

Technical Appendix C: Segment Profiles – Skagit Matrices

- | | |
|------------------------------------|--------------------------------|
| #1 Central I-5/SR538 | #7 South I-5/SR534 |
| #2 East SR20 Burlington | #8 South SR9 Nookachamps Basin |
| #3 East SR538 Nookachamps Basin | #9 SR11 |
| #4 I-5 Gages Slough | #10 SR536 Mount Vernon |
| #5 North I-5 | #11 West SR20/SR536 |
| #6 North SR9 Skagit River Overflow | |



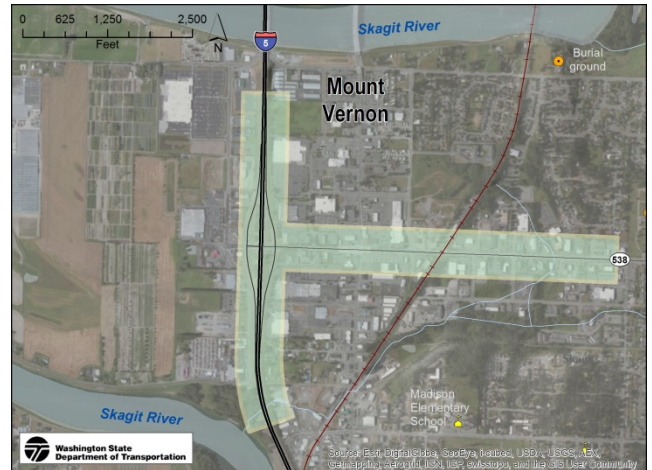
Skagit Segment Index

Segment 1, Central I-5/SR 538

Segment ID	Highway Segment	CIVA* Criticality	CIVA Impacts Base (High)
1	Central I5/SR538	L, H	L, M, (H)

Estimated AADT Max	Truck Percentage	DHV	Federal Function Class	Freight Class
69000	11.5%	11640	51, 54	T1, T3

Segment Description															
<p>Segment 1, Central I-5/SR 538: I-5 (MP 227.25–228.17), SR 538 (MP 0–1.00)</p> <p>This segment is in Mount Vernon. The Skagit River bends around Mount Vernon and frames the southern and northern segment boundary. I-5 is the main north-south corridor for the West Coast, and this segment has an AADT of 69,000. 11.5% of the traffic is truck traffic and it carries more than 10 million tons of freight per year. SR 538 carries between 300,000 to 4 million tons of freight per year. The DHV for this segment is 11,640. I-5 is classified as an Urban Interstate and SR 538 is classified as an Urban Minor Arterial. There is one bridge in this segment as well as six culverts. Five bus routes traverse the segment. The CIVA impacts to this segment are low to moderate for the 2-FT SLR condition and high for the 6-FT SLR condition. This segment is within the Mount Vernon Urban Growth Area. The land use classification categories that surround this segment include commercial, industrial, some residential, Skagit County Public Works, Mount Vernon Police Station, Skagit County Emergency Management, Skagit Valley College.</p> <p>This segment experiences flooding in the existing 10%, 4%, 2%, and 1% ACE events. Maximum flood depths in the existing condition are:</p> <table border="1"> <thead> <tr> <th></th> <th>10% ACE</th> <th>4% ACE</th> <th>2% ACE</th> <th>1% ACE</th> </tr> </thead> <tbody> <tr> <td>I-5</td> <td>N/A</td> <td>N/A</td> <td>10.80'</td> <td>11.19'</td> </tr> <tr> <td>SR 538</td> <td>N/A</td> <td>N/A</td> <td>14.93'</td> <td>15.33'</td> </tr> </tbody> </table> <p>This segment is not flooded during the 1% TSP event. The segment is listed in Flood Zone A and X500.</p>		10% ACE	4% ACE	2% ACE	1% ACE	I-5	N/A	N/A	10.80'	11.19'	SR 538	N/A	N/A	14.93'	15.33'
	10% ACE	4% ACE	2% ACE	1% ACE											
I-5	N/A	N/A	10.80'	11.19'											
SR 538	N/A	N/A	14.93'	15.33'											





Adaptation Strategies

The flooding in this segment would be caused by a levee failure due to scour. This would be addressed by the TSP, and that is why no flooding occurs under the Corps' preferred plan. If this plan is built, then other alternatives are not needed to keep this segment functioning. However, if the TSP is not built, there are other options (in no particular order) that could make this segment more resilient:

- Work with local agencies and the Corps to purchase additional storage capacity behind the dams run by Puget Sound Energy.
- Work with the City of Mount Vernon to extend the floodwall to protect I-5, and SR 536.
- Raise I-5 above the flood elevation.

Floodzones (Floodway)	Tsunami Zone	Discharge Points	Stormwater BMP Type (#)
A, X500	–	34	

Bridges	Under Crossings	Culvert Inventory (End Inv.)	Fish Passage
1	1	6	Unknown

Unstable Slope	Liquifaction	Hydrologic Soils Group	Hydic Soils Area (sf)
–	L-M, M-H, H	B, C, D	9391895

Bus Route	Park and Ride Lots	Land Use Zoning	Schools	Hospital
204, 205, 207, 513, 8		UGA-CL/IND/RES/Public	Skagit Valley College	

WSDOT Site (Type)	Haz Mat Sites	Historic Barns	Cemetery
2		Y	

LEGEND

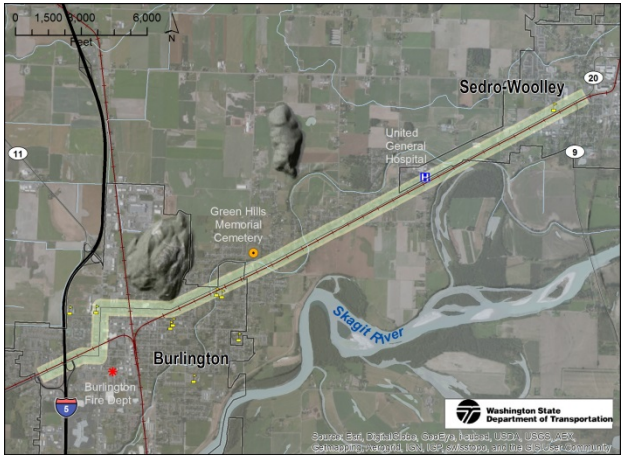
AADT	annual average daily traffic	DHV	design hourly volume
ACE	Annual Chance of Exceedance	GI STUDY	Corps' general investigation
CIVA	Climate Impact Vulnerability Assessment	SLR	sea level rise
Corps	U.S. Army Corps of Engineers	SR	State Route
CULI	Comprehensive Urban Levee Improvement	TSP	tentatively selected plan

Segment 2, East SR 20 Burlington

Segment ID	Highway Segment	CIVA Criticality	CIVA Impacts Base (High)
2	East SR20 Burlington	M, H	H, (H)

Estimated AADT Max	Truck Percentage	DHV	Federal Function Class	Freight Class
22900	11.5	11018	53, 54	T2

Segment Description								
<p>Segment 2, East SR 20 Burlington: SR 20 (MP 59.31–64.90) This segment includes SR 20 through the City of Burlington and eastward to Sedro Woolley. This segment is a principal arterial between Burlington and Sedro Woolley and serves two schools and United General Hospital. It has an AADT of 22,900, and truck traffic represents 11.5% of the total traffic. The segment has four freight tonnage classifications that range from more than 10 million to 300,000 million tons per year. The DHV for this segment is 11,018. There is one bridge in this segment and 12 culverts within the segment. At least one of the culverts requires repair to address fish passage issues. There are a high number (14) of culvert ends listed in this segment. That means that one end of the culvert has been located but not the other end. The segment carries four bus routes. The CIVA 2-FT SLR impacts are moderate to high and the 6-FT SLR impacts are also high. The land use categories that surround this segment include agriculture, rural, and commercial/industrial. It lies within the urban growth boundary. This is a Highway of Statewide Significance.</p> <p>This segment experiences flooding in the existing 10%, 4%, 2%, and 1% ACE events. Maximum flood depths in the existing condition are:</p> <table border="1"> <thead> <tr> <th>10% ACE</th> <th>4% ACE</th> <th>2% ACE</th> <th>1% ACE</th> </tr> </thead> <tbody> <tr> <td>1.69'</td> <td>7.85'</td> <td>6.33'</td> <td>9.54'</td> </tr> </tbody> </table> <p>This segment is flooded during the 1% ACE TSP event; however, a shorter length of road will be flooded than in the existing 1% event. The segment is listed in Flood Zone A and X500.</p>	10% ACE	4% ACE	2% ACE	1% ACE	1.69'	7.85'	6.33'	9.54'
10% ACE	4% ACE	2% ACE	1% ACE					
1.69'	7.85'	6.33'	9.54'					



Adaptation Strategies

This segment runs roughly parallel to the Skagit River and is mainly within the flood plain. The areas that flood during the 1% event are in low-lying areas. The adaptation strategy for this area would be to raise the road. This might be a viable option since the projected flood depths are less than 2 feet. Flooding in the 25% through 1% events is more extensive and much deeper than the 10% event; it is caused by levee failures or overtopping. The flooding in this area is not improved by the TSP. The GI STUDY estimates that the maximum flood depths would be deeper in this segment under the TSP.¹ Raising the road through this segment would be one adaptation strategy, but there would have to be large enough culverts or bridges to allow the water to pass from the Skagit River over to Joe Leary Slough. Other adaptation strategies for this segment include rerouting traffic on to Cook Road or F&S Grade Road. Because of the high number of culvert ends that are identified in this segment, it is possible that the other end may be buried or obstructed and not operating properly. If those culverts are not functioning properly now, fixing them might relieve flooding issues in smaller floods.

Floodzones (Floodway)	Tsunami Zone	Discharge Points	Stormwater BMP Type (#)
A, X500	–	16	SWD (3), RS(1)

Bridges	Under Crossings	Culvert Inventory (End Inv.)	Fish Passage
1	1	12 (14)	Unknown, Repair Req.

Unstable Slope	Liquifaction	Hydrologic Soils Group	Hydric Soils Area (sf)
–	M-H, H	B, C, D	25548285

Bus Route	Park and Ride Lots	Land Use Zoning	Schools	Hospital
8, 513, 300, 717		Ag- NRL, RI, RB, UGA	Burlington Edison HS, Sedro Woolley	United General

WSDOT Site (Type)	Haz Mat Sites	Historic Barns	Cemetery

LEGEND

AADT	annual average daily traffic	DHV	design hourly volume
ACE	Annual Chance of Exceedance	GI STUDY	Corps' general investigation
CIVA	Climate Impact Vulnerability Assessment	SLR	sea level rise
Corps	U.S. Army Corps of Engineers	SR	State Route
CULI	Comprehensive Urban Levee Improvement	TSP	tentatively selected plan

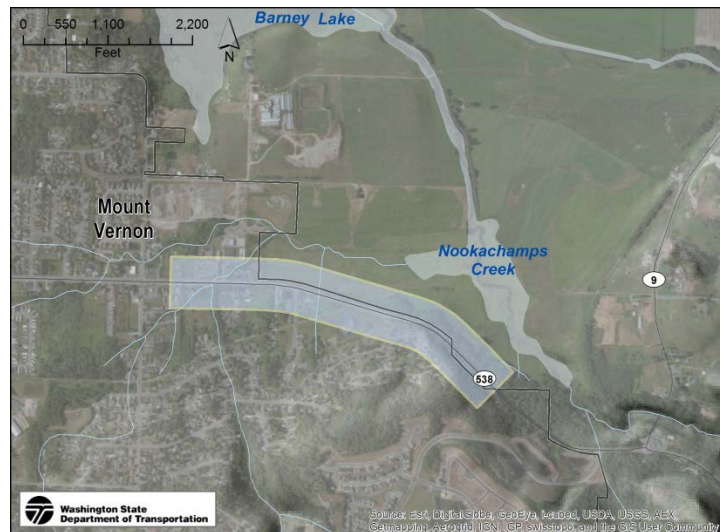
¹ Under the CULI, the Corps proposes to put a flood gate across SR 20 as a part of a new levee that would protect Burlington. This floodgate would close SR 20 for the duration of the flood.

Segment 3, SR 538 Nookachamps Basin

Segment ID	Highway Segment	CIVA Criticality	CIVA Impacts Base (High)
3	East SR538 Nookachamps Basin	L, H	L, M, (H)

Estimated AADT Max	Truck Percentage	DHV	Federal Function Class	Freight Class
8260	7.8%	1622	54	T3

Segment Description								
<p>Segment 3, SR 538 Nookachamps Basin: SR 538 (MP 2.35–3.22)</p> <p>This segment is classified as an Urban Minor Arterial and has an AADT of 8,260. 7.8% of the traffic is truck traffic, and it carries between 300,000 and 4 million tons of freight per year. The segment lies in Mount Vernon and connects I-5 with SR 9. It has one bus route but no other public facilities. The CIVA 2-FT SLR impacts range from moderate to high and the 6-FT SLR impacts are also high along this segment. There are no bridges, but there are six culverts, none of which is listed as a fish barrier. The DHV of the segment is listed as 1,622. The land use in this area is agricultural, residential, and commercial.</p> <p>Flooding occurs through this segment during the 4%, 2%, and 1% ACE events with the following maximum depths:</p> <table border="1"> <thead> <tr> <th>10% ACE</th> <th>4% ACE</th> <th>2% ACE</th> <th>1% ACE</th> </tr> </thead> <tbody> <tr> <td>NA</td> <td>1.59'</td> <td>3.49'</td> <td>4.87'</td> </tr> </tbody> </table> <p>The TSP makes the flooding in this segment worse and floods 0.40 miles more than the existing 1% event. The segment is in Flood Zone A.</p>	10% ACE	4% ACE	2% ACE	1% ACE	NA	1.59'	3.49'	4.87'
10% ACE	4% ACE	2% ACE	1% ACE					
NA	1.59'	3.49'	4.87'					



Adaptation Strategies
The adaptation strategy for this segment would be to raise the road. It appears that this could be done to alleviate flooding for the more frequent flood events, but may be difficult for the 2% and 1% ACE events.

Floodzones (Floodway)	Tsunami Zone	Discharge Points	Stormwater BMP Type (#)
A	–	16	

Bridges	Under Crossings	Culvert Inventory (End Inv.)	Fish Passage
–	–	6 (1)	

Unstable Slope	Liquifaction	Hydrologic Soils Group	Hydric Soils Area (sf)
–	VL, L-M	C	3079740

Bus Route	Park and Ride Lots	Land Use Zoning	Schools	Hospital
8		Ag-NRL		

WSDOT Site (Type)	Haz Mat Sites	Historic Barns	Cemetery

LEGEND

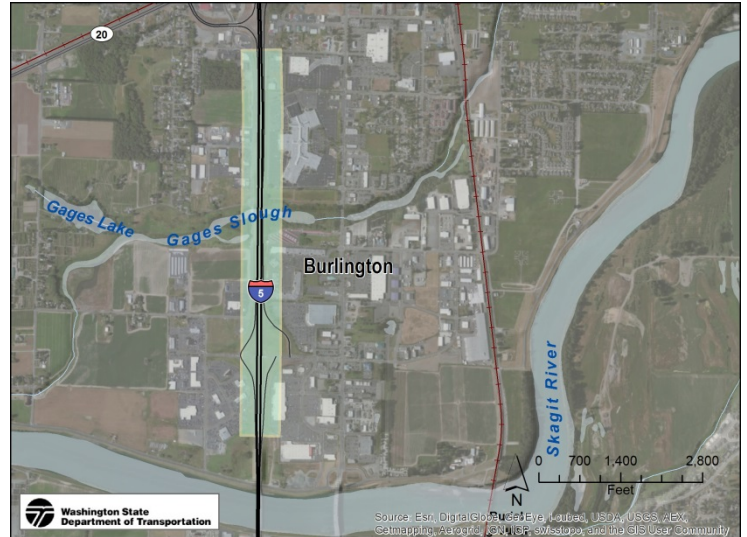
AADT	annual average daily traffic	DHV	design hourly volume
ACE	Annual Chance of Exceedance	GI STUDY	Corps' general investigation
CIVA	Climate Impact Vulnerability Assessment	SLR	sea level rise
Corps	U.S. Army Corps of Engineers	SR	State Route
CULI	Comprehensive Urban Levee Improvement	TSP	tentatively selected plan

Segment 4, I-5 Gages Slough

Segment ID	Highway Segment	CIVA Criticality	CIVA Impacts Base (High)
4	I5 Gages Slough	H	M, (H)

Estimated AADT Max	Truck Percentage	DHV	Federal Function Class	Freight Class
66500	11.5%	11018	51	T1, T3

Segment Description								
<p>Segment 4, I-5 Gages Slough: I-5 (MP 228.61–229.86)</p> <p>This is a Highway of Statewide Significance. I-5 is the main north-south corridor for the West Coast, and this segment has an AADT of 66,500. 11.5% of the traffic is truck traffic and it carries more than 10 million tons of freight per year. The DHV for this segment is 11,018. I-5 is classified as an Urban Interstate. This portion of I-5 has three bridges and one culvert, which is not a fish barrier. There is one bus route that uses this segment. The WSDOT Mount Baker Project Engineer’s office is located just adjacent to I-5 in this segment. The CIVA 2-FT SLR impacts for this segment are moderate and the 6-FT SLR impacts are high. The land use categories that surround this segment are commercial, public, agricultural, residential.</p> <p>Flooding occurs through this segment during the 4%, 2%, and 1% ACE events with the following maximum depths:</p> <table border="1"> <thead> <tr> <th>10% ACE</th> <th>4% ACE</th> <th>2% ACE</th> <th>1% ACE</th> </tr> </thead> <tbody> <tr> <td>NA</td> <td>4.87'</td> <td>6.09'</td> <td>7.00'</td> </tr> </tbody> </table>	10% ACE	4% ACE	2% ACE	1% ACE	NA	4.87'	6.09'	7.00'
10% ACE	4% ACE	2% ACE	1% ACE					
NA	4.87'	6.09'	7.00'					



Adaptation Strategies
The main adaptation strategy for this segment for the existing flood events is to raise the road. A “no regrets” strategy for this segment would be to make SR 9 less vulnerable to flooding. (Segments 6 and 8 could serve as alternate routes if I-5 is closed for any reason.)

Floodzones (Floodway)	Tsunami Zone	Discharge Points	Stormwater BMP Type (#)
A, X500	–	8	RS (3)

Bridges	Under Crossings	Culvert Inventory (End Inv.)	Fish Passage
3	1	1 (1)	

Unstable Slope	Liquifaction	Hydrologic Soils Group	Hydric Soils Area (sf)
–	M-H	D	5917999.7103650812

Bus Route	Park and Ride Lots	Land Use Zoning	Schools	Hospital
513		COM, INDU, RES, Ag		

WSDOT Site (Type)	Haz Mat Sites	Historic Barns	Cemetery
Mount Baker Area (Bld)			

LEGEND

AADT	annual average daily traffic	DHV	design hourly volume
ACE	Annual Chance of Exceedance	GI STUDY	Corps’ general investigation
CIVA	Climate Impact Vulnerability Assessment	SLR	sea level rise
Corps	U.S. Army Corps of Engineers	SR	State Route
CULI	Comprehensive Urban Levee Improvement	TSP	tentatively selected plan

Segment 5, North I-5

Segment ID	Highway Segment	CIVA Criticality	CIVA Impacts Base (High)
5	North I5	L,H	L, M, H, (H)

Estimated AADT Max	Truck Percentage	DHV	Federal Function Class	Freight Class
66500	11.5%	11018	41, 45, 51	T1, T2, T3

Segment Description								
<p>Segment 5, North I-5: I-5 (MP 230.37–234.12) This is a Highway of Statewide Significance. I-5 is the main north-south corridor for the West Coast, and this segment has an AADT of 66,500. 11.5% of the traffic is truck traffic and it carries more than 10 million tons of freight per year. The DHV for this segment is 11,018. I-5 in this segment is classified as an Urban Interstate, a Rural Interstate, and a Rural Major Collector. There are ten bridges in this segment as well as seven culverts. None of the culverts is listed as a fish barrier. The 80X bus route and the Chuckanut Park and Ride lie within this segment. West View Elementary school is located in this segment. The CIVA impacts to this segment range from low to high, depending on exact location, for the 2-FT SLR condition and high for the 6-FT SLR condition. The land uses surrounding this segment include rural, agricultural, and commercial/industrial.</p> <p>Flooding occurs through this segment during the 4%, 2%, and 1% ACE events with the following maximum depths:</p> <table border="1"> <thead> <tr> <th>10% ACE</th> <th>4% ACE</th> <th>2% ACE</th> <th>1% ACE</th> </tr> </thead> <tbody> <tr> <td>NA</td> <td>5.21'</td> <td>4.65'</td> <td>7.98'</td> </tr> </tbody> </table> <p>Flooding occurs in this section during the 1% TSP event and covers 0.37 miles more than in the existing 1% event. The main adaptation strategy for this segment is to raise the road. The TSP sends more water to this segment of roadway, so the road would have to be raised to get above the higher flows as compared to the existing flood elevations. Another adaptation strategy would be to work with other agencies to secure additional water storage from Puget Sound Energy; however, this might not be a viable strategy with the TSP since the Corps has included that storage as an assumption for the TSP.</p>	10% ACE	4% ACE	2% ACE	1% ACE	NA	5.21'	4.65'	7.98'
10% ACE	4% ACE	2% ACE	1% ACE					
NA	5.21'	4.65'	7.98'					



Bayview 2009 – Land to the west of I-5



Adaptation Strategies
<p>Raise road</p> <p>Harden roadway to allow flows and protect road – high velocity location</p> <p>Increase dam storage – work with Corps and local agencies to secure long term funding to purchase storage capacity from Puget Sound Energy</p>

Floodzones (Floodway)	Tsunami Zone	Discharge Points	Stormwater BMP Type (#)
	–	13	FR (1), SWD (2), RS (1)

Bridges	Under Crossings	Culvert Inventory (End Inv.)	Fish Passage
10	2	7	

Unstable Slope	Liquifaction	Hydrologic Soils Group	Hydric Soils Area (sf)
–	L, M-H	B, C	15291350

Bus Route	Park and Ride Lots	Land Use Zoning	Schools	Hospital
80X	Chuckanut	Ag-NRL, RRc-NRL, RRv, RFS, RB	West View Elementary	

WSDOT Site (Type)	Haz Mat Sites	Historic Barns	Cemetery

LEGEND

AADT	annual average daily traffic	DHV	design hourly volume
ACE	Annual Chance of Exceedance	GI STUDY	Corps' general investigation
CIVA	Climate Impact Vulnerability Assessment	SLR	sea level rise
Corps	U.S. Army Corps of Engineers	SR	State Route
CULI	Comprehensive Urban Levee Improvement	TSP	tentatively selected plan

Segment 6, North SR 9 Skagit River Overflow

Segment ID	Highway Segment	CIVA Criticality	CIVA Impacts Base (High)
6	North SR9 Skagit River Overflow	M, H	M

Estimated AADT Max	Truck Percentage	DHV	Federal Function Class	Freight Class
9750	9.88%	1836	45, 54	T3

Segment Description								
<p>Segment 6, North SR 9 Skagit River Overflow: SR 9 (MP 53.49–55.37)</p> <p>This segment of SR 9 lies in the floodway of the Skagit River and is one of three sections that have flooding during the 10% event. It has an AADT of 9,750. 9.9% of the traffic is truck traffic and it carries between 300,000 and 4 million tons of freight a year. The DHV on this section is 1,836, and the Federal Function Classes are Rural Major Collector and Urban Minor Arterial. There is one bus route on this segment. There are three bridges and two culverts and no fish passage barriers. Twenty culvert ends have been mapped on this segment. This indicates that there might be culverts that are not functioning properly since one of the ends might be blocked or buried. The CIVA 2-FT SLR impacts for this segment are moderate and this segment is not affected by 6-FT SLR conditions. The Sedro Woolley South Park and Ride lies within this section as well as a WSDOT gravel pit. The land use zoning in this section includes rural and agricultural.</p> <p>Flooding occurs through this segment during the 10%, 4%, 2%, and 1% ACE events with the following maximum depths:</p> <table border="1"> <thead> <tr> <th>10% ACE</th> <th>4% ACE</th> <th>2% ACE</th> <th>1% ACE</th> </tr> </thead> <tbody> <tr> <td>7.62'</td> <td>10.52'</td> <td>12.26'</td> <td>13.02'</td> </tr> </tbody> </table> <p>Flooding occurs in this section during the 1% TSP event; however, the flooding is less extensive and covers slightly less roadway than in the existing 1% event.</p>	10% ACE	4% ACE	2% ACE	1% ACE	7.62'	10.52'	12.26'	13.02'
10% ACE	4% ACE	2% ACE	1% ACE					
7.62'	10.52'	12.26'	13.02'					





Adaptation Strategies

“No regrets” strategies for this segment would be to build a new alignment out of the floodway or raise the road on a causeway in the existing alignment. Either option would eliminate flooding concerns for this segment and add resilience to north-south travel. SR 9 is an alternate route for I-5. Making this route less likely to flood will improve the resilience of the transportation infrastructure and provide an alternate route that would allow limited north-south traffic flow and access for county residents who would otherwise be stranded or face long detours.

Floodzones (Floodway)	Tsunami Zone	Discharge Points	Stormwater BMP Type (#)
A, (FW)	–	36	

Bridges	Under Crossings	Culvert Inventory (End Inv.)	Fish Passage
3	–	2 (20)	

Unstable Slope	Liquifaction	Hydrologic Soils Group	Hydric Soils Area (sf)
–	Bedrock, L, M-H, H	B, C, D	9703785

Bus Route	Park and Ride Lots	Land Use Zoning	Schools	Hospital
8	Sedro Woolley South	Ag-NRL, RRV		

WSDOT Site (Type)	Haz Mat Sites	Historic Barns	Cemetery
Gravel Bar (Pit)			

LEGEND

AADT	annual average daily traffic	DHV	design hourly volume
ACE	Annual Chance of Exceedance	GI STUDY	Corps’ general investigation
CIVA	Climate Impact Vulnerability Assessment	SLR	sea level rise
Corps	U.S. Army Corps of Engineers	SR	State Route
CULI	Comprehensive Urban Levee Improvement	TSP	tentatively selected plan

Segment 7, South I-5/SR 534

Segment ID	Highway Segment	CIVA Criticality	CIVA Impacts Base (High)
7	South I5/SR534	L,H	L, M, (H)

Estimated AADT Max	Truck Percentage	DHV	Federal Function Class	Freight Class
63700	11.5%	10633	41, 45, 54	T1, T3, T4

Segment Description				
Segment 7, South I-5/ SR 534: I-5 (MP 219.89–225.04), SR 534 (MP 0–0.5)				
I-5 is the main north-south corridor for the West Coast, and this segment has an AADT of 63,700. 11.5% of the traffic is truck traffic and it carries between 10 and 300,000 million tons of freight per year. The DHV for this segment is 10,633. SR 534 has an AADT of 1,934 and truck traffic is less than 1%. I-5 in this segment is classified as a Rural Interstate and a Rural Major Collector. SR 534 is classified as an Urban Minor Arterial. There are four bridges in this segment and 25 culverts. At least one of the culverts is listed as a fish barrier, and others need to be evaluated. The CIVA impacts rating for these segments is low to moderate, depending on location, in the 2-FT SLR condition and high in the 6-FT SLR condition. The Mount Vernon Area 2 Maintenance Office is located along I-5. This is the only segment with a known active unstable slope. The land use zoning in this segment includes agricultural, rural, and commercial/industrial. It also lies within the urban growth boundary.				
Flooding occurs through this segment during the 4% and 1% ACE events with the following maximum depths:				
	10% ACE	4% ACE	2% ACE	1% ACE
I-5	N/A	10.62'	N/A	15.23'
SR 534	N/A	12.13'	N/A	14.83'
Flooding does not occur in this segment during the 2% ACE under the scenarios prepared by the Corps. The different scenarios are based on levee failures at different places and result in the flood waters flowing to different areas of the basin. The levee failure in the 2% ACE causes the water to flow to the north of the river rather than the south so this segment is not flooded. Flooding does not occur in this segment under the TSP.				



Fir Island 2009 – To the west of I-5



Adaptation Strategies

The main adaptation strategies for this segment are to alleviate flooding on SR 9 or to implement the Corps' TSP alternative. Changing SR 9 to alleviate flooding provides a detour route for I-5. Implementing the TSP alleviates flooding in the segment. Another alternative would be to work with the City of Mt. Vernon to extend its floodwall to the south to protect I-5 and SR 534. Further study is needed to determine if this option would protect I-5 and SR 534.

Floodzones (Floodway)	Tsunami Zone	Discharge Points	Stormwater BMP Type (#)
A	–	9	

Bridges	Under Crossings	Culvert Inventory (End Inv.)	Fish Passage
4	2	25 (8)	Unknown, Repair Req.

Unstable Slope	Liquifaction	Hydrologic Soils Group	Hydric Soils Area (sf)
Active, settlement	L-M, M-H, H	C, D	19523415

Bus Route	Park and Ride Lots	Land Use Zoning	Schools	Hospital
–		Ag-NRL, UGA, RRv, RFS		

WSDOT Site (Type)	Haz Mat Sites	Historic Barns	Cemetery
Mt. Vernon Area 2 (Bld, FS)		WH Barn	Y

LEGEND

AADT	annual average daily traffic	DHV	design hourly volume
ACE	Annual Chance of Exceedance	GI STUDY	Corps' general investigation
CIVA	Climate Impact Vulnerability Assessment	SLR	sea level rise
Corps	U.S. Army Corps of Engineers	SR	State Route
CULI	Comprehensive Urban Levee Improvement	TSP	tentatively selected plan

Segment 8, South SR 9 Nookachamps Basin

Segment ID	Highway Segment	CIVA Criticality	CIVA Impacts Base (High)
8	South SR9 Nookachamps Basin	M, H	M

Estimated AADT Max	Truck Percentage	DHV	Federal Function Class	Freight Class
9750	9.87%	1836	45, 54	T3, T4

Segment Description

Segment 8, South SR 9 Nookachamps Basin:

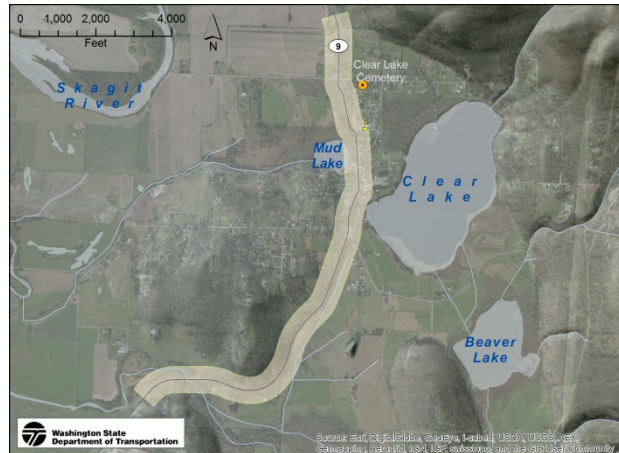
SR 9 (MP 50.92–53.57)

This section of SR 9 has an AADT of 9,750. The truck traffic is 9.9% and carries between 300,000 and 4 million tons of freight a year. The DHV for this segment is 1,836. There is only one bridge in this section and two culverts; however, there are 95 culvert ends listed. The high number of culvert ends indicates that there may be many culverts that are not functioning properly. The CIVA 2-FT SLR impacts for this section are moderate. There are no impacts for the CIVA 6-FT SLR condition. The land use zoning within this segment includes agricultural, rural (including a rural residential village), and commercial/industrial.

Flooding occurs through this segment during the 10%, 4%, 2%, and 1% ACE events with the following maximum depths:

10%	4%	2%	1%
ACE	ACE	ACE	ACE
3.57'	6.94'	8.60'	10.05'

Flooding occurs in this segment in the TSP, and it covers a longer stretch (0.46 mile) of road than in the existing conditions. This segment is in Flood Zone A.



Clear Lake 2003



Adaptation Strategies
Realigning the highway or raising the road are the main adaptation strategies for this section of roadway. Further evaluation is needed to determine if raising the roadway is feasible in the flood-prone areas near Clear Lake. Realignment may be the only alternative in those locations.

Floodzones (Floodway)	Tsunami Zone	Discharge Points	Stormwater BMP Type (#)
A	–	3	

Bridges	Under Crossings	Culvert Inventory (End Inv.)	Fish Passage
1	–	2 (95**)	

Unstable Slope	Liquifaction	Hydrologic Soils Group	Hydric Soils Area (sf)
–	Bedrock, L-M, M-H	C, D	5540076.3419291675

Bus Route	Park and Ride Lots	Land Use Zoning	Schools	Hospital
8		Ag-NRL, RRv, RVR, RVC, RB		

WSDOT Site (Type)	Haz Mat Sites	Historic Barns	Cemetery

LEGEND

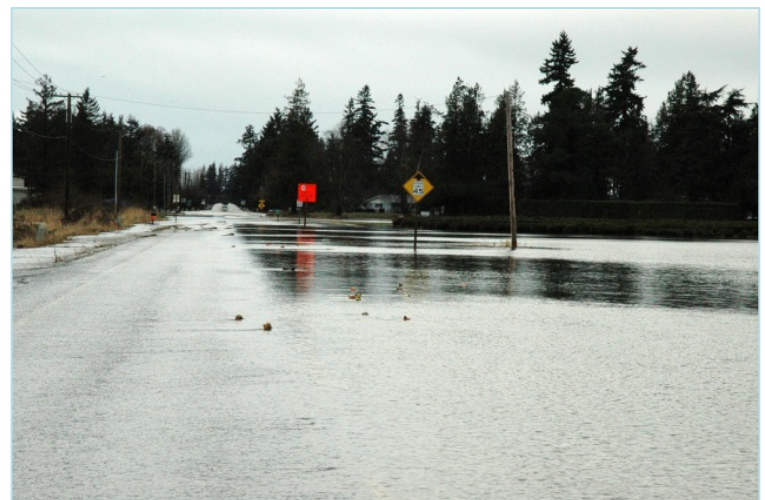
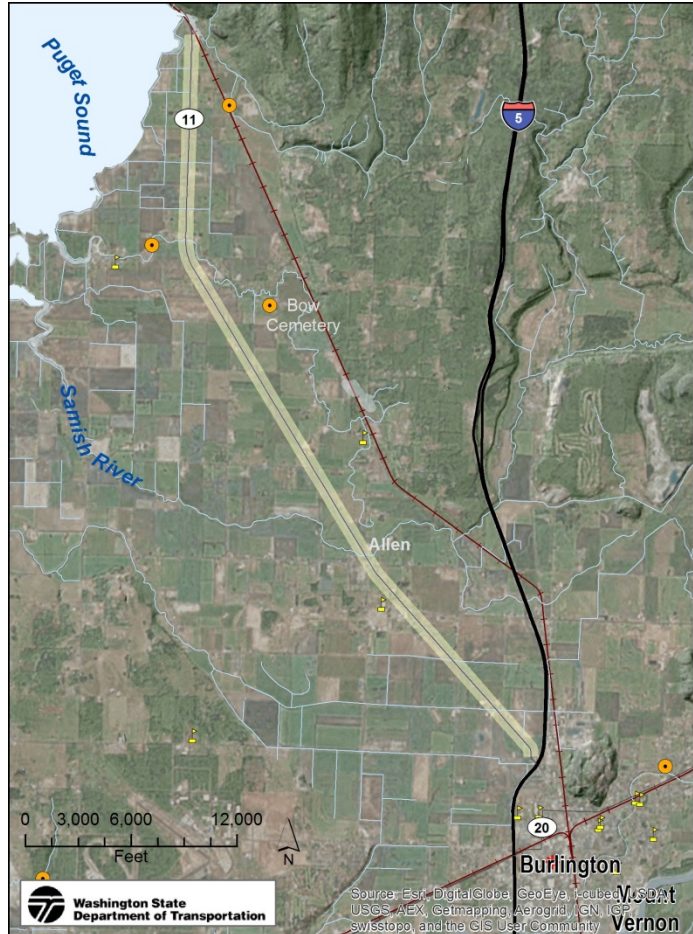
AADT	annual average daily traffic	DHV	design hourly volume
ACE	Annual Chance of Exceedance	GI STUDY	Corps' general investigation
CIVA	Climate Impact Vulnerability Assessment	SLR	sea level rise
Corps	U.S. Army Corps of Engineers	SR	State Route
CULI	Comprehensive Urban Levee Improvement	TSP	tentatively selected plan

Segment 9, SR 11

Segment ID	Highway Segment	CIVA Criticality	CIVA Impacts Base (High)
9	SR11	L	L, H

Estimated AADT Max	Truck Percentage	DHV	Federal Function Class	Freight Class
4530	10.7%	990	45	T3, T4

Segment Description											
<p>Segment 9, SR 11: SR 11 (MP 0.14–9.06)</p> <p>This segment has a low AADT of 4,530 and 10.7% of that is truck traffic. The DHV in this area is 990. It carries between 300,000 and 4 million tons of freight per year and is classified as a Rural Major Collector. There are three bridges and one culvert in this section. The culvert in this section is a barrier to fish passage. There are 95 culvert ends listed. This indicates that there may be a lot of culverts that are not functioning properly because one end is blocked or buried. There are no bus routes in this segment. The CIVA 2-FT SLR impacts for this segment are low and high. The high impact is due to wave action. In the CIVA 6-FT SLR condition, sections of SR 11 would be inundated. The land use zoning in this segment includes agricultural, rural, and commercial/industrial.</p> <p>Flooding occurs through this segment during the 4%, 2%, and 1% ACE events with the following maximum depths:</p> <table border="1"> <thead> <tr> <th>10% ACE</th> <th>4% ACE</th> <th>2% ACE</th> <th>1% ACE</th> </tr> </thead> <tbody> <tr> <td>N/A</td> <td>6.00'</td> <td>3.92'</td> <td>6.80'</td> </tr> </tbody> </table> <p>Flooding occurs in this segment in the TSP and it floods a longer stretch (2.48 miles longer) than the existing 1% event. This segment is in Flood Zone A and X500.</p>				10% ACE	4% ACE	2% ACE	1% ACE	N/A	6.00'	3.92'	6.80'
10% ACE	4% ACE	2% ACE	1% ACE								
N/A	6.00'	3.92'	6.80'								



SR 11 during the 2009 Flood Event



Adaptation Strategies

Raising the road is the only adaptation strategy for this segment. No “no-regrets” strategies were identified for this stretch due to its low AADT.

Floodzones (Floodway)	Tsunami Zone	Discharge Points	Stormwater BMP Type (#)
A, X500	X	11	

Bridges	Under Crossings	Culvert Inventory (End Inv.)	Fish Passage
3	–	1 (85)	Repair Req.

Unstable Slope	Liquifaction	Hydrologic Soils Group	Hydric Soils Area (sf)
–	M-H	C, D	25733195

Bus Route	Park and Ride Lots	Land Use Zoning	Schools	Hospital
–		Ag-NRL, RB, RRv, RC, NRI		

WSDOT Site (Type)	Haz Mat Sites	Historic Barns	Cemetery

LEGEND

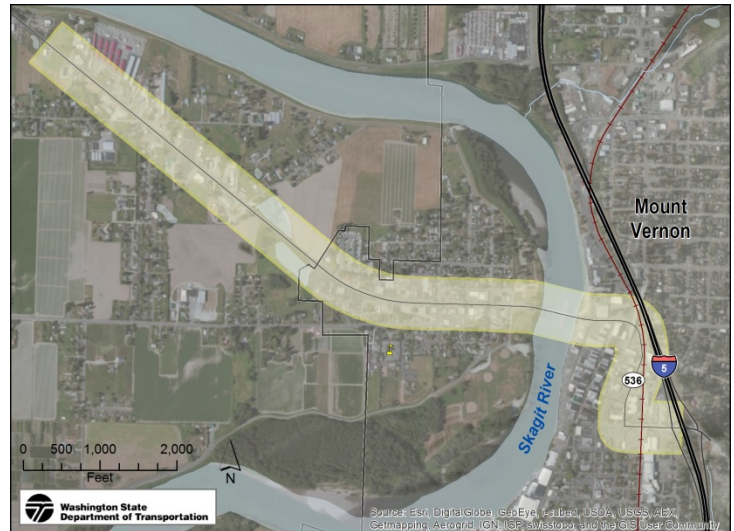
AADT	annual average daily traffic	DHV	design hourly volume
ACE	Annual Chance of Exceedance	GI STUDY	Corps’ general investigation
CIVA	Climate Impact Vulnerability Assessment	SLR	sea level rise
Corps	U.S. Army Corps of Engineers	SR	State Route
CULI	Comprehensive Urban Levee Improvement	TSP	tentatively selected plan

Segment 10, SR 536 Mount Vernon

Segment ID	Highway Segment	CIVA Criticality	CIVA Impacts Base (High)
10	SR536 Mount Vernon	M,H	H, (H)

Estimated AADT Max	Truck Percentage	DHV	Federal Function Class	Freight Class
20100	0.05%	1052	53, 54	T2, T3

Segment Description								
<p>Segment 10, SR 536 Mount Vernon: SR 536 (MP 3.3–5.36)</p> <p>The AADT on this segment is 20,100. The truck percentage is miniscule at 0.05% and it carries 300,000 to 4 million tons of freight per year. The route is classified as an Urban Minor Arterial. There are two bridges and two culverts on this segment. None of the culverts is a fish barrier. There are nine bus routes, and the Skagit STA and Mount Vernon Park and Ride facilities are located on this segment. The CIVA 2-FT SLR impacts are high and the CIVA 6-FT SLR impacts are high on this route. The CIVA looked at the route as a whole and noted flooding and SLR impacts. This segment lies within the urban growth boundary, and the land use zoning includes agricultural and rural.</p> <p>Flooding occurs through this segment during the 1% ACE events with the following maximum depths:</p> <table border="1" data-bbox="245 1245 597 1367"> <tr> <td>10% ACE</td> <td>4% ACE</td> <td>2% ACE</td> <td>1% ACE</td> </tr> <tr> <td>N/A</td> <td>N/A</td> <td>N/A</td> <td>8.39'</td> </tr> </table> <p>Flooding occurs in this segment in the TSP, but a slightly shorter segment of the road is flooded under the TSP than in the existing 1% event. This segment is in Flood Zone A.</p>	10% ACE	4% ACE	2% ACE	1% ACE	N/A	N/A	N/A	8.39'
10% ACE	4% ACE	2% ACE	1% ACE					
N/A	N/A	N/A	8.39'					



Sandbag Revetment during the 1980 flood event



Adaptation Strategies
There were no structural adaptation strategies identified for this segment.

Floodzones (Floodway)	Tsunami Zone	Discharge Points	Stormwater BMP Type (#)
A	–	12	

Bridges	Under Crossings	Culvert Inventory (End Inv.)	Fish Passage
2	1*	2 (1)	

Unstable Slope	Liquifaction	Hydrologic Soils Group	Hydric Soils Area (sf)
–	M-H, H	B, C	20175915

Bus Route	Park and Ride Lots	Land Use Zoning	Schools	Hospital
5, 8, 61, 204, 205, 207, 208N, 208S, 513	Skagit STA, Mount Vernon Park & Ride	Ag-NRL, UGA, RRv		

WSDOT Site (Type)	Haz Mat Sites	Historic Barns	Cemetery

LEGEND

AADT	annual average daily traffic	DHV	design hourly volume
ACE	Annual Chance of Exceedance	GI STUDY	Corps' general investigation
CIVA	Climate Impact Vulnerability Assessment	SLR	sea level rise
Corps	U.S. Army Corps of Engineers	SR	State Route
CULI	Comprehensive Urban Levee Improvement	TSP	tentatively selected plan

Segment 11, West SR 20/SR 536

Segment ID	Highway Segment	CIVA Criticality	CIVA Impacts Base (High)
11	West SR20/SR536	M,H	H

Estimated AADT Max	Truck Percentage	DHV	Federal Function Class	Freight Class
30580	13.2%	5399	42, 43, 44, 53	T2, T3

Segment Description																			
<p>Segment 11, West SR 20/SR 536: SR 20 (MP 51.51–58.98), SR 536 (MP 0–1.89)</p> <p>This segment contains a long portion of SR 20 and a short portion of SR 536 where it intersects SR 20. The AADT on SR 20 is 30,580 and 13.2% of that is truck traffic. This segment of SR 20 carries 4 million to 10 million tons of freight a year. It has a classification of Rural Other Principle Arterial and Urban Other Principle Arterial. The DHV is 2,385. SR 536 has an AADT of 7,418 and 4% truck traffic. It carries 300,000 to 4 million tons of freight a year and is classified as a Rural Minor Arterial. The DHV is 1,435. There is one bus route on this segment. There are nine bridges in the overall segment and 47 culverts; two of the culverts are fish passage barriers. The CIVA 2-FT SLR impacts for this segment are moderate or high due to flooding and sea level rise. The impact varies by exact location. The CIVA 6-FT SLR impact is high. The land use zoning along this segment includes agricultural, commercial/ industrial, and rural. It lies within the urban growth boundary.</p> <p>Flooding occurs through this segment during the 4%, 2%, and 1% ACE events with the following maximum depths:</p> <table border="1"> <thead> <tr> <th></th> <th>10% ACE</th> <th>4% ACE</th> <th>2% ACE</th> <th>1% ACE</th> </tr> </thead> <tbody> <tr> <td>SR 20</td> <td>N/A</td> <td>10.25'</td> <td>10.50'</td> <td>12.00'</td> </tr> <tr> <td>SR 536</td> <td>N/A</td> <td>4.00'</td> <td>5.00'</td> <td>4.60'</td> </tr> </tbody> </table> <p>Flooding occurs on both highways in the TSP, but a shorter segment of the road is flooded under the TSP than in the existing 1% ACE event. This segment is in Flood Zone A and X500.</p>						10% ACE	4% ACE	2% ACE	1% ACE	SR 20	N/A	10.25'	10.50'	12.00'	SR 536	N/A	4.00'	5.00'	4.60'
	10% ACE	4% ACE	2% ACE	1% ACE															
SR 20	N/A	10.25'	10.50'	12.00'															
SR 536	N/A	4.00'	5.00'	4.60'															



SR 20



Adaptation Strategies

There were many adaptation strategies identified for this section of roadway, but most of them were to allow the road to be brought back into service after a flood since the flood depths are so deep on SR 20. The one adaptation strategy that did alleviate the flooding was to build a causeway and get the road above the water. This would allow the water to move under the road. One adaptation strategy is to harden the road prism to allow the water to flow over it with minimal damage. Another is to make portions of the road sacrificial. Those areas would in essence be destroyed by the flood, but in doing so save other sections of the road. Both of these strategies might allow the road to be opened sooner after a flood event. Another adaptation strategy would be to find alternate routes for local traffic and work with the local governments to make those routes more resilient during flood events.

Floodzones (Floodway)	Tsunami Zone	Discharge Points	Stormwater BMP Type (#)
A, X500	X	42	WDP (1), SWD (2), RS (53)

Bridges	Under Crossings	Culvert Inventory (End Inv.)	Fish Passage
9	–	47 (6)	Repair Req. (2)

Unstable Slope	Liquifaction	Hydrologic Soils Group	Hydric Soils Area (sf)
–	M-H, H	C, D	13741900

Bus Route	Park and Ride Lots	Land Use Zoning	Schools	Hospital
513		Ag-NRL, UGA, RB, RI, NRI, RMI, RRv		

WSDOT Site (Type)	Haz Mat Sites	Historic Barns	Cemetery
	1	WH Barn	Y

LEGEND

AADT	annual average daily traffic	DHV	design hourly volume
ACE	Annual Chance of Exceedance	GI STUDY	Corps' general investigation
CIVA	Climate Impact Vulnerability Assessment	SLR	sea level rise
Corps	U.S. Army Corps of Engineers	SR	State Route
CULI	Comprehensive Urban Levee Improvement	TSP	tentatively selected plan