Risk-Based Adaptive Management of Remediation Site Portfolios--Prologue

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Goal

Review methodology and experience in system safety, with the aim toward risk-based adaptive management of a program of remediation sites.

Outline

Investments in system safety

Core values of a safety program

Program-to-program integration

Risk scenarios and site parameters

Investments in System Safety

Table 1. Summary of the Benefits of Lighting (% reduction of nighttime crashes) (CIE 1990)

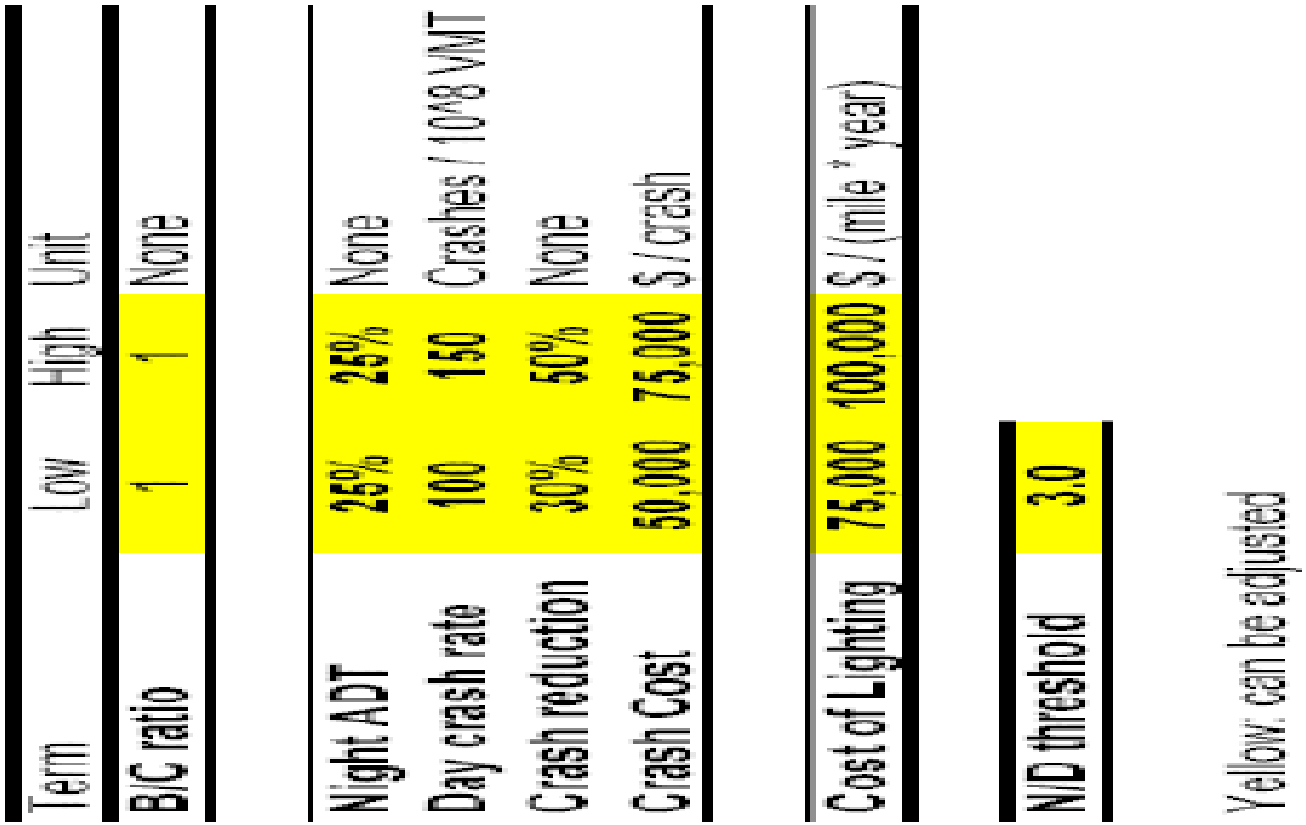
Road Class	Crashes classification: All crashes Sample studies	All crashes Range	All crashes Mean % reduction	Pedestrians Sample studies	Pedestrians Range	Pedestrians Mean % reduction	Fatalities Sample studies	Fatalities Range	Fatalities Mean % reduction
Urban									
Continuous	3	21 to 75	43	2	46 to 75	51	6	29 to 48	34
	10	9 to 75	29	4	16 to 57	42	9	16 to 48	29
Pedestrian				1		64			
Crossings				8	32 to 74	54			
Rural									
Continuous	2	13 to 75	44				2	38 to 53	45
	4	13 to 75	37				6	13 to 100	44
Junctions	1		44						
	2	26 to 44	35				1		9
Freeways									
Continuous	1		57				1		62
	3	56 to 58	57						
Interchanges	1		41						

Investments in System Safety

ADT	Average daily traffic	vehicles per day
%N_ADT	Percentage of night traffic	% of average daily traffic
N/D	Night-to-day crash rate ratio	-
DCR	Day crash rate	crashes per 10^8 VMT
CRF	Crash reduction factor	% of current crashes
ACC	Average crash cost	$ per crash
AIC	Annualized installation cost of lighting	$ per year per mile
AMC	Annual maintenance cost	$ per year per mile
AEC	Annual energy cost	$ per year per mile

$$Benefit-to-Cost\_Ratio = \frac{365 \times ADT \times \%N\_ADT \times N/D \times DCR \times CRF \times ACC}{100{,}000{,}000 \times (AIC + AMC + AEC)}$$

Investments in System Safety



Investments in System Safety

Table 11. Crash Data Grouped by Nodes in Richmond District

N/D Ratio	AADT	Total Crashes	Day Crashes	Night-Lighted Crashes	Night-Unlighted Crashes	Ped. Injury	Ped. Fatality
2.68	23,000	106	56	5	45	0	0
1.26	29,000	126	88	11	26	1	0
1.59	38,000	124	81	9	34	0	0
1.56	34,000	121	79	12	29	1	0
1.37	35,000	121	83	10	28	0	0
1.57	34,000	103	67	10	25	1	0
1.24	50,000	114	80	9	24	1	0
1.52	14,000	95	63	4	28	0	0
1.48	13,000	105	69	5	29	1	1
1.48	64,000	97	65	1	31	0	0
1.45	24,000	87	58	4	24	1	0
1.38	42,000	94	63	6	23	2	0
1.03	47,000	102	76	3	23	0	0
1.28	35,000	98	68	9	20	1	0

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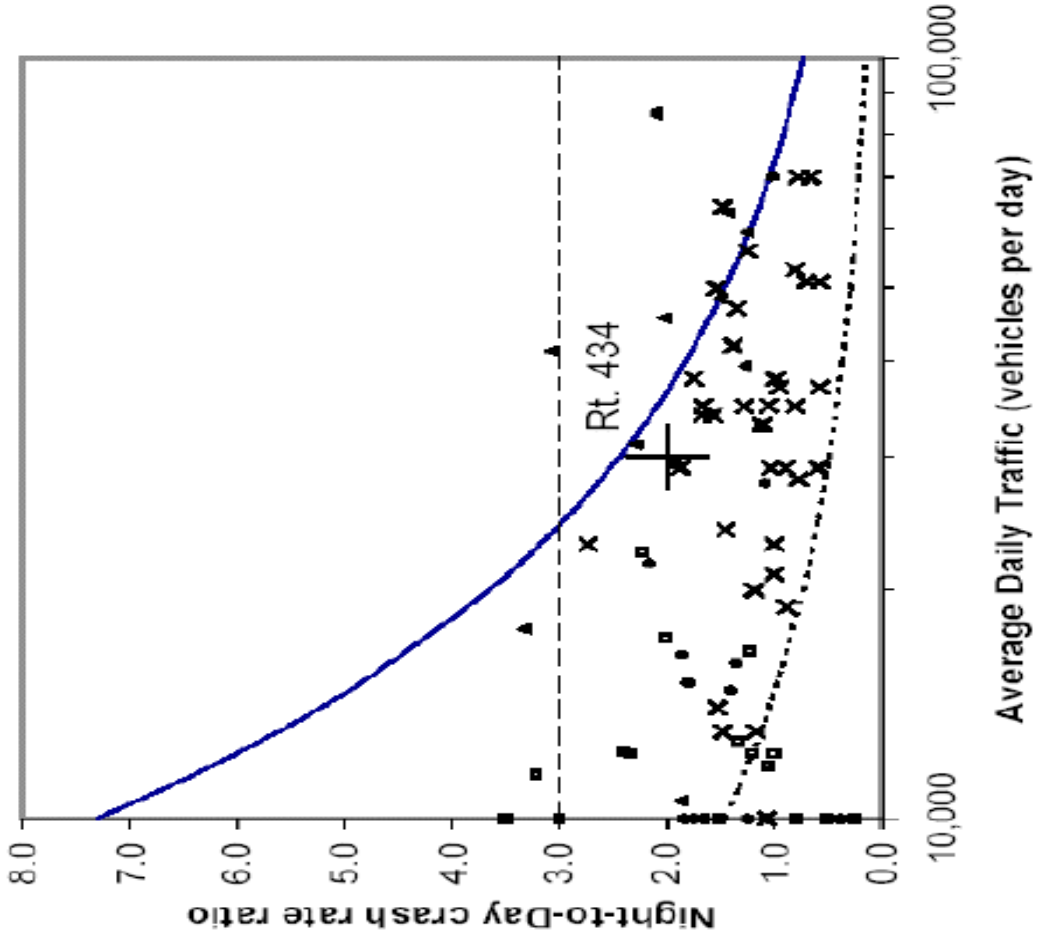
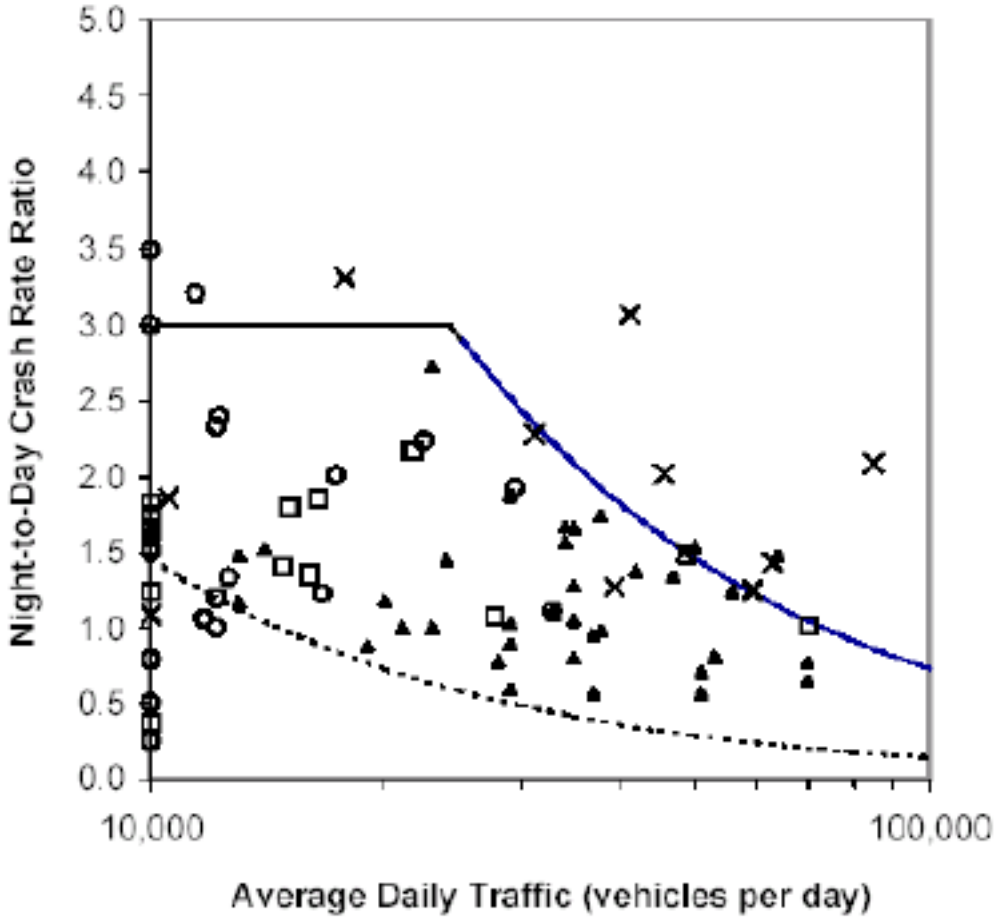
Investments in System Safety

Term	Low	High	Unit
B/C ratio	1	1	None
Night ADT	25%	25%	None
Day crash rate	100	150	Crashes / 10^8 VMT
Crash reduction	30%	50%	None
Crash Cost	50,000	75,000	$ / crash
Cost of Lighting	75,000	100,000	$ / (mile * year)
N/D threshold	3.0		

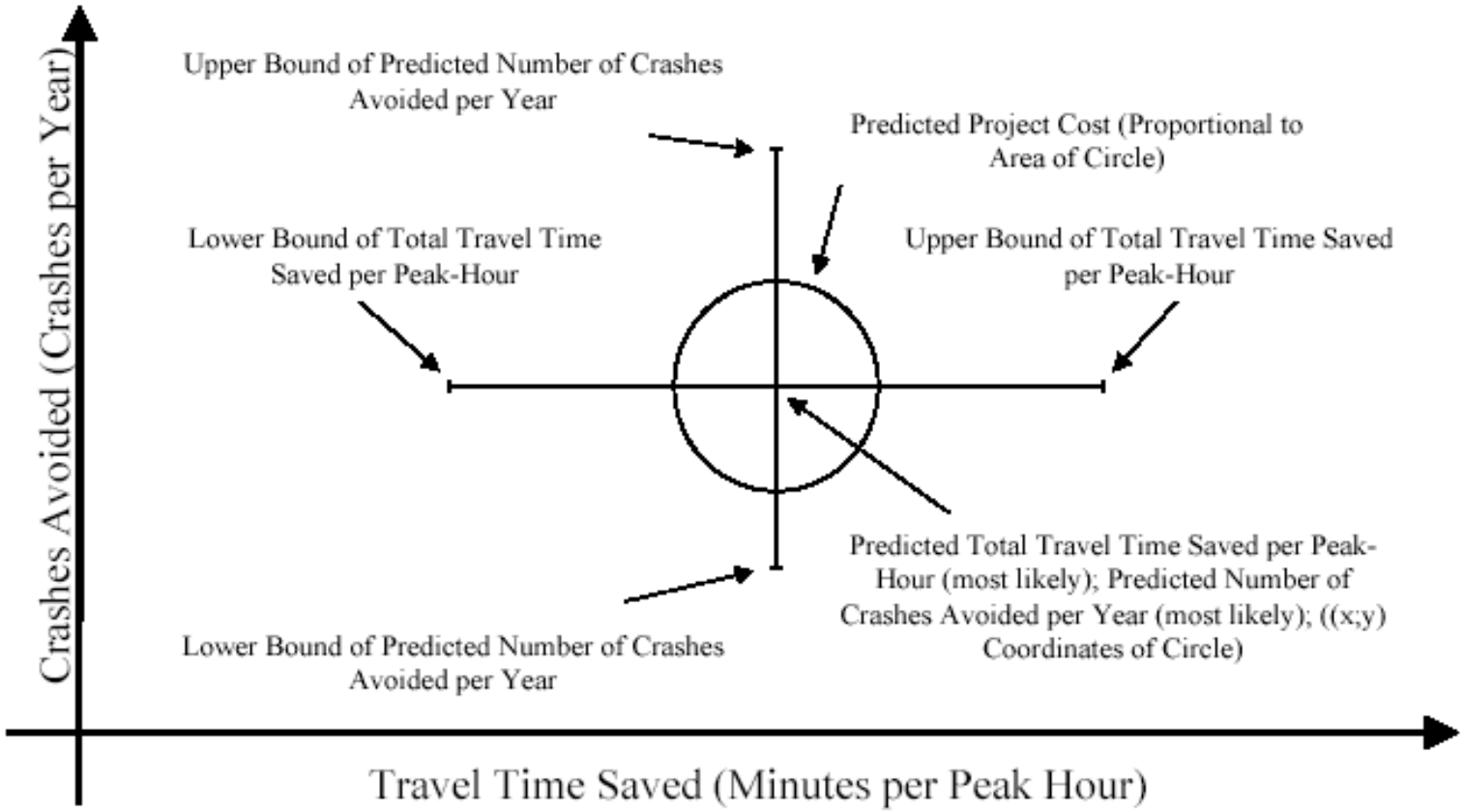
Yellow: can be adjusted



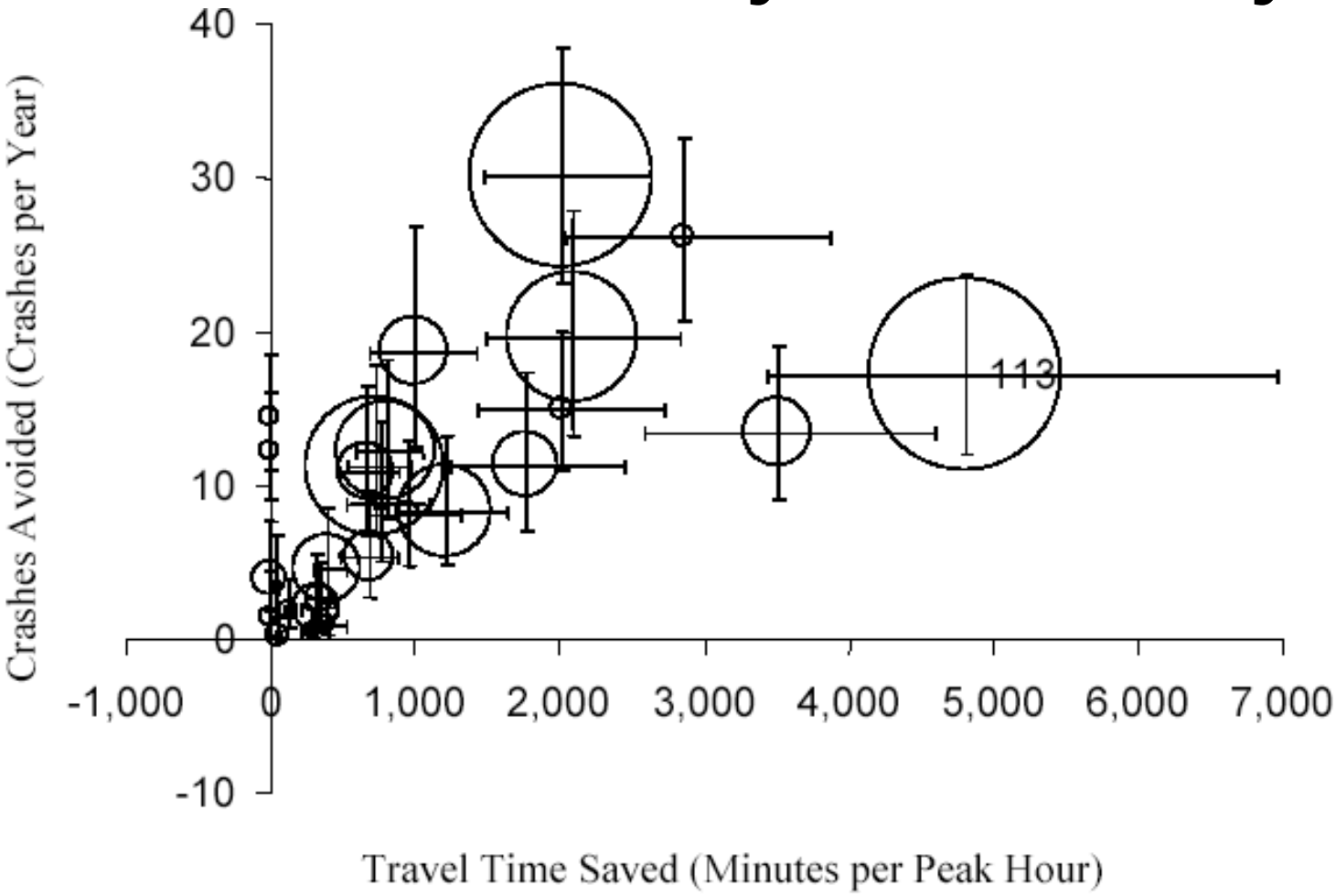
Investments in System Safety



Investments in System Safety



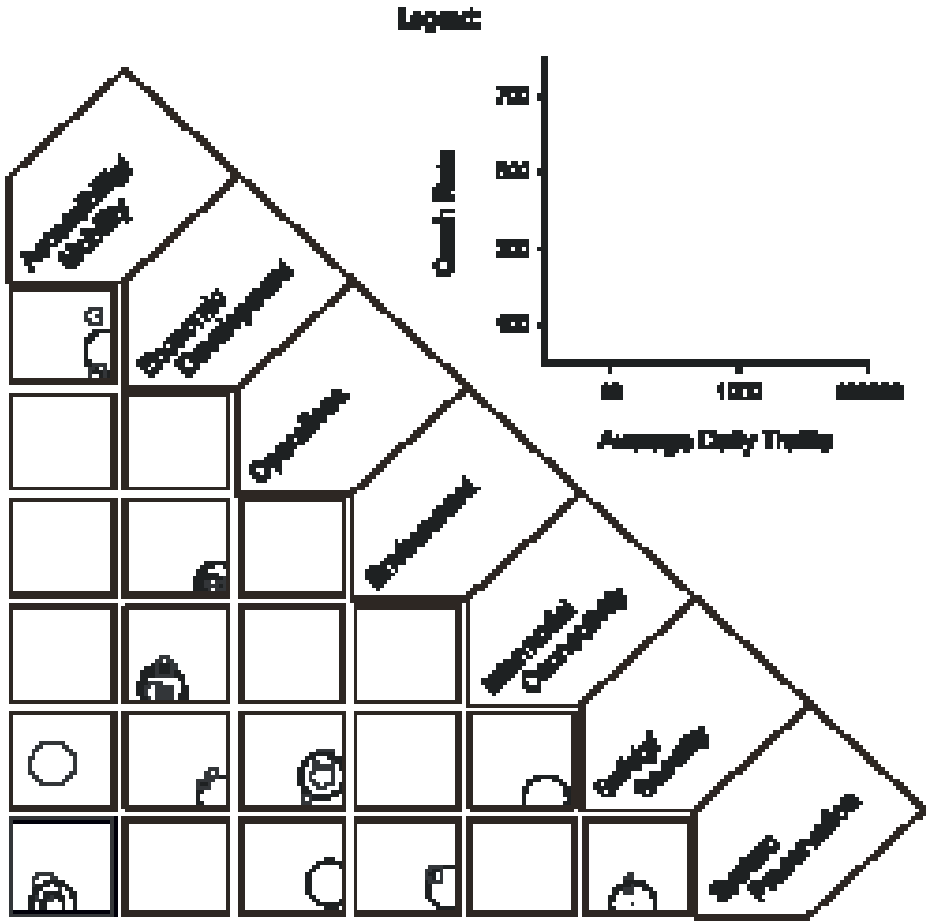
Investments in System Safety



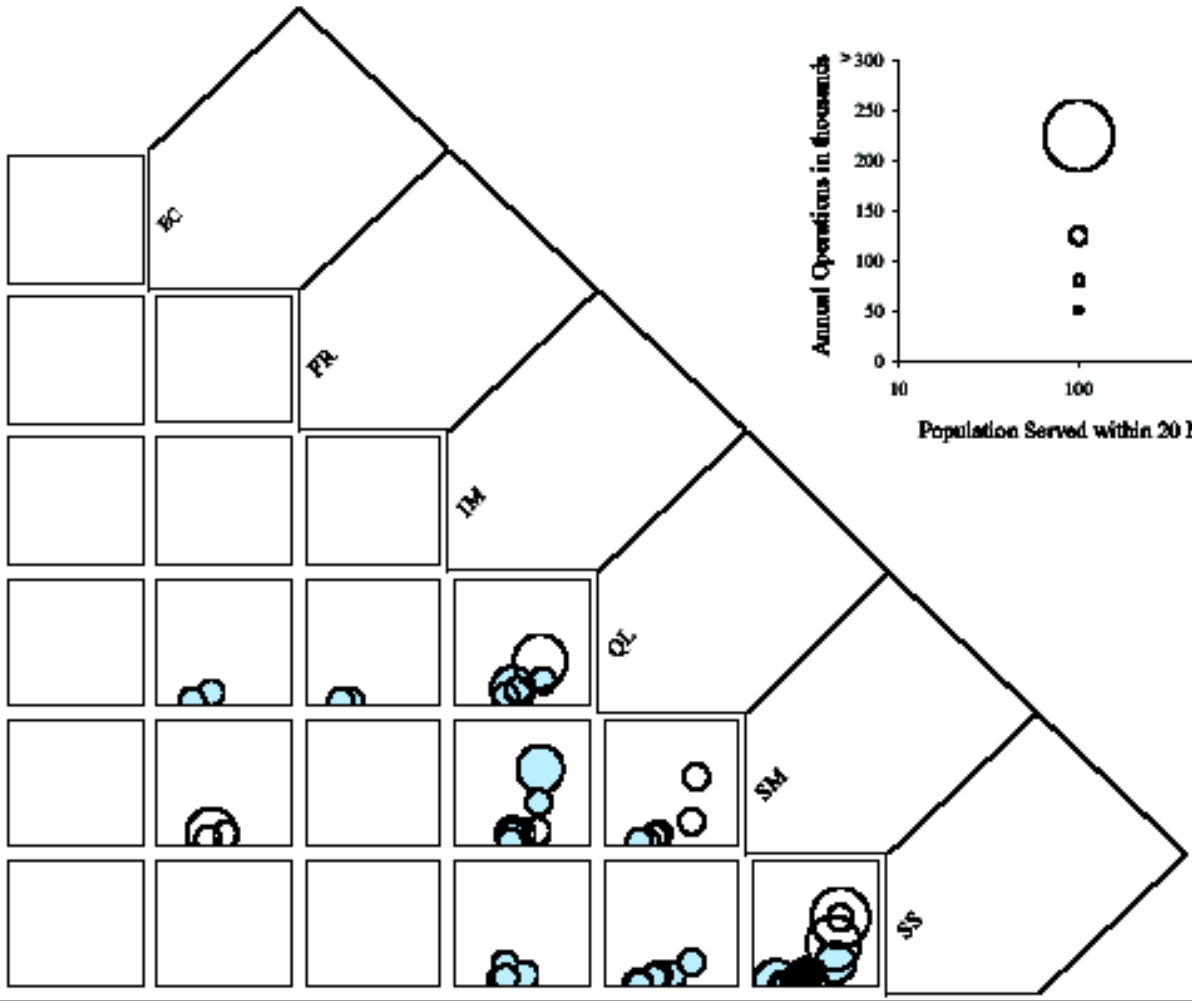
Core Values of a Safety Program

EC: Economic competitiveness
FR: Fiscal responsibility
IM: Intermodalism and mobility
QL: Quality of life
SM: Systems management
SS: Safety and security

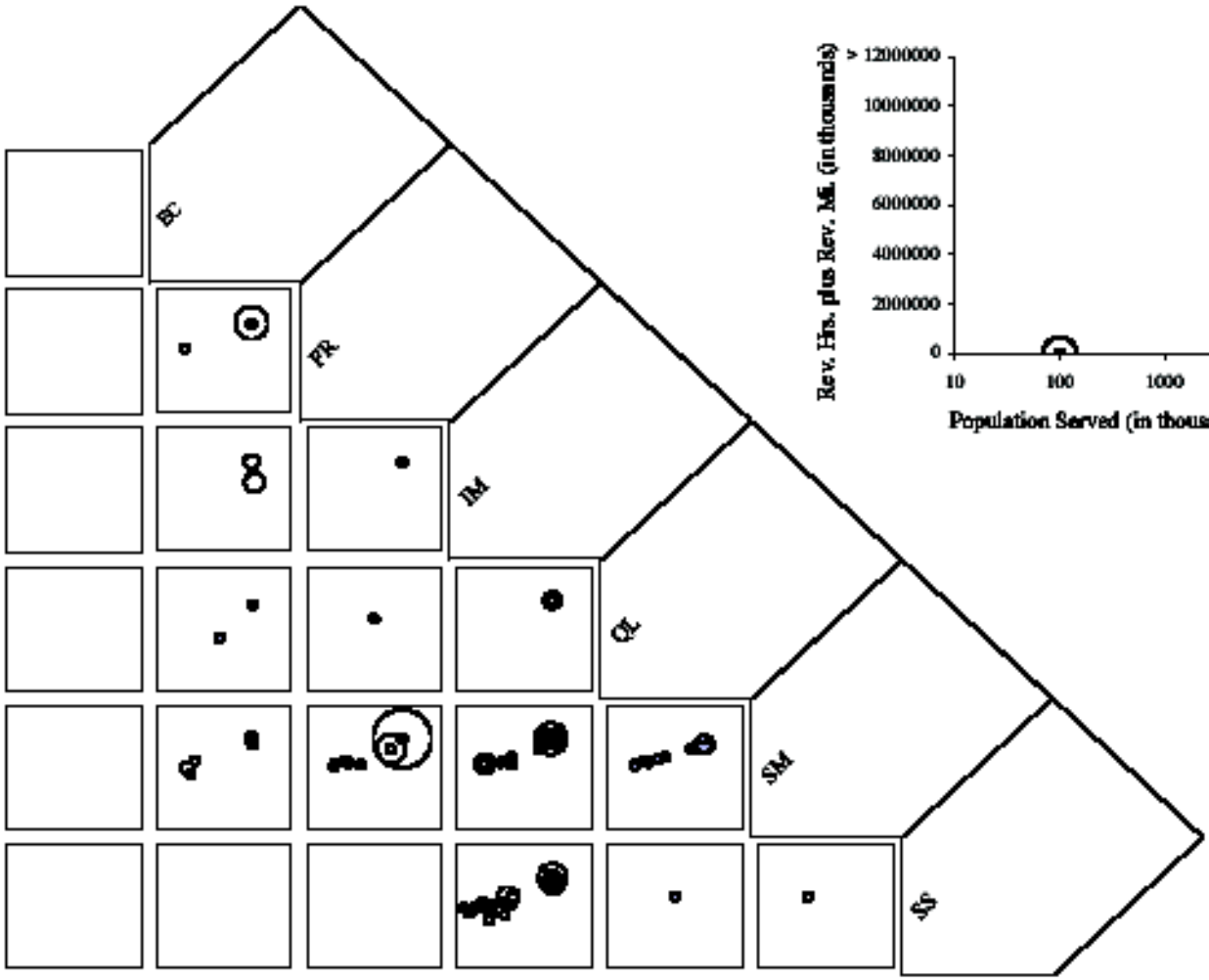
Core Values -- Roads



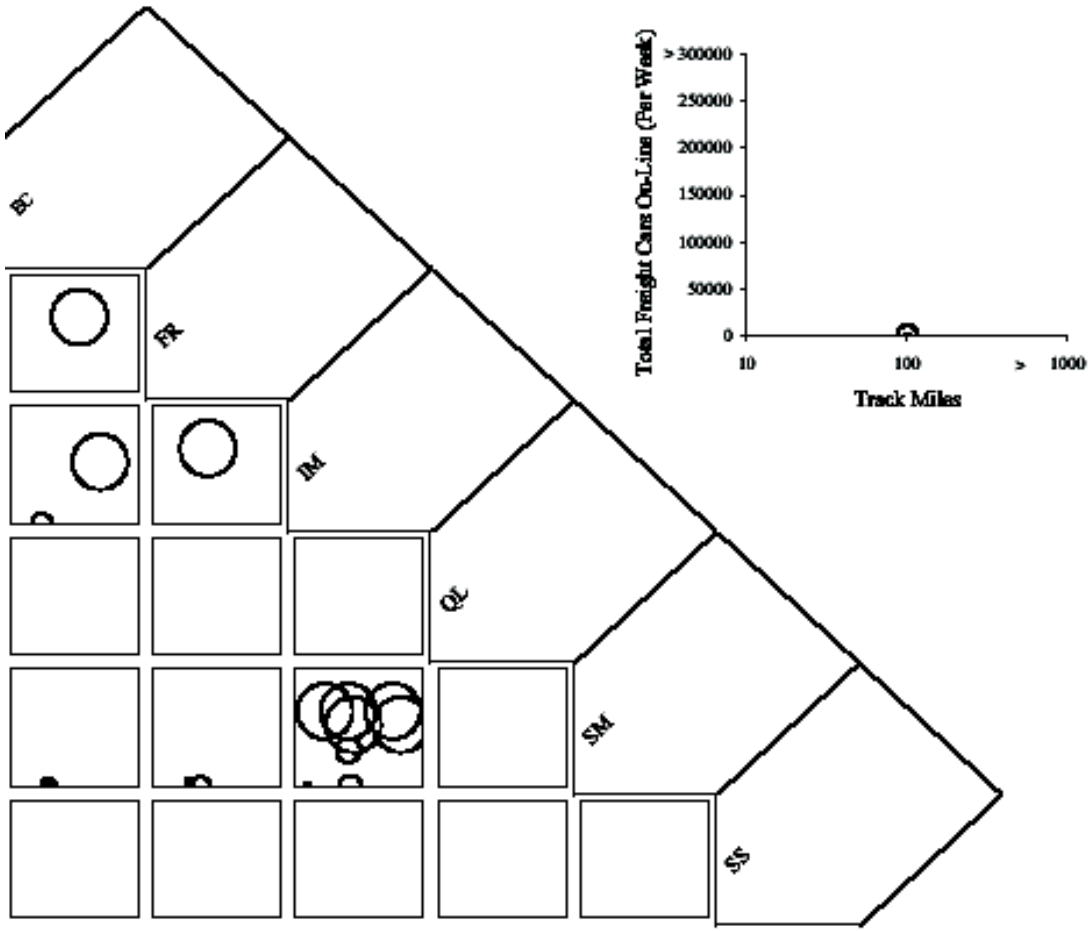
Core-Values --Aviation



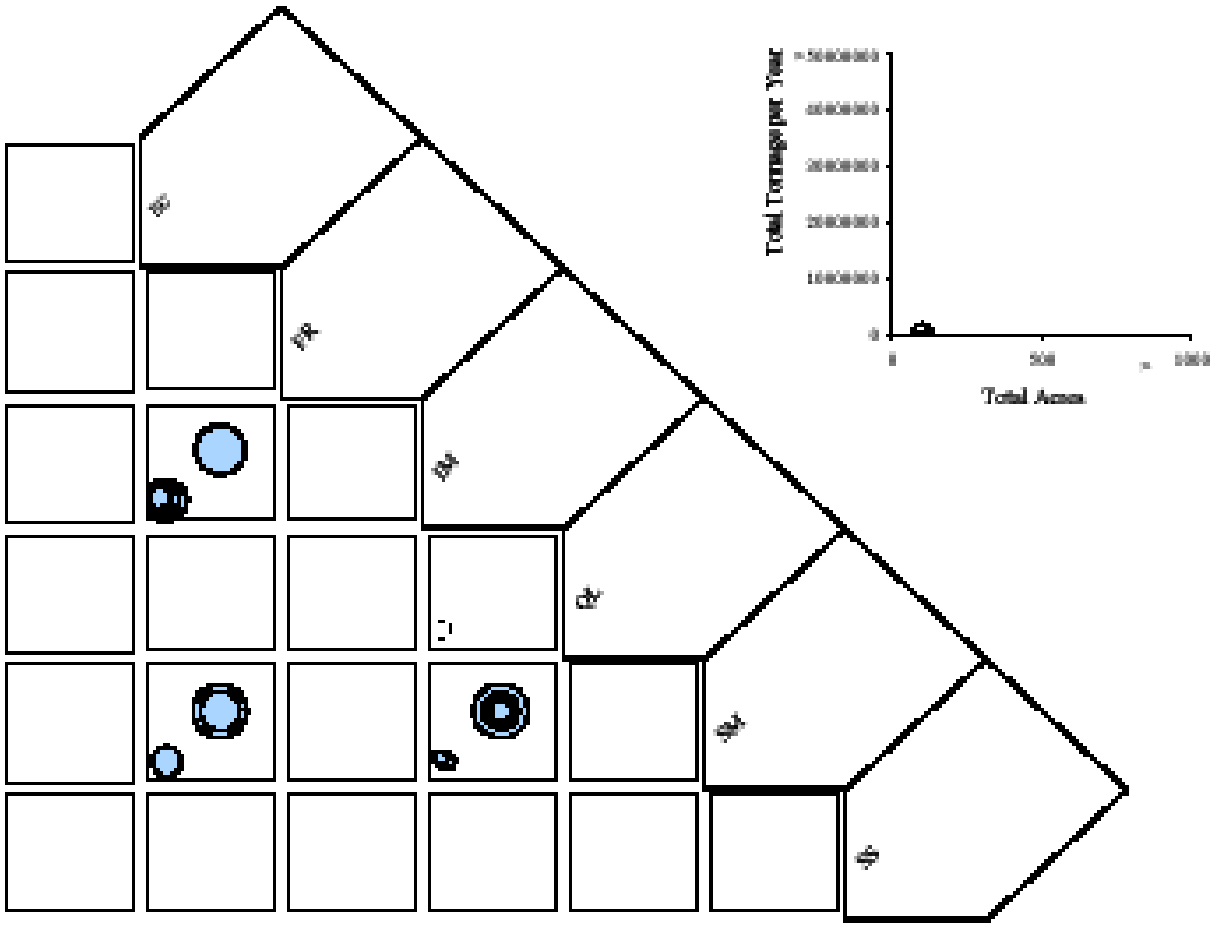
Core Values -- Transit



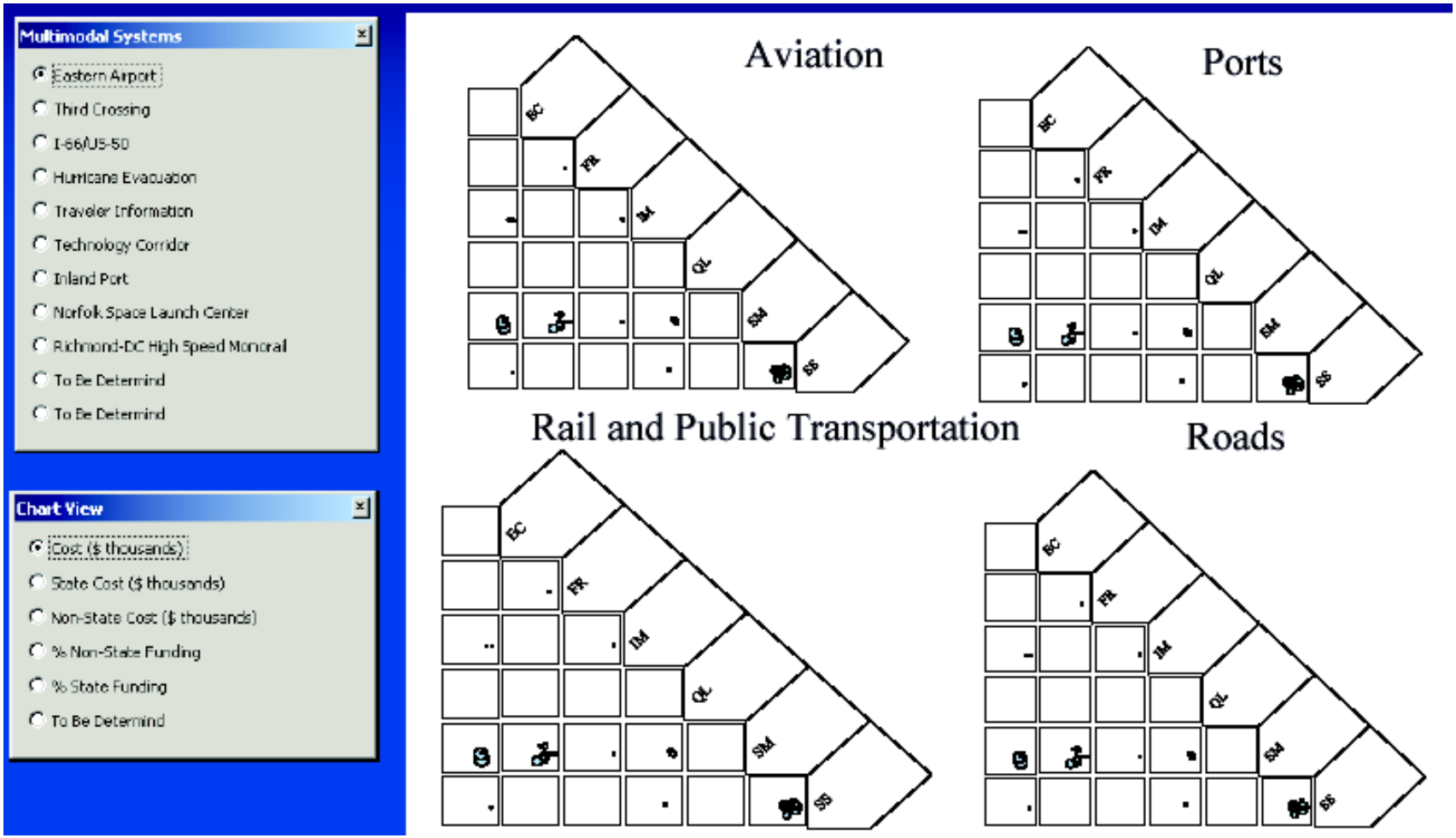
Core Values -- Rail



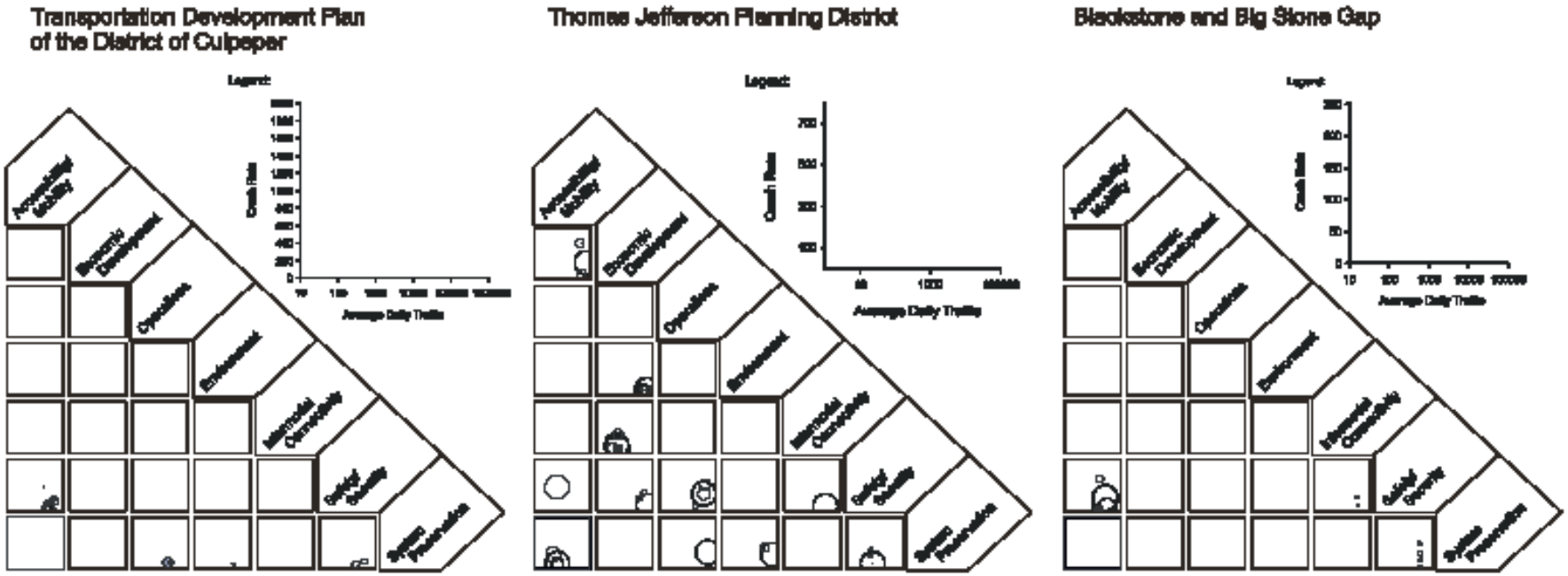
Core Values -- Ports



Program-to-Program Integration



Program-to-Program Integration



Identification of Risk Scenarios

Code	Visibility–loss scenarios	Detailed description/examples
SC 1	Pedestrian conflicts	urban areas (pedestrians crossing)
		terminals (intermodal platform, hub)
		parking lots
SC 2	Glare	veiling luminance
		headlights of other vehicles
		pavement reflectance
SC 3	Driver errors	improper lookout
		Inattention
		Speeding
		internal distraction
		false assumption
SC 4	Stalled/crashed vehicle	stalled vehicle obstructing lane
		stalled vehicle in emergency lane
		stalled vehicle in median or shoulders
		single or multi-vehicle crash
SC 5	Construction activity	Workers
		construction equipment activity
		channelization by cones and barriers
		narrow lanes with short or no shoulders
SC 6	Uneven pavement or road debris	fallen item
		dead animal, animal crossing
		irregular pavement
		debris (tread, exhaust, bumpers...)
		chemical spill
SC 7	Weather conditions	rain, thunderstorm (lightning, heavy rain)
		fog, snow and ice

Identification of Site Parameters

Factor	Low	Moderate	High
Traffic mix (percentage of qualified trucks in the overall traffic)	0 – 15 %	15 - 25 %	> 25 %
Veiling Luminance (percentage of luminous development frontage)	0 – 25 %	25 - 70 %	70 – 100 %
Curvature and grade			
Curvature	< 3 °	4 ° - 5 °	>= 6 °
Grade	Level - Rolling	Mountainous	No Score
Lane configuration			
(Lane width or	> 11 ft	< 10 ft	No Score
Number of lanes)	6 or less lanes undivided	6 or more lanes divided	
Section/Intersection geometry			
(Sight distance or	500 ft	≤ 400 ft	
Median width or	30 - 12 ft	≤ 12 ft	No Score
Shoulder width or	> 7 ft	≤ 7 ft	
Intersection/Interchange frequency)	< 3 /mile	≥ 3 /mile	
Posted Speed	< 45 MPH	> 55 MPH	No Score
Level of Service	D or better	E or worse	No Score
Intermodal transactions			
Distance to tourist, elderly venues and intermoda platforms	1 mile	½ mile	No Score
Adjacent Parking Spaces	Prohibited both sides	Permitted both sides	No Score

Risk Scenarios and Site Parameters

	SC 1 Pedestrian conflicts	SC 2 Glare	SC 3 Drivers errors	SC 4 Stalled / crashed vehicle	SC 5 Construction activity	SC 6 Uneven pavement or road debris	SC 7 Weather conditions
Traffic mix		x	x		x		
Veiling luminance	x	x	x	x			
Curvature and grade		x	x				x
Lane configuration			x	x	x	x	x
Section/I-sect geometry	x		x	x	x		x
Posted speed		x	x	x	x	x	x
Level of service				x	x	x	x
Intermodal transactions	x	x	x				x

References

www.people.virginia.edu/~jhl6d

www.virginia.edu/crmes/comparison

www.virginia.edu/crmes/multimodal

www.virginia.edu/crmes/lighting

www.virginia.edu/crmes/guardrail

www.virginia.edu/crmes/2001hurricane

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www.virginia.edu/crmes/recovery