Background and Introduction

What's the problem we're trying to solve? Developing a multi-year paving plan:

- Is a very time-consuming and manual process,
- Many types of competing modal priorities need to be reconciled by trial and error,
- What are Seattle's highest priority streets? We don't know, the answer depends on the mode or who you ask,
- Explaining the backlog remains a concern.

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Also…the Backlog

- The Current Condition-Based Arterial Pavement Backlog is Almost $1.0B and Growing
- The Majority of Backlog Dollar Value Consists of Expensive Road Reconstruction Projects
- Since Funding is Limited We Almost Certainly Won't Have Enough Money to Eliminate the Backlog Anytime Soon

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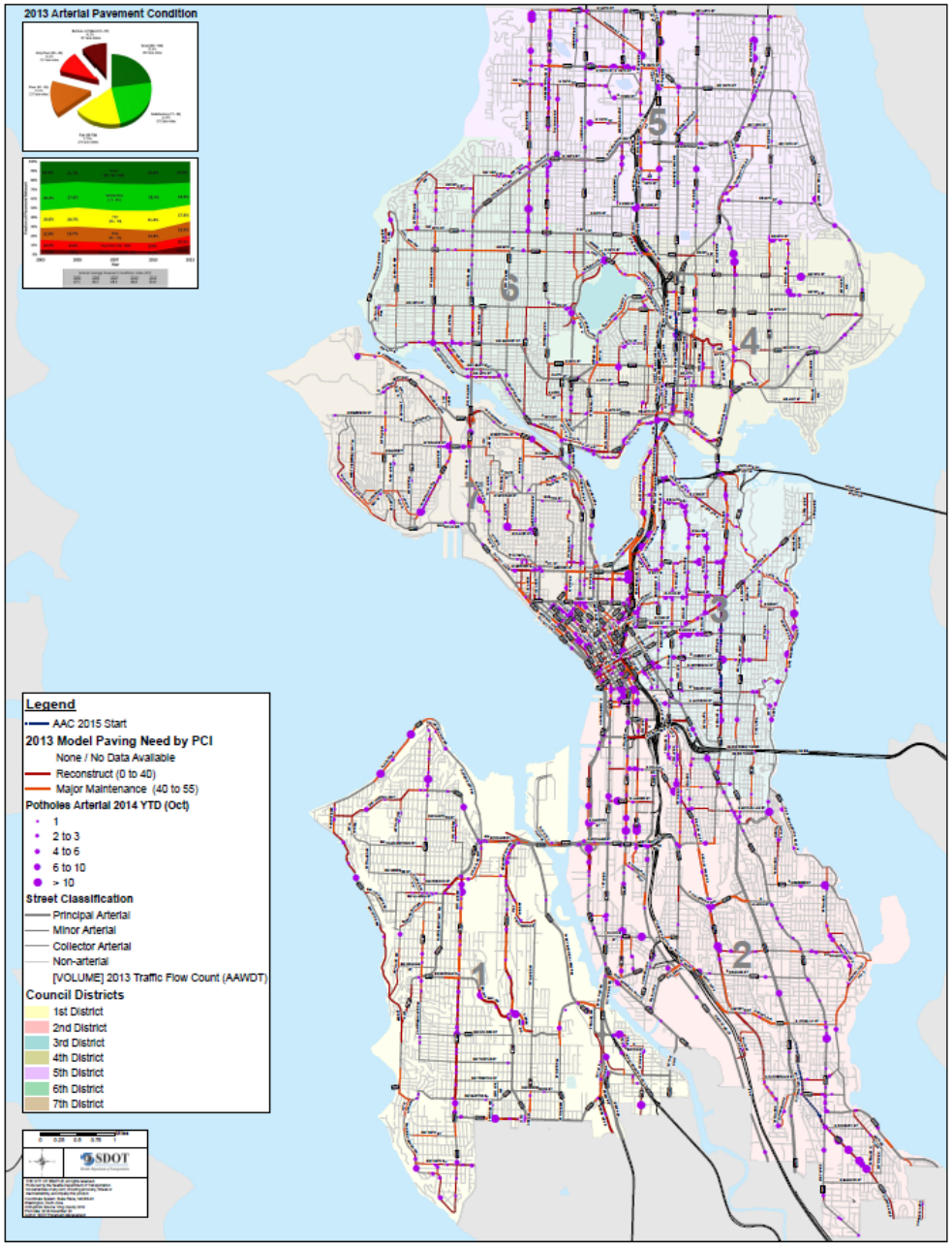

Arterial Paving Needs 2013-14 and Move Seattle Paving

How do we balance the current paving needs and reconcile the existing backlog…all with very limited funding?

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Pavement Condition and Vehicle Operating Costs

"Rough roads… cost the average driver $377 annually in extra vehicle operating costs… with additional vehicle operating costs ranging between $178 and $832 annually for urban areas…" ***Bumpy Roads Ahead: America's Roughest Rides and Strategies to Make our Roads Smoother*****. The Road Information Program, 2013**

"The American public pays for poor road conditions twice—first through additional vehicle operating costs and then in higher repair and reconstruction costs. Driving on rough roads accelerates vehicle depreciation, reduces fuel efficiency, and damages tires and suspension." ***Rough Roads Ahead: Fix Them Now or Pay for Them Later*****. AASHTO, 2009**

Pavement Condition and Vehicle Operating Costs

- **NCAT Report 15---02, LITERATURE REVIEW: THE IMPACT OF PAVEMENT ROUGHNESS ON VEHICLE OPERATING COSTS, National Center for Asphalt Technology, Auburn University, May 2015**

"…numerous studies have been completed on the effect of pavement condition on VOC by studying the effect of pavement roughness on various components of VOC, including fuel consumption, tire wear, repair and maintenance, and oil consumption costs."

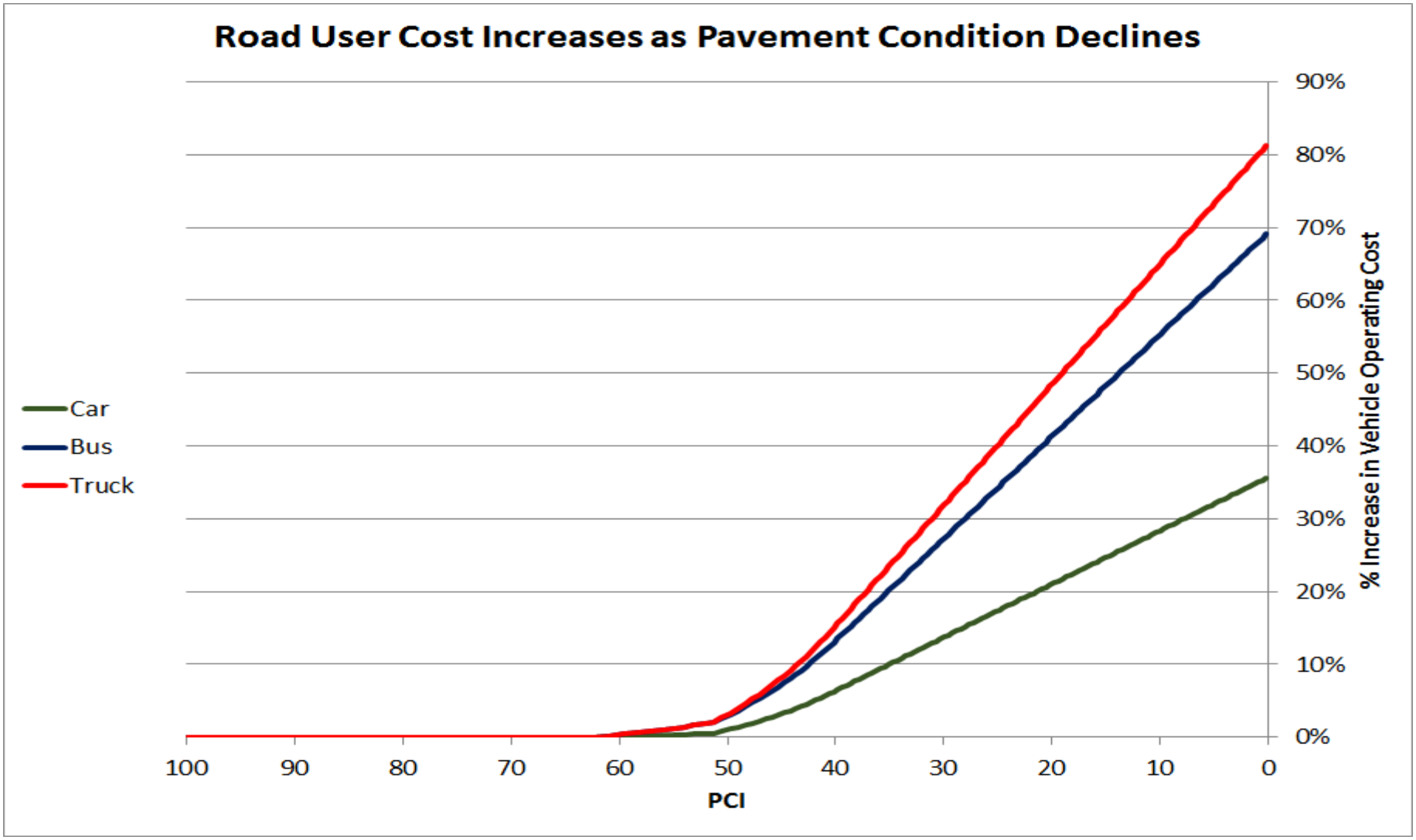
- **THE PER-MILE COSTS OF OPERATING AUTOMOBILES AND TRUCKS, Humphrey Institute of Public Affairs, University of Minnesota, June 2003**

- **NCHRP Report 720: Estimating the Effects of Pavement Condition on Vehicle Operating Costs. Transportation Research Board of the National Academies, Washington, D.C., 2012**

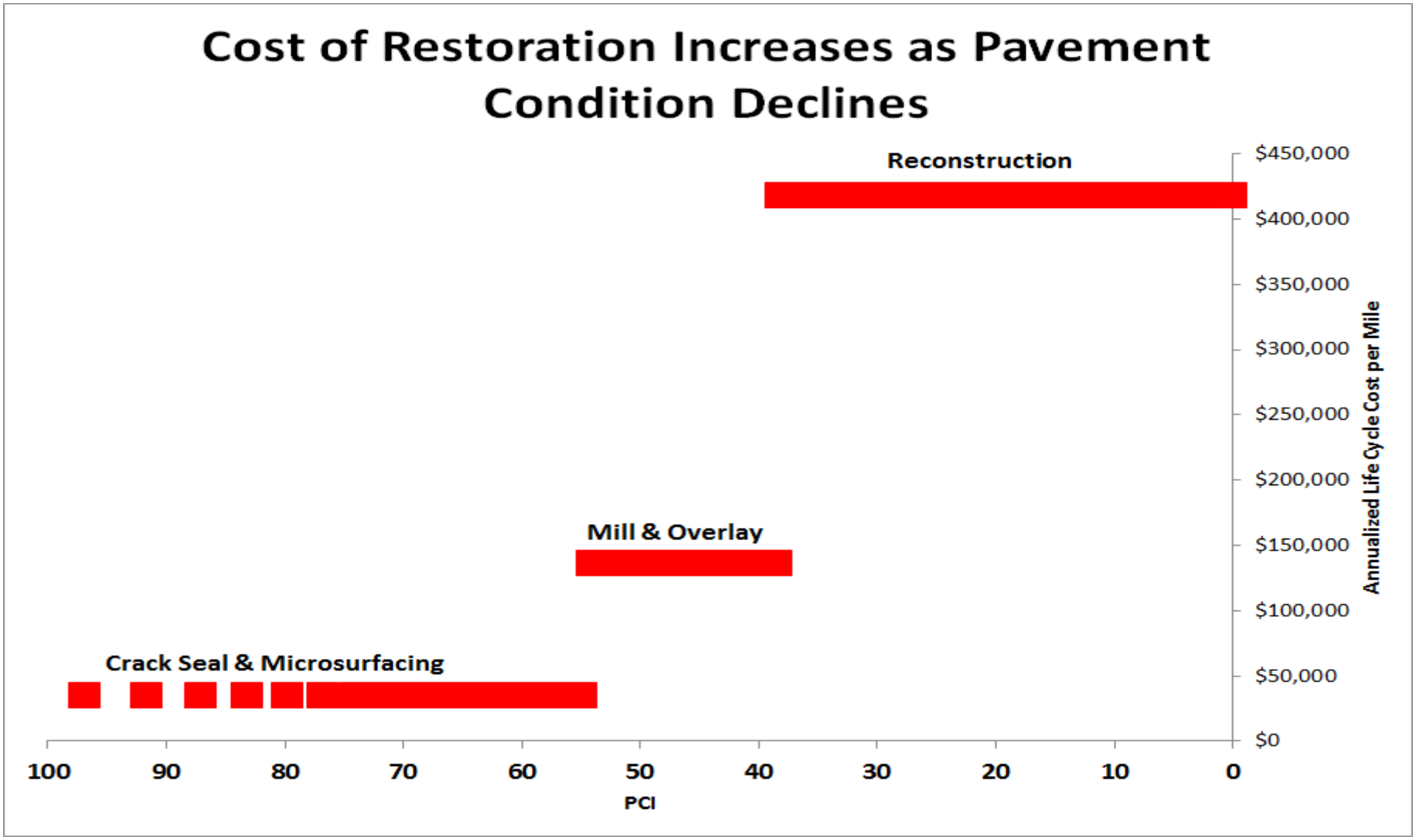
- **Quantification of Road User Savings. World Bank Staff Occasional Papers Number Two, International Bank for Reconstruction and Development, 1966**

- **Measuring Road Roughness and Its Effects on User Cost and Comfort, American Society for Testing and Materials, 1985**

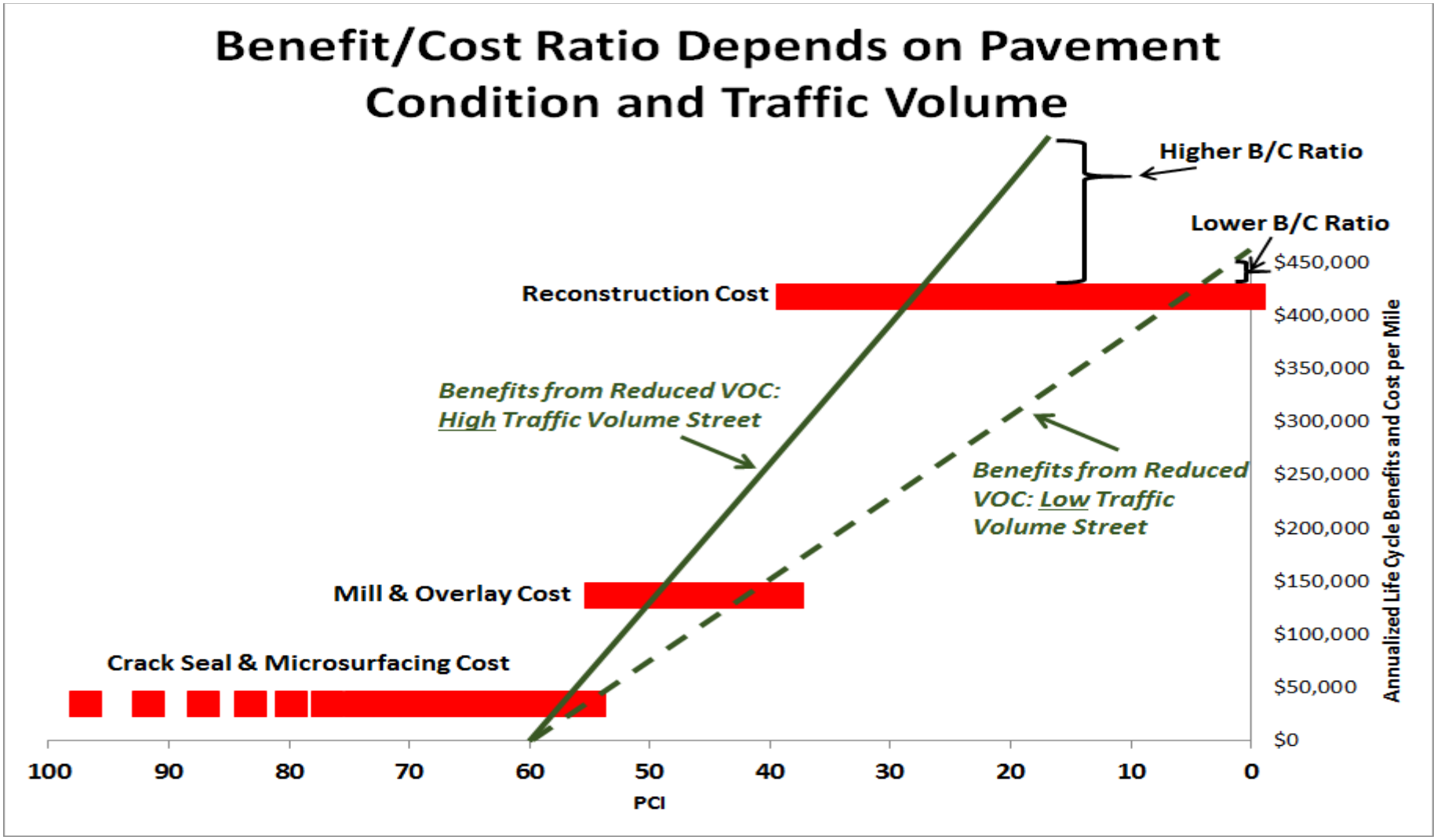
Pavement Condition Affects Vehicle Operating Cost



Pavement Condition Affects Restoration Cost



Benefit/Cost Ratio Determined by Traffic Volume and Pavement Condition



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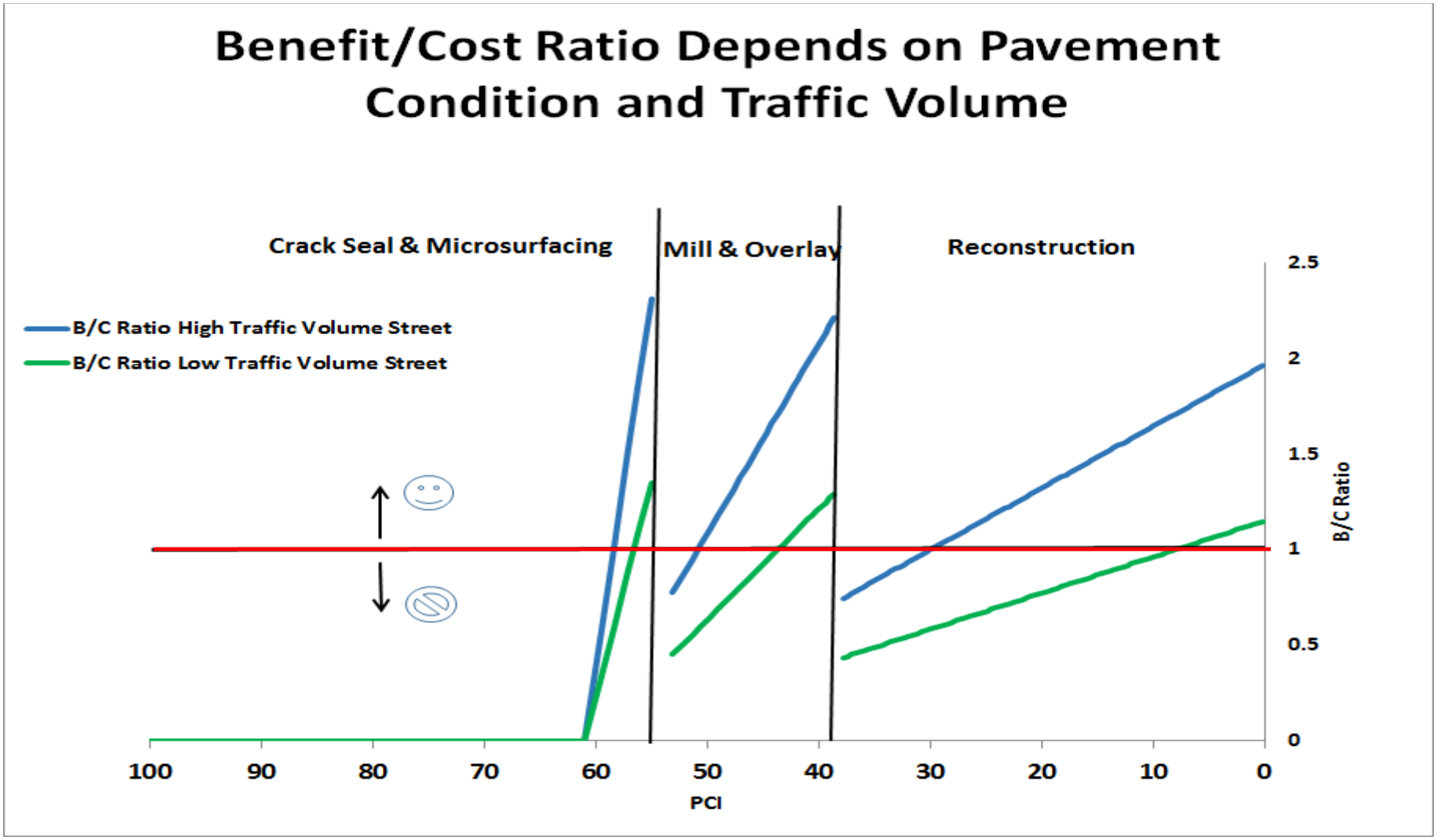

All Street Segments Sorted by B/C Ratio – Calculated Using Car, Truck and Bus Volumes, Current PCI, Future Deterioration Rate, Cost of Restoration Treatment

UNITDESC	SEGLENGTH	ARTDESCRIP	TRANDESCRI	MJTRK_STR_	SURFACEWID	SURFACETYP	PVMTCONDI	ADT	Trucks	Buses	Total PV Benefits	Total PV Costs	B/C Ratio
ROOSEVELT WAY NE BETWEEN NE 55TH ST AND NE 56TH ST	292	Principal Arte	MAJOR TRANSIT ROUTE		40	AC/PCC	62	14,000	45	60	$15,088	$12,978	1.2
NW 61ST ST BETWEEN 36TH AVE NW AND 38TH AVE NW	414	Collector Art	NOT DESIGNATED		24	AC	61	4,000	10	0	$2,853	$11,040	0.3
1ST AVE BETWEEN BLANCHARD ST AND BELL ST	426	Minor Arteria	MAJOR TRANSIT ROUTE		52	AC/PCC	55	8,000	50	100	$55,103	$283,053	0.2
N 105TH ST BETWEEN GREENWOOD AVE N AND PHINNEY AVE N	330	Principal Arte	MINOR TRAN	Y	40	AC	15	15,000	300	50	$555,891	$550,000	1.0
E MADISON ST BETWEEN 22ND AVE E AND 23RD AVE E	386	Principal Arte	MINOR TRANSIT ROUTE		30	PCC	17	13,000	250	75	$709,630	$559,700	1.3

… and so on…

Example:
10th Ave. E. Between E. Roy St. & E. Boston St.

- This street section was given a "serious/failed" PCI condition score in 2003, 2007, 2010, and 2013…it has been "failed" for a decade or more
- No reconstruction has been performed on this ~ 1 mile street section in the interim although some spot paving has occurred.
- It has continued to convey cars, buses, and trucks as usual during this period.

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Example:
10th Ave. E. Between E. Roy St. & E. Boston St.

What SDOT costs were incurred on this street section from 2003 to 2013?

- Pothole repairs, spot paving, claims and related lawsuits

Street Segment	2003 condition	2013 condition	$/yr pothole repair plus spot paving	Estimated $/yr of pothole-related claims (2003-2013)	Increased congestion?	Increased cost of eventual road reconstruction?
10th Ave. E. (E. Roy St. to E. Boston St.)	Serious / Failed	Serious / Failed	$12,000 potholes, $50,000 spot paving	~ $700	Probably Not Much	Probably Not Much

SDOT has spent about $63k/year on this street section from 2003 to 2013

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Example:
10th Ave. E. Between E. Roy St. & E. Boston St.

What user costs were incurred on this street section from 2003 to 2013?

- Increased cost to road users – vehicle operating costs

Added Vehicle Operating Cost Plus Added SDOT Costs @ PCI = 16					
	Car Cost	Truck Cost	Bus Cost	SDOT Cost	Total
% Increase in VOC	19%	37%	44%		20%
Per Vehicle-Trip*	$0.05	$1.02	$0.44		$0.10
Daily Vehicles	13,000	462	145		13,607
Vehicle-Trips/Yr	4,745,000	168,448	52,925		4,966,373
Total Annual Cost	$226,803	$171,145	$23,473	$ 63,213	**$484,635**
*Trip Length =	0.90 Miles				

Users have paid about $420k/year in additional vehicle operating costs on this street section from 2003 to 2013

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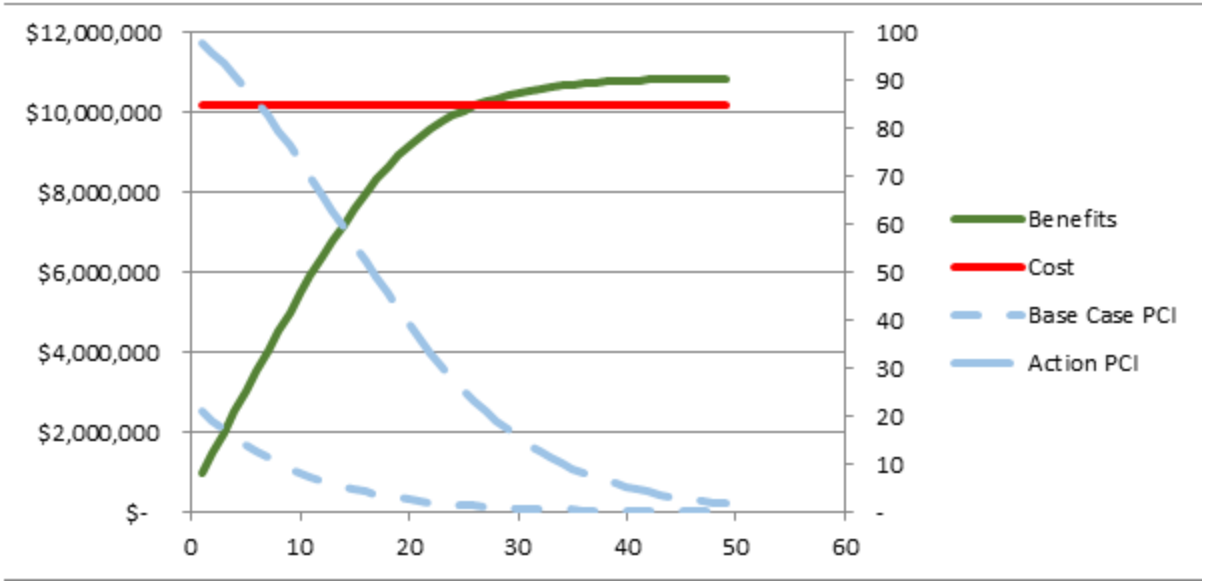
10th Ave E. Roy to E. Boston – Reconstruction Benefit/Cost Ratio

Added Vehicle Operating Cost Plus Added SDOT Costs @ PCI = 24					
	Car Cost	Truck Cost	Bus Cost	SDOT Cost	Total
% Increase in VOC	19%	37%	44%		20%
Per Vehicle-Trip*	$0.05	$1.02	$0.44		$0.10
Daily Vehicles	13,000	462	145		13,607
Vehicle-Trips/Yr	4,745,000	168,448	52,925		4,966,373
Total Annual Cost	$226,803	$171,145	$23,473	$ 63,213	**$484,635**

*Trip Length = 0.90 Miles

50 Years @ Discount Rate =	3%	7%	5%
Present Value of Added VOC (Benefits)	$13,809,076	$8,803,480	$10,854,327
Present Value of Pavement Restoration Cost	$10,176,384	$10,176,384	$ 10,176,384
Benefit/Cost Ratio	**1.36**	**0.87**	**1.07**

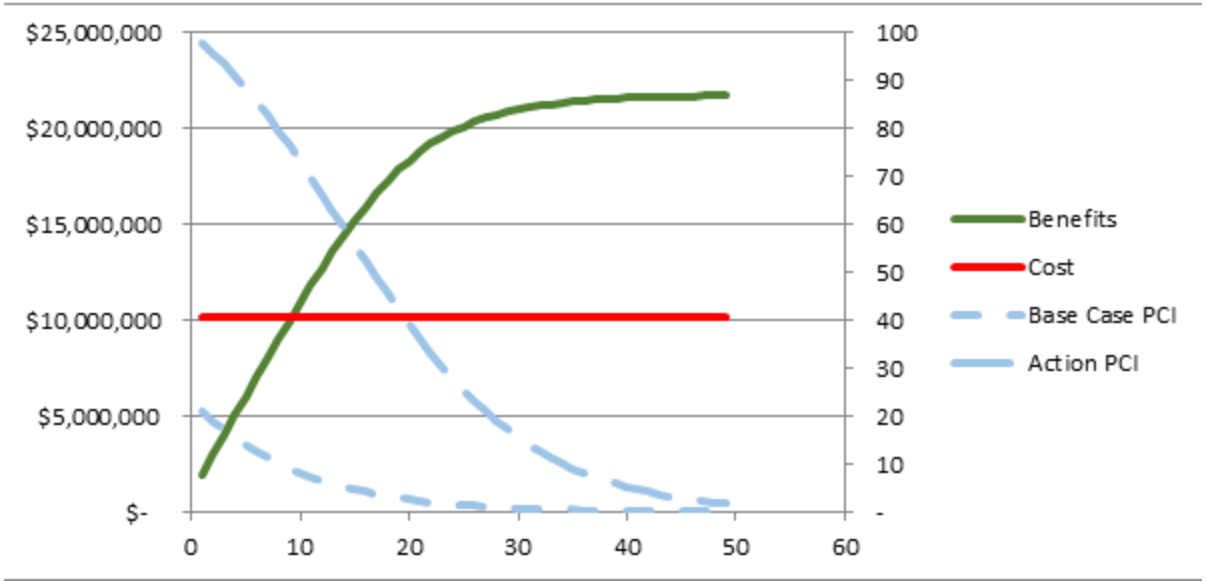


10th Ave E. Roy to E. Boston – Reconstruction Benefit/Cost Ratio

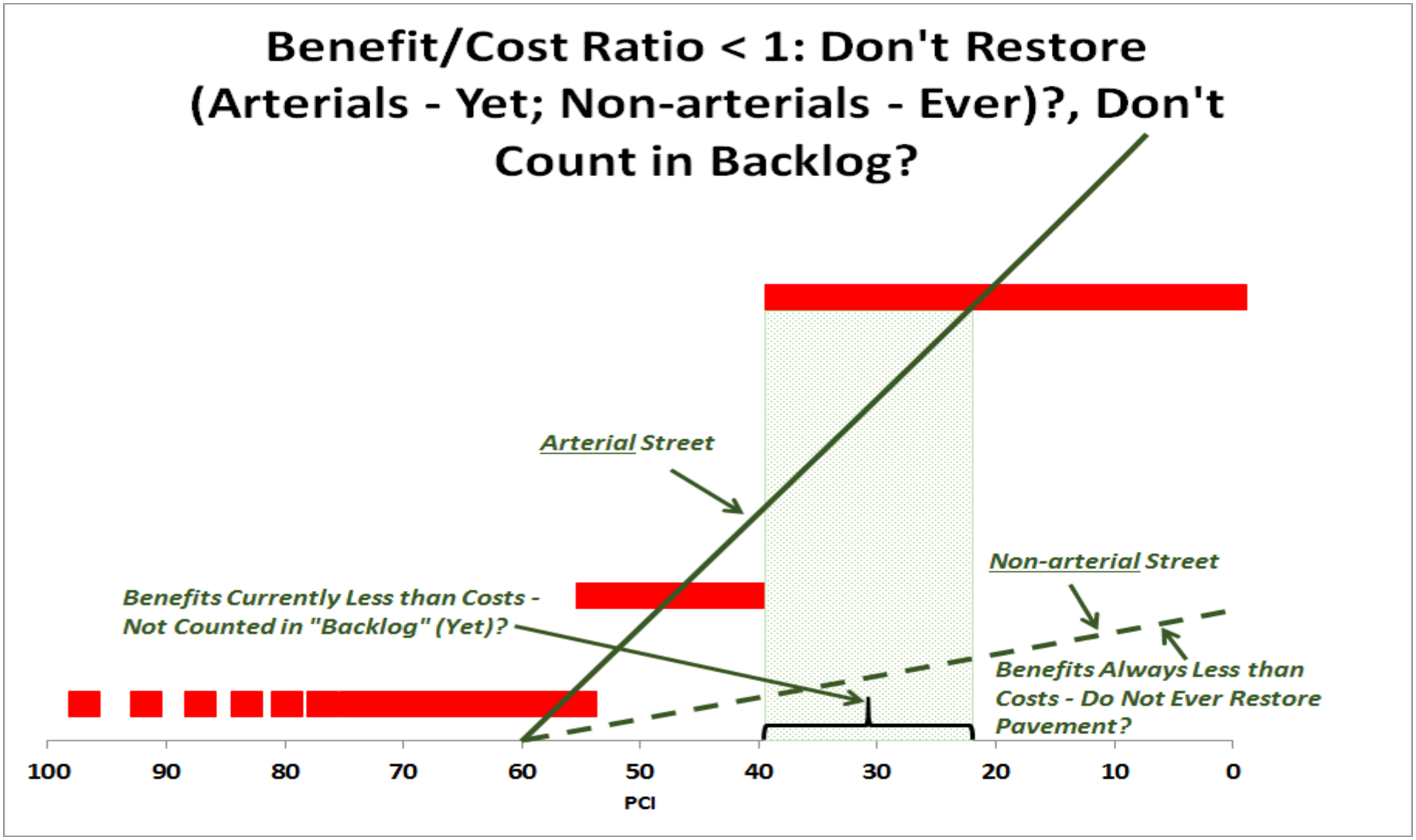
Added Vehicle Operating Cost Plus Added SDOT Costs @ PCI = 24					
	Car Cost	Truck Cost	Bus Cost	SDOT Cost	Total
% Increase in VOC	19%	37%	44%		20%
Per Vehicle-Trip*	$0.05	$1.02	$0.44		$0.10
Daily Vehicles	26,000	923	290		27,213
Vehicle-Trips/Yr	9,490,000	336,895	105,850		9,932,745
Total Annual Cost	$453,607	$342,290	$46,946	$ 126,426	**$969,269**

*Trip Length = 0.90 Miles

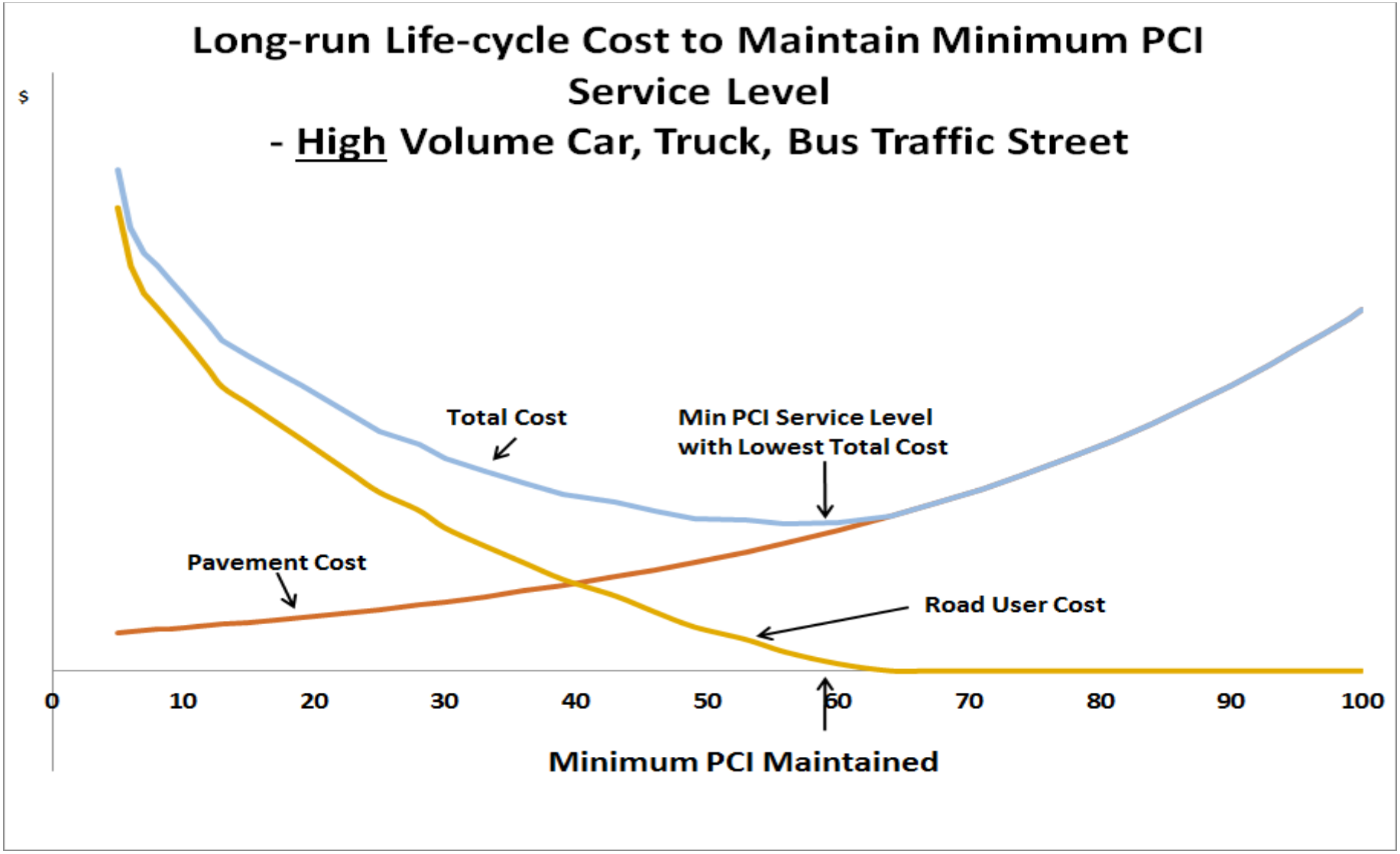
50 Years @ Discount Rate =	3%	7%	5%
Present Value of Added VOC (Benefits)	$27,618,153	$17,606,960	$21,708,654
Present Value of Pavement Restoration Cost	$10,176,384	$10,176,384	$ 10,176,384
Benefit/Cost Ratio	**2.71**	**1.73**	**2.13**



Implications: Variable Service Levels by Traffic Volume and Re-considering "Backlog"



Variable Minimum PCI Service Levels by Traffic Volume



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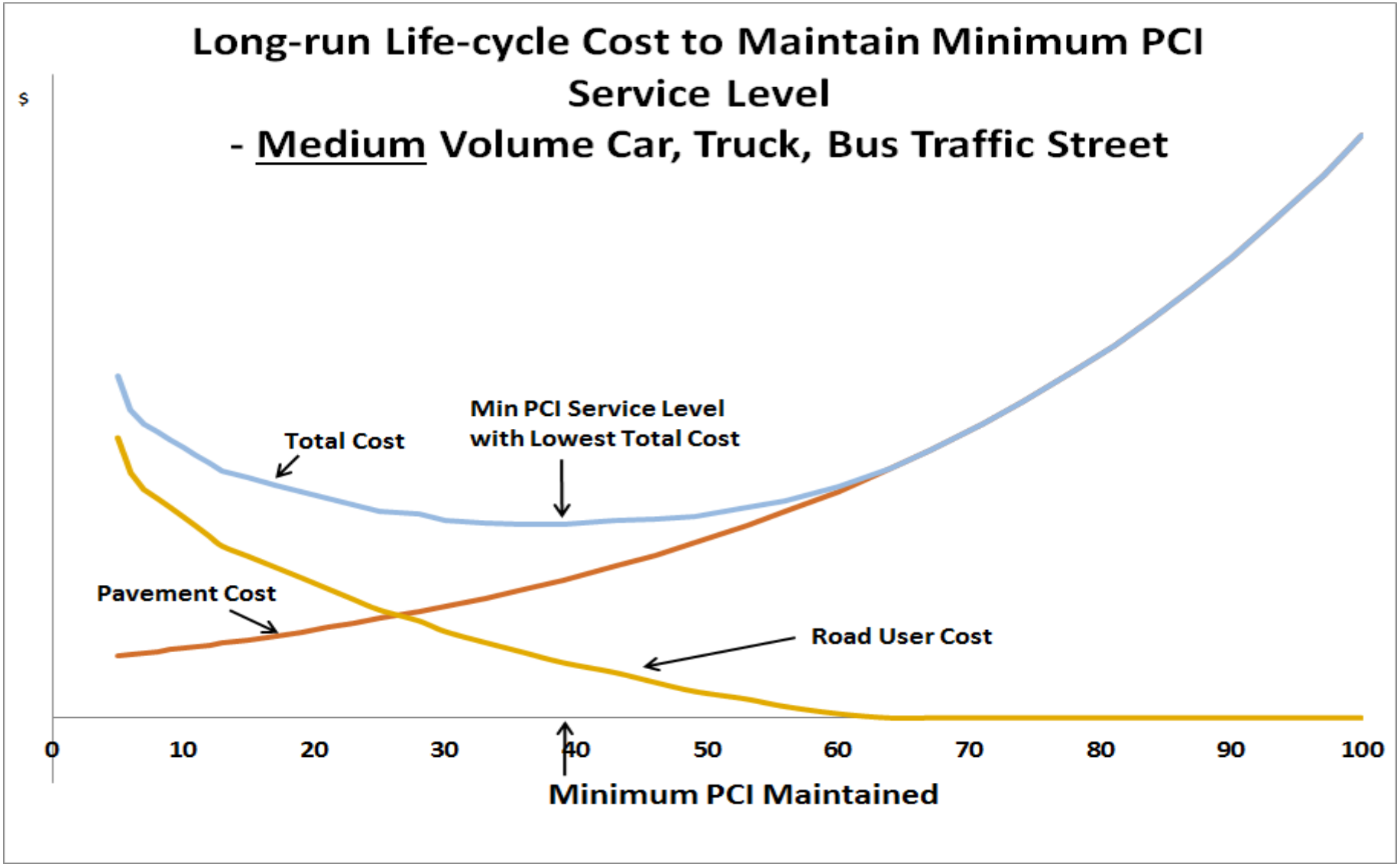
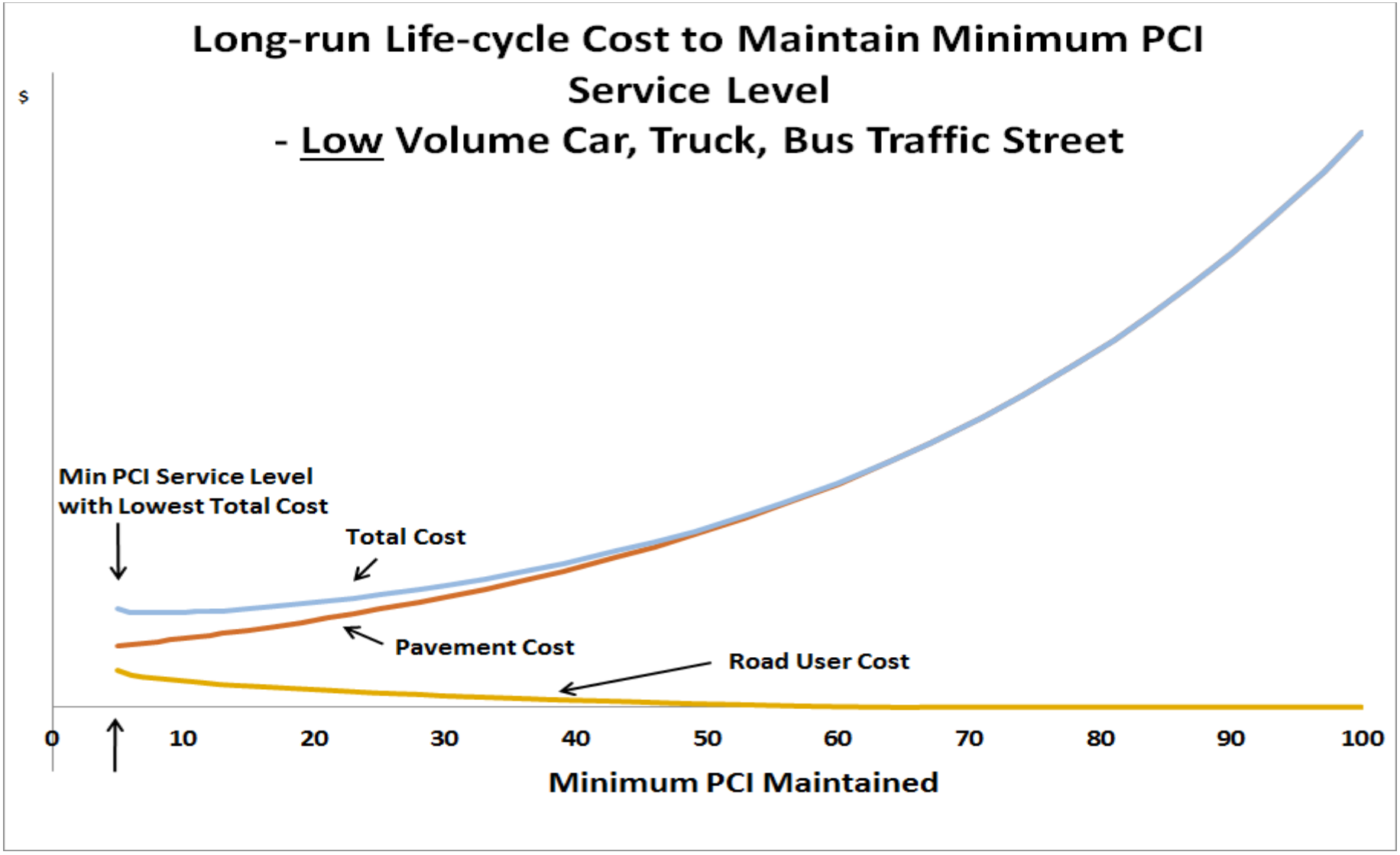


Variable Minimum PCI Service Levels by Traffic Volume



Example: Arterial Pavement Funding

Pavement Condition	Service Level	Minimum Acceptable Condition
Good	Service Level 1 (Highest Level of Service - Expensive)	Fair or Above?
Satisfactory		
Fair		
Poor	Service Level 2 (Medium Level of Service – Less Expensive)	Poor?
Very Poor	Service Level 3 (Low Level of Service – Least Expensive)	Failed?
Serious/Failed		

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