

Providence, RI

COASTAL SEA LEVEL RISE AND STORM SURGE: TRANSPORTATION FACT SHEET



PLANNING FOR SEA LEVEL RISE ON YOUR ROADS

This fact sheet aims to provide municipal leaders and practitioners with a survey of Providence's transportation infrastructure elements that may be affected by sea level rise and storm surge. In addition to explaining and presenting the data, this fact sheet will outline strategies that may help in adapting to these conditions, and point towards resources that will enable further investigation.

Relevance

The impacts of Sea Level Rise (SLR) are often perceived as distant, but the assets being built today will still be within their design life when future effects of sea level rise are felt. In addition, sea level rise will magnify the impacts of 100-year storm surge events by raising the water level. Though current federal guidelines only require federally funded assets be built to survive a 100-year storm event, what the impact of a 100-year storm event entails is likely to change during the design life of the assets currently under consideration around Rhode Island.

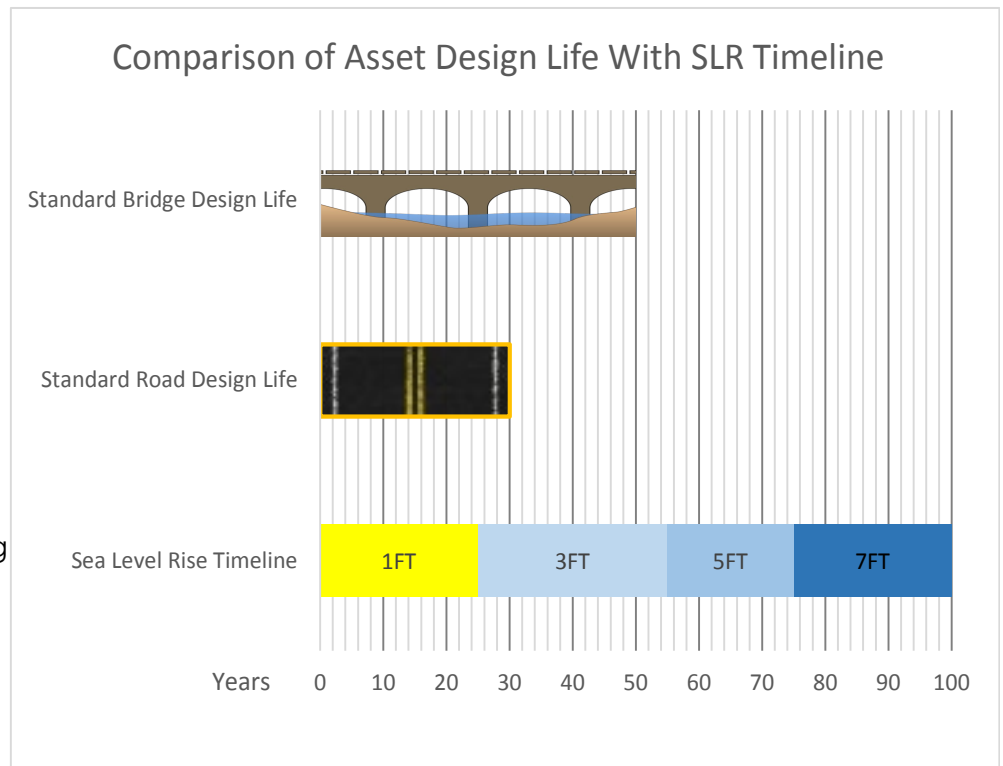


Figure 1

Data and Methodology



To help Rhode Island's cities and towns prepare for these changing conditions, the Statewide Planning Program (SPP) has engaged in an effort to analyze the potential impacts created by the sea level rise and storm surge. Using data developed under the name "STORMTOOLS" by the Coastal Resources Management Council and the University of Rhode Island, SPP identified the assets that could be impacted (exposure), and their vulnerability. As a result of this analysis, SPP identified the roads and bridges most likely to be impacted by Sea Level Rise, and scored their relative vulnerability based on the severity of the hazard they faced and the potential impact of asset damage on the transportation system as a whole.

Figure 2: Flooding near Sauchest Point: June 2013

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Providence Roads Exposed to Sea Level Rise



Figure 3

Given seven feet of sea level rise, a total of 156 miles of road in Rhode Island could be exposed to inundation, 70% of which would occur on local roads. For Providence nine miles of roadway inundation can be expected. Of this, 39% (3.56 miles) are local. Providence's roads (state and local) are the fifth most vulnerable in the state of Rhode Island to sea level rise.

Figure 4

Top 10 Road Assets in Providence Vulnerable to Sea Level Rise (SLR)												
Mun. Rank	Road Name	1 Ft of SLR	3 Ft of SLR	5 Ft of SLR	7 Ft of SLR	Total Linear Feet	Evac. Route	Intermodal Facility	Functional Classification	Vuln. Score	State Rank	
1	I 95 N	85	17	20	41	163	No	Yes	Interstate	6.54	19	
2	I 95 S	85	20	31	40	176	No	Yes	Interstate	6.47	20	
3	CANAL ST	0	0	0	1,244	1,244	No	Yes	Principal Art.	6.43	21	
4	STEEPLE ST	120	11	6	170	306	No	Yes	Principal Art.	6.27	24	
5	ON RAMP I-95 N	166	20	30	50	265	No	Yes	Interstate	6.25	25	
6	DORRANCE ST	0	0	660	1,640	2,300	No	Yes	Minor Art.	6.22	26	
7	DEAN ST	186	14	9	15	224	No	No	Minor Art.	6.22	27	
8	KINSLEY AVE	0	0	0	2,795	2,795	No	Yes	Major Coll.	6.17	31	
9	POINT ST	0	0	4	1,495	1,499	No	No	Principal Art.	5.89	40	
10	EXIT 22	85	5	11	28	129	No	No	Interstate	5.81	43	

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Providence Bridges Exposed to Sea Level Rise

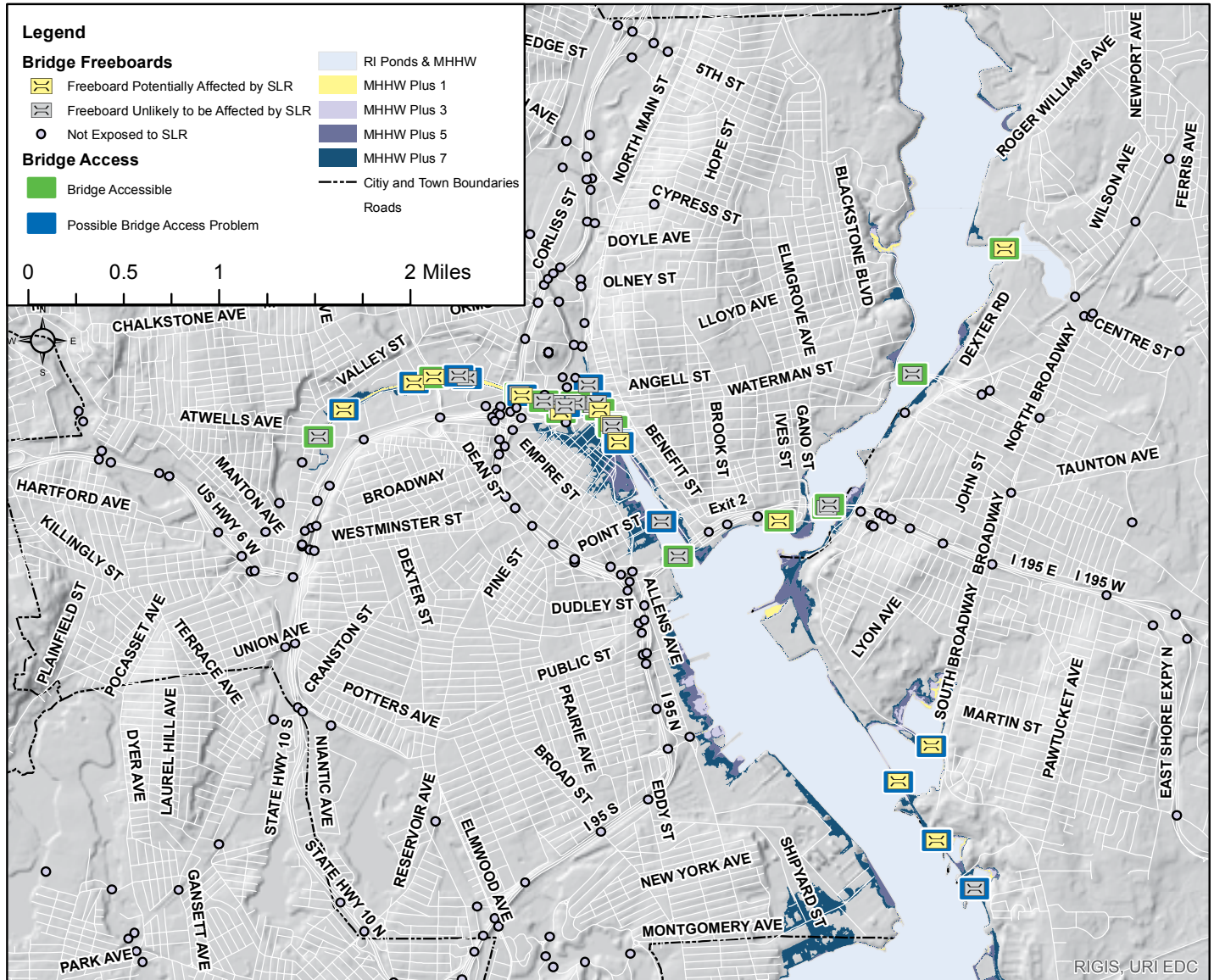


Figure 5

Given seven feet of sea level rise, a total of 90 bridges in Rhode Island cause concern either due to potential freeboard height or accessibility problems. In Providence there are 21 bridges of concern, five of which carry non-motorized facilities. Providence's bridge infrastructure is the most vulnerable in the state of Rhode Island to sea level rise.

Figure 6

Top 10 Providence Bridge Assets Vulnerable to Sea Level Rise											
Mun. Rank	Bridge Name	Facility Carried	Feature Intersected	Inches of Freeboard Relative to 7FtSLR	Terrain Crossed	Landing Access	Intermodal Facility	Evac. Route	AADT	Vuln. Score	State Rank
1	Eagle Street	EAGLE ST	WOONASQUATUCKET R	-8	MHHW	Problem	Yes	No	6,162	8.10	7
2	Park Street	PARK ST	WOONASQUATUCKET R	-25	MHHW	Problem	Yes	No	5,555	8.10	8
3	Crawford Street	SOUTH WATER ST	PROVIDENCE R	-9	MHHW	Problem	Yes	No	6,161	8.10	9
4	Acorn Street	ACORN ST	WOONASQUATUCKET R	-2	MHHW	Problem	Yes	No	1,616	7.50	16
5	Steeple Street East	STEEPLE ST	MOSHASSUCK R	25	MHHW	Problem	Yes	No	10,201	6.90	30
6	Point Street	POINT ST	PROVIDENCE R	37	MHHW	Problem	No	No	23,254	6.40	39
7	Park ROW	PARK ROW	MOSHASSUCK R	23	MHHW	Problem	Yes	No	3,131	6.30	41
8	Atwells Ave	ATWELLS AV	WOONASQUATUCKET R	10	Water	Access	Yes	Yes	11,514	6.20	42
9	Steeple Street West	STEEPLE ST	WOONASQUATUCKET R	70	MHHW	Problem	Yes	No	10,201	6.10	44
10	Washington Street	WASHINGTON ST	PROVIDENCE R	-19	MHHW	Access	Yes	No	6,363	6.10	45

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Providence Roads Exposed to 100-Year Storm Surge Events

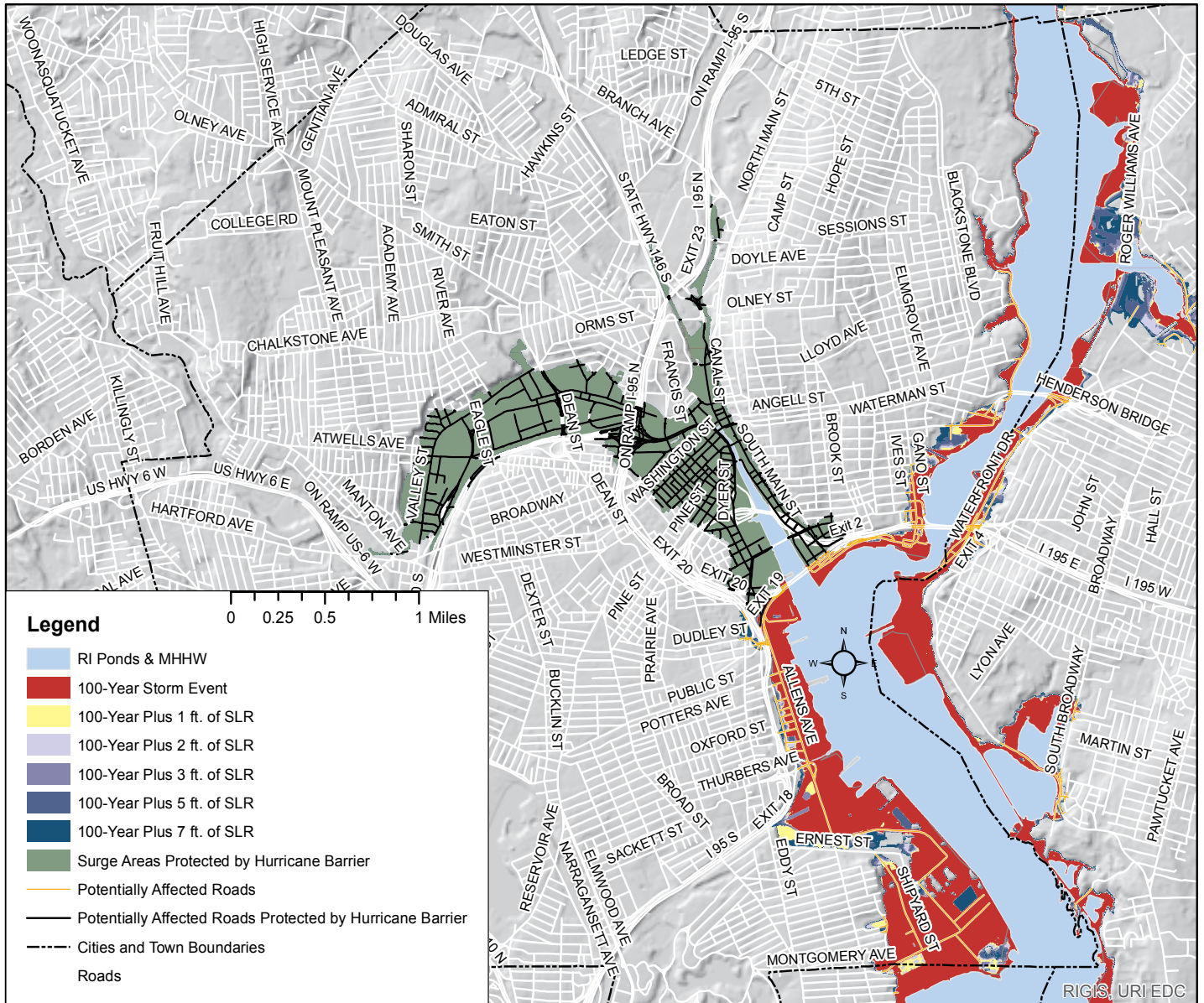


Figure 7

Given seven feet of sea level rise and a 100-year storm surge event, a total of 573 miles of road in Rhode Island will potentially be exposed to inundation, 73% of which will occur on local roads. For Providence, 12 miles of roadway inundation can be expected, 45% (~6 miles) of which are local. Providence's roads are the 15th most vulnerable in the state of Rhode Island to storm surge. Please Note: these totals do not include areas protected from storm surge by the Fox Point Hurricane Barrier.

Figure 8

Top 10 Road Assets in Providence Vulnerable to 100-Year Surge Events												
Mun. Rank	NAME	No SLR	1 Foot of SLR	3 Feet of SLR	5 Feet of SLR	7 Feet of SLR	Total Linear Feet	Evac. Route	Intermodal Facility	Functional Classification	Vuln. Score	State Rank
1	I 195 E	1,134	46	33	37	7	1,257	No	No	Interstate	8.03	28
2	195 EAST ACCESS RD	362	0	0	0	0	362	No	Yes	Principal Art.	7.40	51
3	ALLENS AVE	6,396	48	85	88	88	6,704	No	No	Principal Art.	7.02	78
4	EXIT 3	300	19	48	43	46	456	No	Yes	Interstate	6.89	86
5	EXIT 19	1,521	151	139	39	360	2,210	No	No	Freeways	6.76	96
6	GANO ST	2,204	49	79	79	73	2,484	No	Yes	Minor Art.	6.61	111
7	PUBLIC ST	507	17	35	35	35	628	No	No	Minor Coll.	6.48	125
8	ON RAMP I-195 W	103	13	20	23	24	183	No	No	Interstate	6.47	127
9	ON RAMP I-195 E	457	45	81	134	195	913	No	No	Interstate	6.35	138
10	HENDERSON BRIDGE	424	46	105	104	107	785	No	No	Minor Art.	6.31	145

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Providence Bridges Exposed to 100-Year Storm Surge Events

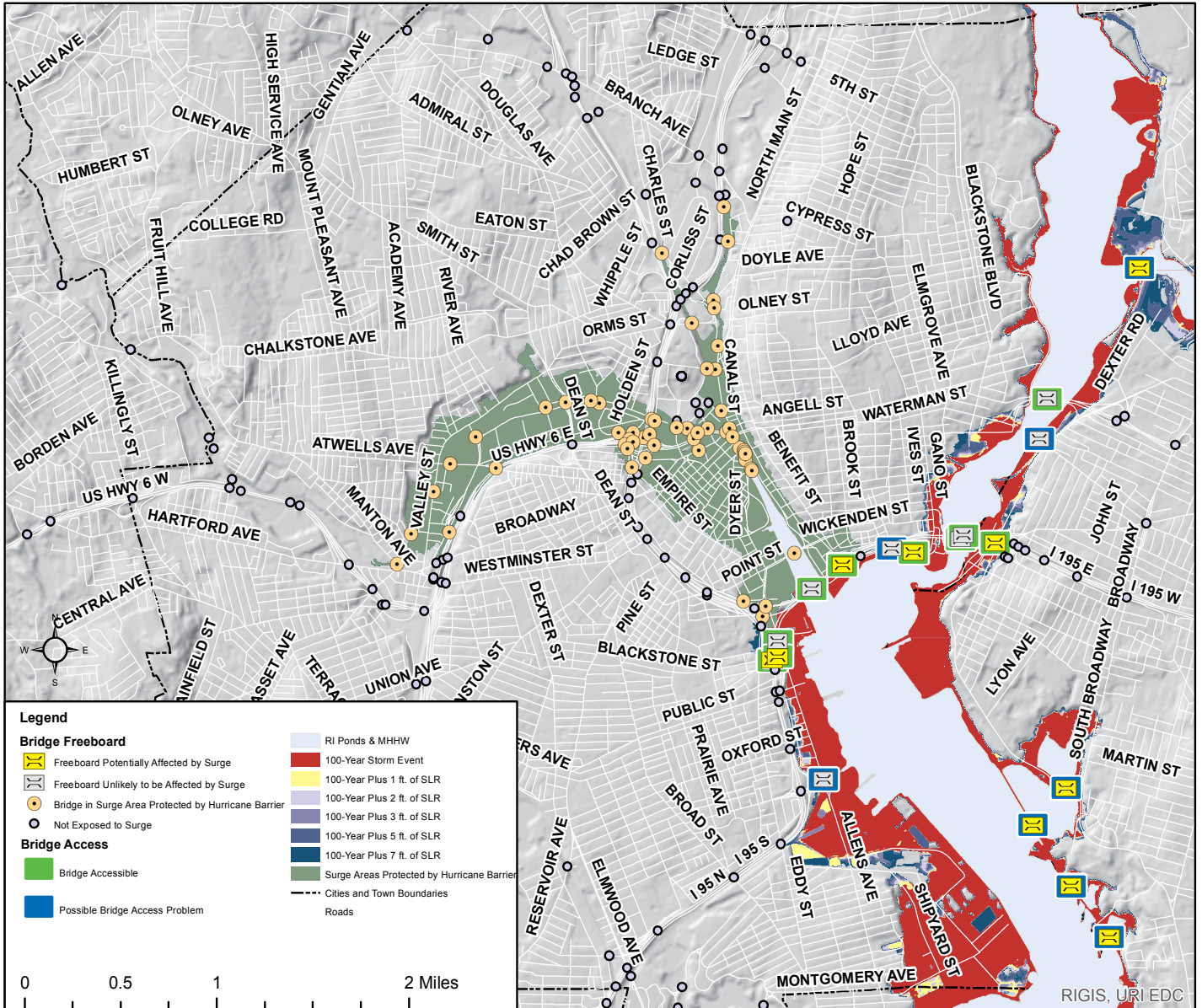


Figure 9

Given seven feet of sea level rise plus a 100-year storm surge event, a total of 148 bridges statewide cause concern either because of potential free-board height or accessibility problems. In Providence there are 19 bridges of concern, one of which is a non-motorized facility. Providence's bridge infrastructure is the third most vulnerable to storm surge in the state of Rhode Island. Please Note: these totals do not include bridges protected from storm surge by the Fox Point Hurricane Barrier.

Figure 10

Top 10 Providence Bridge Assets Vulnerable to Sea Level Rise Plus a 100-Year Storm Surge Event											
Mun. Rank	Bridge Name	Facility Carried	Feature Intersected	Inches of Freeboard Relative to 7FtSLR	Terrain Crossed	Landing Access	Intermodal Facility	Evac. Route	AADT	Vuln. Score	State Rank
1	Francis Street South	FRANCIS ST	WOONASQUATUCKET R	-62	MHHW	Problem	Yes	No	18,585	9.00	14
2	Smith Street	US 44 SMITH ST	MOSHASSUCK R	-84	Water	Problem	Yes	No	12,323	7.30	33
3	Tar Bridge	MANTON AV	WOONASQUATUCKET R	23	Water	Problem	Yes	No	10,255	6.90	46
4	Smith Street RR	US 44 SMITH ST	AMTRAK & P&W RR	144	Water	Problem	Yes	No	12,323	6.10	68
5	Ramp CB-1 Civic Center	RAMP CB	RAMP CC	32	Water	Access	Yes	No	22,100	6.10	69
6	South Main Street Bridge	I-195 EB & WB	SOUTH MAIN STREET	-135	Land	Access	Yes	No	159,294	6.00	80
7	Blackstone Street	I-95 NB & SB	BLACKSTONE ST	-119	Land	Access	Yes	No	167,639	6.00	81
8	Randall Street	RANDALL ST	MOSHASSUCK R	55	Water	Problem	No	No	9,494	5.90	82
9	Ramp BC Civic Center	RAMP BC	WEST EXCHANGE ST	44	Water	Problem	Yes	No	1,100	5.70	86
10	Allens Ave Ramp	I-95 RAMP BR-7	US 1A ALLENS AV	72	Land	Problem	Yes	No	5,800	5.60	94

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Next Steps

Given the potential scale of the impacts of sea level rise and storm surge on local transportation infrastructure, local communities will need to find a way to prepare. A variety of approaches are available, and programs exist to help communities execute these strategies. Finding preparedness strategies will require undertaking further analysis, formulating a clear adaptation strategy, and then taking advantage of planning opportunities that may present themselves.

Further Analysis

The most important step is the pursuit of further analysis. The data contained in this factsheet serves as introduction to municipal level transportation issues associated with sea level rise and storm surge. The data contained here and in Technical Paper #167: Vulnerability of Municipal Transportation Assets to Sea Level Rise and Storm Surge (published by SPP and available at <http://www.planning.ri.gov/geodeminfo/data/slr.php>) should allow local decision makers to prioritize the assets that may require an engineering analysis. Decision makers would also be advised to consult The methodology for STORMTOOLS, a key source of data for this project, which is available on-line at <http://www.beachsamp.org/the-science-behind-stormtools/>.

Figure 11: Consideration of Sea Level Rise can be included in regular planning activities

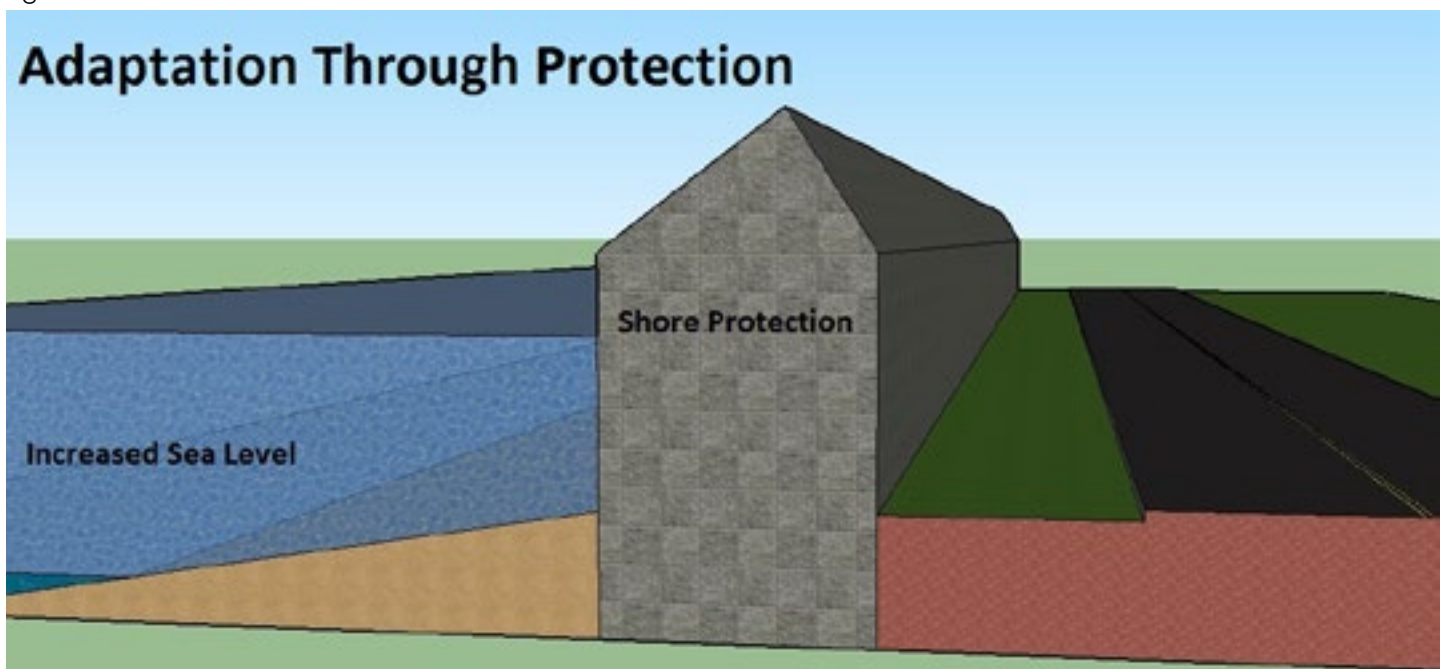


Adaptation

Once the nature of the ongoing changes are understood, a policy should be developed to prepare for the changes holistically. The specific policies to be implemented will vary widely based on the community, the assets under threat, and the resources available. The policies can broadly be described as Protect, Accommodate, Retreat, and Do Nothing.

Protect: Though often popular, this is the most financially expensive option. A municipality can seek to safeguard an asset by building sea walls, or take a slightly more green approach by attempting to artificially recreate the types of dune or wetland structures that naturally stabilize a shoreline. These approaches offer short term security if well designed and implemented, but their effectiveness in the long term may be limited by further changing conditions and the resources required for maintenance.

Figure 12



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Accommodate: Accommodation can imply a number of built solutions that take into account the new conditions. An engineering oriented solution would be to elevate the assets in question above the new waterline, while another option would be to rebuild the asset in a way that suits the new conditions better, for example by rebuilding a road using a new alignment on higher ground.

Retreat: If built solutions are infeasible, a community may decide to simply abandon the asset. Private stakeholders may take over responsibility for the asset, or the need for its maintenance may diminish as users of the asset leave the area. Though undoubtedly the most efficient solution from a fiscal perspective, there are complex legal issues involved that remain unresolved.

Do Nothing: Communities may choose to take no action in response to rising sea levels. In effect this would consist of maintaining the status quo infrastructure, regardless of risk and the increasingly common inundations. In practice this approach may closely resemble retreat, as assets are incapacitated with increasing regularity until all those served by the assets move away. The financial strain of repeated maintenance could have significant fiscal effects on communities.

Planning Opportunities

Once the subject of sea level rise and storm surge have been adequately researched, and an overall municipal adaptation strategy has been decided upon, decision makers should attempt to take advantage of planning opportunities that may allow the city or town to begin implementation of their planning goals. A key first step to this process will be building awareness amongst staff and constituents, either by direct outreach or simply through informal discussions.

As awareness grows, the community would be well served simply by keeping their readiness policy goals in mind when conducting their regular planning activities, such as comprehensive planning, or zoning compliance review. More concrete policies like overlay zones and rolling easements may become important tools for communities seeking a way to realize their policy goals.

Communities that are critically threatened by sea level rise and storm surge may seek to directly invest in readiness measures using municipal funds. Additional funding may be available to aid in this process from state and federal sources. Placing eligible projects for consideration in the State Transportation Improvement Plan, or other sources of Federal and State funding, is a good way to leverage local funding.



Figure 13

Figure 14

