

Performance-Based Design Workshop April 22, 2019

Workshop Outline

- Welcome and Introductions
- Overview from Metro
- Overview of Performance-Based Design and Decision-Making Framework
- Interactive Session
- Closing Remarks



Welcome and Introductions



Updating design guidance for regional streets and trails

Projects funded with regional funds must use the guidelines and performance-based planning framework



Street design implements 2040 Growth Concept





Regional transportation system components

Regional multimodal transportation facilities and services including the following:

- 1. Regional System Design
- 2. Regional Motor Vehicle Network
- 3. Regional Transit Network
- 4. Regional Freight Network
- 5. Regional Bicycle Network
- 6. Regional Pedestrian Network
- 7. Regional System Management and Operations/ Demand Management



Regional street design policy classifications

Different designs apply to different classifications

Regional street design classifications dictate how throughways and arterials in the RTP should be designed: •number of lanes priority functions design speed •separation of modes •flex-zone uses •place-making/public space •green infrastructure 7



Freeway and highway design classifications

Freeway and highway design classifications emphasize long-distance motor-vehicle and high-capacity transit travel, connect major activity centers and are separated from the surrounding land use. Bicycle and pedestrian travel are provided on separate facilities. Freeways are completely grade separated, while highways have some at-grade access and turns. 8



Regional and community <u>boulevard</u> design classifications

Regional and community boulevard classifications are applied to roadways within 2040 centers, station communities and to main streets. Boulevards serve major centers of urban activity and emphasize access and mobility for public transportation and people walking and bicycling.





Regional Boulevard (2 lanes)

RIGHT-OF-WAY 70'-100'

Regional and community <u>street</u> design classifications

Regional and community street classifications are applied to transit corridors, main streets, industrial and employment areas and neighborhoods with designs that integrate all modes of travel and provide accessible and convenient pedestrian, bicycle and public transportation travel.







Industrial street design classification

Industrial street classifications are applied to roadways that serve intermodal facilities such as airports, and to roadways in industrial and employment areas. Designs primarily serve freight mobility and access while integrating multi-modal travel and access to transit. RIGHT-OF-WAY 60'-90'

Overview of Performance-Based Design

- Recent AASHTO Updates
- Metro Designing Livable Streets & Trails Guide
- Making Informed Multimodal Decisions
- Performance-Based Design
 Project Example





What is Performance-Based Design?

- Everyone is talking about it
 - AASHTO, FHWA, ITE, NACTO, NCHRP, State DOT
- What does it really mean?
- How do you implement it?





Performance-Based Design

" A principles-based approach that looks at the outcomes of design decisions as the primary measure of design effectiveness."

> NCHRP Report 785, *Performance-Based Analysis of Geometric Design of Highways and Streets*





Performance-Based Design

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Performance-Based Design

- 1. Identify desired project outcomes
- 2. Establish design decisions
- 3. Evaluating the performance
- 4. Iterating and refining the design
- 5. Assessing the financial feasibility
- 6. Selecting a preferred alternative that aligns with the desired outcomes





National trends

MORE FLEXIBILE, MULTIMODAL DESIGN PRACTICES



Recent AASHTO Trends

- AASHTO Standing Committee on Highways (SCOH) Resolution
- A Policy on Geometric Design of Highways and Streets (Green Book)
 - 2018 7th Edition
 - 2019 8th Edition Visioning and Roadmap



AASHTO Standing Committee on Highways (SCOH) Resolution

Geometric design should be flexible and performance-based to promote safe and efficient multimodal planning and design.

- Approved May 25, 2016



AASHTO Standing Committee on Highways (SCOH) Resolution

"... robustly-researched guidance is needed on how best to incorporate other modes of travel"

"AASHTO should provide guidance to state DOTs and other users of the Green Book regarding flexibility in design"



AASHTO Standing Committee on Highways (SCOH) Resolution

"...guidance should assist in educating engineers and designers on the flexibility..."

"...guidance should address designing in and for a multi-modal transportation system"



Key Themes of Green Book 7th Edition

- Emphasizes design flexibility and performance-based design
- Increased multimodal emphasis
- New context classifications



Key Themes of Green Book 7th Edition

Project Types

- NEW CONSTRUCTION PROJECTS
- **RECONSTRUCTION PROJECTS**
- PROJECTS ON EXISTING ROADS



Key Themes of Green Book 7th Edition

Based on NCHRP Report 855

Two Rural: Rural and Rural Town

Three Urban: Urban, Urban Core and Suburban





NCHRP Report 855 — An Expanded Functional

Classification System for Highways and Streets

	1	r i		Í	1	1
	Context Roadway	Rural	Rural Town	Suburban	Urban	Urban Core
	Principal Arterial	H speed H mobility-L access	L/M speed M mobility-H access	M/H speed M mobility-M access	L/M speed M mobility-M access	L speed M mobility-M access
		LC: L separation; NC: M separation; CC: H separation	LC: L separation; NC, CC: M separation	LC: L separation; NC: M separation; CC: H separation	LC: L separation; NC: M/H separation; CC: H separation	LC: L separation; NC, CC: M separation
		P1: *; P2: Min; P3, P4: Wide	P2: Min; P3: Wide; P4: Enhanced	P1: *; P2: Min; P3: Wide; P4: Wide	P2: Min; P3: Wide; P4: Enhanced	P3: Wide; P4: Enhanced
	Minor Arterial	H speed H mobility-M access	L/M speed M mobility-H access	M speed M mobility-M access	L/M speed M mobility-M/H access	L speed M mobility-M/H access
		LC: L separation; NC: M separation; CC: H separation	LC: L separation; NC, CC: M separation	LC: L separation; NC: M separation; CC: H separation	LC: L separation; NC, CC: M separation	LC: L separation; NC, CC: M separation
		P1: *; P2: Min; P3, P4: Wide	P2: Min; P3: Wide; P4: Enhanced	P1: *; P2: Min; P3: Wide; P4: Wide	P2: Min; P3: Wide; P4: Enhanced	P3: Wide; P4: Enhanced
	Collector	M speed M mobility-M access	L speed M mobility-H access	M speed M mobility-H access	L speed M mobility-H access	L speed M mobility-H access
		LC: L separation; NC, CC: M separation	LC, NC: L separation; CC: M separation	LC: L separation; NC, CC: M separation	LC: L separation; NC, CC: M separation	LC, NC: L separation; CC: M separation
		P1: *; P2: Min; P3, P4: Wide	P2: Min; P3: Wide; P4: Enhanced	P1: *; P2: Min; P3: Wide; P4: Wide	P2: Min; P3: Wide; P4: Enhanced	P3: Wide; P4: Enhanced
	Local	M speed M mobility-M access	L speed M mobility-H access	L speed L mobility-H access	L speed L mobility-H access	L speed L mobility-H access
		LC, NC, CC: L separation	LC, NC, CC: L separation	LC, NC, CC: L separation	LC, NC, CC: L separation	LC, NC, CC: L separation
		P1: *; P2: Min; P3, P4: Wide	P2: Min; P3: Wide; P4: Enhanced	P1: *; P2: Min; P3: Wide; P4: Wide	P2: Min; P3: Wide; P4: Enhanced	P3: Wide; P4: Enhanced



NCHRP Report 855 — An Expanded Functional

Classification System for Highways and Streets





Metro's Land Use and Transportation Transect

Land Use and Transportation Transect

LESS DENSITY	88 66							SPECIAL DISTRICTS
Parks and Natural Areas	Neighborhoods	Main Streets	Town Centers	Corridors	Station Communities	Regional Centers	Central City	Employment and Industrial Lands
Undeveloped natural areas including parks, natural areas, open spaces and scenic areas, rivers and streams, wetlands and floodplains.	Single-family and multi-family residences incorporating a mix of housing types including row houses, duplexes and accessory dwelling units. Newer neighborhoods are slightly more compact while some older neighborhoods have larger lots and fewer street connections.	Neighborhood scale commercial retail and housing in one to three-story buildings along multimodal streets with good transit service.	Two to five-story mixed use buildings with professional services and commercial retail outlets complimenting housing that is well served by transit.	One to three-story buildings containing commercial retail, small scale employment or housing along major transportation routes that link centers together and are well served by transit.	Areas around light-rail or high capacity transit stations outside of centers with significant employment development and numerous housing types.	Two to six-story compact employment and housing development with destination retail served by high capacity transit.	Center of business and cultural activities for the region with intensive employment and housing in high-rises served by numerous transit options.	A mix of large scale employment and industrial uses that include office parks, manufacturing, distribution centers, marine and airport facilities and railroad switching yards.
TRANSPORTATION DESIGN Transportation routes designed to protect and enhance natural features. In some cases a Parkway design overlay may be appropriate.	Regional and Community Streets	Regional and Community Boulevards	Regional and Community Boulevards	Regional and Community Streets	Regional and Community Boulevards	Regional and Community Boulevards	Regional and Community Boulevards	Industrial Streets, Regional and Community Streets

Let's start planning for Green Book 8

- NCHRP 20-07, Task 423

 "Planning for a Comprehensive Update and Restructuring of AASHTO's Policy on Geometric Design of Highways and Streets"
 - Green Book 8 (GB8) Vision
 - Potential GB8 Document Framework
 - Roadmap for Implementation



Green Book 8 Visioning and Roadmap

- What we considered
 - Input from Outreach Meetings
 - Suggested documents and resources
 - Detailed guidance, suggested approaches, GB8 considerations
 - Explicit reference documents
 - NCHRP Reports 785, 839, 855 etc.
 - AASHTO A Guide for Achieving Flexibility in Highway Design
 - Many others



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Green Book 8 Visioning and Roadmap

- Vision
 - Integrating Planning and Design
 - Understanding the Project Development
 Process
 - Document Framework and Design
 Model



Green Book 8 Visioning and Roadmap

- GB8 Document Framework
 - Introduction Chapters
 - Performance-Based Design Evaluations
 - Design Model
 - Performance-Based Design Process Framework
 - Roadway Planning and Geometric Design
 - Facility Type
- Roadmap for Implementation
 - Activities to advance the GB8 Vision
 - Identifying partnerships and early adopters



Metro's Designing Livable Streets & Trails Guide

Livable Streets and Trails Functions

Bicycle

communities.

ACCESS & MOBILITY



Freight

residents.

ACCESS & MOBILITY

Key freight corridors provide

streets allow delivery access

to serve both businesses and

reliable freight movement, and



Pedestrian ACCESS & MOBILITY

Every street and trail has safe, comfortable space for people walking, rolling and enjoying the place they're in.

Transit ACCESS & MOBILITY

Connected bicycle networks, Our streets enable transit separated from heavy vehicle to serve the region with an traffic, ensure that bicycling is efficient, reliable way to travel a great way to get around our between and within our communities.

Motor vehicle ACCESS & MOBILITY

Our streets and throughways provide for safe, reliable travel in motor vehicles, providing space to facilitate pooled or shared trips.

Place-making & Public Space

Our streets and trails are a canvas for our community life and daily commerce, helping to form our regional identity.

Corridors for Nature & Stormwater

Weaving nature and sustainable stormwater management into our streets and trails enhances livability and protect our water, air and natural assets.

Utility

Corridors

Physical

Activity

Our transportation corridors Our streets and trails are places move more than just people and where people enjoy exercising goods; they also move water, and spending time outdoors power, gas, communications whether for recreation or to get and information. to where they need to go.

Emergency Response

In case of a local or widespread emergency, our streets and throughways must provide access and evacuation routes to keep people safe.

Metro Designing Livable Streets & Trails Guide

- Design Elements Support Functions to Achieve Outcomes
- Multidiscipline project teams improve decision-making
- A performance-based design decisionmaking framework contributes to systemwide networks and regional outcomes.
- It starts with a **well-defined project need** and **clear objectives.**



What is in the design guidelines?

- 1. Purpose and how to use the guidelines
- 2. Policy framework and desired outcomes
- 3. Design functions and classifications
- 4. Design elements, recommendations, considerations
- 5. Visualizations, street illustrations
- 6. Performance-based decision making framework





Connecting to the land use

Land Use and Transportation Transect



Design decisions are guided by desired policy outcomes/design principles






With performancebased design, design elements support street functions to achieve desired outcomes



Metro Designing Livable Streets & Trails Guide



Project Example to Illustrate Steps: Cascade Avenue

- Reconstructing an existing auto-oriented urban arterial
 - Complete street attributes
 - Economic revitalization
- Objectives:



- Accommodating multiple modes;
- Illustrating tradeoffs between modes; and
- Consider the constrained physical environment.





Step 1: Affirm Context and Policy Direction

- Verify that the design is staying true to:
 - existing systemwide plans
 - adopted policies
 - stakeholder engagement
 - decisions made in the funding process.





Cascade Avenue Step 1: Affirm Context and Policy Direction

Target audience

- Business community stakeholders
- Transit riders, pedestrians and bicyclists
- Local residents and existing motorists

Intent of the Study

- Improve the road user experience
- Provide access to road users not previously served
- Enhance the economic vitality and activity



of the street

- Performance Measures
 - Multimodal Level of Service (MMLOS)
 - Crash frequency and conflict points
 - Type and presence of facilities and transit service characteristics
 - Average travel time



Step 2: Assess Existing Conditions and Confirm Functions

- Preparation for the development and evaluation of project alternatives in Steps 3 and 4.
- Focused on:
 - collecting existing conditions information
 - identifying functions currently served
 - determining which functions should be served





Cascade Avenue *Step 2: Assess Existing Conditions and Confirm Functions*

- Cascade Avenue
 - Urban arterial
 - North-south connection between the downtown and university
 - AADT volume 22,000 vehicles per day
 - Three different fixed transit routes 45% of riders within the City
 - Frequently used by bicyclists
 - Posted speed on Cascade Avenue is 35 mph





Alternative 1 – Existing Conditions

- Step 3: Develop Alternatives
 - Initiate the development of design alternatives to address the project need, contribute to systemwide outcomes and serve the functions confirmed in Step 2.
 - Guidance considers:
 - Preferred condition
 - Typical condition
 - Not a typical/preferred condition





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• Consider various elements (e.g., lane width)

	Motor Vehicle Travel Lanes							
Regional Design Classifications	<10 foot lanes	10 foot lanes	11 foot lanes	12 foot lanes	>12 foot lanes	Two-way left-turn Ianes	Turn lanes at intersections	Transit or Business Access/Transit Lanes
Freeways					\bigcirc			
Highways			0		\bigcirc			
Regional Boulevard				\bigcirc		•		
Community Boulevard				\bigcirc				\bigcirc
Regional Street				•			•	
Community Street				•			•	
Industrial Street			•	•	•	•	•	•
		Preferred condition						
	0	Typical condition						
	Not a typical/preferred condition							





• Consider various elements (e.g., bicycle facility)

			Bic	ycle Facilii	lity			
Regional Design Classifications	Shared street/ shared lanes*	Standard 6' bike Iane*	Buffered bike Iane	Separated Bike Lanes (one-way)	Separated Bike Lanes (two-way)	Multi-use path (shared alignment)	Parallel facility (path or street)	
Freeways								
Highways				0				
Regional Boulevard			\bigcirc		\bigcirc		\bigcirc	
Community Boulevard			0		\bigcirc	•	0	
Regional Street			0		0	•	0	
Community Street			0		0	0	0	
Industrial Street	•	•	•	•	•		•	
		Preferred o	condition					
	0	Potential condition						
		Not a preferred condition		lition				



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Consider various elements (e.g., transit priority treatment)

		_	Transit	atment			
Regional Design Classifications	Exclusive Transitways	Transit-only Lanes	Peak-Hour Transit-only Lanes	Transit Approach Lane	Queue Jumps	Transit Signal Priority	Signal Progression
Freeways			\bigcirc				
Highways			•	\bigcirc		\bigcirc	
Regional Boulevard	\bigcirc						
Community Boulevard	\bigcirc						0
Regional Street	\bigcirc						
Community Street	\bigcirc			\bigcirc			0
Industrial Street	\bigcirc		•	\bigcirc		\bigcirc	
		Preferred condition					
	0	Potential condition					
		Not a preferred condition					



Cascade Avenue Step 3: Develop Alternatives

- Cross-sectional elements likely to influence the performance measures
 - Lane width
 - Number of automobile through lanes
 - Bicycle facility presence and type
 - Sidewalk width
 - Landscaped buffer between sidewalk and travel lanes
 - On-street parking
 - Bus only lanes
 - Central roadway median



Cascade Avenue Potential Solutions – Solution Development

- Common Elements
 - More pedestrian space
 - Removal of on-street parking
- Other tradeoffs considered
 - Allocating lanes for specific modes Transit-only lane
 - Providing bicycle lanes and wider sidewalks for pedestrians
 - Including a central landscaped median



Cascade Avenue Potential Solutions

Alternative 1 – Existing Conditions

1							Į	
SIDE WALK 5'	PARALLEL PARKING 10'	TRAVEL LANE 14'	TRAVEL LANE 12'	TRAVEL LANE 12'	TRAVEL LANE 14'	PARALLEL PARKING 10'	SIDE WALK 5'	
1	$\frac{1}{82'}$							

Alternative 2 – Transit Oriented





Cascade Avenue Potential Solutions

Alternative 3 – Bicycle and Pedestrian Oriented



Alternative 4 – Hybrid of Transit, Pedestrian and Bicycle





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- Step 4: Evaluate Alternatives
 - Use a performance-based analysis to evaluate the alternatives developed in Step 3 and using the performance measures selected in Step 2.





Cascade Avenue Step 4: Evaluate Alternatives (*Potential Solution – Primary Alternative Evaluation*)

- Common considerations across the alternatives
 - Within the existing 82 feet of right-of-way width
 - Require changing the existing curb locations
 - Reduce the capacity for automobiles
 - Remove on-street parking
 - Increase sidewalk width for pedestrians



Cascade Avenue Step 4: Evaluate Alternatives (*Potential Solution – Primary Alternative Evaluation*)

- Differentiating factors across the alternatives
 - Amount of space designated for bicyclists
 - Presence of a central median
 - Presence of a physical buffer for pedestrians and bicyclists from autos
 - Type of space allocated for transit vehicles



Cascade Avenue Evaluation and Selection

• Estimating Performance

- Evaluation resources
 - Highway Safety Manual
 - Highway Capacity Manual
 - Qualitative Assessment



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Cascade Avenue Evaluation and Selection

Performance Evaluation Results

		Mobility: Avorago	Reliability:		Quality of
Alternative	Safetv	Travel Time (min)	Travel Time	Accessibility	MMLOS
#1 – Existing Condition					
Pedestrian	Low	-	-	Low	D
Bicycle	Low	-	-	Low	F
Transit	Low	4.43	3.68 to 5.26	Moderate	D
Auto	Low	2.67	2.42 to 3.17	High	А
#2 – Transit Oriented					
Pedestrian	High	-	-	Moderate	С
Bicycle	Moderate	-	-	Moderate	E
Transit	High	4.40	3.68 to 4.76	High	В
Auto	High	3.43	3.35 to 3.60	Low	С
#3 – Bicycle and Pedestrian Oriented					
Pedestrian	High	-	-	High	В
Bicycle	High	-	-	High	С
Transit	High	4.80	3.97 to 6.00	Moderate	D
Auto	High	4.80	3.80 to 6.10	Low	D
#4 – Hybrid of Transit, Bio	ycle and Pedestr	ian			
Pedestrian	Low	-	-	Moderate	С
Bicycle	Moderate	-	-	Moderate	D
Transit	Moderate	4.38	3.65 to 4.78	High	В
Auto	Low	3.45	3.32 to 3.56	Low	С



Cascade Avenue Evaluation and Selection

- Incorporating Financial Feasibility
 - Identify the planning level cost of each alternative

Alternative	Cost per Mile
Alternative #1 – Existing Condition	\$0
Alternative #2 – Transit Oriented	\$1.4 million
Alternative #3 – Bicycle and Pedestrian Oriented	\$1.6 million
Alternative #4 – Hybrid of Transit, Bicycle and Pedestrian	\$1.0 million



- Step 5: Refine Design Decisions
 - Provides guidance on how to refine design decisions for one or more alternatives to lead to selection and development of a preferred design concept in Step 6.
 - Draw on the alternatives evaluation from
 Step 4 to further refine the design of one
 or more alternative.







Cascade Avenue Step 5: Refine Design Decisions *Continue to refine alternatives*

Alternative 2 – Transit Oriented

Alternative 3 – Bicycle and Pedestrian Oriented

Alternative 4 – Hybrid of Transit, Pedestrian and Bicycle





- Step 6: Decide on Preferred Design Concept
 - Decide which design concept alternative to move forward.
 - Should reflect a performance-based approach to serving the prioritized functions and contributing to systemwide outcomes.







Cascade Avenue Step 6: Decide on Preferred Design Concept

- City and project stakeholders Alternative 2
 - Provides improved safety, reliability, access, and quality of service for transit riders, pedestrians and bicyclists.
- Local business community Alternative 3
 - City plans to integrate Alternative 3 attributes into Alternative 2
 - Landscaping along the sidewalks
 - Characteristics to better serve bicyclists





Alternative 2 – Transit Oriented

- Step 7: Final Design
 - Developed based on the preferred design concept.
 - The final design and implementation should serve the identified functions, contribute to systemwide networks and further regional outcomes.







- Step 8: Construct, Operate, Maintain, and Evaluate
 - The project is constructed and becomes part of the transportation system.
 - Operations and maintenance are key aspects of ensuring that the street serves the intended functions.
 - A performance evaluation and ongoing monitoring following construction can help contribute to best practices for future projects.

PROJECT FINISH Construct, operate, maintain, & evaluate





Interactive Discussion

- Overview of Project
 - Handouts
- Interactive discussion
 - Facilitators will be roaming if you have questions
 - Designate a speaker to present to larger group
 - Take notes and address a list of questions
- Facilitated Group Discussion
 - Provide feedback to larger group
- Close out







Project Purpose

- Primary:
 - Reduce deadly and serious injury crashes for all people, using all modes
- Secondary:
 - Slow motor vehicle operating speeds
 - Provide safe access and crossings for people riding bicycles and walking and taking transit



Roadway Jurisdiction Coordination

- City of Maywood Park
 - City jurisdiction over half of 102nd, Fremont to Prescott
- ODOT
 - Critical project area at Sandy Blvd is owned by ODOT
- Structure over I-84
 - Owned by ODOT
 - Maintained by PBOT



PBOT Study Area

Corridor length: 1.75 miles Speed limit : 35 mph



102nd Avenue Cross-Section



Existing Conditions



existing crossing meets standards

existing crossing does not meet standards





102nd Avenue Crash History—Corridor-wide

Total Crashes: 354 Pedestrian Crashes: 9 Bicycle Crashes: 9






Primary Crash Cause





Bicycle and Pedestrian Crashes



Volumes of PM Peak Hour Users: Bicyclists & Pedestrians





Volumes of Daily Users: Motorists





Speeds and Volumes at Sacramento





102nd Avenue Corridor

Speeds and Volumes at Shaver









Small Group Work Session

- Clarify desired project outcomes
 - Who are you trying to serve?
 - What are you trying to achieve?
- Consider the tradeoffs
 - What are the options? And compromises?
- Develop a Cross Section
 - How would you allocate the space?
- Consider documentation needs
 - Did you document your design decisions?









