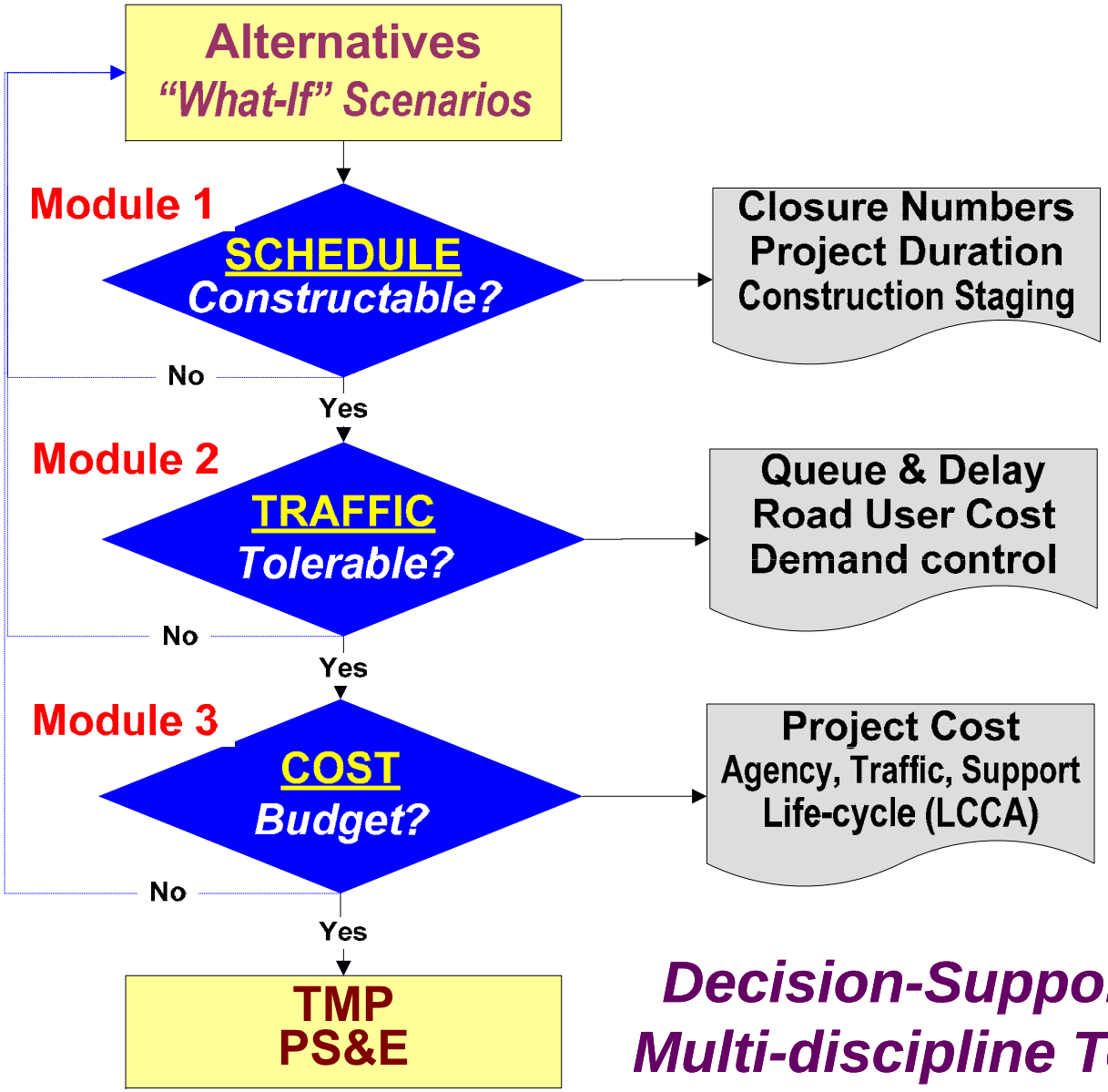
U. S. Department of Transportation
Federal Highway Administration

AASHTO The Voice of Transportation

CA4PRS Implementation Projects

CA DOT (Caltrans) Projects								
No	Route	Location	Type	Project Cost	Savings*	Distance	Year	Status
1	I-10	Pomona, D7	Rehab	$16M	$0.3M	1 mile	2000	Partially adopted
2	I-710	Long Beach, D7	Rehab	$17M	$1M	5 miles	2003	Adopted
3	I-15	Devore-I, D8	Rehab	$16M	$8M	3 miles	2005	Adopted
4	I-15	Devore-II, D8	Rehab	$24M	$4M	5 miles	2007	Adopted
5	I-15	Ontario, D8	Rehab	$59M	$5M	8 miles	2009	Adopted
6	I-280	Santa Clara, D4	CAPM	$20M	$2M	6 miles	2009	Not adopted
7	US-101	San Jose, D4	CAPM	$27M	$3M	7 miles	2009	Partially adopted
8	I-680	San Ramon, D4	Rehab	$70M	$1M	12 miles	2010	Partially Adopted
9	US-101	Ukiah, D1	CAPM	$19M	$2M	6 miles	2010	Partially adopted
10	I-5	Redding, D2	Rehab	$50M	-	14 miles	2011	Not adopted
11	I-80	Sacramento, D3	Rehab	$92M	$3M	9 miles	2011	Partially adopted
12	I-5	Sacramento, D3	Rehab	$88M	-	17 miles	2011	Partially adopted
13	SR-99	Elk Grove, D3	CAPM	$21M	$3.5M	14 miles	2010	Not adopted
14	I-5	Yolo/Colusa, D3	CAPM	$25M	-	24 miles	2010	Not adopted
15	I-5	Stockton, D10	Rehab	$45M	-	3 mile	2012	Adopted
Other State DOT Projects								
16	I-5	Seattle, WA	Rehab	$5	-	2 miles	2005	Verification
17	I-494	St. Paul, MN	Rehab	$10M	-	10 miles	2004	Verification
18	I-15	St. George, UT	Rehab	$16	$2M	8 miles	2010	Adopted
19	I-35	Oklahoma City, OK	Rehab				2010	Verification

CA4PRS Analysis Process

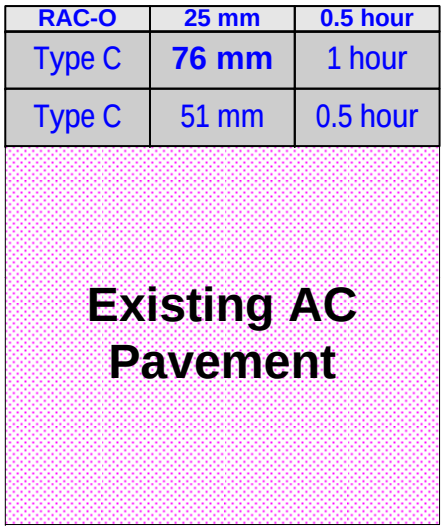


Decision-Support Model
Multi-discipline Team-work

CA4PRS Comparison Alternatives

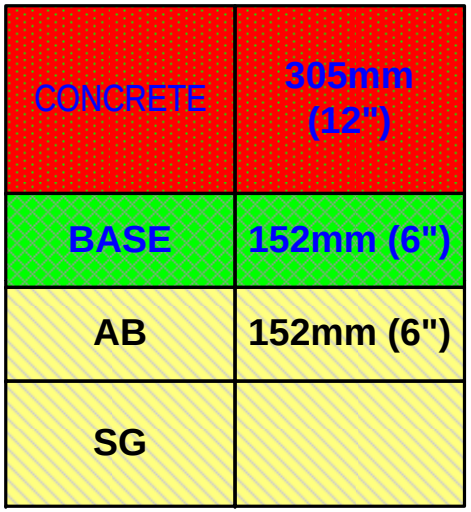
- Pavement Design Alternatives
  - Rehabilitation Strategies
    - ***Rigid: JPCP, CRCP, Precast***
    - ***Flexible: Overlay, Milling-filling AC, Full-depth AC***
  - Variation: Cross-section, Mix, Base type
- Work-zone Traffic Alternatives
  - Construction window: Night, Day, Weekend, Continuous
  - WZ Capacity Sensitivity: Lane width, Geometry, Trucks
  - Demand Sensitivity: No-shows and Detours
- Constructability and Logistics Alternatives
  - Construction trucks: Loading & discharging cycle
  - Construction sequence: Site access
  - Constructability: Demolition methods, and Mix types

Concrete Pavement Cross-sections



(a) Milling Filling AC

OR



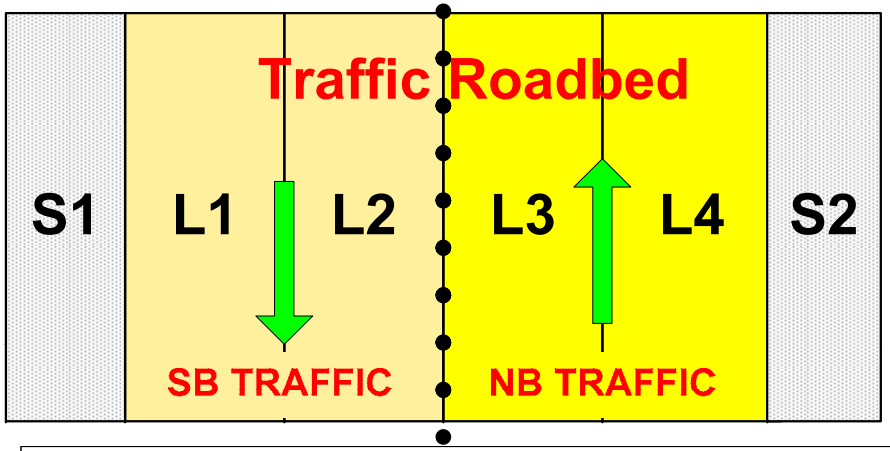
(b) Concrete Slab Replacement

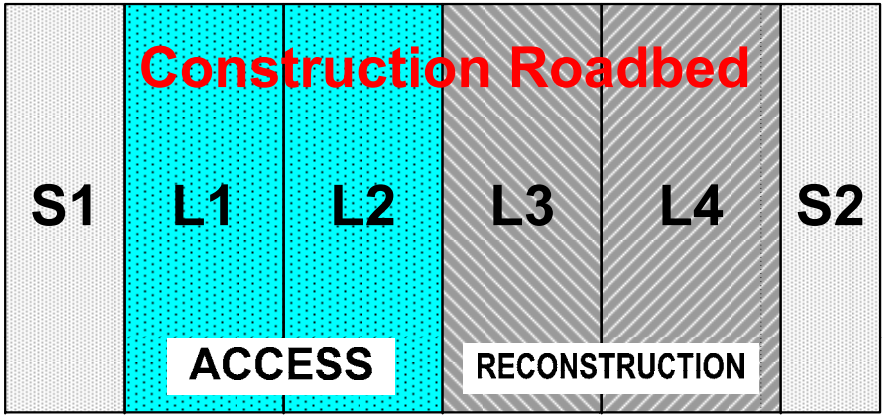
(c) Concrete Slab & Base Reconstruction

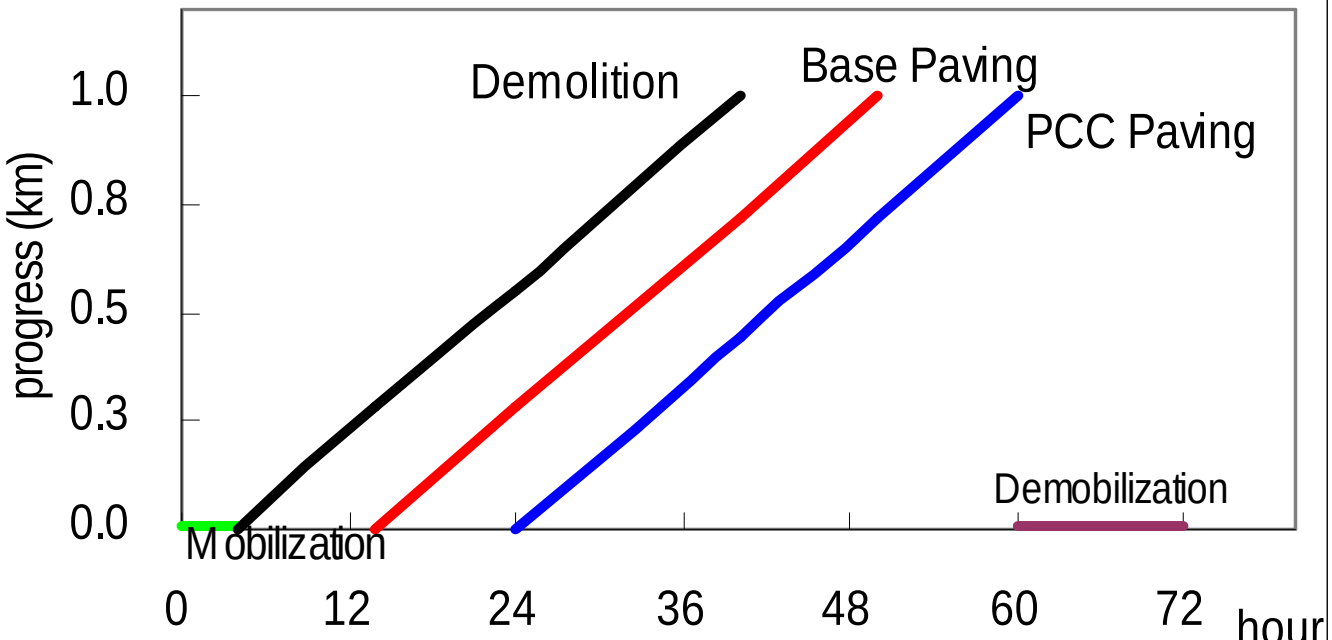
CA4PRS Compares Cross-section Change Alternatives from SCHEDULE-TRAFFIC-COST

Closure <=> Access <=> Production

Full Closure for Concurrent Method







More Closure=>

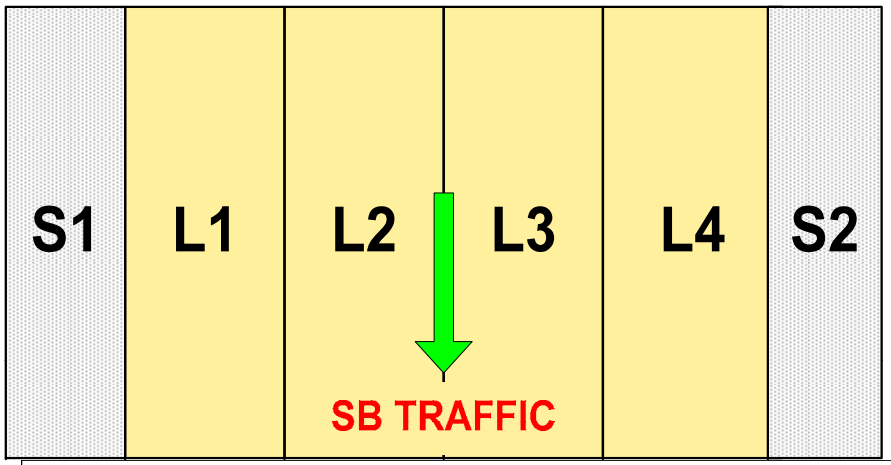
Better Access=>

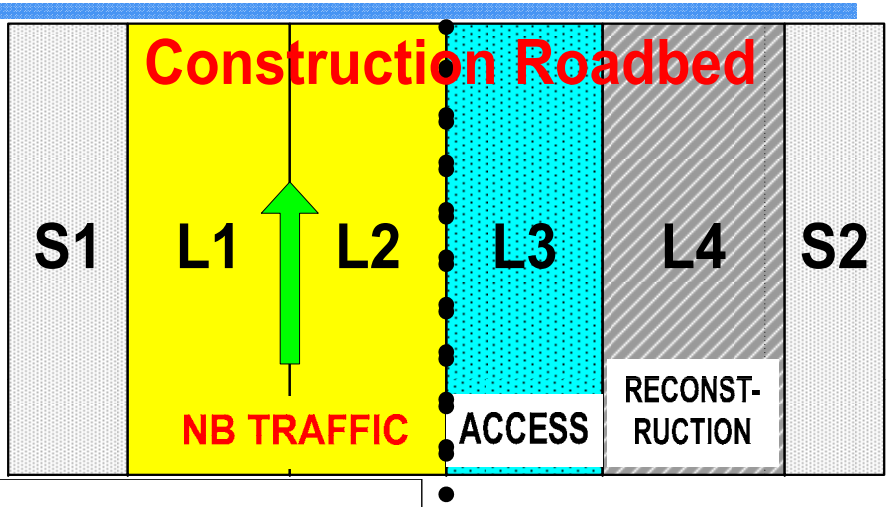
Faster Schedule;

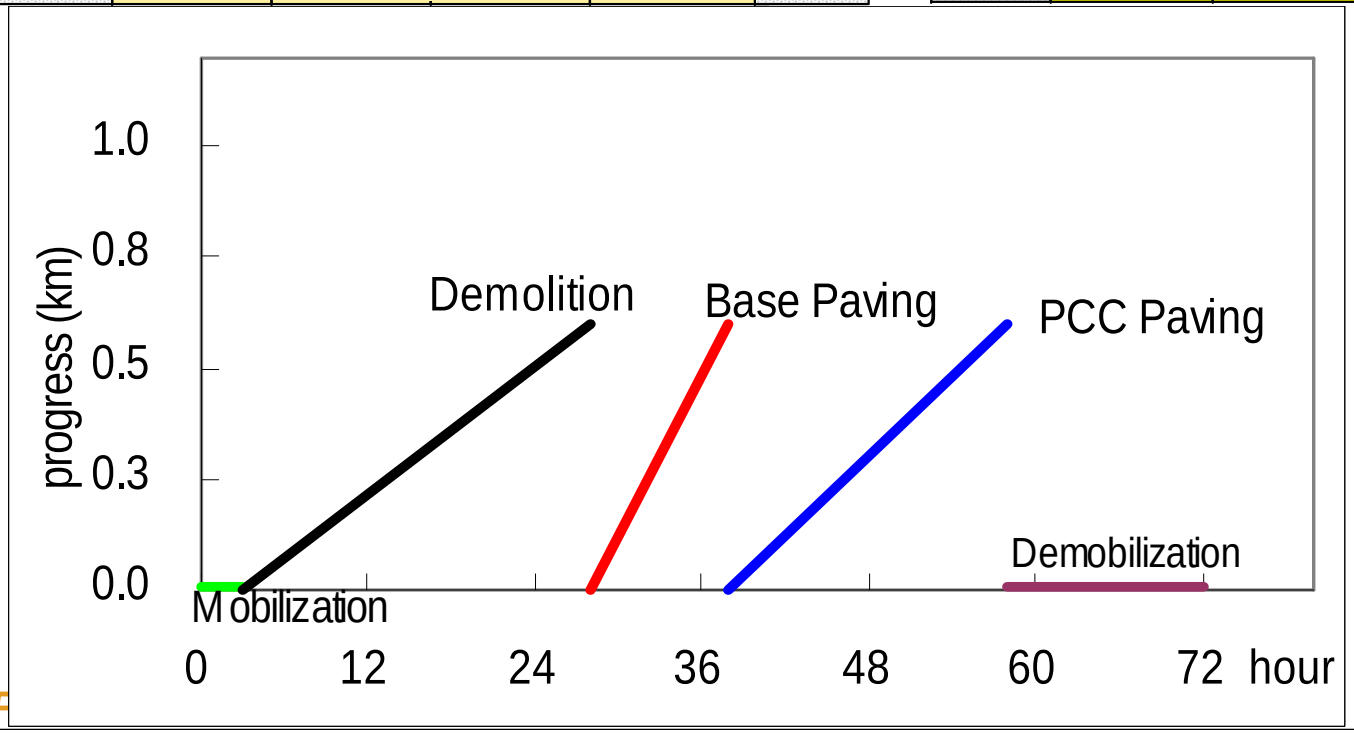
Higher Delay

Closure <=> Access <=> Production

Partial Closure for Sequential Method







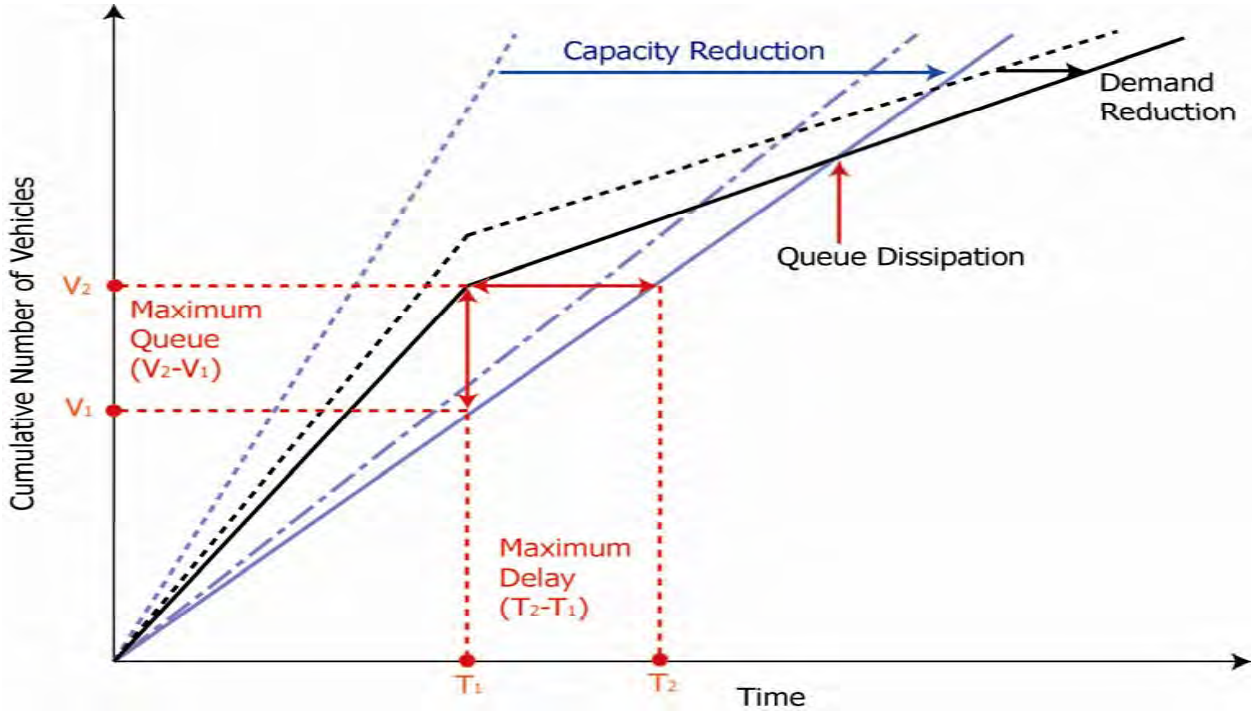
Less Closure=>

Limited Access=>

Slower Schedule

Less Delay

Work-zone Traffic Delay Analysis
Demand-Capacity (Macro-model): HCM 2000

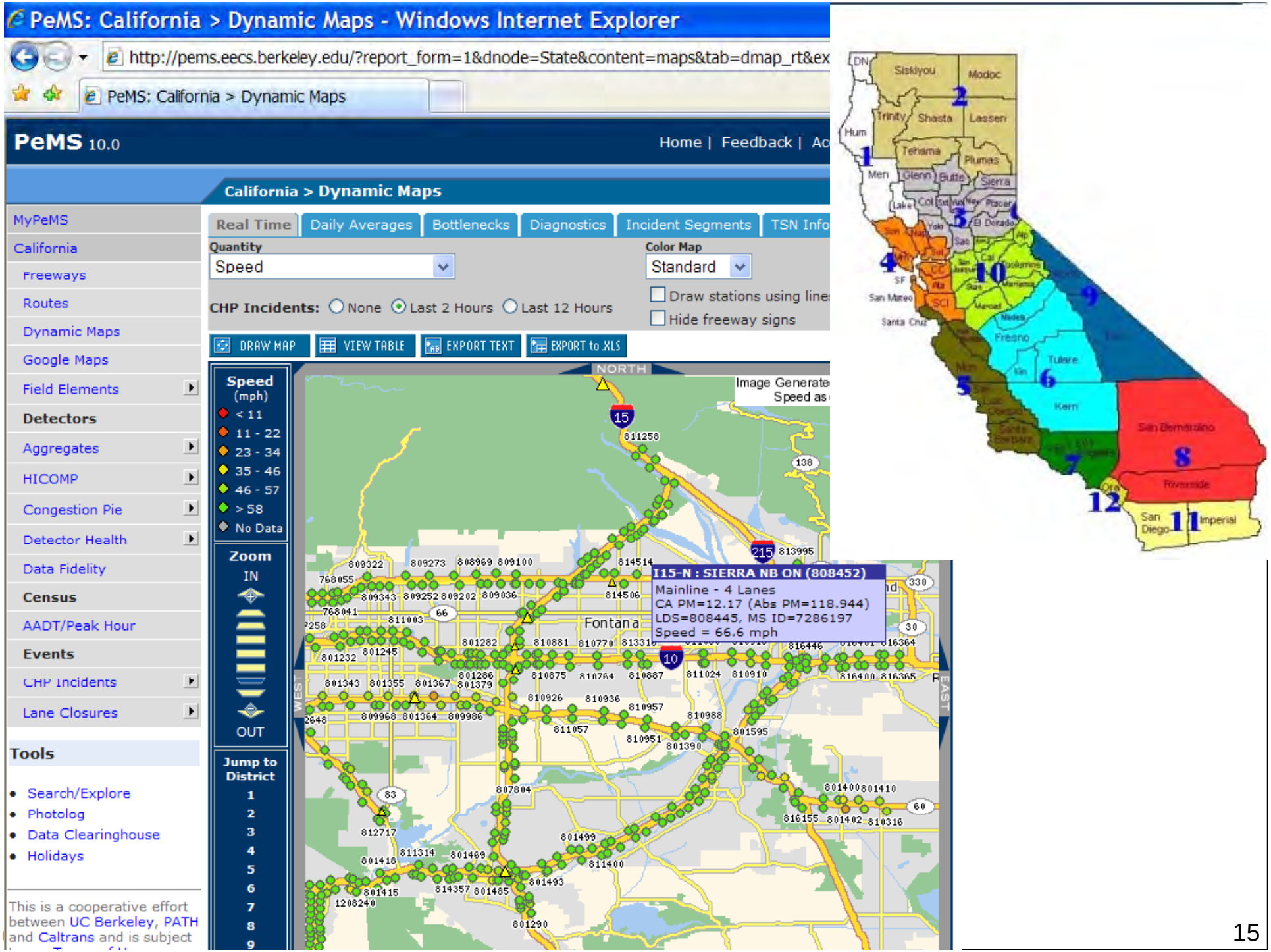


- Road user cost (RUC)
  - Delay cost: Queue-delay (traveler's time value)
  - Vehicle operation costs: maintenance, fuel, emission, crash
  - Detour cost: circuity or diversion (better in network analysis)

13

CA4PRS WZ Traffic Module Inputs & Outputs (HCM Model)

- **Basic Input Data**
  - Closure schedule inputs: from SCHEDULE module
  - 24 hourly traffic volumes
  - Lanes open (closure) schemes
  - User's Time values (vehicle cost)
  - WZ Capacity (Sensitivity) and Demand Management
- Demand-management & Capacity-adjustment
  - Demand reduction: no-shows and detour
  - WZ capacity: Terrain, Truck, lane-width, lateral clearance
- **WZ Impact Analysis Outputs**
  - Max queue length and Max delay per closure
  - Total Road User Cost
- **WZ Analysis Application**
  - Evaluate TMPs and develop Lane closure charts
  - Contract: Incentives/Disincentive & A+B


PeMS: California > Dynamic Maps - Windows Internet Explorer
http://pems.eecs.berkeley.edu/?report_form=1&dnode=State&content=maps&tab=dmap_rt&ex
PeMS: California > Dynamic Maps
PeMS 10.0
Home | Feedback | Ac
California > Dynamic Maps
MyPeMS
California
Freeways
Routes
Dynamic Maps
Google Maps
Field Elements
Detectors
Aggregates
HICOMP
Congestion Pie
Detector Health
Data Fidelity
Census
AADT/Peak Hour
Events
CHP Incidents
Lane Closures
Tools
Search/Explore
Photolog
Data Clearinghouse
Holidays
This is a cooperative effort between UC Berkeley, PATH and Caltrans and is subject
Real Time
Daily Averages
Bottlenecks
Diagnostics
Incident Segments
TSN Info
Quantity
Speed
Color Map
Standard
CHP Incidents: None Last 2 Hours Last 12 Hours
Draw stations using line
Hide freeway signs
DRAW MAP
VIEW TABLE
EXPORT TEXT
EXPORT to XLS
Speed (mph)
< 11
11 - 22
23 - 34
35 - 46
46 - 57
> 58
No Data
Zoom
IN
OUT
Jump to District
1
2
3
4
5
6
7
8
9
NORTH
WEST
EAST
Fontana
I15-N : SIERRA NB ON (808452)
Mainline - 4 Lanes
CA PM=12.17 (Abs PM=118.944)
LDS=808445, MS ID=7286197
Speed = 66.6 mph
Siskiyou
Modoc
Trinity
Shasta
Lassen
Tehama
Plumas
Glenn
Butte
Sierra
El Dorado
Fresno
Tulare
Kern
San Bernardino
Riverside
San Diego
Imperial

PeMS: California > I15-N > 808452 (ML - 4 lanes) > Aggregates - Windows Internet Explore

http://pems.eecs.berkeley.edu/?report_form=1&dnode=VDS&content=loops&tab=det_tod&export=&station_id=80

PeMS: California > I15-N > 808452 (ML - ...

PeMS 10.0 Home | Feedback | A

California > I15-N > 808452 (ML - 4 lanes) > Aggregates

- California
- District 8
- San Bernardino County
- (Unincorporated)
- I15-N
- 808452
- **Detectors**
- Aggregates
- Planning
- Modeling
- TMG Report
- Detector Health
- Data Fidelity
- Inputs
- **Events**
- Lane Closures

Tools

- Search/Explore
- Photolog
- Data Clearinghouse
- Holidays

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Timeseries | Time of Day | Day of Week | Quantity Relationships

From: Jun 1 2009 To: Jun 30 2009

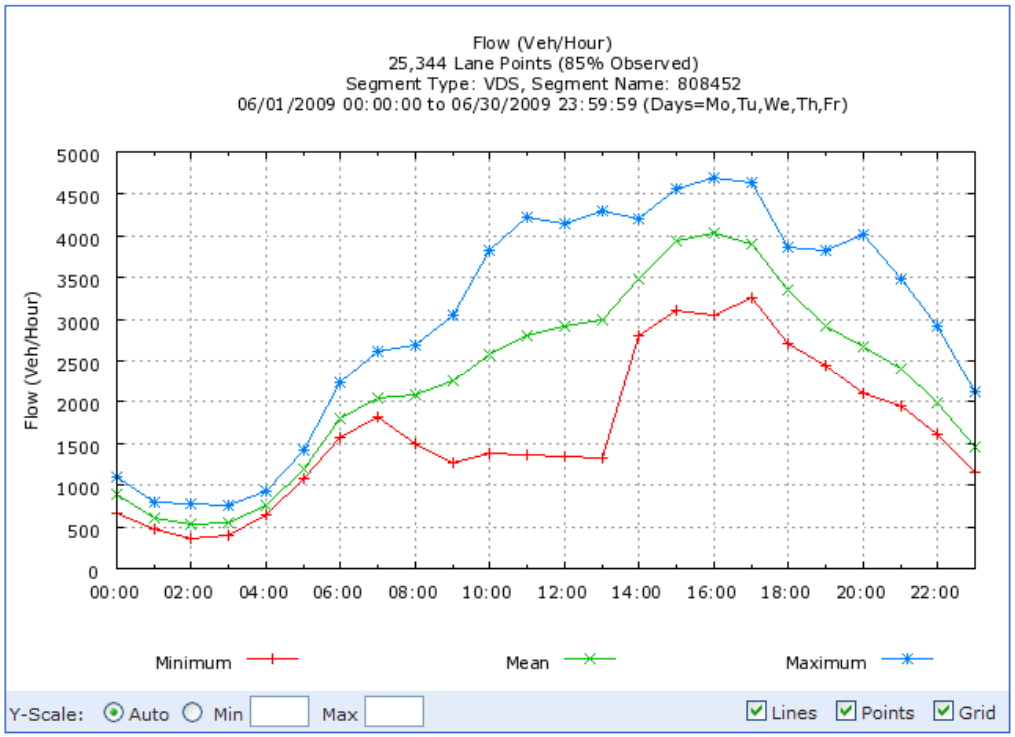
Max Range: 1 month

Include Days: Su Mo Tu We Th Fr Sa Holidays

Quantity: Flow

Statistics: Mean, Min, Max / Mean, Mean+σ,Mean-σ / Median, 25 %, 75 % / Discrete Days

DRAW PLOT | VIEW TABLE | EXPORT TEXT | EXPORT to XLS



Y-Scale: Auto Min Max Lines Points Grid

Microsoft Excel - pems_output[1].xls

File Edit View Insert Format Tools Data

C1 Mean

	A	B	C	D
1	Time	Minimum	Mean	Maximum
2	0:00	662	892	1,093
3	1:00	466	609	796
4	2:00	351	528	778
5	3:00	399	545	757
6	4:00	649	752	923
7	5:00	1,077	1,201	1,414
8	6:00	1,565	1,790	2,233
9	7:00	1,819	2,055	2,618
10	8:00	1,503	2,076	2,687
11	9:00	1,268	2,253	3,044
12	10:00	1,383	2,580	3,834
13	11:00	1,360	2,805	4,218
14	12:00	1,349	2,908	4,146
15	13:00	1,335	2,995	4,291
16	14:00	2,806	3,481	4,203
17	15:00	3,102	3,946	4,563
18	16:00	3,056	4,037	4,688
19	17:00	3,266	3,906	4,636
20	18:00	2,714	3,345	3,871
21	19:00	2,437	2,908	3,831
22	20:00	2,101	2,677	4,023
23	21:00	1,943	2,402	3,480
24	22:00	1,602	1,997	2,908
25	23:00	1,154	1,456	2,113

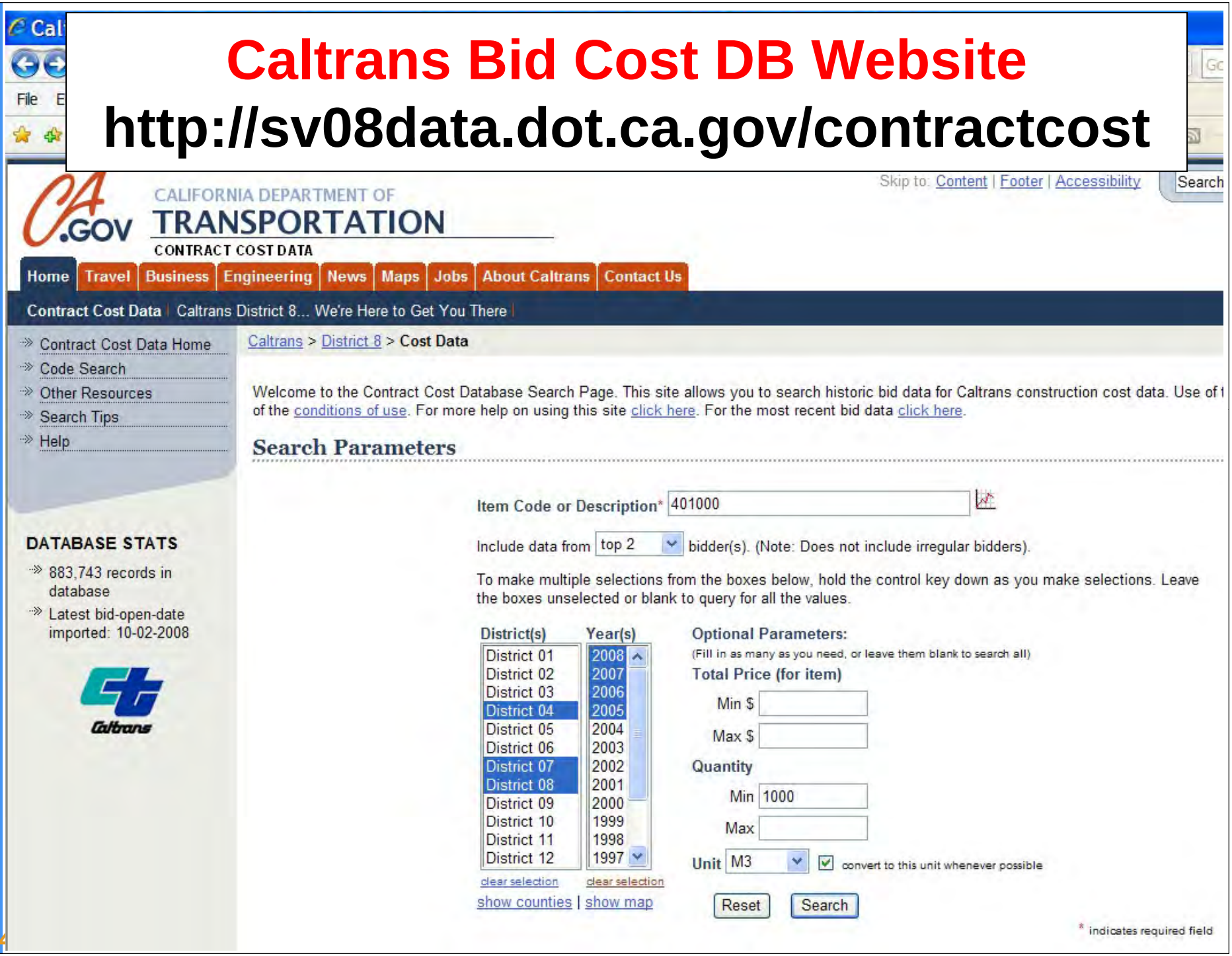
CA4PRS Estimate
Agency (Project) Cost

- Pavement Cost: Itemized unit-price and Qty
  - Materials (PCC, HMA, RAC, Pre-cast), Base, Subbase
  - Item unit-price from Bid-database
- Non-pavement Cost: % of Construction-cost
  - Earth work cost; Drainage cost
  - Specialty (Retaining/Barrier), Storm-water (SWPPP)
- Traffic Cost
  - TMP (COZEEP, I/D) and Traffic-handling, Outreach
- Indirect Cost: % of Construction-cost
  - Minor, Mobilization, Supplemental, Contingency
  - Supporting: Agency (Plan, Design, Traffic, Construction)
- Other Optional Cost
  - Structure and ROW

=> Project Cost

Caltrans Bid Cost DB Website

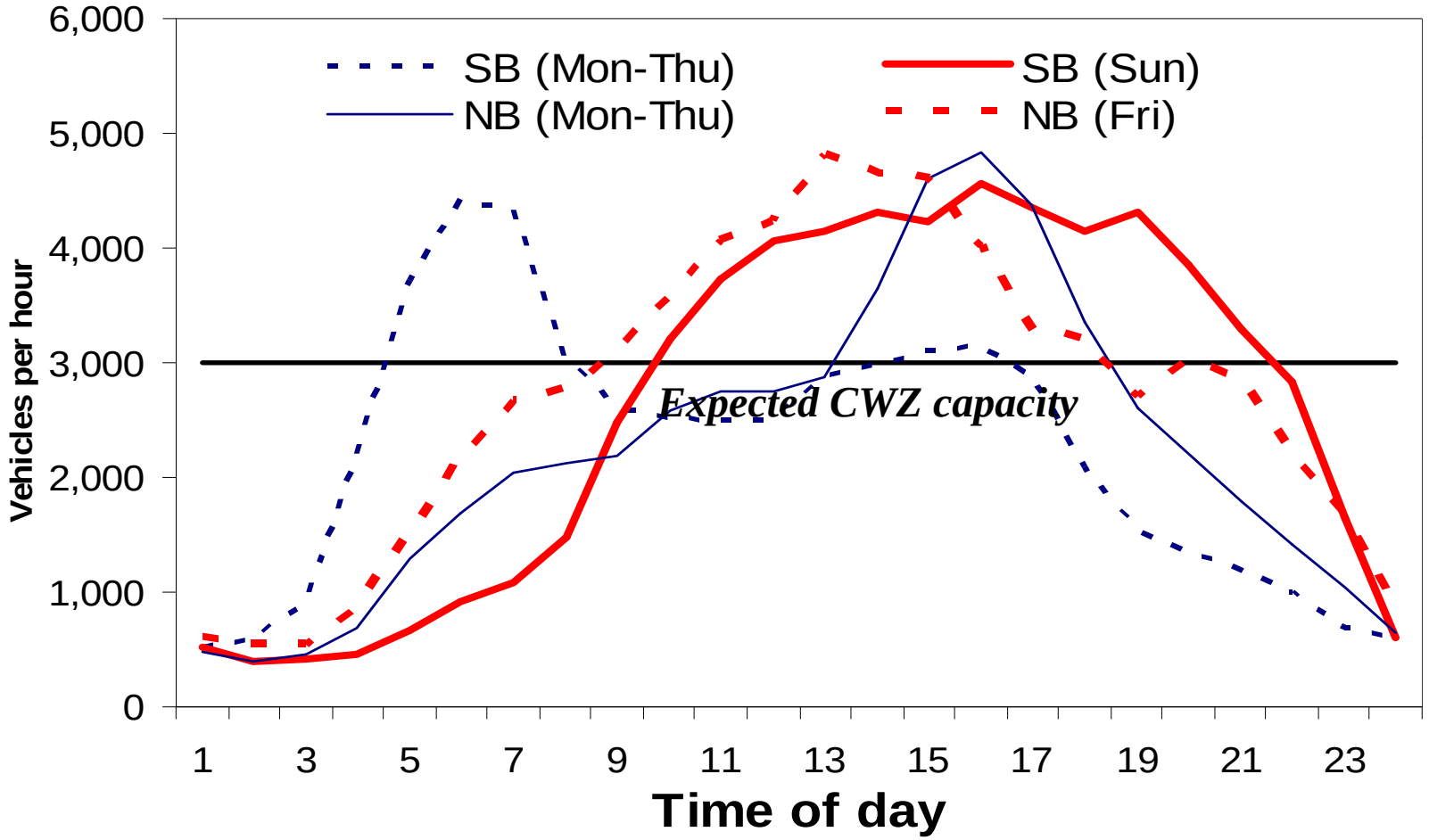
http://sv08data.dot.ca.gov/contractcost



I-15 Devore PCC Reconstruction Project, 2005

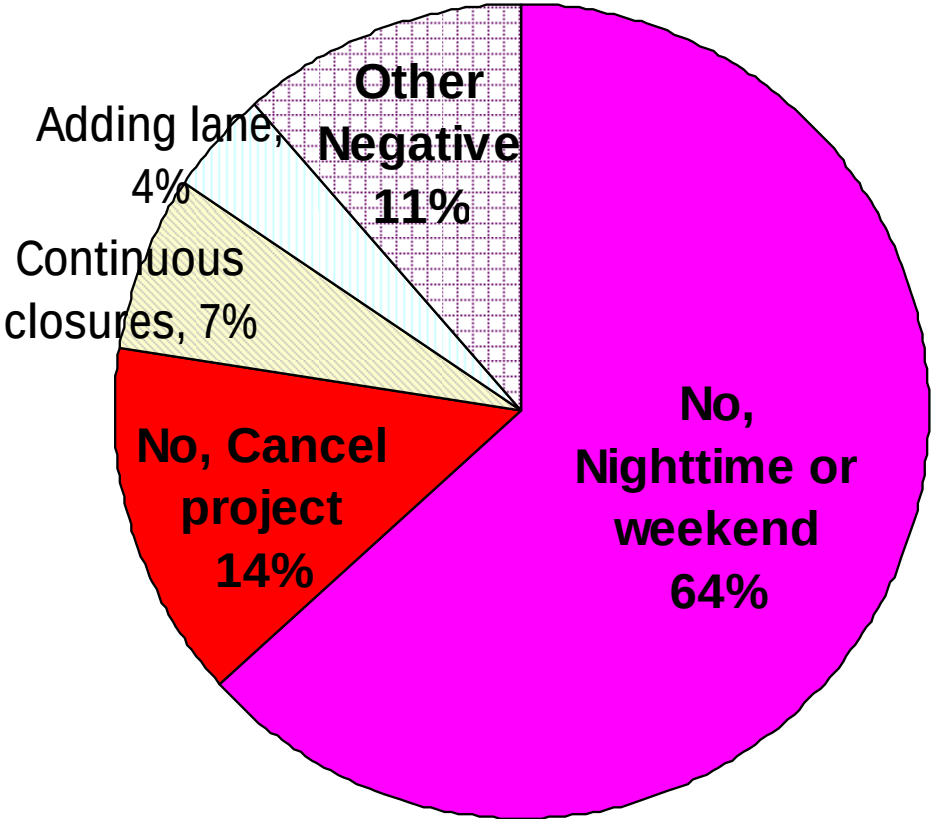
I-15 Devore Daily Traffic Patterns

- Approximately 120,000 ADT (10% trucks)
- Weekdays Commuters + Weekend Leisure



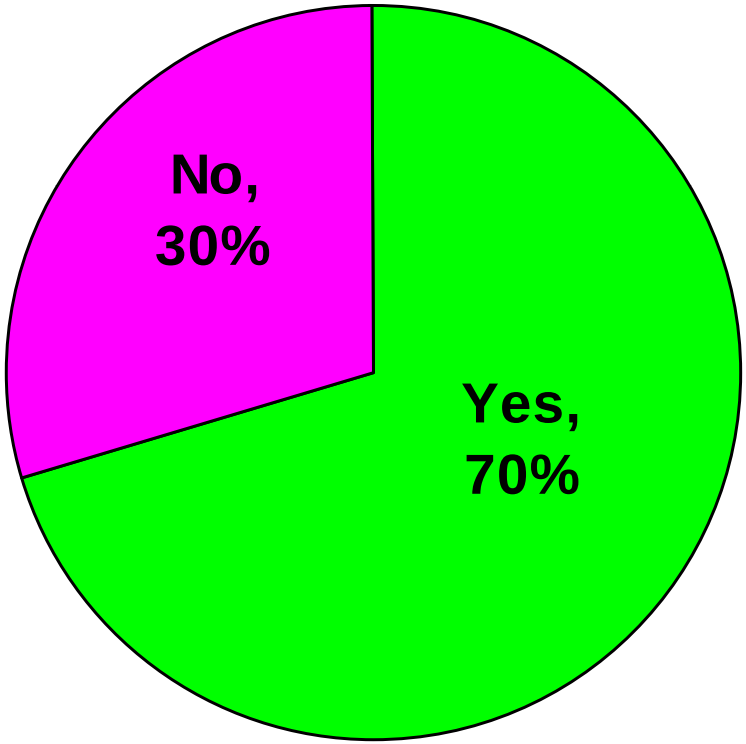
I-15 Devore Web-Surveys
Public Perception Changes

Before- construction



Do you support 72-h (3-weekday) Weekday closures?

After-construction



Do you support future "Rapid-Rehab" projects?

CA4PRS on the Web (CD)

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- Site Index

Click Here to Access CA4PRS Software
This is free for Caltrans only. Installation password is provided on the DRI Intranet.

Implementation

Caltrans > DRI Home > Roadway > CA4PRS

Construction Analysis for Pavement Rehabilitation Strategies
Caltrans "Rapid Rehab" Software

A Decision-Support Tool to Integrate Design, Construction, and Traffic for Highway Projects

Development Background

State transportation agencies are increasingly shifting their focus from constructing new highways to rehabilitating and reconstructing existing facilities. Because highway rehabilitation projects often cause congestion, safety problems, and limited access for road users, agencies face a challenge in finding economical ways to rehabilitate deteriorating roadways in metropolitan areas while keeping the traveling public as safe as possible and minimizing disruptions for local communities and surrounding businesses.

One innovation in the effort to reduce highway construction time and its impact on traffic is software called CA4PRS, Construction Analysis for Pavement Rehabilitation Strategies. CA4PRS is a schedule and traffic analysis tool that helps planners and designers select effective, economical rehabilitation strategies. Funded through an FHWA (Federal Highway Administration) pooled-fund, multistate consortium (California, Minnesota, Texas, and Washington). CA4PRS was developed by the University of California Pavement Research Center (UCPRC) through the UC Berkeley Institute of Transportation Studies. FHWA formally endorsed CA4PRS as a "Priority, Market-Ready Technologies and Innovations" product in 2008 for national wide deployment. Caltrans IT recently added CA4PRS into the standard software list for its statewide implementation.

http://www.dot.ca.gov/hq/research/roadway/ca4prs/index.htm

CA4PRS Implementation in Project Life Cycle Process

- Planning Stage (PSR/PA&ED): Scope and Priority
  - VE Analysis and Life-cycle Cost Analysis
- Design Stage: PS&E & TMP packages
  - Working-days (CPM); Construction staging plans
  - TMP Report and Lane closure charts
- Construction Stage
  - Validate contractor's work-plans and CCO
- Upcoming Enhancement Modules
  - Currently V2.5: Schedule-Traffic-Cost for M & R
  - V3.0 Roadway Widening Module
  - V3.5 Bridge Replacement Module
  - V4.0 LCCA Interaction Module

More CA4PRS Information?

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    - 202-366-6503; Ken.Jacoby@dot.gov
  - Dr. Nadarajah Sivaneswaran (Siva): FHWA Turner-Fairbank
    - (202) 493-3147; n.sivaneswaran@dot.gov
  - Michael Samadian: Caltrans Research
    - (916) 324-2048; Michael_M_Samadian@dot.ca.gov

I-15 Devore Pre-construction Analysis

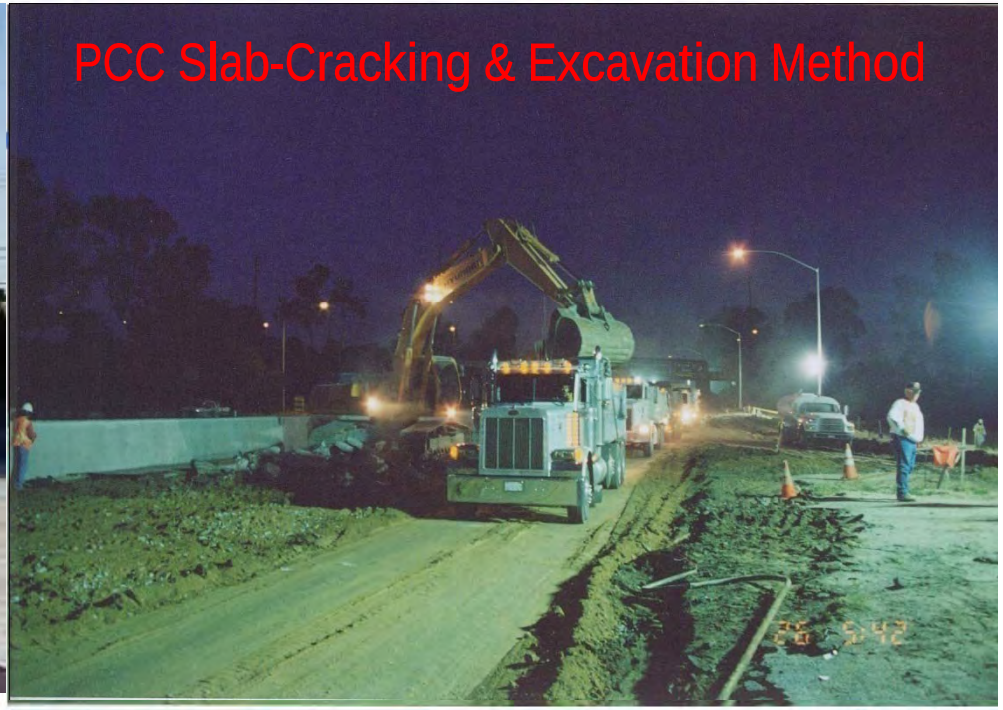
CA4PRS Schedule-Traffic-Cost Comparison

Construction Scenario	Construction Schedule		WZ Traffic Delay		Cost	
	Total Closures	Closure Hours	Max. Delay(Min)	Delay (RUC) Cost ($M)	Agency Cost ($M)	Total Cost ($M)
One Roadbed Continuous (24/7)	2	400	80	5.0	25.0	30.0
72-Hour Weekday Non-stop	8	576	50	8.0	26.0	34.0
55-Hour Weekend Extended	16	880	80	14.0	27.0	41.0
9-Hour Nighttime Closures	230	2,100	50	7.0	31.0	38.0
8-Hour Nighttime Closures	300	2,400	20	3.0	33.0	36.0
7-Hour Nighttime Closures	410	2,900	10	1.0	35.0	36.0

Constructability Inputs: Truck-numbers for Demolition and Mix-type

PCC Slab Saw-cut & Lift Method

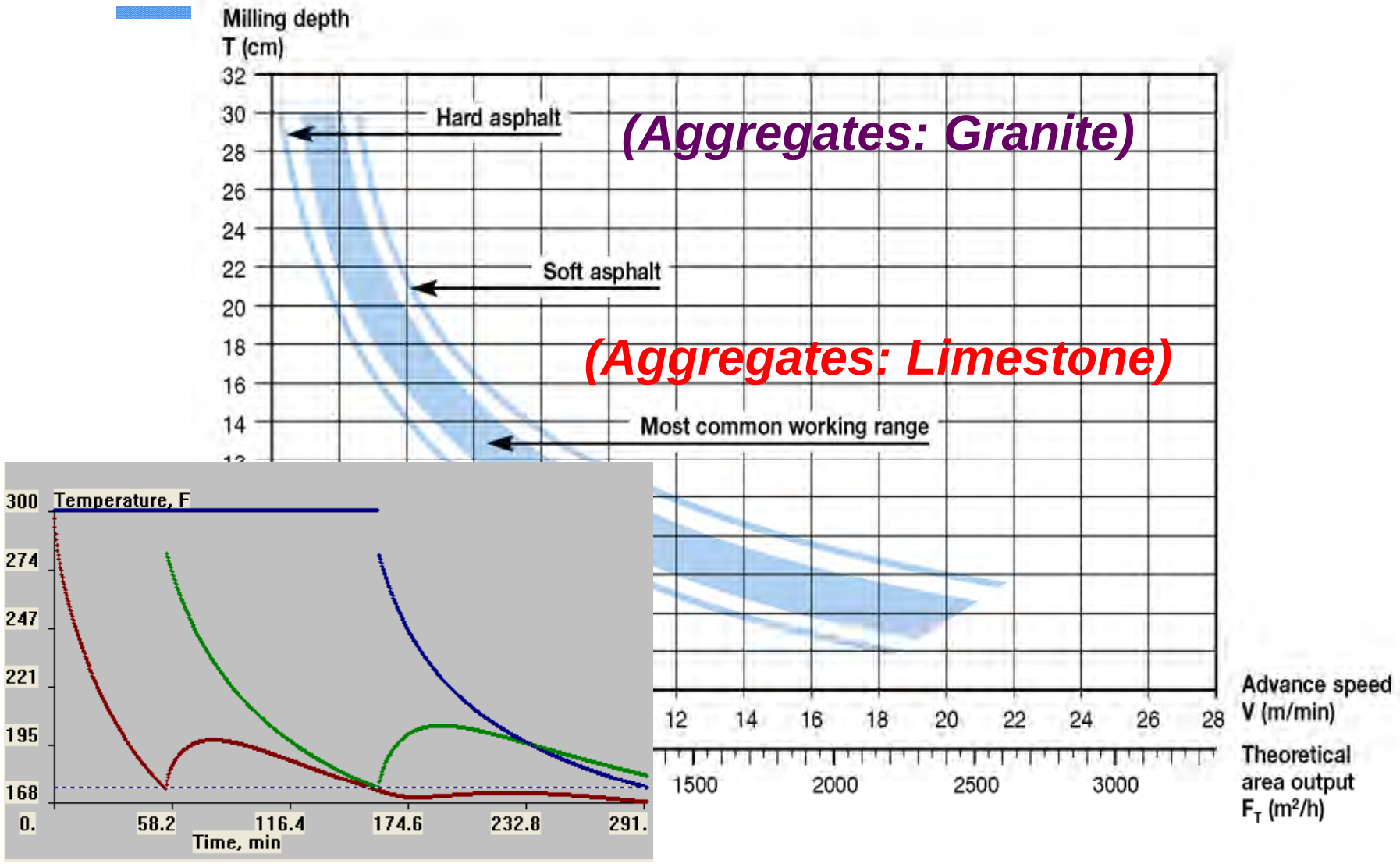
PCC Slab-Cracking & Excavation Method



FSHCC (Nighttime): Ready-mixer Truck

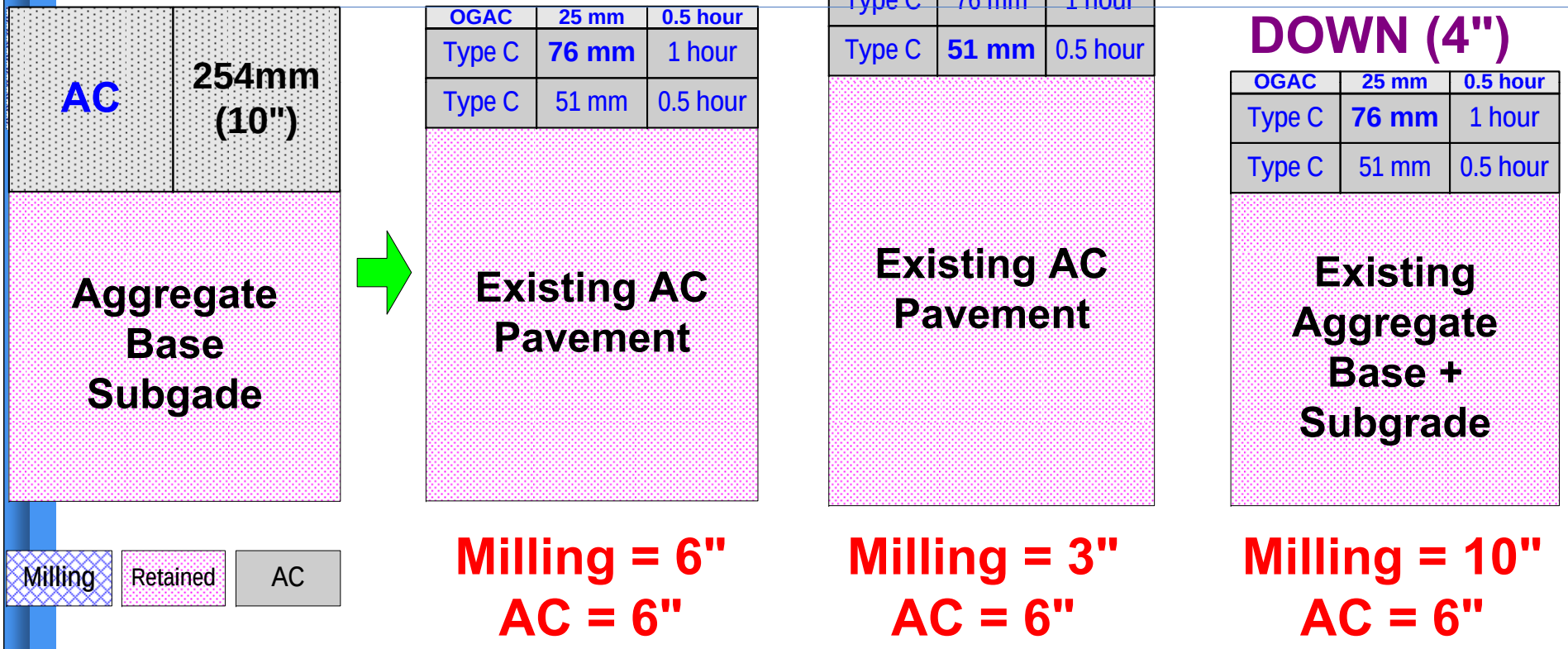
PCC or RSC: End-dump Truck

Milling (Cold-plane) **Production Trend**



(Wirtzen W1900 Model)

Roadway Elevation Change
No-, Up-, or Down-elevation



CA4PRS Inputs Range

Summary Table: CA4PRS Inputs Guideline (2010)

Input Window	Parameters	Nighttime Closures	Extended Closures
Project Details	Objective / Scope (lane-mile)	Sum of [distance x lane numbers x direction] Ex: 20 lane-mile = 5 mile stretch x 2 lanes x 2 direction	
Activity Constraints	Mobilization (hour)#	0.5 – 1.0	2 - 3
	Demobilization (hour)^	2 - 4	4 - 6
	Lag time (hour)	-1 – 2 (Sequential)	9 - 10 (Concurrent)
Resource Profile	Demolition Hauling Trucks (size=24 ton)* / Hour	6 (CRCP) 8 (slab-lift) 9 (Cracking) 10 (Milling)	8 (CRCP) 10 (slab-lift) 12 (Cracking) 12 (Milling)
	Demolition Packing Efficiency	0.5 (Slab-lift) 0.6 (Cracking) 0.75 (Milling)	0.5 (Slab-lift) 0.6 (Cracking) 0.75 (Milling)
	Demolition Team Numbers	1	2
	Concrete Delivery Truck* (size=8- 9.5 CY) / Hour	8 (FSHCC) 10 (CRCP) 10 (RSC/JPCP)	10 (FSHCC) 12 (CRCP) 15 (RSC/JPCP)
	HMA Delivery Truck *(size=24 ton) / Hour	10	12
	Base Delivery Truck* (size=8 CY) / Hour	8	10
	[illegible] Capacity / Hour	110 CY (PCC) 300 ton (HMA)	135 CY (PCC) 400 ton (HMA)
	Paver Speed / Minute	1.5 feet (PCC)	7 feet (PCC)
	Milling AC Material Type Milling-Down Efficiency	Soft or Medium (Limestone); Medium or hard (Granite) 0.75	
	Rebar (CRCP) Hourly Install	100 0 – 1,500 SF	2,500 – 3,000 SF
	[illegible] (Precast) Install	300-600 SF	500-1,000 SF
	[illegible] Install / Hour	3-6	5-10
Work-zone Traffic	WZ Speed Limit (mph)	50	55
	Roadway Capacity (vphpl)	1,800 (TWO-lane HWY); 2,200 (Multi-lane HWY)	
	WZ Capacity (vphpl)	1,200 (Single-lane Open); 1,600 (Multi-lane Open)	
	Vehicle Cost ($/hour)	11.51 (car) 27.83 (truck)	9 (car) 27.83 (truck)

Summary Table: CA4PRS Inputs Guideline (2010)

Input Window	Parameters	Nighttime Closures	Extended Closures
Project Details	Objective / Scope (lane-mile)	Sum of [distance x lane numbers x direction] Ex: 20 lane-mile = 5 mile stretch x 2 lanes x 2 direction	
Activity Constraints	Mobilization (hour)#	0.5 – 1.0	2 - 3
	Demobilization (hour)^	2 - 4	4 - 6
	Lag time (hour)	-1 – 2 (Sequential)	9 - 10 (Concurrent)
Resource Profile	Demolition Hauling Trucks (size=24 ton)* / Hour	6 (CRCP) 8 (slab-lift) 9 (Cracking) 10 (Milling)	8 (CRCP) 10 (slab-lift) 12 (Cracking) 12 (Milling)
	Demolition Packing Efficiency	0.5 (Slab-lift) 0.6 (Cracking) 0.75 (Milling)	0.5 (Slab-lift) 0.6 (Cracking) 0.75 (Milling)
	Demolition Team Numbers	1	2
	Concrete Delivery Truck* (size=8- 9.5 CY) / Hour	8 (FSHCC) 10 (CRCP) 10 (RSC/JPCP)	10 (FSHCC) 12 (CRCP) 15 (RSC/JPCP)
	HMA Delivery Truck *(size=24 ton) / Hour	10	12
	Base Delivery Truck* (size=8 CY) / Hour	8	10
	Batch Plant Capacity / Hour	110 CY (PCC) 300 ton (HMA)	135 CY (PCC) 400 ton (HMA)
	Paver Speed / Minute	1.5 feet (PCC)	7 feet (PCC)
	Milling AC Material Type Milling-Down Efficiency	Soft or Medium (Limestone); Medium or hard (Granite) 0.75	
	Rebar (CRCP) Hourly Install	100 0 – 1,500 SF	2,500 – 3,000 SF
	Bedding (Precast) Install	300-600 SF	500-1,000 SF
	Precast Panel Install / Hour	3-6	5-10
Work-zone Traffic	WZ Speed Limit (mph)	50	55
	Roadway Capacity (vphpl)	1,800 (TWO-lane HWY); 2,200 (Multi-lane HWY)	
	WZ Capacity (vphpl)	1,200 (Single-lane Open); 1,600 (Multi-lane Open)	
	Vehicle Cost ($/hour)	11.51 (car) 27.83 (truck)	9 (car) 27.83 (truck)

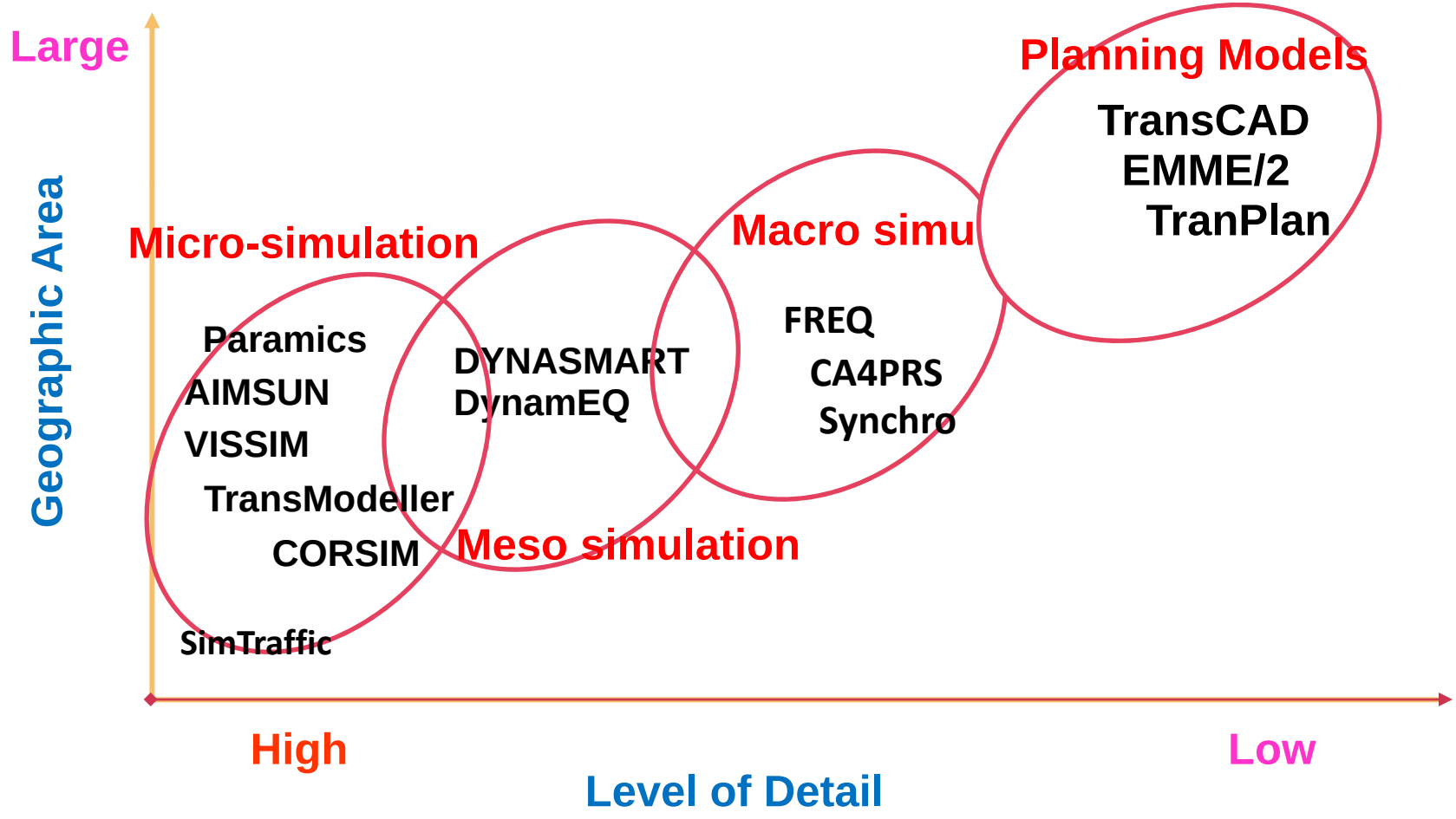
I-15 Devore WZ Capacity: Full-closure Dynamic Lane Configuration Using QCMB

QCMB Operation Video

Classification of Traffic Analysis Models

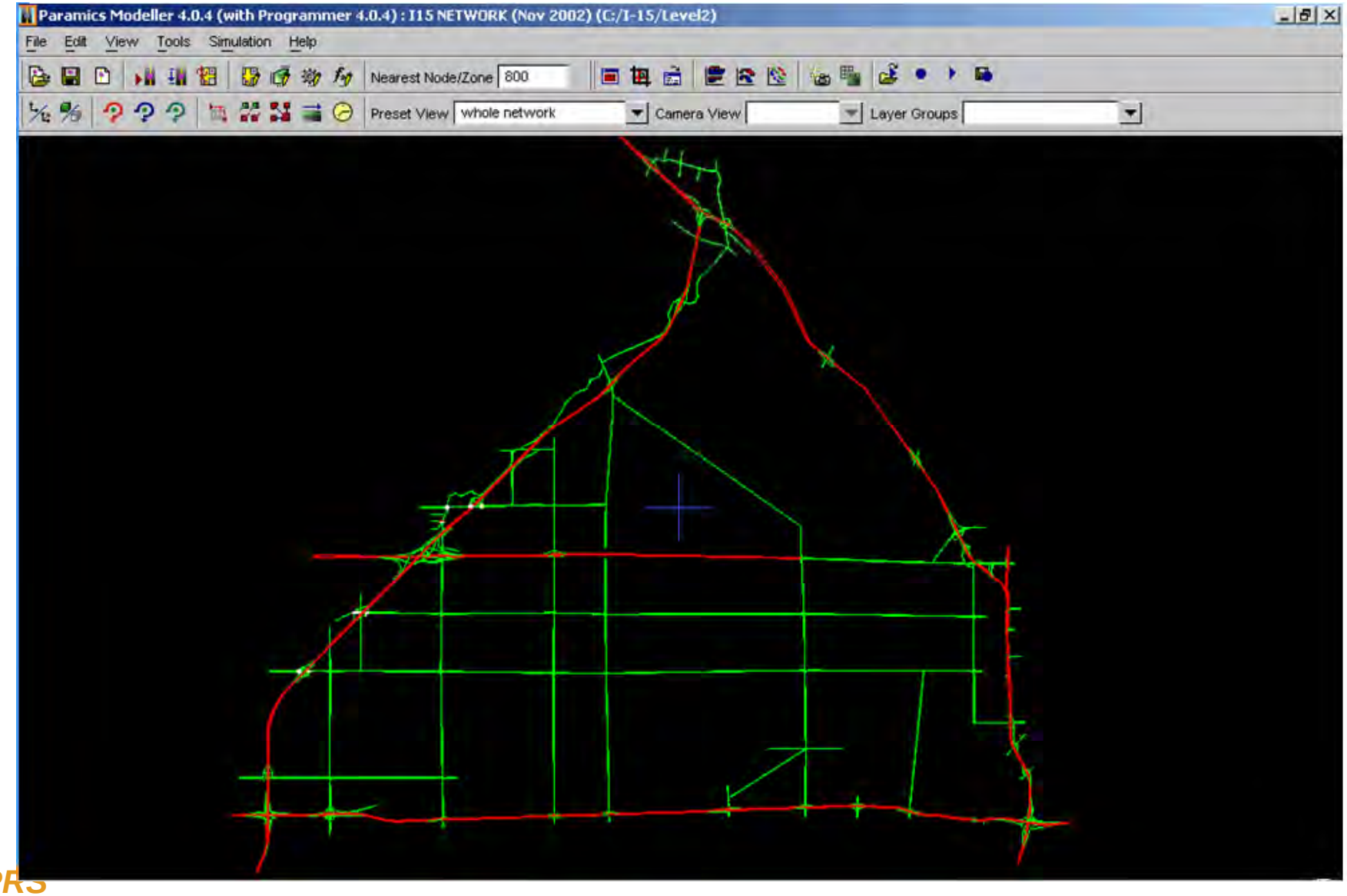
Scale & Level of Detail

Bridging Gap: Transportation Planning and Traffic Operations



I-15 Devore Simulation for TMP: Paramics

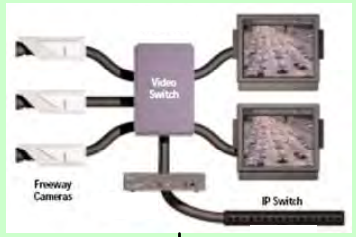
Microscopic Network Traffic Analysis



Vissim 3-D: Work-zone Lane-closure and Traffic-movement

I-15 Devore AWIS

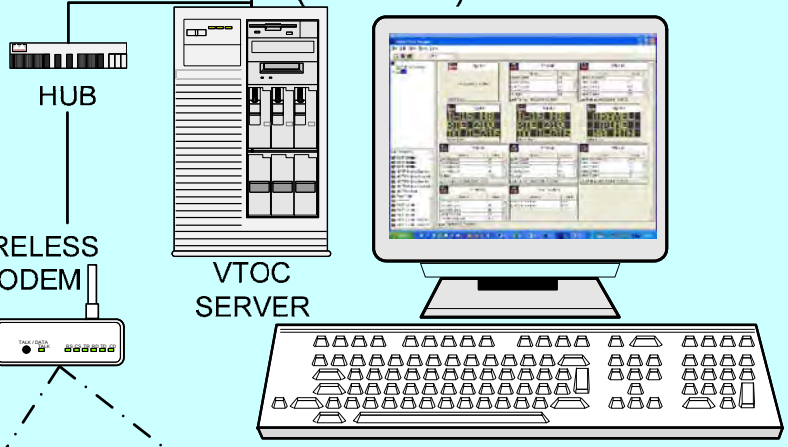
District TMC



I-15 Command Center (Caltrans)

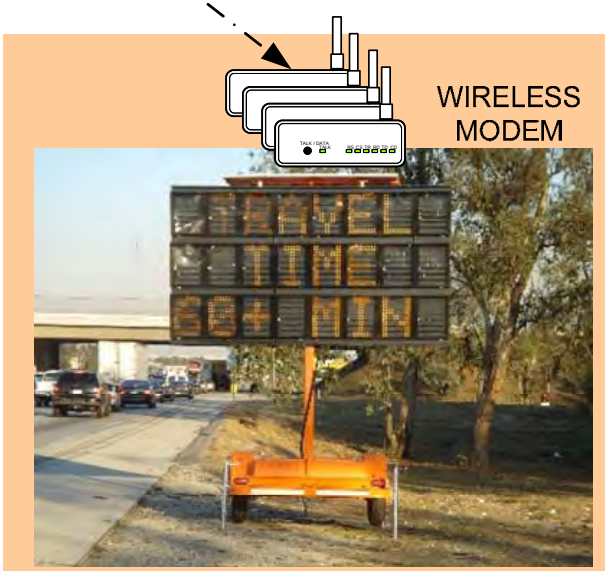
CCTV MONITORS

Virtual Transportation Operations Center (St. Paul)



Traffic Monitoring Stations

Permanent Changeable Message Signs



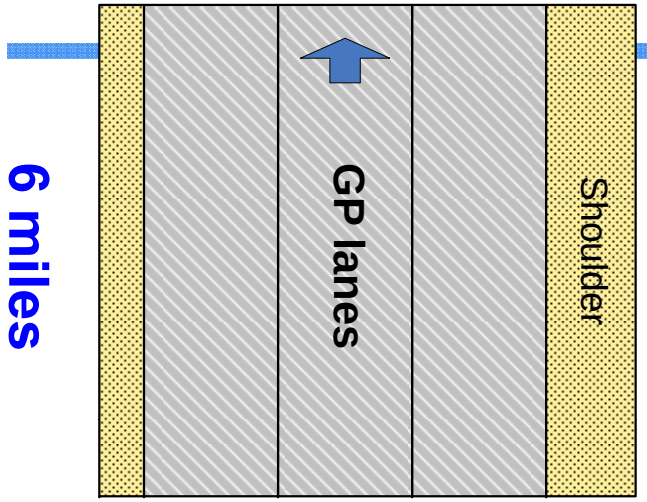
Portable Changeable Message Signs

Challenges: WZ Simulation Tools

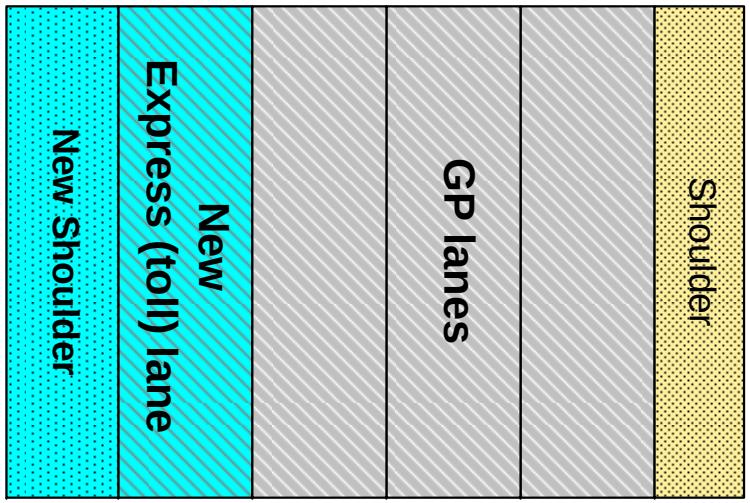
- Usability Challenges
  - Limited work zone behaviors: utilize incident functionality
  - Poor menu & interfaces for work zone configuration
  - Need complicated post-analysis process: time & costs
  - Weekend OD is not available: converted from Weekday data (peak-hour commuter traffic).
  - Not enough model for travelers' learning mechanism
    short-term vs long-term closures (user equilibrium)
- Implementation Challenges
  - Require large amount of data and calibration: time - cost
  - User needs traffic and simulation knowledge (UE & SO)
  - Usually expensive license of commercial package
  - Oftentimes, outsourcing to consultants

35

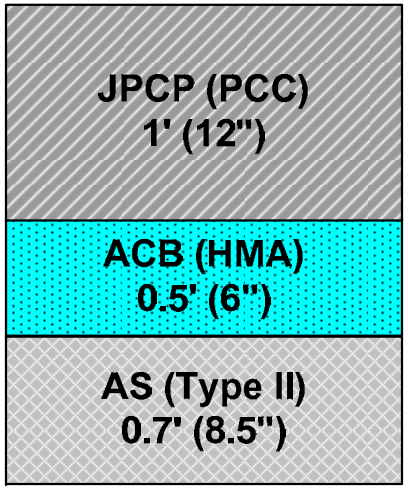
CA4PRS => LCCA Integration: I-15 HOT Widening



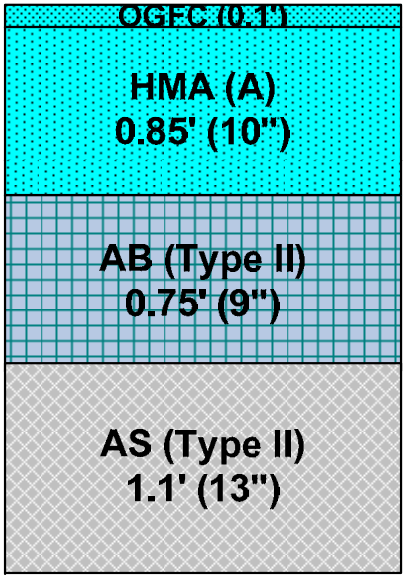
(a) Plan View: Existing Roadway (NB)



(b) Plan View: After Widening (NB)



(c) Cross-section: Long-life (40-y) PCCP



(d) Cross-section: Standard-life (20-y) ACP

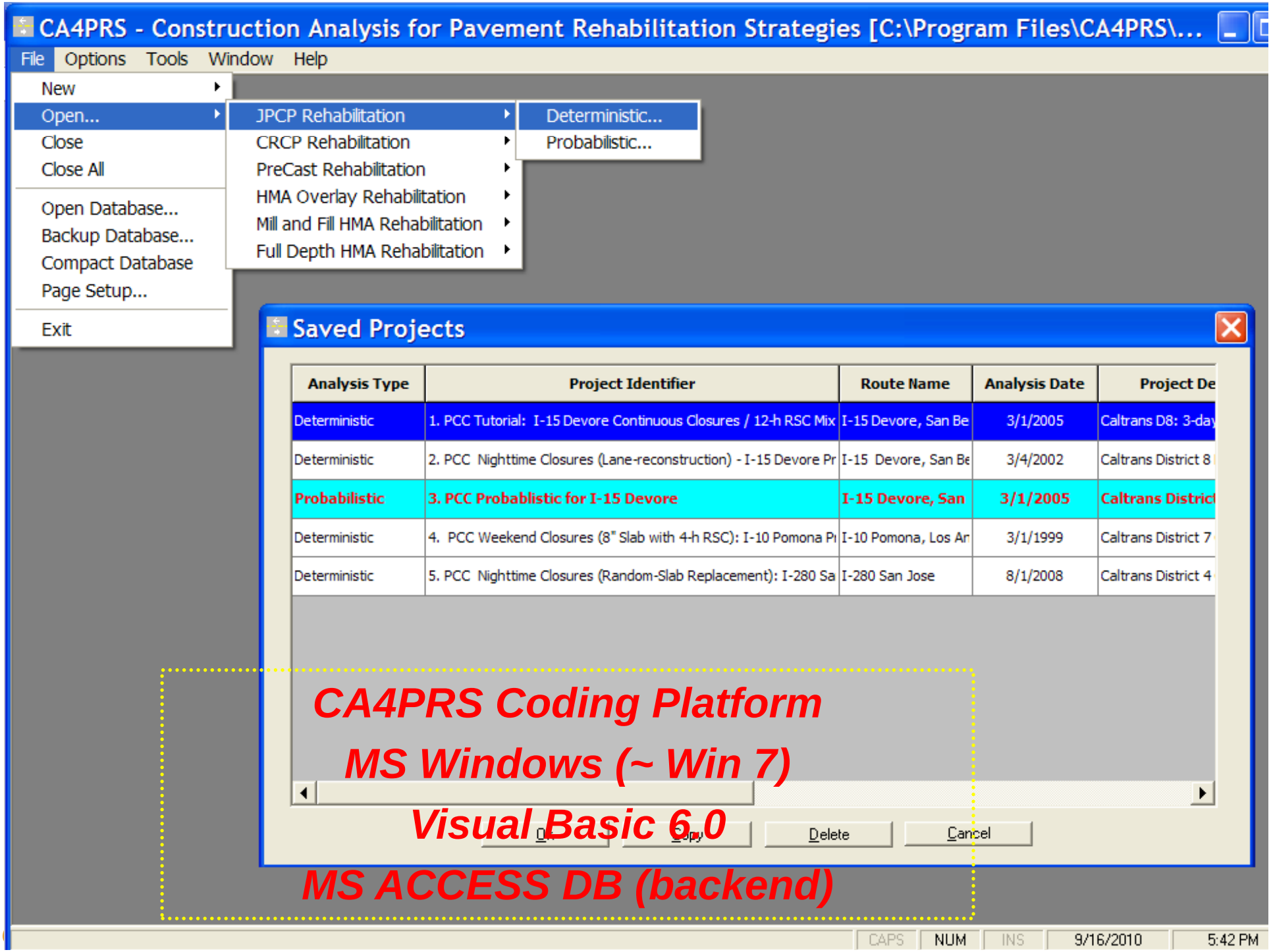
I-15 Riverside Widening Life-Cycle Cost (30 analysis)

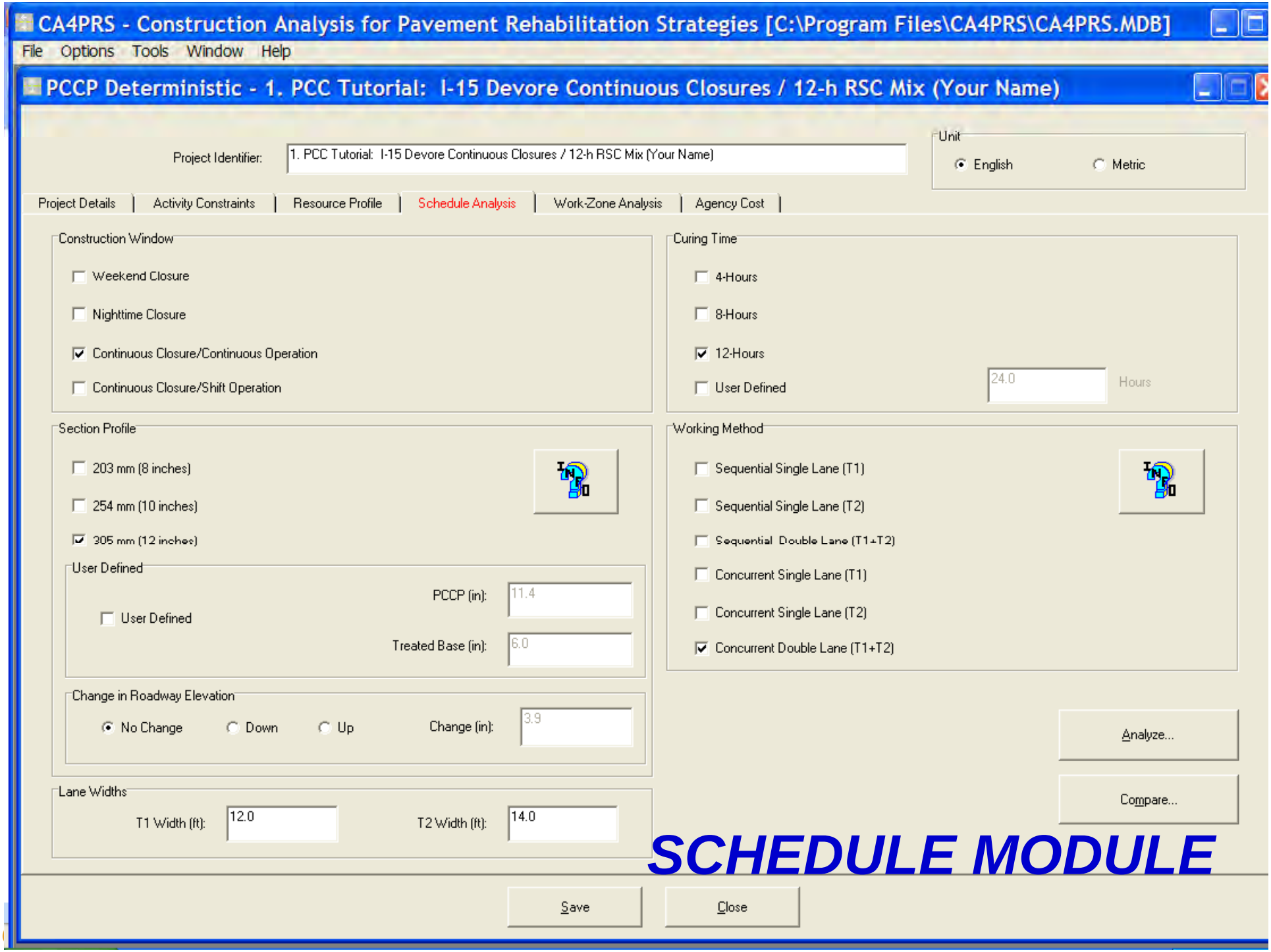
Type	Construction	Life	Year	AGENCY COST ($ Millions)	
				NPV Discounted	Un-discount
PCCP (40-year Long -life)	PCCP Widening	40	2015	$46	$46
	1st PCCP CAPM	5	2055	$1	$3
	2nd PCCP CAPM	5	2060	$2	$9
	3rd PCCP CAPM	10	2065	$2	$11
	Annual Maint. Cost			$1	$2
	PCCP Total	60		$51	$71
ACP (20-year Standard -life)	ACP Widening	20	2015	$38	$38
	1st OGFC	10	2025	$3	$4
	1st ACP CAPM	10	2035	$7	$15
	2nd ACP CAPM	10	2045	$5	$15
	1st ACP Rehab.	20	2055	$5	$24
	2nd OGFC	10	2065	$1	$4
	Annual Maint. Cost			$3	$7
	ACP Total	60		$61	$108
Difference (PCCP-ACP)				($10)	($37)

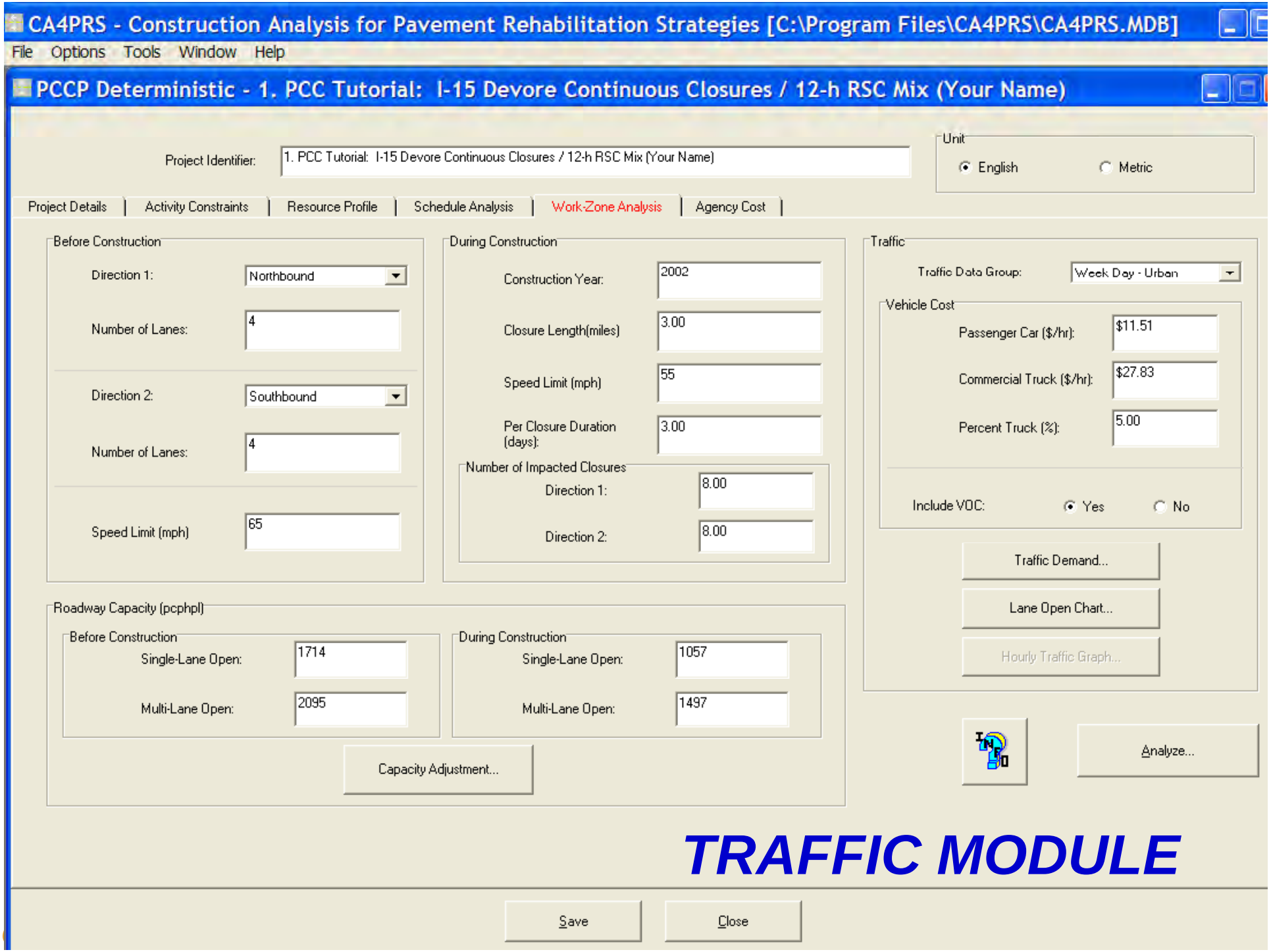
ACP needs $8M less Initial Cost, but $10M more LCC than PCCP

CA4PRS Implementation Issues

- **Primary Users**
  - Agency: Planning, Roadway Design, Traffic Operations, Construction and Materials
  - Industry: Consultants, Contractors, Vendors
- **Candidate Projects**
  - Major maintenance, Rehab/Reconstruction, Widening projects
  - High-profile, public outstanding, urban corridor projects
- **Implementation Stages**
  - The earlier, the better; mainly in Design stage
  - LCCA Interactions
- **Analysis time needed**
  - Pre-construction Analysis (scenario comparison): 1-2 months
  - Construction-staging plans and TMPs: about 2-3 months
  - Data collection take time
  - Incorporate with WZ network simulation: 6-12 months


CA4PRS - Construction Analysis for Pavement Rehabilitation Strategies [C:\Program Files\CA4PRS\...
File
Options
Tools
Window
Help
New
Open...
Close
Close All
Open Database...
Backup Database...
Compact Database
Page Setup...
Exit
JPCP Rehabilitation
CRCP Rehabilitation
PreCast Rehabilitation
HMA Overlay Rehabilitation
Mill and Fill HMA Rehabilitation
Full Depth HMA Rehabilitation
Deterministic...
Probabilistic...
Saved Projects
Analysis Type
Project Identifier
Route Name
Analysis Date
Project De
Deterministic
1. PCC Tutorial: I-15 Devore Continuous Closures / 12-h RSC Mix
I-15 Devore, San Be
3/1/2005
Caltrans D8: 3-day
Deterministic
2. PCC Nighttime Closures (Lane-reconstruction) - I-15 Devore Pr
I-15 Devore, San Be
3/4/2002
Caltrans District 8
Probabilistic
3. PCC Probablistic for I-15 Devore
I-15 Devore, San
3/1/2005
Caltrans District
Deterministic
4. PCC Weekend Closures (8" Slab with 4-h RSC): I-10 Pomona Pr
I-10 Pomona, Los An
3/1/1999
Caltrans District 7
Deterministic
5. PCC Nighttime Closures (Random-Slab Replacement): I-280 Sa
I-280 San Jose
8/1/2008
Caltrans District 4
Delete
Cancel
CA4PRS Coding Platform
MS Windows (~ Win 7)
Visual Basic 6.0
MS ACCESS DB (backend)
CAPS
NUM
INS
9/16/2010
5:42 PM


CA4PRS - Construction Analysis for Pavement Rehabilitation Strategies [C:\Program Files\CA4PRS\CA4PRS.MDB]
File Options Tools Window Help
PCCP Deterministic - 1. PCC Tutorial: I-15 Devore Continuous Closures / 12-h RSC Mix (Your Name)
Project Identifier:
1. PCC Tutorial: I-15 Devore Continuous Closures / 12-h RSC Mix (Your Name)
Unit
English
Metric
Project Details
Activity Constraints
Resource Profile
Schedule Analysis
Work-Zone Analysis
Agency Cost
Construction Window
Weekend Closure
Nighttime Closure
Continuous Closure/Continuous Operation
Continuous Closure/Shift Operation
Curing Time
4-Hours
8-Hours
12-Hours
User Defined
24.0
Hours
Section Profile
203 mm (8 inches)
254 mm (10 inches)
305 mm (12 inches)
User Defined
User Defined
PCCP (in):
11.4
Treated Base (in):
6.0
Change in Roadway Elevation
No Change
Down
Up
Change (in):
3.9
Working Method
Sequential Single Lane (T1)
Sequential Single Lane (T2)
Sequential Double Lane (T1+T2)
Concurrent Single Lane (T1)
Concurrent Single Lane (T2)
Concurrent Double Lane (T1+T2)
Analyze...
Compare...
Lane Widths
T1 Width (ft):
12.0
T2 Width (ft):
14.0
SCHEDULE MODULE
Save
Close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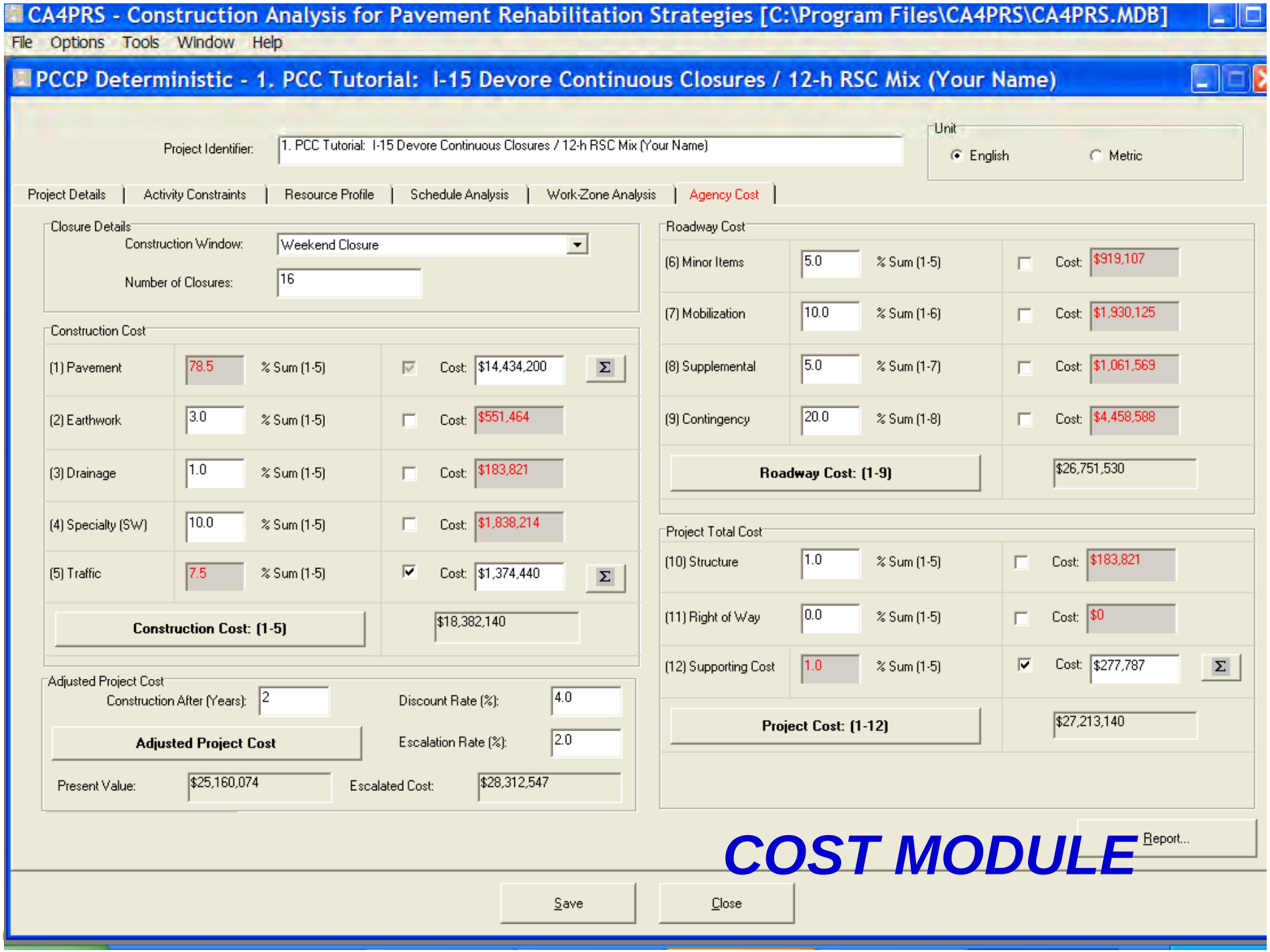
Project Identifier:
1. PCC Tutorial: I-15 Devore Continuous Closures / 12-h RSC Mix (Your Name)
Unit
English
Metric
Project Details
Activity Constraints
Resource Profile
Schedule Analysis
Work-Zone Analysis
Agency Cost
Before Construction
Direction 1:
Northbound
Number of Lanes:
4
Direction 2:
Southbound
Number of Lanes:
4
Speed Limit (mph)
65
During Construction
Construction Year:
2002
Closure Length(miles)
3.00
Speed Limit (mph)
55
Per Closure Duration (days):
3.00
Number of Impacted Closures
Direction 1:
8.00
Direction 2:
8.00
Traffic
Traffic Data Group:
Week Day - Urban
Vehicle Cost
Passenger Car ($/hr):
$11.51
Commercial Truck ($/hr):
$27.83
Percent Truck (%):
5.00
Include VOC:
Yes
No
Traffic Demand...
Lane Open Chart...
Hourly Traffic Graph...
Roadway Capacity (pcphpl)
Before Construction
Single-Lane Open:
1714
Multi-Lane Open:
2095
During Construction
Single-Lane Open:
1057
Multi-Lane Open:
1497
Capacity Adjustment...
Analyze...
TRAFFIC MODULE
Save
Close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Project Identifier: 1. PCC Tutorial: I-15 Devore Continuous Closures / 12-h RSC Mix (Your Name)
Unit
English
Metric
Project Details | Activity Constraints | Resource Profile | Schedule Analysis | Work-Zone Analysis | Agency Cost
Closure Details
Construction Window: Weekend Closure
Number of Closures: 16
Construction Cost
(1) Pavement 78.5 % Sum (1-5) Cost: $14,434,200
(2) Earthwork 3.0 % Sum (1-5) Cost: $551,464
(3) Drainage 1.0 % Sum (1-5) Cost: $183,821
(4) Specialty (SW) 10.0 % Sum (1-5) Cost: $1,838,214
(5) Traffic 7.5 % Sum (1-5) Cost: $1,374,440
Construction Cost: (1-5) $18,382,140
Adjusted Project Cost
Construction After (Years): 2
Discount Rate (%): 4.0
Adjusted Project Cost
Escalation Rate (%): 2.0
Present Value: $25,160,074
Escalated Cost: $28,312,547
Roadway Cost
(6) Minor Items 5.0 % Sum (1-5) Cost: $919,107
(7) Mobilization 10.0 % Sum (1-6) Cost: $1,930,125
(8) Supplemental 5.0 % Sum (1-7) Cost: $1,061,569
(9) Contingency 20.0 % Sum (1-8) Cost: $4,458,588
Roadway Cost: (1-9) $26,751,530
Project Total Cost
(10) Structure 1.0 % Sum (1-5) Cost: $183,821
(11) Right of Way 0.0 % Sum (1-5) Cost: $0
(12) Supporting Cost 1.0 % Sum (1-5) Cost: $277,787
Project Cost: (1-12) $27,213,140
Report...
COST MODULE
Save
Close