

Washington State DOT's Vulnerability Assessment: Asking the “Climate Question”



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Washington State DOT

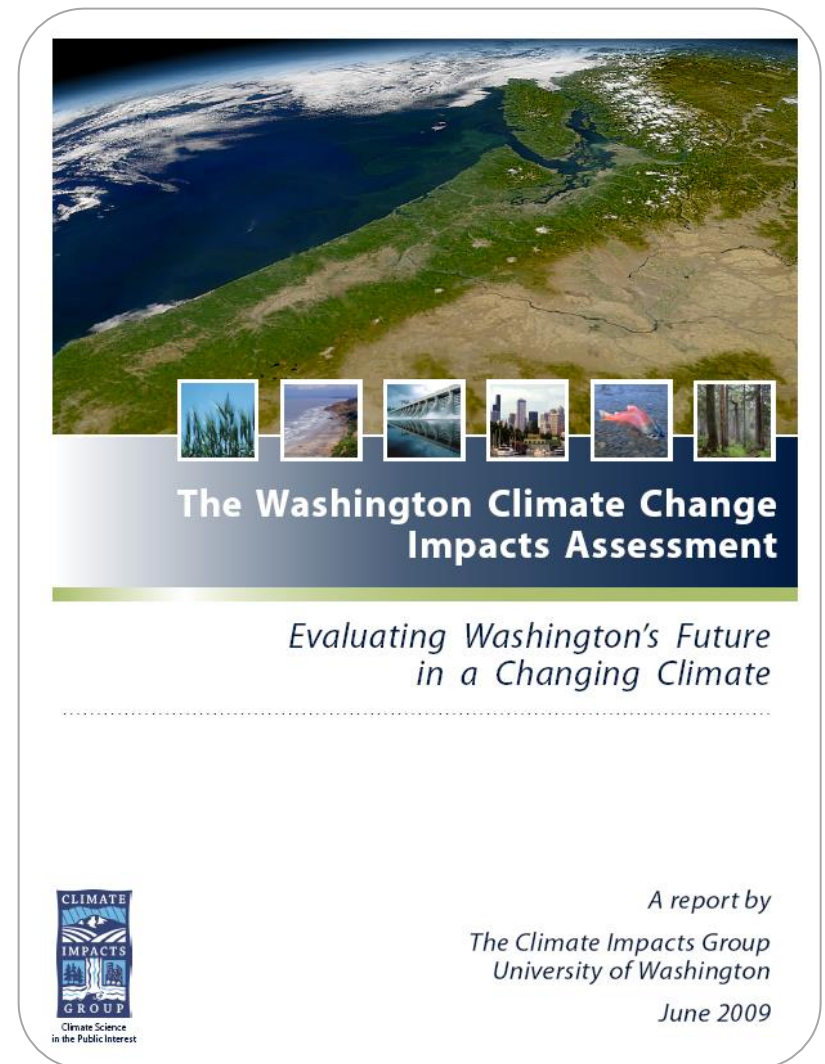
Lynn Peterson
Secretary of Transportation

**AASHTO Extreme Weather
Events Symposium**
Washington, D.C.

May 22, 2013

Washington Climate Change Impacts Assessment

- Funded by the Washington State Legislature
- Governor and the state legislature directed state agencies to use this science (Executive Order 09-05)
- Published in 2009
- Comprehensive report on climate change impacts in Washington
- Detailed data and technical support available




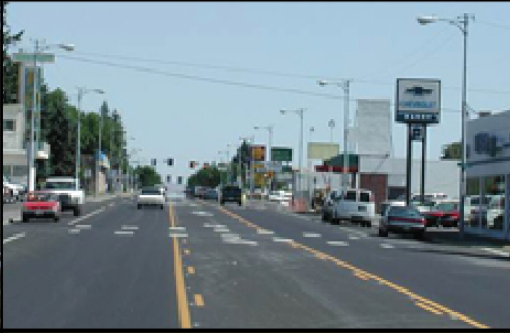

Goal: Preserve assets in a changing environment

- Apply an asset management approach
 - Be ready for severe weather events and long-term changes in site conditions
 - Inform long-term decisions
 - Build resilience where possible
- Conduct a statewide vulnerability assessment
 - Test-drive the FHWA model
 - Understand and communicate current science
 - Scope: Consider impacts on our all WSDOT assets (Highways, Ferries, State-owned Rail and Airports)



Step 1 – How critical is the asset?

WSDOT Methodology

Very low to low			Moderate			Critical to Very Critical			
1	2	3	4	5	6	7	8	9	10
Criticality of asset									
<p>Notice that along with the qualitative terms there is an associated scale of 1 to 10, this is to serve as a facilitation tool for some people who may find it useful to think in terms of a numerical scale - although the scoring by each individual is of course subjective. The scale is a generic scale of criticality where “1” is very low (least critical) and “10” is very critical.</p>									
									
<p>Typically involves: non-NHS low AADT alternate routes available</p>			<p>Typically involves: some-NHS non-NHS low to medium AADT serves as an alternative for other state routes</p>			<p>Typically involves: Interstate Lifeline some NHS sole access no alternate routes</p>			

Record impact score

10
9
8
7
6
5
4
3
2
1



Complete catastrophic failure

Results in total loss or ruin of asset. Asset *may* be available for *limited* use after at least 60 days and would require major repair or rebuild over extended period of time. “Complete and/or catastrophic failure” typically involves:

- Immediate road closure;
- Disruptions to travel;
- Vehicles forced to re-route to other roads;
- Reduced commerce in affected areas;
- Reduces or eliminates access to some destinations;
- May sever some utilities located within right-of-way;
- May damage drainage conveyance or storage systems.



Temporary operational failure

Results in minor damage and/or disruption to asset. Asset would be available with either full or limited use within 60 days and may have immediate limited use still available. “Temporary Operational Failure” typically involves:

- Temporary road closure, hours to weeks;
- Reduced access to destinations served by the asset;
- Stranded vehicles;
- Possible temporary utility failures.



Reduced capacity

Results in little or negligible impact to asset. Asset would be available with full use within 10 days and has immediate limited use still available. “Reduced capacity” typically involves:

- Less convenient travel;
- Occasional/ brief lane closures, but roads remain open;
- A few vehicles may move to alternate routes;

Figure 2.1 Photo depictions of qualitatively assessed climate change consequences

Step 2: What are the Climate Threats?

- Began with climate change forecast from UW Climate Impacts Group
- Talked about observed changes and extreme events with a variety of disciplines including: Maintenance, hydraulics, bridge, geotechnical, materials, environmental staff, etc
- Key Questions:
 - “What keeps you up at night?”
 - “What if it gets worse (given the scenario)?”
 - “How resilient is our existing system?”
- WSDOT’s internal experts ranked all WSDOT assets

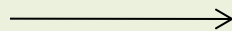


Workshops: How might climate impact assets?

Primary climate drivers

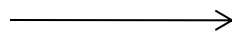
Can lead to impacts on...

Temperature



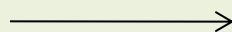
Expansion joints, pavement, rail tracks, construction periods, habitat projects, electrical equipment

Precipitation



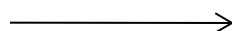
Flooding of surface roads & tunnels, road washout, pump capacity, drainage

Hydrologic shifts



Soil instability, water supply, bridge and road support structures

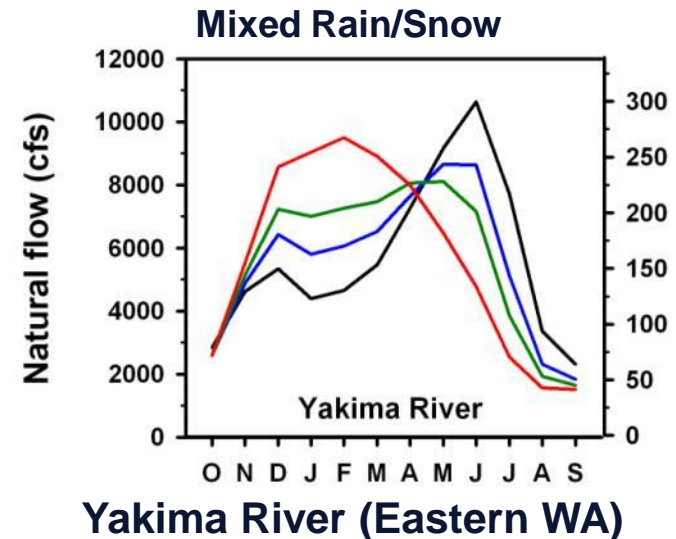
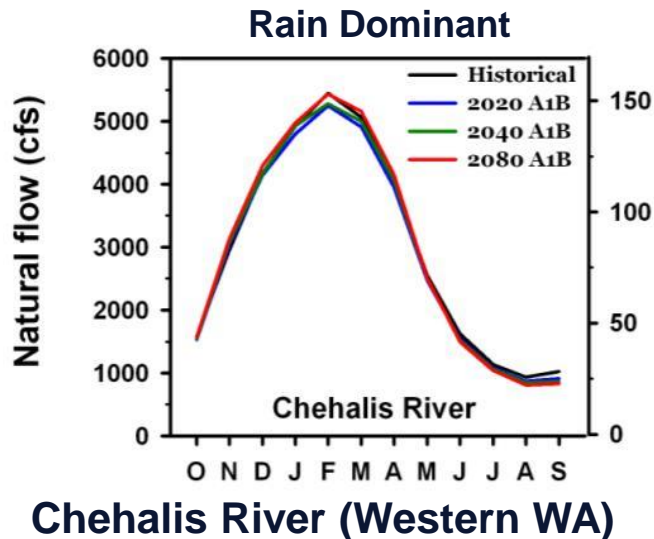
Sea level rise, storm surge



Coastal erosion, coastal and upriver flooding, bridge footings, drainage, roadside stability, salt / corrosion

Changes in Flood Risks

- Flooding in western Washington has changed in magnitude and frequency due to the combined effects of warming, increasingly intense winter storms and sedimentation.
- In other parts of the State, changes in flooding are mixed, and in eastern Washington projected *reductions* in spring flood risk are common due to loss of spring snow cover.



Erosion and Scour



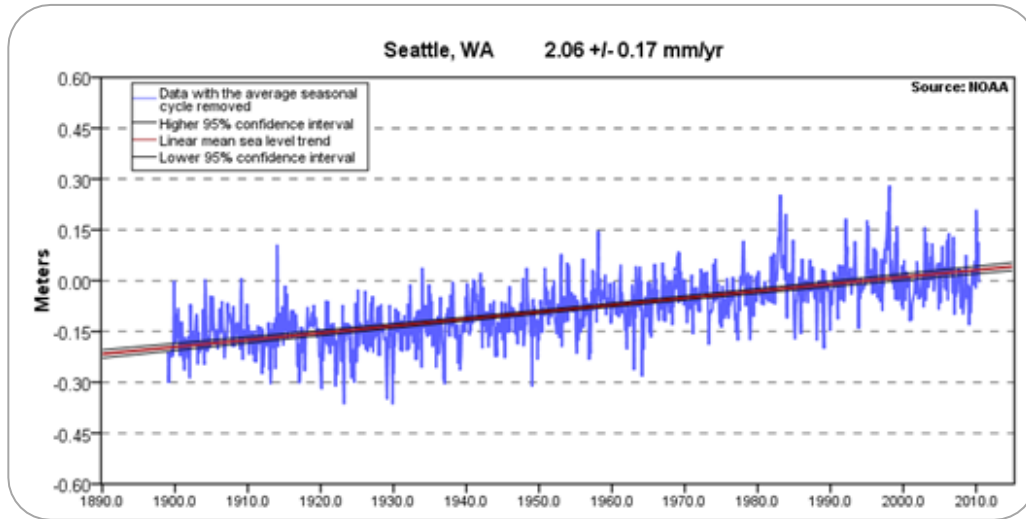
Scour and damage to structures - Just off SR410 White River

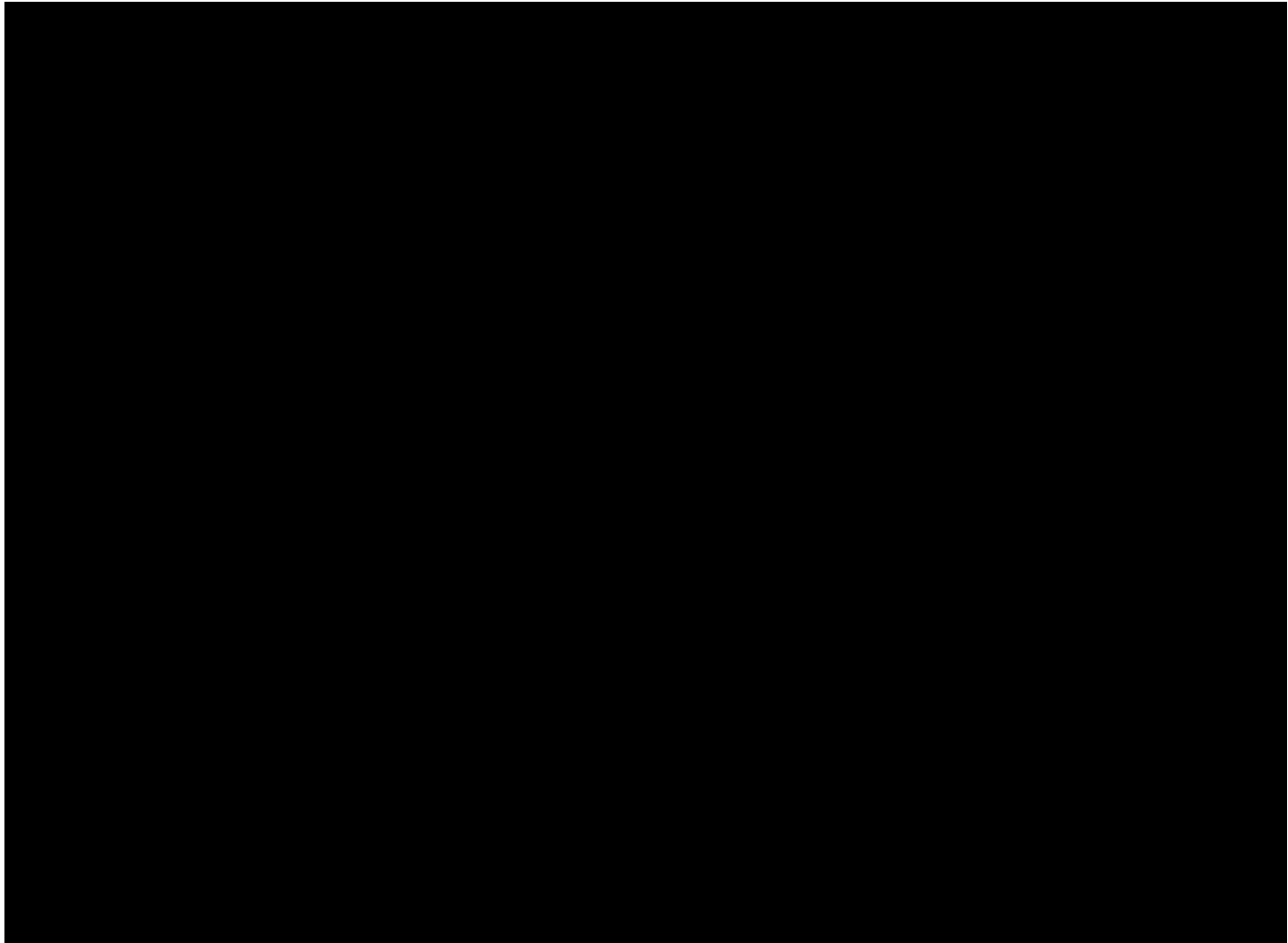
Rock and Mudslides

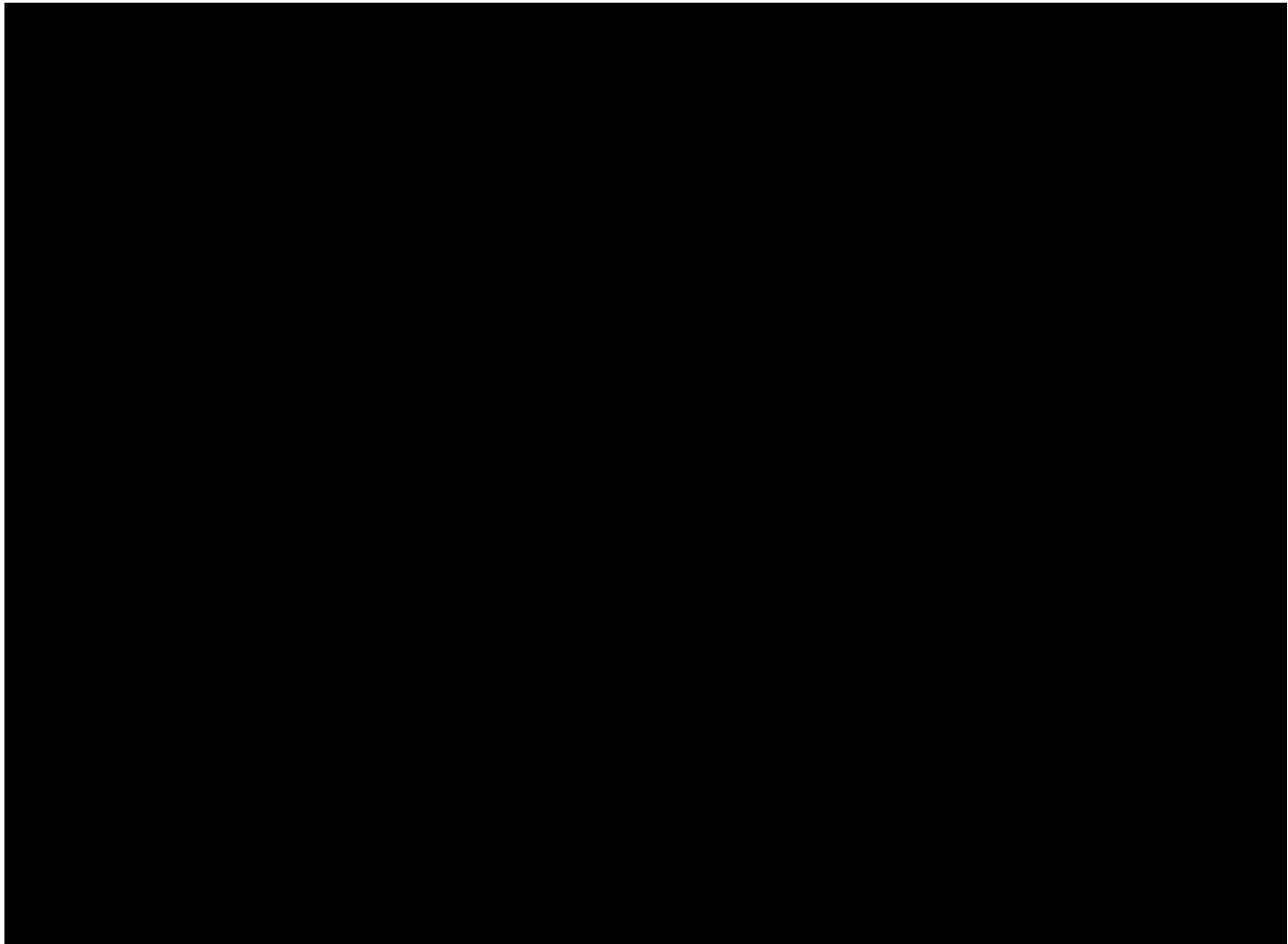


US 2

Mean Sea Level Trends







Bridge Engineering Information System (BEIS)



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BRIDGE AND STRUCTURES OFFICE

BRIDGE INFORMATION

- [Bridge and Structures](#)
- [Bridge Information](#)
- [Bridge Repairs](#)
- [Sign Repairs](#)
- [Standard Plans](#)
- [Scour Files](#)
- [Schedule](#)
- [Support](#)

Bridge Engineering Information System

This site provides access to inventory data, plans, rating reports, inspection reports, photographs, and related files for bridge structures in the WSDOT bridge inventory. This inventory of bridge structures includes some locally owned agency structures.

There are over 8,500 bridge structures in this database, therefore it is necessary to provide information about the structures of interest to reduce the list to a displayable level. Please provide one or more pieces of information about the structure(s) you are interested in:

Structure ID

Bridge Number

County

[Show Map](#)

Contract Number

Route

Milepost Range -

[Hide Search Criteria](#)

Mud Bay Bridge (101/508E)

BRIDGE AND STRUCTURES OFFICE

BRIDGE INFORMATION

- Bridge and Structures
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- Bridge Repairs
- Sign Repairs
- Standard Plans
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- Schedule
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STRUCTURE DATA

- Current Bridge
- Plans
- Scour POA
- Contracts
- Inspection Photos
- Inspection Files
- Correspondence
- Inspection Reports
- Repairs
- Maintenance
- WS SI&A (English)
- WS SI&A (Metric)

MUD BAY

Hide current Bridge Information

Bridge Number **101/508E** Structure Type **CS**
 Structure Identifier **0005677A** Operating Rating Tons **56**
 Location **1.3 S JCT SR 8** Inventory Rating Tons **34**
 Route **00101** Min Over Deck **99' 99"**
 Mile Post **362.83** Min Under Bridge **0"**
 Feature Intersected **MUD BAY** Sufficiency Rating **80.42**
 Facilities Carried **US 101** Year Built **1958**
 Region **OL** Year Rebuilt
 Owner **Washington State** SD/FO **N/A**
 Open Close Posted Code **A**

Inspections Performed

Hide Current Inspections Performed

Report Type	Inspn Date	Inspn Freq	Insp Type
Routine	2010-05-12	24	
Equipment	2010-05-12	72	

MUD BAY Image

Hide Current Bridge Image

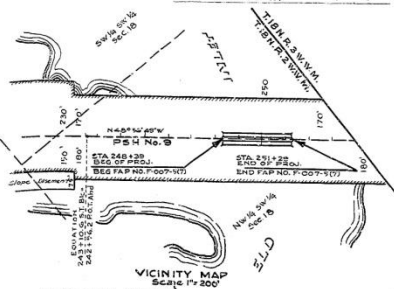
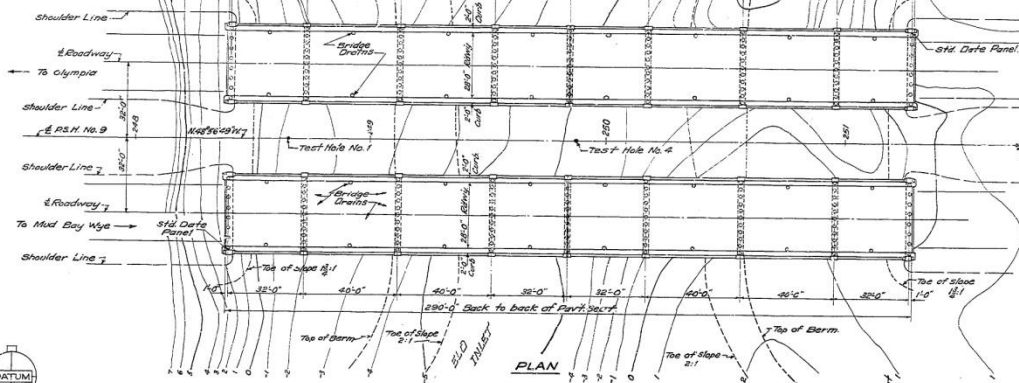


Mud Bay Bridge (101/508E) As-Builts

NOTE:
Grade elevations shown are
finished grades and equal to
profile grades on & roadway

SEC. 18 T. 18 N. R. 2 W. W.M.

1 4
FSD 107



GENERAL NOTES

All material and work shall be in accordance with the requirements of the State of Washington, Department of Highways, Standard Specifications for Road and Bridge Construction, dated July, 1957.
All concrete shall be Class A mix.
Each pile shall be driven to a depth sufficient to develop a minimum load bearing capacity of twenty-two (22) tons.
Sufficient shall not be released in any case until all concrete has developed sufficient strength as outlined in the specifications. Release shall be carefully released to prevent impact or undue stresses in the structures.

SEQUENCE OF POURING

- 1 Roadway Slabs, Cross beams and End Walls.
- 2 Curbs, Rail Bases and End Posts.
- 3 Railings.

U.S.C.G.S. (BLM) 558 (corrected copy)
Old Inlet Bridge (BLM) 558 (copy) (BLM)
Top of S.E. End of S.W. Sandstone
Bearing - 5.8 higher than post



ELEVATION

Station	Description	Station	Description	Station	Description	Station	Description
7	Blue silt	1	Blue silt	10	Blue silt	1	Blue silt
6	Blue silt	2	Blue silt	11	Blue silt	2	Blue silt
5	Blue silt	3	Blue silt	12	Blue silt	3	Blue silt
4	Blue silt	4	Blue silt	13	Blue silt	4	Blue silt
3	Blue silt	5	Blue silt	14	Blue silt	5	Blue silt
2	Blue silt	6	Blue silt	15	Blue silt	6	Blue silt
1	Blue silt	7	Blue silt	16	Blue silt	7	Blue silt
0	Blue silt	8	Blue silt	17	Blue silt	8	Blue silt
		9	Blue silt	18	Blue silt	9	Blue silt
		10	Blue silt	19	Blue silt	10	Blue silt
		11	Blue silt	20	Blue silt	11	Blue silt
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		15	Blue silt	24	Blue silt	15	Blue silt
		16	Blue silt	25	Blue silt	16	Blue silt
		17	Blue silt	26	Blue silt	17	Blue silt
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		19	Blue silt	28	Blue silt	19	Blue silt
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		21	Blue silt	30	Blue silt	21	Blue silt
		22	Blue silt	31	Blue silt	22	Blue silt
		23	Blue silt	32	Blue silt	23	Blue silt
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		82	Blue silt	91	Blue silt	82	Blue silt
		83	Blue silt	92	Blue silt	83	Blue silt
		84	Blue silt	93	Blue silt	84	Blue silt
		85	Blue silt	94	Blue silt	85	Blue silt
		86	Blue silt	95	Blue silt	86	Blue silt
		87	Blue silt	96	Blue silt	87	Blue silt
		88	Blue silt	97	Blue silt	88	Blue silt
		89	Blue silt	98	Blue silt	89	Blue silt
		90	Blue silt	99	Blue silt	90	Blue silt
		91	Blue silt	100	Blue silt	91	Blue silt

SUMMARY OF QUANTITIES		LENGTH = 230 LIN. FEET
ITEM NO.	ITEM	QUANTITY
1	Superstructure	Lump Sum
2	Furnishing Timber Piling (untreated)	13,000 Lin. Ft.
3	Furnishing Concrete fill first 10 feet	6270 Lin. Ft.
4	Driving composite Piles - Over 10 feet	186 Only
5	Furnishing and Driving Timber Test Piles	12,000 Lin. Ft.
6	Pile Splices	186 Only
7	Structure Excavation	72 Cu. Yds.

LOADING H 20-S16

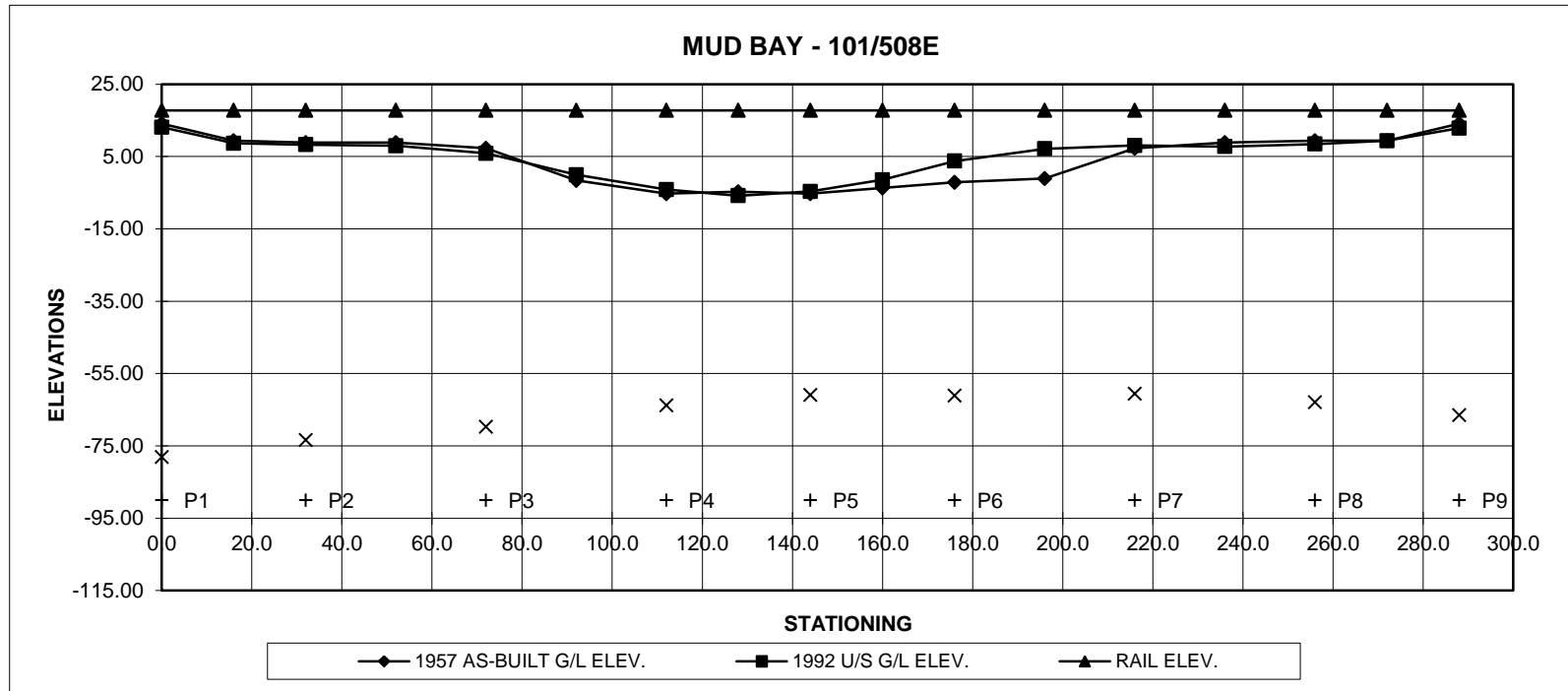
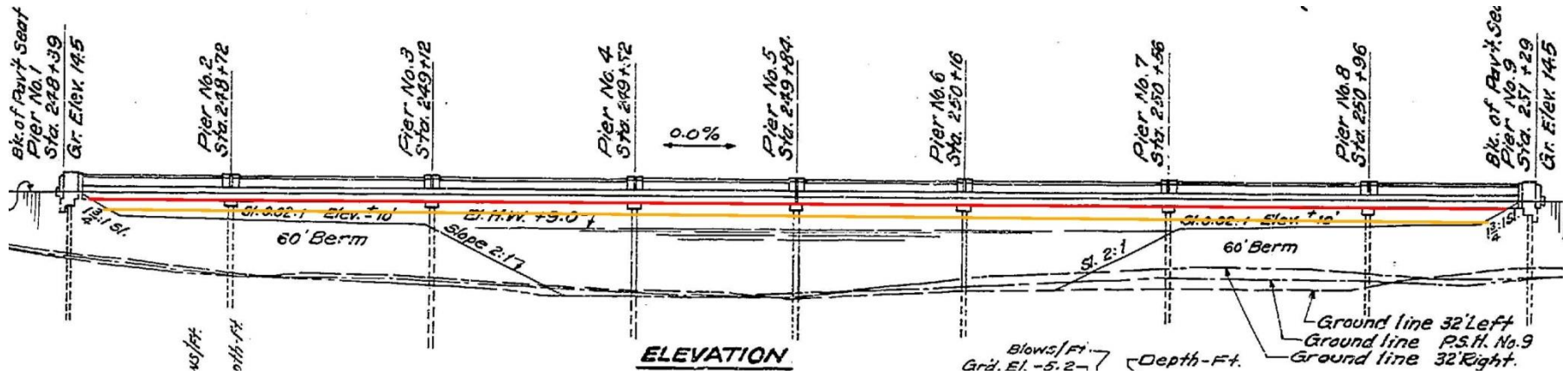


PRIMARY STATE HIGHWAY NO. 9
MUD BAY BRIDGE
THURSTON COUNTY

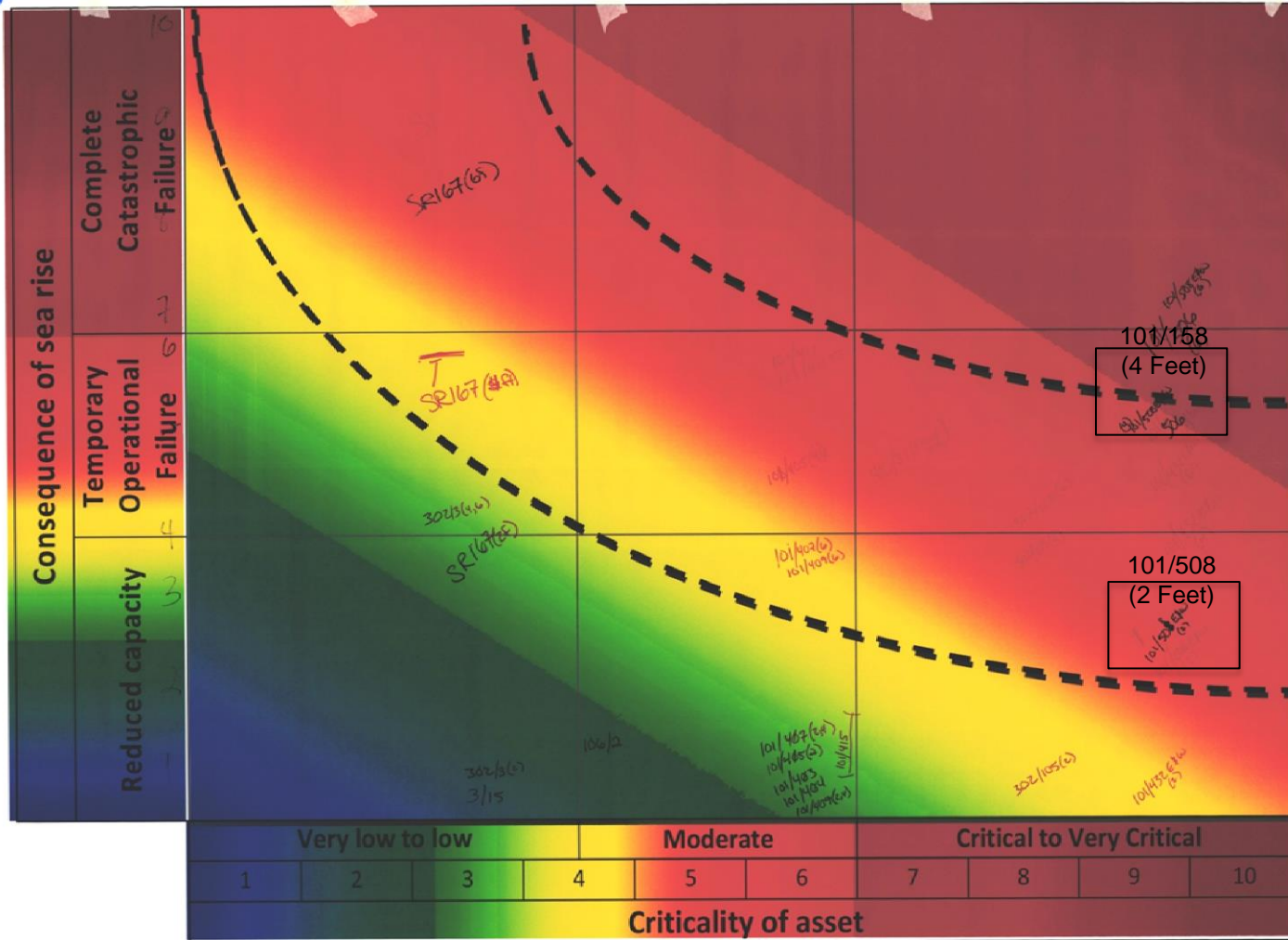
LAYOUT
WASHINGTON STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS

Approved Sept. 17, 1957
E.C. James
SHEET 1 OF 4 SHEETS

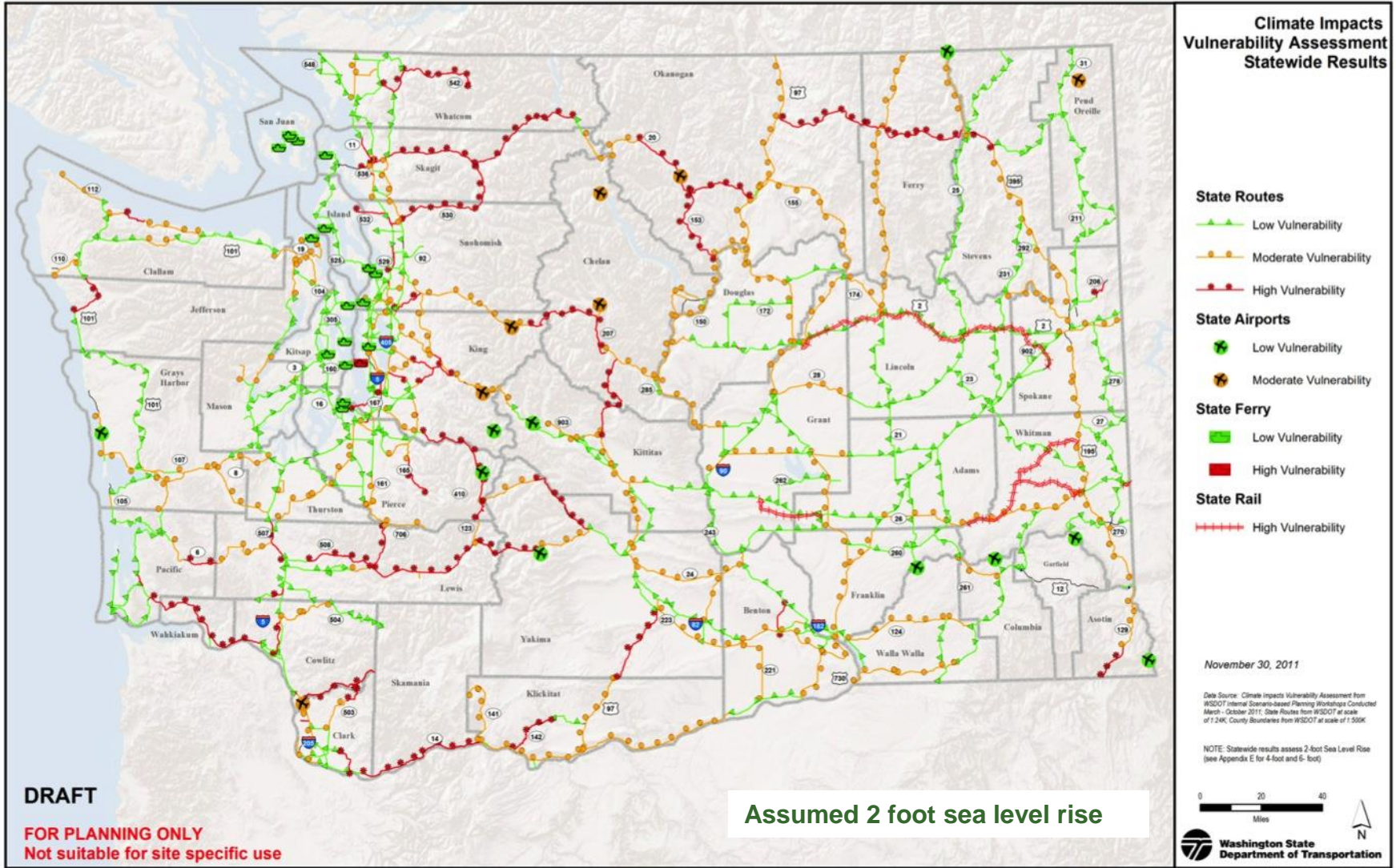
Mud Bay Bridge (101/508E) As-Builts



Mud Bay Bridge (101/508E)



Statewide Results



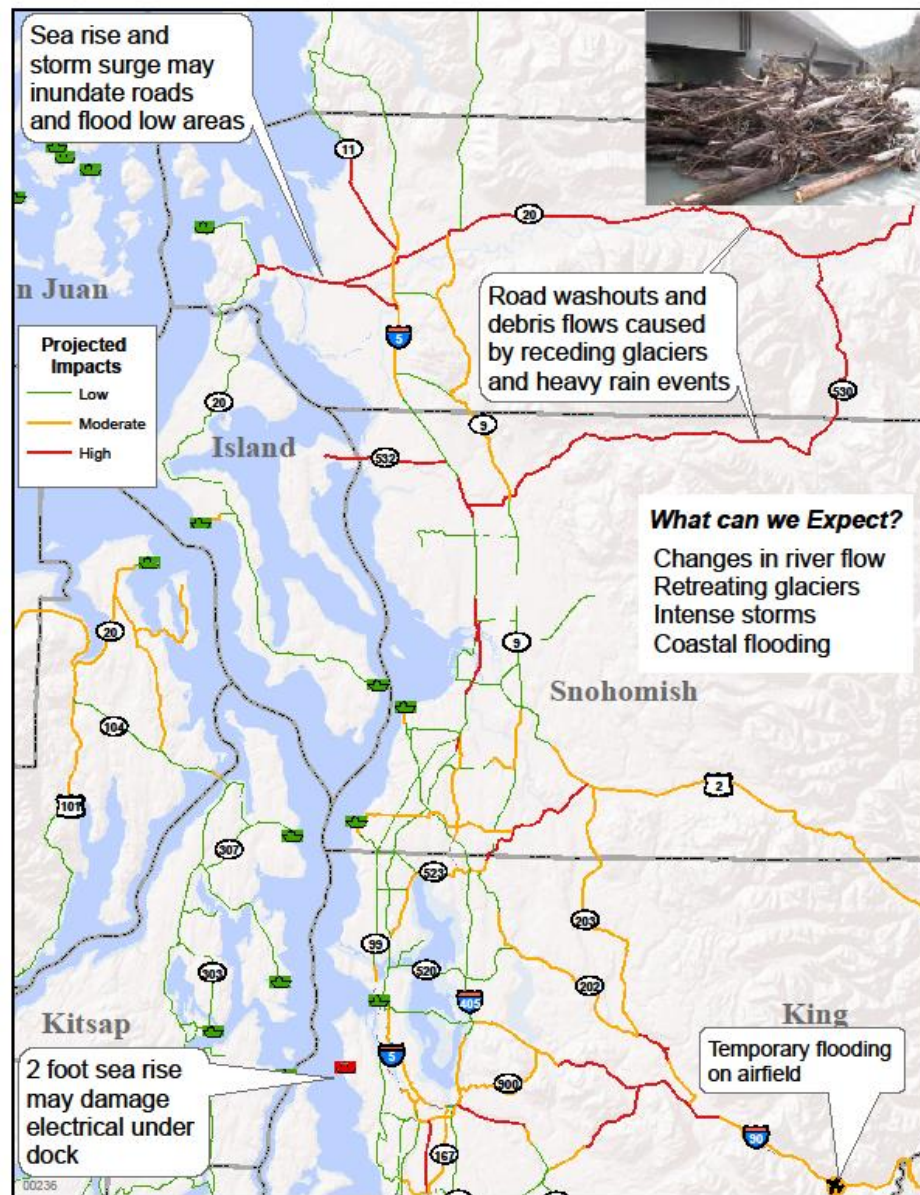
DRAFT

FOR PLANNING ONLY
Not suitable for site specific use

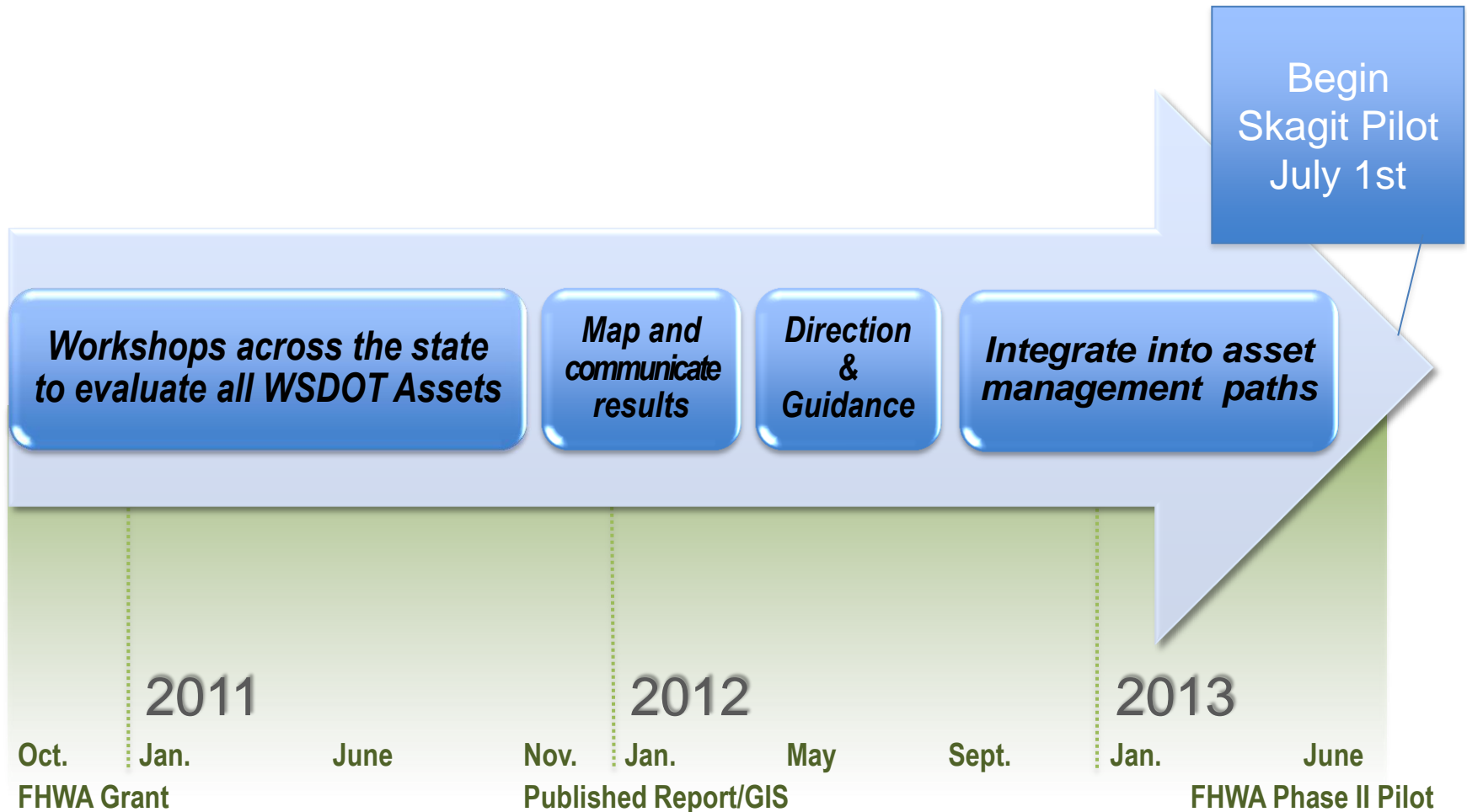
Assumed 2 foot sea level rise

What did we find?

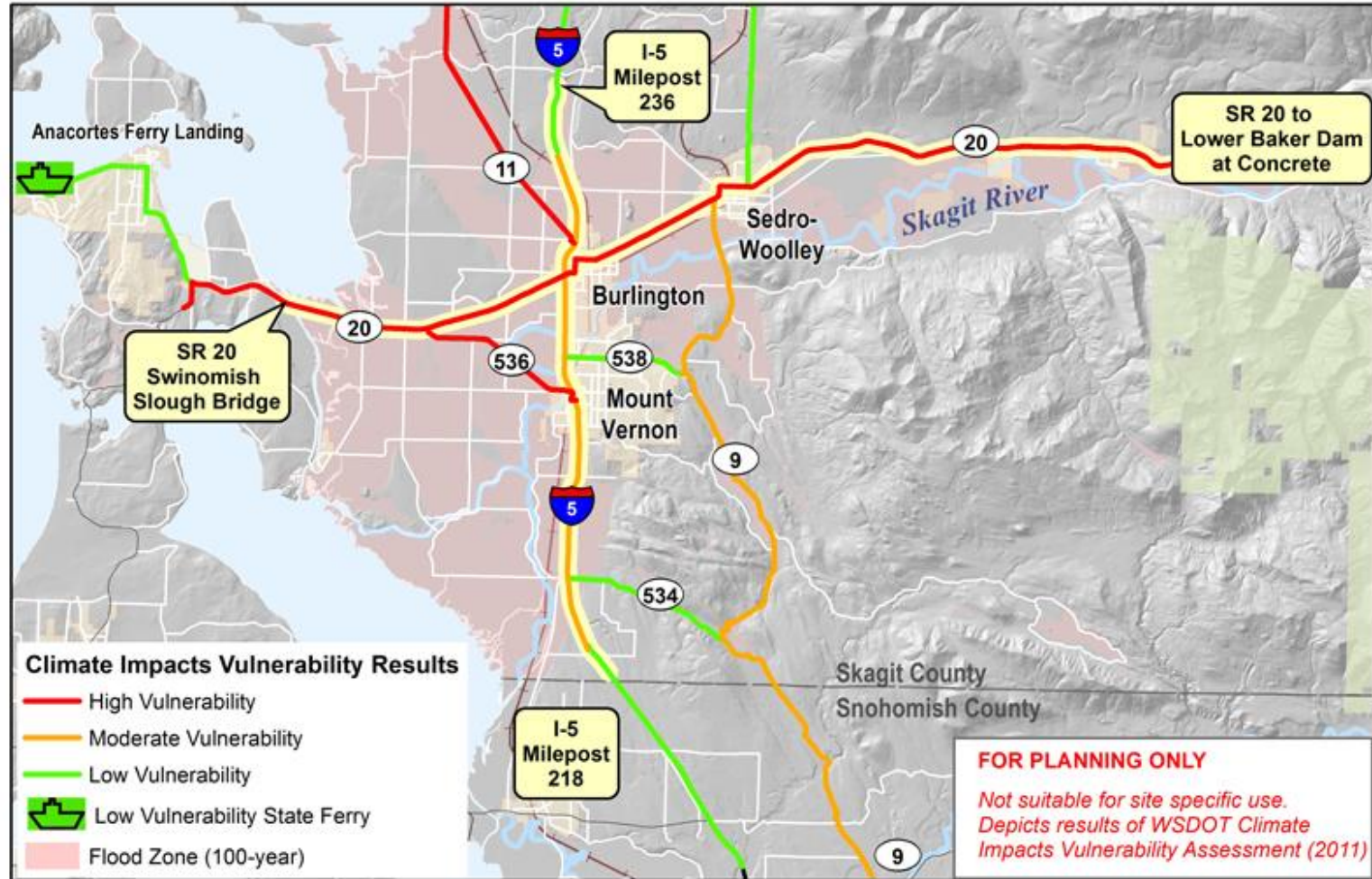
- Intensifies known threats
- Reinforces value of our current maintenance and retrofit programs
- Some surprises
- Unique way to capture knowledge of field staff



Timeline of WSDOT's Assessment



2011 WSDOT Climate Impacts Vulnerability Assessment Results in Skagit Basin



2013 Skagit Project Team Members

- **WSDOT Project Team Members**
 - Region Planning
 - HQ – Technical Experts
 - Hydraulics, hydrology, stormwater
 - Emergency preparedness and response
 - Climate Change Steering Committee
 - Sustainable Transportation staff from Environment, Design, Public Transportation
- **US Army Corps of Engineers**
- **County Partners**

Questions?

For more information:

<http://www.wsdot.wa.gov/SustainableTransportation/adapting.htm>

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