



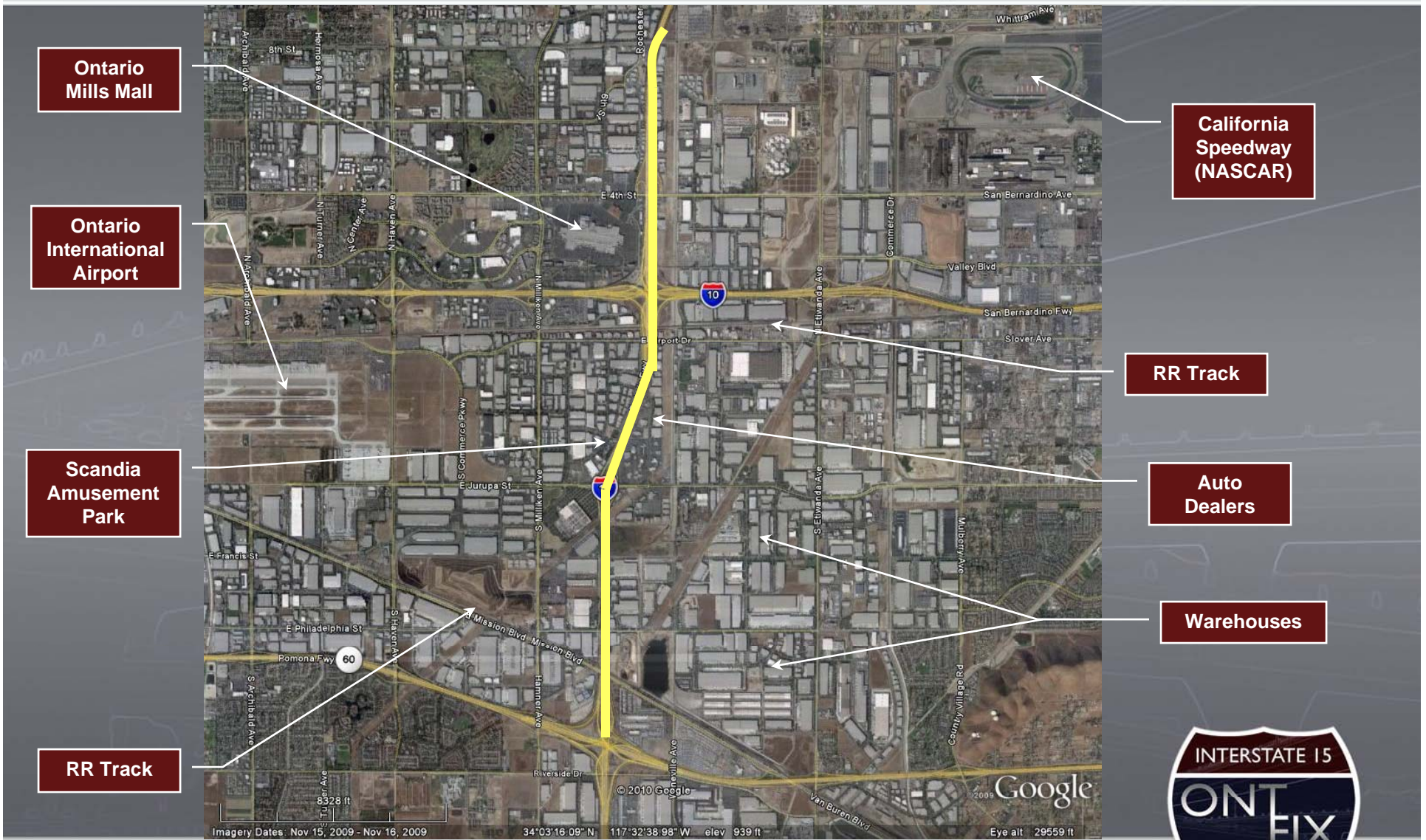
EA 08-472214

Jonathan den Hartog, P.E.



Project Location

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Project Location

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Project Features

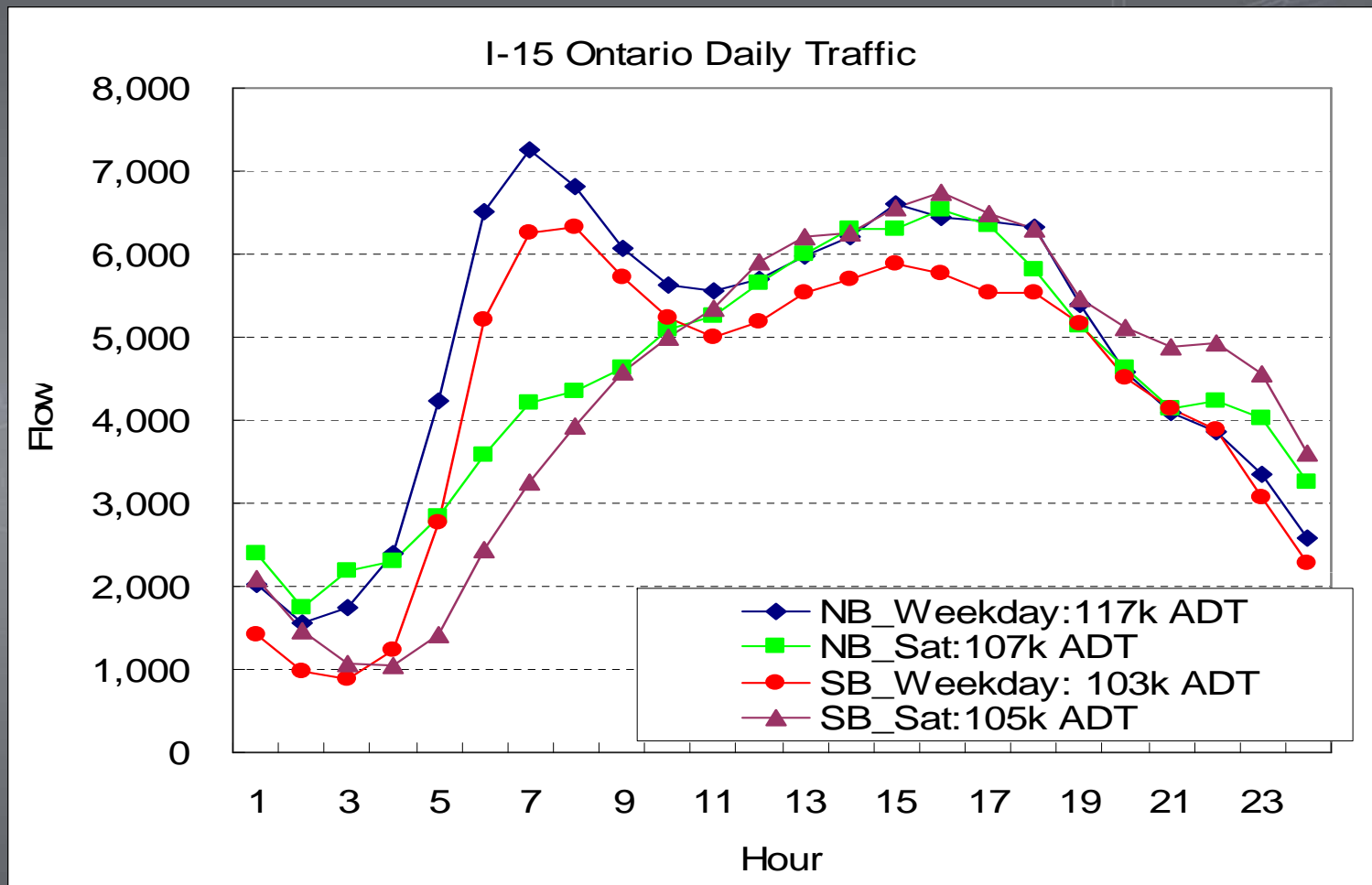
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- Median Paving
- Bridge Widening
- New Median Barrier
- Shoulder/Ramp Rehab
- Pavement Rehabilitation
 - 12 In-mi lane replacement
 - Random slab replacements
 - Includes connectors
 - Precast Pavement (Super-Slab)



Traffic Volumes

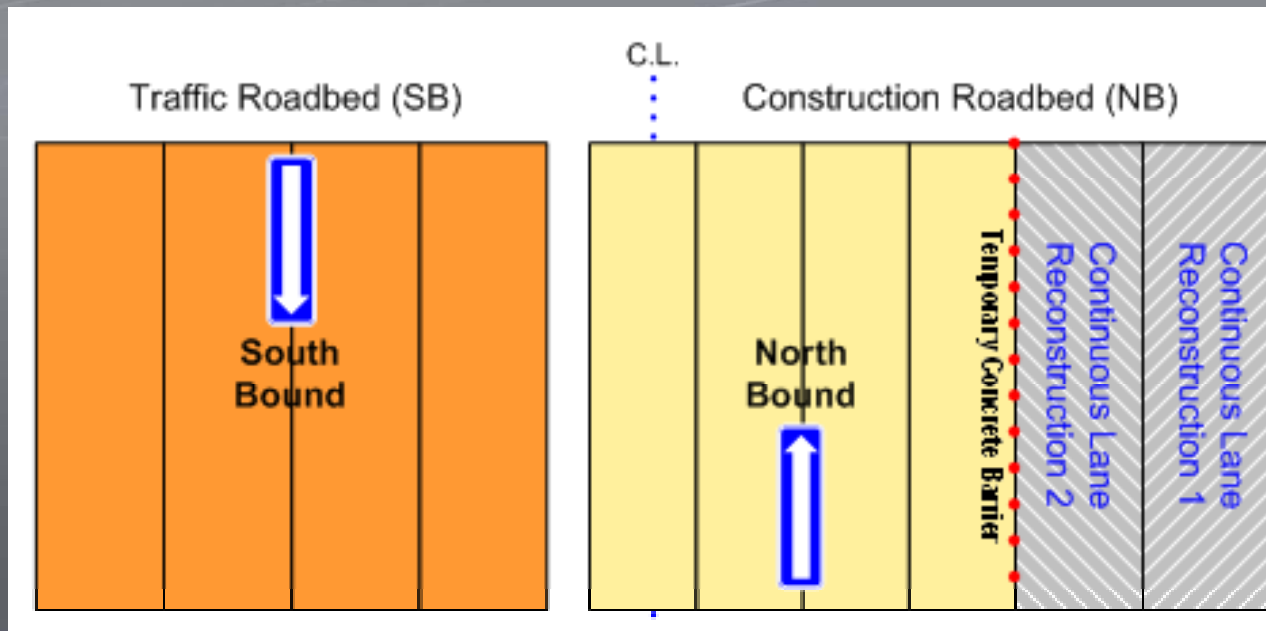
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Construction Sequence

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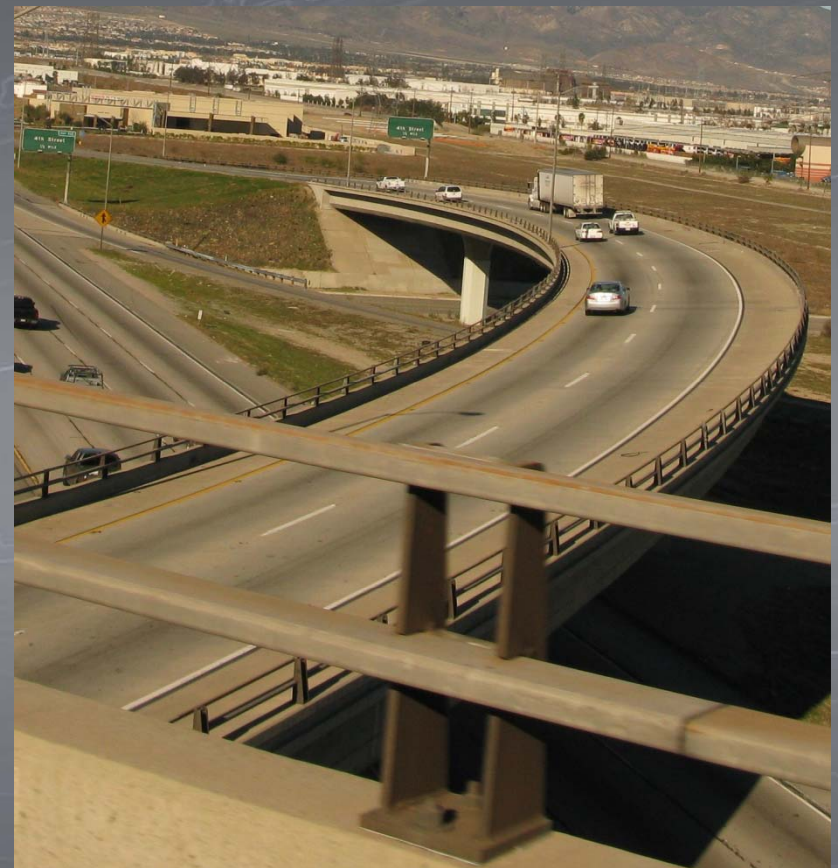
- Pave median, widen bridges
- Shift southbound I-15 two lanes toward the CL
- Rehab pavement weekday and weekend
- Repeat for northbound I-15



Rapid Weekends

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- 5 Major Stages,
25 sub-stages
- 410 Working Days (~2 yrs)
- 55-Hour Weekend Closures
 - Beginning late Friday evening
 - Ending early Monday morning
- Approximately 30 weekends
- ~8 full roadbed closures



Typical Closure



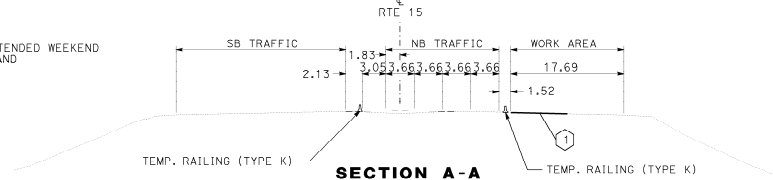
DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
08	Riv. Sbd	15	82.8/84.1, 6.0/6.3	254	674

REGISTERED CIVIL ENGINEER	DATE
JONATHAN DEN HARTOG	10-31-07
PLANS APPROVAL DATE	
1-14-08	

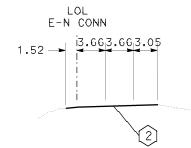
REGISTERED PROFESSIONAL DESIGNER	DATE
JONATHAN DEN HARTOG	10-31-07
REGISTERED CIVIL ENGINEER	DATE
JONATHAN DEN HARTOG	10-31-07

NOTES:

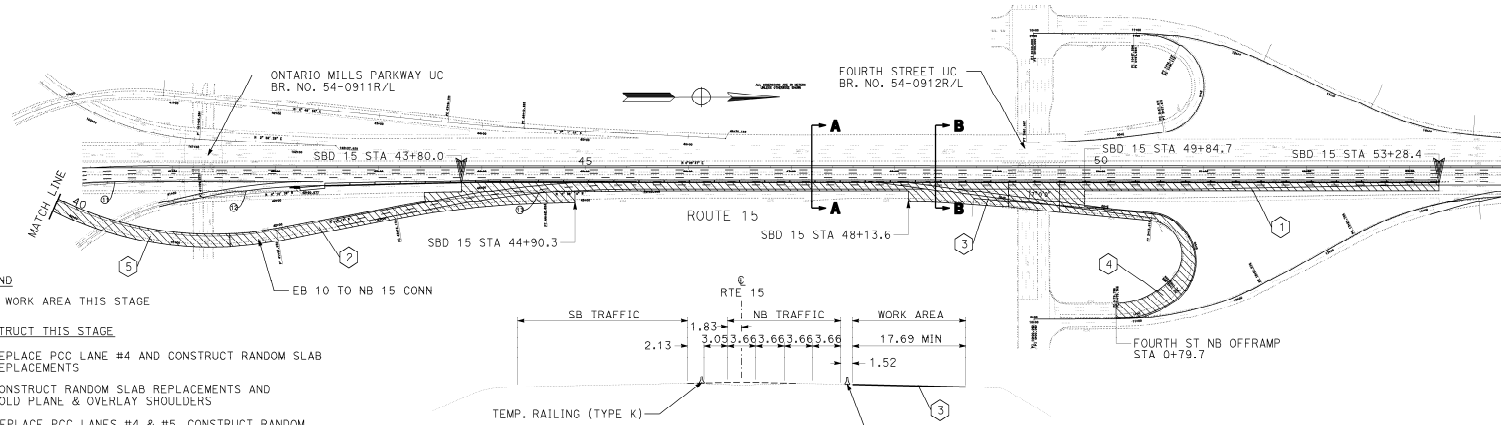
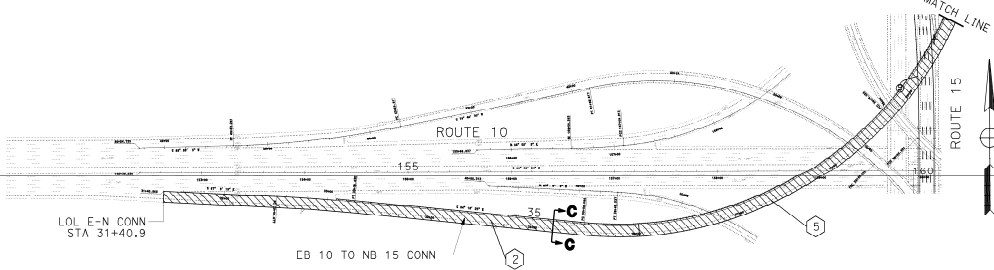
1. WORK DURING STAGE 4F PROCEED CONCURRENTLY WITH WORK IN STAGE 4.
2. STAGE 4F WORK TO BE PERFORMED USING 55-HOUR EXTENDED WEEKEND CLOSURES OF NORTHBOUND FOURTH STREET OFFRAMP AND EASTBOUND 10 CONNECTOR TO NORTHBOUND 15.



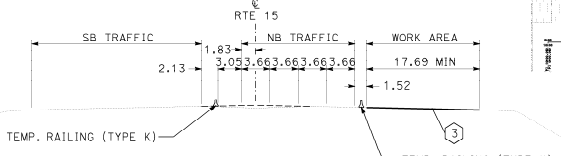
SECTION A-A
 RTE 15 STA 44+90.3 TO STA 48+13.6
 RTE 15 STA 49+84.7 TO STA 53+28.4



SECTION C-C
 EB 10 TO NB 15 CONN



- LEGEND**
- WORK AREA THIS STAGE
 - CONSTRUCT THIS STAGE**
 - 1 REPLACE PCC LANE #4 AND CONSTRUCT RANDOM SLAB REPLACEMENTS
 - 2 CONSTRUCT RANDOM SLAB REPLACEMENTS AND COLD PLANE & OVERLAY SHOULDERS
 - 3 REPLACE PCC LANES #4 & #5, CONSTRUCT RANDOM SLAB REPLACEMENTS AND COLD PLANE & OVERLAY SHOULDER
 - 4 COLD PLANE & OVERLAY RAMP
 - 5 BRIDGE DECK WORK (SEE STRUCTURES PLANS)



SECTION B-B
 RTE 15 STA 43+80.0 TO STA 44+90.3
 RTE 15 STA 48+13.6 TO STA 49+84.7

STAGE 4F
STAGE CONSTRUCTION
 NO SCALE
SC-43

THIS PLAN ACCURATE FOR STAGE CONSTRUCTION WORK ONLY.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

BORDER LAST REVISED 3/1/2007



USERNAME -> rph110
 DON FILE -> 847221.mxd(843.dwg)

CII 082??

EA 4/2211



10-31-07 TIME PLOTTED 10:31:07 AM 10/31/07



CA4PRS Study

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- 2 Phase Study
 - Alternative Analysis And Comparison
 - Detailed Study of Preferred Alternative
- Performed by consultant sub

The screenshot shows a software window titled "PCCP Deterministic - ONT-FIX - Study". The interface includes a "Project Identifier" field containing "ONT-FIX - Study" and a "Unit" selection area with radio buttons for "English" and "Metric". A horizontal menu bar contains several tabs: "Project Details" (highlighted in red), "Activity Constraints", "Resource Profile", "Schedule Analysis", "Work-Zone Analysis", and "Agency Cost". Below the menu bar, the "Project Description" field contains the text "Ontario I-15 Pavement Rehabilitation Project".

CA4PRS Study Purpose

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- Validate the alternative chosen
- Provide a detailed estimate of:
 - Working days for the project
 - Number of closures needed for each stage
- Basis for Incentive/Disincentive

\$150,000 per saved closure

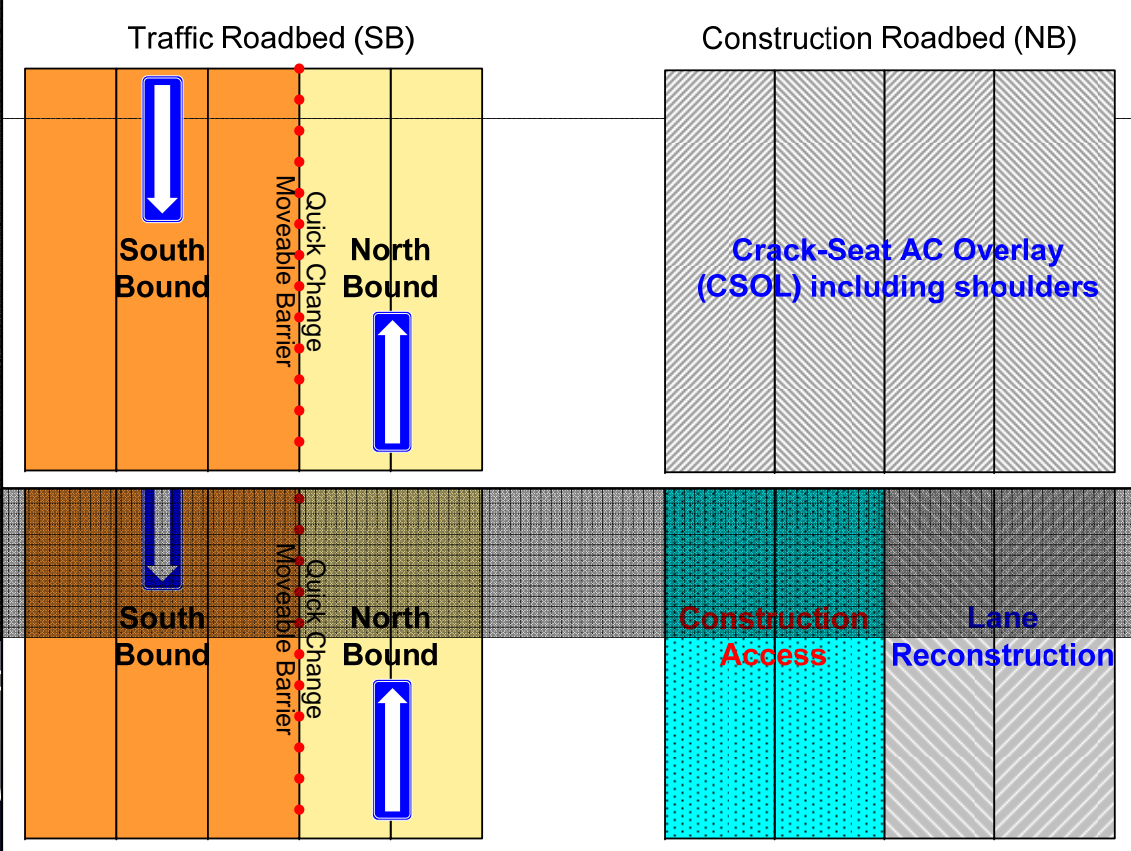
(Max \$900,000)

\$175,000 per extra closure



Alternatives Analysis

Scenario	Closure Duration	Traffic*		Cost (\$millions)		Cost Ratio
		RUC (\$M)	Delay (min)	Agency	Total**	
1 Original	35 weekends	3	16	78	79	100%
3 Contraflow 55-hr Weekend						6%
4 Progressive Continuous						8%
5 Traditional Nighttime						6%
6 CSOL 55-hour weekend						6%



** Total Cost = 1/3 RUC + Agency Cost



Road User Costs/Delay

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Scenario		Demand Reduction	1,500 vphpl* capacity			1,700 vphpl* capacity		
			Queue	Delay	RUC**	Queue	Delay	RUC**
			Miles	Minutes	\$(Millions)	Mile	Minute	\$(Millions)
1	Original	20%	8	61	20	2	18	2
		30%	2	16	3	0	0	0
3	55-hour Weekend	30%	51	363	119	34	210	63
		40%	25	179	45	13	81	17
4	Progressive Continuous	30%	51	363	123	34	210	51
		40%	25	179	47	13	81	13
5	8-hour Nighttime	5%	8	57	418	-	-	-
		10%	3	22	133	-	-	-
6-1	CSOL (Weekend)	30%	51	363	69	34	210	36
		40%	25	179	25	13	81	10
6-2	CSOL (Nighttime)	5%	8	57	120	-	-	-
		10%	3	22	38	-	-	-

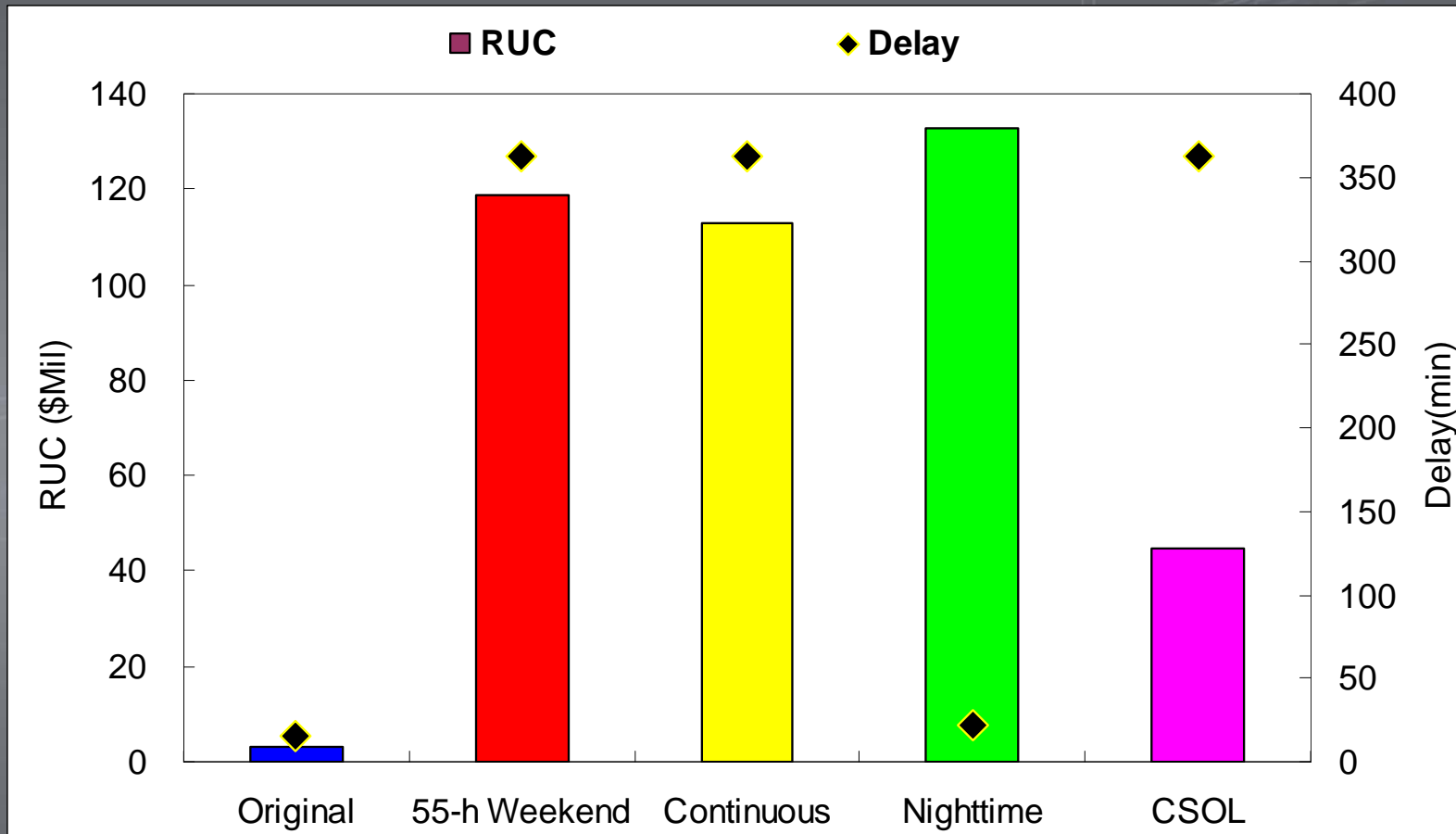
* vphpl: vehicle per hour per lane

** RUC: Road User Cost



Road User Costs/Delay

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Stage Analysis (Sample)

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Stage	Station		No. of Lanes	Length		Rehab Type	Total	55-hour Closures
	Start	End		(m)	(lane-km)		(lane-km)	Estimate
4B, 4C	836+81	837+81	1	100.00	0.100	CLR	2.50	2
	SB I-15 Conn WB SR-60		2	773.20	1.546	CLR		
	SB I-15 Conn EB SR-60		2	1430.50	0.858	RSR		
2A	7+40	11+79	2	439.00	0.878	CLR	1.28	1
	Jurupa On-ramp SB I-15		2	500.00	0.400	ACR		
2B	20+90	22+77	2	187.00	0.374	CLR	3.01	3
	22+77	28+51	1	574.00	0.574	CLR		
	28+51	33+03	2	452.00	0.904	CLR		
	20+96	28+95	1	799.00	0.240	RSR		
	WB I-10 CONN SB I-15		1	337.70	0.338	CLR		
	SB I-15 Jurupa Off-ramp		2	500.00	0.400	ACR		
	WB I-10 Conn SB I-15		2	300.00	0.180	RSR		

Note: CLR=Continuous Lane Reconstruction; RSR=Random Slab Replacement; ACR=Asphalt Concrete Rehabilitation



Traffic Study (Dynameq)

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Closure	Delay (min)	
	Study 1	Study 2
WB10-SB15	5.5	8.4
EB10-SB15	4.1	7.7
SB15-WB10	4.5	72.6
NB15-E/W10	5.8	58.6
EB10-NB15	5.8	8.0
Reduce SB 15	3.0	
SB15-E/W60		121.4

Schedule

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- NTP with CA4PRS study: May 2005
- 30% PS&E: February 2006
- Draft CA4PRS Report: March 2006
- CA4PRS study: October 2006
- 60% PS&E: January 2007
- Advertise: September 2008
- Award: January 2009
- Construction Begins: April 2009
- Anticipated Completion: December 2010



VALIDATION OF RESULTS



Screenshots

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PCCP Deterministic - ONT-FIX - Actual

Project Identifier: Unit: English Metric

Project Details | Activity Constraints | Resource Profile | Schedule Analysis | Work-Zone Analysis | Agency Cost

Project Description:

Analyst Name: Analysis Date:

Route Name:

Begin KM: End KM:

Objective/Scope (lane-km):

Location:

Project Notes:



Screenshots

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PCCP Deterministic - ONT-FIX - Actual

Project Identifier: Unit: English Metric

Project Details | **Activity Constraints** | Resource Profile | Schedule Analysis | Work-Zone Analysis | Agency Cost

Mobilization: Mobilization (Hours): Construction Start Date:

Construction Window Settings

Weekend Closure	Nighttime Closure
Start Time: <input type="text" value="Friday 10:00 PM"/>	Start Time on First Day: <input type="text" value="08:00 PM"/>
End Time: <input type="text" value="Monday 05:00 AM"/>	End Time on Next Day: <input type="text" value="06:00 AM"/>
Available Hours: <input type="text" value="55.0"/>	Available Hours per Day: <input type="text" value="10.0"/>

Continuous Closure/Continuous Operation	Continuous Closure/Shift Operation
Start Time on First Day: <input type="text" value="12:00 AM"/>	Daily Start Time: <input type="text" value="08:00 AM"/>
No. of Continuous Work Days: <input type="text" value="3.0"/>	No. of Continuous Work Days: <input type="text" value="6.0"/>
Available Hours per Day: <input type="text" value="24.0"/>	Available Hours per Day: <input type="text" value="10.0"/>

Screenshots

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PCCP Deterministic - ONT-FIX - Actual

Project Identifier: Unit: English Metric

Project Details | Activity Constraints | **Resource Profile** | Schedule Analysis | Work-Zone Analysis | Agency Cost

Resource Type	Parameter	Value
Demolition Hauling Truck	Rated Capacity (tonne)	22.0
	Trucks per Hour per Team	10.0
	Packing Efficiency	0.55
	Number of Team	3.0
	Team Efficiency	0.70
Batch Plant	Capacity (cu. m/hour)	90.0
	Number of Plants	1
Concrete Delivery Truck	Capacity (cu. m)	6.0
	Trucks per Hour	15
	Packing Efficiency	1.00
Base Delivery Truck	Capacity (cu. m)	6.0
	Trucks per Hour	16
	Packing Efficiency	1.00
Paver	Speed (m/min)	2.0
	Number of Pavers	1

Screenshots

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PCCP Deterministic - ONT-FIX - Actual

Project Identifier: 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 Hours

Section Profile

- 203 mm (8 inches)
- 254 mm (10 inches)
- 305 mm (12 inches)

User Defined

- User Defined
- PCCP (mm):
- Treated Base (mm):

Change in Roadway Elevation

- No Change Down Up
- Range (mm):

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)

Lane Widths

- T1 Width (m):
- T2 Width (m):

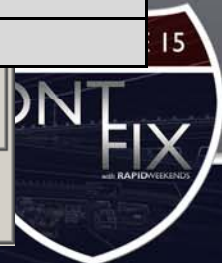
Analyze...
Compare...

Save Close

Inputs: Predicted Vs. Actual

Tab	Input	Study	Actual	Unit	Default Values
Activity Constraints	Mobilization	3	1	hrs	2-3
Activity	Resource Utilization - ONT-FIX - Study				
Activity	Project Identifier: ONT-FIX - Study				
Activity	<div style="display: flex; justify-content: space-between;"> Production Details Production Chart Gantt Chart </div>				
Resource	Construction Window:	Weekend Closure (55 Hours/Weekend)			10 for cut & lift, 12 for impact methods
Resource	Working Method:	Concurrent Single Lane (T1)			0.5 for cut & lift, 0.6 for impact
Resource	Section Profile:	PCCP: 315.0 mm, New Base: 150.0 mm			2
Resource	Curing Time:	12-Hours			Batch Plant (cu-m/hour)
Resource	Objective/Scope (lane-km):	2.50			10 for bottom dump, 6 for end dump
Resource	Closure Production (lane-km):	0.69			10
Resource	Closure Production (c/l-km):	0.69			
Resource	Construction Windows Needed To Meet Objective/Scope:	3.64			100
Resource	Demolition Quantity (cu. m):	1167.4			6-7
Resource	New Base Quantity (cu. m):	376.6			15
Resource	Concrete Quantity (cu. m):	790.8			2
Resource	Constraint Resource:	Demolition Hauling Truck			
Schedule	Demolition to Paving:	N/A			
Schedule	Demolition Hours:	17.0			

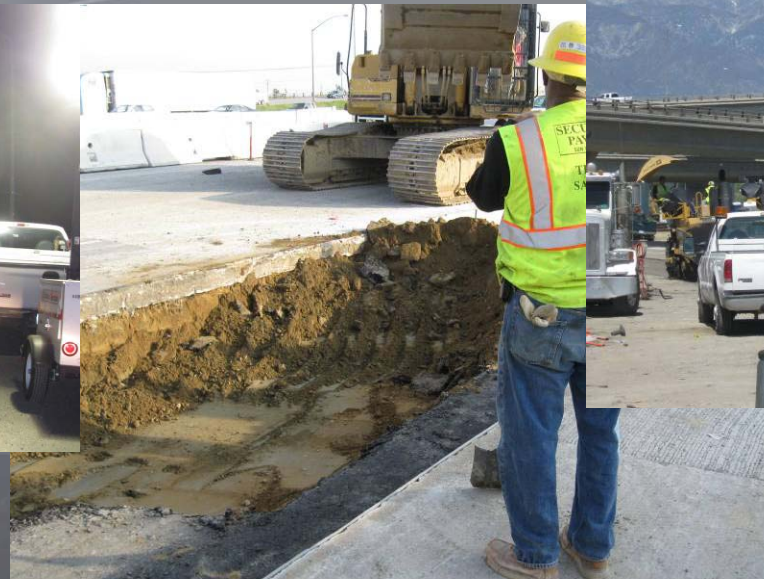
Report... Close



Predicted Vs. Actual

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- Random slabs as night work
- Sometimes paving two lanes wide on connectors
- Combined stages
- Concurrent vs. Sequential



Caltrans



Predicted Vs. Actual (PRELIMINARY)

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Stage		Stage Description	No. of Weekends			Notes
Plan ¹	Study ¹		Study ²	Actual ²	Revised Inputs ³	
4B,C	5B,C	SB I-15 connectors to E/W SR-60	2	2		Contractor was restricted by width of connector, which forced him to pave one lane at a time. Only 2 demo teams used. Thus very similar to study
2B,C	2B,C	SB Jurupa offramp, W10-S15 conn, E10-S15 conn	4	2	2	Study had separate closures for 2B, 2C. Contractor chose to combine stages.
2D,E	2D,E	SB I-15 connectors to E/W I-10	5	2	2	Contractor may have included more in 2E,F combination, also need to determine how contractor handled 3-lane widths
2E,F	2E,F	Fourth St SB ramps	3	1	1	Added 2E work north of S15-E10 connector diverge

Footnotes (Column descriptions)

1. 'Plan' is the stage designation as it is called out on the project plans. 'Study' is the stage designation as it is called out in the design study. Differences exist because of changes that occurred between when the study was completed and the project design was finished.
2. 'Study' is the number of closures (weekends) estimated to be needed by the design study to complete the work for the stage. 'Actual' is the number of closures actually required to complete the work.
3. 'Revised Inputs' indicates how many closures were estimated to be needed using the revised inputs for CA4PRS shown in the previous slide.



Time Spent

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- Pre-Construction Study:
~160 hours
- Validation of Results:
~40 hours



Lessons Learned

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- Construction experience is IMPORTANT
- Design input important for efficiency
- Breadth of knowledge required
 - Traffic
 - Pavement
 - Construction
 - Estimating
- Team approach may be best



For Further Study

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- More detailed field validation.
- How much did the economy effect traffic volumes, allowing the combined closures?
- What kind of traffic diversion did we get?
- Document experience with precast pavement (Super-Slab) to validate precast module.



Contact Info

www.caltrans8.info

Jonathan den Hartog
(909) 383-5998
jdenhart@dot.ca.gov



More info:

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

<http://www.fhwa.dot.gov/crt/lifecycle/ca4prs.cfm>

