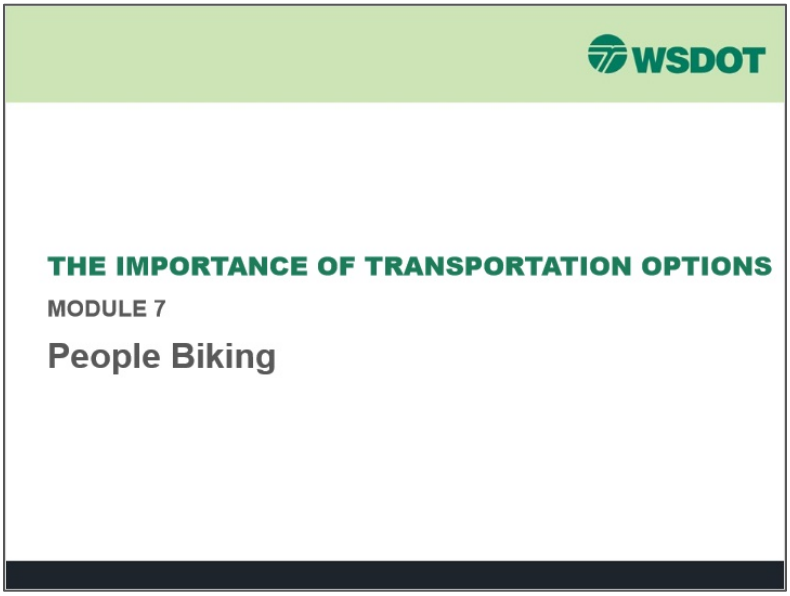
Module 7 People Biking

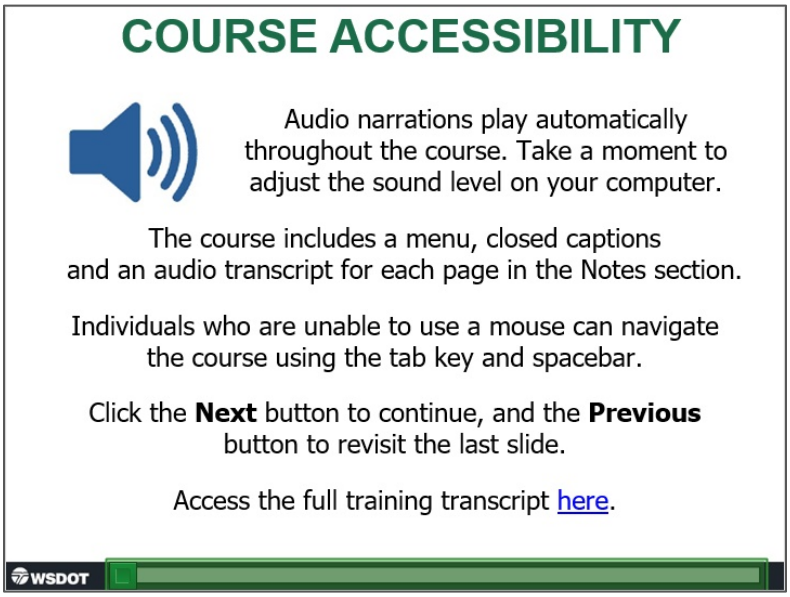
1. Introduction

Slide 1.2



Notes:
Welcome to Module 7 of the Multimodal Fundamentals course – “People Biking”.

Slide 1.3



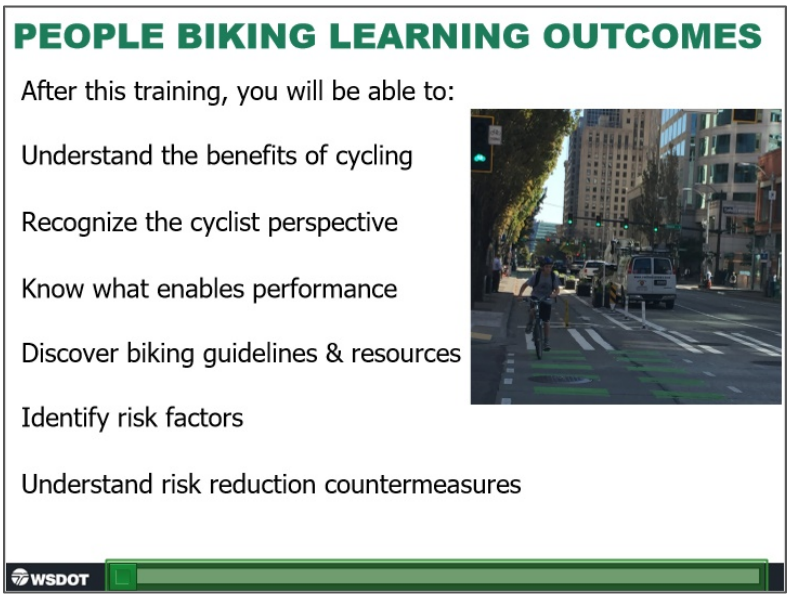
Notes:
Audio narrations play automatically throughout the course. Take a moment to adjust the sound level on your computer.

The course includes a menu, closed captions and an audio transcript for each page in the Notes section.

Individuals who are unable to use a mouse can navigate the course using the tab key and spacebar.

Click the Next button to continue, and the Previous button to revisit the last slide.

Slide 1.4



Notes:
After this training, you will be able to understand the benefits of cycling, recognize the cyclist perspective, know what enables performance, discover biking guidelines and resources, identify risk factors, and understand risk reduction countermeasures.

2. Benefits

Slide 2.1

Notes:
Complete Streets are designed and operated to enable safe access for all users, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities.

Increased transportation choices: Complete Streets improvements, by definition and according to best practices policy, provide users with multiple options for traveling to their destinations and can increase capacity of a corridor.

Economic revitalization: There is a correlation to increased community economic benefits due to Complete Streets improvements. Multimodal routes and improved access and efficiency to work and leisure destinations attract increased attention and a rise in private investment along the corridor.

Environmental benefits: Providing alternate modes of travel beyond just the automobile helps to reduce congestion, air emissions and dependency on nonrenewable fossil fuels. It also decreases the need for accommodating the land use footprint from parking associated with vehicle travel.

Public health: Complete Streets can greatly reduce motor-vehicle-related injury and deaths. In addition it provides users with facilities that encourage walking, cycling and in general increased physical activity, which has a significant impact on reducing rates of obesity, diabetes, heart disease, stroke, and other chronic health conditions.

Accessibility: Incomplete streets are sometimes not accessible for persons with disabilities. Designing our roadways to be usable by persons of all abilities is not only the law, but also good practice.

Safety: when Complete Streets are implemented with careful design considerations, the improvements can greatly improve safety and reduce accidents.

Slide 2.2

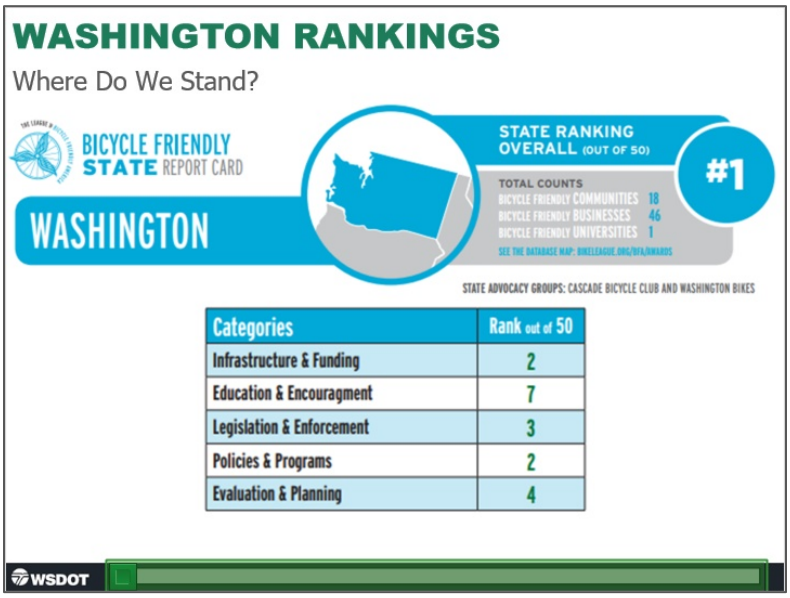
Notes:
In the past few years, FHWA has published multiple bicycle planning and design related guides. Additional guides on street modifications like the Road Diet guide also support the rapid

changes in information about design for cyclists. It's not just FHWA either, NACTO published it second edition of the Urban Bikeway Design Guide in 2014, and companion guides like the Urban Street Design Guide in 2013, which is endorsed by WSDOT. State DOT's are also either updating their guidance or publishing additional manuals on the topic. Massachusetts DOT won an award for their 2015 publication "Separated Bike Lane Planning and Design Guide".

City and State DOT's are rapidly testing new traffic control technology for bicycle facilities. Many new concepts have gone from experimental to interim approval in the last 5 years as case studies; continued research and empirical evidence show benefits in both usage and safety performance.

What is important to realize with all of these guides is that they promote treatments that use traffic control devices that are still in experimental or interim approval. Its critical to recognize that non-MUTCD approved traffic control devices are currently our best known treatments and agencies and organizations are trying to highlight that this fact shouldn't deter the application of treatments. This is how the MUTCD works, they need these traffic control devices tested before they are standardized.

Slide 2.3



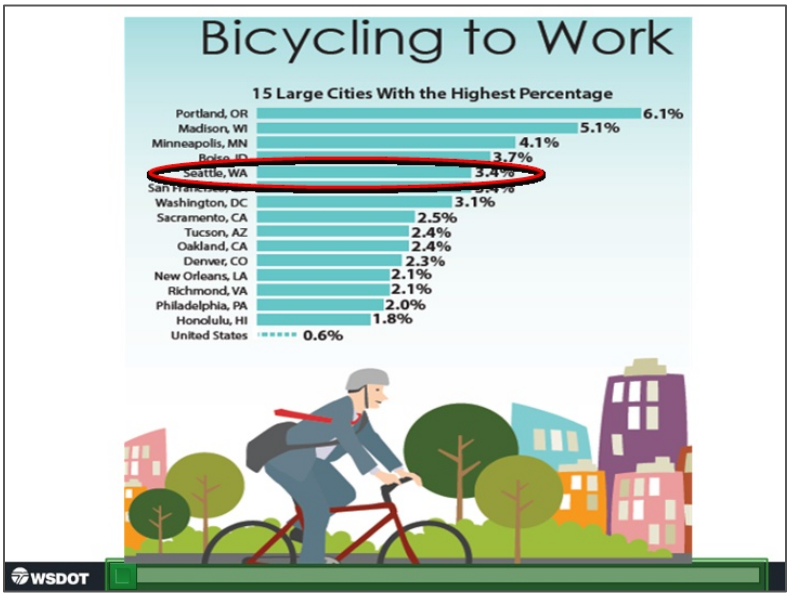
Notes:
Washington continues to rank as the #1 bicycle friendly state (2019 latest ranking on League website), multiple years in a row. This includes 17 bicycle friendly communities, 43 bicycle friendly businesses and 1 bicycle friendly university.

WSDOT is actively taking steps to address improvement areas recommended by the League. One objective was to increase our staff and focus on pedestrian and bike facilities; creating the Active Transportation Division, was a way to help meet that objective.

An interesting point regarding the largest cities with people bike commuting is the top five are all in cities that have questionable weather reliability. It begs the question if weather is an impediment to people biking.

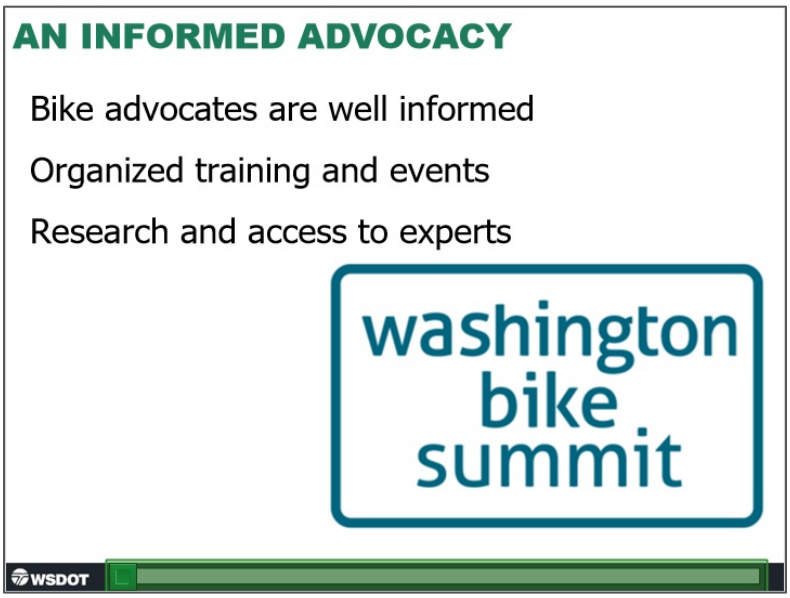
Despite being recognized as the #1 bike friendly state, the League for American Bicyclists recommends:

- The Washington State Department of Transportation (WSDOT) should build upon its past successes by increasing staff capacity for planning, engineering, and implementation of solutions that make bicycling and walking safer and more convenient.
- Washington State should update and revitalize its State Bicycle and Walking Plan, which was last updated 7 years ago, so that WSDOT and other state agencies have a clear vision for growing active transportation programs and projects.
- Washington State should pursue inter-agency and inter-governmental activities that use bicycling and walking as a solution to health, environmental, and other problems. Identifying and prioritizing bicycling and walking as parts of broader solutions at the state, regional, and city level will continue Washington's leadership role as a state.
- In order to adopt a Vision Zero approach, the Washington State Traffic Safety Commission needs to fully address bicycle/pedestrian safety issues via funding and programs. This should include more flexible use of state and federal funding programs that allow for more roadway reconfigurations.
- Strengthen and expand the state bicycle/pedestrian advocacy committee. The committee should include diverse representation, including user groups.
- Protect and grow dedicated state funding for Safe Routes to School, and Bicycle/Pedestrian Safety grant programs.



3. Terminology

Slide 3.1



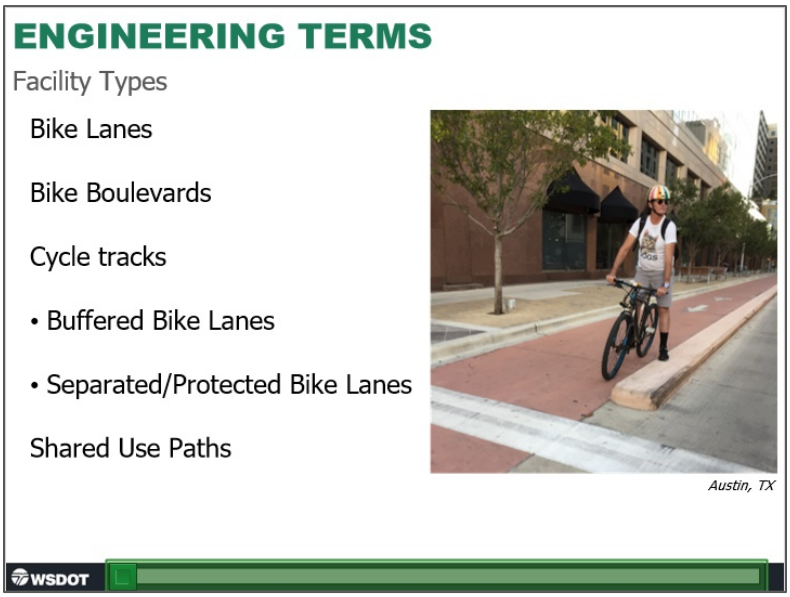
Notes:
Bike groups in Washington are extremely organized and well-funded. They offer different types of training which cover many different topic areas, from actual engineering design to workshops on how to better advocate within the public process from the policy level to the project level. Recently a Seattle based group, Cascade Bicycle Club, supported a WSDOT research project installing automated bike counters throughout Seattle.

Because of their organization and dedication to this topic, bike advocates can present opportunities and challenges on any project. This can make it difficult to find reconciliation within a project design, especially when the advocates understand the engineering behind bike facilities.

The groups also help to support each other; smaller bike clubs will bring in larger clubs to ensure they are approaching a project in an effective way. This should be expected and planned for in the state that is ranked #1 Bike Friendly State for nearly a decade now.

Washington is home to the authors of many of the guides being published by FHWA, AASHTO and others. This provides both access to experts and well informed advocates at the community level.

Slide 3.2



Notes:
Since bike advocates are so well informed, a first test of your knowledge will come with the use of terms. Our credibility could be compromised if we don't have a basic understanding of terms that are now nationally accepted and documented in most literature including FHWA, NACTO and the WSDOT Design Manual.

We're going to take a moment and quickly run through the different types of bike lanes and associated terminology.

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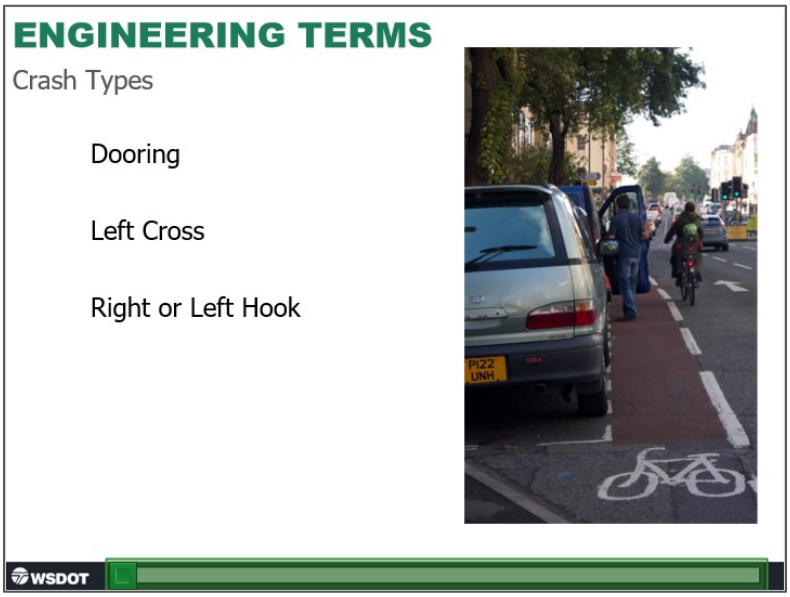


Notes:
Crash types include dooring, left cross and right or left hook.

Slide 3.4

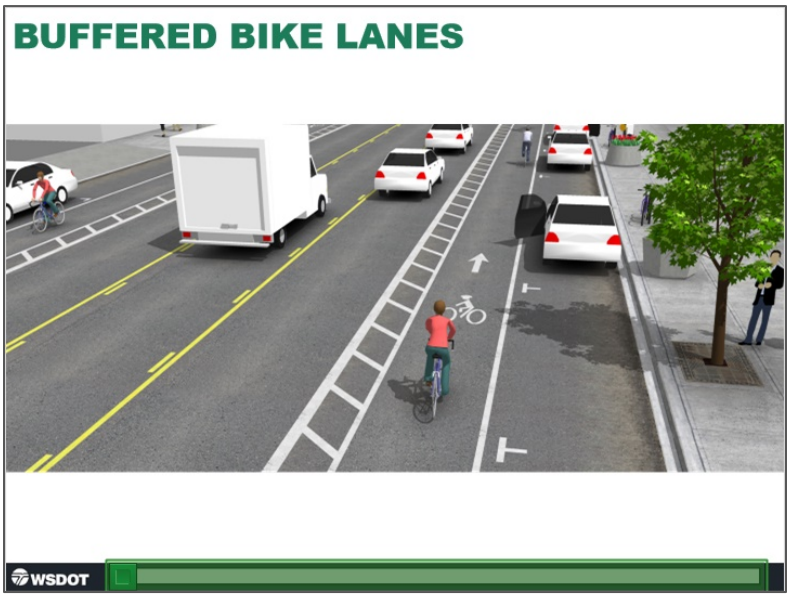
Notes:
Streets with low motorized traffic volumes and speeds can be designated and designed to give bicycle travel priority. Bicycle boulevards use signs, pavement markings, and speed and volume management measures to discourage through trips by motor vehicles and create safe, convenient bicycle crossings of busy arterial streets.

Slide 3.5

Notes:
While bike boulevards are not likely to be coincident with our state routes, they may need to cross them. Because these types of facilities are prioritized for people biking, the crossing location may need to account for the increased performance needs of the cyclist crossing.

This may include specific median crossing or intersection treatments.

Slide 3.6



Notes:
A term that you are likely to hear is 'Cycle Track', which is a broad term that covers any of the below bike lane terms. The key to a cycle track is either buffered or separation with exclusive use to bikes, and it can be two way, one way or contraflow. Cycle tracks are also defined as generally free-flowing with minimum or conflicts along path, and include sidewalks, driveways, intersections, etc.

A Buffered Bike Lane is a conventional bike lane with additional horizontal separation delineated by paint striping, according to FHWA.

Slide 3.7

Notes:
A separated bike lane is an exclusive space for bicyclists along or within a roadway that is physically separated from motor vehicles and pedestrians by vertical and horizontal elements. - Massachusetts DOT

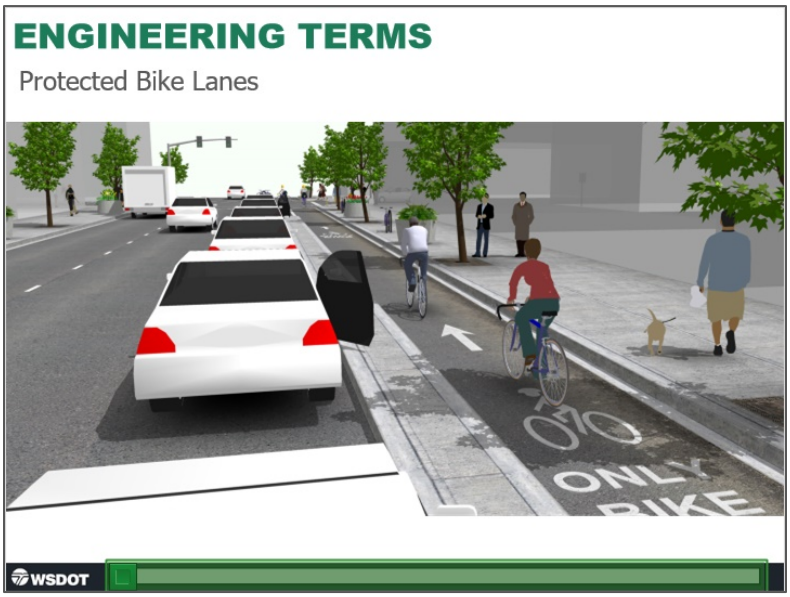
A separated bike lane is an exclusive facility for bicyclists that is located within or directly adjacent to the roadway and that is physically separated from motor vehicle traffic with a vertical element. - FHWA

Slide 3.8

Notes:
Raised and curb separated facilities are typically a sidewalk level bike lane, separated from traffic lanes by a curb, and is for the exclusive use for bicycles. It typically incorporates additional delineation, such as pavement type, signage and pavement markings.

Raised and curb separated facilities change the curb location and therefore the general jurisdictional responsibilities for cities with populations over 25,000, because we've define jurisdictional responsibilities based on the back of curb. However, jurisdictional responsibility can be adjusted with specific operational and maintenance agreements established between a region and our partners.

Slide 3.9



Notes:
Protected bike lanes is another term used to describe separated bike lanes. This term was initially developed by the planning community, however, there is some dispute over the use of the term 'protected', since many separated bike lane adaptations don't provide an actual physical crash tested barrier.

Slide 3.10

Notes:
Most of these concepts have been around only a decade; we can expect the language to continue to evolve around the different treatments.

Slide 3.11

Notes:
Shared use paths are different from cycle tracks due to the additional separation from the roadway. Additionally, shared use paths provide for more user types; bicyclists, peds, and in some applications equestrian use.

Slide 3.12

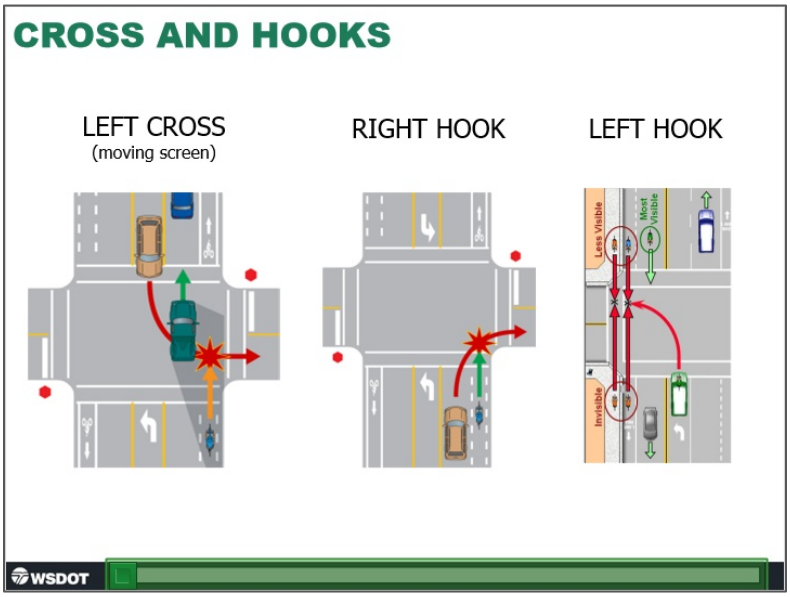
Notes:
Dooring describes a particular crash risk associated with bike lanes adjacent to on-street parking. Dooring refers to an occupant of a parked vehicle opening their vehicle door into the bike lane in front of an approaching cyclist.

Providing additional width in the bike lane, or reconfiguring the cross section can reduce this crash type from occurring.

Slide 3.13

Notes:
The "Dutch Reach" is a technique for drivers to open their car door using their far hand. This has been included in the Washington State Driver Guide.

Slide 3.14



Notes:
Left Cross:

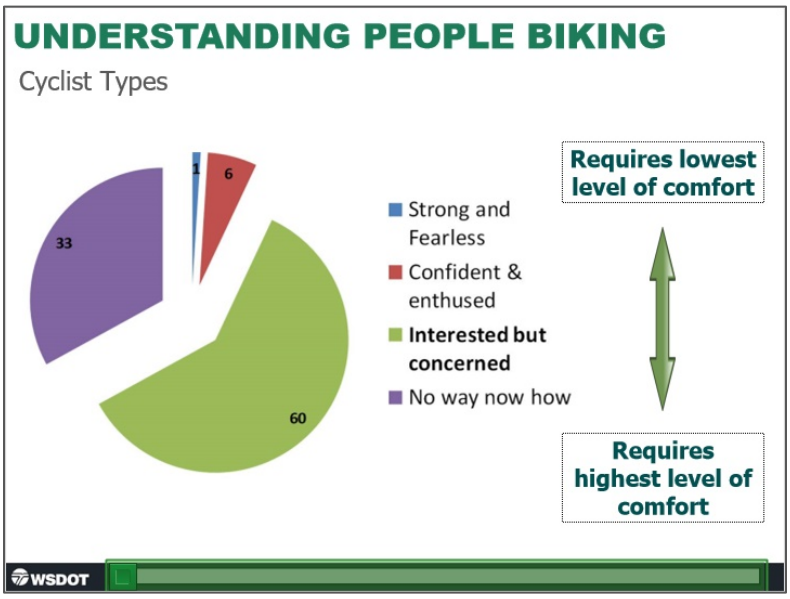
- Describes a crash risk and type in which the cyclist approaches an intersection and a motorist entering the intersection from the other direction either crosses in front of or runs into the cyclist.
- This crash type is more of an issue on multilane roadways.
- Right or Left Hook:

- Describes a crash risk and type in which the cyclist traveling through an intersection is struck by a vehicle turning right or left at the intersection. . - FHWA

Restricting right turns and/or bike boxes are countermeasures for this crash type.

4. Perspective

Slide 4.1



Notes:
These cycling categories were originally based on research of users within the City of Portland, OR, and now at a national level. The research was more important than simply categorizing groups of people into different potential types of cyclists, it really provided an understanding of user perception, and what potential latent demand might exist within the total population. It also helps confirm some pre-existing research related to what roadway conditions contribute to a negative perception of safety: traffic volume and traffic speed.

So who are these different types of cyclists?

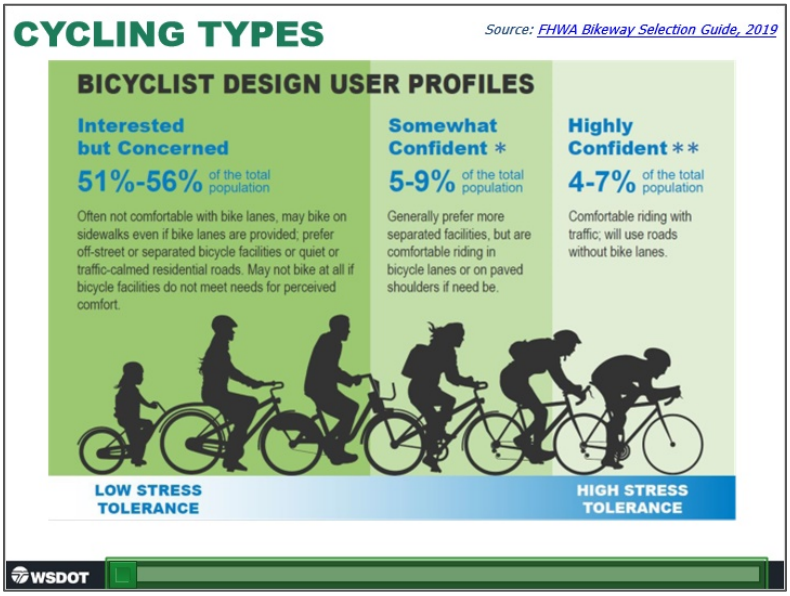
- Strong and Fearless - the segment of the total population that will bicycle no matter what happens out on the roadway with or without bike facilities
- Enthused and Confident (MassDOT calls these Casual and Somewhat Confident) - the segment of the total population that is comfortable sharing the roadway with autos, but prefer their own facilities. Most of the bike facilities that we've applied on state routes here (mostly conventional bike lanes) are okay for this user but they would prefer a less stressful ride. Most of the riders you see today fit this category.
- Interested but Concerned - is our latent demand group. They are curious about biking, desire to be more active but are challenged to do so. They generally like riding bikes for recreation, or when they were younger. However, this group does not feel comfortable riding in or adjacent to traffic and it is hard for them to overcome concerns about what might happen. They are essentially afraid to ride.
- Last group is the no way no how group which will not likely bicycle under any situation either because they simply don't want to or they are unable to for another reason.

References:

Jennifer Dill and Nathan McNeil, "Four Types of Cyclists? Examination of Typology for Better Understanding of Bicycling Behavior and Potential," Transportation Research Record: Journal of the Transportation Research Board, 2387: 129-138, 2013.

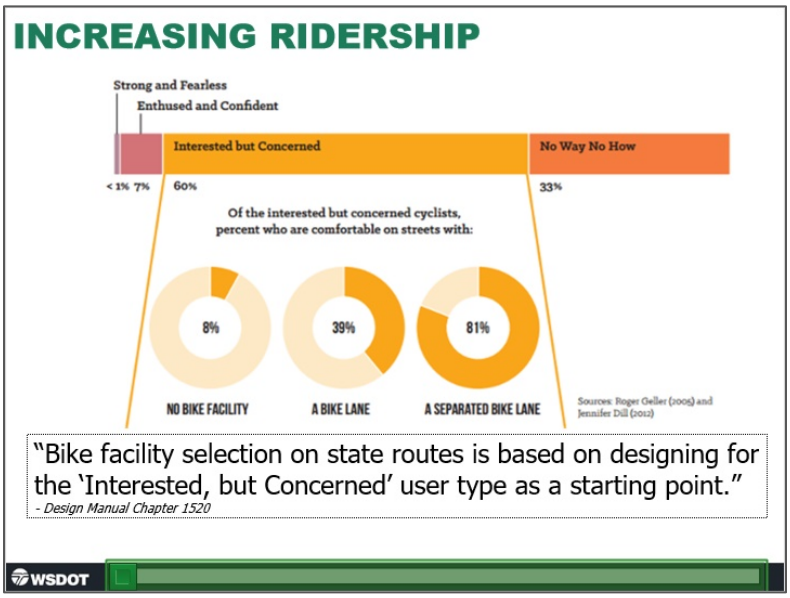
Jennifer Dill and Nathan McNeil, "Revisiting the Four Types of Cyclists: Findings from a National Survey," Transportation Research Record: Journal of the Transportation Research Board, 2587: 90-99, 2016.

Slide 4.2



Notes:
This illustration depicts bicyclist design user and the level of traffic stress.

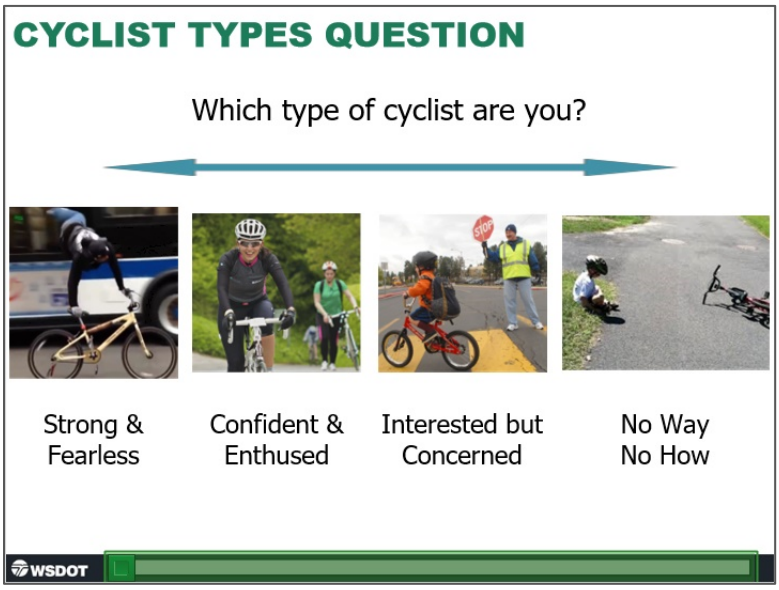
Slide 4.3



Notes:
This demonstrates possible mode conversion by types of improvements, even just new bike lanes can make a difference, depending on corridor.

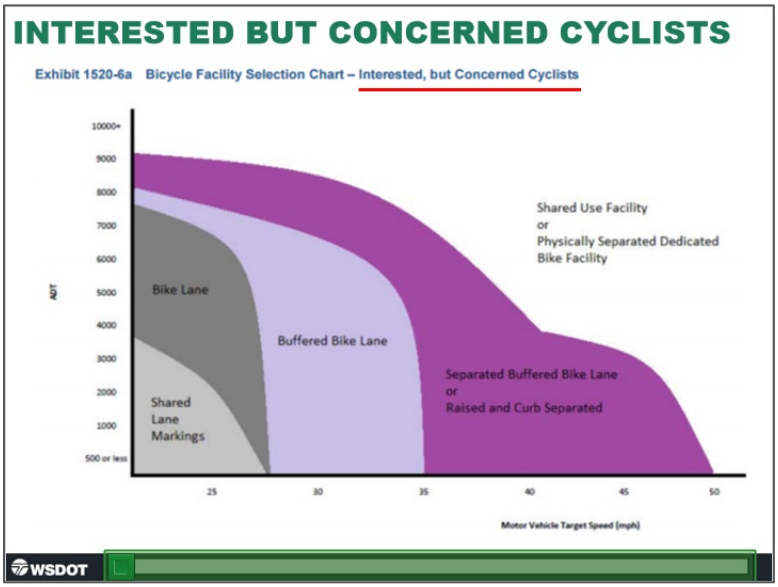
This is why understanding human factors will be important to informing which design strategy to go with. Is there enough latent demand out of the IBC crowd to warrant a separate lane? The basic answer is yes, but we don't have a full prediction model.

Slide 4.4



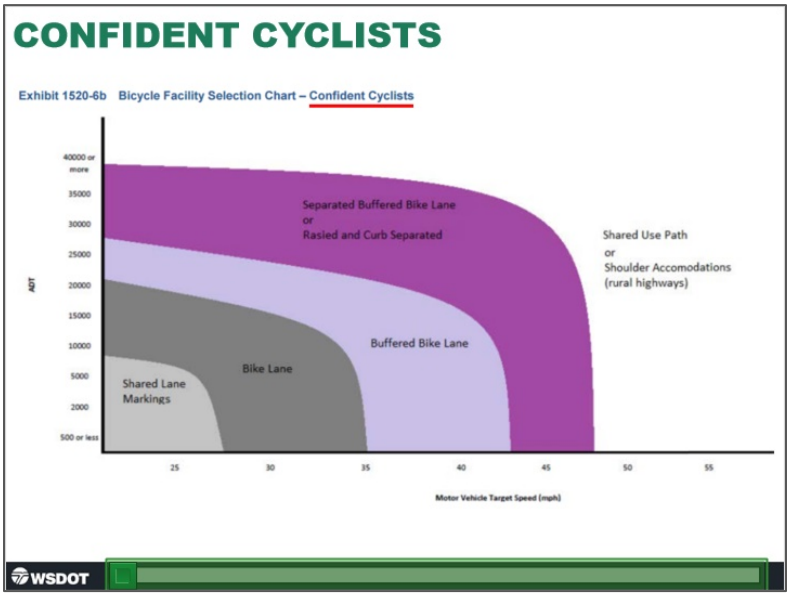
Notes:
So what category do you feel you fit into? Strong and fearless, confident and enthused, interested but concerned, or no way, no how?

Slide 4.5



Notes:
This facility selection chart is specific to the interested but concerned user. If you want to attract that latent demand of cyclists, this is the type of facility that we might want to provide. Speed of traffic becomes a more relevant indicator of facility type than volume, but note that this chart covers a much smaller range of traffic volumes.

Slide 4.6



Notes:
The WSDOT Design Manual has been update to associate the cyclist typology with facility selection. There are two facility selection charts to choose potentially use. One chart provides facilities that are potentially tolerated by the enthused and confident cyclist type as well as the strong and fearless.

There isn't too much to this chart, and it is pretty simple to understand the basic concept - as motor vehicle speed and volume increase, so does degree of separation for the bike facility.

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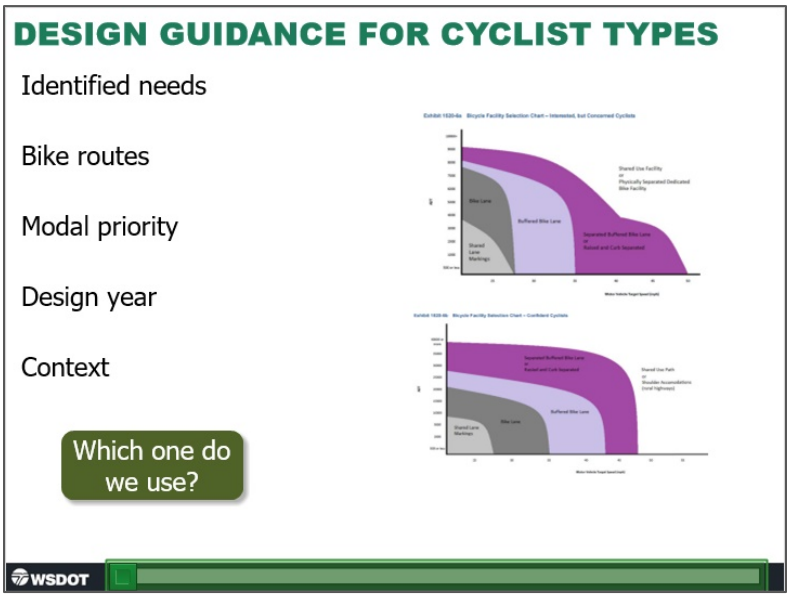


Notes:
Excerpts from Design Manual Chapter 1520 - Roadway Bicycle Facilities:

Bike facility selection on state routes is based on designing for the "Interested, but Concerned" user type as a starting point.

If the state highway is the bike route, intersects with an existing route, or if bicycle users are an identified modal priority (See Chapter 1103), account for the bike facility needs within the design. Other projects need to consider a design that does not preclude the future vision for a planned bike route, depending on the context identification selection (See Chapter 1102) and design year selection (See Chapter 1103).

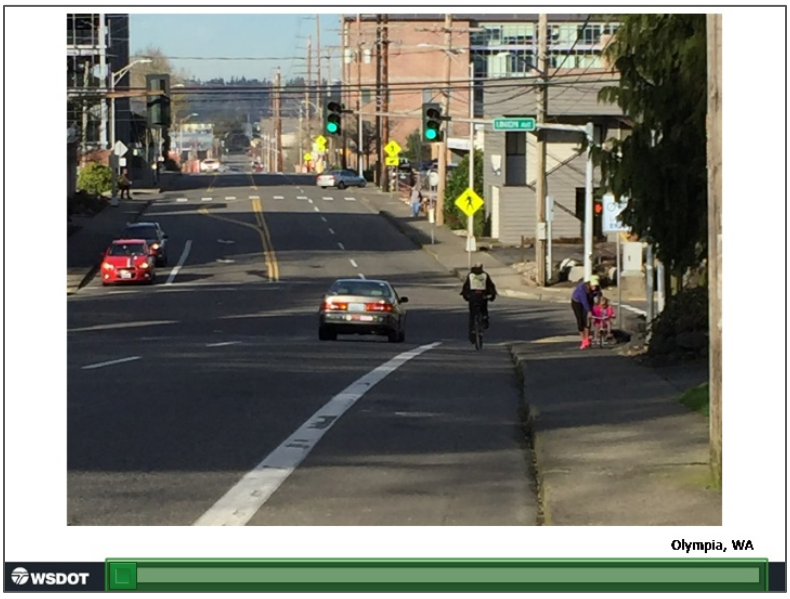
Slide 4.8

Notes:
As with people walking, it is a challenge to apply traffic operation characteristics to a different mode that fundamentally operates differently. When encountering conflict areas, the cyclist doesn't necessarily have a higher decision workload than a driver, but the risks resulting from decisions are different.

Stopping distance is not that cut and dry when thinking about the various braking systems that different bicycle use. There is no standard for this and it can dramatically alter the actual distance required for a bike to stop. We've talked about the impact of grade, but weather also affects bike braking systems. During rain events the most common braking system 'rim brakes' and their performance is significantly effective. Traveling at 20 mph on a downgrade in the rain can double the amount of distance required to stop. Because of this issue, cyclist riding in the rain are adding to their workload of issues they need to consider. Some will travel at slower speeds, others are looking at other indicators to help them predict when to stop, such as judging their speed and distance by pedestrian count downs which may mean they are less focus on other issues approaching an intersections.

Think about what is happening in this photo in Olympia WA. This is off-peak with very little traffic, but the number of things the cyclist needs to consider here are significant. The cyclist is travelling down a grade, which means they are likely traveling at a similar operating speed as the car next to them. The increase in speed, combined with the grade, means that braking will take a longer distance. But what makes this more challenging is the fact that the bike lane ends at this intersection, and there are no markings to indicate a shared lane situation to the driver. The driver is likely not even aware the cyclist is there, which puts additional uncertainty and workload on the cyclist. What type of rider do you think would use this bike lane?

Olympia



5. Design

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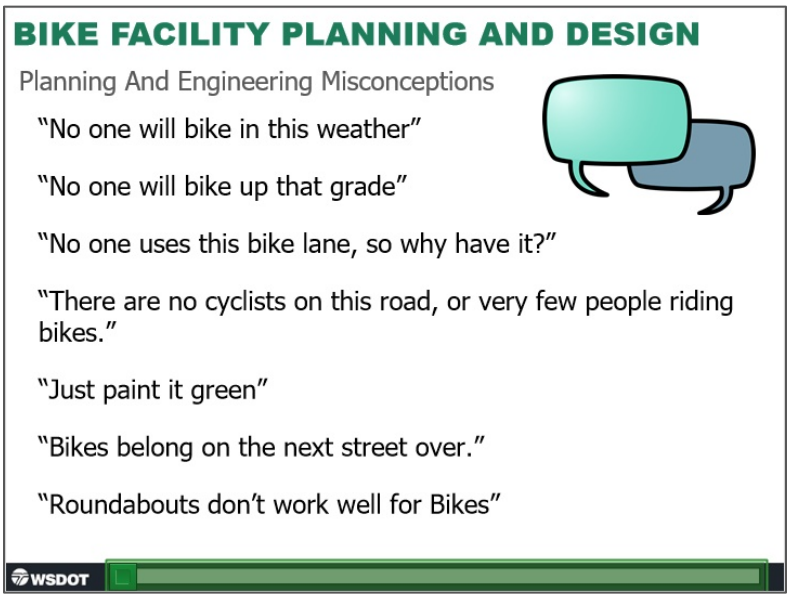
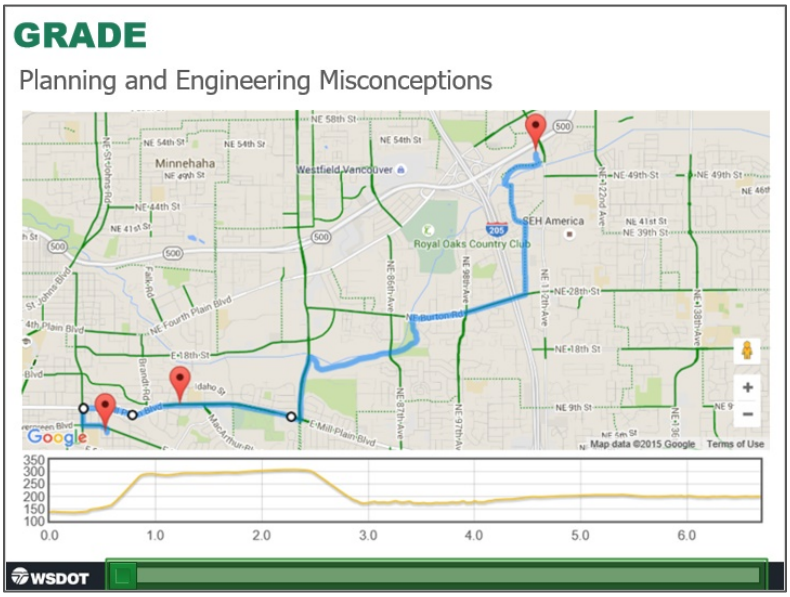


Notes:
These are some fairly common comments made that are often used to dismiss bike facility implementation on state routes. These are based on feedback from technical experts within Regions or at HQ when working with planning and project teams.

We've tackled the weather issue by just looking at the cities with the highest cyclist commute percentage, and now we're going to take these other misconceptions on one at a time.

Slide 5.2



Notes:
We already discussed the some of the implications of grade and the cyclist behavior and workload. But grade is often said to be a major mobility barrier for cyclist. It is often implied that

grade is such a deterrent for cyclists that placing bike facilities on a grade are a waste of investment. However, this is simply not the case and it's largely due to the technology in place on bikes. Riders in southeast Vancouver know this, all too well because there is virtually no way to avoid the hump in topography that extends the length of Vancouver.

Andrew Personal Story:

This was my first bike commute from my house to the Southwest Region HQ, about a 7 mile ride which entailed a 7% grade in both directions. There was no way to avoid this grade unless I went way out of direction toward downtown (off the picture to the left), and then headed back, even then I'm still encountering about a 5% grade at some point in the trip. When I started biking I wasn't sure I would like it and didn't want to invest much on my bike, leaving me with an old steel frame (heavy) 5 speed bike. While I'll avoid steep grades when I can, it is not a major obstacle. In many cases, I'll deal with the grade for a more direct route.

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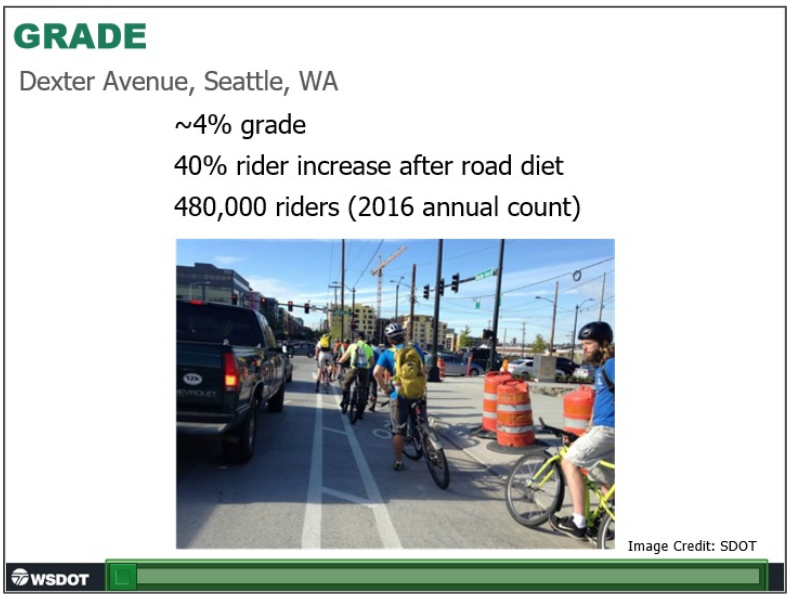

Notes:
Riders on Dexter Avenue have to ride up to crest of the street only to ride back down again. Grade is about 4% and is more pronounced at around 4.5% on the north side of 6th Avenue North.

2016 annual count is 480,000 riders. SDOT saw a 40% increase in ridership after a road diet project that improved the bike lane on Dexter. Dexter is taking about half the riders coming across the Fremont Bridge now, the highest bike count location in Seattle.

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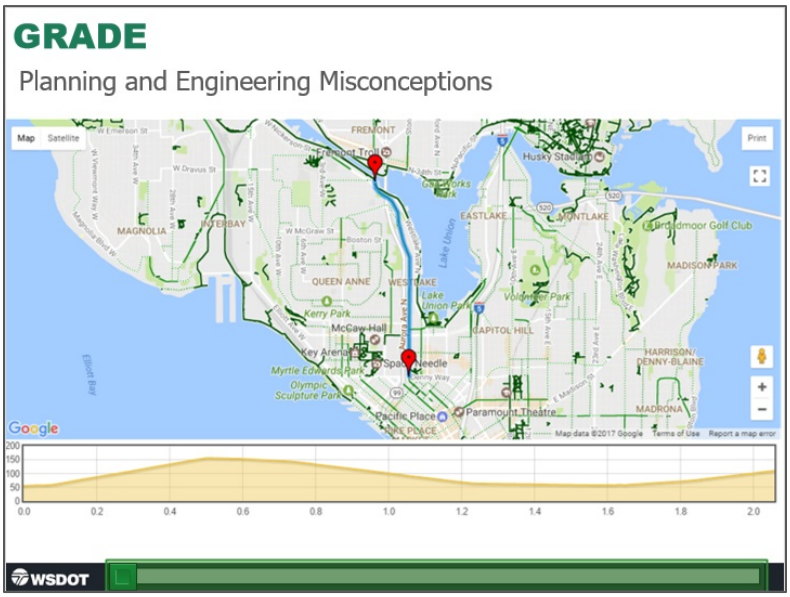

Notes:
Asymmetry within the geometric cross section is a useful way to manage restrictive right of way and the need for low speed multimodal facilities.

Down grade facilities can use shared lane markings, or sharrows, while up-grade facilities might use a buffered bike lane.

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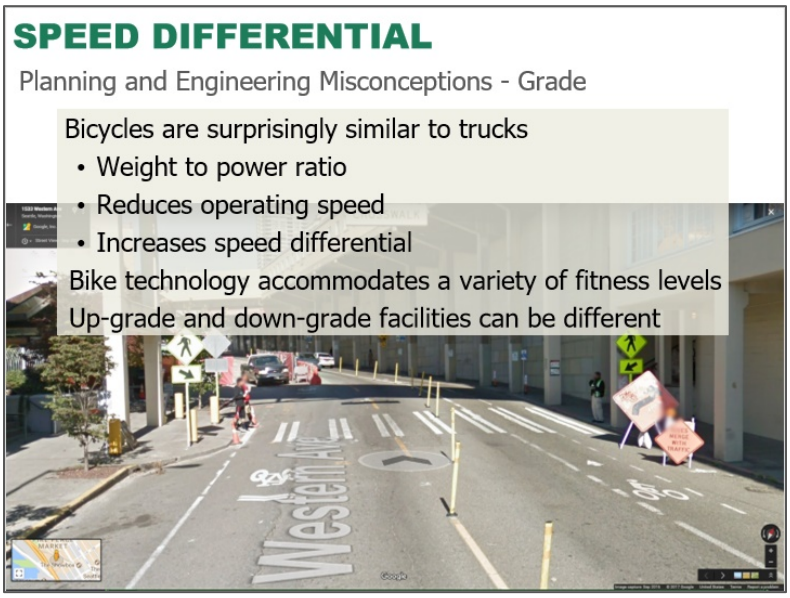

Notes:
Just like with trucks, the major impact of riding up-grade is speed reduction, which affects riders much differently depending on their gear ratio, total weight the vehicle is carrying, and the fitness level of the rider. This is important to understand when considering bike facility on an upgrade, because the speed differential increases so substantively. So just like we accommodate

speed differential for heavy trucks by building truck climbing lanes we need to be conscientious about addressing speed differential with other modes as well.

State routes have managed the grade for large vehicles, at a much higher standard than our local agency networks. The grades on state routes are actually much calmer in some situations, making them a bit more attractive for bicycle facilities.

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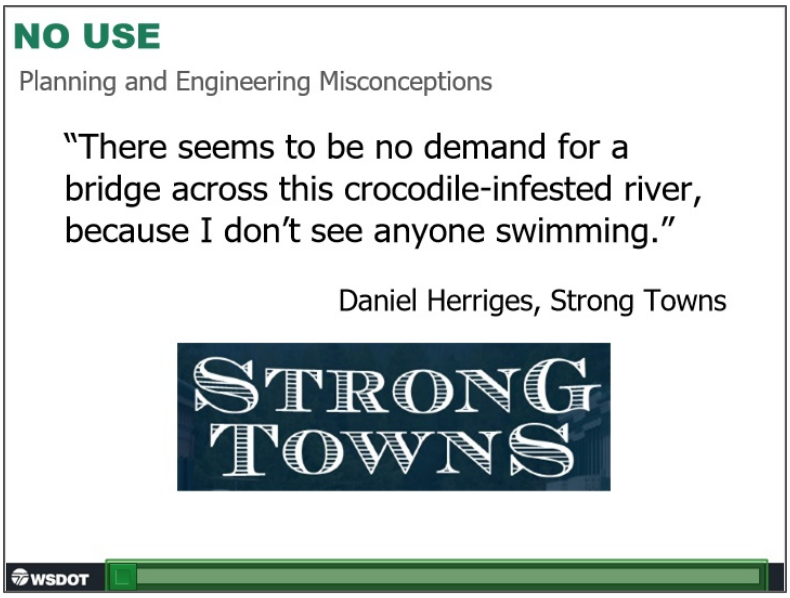
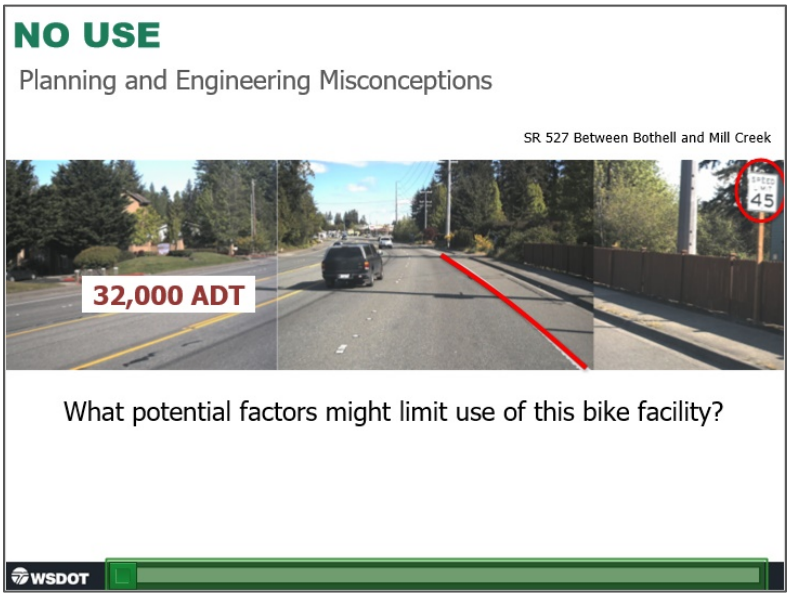


Notes:
Daniel Herriges of Strong Towns said that "there seems to be no demand for a bridge across this crocodile-infested river, because I don't see anyone swimming".

Slide 5.7



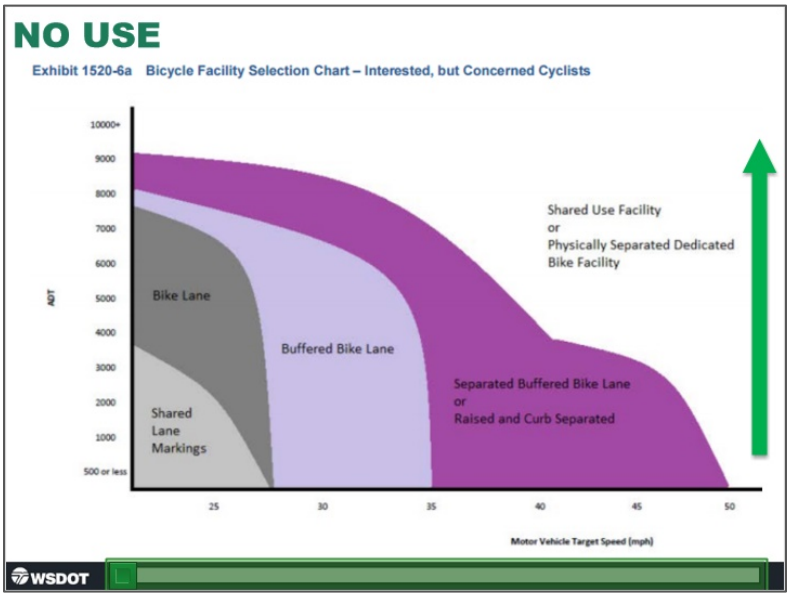
Notes:
Another common misconception conveyed is that “we put in a bike lane but no one uses it.” On SR 527, we installed a conventional bike lane at some point per the Design Manual standards at the time. Please note that prior the 2015 DM Update, WSDOT only provided for the inclusion of conventional bike lanes.

SR 527 is posted at 45 mph, and the operating speed in this segment is slightly higher in the off-peak and during peak hour it operates at around 30mph. As of 2015 the ADT for this segment was 32,000. This corridor experiences significant congestion during the peak hour, and tends to operate during these times around 35 mph. All intersections are at-grade and signal controlled on the corridor. Peak hour bike counts for 2015 were 20 and 22 in the AM and PM, respectively. Bike counts are only taken from 7-9am and 4-6pm for one day out of the year. These numbers are hard to argue with, yes?

What potential factors might limit use of this facility?

There are a number of factors that make this a challenging corridor for bicyclist. We know that ADT and speed are issues in general. Looking at the bike facility charts, when designing for the confident cyclist we are looking at a separated bike lane or raised and curb separated. But we are trying to capture the interested but concerned user, for this designated bike route so likely more separation is preferable.

Slide 5.8



Notes:
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Slide 5.9

Notes:
What is the meaning of green bike lanes?

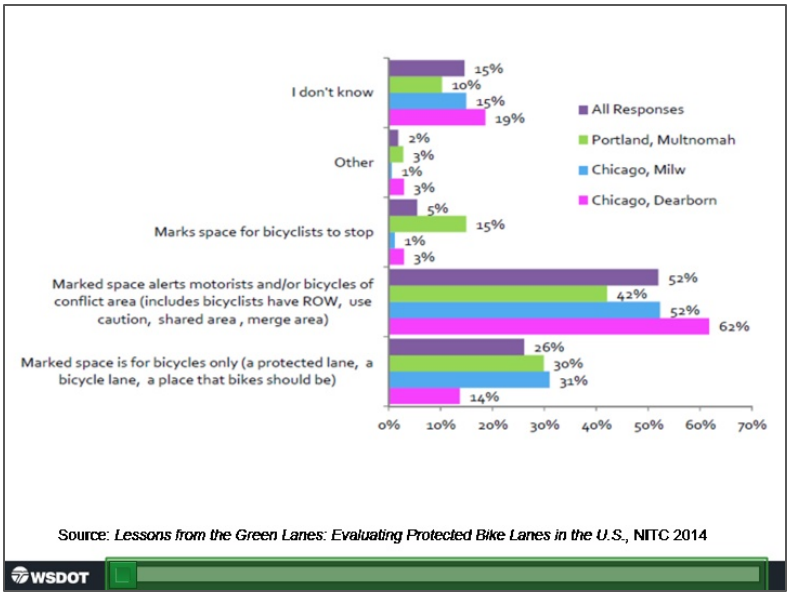
Green is currently used for two things: 1) conflict notification and 2) Designation of an exclusive facility…but how do drivers interpret green paint?

Andrew's personal story:

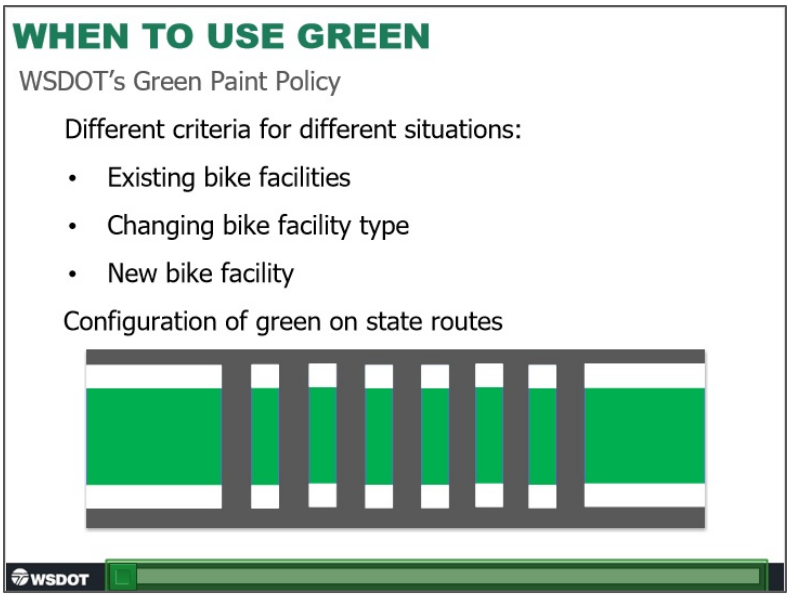
Here in Olympia I ride this route occasionally. The city recently paved and restriped this facility, which incorporated green paint. Right after taking this picture, I found myself stopped in the green paint area. A van pulled up next to me, the driver and I looked at each other and nodded. The light changed, and the van took a right turn in front of me as I was starting up. Do I think that driver was a jerk? Yes, but only until I gave him the benefit of the doubt. I honestly believe he felt the green was a yield box for bikes.

There is some research on this and there are valid concerns from both the driver's and cyclist perspective. 2014 research found that drivers really don't know what it means with green paint is present. This is a significant study because Portland and Chicago were both early adopters, so we would expect drivers in those cities to be most familiar with the treatment. A 1999 study made observations regarding cyclists behavior and noted that cyclist appeared to check and verify their safety less frequently.

This isn't to say don't use green paint; you should use it where appropriate, and where there is a need to. This is an explanation of why it is important to consider all the implications of applying this traffic control device aside from just the added maintenance.



Slide 5.10



Notes:
Design Manual Chapter 1520 presents three situations with different criteria for using green paint. And within this criteria we provide a lot of potential flexibility. Basically there are three different situations in the Design Manual for when to apply green paint *(see below if asked)*.

For mixing zones WSDOT has adopted the latter striping configuration. This is WSDOT's policy. That said our Chapter 1520 does allow for consistency with local agency policies/preference as well.

WSDOT has blanket experimental approval for the application of green paint in bike lanes, but this does not necessarily extend to a green bike box.

Existing Bike Facilities - retrofitting an existing facility with green pavement may be considered when two or more of the following apply:

a) It is the engineering judgment of the Region Traffic Engineer
b) There is an existing traffic conflict area, such as bike lane crossing a motor vehicle turn lane, and there are one or more observed motor vehicle and bicyclist crashes in the last 5 years.
c) The bike mode is a modal priority (see Chapter 1103), and there is a baseline or contextual need identified associated with increasing safety performance of the mode.
d) When a bike route intersects a multilane highway, and the crossing is neither signalized nor a roundabout.

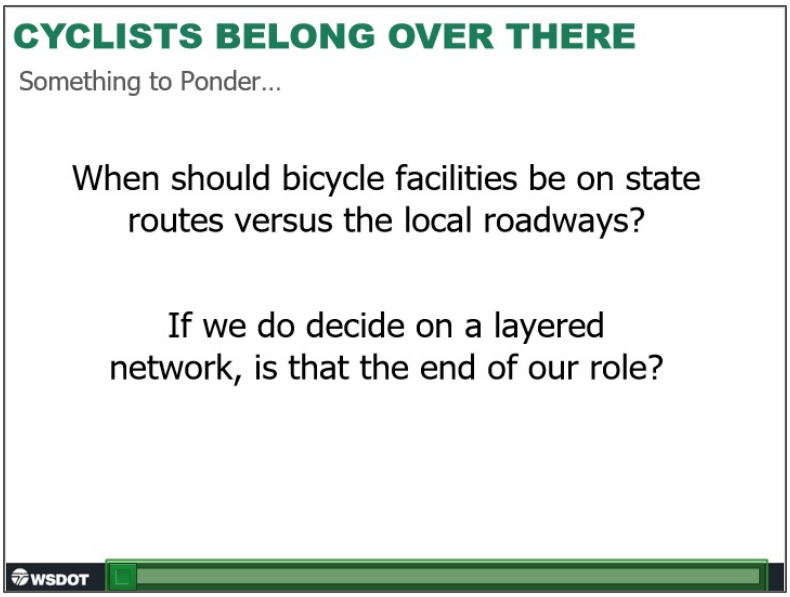
Changing of Bike Facility Type -consider green pavement markings when one or more of the following apply:

a) It is the engineering judgment of the Region Traffic Engineer.
b) A transition from a separated facility through a functional intersection or interchange area necessitates additional delineation to create a clear, visible, predictable and distinct travel path for bike users, and a bike signal or actuation device is not used.
c) The facility type change does not substantively alter the configuration of an existing conflict area, and there are one or more observed motor vehicle and bicyclist crashes in the last 5 years at that conflict area.

New Bike Facility - Generally, the immediate application of green colored pavement on a new bike facility is discouraged until the need for increased safety performance is demonstrated. This said, consider green colored pavement when two or more of the following conditions exist:

a) It is the engineering judgment of the Region Traffic Engineer
b) The bike mode is a modal priority (see Chapter 1103), and there is a baseline or contextual need in which the application of green colored pavement markings is needed to meet the stated modal safety performance target (see Chapter 1101).
c) The bike facility nodes and/or crossings are within 1 mile of activity centers, such as schools, libraries, colleges, etc.
d) The bike facility crosses a motor vehicle free right turn to or from an interchange ramp.
e) The bike facility is a bike route or bike boulevard (for definition, see NACTO's Urban Bikeway Design Guide).
f) The state route is also a city street, and the city policy or municipal code requires green colored pavement markings as their standard.
g) The bike facility is raised and curb separated, and the city engineer requests green colored pavement markings at either crossings or conflict areas.

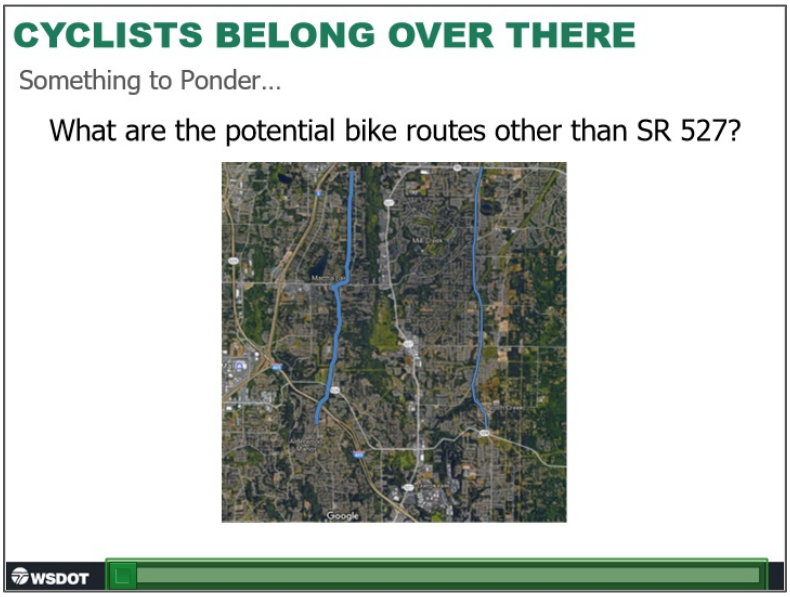
Slide 5.11



Notes:
When should bicycle facilities be on state routes versus the local roadways?

If we do decide on a layered network, is that the end of our role?

Slide 5.12



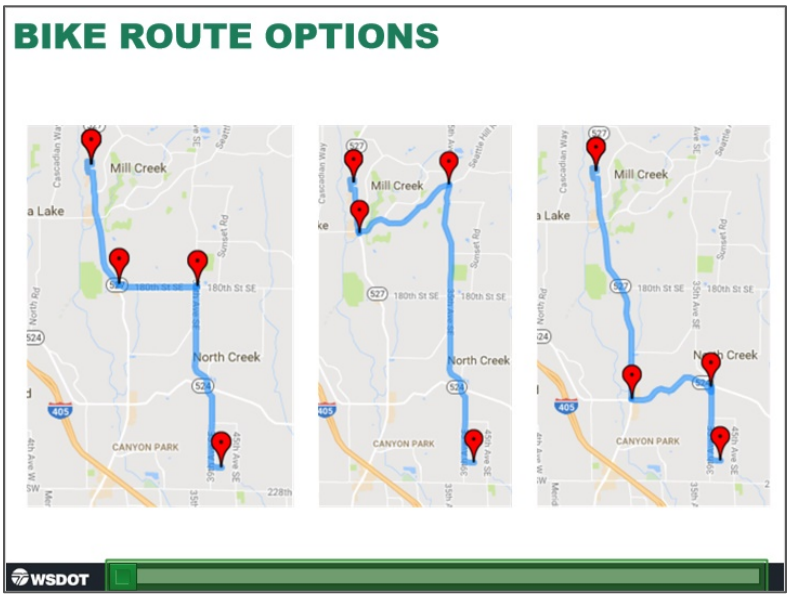
Notes:
We talked a little bit about SR 527, and I'm guessing that some of you were immediately thinking "put the bikes somewhere else". Where would you put them if not on SR527?

Here are two potential routes. Something to ponder: do cyclists just ride for the sake of riding? where are they trying to go?

This is an important question. Remember that we've described mobility as a function of both the transportation and land use. Where are the job centers, where is the entertainment and dinning, where are the activity centers? Most all of these are within close proximity to SR 527.

The interurban trail parallels I-5 in this photo, a long way from SR527.

Slide 5.13



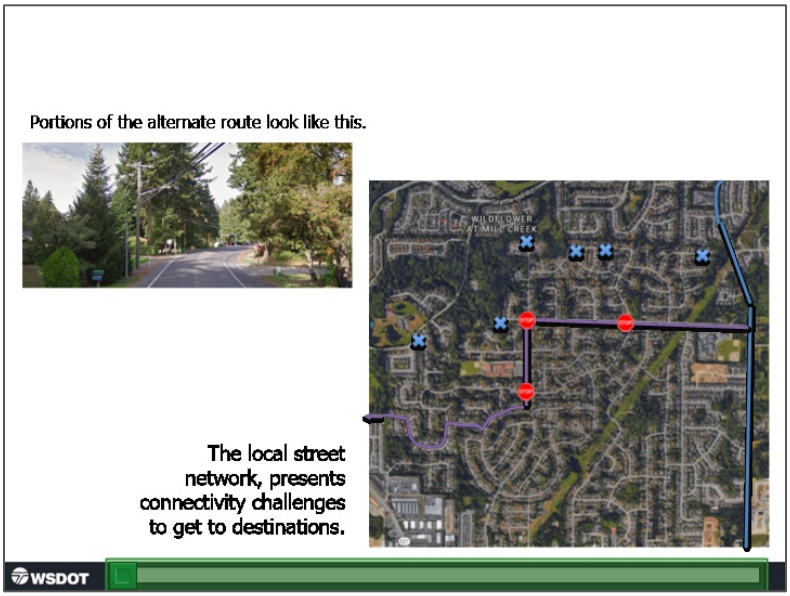
Notes:
So I want to get from my house to my job at the mill creek town center. There are really only three potential routes, and all of them would require use of SR 527 to make the trip. *But why is this the case?*

This type of development pattern is an major issue for providing layered networks. Its not that simple when all the destinations are configured for easy motor vehicle access off our state highways.

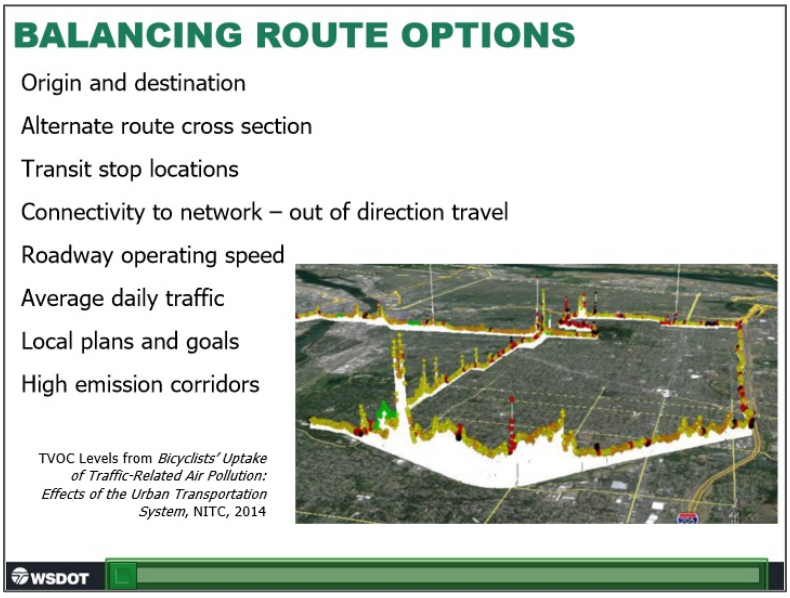
The Active Transportation Plan will shed light on this:

- Level of traffic stress
- Off-system investments
- Balancing directness of route with comfort and safety

Alternate route



Slide 5.14



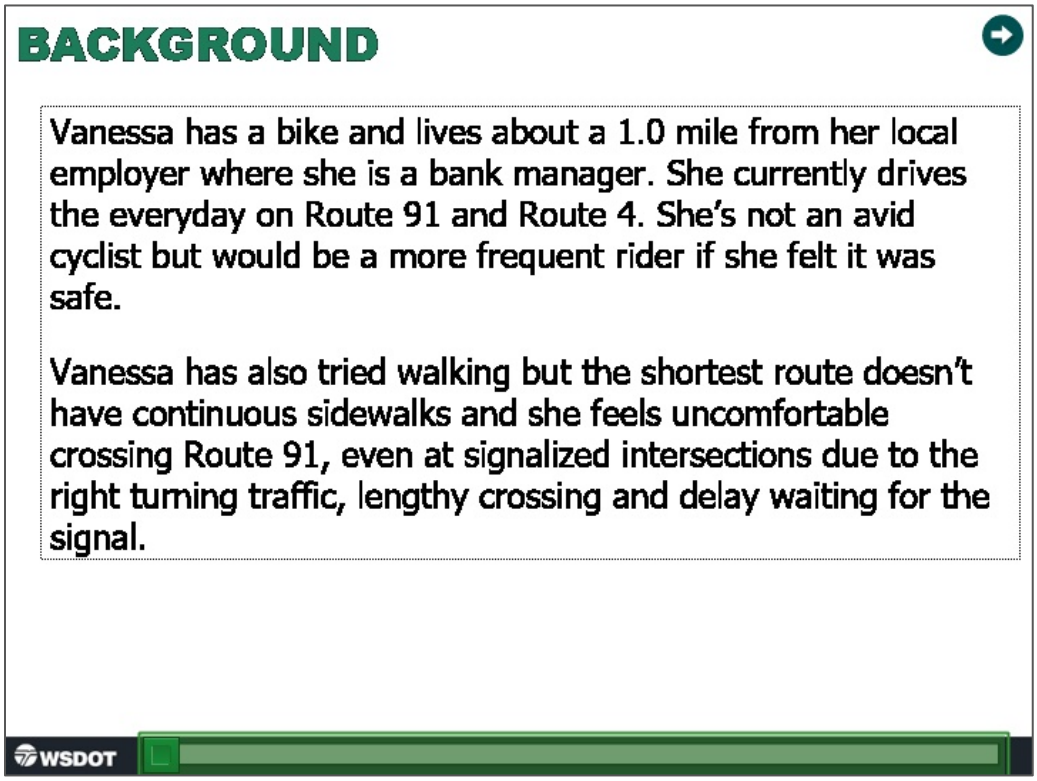
Notes:

There is a lot to balance - it is not just a decision to be made on a whim or something you can assume. Everything with multimodal relies on network connectivity. While it would be beneficial to relocate the bikes to an alternate corridor, there is little ability to do so. Given the emphasis on throughput for our state routes over the years, locating bike facilities for mobility and accessibility performance needs makes sense.

So there are many issues to consider and balance, it is not just a matter of saying this is a local network problem. Especially since in some cases we've contributed to that barriers to connectivity.

We have had great successes too. The interurban trail is one example, and is a reason why SR99 was able to focus on BRT integration through shoreline.

There are some public health concerns about bike facilities and high traffic corridors. Even though biking is generally viewed as a healthy activity, a PhD dissertation that used breath biomarkers to measure absorbed doses of volatile organic compounds, or VOCs. The study found that locating bike facilities on low volume adjacent roadways does provide a benefit in reducing uptake of VOCs versus higher volume routes.



BACKGROUND

Vanessa tried biking on different routes that have more robust bike facilities, but the out of direction distance is a problem for one route. The other route has heavy traffic turning into the transit center park and ride lot in the morning, and she encountered a near miss situation while crossing Route 91 at the Market Place intersection.

The near miss involved a driver making a right from Market Place to Route 91 northbound. Vanessa was stopped at the intersection in the bike lane, and went to proceed straight through went the car turned in front of her.

These instances have led her to keep driving despite her close proximity.

WSDOT

WSDOT

CONTEXT

Vanessa also represented the small business community during the Vernal Village Subarea planning effort. While her personal concerns about biking to the west of Route 91 are at the forefront of her mind, she is starting to question the viability of locating major employment centers west of Route 91.

The city and their consultant had claimed that local employment centers would help with highway congestion and offer local jobs that citizens could walk or ride to, but given her own experiences she's not confident that will occur without changes to facilities.

WSDOT

ALTERNATE NORTHERN BIKE ROUTE FOR VANESSA

WSDOT

ALTERNATE SOUTHERN BIKE ROUTE FOR VANESSA

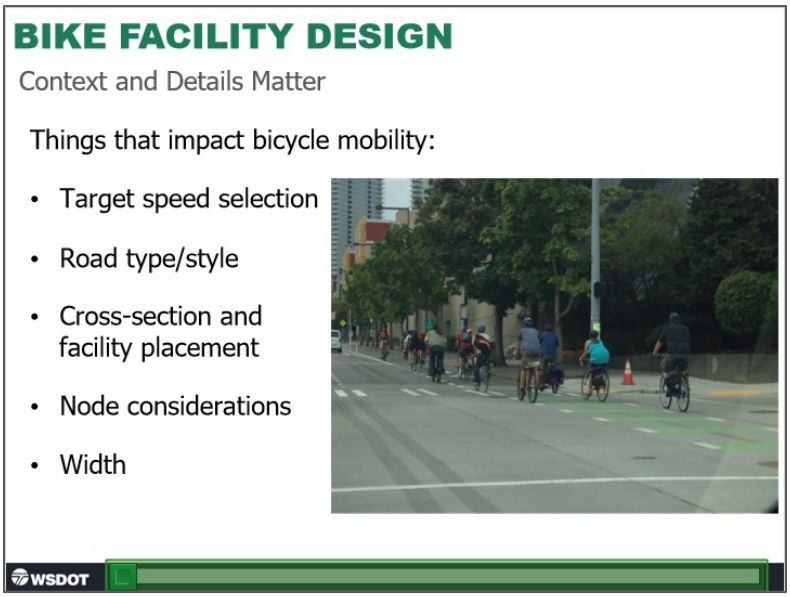
WSDOT

QUESTIONS

1. What is the need here, in general?
2. What other aspects about Vernal's plans are related to this need?
3. What engineering options exist to better support the future economic vitality and multimodal mobility in Vernal?
4. Qualitatively, what are the tradeoffs associated with your options?

WSDOT

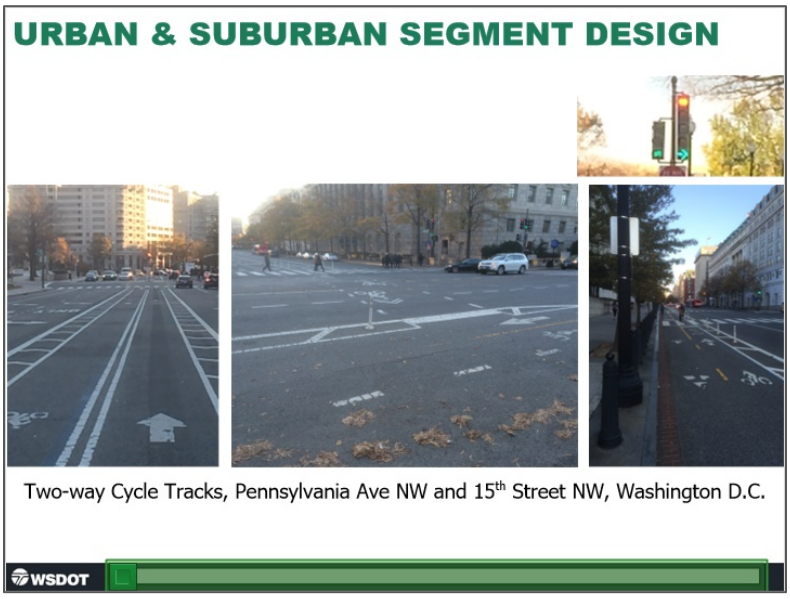
Slide 5.15



Notes:
We've already discussed the relationship with speed and facility selection, but the target speed, road type and placement of the facility within the road type can enable increase mobility and/or safety performance for people biking.

While the target speed and average daily trips, combine with performance needs, context and modal priority might lead you to a particular facility type there are different arrangements of the geometric cross section that might better tie into the modal network, support modal goals or increase accessibility performance with the land use. Given the potential variability along the segment, it may be necessary to transition the bicycle facility type throughout a corridor or segment.

Slide 5.16



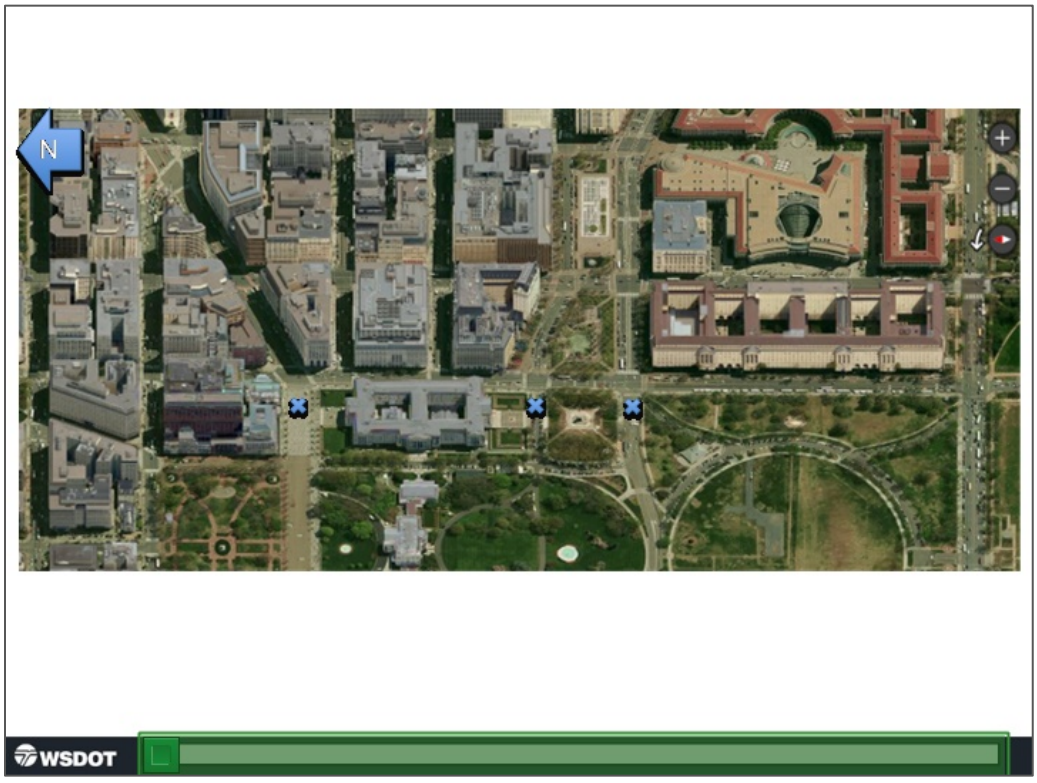
Notes:
This two way cycle track on Pennsylvania Ave (left) isn't a contraflow facility because of its position in the center of the roadway; there are three lanes of traffic on each side of this buffered bike lane. Placement of the cycle track is really important to consider how you provide connectivity to the other facilities. It isn't a decision to take lightly, just putting the bike facilities as the outside lane in a cross section is not always appropriate and can have considerable impacts for the operations at the node for all modes.

Some might question this center cycle track configuration, however, it enables the connection with the side running two-way cycle track on 15th street. The DOT used bike signals to coordinate modal movements.

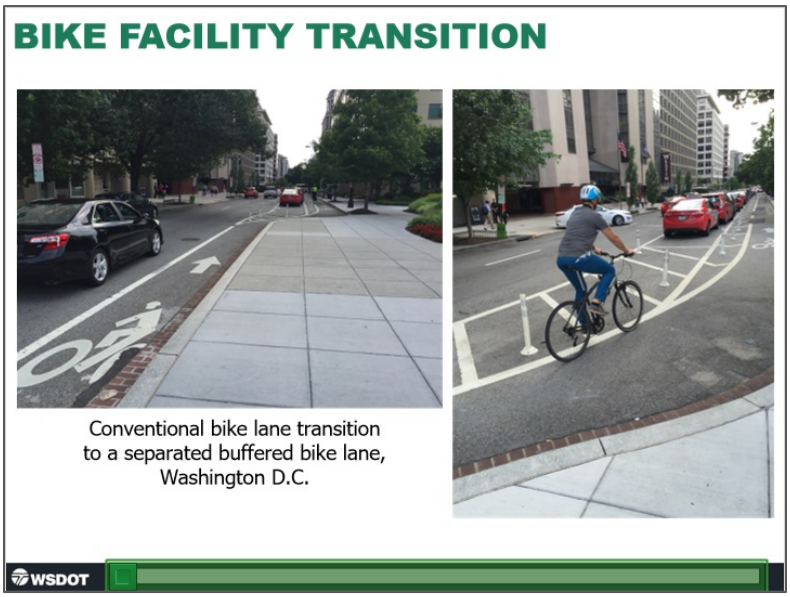
When you look at the broader network, the side placement of the cycle track on 15th makes a lot of sense. 15th Street runs adjacent to the White House, which has limited secure entrances covering multiple blocks (where the 'Xs' are). The side running cycle track enables a nice stretch of uninterrupted throughput for the bicyclist.

This can be really attractive to particularly at the intersection with Pennsylvania Ave. People using the cycle track on 15th Street don't even have to stop except when the white house security guard manually directs them to, in order to allow White House employees and visitors access. The center lane cycle track placement on Pennsylvania Avenue was not just a wacky idea, it helps to enable the connectivity of the bike network.

Locations

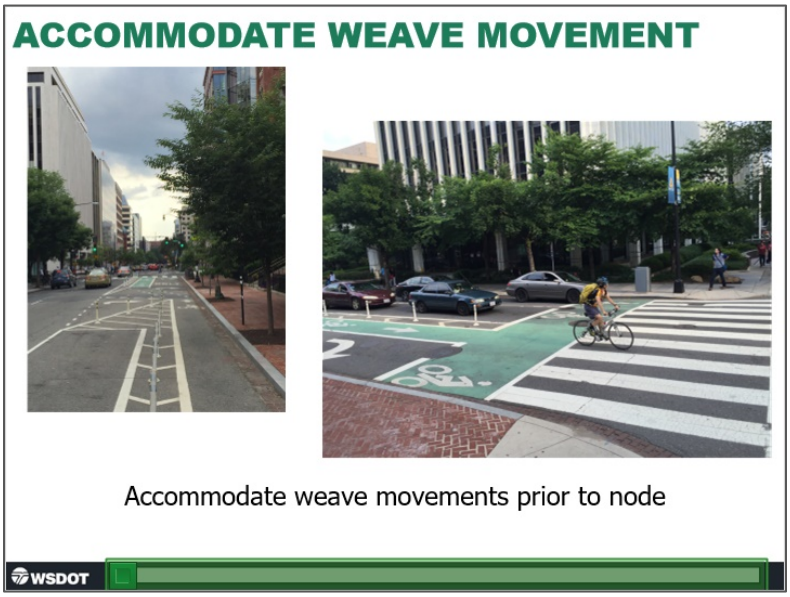


Slide 5.17



Notes:
The geometric cross section and available width can be difficult to manage from block to block, particularly within developed land uses. Here is a transition between bike facility types.

Slide 5.18

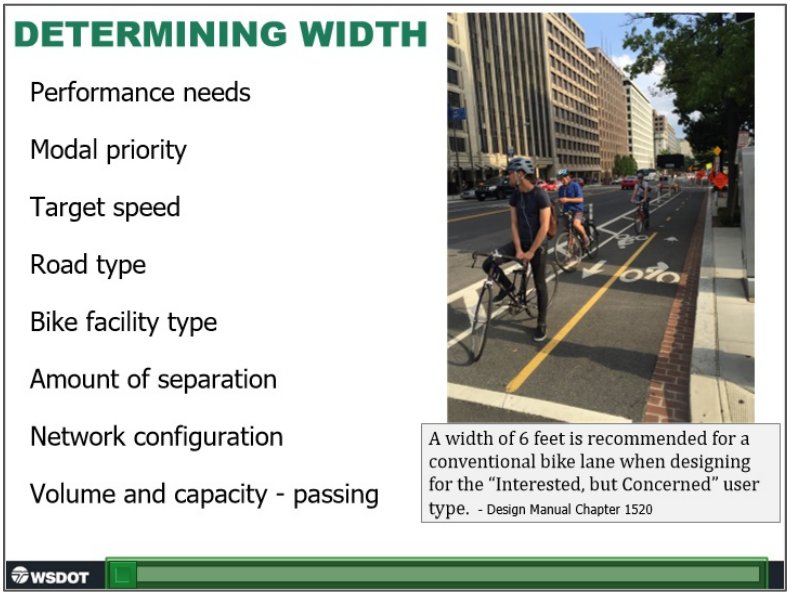


Notes:
It is important to rearrange the cross sectional position and potential weave movements prior to the node. We want to break up the work load for both the cyclist and driver. In this application it would be nice to have a little bit more distance to set up the weave movement prior to the intersection. This would impact a couple more parking spaces.

The weave movement here is fairly abrupt, and when a vehicle is parked here the driver might not have sufficient perception reaction time. While the slow speed of the corridor helps with

this, it could be set up a bit better. Bring the bikes adjacent to the travel lane first, and then shorten the crossing distance and weave maneuver.

Slide 5.19



Notes:
Determining the width is not a simple task and depends on balancing the performance of multiple modes, as well as knowledge of what widths create substantive changes in operational mobility and safety performance for each mode, while keeping in mind the network configuration.

Understanding and predicting volumes is a huge challenge. At Dexter Ave. in Seattle, not many people could have predicted a 40% increase in ridership. Because a rider's individual comfort level, age, fitness level and bike tech vary significantly, lanes that are too narrow can significantly impede other riders. In D.C. the cycle track widths are narrow, but the total width of the two way cycle track including the buffer provides some ability to pass as long as the volumes are not too high in both directions.

Different road types will affect how some of these elements are changing. If you have a multiway boulevard versus and avenue, then you might be looking at different widths.

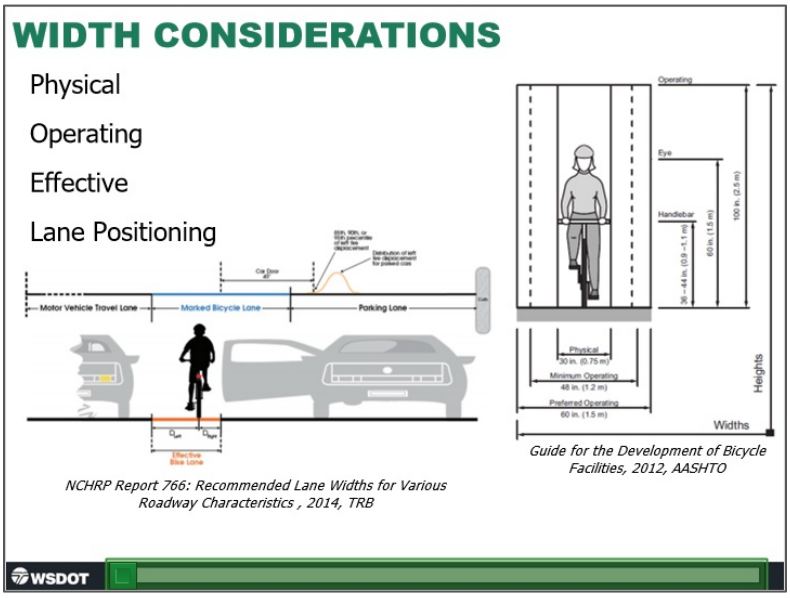
The Design Manual Chapter 1520 recommends 6 feet in width for a conventional bike lane, however you are permitted to use 5 feet on tangents and 4 feet for weave maneuvers as minimums.

Slide 5.20

Notes:
Illinois DOT had a governor-mandated moratorium for bike lanes on state owned facilities for a number of years, which challenged establishing strong spines for the cities bike network. The moratorium was lifted and this is their first installation on a state route.

Here in Chicago this separated buffered bike lane is about 5 feet wide and is a one-way cycle track. Because of the free right for cyclists at the signal, they striped in a through lane and a turn lane to hopefully separate movements and enable mobility. However, this will be a challenge for cyclists to manage given the overall width and hardscaping.

Slide 5.21



Notes:
The Design Manual does not go into the basic information and details about these width considerations. Rather, it focuses on policy around facility type selection, intersection/interchange options, and criteria for traffic control devices.

Widths are much more complex than just picking something out of a book.

NCHRP Report 766: Recommended Lane Widths for Various Roadway Characteristics found that lane positioning of a cyclist is affected by many things, but ADT really creates a situation that pushes the cyclist away from the motor vehicle travel lanes. This needs to be factored into the width considerations and adjacent uses. If you're in this situation you might push the cyclist into parking or drainage structures.

Poor bike design can have unintended consequences to the operations of other modes, in addition to impacting the potential use of a bike facility. If the cyclist really doesn't feel comfortable adjacent traffic, then they may occupy a travel lane, potentially impacting the anticipated performance balance.

Visualizations can be an important tool. There are many freeware applications like streetmix.net, a drag and drop application so you can really look at how to use the cross section in different ways. Visualization can be also helpful if you haven't figured out or selected a road type because you can look through all the different cross-section possibilities. Additionally, WSDOT's Visual Engineering Resources Group can provide everything from 2D visualizations to animations.

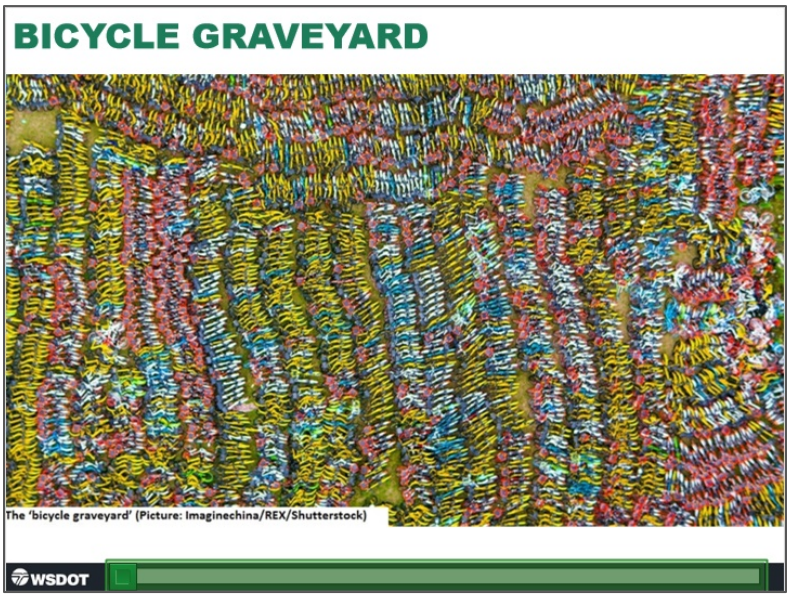
Slide 5.22

Notes:
Docked bike share in Seattle started in the summer of 2017. Is there a bike share bubble?

Slide 5.23

Notes:
Dockless bike share followed.

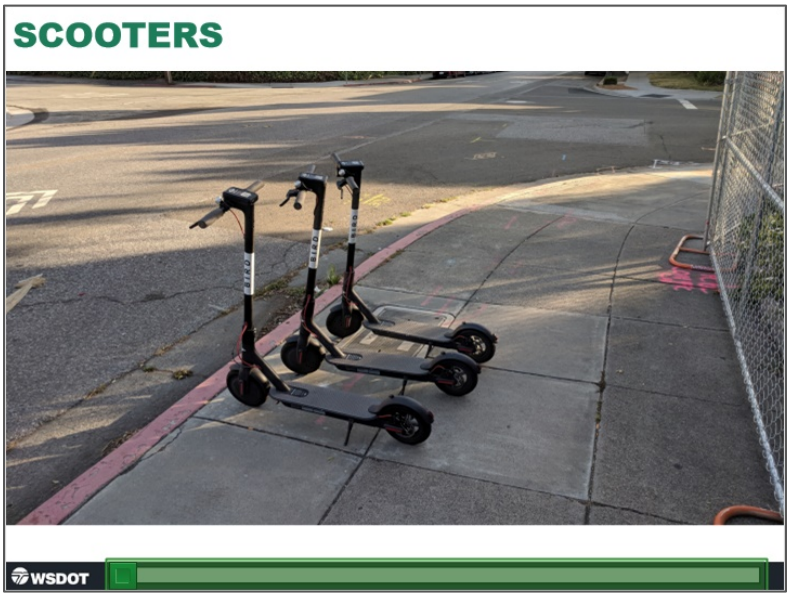
Slide 5.24



Notes:
This image is a bicycle graveyard in China.

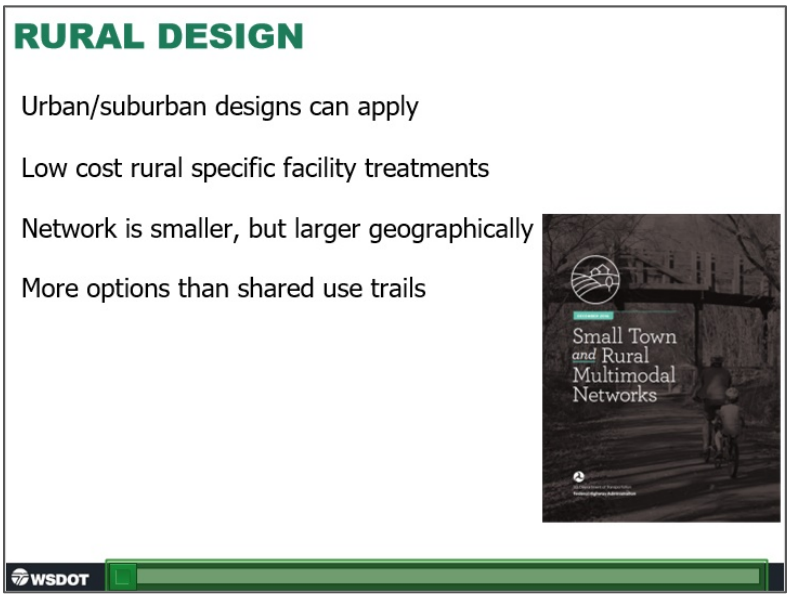
Bike sharing took off in China, but the rapid growth vastly outpaced immediate demand and overwhelmed Chinese cities, where infrastructure and regulations were not prepared to handle a sudden flood of millions of shared bicycles. As cities impounded derelict bikes by the thousands, they moved quickly to cap growth and regulate the industry. Vast piles of impounded, abandoned, and broken bicycles have become a familiar sight in many big cities. Huge surpluses of bicycles can be found collecting dust in vast vacant lots.

Slide 5.25



Notes:
From pikebedinfo.org: “The potential health, environmental, and congestion relief benefits of e-scooters, e-bikes, and station-based and dockless bike share transportation systems are promising as a complement to existing modes of travel. They also provide "micromobility" and an affordable, low emissions alternative to driving. Many communities see possibilities in micromobility to help extend the transit ridership shed and support first/last mile trips to transit connections. As with all new innovations, there is much to learn about safe implementation, compliance, equity considerations, and infrastructure planning and design to support emerging forms of transportation and technology.”

Slide 5.26

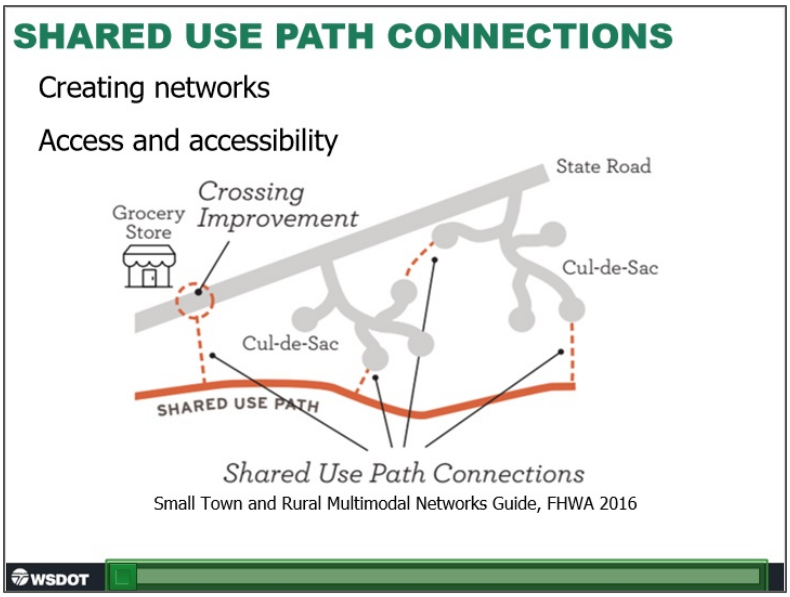


Notes:
As previously discussed until the 2015 update, the WSDOT Design Manual did not have many different types of roadway bike facilities. We allowed for three options: conventional bike lane, bike on shoulder and shared-use paths. The most recent update preceded the STAR guide, which was published in January 2017. Its important to understand that some traditionally urban bike facilities work in rural contexts, but many of the facilities presented in the STAR guide are not appropriate for urban uses.

Please note that some of the treatments listed as "preferred" and/or "potential" recommendations in the guide are more like "common practice" than actual recommendations with research behind it. Also, there are things in the guide like the pedestrian lanes that are not in the MUTCD, but it is currently the most current and comprehensive guide regarding rural active transportation networks that we have.

The Design Manual does not cover these applications, but can be implemented with little work. In terms of the interaction with the rural network, in many cases the highway is a crossing location while in other cases the highway might be an integral part of the small town, such as its main street. Each of these contexts presents different challenges.

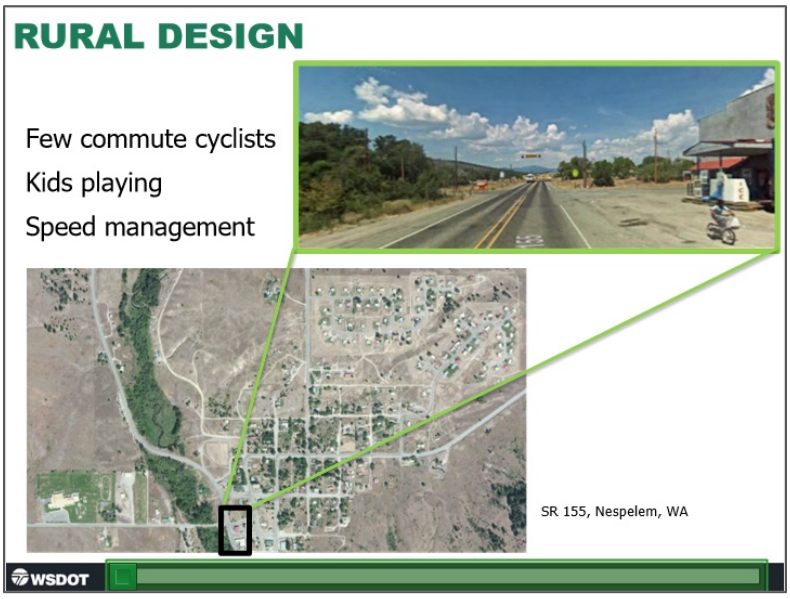
Slide 5.27



Notes:
As we've mentioned before, facility type selection requires information on how other aspects of the network are configured. In some cases, when a bike facility need on a state highway is leading, you may need to do a bit more work with our local partners and the community before making a selection.

There needs to be a shared understanding of what the network might look like and accessibility to the facility. You may not have other elements of the network as part of your scope but it is critical. Just like in our urban/suburban example, you can build a great shared use path, but without understanding how you provide access to and from the shared use path, your facility might get underutilized or accessed through different areas.

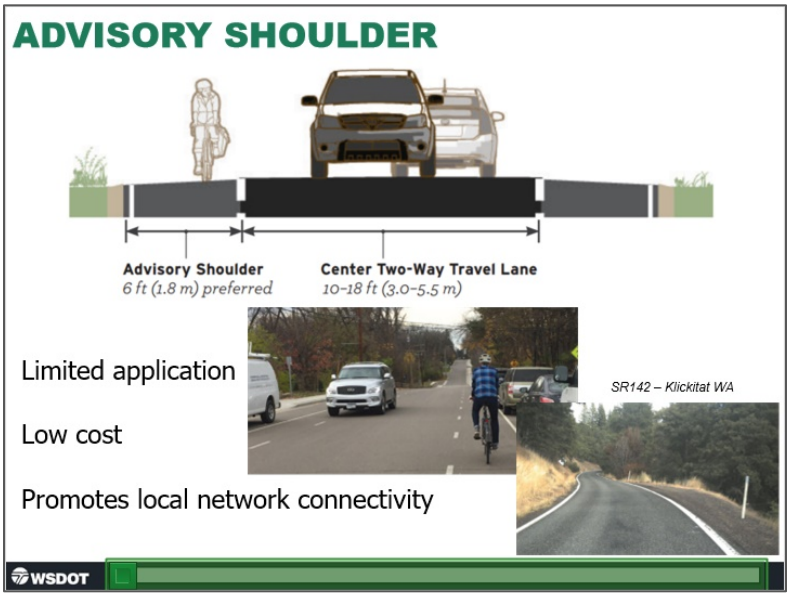
Slide 5.28



Notes:
In small towns like this one, you may not find many commute cyclists, but you are likely to find children trying to get around. Limited interruption in the target speed for isolated situations may be appropriate depending on the context. Here in Nespelem on SR155, there is a small residential area with a Pre-K - 8th grade school. In small communities, the public facilities are multipurpose - it's a school, it's a playground, it's a community center, and it's a sports field.

High speed roundabouts can be an effective treatment at lowering the operating speeds as these types of isolated crossing locations. Given the small size of the town, the center feature can also play a role as a type of gateway as well.

Slide 5.29



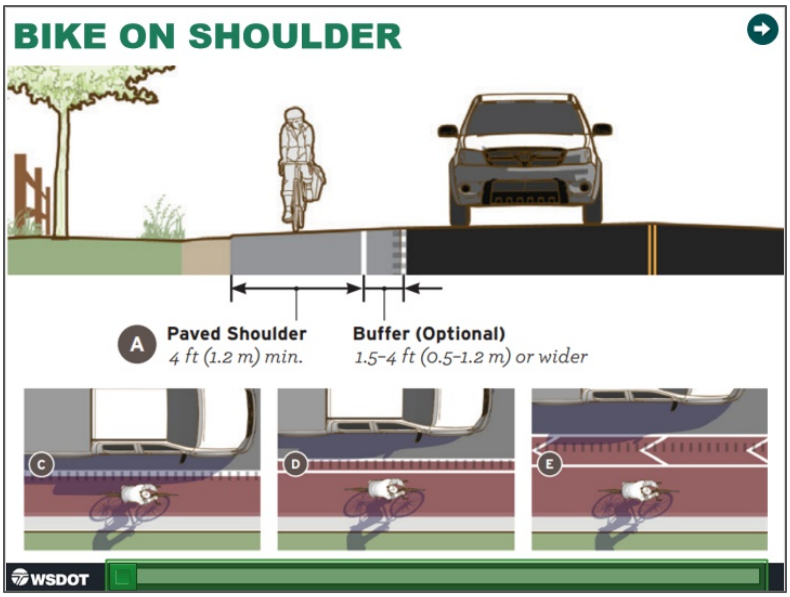
Notes:
The STAR guide presents a number of facilities types that apply to the local roads, but you are more likely to use different treatments on the highway. Understanding these applications can help with network discussions and opportunities for the connectivity on the local agencies part.

A simple low cost striping of an advisory shoulder on the local network may help expedite completing connections to the state route. Many small local agencies have a public works department, but may not have a transportation expert. A role for us may be to help them think about what low cost options exist.

Note that this is not MUTCD approved at this time, experimental approval is needed.

While not likely applicable on nearly all state routes, there may be at least one state route that could apply the advisory shoulder. Here in Klickitat, SR 142 acts as the main street through town. Six miles north as you head to Goldendale WA, the two lane roadway changes to a single lane supporting two directions of traffic. With 2015 ADT counts at 710, an advisory shoulder on this route may be appropriate. It may even attract cyclist to this route from SR 14, which has varied shoulders and more traffic.

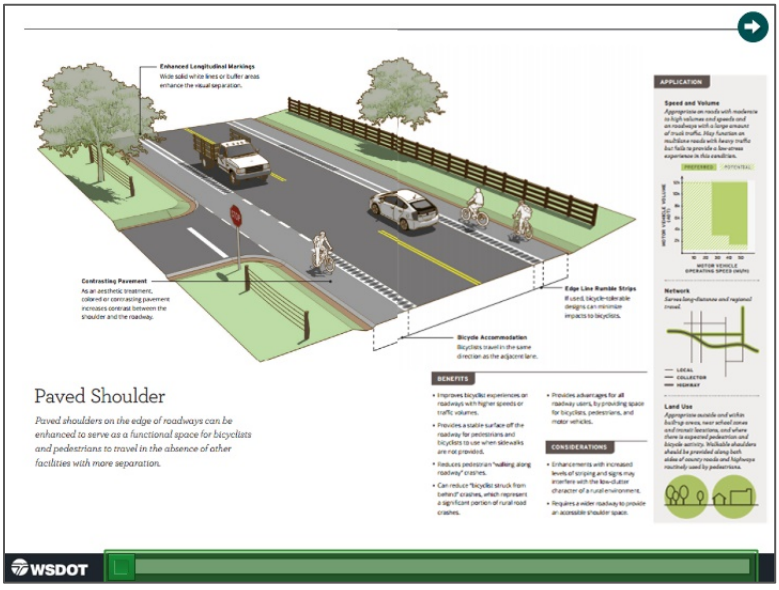
Slide 5.30

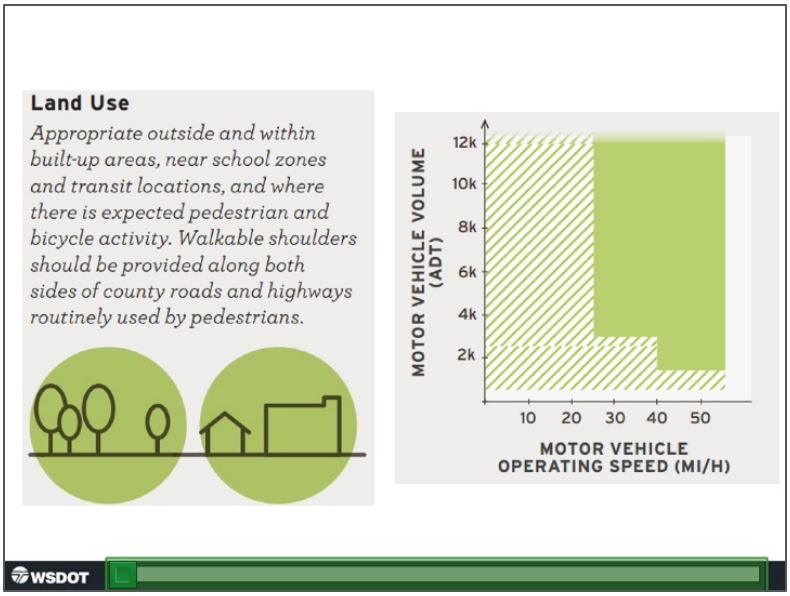


Notes:
Bike on shoulder applications are what most of us are familiar with. The STAR guide offers more options beyond what we commonly provide. The same minimum shoulder width is suggested, but they do recommend going above and beyond the 5' shoulder that the WSDOT Design Manual suggests. They also recommend enhanced striping options.

Some are considerations that need to be discussed with your materials and traffic engineers. For example pigmented pavement might be of concern for longer term maintenance cycles. Also, some of the enhanced striping options appear to warrant special lane use designation, which has implications on operations and the rules of the road that may not be appropriate to introduce.

The STAR Guide is really simple to use from a context perspective. While the guide is light on design details, it gives great context and speed compatibility information for each treatment.

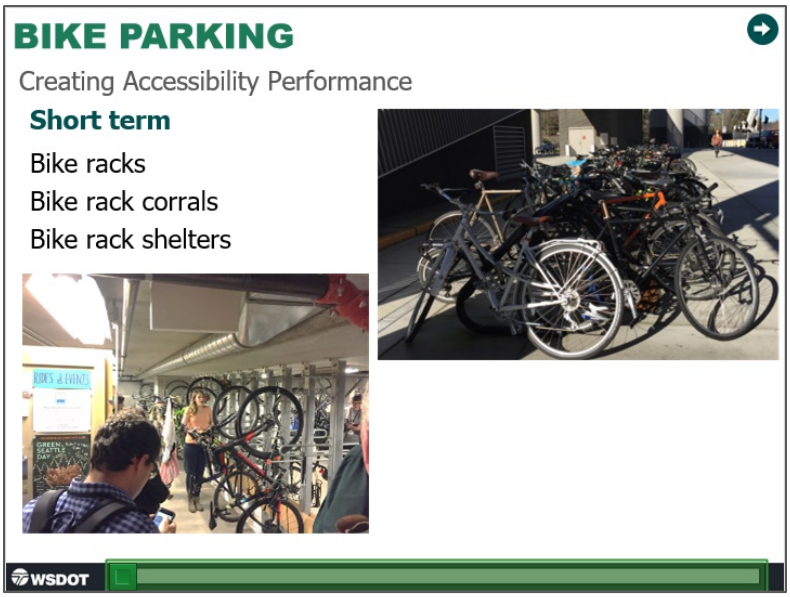




Slide 5.31

Notes:
US 2 in Newport WA shows some great rural town center features, including one-way conventional bike lanes on the one-way pairs of the couplet. This facility could potentially be converted to a two-way street because of low traffic volumes and ample geometry. This could slow vehicular movements and simplify navigation for improving economic vitality.

Slide 5.32



Notes:
We've discussed accessibility in many different ways. But one definition that we're sticking with until we know otherwise is to say that accessibility is the "ease of reaching valued destinations". Designing bike parking for the intermodal trip is an important consideration for multimodal networks.

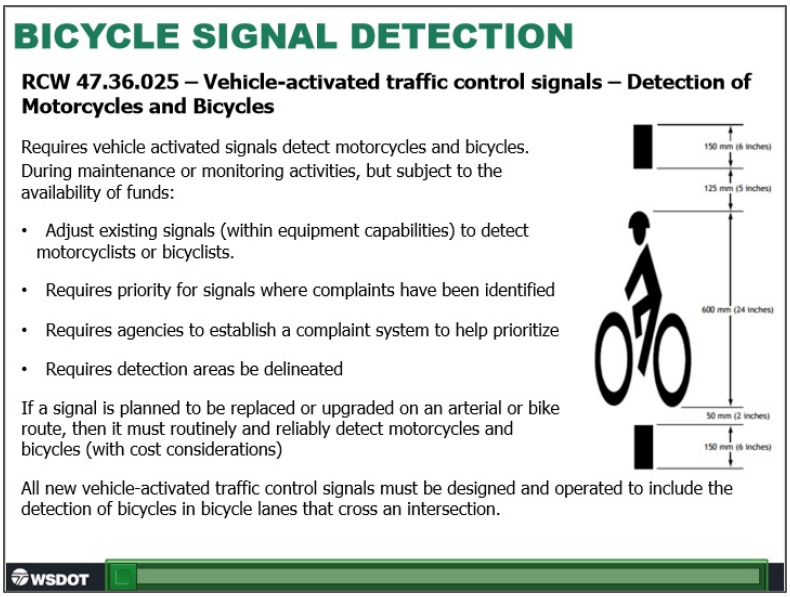
Short term vs Long term tradeoffs:

Bike parking options come in many different forms and price ranges. At the low end there are your basic bike racks, next you have bike rack or locker clusters. On the higher end, you have your enclosed facilities which can range from simple cages to fully enclosed facilities.

Parking placement considerations:

- Destination location
- Destination type
- Level of security

Slide 5.33

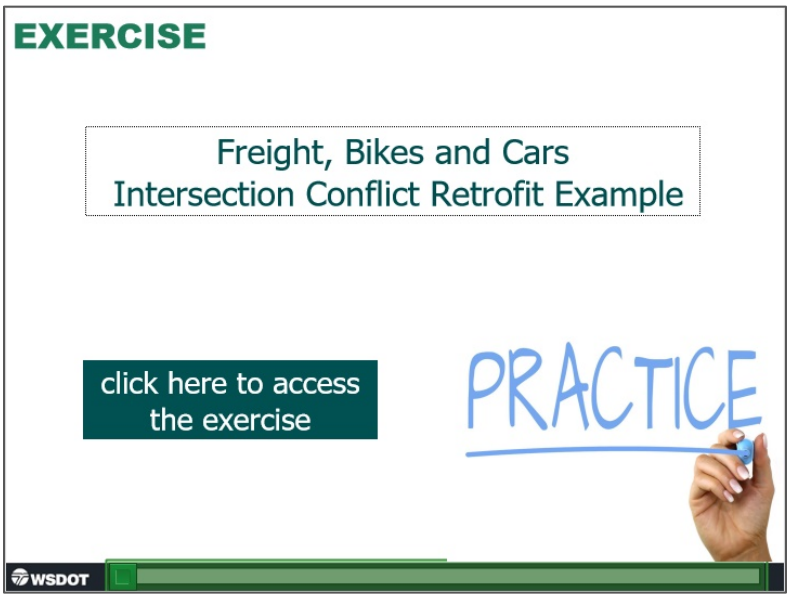


Notes:
This law requires the inclusion of automated detection of bikes and motorcycles on major and minor arterials. While there are specific conditions identified under the different categories of work, for the most part, if you aren't seeing detection on your signals systems - then you should ask about it.

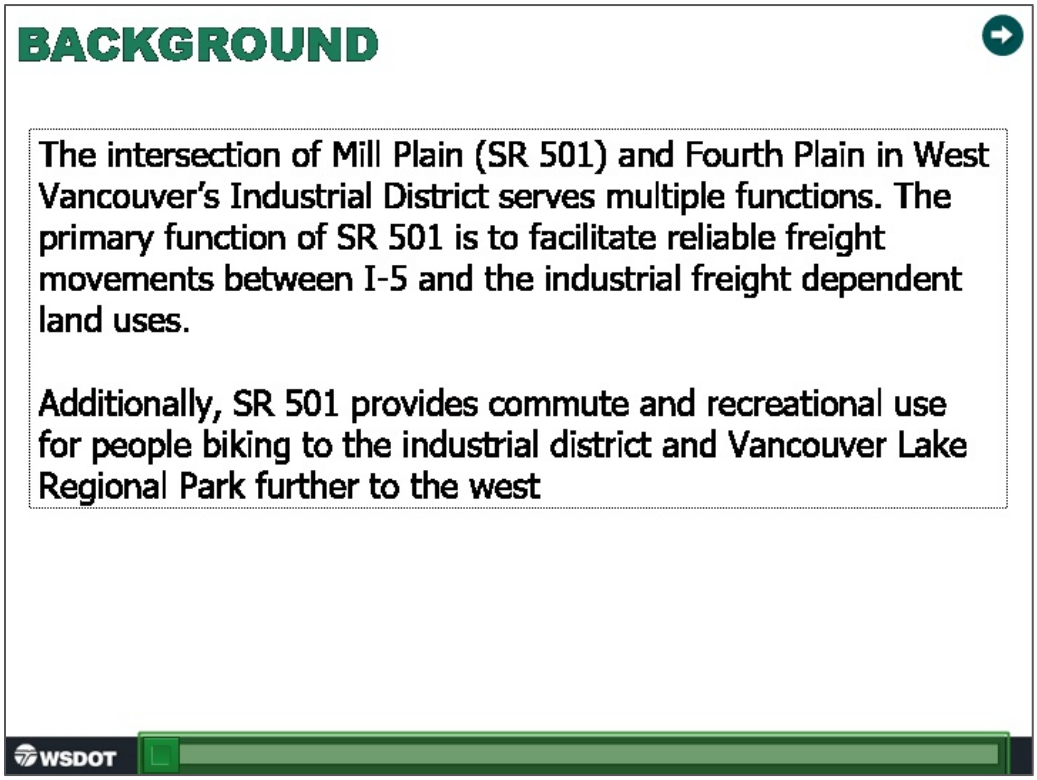
RCW 47.36.025 - Vehicle-activated traffic control signals-Detection of motorcycles and bicycles.

6. Recap

Slide 6.1



Notes:
This exercise highlights some modal conflict points in a freight, bikes and cars intersection conflict retrofit example.



BACKGROUND

The city of Vancouver, WSDOT and the Port of Vancouver have selected modal priorities for freight, bike, transit and pedestrians on SR 501 through downtown, with freight and bike modal priorities for the section of SR501 west of downtown (including the Mill Plain/Fourth Plain Intersection).

Additionally, the city of Vancouver has recently completed a planning effort called the West Side Mobility Strategy to identify needs and prioritize potential improvements in West Vancouver.

The planning effort engaged the local community and freight operators, among other groups and reached consensus regarding the corridor functions and emphasis.

SR 501 has a baseline need to facilitate reliable freight travel times.

WSDOT

BACKGROUND

The Mill Plain/Fourth Plain Intersection has experienced two bike-auto crashes, and the local cyclist community has expressed repeated near miss situations at the intersection when traveling westbound on SR 501, and has requested WSDOT and the City to consider reconfiguring the intersection with an emphasis on bike safety and mobility.

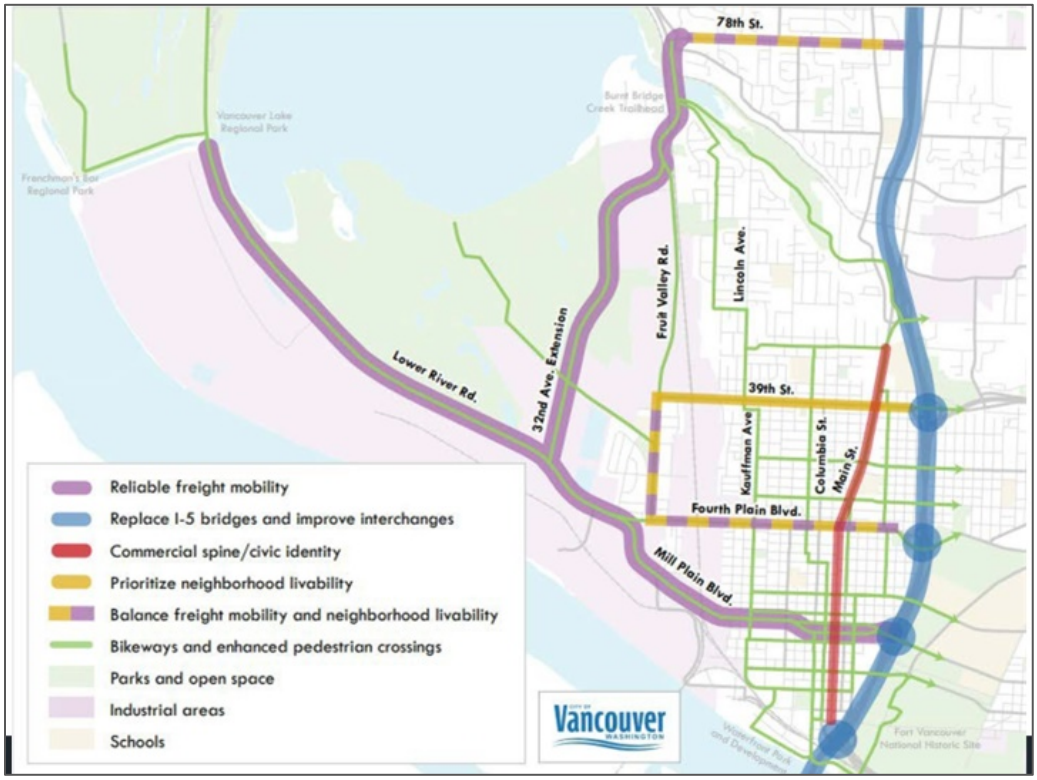
WSDOT

EXERCISE

Use information in the following pages to evaluate potential retrofit solutions to the intersection of Mill Plain and Fourth Plain that improves the crossing conflicts without affecting freight mobility in terms of reliable travel times.

Identify assumptions and modal performance tradeoffs.

WSDOT



CORRIDOR SKETCH SUMMARY

WSDOT

Corridor Sketch Summary

Printed at: 9:50 AM 9/20/2017

WSDOT's Corridor Sketch Initiative is a collaborative planning process with agency partners to identify performance gaps and select high-level strategies to address them on the 304 corridors statewide. This Corridor Sketch Summary acts as an executive summary for one corridor. Please review the User Guide for Corridor Sketch Summaries prior to using information on this corridor:

SR 501: I-5 Jct (Vancouver) to Ridgefield National Wildlife Refuge

This 11-mile segment of State Route 501 extends between the interchange with Interstate 5 in downtown Vancouver, the Port of Vancouver, and the Ridgefield National Wildlife Refuge at its northwestern end. Most of the corridor is rural in character, with the primary land use being agriculture and open space. The southeastern end of the corridor in downtown Vancouver is distinctly urban and features significant industrial land use, a large rail yard, and a mixed-use dense urban area with residential, government, and commercial use. The corridor follows the curve of the Columbia River and passes Vancouver Lake, an environmentally sensitive area, as well as regional parks such as Frenchman's Bar Regional Park. Large numbers of waterfowl and other wildlife inhabit this westerly portion of the corridor. Vegetation along the corridor ranges from maintained urban landscapes with decorative trees and shrubs on the southeastern end to open agricultural fields with stands of deciduous trees and significant amount of wetlands on the northwestern end.

Current Function

SR 501 is a regional highway with two sections: a southern section near Vancouver, and a northern section in Ridgefield. Both sections connect communities to I-5. This corridor is the southern section of SR 501 and connects the greater Vancouver region with the Port of Vancouver and recreational opportunities along the Columbia River. This corridor serves several functions. Near the port, it is primarily a freight corridor with significant truck traffic off- and on-loading cargo at the railyard, the marine port, and numerous industries in and near the port. In downtown Vancouver, the corridor is largely used by local traffic and commuters. This section has significant transit, pedestrian, and bicycle traffic. Bus stops operated by C-Tran, bike lanes, and sidewalks are located directly on this portion of the corridor. An Amtrak station is also located just south of the corridor next to the port. Finally, the northwestern end the corridor primarily serves recreational traffic accessing the many recreational sites near the facility. The primary traffic generators for this corridor are the Port and downtown Vancouver which draw in traffic from the surrounding area.

Future Function

Based on the projected population, land use, and economic trends, the future function of this corridor is expected to remain the same. The Port of Vancouver is developing its 108-acre Centennial Industrial Park, as well as other areas in their property. The city of Vancouver as well as private investors are also developing a 32-acre, high density, mixed use urban redevelopment, just south of this corridor. WSDOT may re-evaluate state interest in the northwestern portion of this corridor in the future.

Highlights and Performance

SR 501 is mainly a two-lane, undivided highway. A major exception is in downtown Vancouver where the facility is four lanes and divides into two one-way couplets. Average daily traffic is highest near I-5 in downtown Vancouver and lowest at the western end of the corridor near Ridgefield National Wildlife Refuge.

What's working well?

- There are no bridge preservation needs currently on the corridor.
- None of the corridor experiences congestion on a regular basis.
- This corridor facilitates significant transit use and non-motorized travel.

What needs to change?

- Roughly 14% of surveyed pavements on the corridor are in poor to very poor condition.
- There are significant conflicts between heavy freight traffic and other modes in downtown Vancouver.
- Repeated maintenance issues on some sections may become chronic environmental deficiencies.
- Here re user conflicts between freight traffic and recreational users, particularly bikes, near the port.

WSDOT monitors the state system in ongoing efforts to track asset performance. For this corridor, WSDOT finds:

High	Low	
26,314	923	Annual Average Daily Traffic (AADT)
23.7%	4.8%	Bus/Truck Percent
26.52		Number of Lane Miles
17		# of Signalized/Stop Controlled Intersections
$0		Corridor Investments (2005-2016)

Preservation

Roadway Surface Type

Roadway Surface Condition (Percent of Surveyed Area)

Corridor Bridge Preservation Needs

Border Bridge			
Bridge Repair		Bridge Deck	None identified
Rehabilitate Bridge		Paint Bridge	
Replace Bridge		Scour Repair	
Seismic Retrofit		Moveable Bridge	

Mobility

Percent of Corridor Congested (Statewide Screen)

Environment

	Protect	Restore/ Enhance/ Assess
Fish Barriers	None	0% to Do
Noise Walls	0% Resolved	0% Unresolved
Chronic Environmental Deficiencies	0% Built	0% Proposed
Wildlife Connectivity	0 Structures in Place	0 High Priority Miles
Stormwater Treatment	0 BMPs	Retrofit Prioritization in progress
55.8	% of Corridor with high potential for increased	
	Climate Impacts	
None	Wetland Mitigation Locations	
None	Historical Bridges	

1) 2015 data unless otherwise noted. 2) For more information see the User Guide for Corridor Sketch Summaries at http://hst.ly/WSDOTcorridorsketch

What we heard from our partners

WSDOT planners collected feedback from partners including Southwest Washington Regional Transportation Council and the city of Vancouver. Key themes included:

- Partners expressed concern about the facility's functionality for the various modes that use it. Specifically, the mix of heavy freight traffic through downtown Vancouver with downtown traffic and short block length combined with frequent signals.
- The city of Vancouver stated that speeding is a problem for downtown Vancouver neighborhoods the road passes through. The City is reviewing all major streets in this area as part of its Westside Mobility Strategy development process.
- The city of Vancouver expressed concern that the corridor serves freight well but, largely to the detriment of downtown Vancouver urban livability.
- SR 501 signal mast arms, signals and geometric clearances limit over-dimensional freight causing detours onto Washington Street to access I-5.
- Rapid Transit or transit between I-5 and Washington Street is recommended.

Strategies

WSDOT identified the following strategies and associated actions to keep the corridor working well and address performance gaps. Regional partners collaborated on high-level mobility strategies. The identified strategies are not meant to be all-inclusive, nor an established list of priorities. Further evaluation is needed before any strategy can be recommended as a solution to address performance. Project funding decisions will take place at the programming phase, and are subject to statewide prioritization. For more strategy information, visit the Corridor Sketch Summary User Guide.

Policy Goals / Strategies	Description and Near-Term Actions
Economic Vitality	
Urban Development	*WSDOT will continue to work with partners in developing strategies to address economic vitality.*
Environment	
Protect and Maintain	*Protect and maintain existing assets that provide environmental function (these include WSDOT's mitigation sites, storm water systems, fish passable culverts).*
Enhance or Restore	*Enhance or restore natural areas and environmental functions associated with the multimodal transportation system.*
Fish Barrier Retrofit	*WSDOT has prioritized the removal of state-owned culverts that block habitat for salmon and steelhead. See interactive map of uncorrected fish barriers at http://www.wsdot.wa.gov/Projects/FishPassage/default.htm.*
Mobility	
Assessment	*A mobility performance strategy has not been identified by WSDOT.*
Preservation	
Maintenance	*Based on expenditure history, it is expected that the top three activities will continue to be maintenance on snow and ice control, pavement repair, and rest areas.*
Pavement	*WSDOT has identified two Pavement actions in the next six years encompassing 84% of the corridor.*
Stewardship	
Planning	*Under Practical Solutions, the Corridor Sketch Initiative identifies corridor performance, and assesses alternative strategies to improve the quality, effectiveness, and efficiency of the transportation system.*

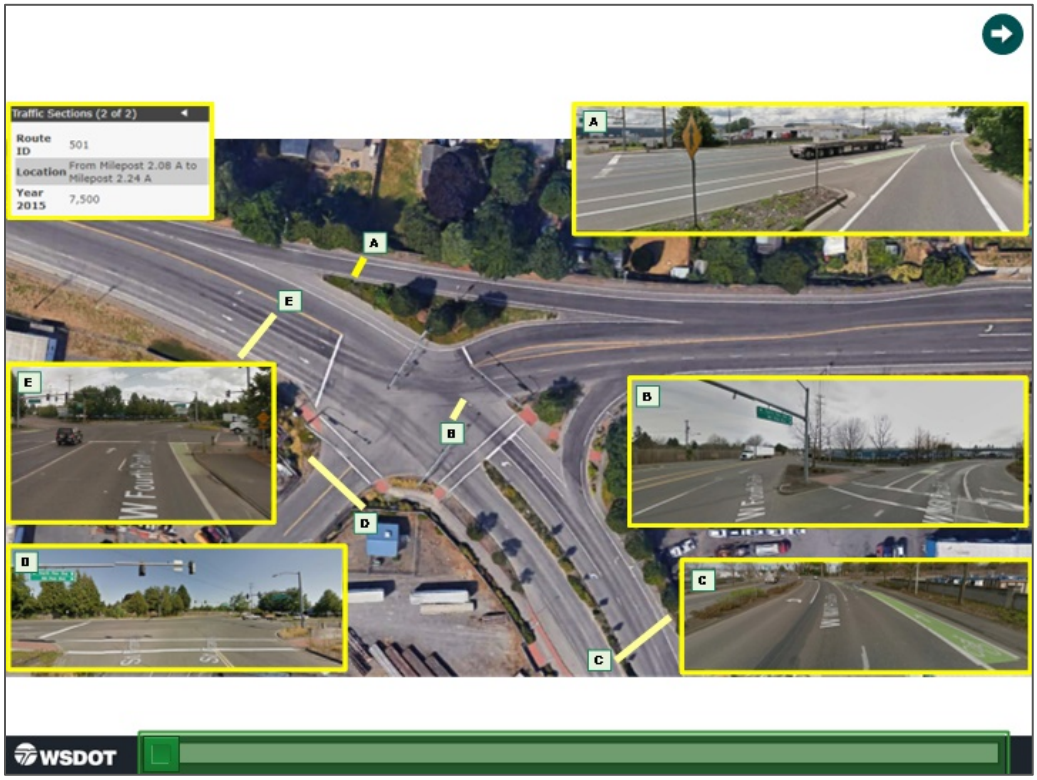
AERIAL IMAGE OF WEST VANCOUVER AREA

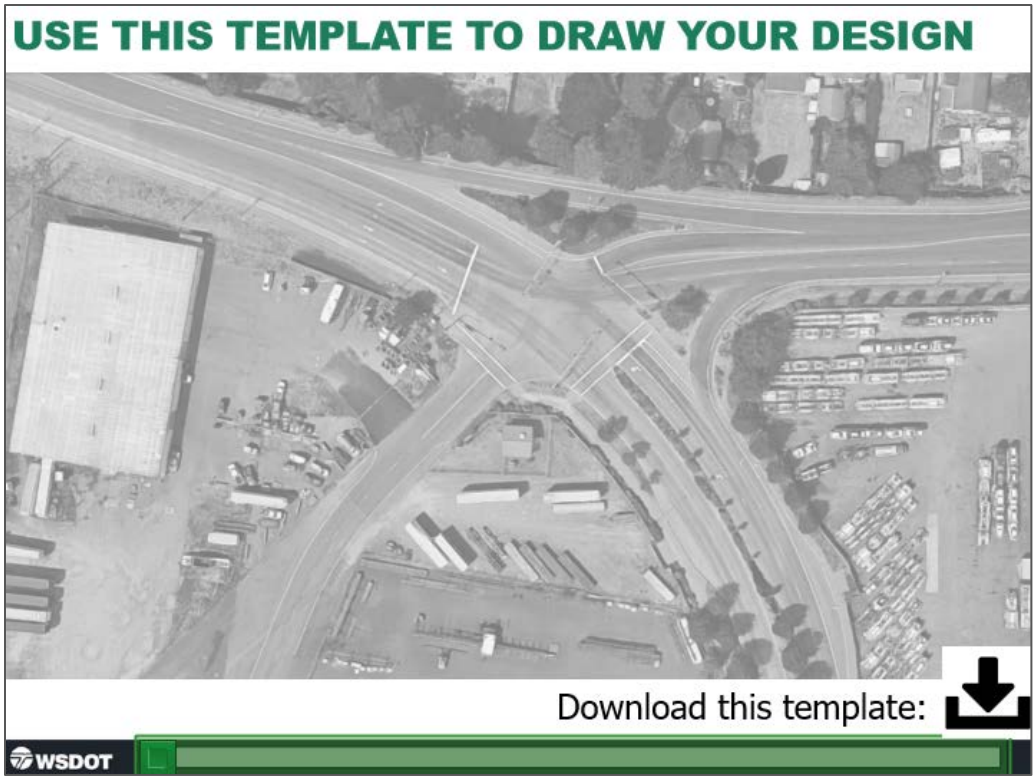
WSDOT

PORT OF VANCOUVER

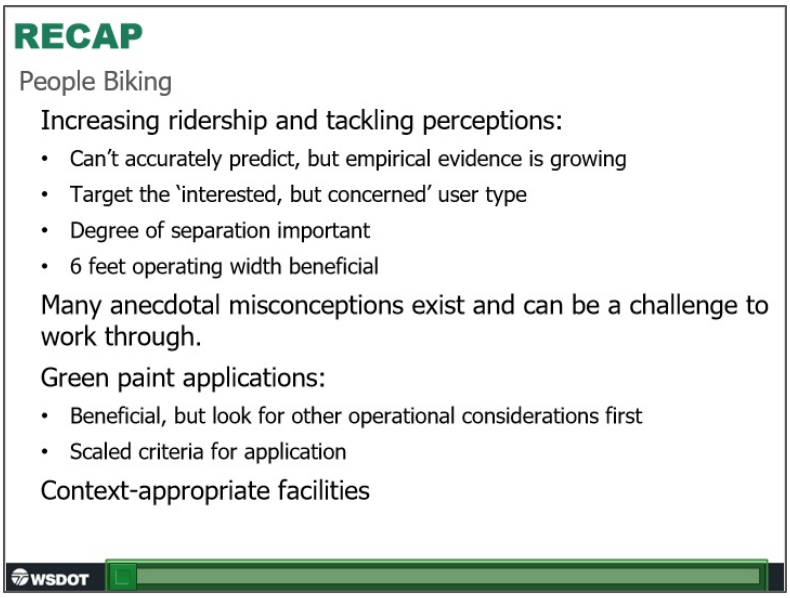
WSDOT


Traffic Counts (1 of 2)
Route ID 501
Location Before Milepost 1.71 A: RIGHT WYE CONNECTION FOURTH PLAIN BLVD
Direction of Travel Bothways
Single Unit Truck Percent 10.85%
Double Unit Truck Percent 10.96%
Triple Unit Truck Percent 1.9%
Year 2015 5,700
D
C
B
A
Retired bus pullout
Retired bus pullout
WSDOT


Traffic Sections (2 of 2)
Route ID 501
Location From Milepost 2.08 A to Milepost 2.24 A
Year 2015 7,500
A
E
B
D
C
WSDOT



Slide 6.2



Notes:
In this training, we learned about increasing ridership and tackling modal perceptions. We learned about design and risk factors, and context-appropriate bicycle facilities.