MEMORANDUM

Date:	February 11, 2010	**TG:**	08301.00
To:	Technical Review Committee (TRC) Members		
From:	Project Team		
Subject:	Level 3 Screening – Preliminary Results		

This memorandum presents the preliminary draft results of the Level 3 screening evaluation for three concept groupings which incorporate various interchange improvements as well as system (mainline) improvements. At the previous TRC meeting, the project team presented several improvement concepts at the four primary interchanges included in the study. These interchanges included:

- DuPont-Steilacoom Road (Exit 119)
- 41st Division Drive (Exit 120)
- Berkeley Street (Exit 122)
- Thorne Lane (Exit 123)

Since the last TRC meeting, the project team has developed three primary concept groupings that incorporate interchange and system/mainline improvements. In addition, further analysis was conducted to determine the need for a collector/distributor system or auxiliary lanes at and between the interchanges.

The following provides a brief overview of the proposed improvement concept groupings and summarizes the results of the Level 3 screening evaluation.

Description of the Concept Groupings

A number of system improvements were reviewed with the TRC at the last meeting. These system improvements, related to the I-5 corridor, included ITS improvements and mainline improvements. Other system improvements included demand management strategies, transit improvements in the area, and the construction of a new parallel corridor. The system improvement evaluation highlighted the need for additional capacity along I-5 in combination with ITS infrastructure, demand management strategies, and additional transit improvements.

Following the presentation of the initial interchange improvement concepts to the TRC members, an additional interchange improvement was brought to the project team. This concept, referred to as a diverging diamond, is discussed as an alternative to the Single Point Urban Interchange (SPUI) concepts at both the DuPont-Steilacoom Road interchange as well as the Berkeley Street interchange. The construction of this type of interchange design allows for further flexibility in the construction phasing and has been considered in the Level 3 screening evaluation.

Illustrations of the concept groupings are attached (Attachments A through C) and described in more detail in the following section.

An example of a "diverging diamond" interchange configuration.

Concept Grouping 1 (Attachment A)

Concept Grouping 1 includes the lowest impact/cost solutions at each of the interchanges, with no I-5 mainline improvements. The key elements of this concept grouping include:

- **DuPont-Steilacoom Road (Exit 119):** Construct a southbound I-5 flyover on-ramp.
- **41st Division Drive (Exit 120):** Widen the southbound off-ramp (access to JBLM North) to two lanes to provide additional vehicle storage/capacity.
- **Berkeley Street (Exit 122):** Construct flyover ramps for the southbound off and on-ramps.
- **Thorne Lane (Exit 123):** Widen the northbound off/on ramps and improve intersection with Murray Road.
- **System Improvements:** Construct ITS improvements along the corridor consistent with Tier 1 improvements identified in the 2007-2026 State Highway System Plan. These improvements include ramp metering and driver information systems.

Concept Grouping 2 (Attachment B)

Concept Grouping 2 reflects a higher level of investment to reconstruct the existing infrastructure at each interchange. It includes two potential interchange options at the Berkeley Street and DuPont-Steilacoom Road interchanges. These potential interchange improvements include either a SPUI or diverging diamond configuration. There are a limited number of diverging diamonds that have been completed in the US, although several are planned. FHWA has prepared a technical brief (http://www.fhwa.dot.gov/publications/research/safety/09054/index.cfm) that provides an overview of the general operations and safety impacts of this interchange configuration.

- **DuPont-Steilacoom Road (Exit 119):** Construct either a SPUI (concept 2a) or a diverging diamond (concept 2b).
- **41st Division Drive (Exit 120):** Provide grade separation for the southbound off-ramp to JBLM North access gate.
- **Berkeley Street (Exit 122):** Construct either a SPUI (concept 2a) or a diverging diamond (concept 2b).
- **Thorne Lane (Exit 123):** Construct SPUI consistent with Cross-base Highway design plans.
- **System Improvements:**
    - Construct ITS improvements along the corridor consistent with Tier 1 improvements identified in the 2007-2026 State Highway System Plan. These improvements include ramp metering and driver information systems.
    - Construct southbound auxiliary lanes between the Berkeley Street and Thorne Lane interchanges. Construct braided ramps northbound between Berkeley Street and Thorne Lane interchanges.
    - Construct a northbound auxiliary lane between Thorne Lane and Gravelly Lake Drive.

Concept Grouping 3 (Attachment C)

Concept Grouping 3 reflects a similar level of interchange improvements as Concept Grouping 2, but includes additional improvements along the I-5 mainline. Under this concept grouping, new northbound and southbound general purpose lanes are constructed from Mounts Road to the Thorne Lane interchange. Similar to the Concept Grouping 2, both the SPUI and diverging diamond configurations are presented as options at the DuPont-Steilacoom Road and Berkeley Street interchanges.

- **DuPont-Steilacoom Road (Exit 119):** Construct either a SPUI (concept 3a) or a diverging diamond (concept 3b).
- **41st Division Drive (Exit 120):** Provide grade separation for the southbound off-ramp to JBLM North access gate. In addition, due to the widening of I-5, it is anticipated that the clover leaf design on the east (JBLM Main) side of I-5 would be reconstructed.
- **Berkeley Street (Exit 122):** Construct either a SPUI (concept 3a) or a diverging diamond (concept 3b).
- **Thorne Lane (Exit 123):** Construct SPUI consistent with Cross-base Highway design plans.
- **System Improvements:**
    - Construct ITS improvements along the corridor consistent with Tier 1 improvements identified in the 2007-2026 State Highway System Plan. These improvements include ramp metering and driver information systems.
    - Construct southbound auxiliary lanes between the Berkeley Street and Thorne Lane interchanges. Construct braided ramps northbound between Berkeley Street and Thorne Lane interchanges.
    - Construct northbound auxiliary lane between Thorne Lane and Gravelly Lake Drive.
    - Construct northbound and southbound general purpose lane from Mounts Road to Thorne Lane.

Level 3 Screening Overview & Methodology

The Level 3 screening process was much more detailed than the previous two screening processes. While some of the criteria are similar to those measured previously, the Level 3 screening evaluates the concept groupings, rather than focusing on individual interchange improvements. This required the preparation of preliminary engineering drawings for each of the concept groupings in order to evaluate each based on the categories and metrics listed in Table 1.

Table 1. Level 3 Screening Criteria

Category[1]	Description of Metrics[2]
Design Feasibility	• Level of Design for On-ramp Connections • Level of Design for Off-ramp Connections • Profile Feasibility • Radius/Design Speed • Constructability
Safety	• Improvements in locations where serious & fatal collisions have occurred (ramps) • Improvements in locations where serious & fatal collisions have occurred (mainline) • Number of Modes Addressed (vehicles, peds, bikes, and transit)
Mobility / Operations	• Change in Mainline Delay (veh-hrs per PM peak hour) • Change in Average Interchange Delay (seconds per vehicle per PM peak hour) • Change in Freight / Transit / Vehicle Mobility (mainline mph) • Change in Average Military Route Travel Speed (mph)
Environment	• Number / Type of Impacted Sensitive Areas • Amount of Additional Impervious Surface • Change in VMT • No. of Impacted Historical/ Cultural Resources • Impact on JBLM Property (# of locations)
Benefit / Cost	• Estimated Construction Costs • Benefit / Cost Ratio

1. The categories are consistent and supportive with the WSDOT statewide priorities.
2. Metrics that were used to evaluate improvement concepts.

Description of the Screening Categories and Metrics

The ranking of the concept groupings is based on quantitative metrics for each of the screening categories. Results from the existing conditions and future alternatives analyses were used to evaluate each concept grouping. The screening criteria were organized by category with specific metrics identified to evaluate how a concept grouping benefited or impacted the category. A total of five categories were identified. A more detailed description of each category and the specific metrics from each are summarized below.

Design Feasibility – Measures design related components such as feasibility of the design, ability to meet targeted design standards, and overall ability to minimize construction impacts. The specific metrics included:

- *Level of Design for On-ramp Connections* – Focuses on the functional level of the proposed interchange design. Configurations with intersections at ramp terminals were scored lower than configurations with unrestricted free movements.
- *Level of Design for Off-ramp Connections* - Focuses on the functional level of the proposed interchange design. Configurations with intersections at ramp terminals were scored lower than configurations with unrestricted free movements.
- *Profile Feasibility* - Evaluates the adequacy of the vertical alignments. Steep grades have a negative impact on average vehicle speeds, particularly for trucks. Scoring was based on WSDOT's preferred, desired and minimum grades for ramps.
- *Radius/Design Speed* - Evaluates the adequacy of the horizontal alignments. Small radii designs have a negative impact on average vehicle speeds. While all concepts were designed to meet WSDOT's horizontal alignment design standards, design radii differed based on constraints.
- *Constructability* - Likelihood of potential impacts of construction phasing to adjacent jurisdictions.

Safety – Measures whether improvements are proposed in areas where serious and/or fatal collisions have occurred, and whether the improvements addressed safety for one or more modes of travel. Since future safety quantification is not able to be predicted, the measure attempts to provide points to concepts that have a potential for addressing existing safety related issues. The specific metrics included:

- *Improvements in locations where serious & fatal collisions have occurred (ramps)* – Focuses on whether the concept grouping includes improvements at interchanges where serious and/or fatal collisions have occurred in the past.
- *Improvements in locations where serious & fatal collisions have occurred (mainline)* – Focuses on whether the concept grouping includes improvements along the I-5 mainline where serious and/or fatal collisions have occurred in the past.
- *Modes Addressed (vehicles, peds, bikes, and transit)* – Evaluates how each concept may provide safety benefits to one or more modes of travel. The more modes it addresses, the greater points it receives.

Mobility / Operations – Measures the degree to which each concept grouping improves mobility and operational performance criteria when compared to baseline conditions. The specific metrics included:

- *Change in Mainline Delay (total vehicle hours per PM peak hour)* – The reduction in the number of total vehicle hours of delay along I-5 through the study area during the PM peak hour as compared to baseline conditions.
- *Change in Average Interchange Delay (seconds per vehicle per PM peak hour)* – The reduction in the average interchange delay during the PM peak hour as compared to baseline conditions. The measure is an average of each of the four interchanges.
- *Change in Freight / Transit / Vehicle Mobility (mainline mph)* – The increase in the average freight/transit/vehicle speed during the PM peak hour as compared to baseline conditions for the I-5 mainline.
- *Change in Average Military Route Travel Speed (mph)* – The increase in the average speed on key military routes during the PM peak hour. Represents prominent travel patterns of trips to and from the installation.

Environment – Measures the degree to which each concept grouping impacts the environment. The specific metrics included:

- *Number / Type of Impacted Sensitive Areas* – The number and type of sensitive areas that could be potentially impacted by the concept grouping.
- *Amount of Additional Impervious Surface* – The amount of new impervious areas as compared to baseline conditions.
- *Change in Vehicle Miles Travelled (VMT)* – The change in total vehicle miles travelled within the study area as compared to baseline conditions.
- *Number of Impacted Historical / Cultural Resources* – The number and type of historical and cultural resources that could be potentially impacted by the concept grouping.
- *Impact on JBLM Property* – The number of locations where JBLM property and/or facilities would be impacted by the concept grouping.

Benefit / Cost – Measures the benefits versus the costs (b/c) using construction cost estimates and WSDOT b/c formulas. The specific metrics included:

- *Estimated Construction Costs* – The estimated costs to construct the improvements depicted in the concept group.
- *Benefit / Cost Ratio* – The WSDOT b/c formula that compares the costs to the benefits the improvement is expected to provide.

How the Concept Groupings were Scored

The quantitative metrics were calculated and used to score each concept grouping to one another. Points were distributed amongst the metrics based on the overall benefit or impact. The maximum score any concept grouping could receive was 20 points overall. Assuming each category is weighted equally, each concept could receive a maximum of 4 points per category.

However, the study team weighted the categories based on how closely they aligned with the purpose and need of the study. Since the study purpose and need is tied to military growth and impacts, additional weighting was applied to the mobility and operations category as it addressed the accessibility and mobility to/from the JBLM. As a result, the environment and benefit / cost categories were weighted less.

In the end, a higher overall score represents a positive result, indicating a concept grouping with greater benefits and lesser impacts as compared to one another.

Level 3 Screening Results

The screening process began with the assimilation of the quantitative analytical work related to each of the major categories and associated metrics where quantitative analyses were conducted. For those categories where quantifiable numbers are available and can be easily understood, a summary or the results are provided in Table 2. The mobility/operations category metrics are based on a 2030 baseline forecast.

Table 2. Level 3 Screening – Quantitative Results

Category[1]	2030 Baseline[2]	Concept Group (Change from 2030 Baseline)				
		1	2a SPUI	2b Diverging Diamond	3a SPUI	3b Diverging Diamond
Mobility / Operations						
Change in Mainline Delay (total vehicle hours per PM peak hour)	1,660	0	-270	-270	-1,135	-1,135
Change in Average Interchange Delay (seconds per vehicle per PM peak hour)	124	-46	-103	-107	-103	-107
Change in Freight / Transit / Vehicle Mobility (mainline mph)	31	0	+2	+2	+15	+15
Change in Average Military Route Travel Speed (mph)	28	0	+3	+4	+13	+13
Environment						
Impacted Sensitive Areas (# of locations)	0	0	0	0	0	0
Amount of Additional Impervious Surface (1,000 sq ft)	0	+187	+1,404	+958	+3,609	+3,163
Change in Vehicle Miles Travelled (from baseline)	0	0	+1,000	+1,000	+3,000	+3,000
Impacted Historical / Cultural Resources (# of locations)	0	0	0	0	1	1
Impact on JBLM Property (# of locations)	0	1	3	1	3	2
Benefit / Cost						
Estimated Construction Costs (in $1,000)	$0	$51,300	$331,600	$232,100	$911,000	$811,500

1. Only includes categories and metrics where quantifiable numbers are available and which can be easily understood.
2. Values for the 2030 baseline are actual amounts and are shown to understand how each concept group compares.

Table 3 provides the final summary scoring of each category. As shown, weighting factors were applied to the categories in the screening process. More weight was given to the mobility/operations category as the purpose and need of the project is to improve access and mobility for the area related to the JBLM growth. A column is also shown that illustrates the maximum number of points that could be received for each category to provide context and comparison between each of the concepts.

Table 3. Level 3 Screening – Resulting Scores

Category	Concept Group					Scoring Weight	Maximum Possible Points
	1	2a SPUI	2b Diverging Diamond	3a SPUI	3b Diverging Diamond		
Design Feasibility	2.6	2.2	2.0	2.4	2.2	20%	4
Safety	1.1	2.7	2.7	3.1	3.1	20%	4
Mobility / Operations	1.2	2.8	3.0	5.6	5.8	40%	8
Environment	1.6	1.0	1.5	0.8	1.0	10%	2
Benefit / Cost	2.0	0.5	1.3	0.3	0.5	10%	2
Total	**8.5**	**9.2**	**10.4**	**12.1**	**12.6**	**100%**	**20**

In general, it appears the spread of points between the concept groupings is not very significant. However, considering the total possible points, the results indicate Concept Grouping 3a/3b scored 42 to 48 percent higher than Concept Group 1. This suggests a more significant difference between each of the concepts than appears at first blush. Below is a general summary of each concept group and its ranking.

Concept Group 1

As shown in Table 3, relative to the other concept groupings, it scored the lowest in terms of safety and mobility/operations. Concept 1 does not address mainline operations in the same way and to the same level as Concept Groupings 2 and 3, resulting in a lower overall mobility/operations scoring.

Although this concept grouping provides some level of improvement at the interchanges, the scope of the improvements are smaller than those included in Concept Groupings 2 and 3 (i.e. no improvements to the mainline), thus scores are less than the other concepts. Although the benefits to the mobility and operations are not as high as the other groupings, the lower costs of the improvements themselves outweigh the benefits and result in a higher benefit/cost ratio.

Concept Grouping 2a/2b

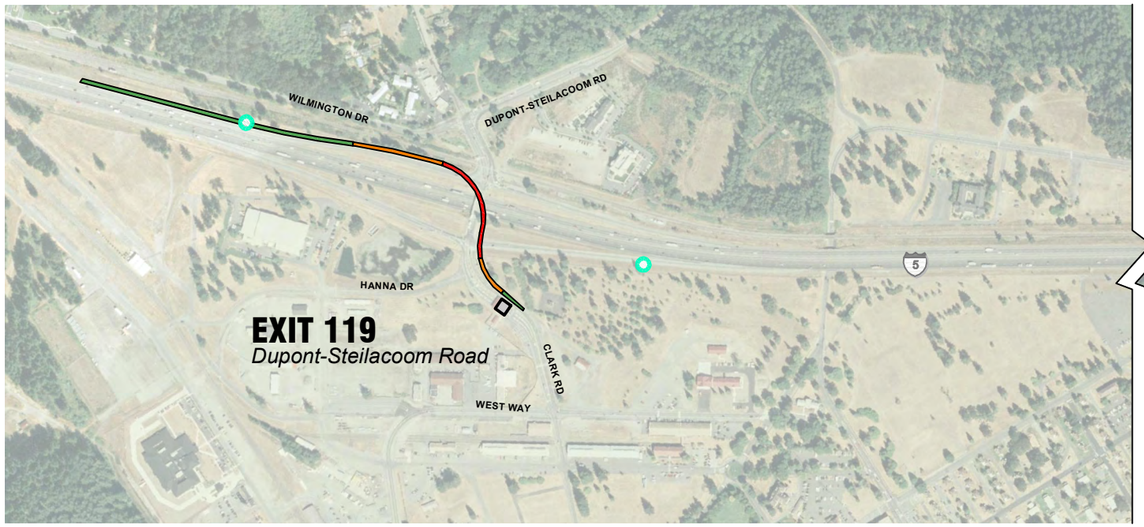
Relative to Concept Grouping 1, the scoring for this Concept Grouping 2a overall is approximately the same. The most notable differences in the categories include the safety, mobility/operations, and benefit/cost analysis. The benefits gained, in terms of safety and mobility, are offset by the high cost of the SPUI configurations at two locations. The scoring for concept 2b is a bit higher then 2a due to the lower costs of the diverging diamond configuration and similar operational benefits as 2a.

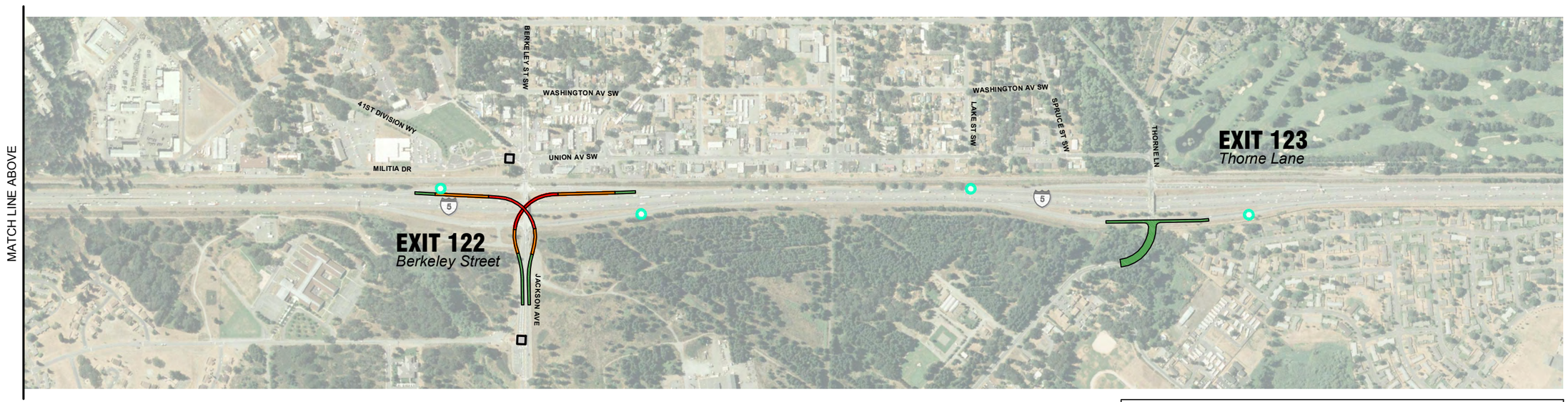
Concept Grouping 3a/3b

The Concept Groupings 3a and 3b scored the highest overall when compared to Concept Grouping 1 and Concept Grouping 2. Relative to the Concept Groupings 1 and 2, these improvements showed a significant increase in the mobility/operations scoring, almost four times higher than Concept Grouping 1. This increase was due primarily to the addition of northbound and southbound general purpose lanes through the study area. As described previously, the lanes would connect to the existing drop and add lanes north of Thorne Lane. The cost however for these improvements are significant, resulting in a relatively lower b/c ratio.

Next Steps

Once input and comments are received from the TRC members and their representative organizations, the project team will finalize the Level 3 screening results. Phasing and implementation strategies, along with further design considerations, will be prepared and incorporated as part of the highest ranking concept grouping.





LEGEND

- ARTERIAL BRIDGE
- ELEVATED RAMP
- SURFACE IMPROVEMENTS
- AUXILIARY LANE
- GENERAL PURPOSE LANE
- MILITARY ACCESS CONTROL POINT
- RAMP METER

Concept Group 1

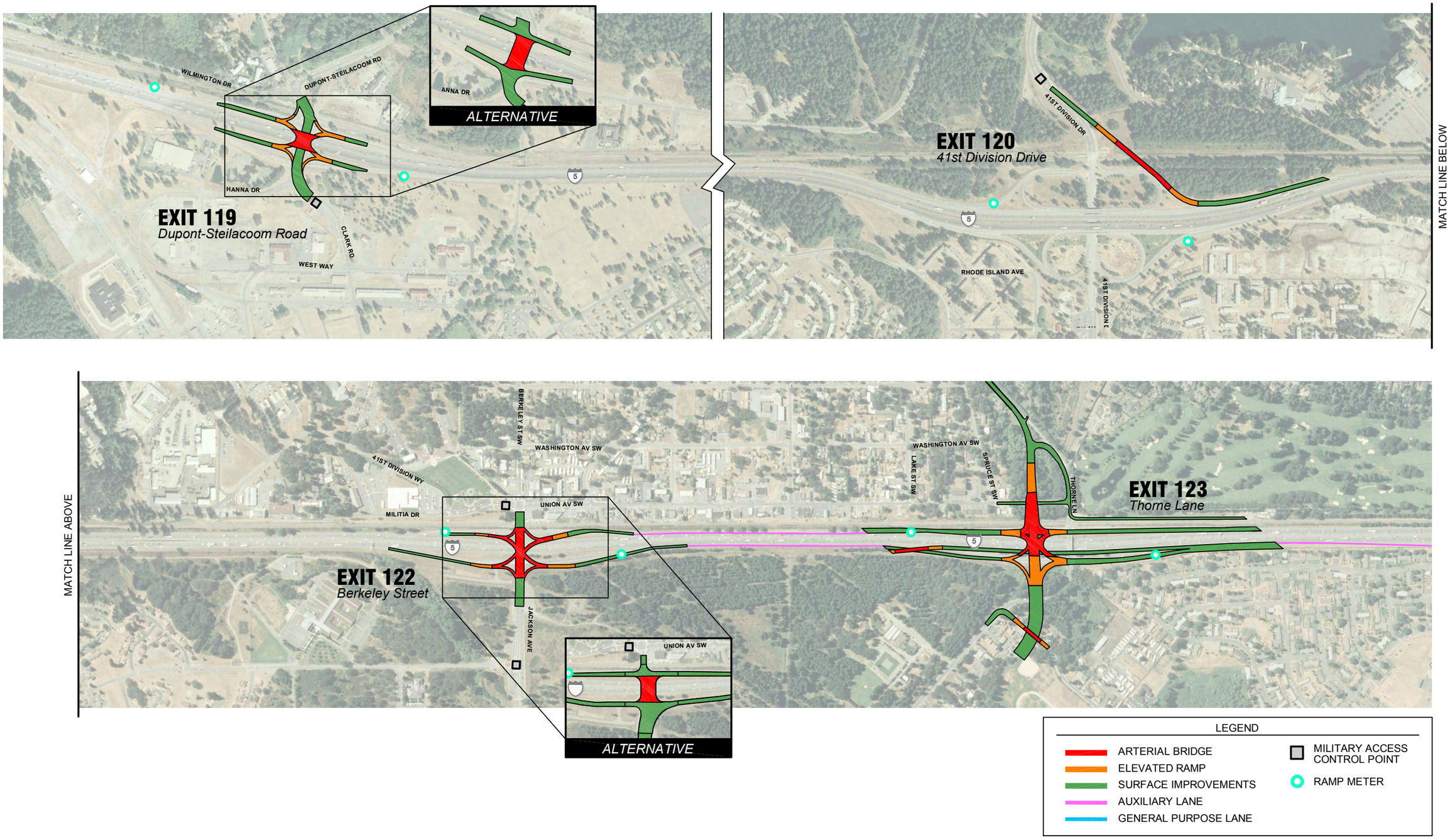
I-5 Transportation Alternatives Analysis and Operations Model

M:\08\08301 Lakewood I-5 Growth Study\Graphics\Concepts_WSDOT <A> robertm 02/10/10 15:51

transpoGROUP

ATTACHMENT

A



Concept Group 2

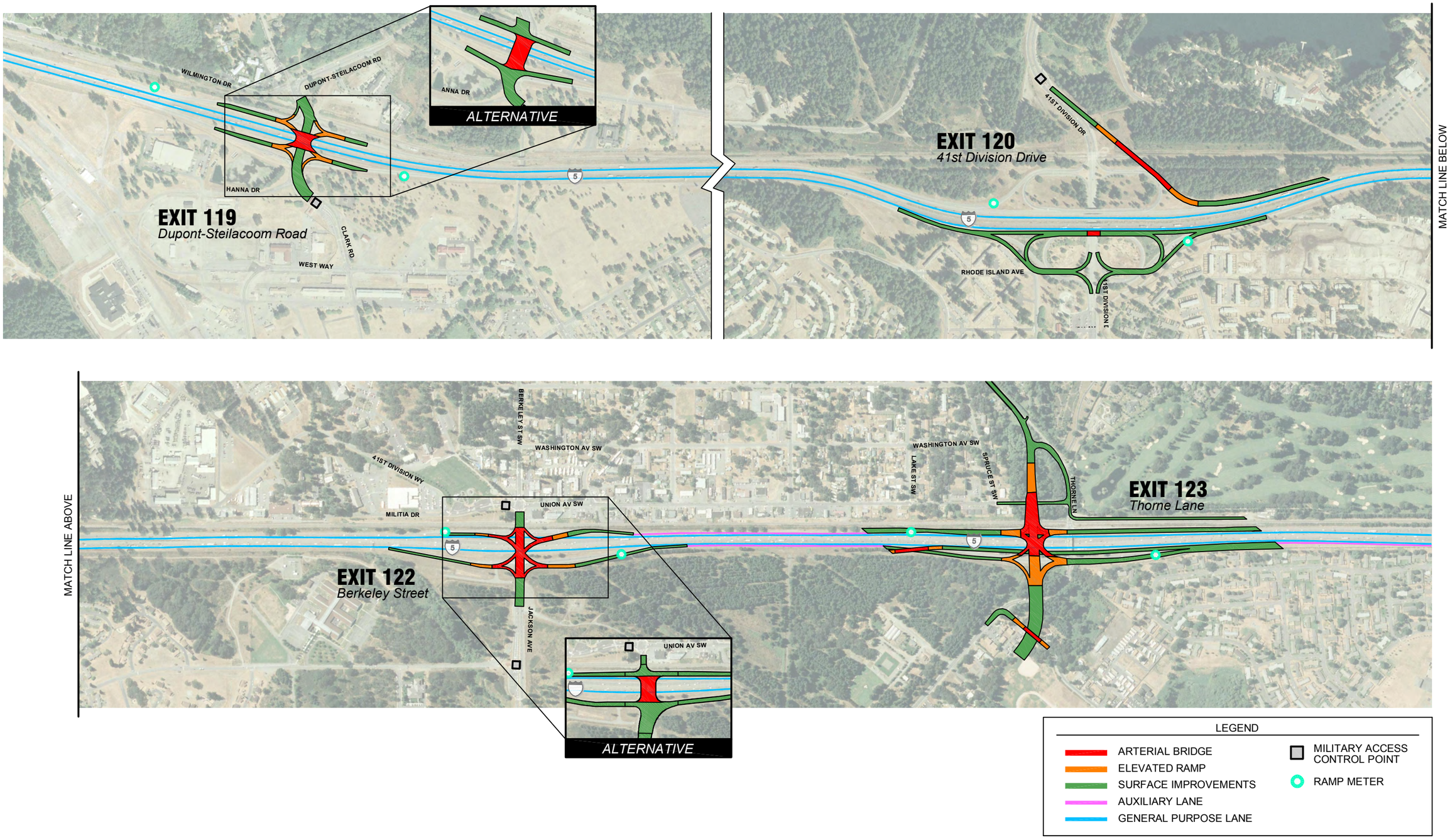
I-5 Transportation Alternatives Analysis and Operations Model

M:\08\08301 Lakewood I-5 Growth Study\Graphics\Concepts_WSDOT <B> robertm 02/10/10 15:50

transpoGROUP

ATTACHMENT

B



Concept Group 3

I-5 Transportation Alternatives Analysis and Operations Model

M:\08\08301 Lakewood I-5 Growth Study\Graphics\Concepts_WSDOT <C> robertm 02/10/10 15:45

transpoGROUP

ATTACHMENT

C