CALTRANS
Adaptation Priorities
REPORT

DISTRICT 4

December
2020

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1. INTRODUCTION

California's climate is changing. Temperatures are warming, sea levels are rising, wet years are becoming wetter, dry years are becoming drier, and wildfires are becoming more intense. Most scientists attribute these changes to the unprecedented amounts of greenhouse gases in the atmosphere. Given that global emissions of these gases continue at record rates, further changes in California's climate are, unfortunately, very likely.

The hazards brought on by climate change pose a serious threat to California's transportation infrastructure. Higher than anticipated sea levels can regularly inundate roadways, extreme floods can severely damage bridges and culverts, rapidly moving wildfires present profound challenges to timely evacuations, and higher than anticipated temperatures can cause expensive pavement damage over a broad area. As Caltrans' assets such as bridges and culverts age, they will be forced to weather increasingly severe conditions that they were not designed to handle, adding to agency expenses and putting the safety and economic vitality of California communities at risk.

Recognizing this, Caltrans has initiated a major agency-wide effort to adapt their infrastructure so that it can withstand future conditions. The effort began by determining which assets are most likely to be adversely impacted by climate change in each Caltrans district. That assessment, described in the Caltrans Climate Change Vulnerability Assessment Report for District 4, identified stretches of the State Highway System within the district that are potentially at risk. This Adaptation Priorities Report picks up where the vulnerability assessment left off and considers the implications of those impacts on Caltrans and the traveling public, so that facilities with the greatest potential risk receive the highest priority for adaptation. District 4 anticipates that planning for, and adapting to, climate change will continue to evolve subsequent to this report's release as more data and experience is gained.

Other current Caltrans efforts to respond to climate change impacts include the Marin and Sonoma County Highway 1 Storm Damage Repair Guidelines,[1] which will address landslide problems caused by winter storms by creating retaining walls, drainage improvements, 12-foot wide lanes and 4-foot wide shoulders. Caltrans District 4 is also addressing storm damaged roadways in San Mateo County. In addition, the Bay Conservation and Development Commission (BCDC) is working in collaboration with Caltrans District 4, Metropolitan Transportation Commission, and the Bay Area Regional Collaborative (BARC), is conducting a project funded through a Caltrans grant to complete a vulnerability assessment for the Bay Area. This vulnerability assessment will include transportation assets, vulnerable and disadvantaged communities, Priority Development Areas, and Priority Conservation Areas. The grant also provides funding to develop initial adaptation strategies for these assets. BCDC has a history of addressing SLR across the Bay Area and continues to be an important partner for District 4 as concerns specific to the State Highway Network are defined and addressed.

1.1. Purpose of Report

The purpose of this report is to prioritize the order in which assets found to be exposed to climate hazards will undergo detailed asset-level climate assessments. Since there are many potentially

[1] California Department of Transportation, District 04, Marin State Route 1 Repair Guidelines Final, July 2015. California Department of Transportation, District 04, Sonoma State Route 1 Repair Guidelines Final, March 2019.

exposed assets in the district, detailed assessments will need to be done sequentially according to their priority level. The prioritization considers, amongst other things, the timing of the climate impacts, their severity and extensiveness, the condition of each asset (a measure of the sensitivity of the asset to damage), the number of system users affected, and the level of network redundancy in the area. Prioritization scores are generated for each potentially exposed asset based on these factors and used to rank them. Though it is likely that climate change will cause a wide array of hazards that will impact many physical asset categories, this report is focused on bridges, large culverts, small culverts, and roadways.

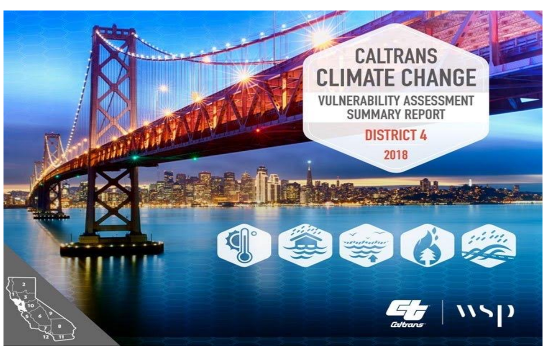
1.2. Report Organization

The main feature of this report is the prioritized list of potentially exposed assets within District 4. Per above, this information will inform the timing of the detailed adaptation assessments of each asset, which is the next phase of Caltrans' adaptation work. The final prioritized list of assets for District 4 can be found in Chapter 4 of this document. The interim chapters provide important background information on the prioritization process. For example, those interested in learning more about Caltrans' overall adaptation efforts, and how the prioritization fits into that, should refer to Chapter 2. Likewise, those who are interested in learning more about how the prioritization was determined should refer to Chapter 3.

2. CALTRANS' CLIMATE ADAPTATION FRAMEWORK

Enhancing Caltrans' capability to consider adaptation in all its activities requires an agency-wide perspective and a multi-step process to make Caltrans more resilient to future climate changes. The process for doing so will take place over many years and will, undoubtedly, evolve over time as everyone learns more about climate hazards, better data is collected, and experience shows which techniques are most effective. Researchers have just started examining what steps an overarching adaptation framework for a department of transportation should entail. Figure 1 provides a graphical illustration of one such path called the Framework for Enhancing Agency Resiliency to Natural and Anthropogenic Hazards and Threats (FEAR-NAHT).[2] This framework, developed through the National Cooperative Highway Research program (NCHRP), has been adopted by Caltrans as part of its long-term plan for incorporating adaptation into its activities (hereafter referred to as the Caltrans Climate Adaptation Framework or "Framework"). In coastal districts, such as District 4, this work aligns with Step 3 in the flowchart and advice for addressing Local Coastal Programs and other plans under the California Coastal Commission's Sea Level Rise Policy Guidance.[3]

Steps 1 through 4 of the Framework represent activities that are currently underway at Caltrans Headquarters to effectively manage its new climate adaptation program and develop policies that will help jumpstart adaptation actions throughout the organization. Step 1, *Assess Current Practice*, and Step 4, *Implement Early Wins*, are both addressed within a document called the Caltrans Climate Adaptation Strategy Report. The Adaptation Strategy Report undertook a comprehensive review of all climate adaptation policies and activities currently in place or underway at Caltrans. The report also includes numerous no-regrets adaptation actions ("early wins") that can be taken in the near-term to enhance agency resiliency. Several of these strategies also touch on elements of Step 2, *Organize for Success*, and Step 3, *Develop an External Communications Strategy and Plan*. In addition to this, a comprehensive adaptation communications strategy and plan for climate change is being developed as part of a Caltrans pilot project with the Federal Highway Administration.



COVER OF THE CALTRANS CLIMATE CHANGE VULNERABILITY ASSESSMENT SUMMARY REPORT FOR DISTRICT 4

Step 5, *Understand the Hazards and Threats*, is the first step where detailed technical analyses are performed, and in this case, identify assets potentially exposed to various climate stressors. This step has been completed for a subset of the assets and hazards in District and the results are presented in the Caltrans Climate Change Vulnerability Assessment Report for District. The exposure information generated in the Vulnerability Assessment Report is used as an input to this study.

[2] This framework and related guidance for state DOTs is being developed as part of NCHRP 20-117, Mainstreaming System Resilience Concepts into Transportation Agencies: A Guidebook (expected completion in 2020).
[3] California Coastal Commission, Sea Level Rise Policy Guidance, Adopted August 2015, Updated November 2018.

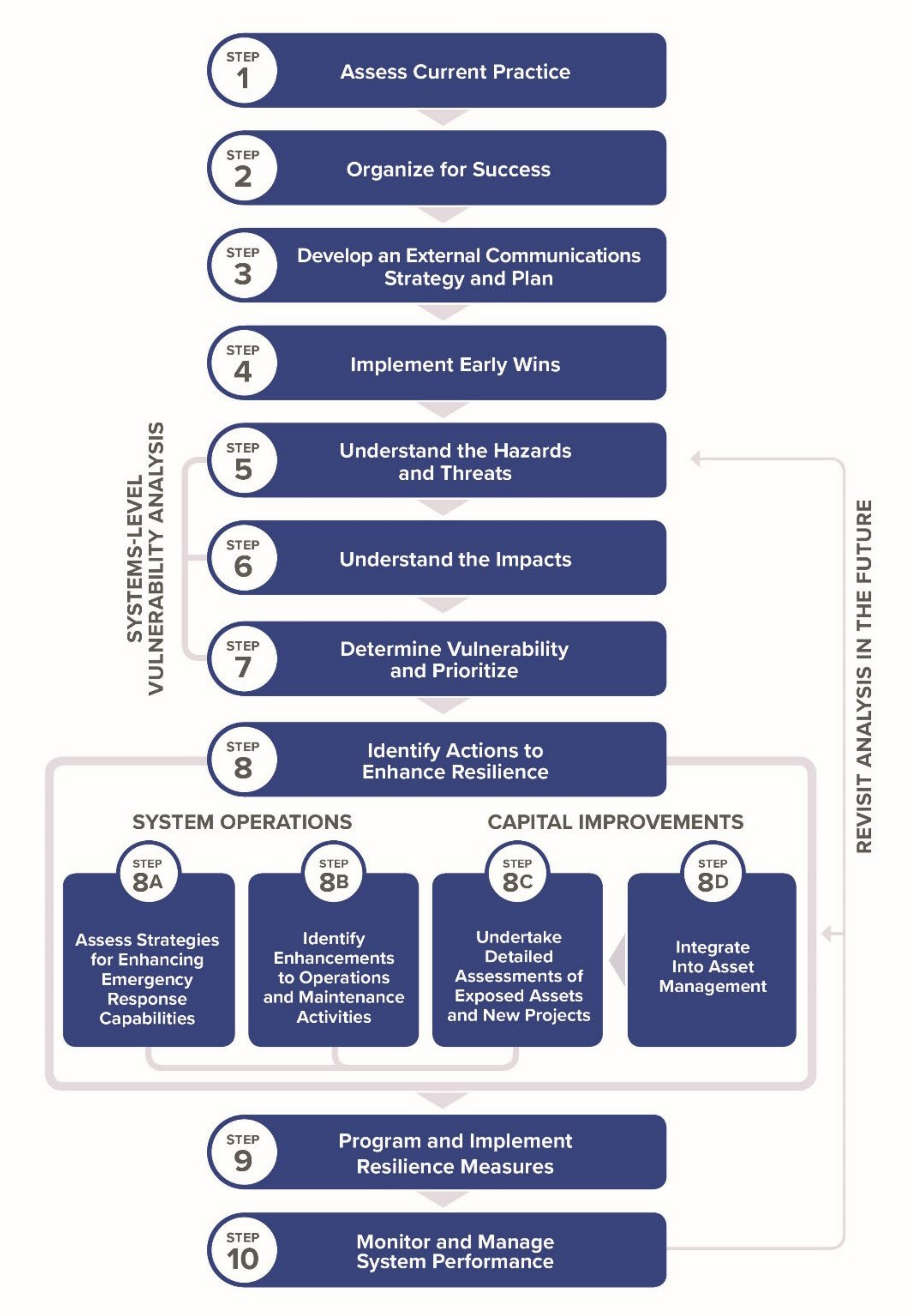


FIGURE 1: CALTRANS' CLIMATE ADAPTATION FRAMEWORK

The work undertaken for this study, the District 4 Adaptation Priorities Report, covers both Steps 6 and 7 in the Framework. Step 6, *Understand the Impacts*, is focused on the implications of the exposure identified in Step 5. This includes understanding the sensitivity of the asset to damage from the climate stressor(s) it is potentially exposed to and understanding the criticality of the asset to the functioning of the transportation network and the communities it serves. Developing an understanding of these considerations is part of the prioritization methodology described in the next chapter.

Step 7, *Determine Vulnerability and Prioritize*, focuses on creating and implementing a prioritization approach that considers both the nature of the exposure identified in Step 5 (its severity, extensiveness, and timing) and the consequence information developed in Step 6. The goal of the prioritization is to identify which assets should undergo detailed adaptation assessments first, because resource constraints will prevent all assets from undergoing detailed study simultaneously.

After Step 7, the Framework divides into two parallel tracks, one focused on operational measures to enhance resiliency and the consideration of adaptation (Steps 8A and 8B) and the other on identifying adaptation-enhancing capital improvement projects (Steps 8C and 8D). Collectively, these represent the next steps that should be undertaken using the information from this report. On the operations track, the results of this assessment should be reviewed for opportunities to enhance emergency response (Step 8A) and operations and maintenance (Step 8B). Caltrans' next step on the capital improvement track should be to undertake detailed assessments of the exposed facilities (Step 8C). The prioritization information generated as part of this assessment should also be integrated into the state's asset management system (Step 8D). All projects recommended through the asset management process should also undergo detailed adaptation assessments (hence the arrow from Step 8D to 8C).

Thus, there will be two parallel pathways for existing assets to get to detailed facility level adaptation assessments. The first is through this prioritization analysis, which is driven primarily by the exposure to climate hazards with asset condition as a secondary consideration. The second is through the existing asset management process, which is driven primarily by asset condition and will have vulnerability to climate hazards as a secondary consideration.

The detailed adaptation assessments in Step 8C will involve engineering-based analyses to verify asset exposure to pertinent climate hazards (some exposed assets featured in this report will not be exposed after closer inspection). Then, if exposure is verified, Step 8C includes the development and evaluation of adaptive measures to mitigate the risk. The highest priority assets from this study will be evaluated first and lower priority assets will be evaluated later. Once specific adaptation measures have been identified, be they operational measures or capital improvements, these projects can then be programmed (Step 9). Step 10 then focuses on continuous monitoring of system performance to track progress towards enhancing resiliency. Note the feedback loops from Step 10 to Steps 5 and 8. The arrow back to Step 5 indicates that the exposure analysis should be revisited in the future as new climate projections are developed. The arrow back to Step 8 indicates how one can learn from the performance indicators and use this data to modify the actions being undertaken to enhance resilience

3. PRIORITIZATION METHODOLOGY

3.1. General Description of the Methodology

The methodology used to prioritize assets exposed to climate hazards draws upon both technical analyses and the on-the-ground knowledge of all district staff. The technical analysis component was undertaken first to provide an initial indication of adaptation priorities. These initial priorities were then reviewed with district staff at a workshop and, if necessary, adjusted to reflect local knowledge and recommendations. These adjustments are embedded in the final priorities shown in Chapter 4.

With respect to the technical analysis, there are a few different approaches for prioritizing assets based on their vulnerability to climate hazards. The approach selected for this study is known as the *indicators approach*. The indicators approach involves collecting data on a variety of variables that are determined to be important factors for prioritization. These are then put on a common scale, weighted, and used to create a score for each asset. The scores collectively account for all the variables of interest and can be ranked to determine priorities.

It is important to note that, since the prioritization process is focused on determining the order in which detailed adaptation assessments are conducted, only assets determined to be potentially exposed to a climate hazard are included in this analysis. Assets that were determined to have no exposure to the hazards studied are not included in this study.

The remainder of this chapter describes the prioritization methodology in detail. Section 3.2 begins by describing the asset types and hazards studied. Next, Section 3.3 discusses the individual prioritization metrics (factors) that were used in the technical analysis. Following this, Section 3.4 describes how those individual factors were brought together into an initial prioritization score for each asset. Lastly, Section 3.5 describes how the initial prioritization was adjusted with input from district staff.

3.2. Asset Types and Hazards Studied

Caltrans is responsible for maintaining dozens of different asset types (bridges, culverts, roadway pavement, buildings, etc.). Each of these asset types is uniquely vulnerable to a different set of climate stressors. Resource constraints only allowed this study to investigate a subset of the asset types owned by Caltrans in District 4 and, for those, only a subset of the climate stressors that could impact them. Additional exposure and prioritization analyses are needed in the future to gain a fuller understanding of Caltrans' adaptation needs.[4]

EROSION CAUSING ROADWAY HAZARD

[4] Photo from California Department of Transportation, 2014. All rights reserved.

The subset of asset types and hazards included in this study generally mirror those that were included in the District 4 Climate Change Vulnerability Assessment Report. That said, exposure to two additional hazards was included as part of this study: (1) riverine flooding impacts to bridges and culverts and (2) temperature impacts to pavement binder grade. Table 1 shows all the asset types included in this study for District 4 and marks with an "X" the hazards that were evaluated for each in the exposure analysis.

TABLE 1: ASSET-HAZARD COMBINATIONS STUDIED

	Temperature	Riverine Flooding	Wildfire	Sea Level Rise	Storm Surge	Coastal Cliff Retreat
Pavement Binder Grade	X					
At-Grade Roadways				X	X	X
Bridges		X		X	X	X
Large Culverts[5]		X		X	X	X
Small Culverts[6]		X	X	X	X	X

The various asset-hazard combinations include:

- **Pavement binder grade exposure to temperature changes:** Binder can be thought of as the glue that holds the various aggregate materials in asphalt together. Binder is sensitive to temperature. If temperatures become too hot, the binder can become pliable and deform under the weight of traffic. On the other hand, if temperatures are too cold, the binder can shrink causing cracking of the pavement. There are various types (grades) of binder, each suited to a different temperature regime. This study considered how climate change will influence high and low temperatures and how this, in turn, could affect pavement binder grade performance.

  Assumptions were made that (1) all roadways are currently (or could be in the future) asphalt and (2) the binder grade currently in place on each segment[7] of roadway matches the specifications in the Caltrans Highway Design Manual. From here, the allowable temperature ranges of each binder grade were compared to projected temperatures in 2040, 2070, and 2100. If the temperature parameters exceeded the design tolerance of the assumed binder grade, that segment of roadway was deemed potentially exposed.[8]

DISTRICT 4 ROAD CLOSURE

[5] Culverts 20 feet or greater in width.
[6] Culverts less than 20 feet in width.
[7] Roadway are segmented at intersections with other roads.
[8] Photo from California Department of Transportation, 2014. All rights reserved.

- **Bridge exposure to riverine flooding:** Bridges are sensitive to higher flood levels and river flows. With climate change, precipitation is generally expected to become more intense in District 4 leading to increased flooding in rivers and streams. These higher flows could exceed the design tolerances of bridges. In addition, wildfires are also expected to become more prevalent in District 4 as climate changes. After a wildfire burns, the ground can become hard and less capable of absorbing water. As a result, flood flows can increase substantially in the aftermath of a fire, which could further exacerbate the risks to bridges. To better understand the threat posed to bridges in District 4, a flood exposure index was developed and calculated for each bridge that crosses a river or stream. The index considered both the changes in precipitation and wildfire likelihood in the area draining to the bridge in the early, mid, and late century timeframes. The index also considers the capacity of the bridge to handle higher flows using waterway adequacy information from the National Bridge Inventory (NBI). A higher score on the index indicates bridges at relatively greater risk due to a combination of higher projected flows and lower capacity.

- **Large culvert exposure to riverine flooding:** A distinction is made in the analysis between large and small culverts due to different data being available for each. Large culverts are included in the NBI and are generally 20 feet or greater in width. Small culverts are generally shorter than 20 feet in width and covered through a different inventory/inspection program. Large culverts, like bridges, are sensitive to increased flood flows. Thus, a flood exposure index was calculated for each large culvert in the same manner as was done for bridges.

- **Small culvert exposure to riverine flooding:** Small culverts (those less than 20 feet in width) are, like bridges and large culverts, also sensitive to higher flood flows. Hence, a flood exposure index like the one for bridges and large culverts was calculated for this asset type. The one difference is that the capacity component of the index for small culverts used the actual dimensions of the culvert, information that was not available for bridges and large culverts. Although the actual dimensions of small culverts were available, due to resource and data constraints, no hydraulic analyses were performed to determine overtopping potential. Instead, the size was simply used as a factor in the riverine flood exposure index.

- **Small culvert exposure to wildfire:** Culverts can be sensitive to the direct impacts of fire. Certain culvert materials (e.g. wood and plastic) can easily burn or be deformed during a fire. Thus, an assessment was made to determine the likelihood of a wildfire directly impacting each small culvert in the early, mid, and late century timeframes. This analysis was only conducted for small culverts because information on culvert construction materials was not available for large culverts.

- **At-grade roadway exposure to sea level rise:** Sea level rise, caused by the warming of ocean waters and the melting of land-based glaciers, is a prominent hazard brought on by climate change. In low-lying coastal areas, at-grade roads (defined here as those portions of the road network that are not elevated on a bridge) may become subject to regular inundation at high tides as sea levels rise. This can lead to frequent road closures that disrupt travel and accessibility. In some locations with regular inundation, premature degradation of the pavement may also occur.

- **Bridge exposure to sea level rise:** There are several ways in which sea level rise may adversely affect bridges. For very low bridges, a rise in sea levels may result in water overtopping the deck and impeding travel. It is important to recognize, however, that serious impacts to bridges can still occur from sea level rise even if water does not overtop the deck. For example, on some bridge designs, if sea levels rise just enough to result in waves contacting the bottom of the deck, the uplifting forces may be enough to separate the deck from the rest of the structure. Even bridges whose decks are well above projected water levels may be impacted by sea level rise. For example, waves may contact piers at a higher elevation than they were designed for leading to more rapid corrosion of bridge components and unexpected strain being put on the bridge structure. The bridge abutments may also be adversely impacted by waves regularly hitting higher than initially designed and eroding the approach embankments. Furthermore, the navigability of shipping channels may become impeded as sea level rise diminishes clearance levels for ships.

- **Large and small culvert exposure to sea level rise:** Culverts are primarily used to convey streams and stormwater underneath roadways, and some are also used in tidally influenced environments. If sea levels rise enough for sea water to reach the culvert, this can change the hydraulic performance of the culvert leading to more frequent overtopping of the roadway. For culverts that were not designed for a tidal setting, the frequent unanticipated presence of saltwater can also lead to corrosion and other maintenance issues that may decrease the anticipated lifespan of the asset.

- **At-grade roadway exposure to storm surge:** Storm surge refers to the elevating of coastal waters during major storm events. When strong winds blow onshore during such events, this can cause the water to pile up and reach levels much greater than during the normal tidal cycle. Sea level rise can cause the water to reach even higher during major storm events and increase the frequency and severity of inundation. Inundation of at-grade roadways from storm surge may require the road to be closed, disrupting travel. Also, the surge and associated wave action often associated with storm events can cause erosion of the roadway embankment.

SUNNY DAY FLOODING FROM HIGH TIDES

- **Bridge exposure to storm surge:** Storm surge presents many threats to bridges that may not have been fully anticipated if sea level rise was not considered during design. Some low bridges may be overtopped by the surge and others may be affected by uplifting forces from wave action hitting the bottom of the deck. Either situation is likely to lead to the closure of the bridge and introduce the potential for serious structural damage. Even if the water is not high enough to reach the bridge deck, the elevated water levels and associated wave action can cause erosion or flooding around bridge approaches. Furthermore, if the surge approaches or recedes at a high enough velocity, scouring of soils can occur around bridge piers and abutments weakening the structure and potentially compromising the bridge's integrity. This is a particularly acute threat for surge-impacted bridges built over roadways or railroads (as opposed to over water) because scour may not have been considered during their initial designs.

- **Large and small culvert exposure to storm surge:** Storm surge can overtop culverts and flood roadways, impeding travel. If the velocity of the surge is great enough, the hydraulic forcing of excessive water through too small an opening can also damage the culvert. Water overtopping the roadway embankment on top of the culvert may also cause erosion resulting in damages to the roadway and the culvert itself.

- **At-grade roadway exposure to coastal cliff retreat:** Cliff retreat refers to the erosion of coastal cliff faces. This process can be accelerated by sea level rise since higher water levels cause more frequent instances of wave action reaching the base of the cliff and causing erosion. At-grade roadways that are immediately along the coast can be totally lost if erosion encroaches upon them. Caltrans has had to relocate several roads already, often at significant expense, to avoid retreating coastal cliff faces.

- **Bridge exposure to coastal cliff retreat:** Any bridges in the vicinity of coastal cliff faces are at risk of a total loss should the cliff retreat towards the bridge abutment. Should the abutment of the bridge be compromised by erosion, the structural stability of the bridge will be lost and the bridge no longer usable.

- **Large and small culvert exposure to coastal cliff retreat:** As with bridges and at-grade roadways, any culverts along a segment of road exposed to coastal cliff retreat are at risk of being lost or damaged. The erosion might compromise their stability causing them and the roadway above them to tumble into the sea.

3.3. Prioritization Metrics

Metrics are the individual variables used to calculate a prioritization score for each asset. These can be thought of as the individual factors that, collectively, help determine the asset's priority for adaptation. Each of the asset-hazard combinations described in the previous section has its own unique set of factors that are used in the prioritization. The metrics were selected based on their relevancy to each asset-hazard combination and the data availability. For example, the condition rating of a culvert is a very relevant metric for prioritizing culverts exposed to riverine flooding, however, it is not at all relevant to prioritizing bridges exposed to the same hazard. Table 2 provides an overview of all the metrics included in this study and denotes with an "X" their application to the various asset-hazard combinations studied.

TABLE 2: METRICS INCLUDED FOR EACH ASSET-HAZARD COMBINATION STUDIED

	Sea Level Rise				Storm Surge				Coastal Cliff Retreat				Wildfire	Tempera-ture	Riverine Flooding		
Metrics	**At-Grade Roadways**	**Bridges**	**Large Culverts**	**Small Culverts**	**At-Grade Roadways**	**Bridges**	**Large Culverts**	**Small Culverts**	**At-Grade Roadways**	**Bridges**	**Large Culverts**	**Small Culverts**	**Small Culverts**	**Pavement Binder Grade**	**Bridges**	**Large Culverts**	**Small Culverts**
Exposure																	
Past natural hazard impacts	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
Lowest impactful sea level rise (SLR) increment	X	X	X	X													
Percent of road segment exposed to 6.6 ft. of SLR	X																
Lowest impactful SLR increment with 100-year storm surge					X	X	X	X									
Percent of road segment exposed to a 100-year storm with 6.6 ft. of SLR (4.6 ft. in the Delta)					X												
Lowest SLR increment that results in damage from coastal cliff retreat									X	X	X	X					
Percent of road segment exposed to coastal cliff retreat at 6.6 ft. of SLR									X								
Initial timeframe for elevated level of concern for wildfire													X				
Highest projected wildfire level of concern													X				
Initial timeframe when asphalt binder grade needs to change														X			
Maximum riverine flooding exposure score for the 2010-2039 timeframe															X	X	X
Maximum riverine flooding exposure score															X	X	X
Consequences																	
Bridge substructure condition rating						X									X		
Channel and channel protection condition rating															X	X	
Culvert condition rating							X	X								X	X
Culvert material				X									X				
Scour rating						X									X		
Average annual daily traffic (AADT)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Average annual daily truck traffic (AADTT)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Incremental travel distance to detour around the asset													X		X	X	X
Incremental travel distance to detour around the asset for the lowest impactful SLR increment	X	X	X	X	X	X	X	X	X	X	X	X					
Incremental travel distance to detour around the asset with 6.6 ft. of SLR (4.6 ft. for storm surge in the Delta)	X	X	X	X	X	X	X	X	X	X	X	X					

The metrics included in this study fall into two categories: exposure metrics and consequence metrics. Exposure metrics capture the extensiveness, severity, and timing of a hazard's projected impact on an asset. Assets that have more extensive, more severe, and sooner exposure are given a higher priority. Consequence metrics provide an indication of how sensitive an exposed asset is to damage using information on the asset's condition. Consequence metrics also indicate how sensitive the overall transportation network may be to the loss of that asset should it be taken out of service by a hazard. The poorer the initial conditions of the potentially exposed asset and the more critical it is to the functioning of the transportation network, the higher the priority given. The specific metrics that are included within each of these categories are described in the sections that follow. The sea level rise metrics and projections used generally align with the California Coastal Commission's guidance on sea level rise scenarios for facility level assessments.[9]

3.3.1. Exposure Metrics

The following metrics were used to assess asset exposure in District 4:

- **Past natural hazard impacts:** Assets that have experienced past damages, such as flood, cliff retreat, or fire-related impacts, are likely to experience more issues in the future as climate changes and these assets should be prioritized. To obtain information on past impacts, District 4 maintenance staff were surveyed and asked to identify any at-grade roadways, bridges, large culverts, or small culverts that had experienced sea level rise, storm surge, or coastal cliff retreat issues in the past. Staff were also asked to document past riverine flooding impacts for all these asset types except at-grade roadways. Care was taken to ensure that these impacts occurred on assets that had not been replaced with a more resilient design after the event occurred. In addition, staff was also asked if any small culverts were damaged directly by fire and replaced with culverts of the same material. Any asset that was identified as previously impacted by tidal or riverine flooding, cliff retreat, or wildfire was flagged and that asset was given a higher priority for adaptation.

- **Lowest impactful sea level rise increment:** Assets that are likely to be impacted by sea level rise sooner should receive higher priority for detailed facility level assessments. To consider this in the asset scoring, a metric was developed that captured the lowest (first) increment of sea level rise[10] to potentially impact each at-grade roadway, bridge[11], large culvert, and small culvert. This metric made use of the sea level rise data used on the District 4 Climate Change Vulnerability Assessment Report. On the Pacific coast and in San Francisco Bay, this data was sourced from the United States Geological Survey's (USGS) Coastal Storm Modeling System (CoSMoS) dataset for an annual flooding event and utilized sea level rise increments of 0.0, 0.8, 1.6, 2.5, 3.3, 4.1, 4.9, 5.7, and 6.6 feet. This dataset was not available for the Delta portion of District 4. In this area (east of Pittsburg), Climate Central sea level rise data was used instead. The sea level rise increments used for the Climate Central data mirrored those that were used

[9] California Coastal Commission, Sea Level Rise Policy Guidance, Adopted August 2015, Updated November 2018.

[10] Sea level rise areas hydrologically connected to the sea and hydrologically disconnected low-lying areas potentially vulnerable to sea level rise inundation were both used for this assessment.

[11] The lowest impactful sea level rise scenario for bridges was determined by whichever increment of sea level rise first causes inundation under the bridge. For bridges already over coastal waters, potential impacts were assumed to occur at the lowest available increment of sea level rise. No analyses were performed to compare the elevations of the bottoms of the bridge decks to the underlying water elevations. The analysis was set up this way in recognition of the impacts possible at bridges from sea level rise before water touches the deck (i.e., enhanced corrosion and structural stability, erosion, and navigability concerns).

for the CoSMoS data. Whichever the data source, the lower the sea level rise increment that first impacts the asset, the higher priority it received.

- **Percent of road segment exposed to 6.6 ft. of sea level rise:** For at-grade roadway segments[12], not only is the timing of sea level rise impacts an important factor, but also the extensiveness of the impacts. All else being equal, a segment of road that is impacted over a large proportion of its length should receive higher priority than one impacted over only a small area. The 6.6 feet sea level rise increment from the data sources mentioned above was used for this metric in order to provide an indicator of more severe, potential impacts at the end of the century under a pessimistic greenhouse gas emissions scenario.[13]

ROADWAY EXPOSURE TO TIDAL FLOODING, SURGE, AND EROSION

- **Lowest impactful sea level rise increment with 100-year storm surge:** As with sea level rise, assets that are likely to be impacted by storm surge sooner should receive higher priority for detailed facility level assessments. To factor this into the analysis, this metric captures the lowest (first) sea level rise increment at which the 100-year storm surge[14] could potentially impact each at-grade roadway, bridge[15], large culvert, and small culvert. USGS CoSMoS storm surge data at increments of 0.0, 0.8, 1.6, 2.5, 3.3, 4.1, 4.9, 5.7, and 6.6 feet was used for the analysis on the coast and within San Francisco Bay. Within the Delta (east of Pittsburg), CoSMoS storm surge data was not available. To assess assets in this area, projections from the CalFloD-3D model were used instead.[16] The CalFloD-3D model was run for a more limited set of future sea level rise increments than the CoSMoS model (0.0, 1.6, 3.3, and 4.6 feet). As a result, assets in the Delta were assessed only against these more limited sea level rise increments.

- **Percent of road segment exposed to a 100-year storm surge with 6.6 feet of sea level rise (4.6 feet in the Delta):** This metric measures the proportion of each at-grade roadway segment exposed to a 100-year storm surge. As with the sea level rise length metric, 6.6 feet of sea level

[12] At-grade roadways are segmented at intersections with other roads thereby matching the segmentation used for the pavement binder grade analysis.

[13] Photo from the California Department of Transportation, 2016. All right reserved.

[14] Storm surge areas hydrologically connected to the sea and hydrologically disconnected low-lying areas potentially vulnerable to storm surge inundation were both used for this assessment.

[15] As with sea level rise, the lowest impactful sea level rise scenario for bridges was determined by whichever increment of sea level rise first causes storm surge inundation under the bridge. For bridges already over coastal waters, potential impacts were assumed to occur at the lowest available increment of sea level rise. No analyses were performed to compare the elevations of the bottoms of the bridge decks to the underlying water elevations. The analysis was set up this way in recognition of the impacts possible at bridges from storm surge before water touches the deck (i.e., structural stability, erosion, and scour concerns).

[16] Climate Central, the source of sea level rise projections in the Delta, had not conducted any storm surge modeling in the Delta either.

rise was used in order to provide an indicator of potential impacts at the end of the century under a somewhat pessimistic greenhouse gas emissions scenario. Since the 6.6 feet increment was unavailable in the Delta for storm surge, the maximum increment available there, 4.6 feet, was used instead. All else being equal, the greater the proportion of roadway length exposed to storm surge, the higher the priority of that segment.

- **Lowest sea level rise increment that results in damage from coastal cliff retreat:** At-grade roadways, bridges, large culverts, and small culverts that are exposed to coastal cliff retreat sooner should receive higher priority for facility level adaptation assessments. Thus, this metric was included to capture the timing of impacts. The greatest threat from coastal cliff retreat is along the open Pacific coastline where the erosive effects of waves are highest, so the analysis focused on these areas. As with sea level rise and storm surge, USGS CoSMoS data was utilized where available. CoSMoS data on coastal cliff retreat was only available south of the Golden Gate for sea level rise increments of 0.0, 0.8, 1.6, 2.5, 3.3, 4.1, 4.9, 5.7, and 6.6 feet. North of the Golden Gate, this study relied upon a coastal cliff retreat assessment of Caltrans assets in northern California performed by Dr. Nicholas Sitar of the University of California, Berkeley. This study was conducted as part of the development of the District 1 Climate Change Vulnerability Assessment Report. Dr. Sitar's study did not directly link different sea level rise increments to roadway exposure. Instead, it provided a qualitative exposure rating (either low, moderate, or critical) of Caltrans roadways near the coast. In order to utilize this data on this study and provide a means of prioritizing assets to this hazard throughout the district, some assumptions were made to relate the qualitative categories used by Dr. Sitar with the sea level rise increments available from CoSMoS. All else being equal, assets assigned a critical exposure designation in Dr. Sitar's work were given the same prioritization as assets exposed to the 0.8-foot sea level rise increment in CoSMoS. Assets with a moderate exposure rating were prioritized the same as those exposed to 3.3 feet of sea level rise. Lastly, assets with a low exposure rating were prioritized the same as those exposed to 6.6 feet of sea level rise.

- **Percent of road segment exposed to coastal cliff retreat at 6.6 ft. of sea level rise:** This metric captures the proportion of each at-grade roadway segment that is exposed to coastal cliff retreat. As with sea level rise and storm surge, 6.6 feet of sea level rise was used in order to provide an indicator of potential impacts at the end of the century under a somewhat pessimistic greenhouse gas emissions scenario. All else being equal, the greater the proportion of roadway length exposed to coastal cliff retreat, the higher the priority of that segment.

- **Initial timeframe for elevated level of concern from wildfire:** Assets that are more likely to be impacted by wildfire sooner should be prioritized first. Using future wildfire projections developed for the Caltrans Climate Change Vulnerability Assessments, the initial timeframe (2010-2039, 2040-2069, 2070-2099, or beyond 2099) for heightened wildfire risk was determined for each small culvert. The most recent timeframe across the range of available climate scenarios was chosen. Assets that were impacted sooner were given a higher priority for adaptation.

- **Highest projected wildfire level of concern:** Assets that are exposed to a greater wildfire risk should be prioritized. The wildfire modeling conducted for the Caltrans Climate Change Vulnerability Assessments classified fire risk into five levels of concern (very low, low, moderate, high, and very high) at various future time periods. Using this data, the highest level of concern was determined for each small culvert between now and 2100 and across all climate scenarios. Assets with higher levels of concern were given a higher priority for adaptation.

- **Initial timeframe when asphalt binder grade needs to change:** Roadway segments that are more likely to need binder grade changes sooner should be prioritized. Using the assumptions and data from the pavement binder grade exposure analysis described above, the initial timeframe (prior to 2010, 2010-2039, 2040-2069, or 2070-2099) for binder grade change was determined. Roadway segments that were found to need binder grade changes sooner were given a higher priority for detailed adaptation assessments.
- **Maximum riverine flooding exposure score for the 2010-2039 timeframe**: Assets that have relatively higher exposure to riverine flooding in the near-term should be prioritized. Using the riverine flood exposure index values calculated using the process described above, the highest score for the near-term (2010-2039) period was determined for each bridge, large culvert, and small culvert considering all climate scenarios and the range of outputs from all climate and wildfire models. Assets with the highest overall riverine flooding scores in this initial period received a higher priority for adaptation.[17]

BUS ENTERING FLOODED MANZANITA PARK & RIDE LOT, MARIN COUNTY

- **Maximum riverine flooding exposure score:** In addition to understanding the most pressing near-term needs for dealing with riverine flooding, assets that have relatively higher exposure to riverine flooding at any point over their lifespans should also be prioritized. To calculate this metric, the highest riverine flooding exposure score was determined for each asset considering all time periods (from now through 2100), all climate scenarios, and all climate and wildfire models. Assets with the *highest overall* riverine flooding scores received a higher priority for adaptation.

3.3.2. Consequence Metrics

The following metrics were used to understand the consequences of each asset's exposure, considering both the asset sensitivity to damage and network sensitivity to loss of the asset:

- **Bridge substructure condition rating:** Poor bridge substructure condition can contribute to failure during flooding and storm surge events. The NBI assigns a substructure condition rating to each bridge. Values range from 9 to 2 with lower values indicating poorer condition. Bridges with poor substructure condition ratings were given higher priority for adaptation assessments.

[17] Photo from California Department of Transportation, 2015. All Right Reserved.

- **Channel and channel protection condition rating:** Poor channel conditions or inadequate channel protection measures can contribute to failure during riverine flooding events. The NBI assigns a channel and channel protection condition rating to each bridge and large culvert. Values range from 9 to 2 with lower values indicating poorer condition. Bridges and large culverts with poor channel or channel protection ratings were given higher priority for adaptation assessments.

- **Culvert condition rating:** Poor culvert condition can contribute to failure during coastal and riverine flooding events. The NBI assigns a culvert condition rating to each large culvert. Values range from 9 to 2 with lower values indicating poorer condition. Caltrans has developed their own culvert condition rating system for small culverts. Possible ratings in the Caltrans system include good, fair, critical, and poor. Large and small culverts with poorer condition ratings in either system were prioritized.

- **Culvert material:** Culvert material determines the sensitivity of culverts to direct damage from wildfires and material degradation due to sea level rise. Caltrans includes material data in its databases on small culverts (no equivalent information exists for large culverts). Possible culvert materials include HDPE (high density polyethylene [plastic]), PVC (polyvinyl chloride [plastic]), corrugated steel pipe, composite, wood, masonry, and concrete. HDPE, PVC, corrugated steel pipe, composite, and wood culverts are all more sensitive to wildfire and any small culverts made from these materials that are exposed to an elevated risk from wildfire were prioritized for adaptation. Likewise, corrugated steel pipe and concrete are more sensitive to regular saltwater inundation and any small culverts made from these materials that are exposed to sea level rise were assigned a higher priority.

- **Scour rating:** Scour is a condition where water has eroded the soil around bridge piers and abutments. Excessive scour of bridge foundations makes bridges more prone to failure, especially during storm surge and riverine flooding events. The NBI assigns a scour condition rating to each bridge. Values range from 8 to 2 with lower values indicating greater scour concern. Bridges with lower values (higher scour concern) were given higher priority for adaptation assessments.

- **Average annual daily traffic (AADT):** AADT is a measure of the average traffic volume on a roadway. The consequences of weather and sea level rise-related failures/disruptions/maintenance are greater for assets that convey a higher volume of traffic. Disruptions on higher volume roads affect a greater proportion of the traveling public and there is a greater chance of congestion ripple effects throughout the network because alternate routes are less likely to be able to absorb the diverted traffic. AADT data was obtained from Caltrans databases and assigned to all the asset types included in this study. Exposed assets with higher AADT values were given greater priority for adaptation.

- **Average annual daily truck traffic (AADTT):** AADTT is a measure of the average truck volumes on a roadway. Efficient goods movement is important for maintaining economic resiliency and for providing relief supplies after a disaster. The consequences of weather and sea level rise-related failures/disruptions/maintenance are greater for assets that are a critical link in supply chains. AADTT data was obtained from Caltrans databases and assigned to all the asset types included in this study. Potentially exposed assets with higher AADTT values were given greater priority for adaptation.

- **Incremental travel distance to detour around the asset:** This metric measures the degree of network redundancy around each asset. A detour routing tool was developed for this project that can find the shortest path detour around a segment of road, bridge, large culvert, or small culvert and calculate the additional travel distance that would be required to take that detour.[18]

CALTRANS WORKERS CLEAN UP SLIDE DEBRIS

A simplified version of the tool that did not consider whether the detour routes would be passible during a flood event was run for each of the bridge and culvert assets studied that were exposed to riverine flooding.[19] Assets that had very long detour routes were given greater priority for adaptation.

- **Incremental travel distance to detour around the asset for the lowest impactful SLR increment:** A more complex version of the detour routing tool was used to determine the shortest detour for the lowest impactful sea level rise increment that would result in sea level rise, storm surge, and coastal cliff retreat affecting each asset. This provides an indication of the initial network redundancy issues that may be created by impacts in coastal areas. For these hazards, the detour tool considered the inundation/erosion throughout the roadway network for each increment of sea level rise evaluated. This ensured that detours were not routed onto roads that would also be inundated or eroded under the same amount of sea level rise.[20] In

[18] Photo from California Department of Transportation, 2017. All rights reserved.

[19] The exposure of detour routes to flooding was not able to be determined within the resources of this project since no future floodplains accounting for climate change were available at the time of publication.

[20] An exception was made for Caltrans bridges impacted by sea level rise or storm surge within District 4. These assets were assumed to remain passible for such hazards. This assumption was made because, as noted above, exposure for bridges was assumed to occur for sea level rise and storm surge even if the deck was never touched by water (to reflect concerns over corrosion, navigability, etc.). If the deck was not

other words, when run for assets exposed to sea level rise or coastal cliff retreat, the detour routing algorithm ensured that no road affected by either sea level rise or coastal cliff retreat[21] at that same increment of sea level rise could be considered a detour route. When run for assets exposed to storm surge, the detour routing algorithm ensured that no road affected by either sea level rise, coastal cliff retreat, or storm surge at the same increment of sea level rise could be considered a detour route.[22] As with the riverine flooding detours, assets that had very long detour routes were given greater priority for adaptation.

- **Incremental travel distance to detour around the asset with 6.6 feet of SLR (4.6 feet in the Delta for storm surge):** This metric captures the level of network redundancy around exposed at-grade roadways, bridges, large culverts, and small culverts at 6.6 feet of sea level rise. As with the coastal hazard exposure metrics, 6.6 feet was chosen sea level rise increment representative of end of the century conditions under a somewhat pessimistic greenhouse gas emissions scenario. When considering storm surge impacts in the Delta, 4.6 feet (the highest available there) had to be used because storm surge inundation mapping for 6.6 feet of sea level rise was not available. The detour values for this metric were calculated the same way as was done for the lowest impactful sea level rise increment detour metrics described above. Likewise, assets that had very long detour routes under this sea level rise increment were given greater priority for adaptation.

3.4. Calculation of Initial Prioritization Scores

Once all the metrics had been gathered/developed, the next step was to combine them and calculate an initial prioritization score for each asset. Calculating prioritization scores is a multi-step process that was conducted using Microsoft Excel. The primary steps are as follows:

1. **Scale the raw metrics:** Several of the metrics described in the previous section have different units of measurement. For example, the AADT metric is measured in vehicles per day whereas the incremental travel time to detour around the asset is measured in minutes. There is a need

touched by water, it is likely that the bridge would remain open as a detour route and adaptation/repair work could be undertaken while the facility was still in service. Since most Caltrans bridges shown as exposed in the analysis would not actually have their decks touched by water, it was assumed all would remain passible under these hazards lest excessively long and inaccurate detours be generated. That said, the detour metrics will be inaccurate for the few cases where detour routes traverse a Caltrans bridge whose deck would be touched by water and the bridge shut down. In these cases, the detour algorithm will have incorrectly assumed that the bridge would remain open and return a shorter detour length than would be the case. Also, note that this exception does not apply to non-Caltrans owned bridges or to Caltrans owned bridges in the Delta that are outside District 4. It was beyond this project's scope to delineate all non-Caltrans bridges around the state; a necessary step to making this exception regarding the exposure of bridges. Thus, all non-Caltrans bridges were assumed to be impassible as a detour route if inundation was shown to be underneath them for any of the sea level rise or storm surge scenarios. Bridges in the Delta outside District 4 were not delineated for this assessment either because potential detour routes through the Delta on Caltrans roads outside of District 4 appeared to have several at-grade portions already blocked by exposure to sea level rise and storm surge making this delineation moot.

[21] One exception for coastal cliff retreat occurs in the area north of the Golden Gate. As described previously, the only coastal cliff retreat exposure data that was available at the time of publication in this area was from Dr. Sitar. Dr. Sitar's study only evaluated the exposure of Caltrans assets, not the exposure of other non-Caltrans roadways that may serve as detour routes. Consequently, detour routes in this area could erroneously traverse roadways that would be eroded by coastal cliff retreat under the sea level rise increment being evaluated. In such cases, the detour metric included in the analysis would underestimate the actual detour length.

[22] One exception to the same sea level rise increments being used for storm surge is in the Delta. As discussed in the exposure metrics section, the maximum sea level increment for which storm surge inundation mapping was done is 4.6 feet. Thus, any assets outside the Delta being evaluated for detours at increments of sea level rise higher than 4.6 feet did not receive a full consideration of whether the detour route is passable at that increment should the detour traverse the Delta. Instead, the 4.6 feet inundation area, the highest available, was used in the Delta as a barrier to assess detour route availability for all increments above this value. Thus, it is possible that some of the detour metrics may underestimate the detour length for a small subset of assets whose detours traverse the Delta. That said, many routes in the Delta become inundated by storm surge at lower increments of sea level rise so this nuance may be somewhat moot anyway.

to put each metric on a common scale to be able to integrate them into one scoring system. For this study, it was decided to use a scale ranging from zero to 100 with zero indicating a value for a metric that would result in the lowest possible priority level and 100 indicating a value for a metric that would result in the highest possible priority level. The district-wide minimum and maximum values for each metric were used to set that metric's zero and 100 values. The past weather/fire impacts metric (which had binary values) was assigned a zero if the condition was false (i.e., there were no previous weather/fire impacts reported) and 100 if the condition was true. Categorized or incremental values, like the various condition rating metrics or the sea level rise increments, were generally parsed out evenly between zero and 100 (e.g., if there were seven condition rating values, the minimum and maximum values were coded as zero and 100, respectively, with the five remaining categories assigned values at intervals of 20). The remaining metrics with continuous values could fall at their proportional location within the re-scaled zero to 100 range.

2. **Apply weights:** Some metrics have been determined by Caltrans to be more important than others for determining priorities. Therefore, the relative importance of each metric was adjusted by multiplying the scaled score by a weighting factor. Metrics deemed more important to prioritization were multiplied by a larger weight. For consistency, Caltrans Headquarters staff harmonized the weights to be used in all districts based on national best practices and input from the districts. Table 3 shows the weighting schema applied to the asset-hazard combinations in District 4. The weights are percentage based and add to 100% for all the metrics within a given asset-hazard combination (column).

   In general, higher weights were assigned to the future exposure metrics (including those considering both the hazard timing and severity) as they are the primary drivers of adaptation need. This helps ensure adaptations are considered proactively before the hazards affect the assets. It also focuses the first detailed assessments on those assets that are projected to be most severely affected by climate change.

TABLE 3: WEIGHTS BY METRIC FOR EACH ASSET-HAZARD COMBINATION STUDIED

Metric	Percentage Weights by Asset Class																
	Sea Level Rise				Storm Surge				Cliff Retreat				Wildfire	Tempera-ture	Riverine Flooding		
	At-Grade Roadways	Bridges	Large Culverts	Small Culverts	At-Grade Roadways	Bridges	Large Culverts	Small Culverts	At-Grade Roadways	Bridges	Large Culverts	Small Culverts	Small Culverts	Pavement Binder Grade	Bridges	Large Culverts	Small Culverts
Exposure																	
Past natural hazard impacts	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	-	20%	20%	20%
Lowest impactful sea level rise (SLR) increment	22.5%	45%	45%	40%	-	-	-	-	-	-	-	-	-	-	-	-	-
Percent of road segment exposed to 6.6 ft. of SLR	22.5%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lowest impactful SLR increment with 100-year storm surge	-	-	-	-	22.5%	45%	45%	45%	-	-	-	-	-	-	-	-	-
Percent of road segment exposed to a 100-year storm with 6.6 ft. of SLR (4.6 ft. in the Delta)	-	-	-	-	22.5%	-	-	-	-	-	-	-	-	-	-	-	-
Lowest SLR increment that results in damage from coastal cliff retreat	-	-	-	-	-	-	-	-	22.5%	45%	45%	45%	-	-	-	-	-
Percent of road segment exposed to coastal cliff retreat at 6.6 ft. of SLR	-	-	-	-	-	-	-	-	22.5%	-	-	-	-	-	-	-	-
Initial timeframe for elevated level of concern for wildfire	-	-	-	-	-	-	-	-	-	-	-	-	17.5%	-	-	-	-
Highest projected wildfire level of concern	-	-	-	-	-	-	-	-	-	-	-	-	17.5%	-	-	-	-
Initial timeframe when asphalt binder grade needs to change	-	-	-	-	-	-	-	-	-	-	-	-	-	60%	-	-	-
Maximum riverine flooding exposure score for the 2010-2039 timeframe	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22.5%	22.5%	22.5%
Maximum riverine flooding exposure score	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22.5%	22.5%	22.5%
Consequences																	
Bridge substructure condition rating	-	-	-	-	-	1.5%	-	-	-	-	-	-	-	-	1%	-	-
Channel and channel protection condition rating	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.5%	2.5%	-
Culvert condition rating	-	-	-	-	-	-	5%	5%	-	-	-	-	-	-	-	2.5%	5%
Culvert material	-	-	-	15%	-	-	-	-	-	-	-	-	20%	-	-	-	-
Scour rating	-	-	-	-	-	8.5%	-	-	-	-	-	-	-	-	6.5%	-	-
Average annual daily traffic (AADT)	10%	10%	10%	7%	10%	7%	7%	7%	10%	10%	10%	10%	7%	13%	7%	10%	10%
Average annual daily truck traffic	5%	5%	5%	3%	5%	3%	3%	3%	5%	5%	5%	5%	3%	27%	3%	5%	5%
Incremental travel distance to detour around the asset	-	-	-	-	-	-	-	-	-	-	-	-	15%	-	15%	15%	15%
Incremental travel distance to detour around the asset for the lowest impactful SLR increment	10%	10%	10%	7.5%	10%	7.5%	10%	10%	10%	10%	10%	10%	-	-	-	-	-
Incremental travel distance to detour around the asset with 6.6 ft. of SLR (4.6 ft. for storm surge in the Delta)	10%	10%	10%	7.5%	10%	7.5%	10%	10%	10%	10%	10%	10%	-	-	-	-	-
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Amongst the consequence metrics, more weight is given to the AADT and detour route variables relative to the condition rating related variables (bridge substructure condition rating, channel and channel protection condition rating, culvert condition rating, and scour rating). The logic for this is as follows. First, except for the scour rating, the connection between asset condition and asset failure during a hazard event is not always straightforward. Where there is less confidence in a metric, it is weighted less.[23] Second, other prioritization systems used by Caltrans, namely the asset management system, focus on condition to prioritize assets. Thus, poor condition assets will already be prioritized through that program and, per Caltrans' Climate Adaptation Framework shown in Figure 1, will also undergo detailed adaptation assessments before upgrades are made. There is little value in duplicating that prioritization system for this report; instead this effort puts more priority on assets based on their exposure to climate change-related hazards. Lastly, the traffic volume and detour length variables are the primary measures by which impacts to users of the system are captured and, given the importance of mobility to the functioning of the state, were weighted higher.[24]An exception to some of the logic noted above can be found with small culvert exposure to wildfire and sea level rise. For these assets, nearly as much weight is given to the culvert material variable as to the AADT and detour route variables collectively. This is because the very nature of the threat to small culverts from wildfire and sea level rise is highly related to the material of the culvert. For example, if the culvert is plastic or wood, it is much more susceptible to fire damage than, say, a concrete culvert. Since they are less likely to be adversely affected by fire in the first place, one would not want to give high priority to concrete culverts for wildfire just because they convey a high AADT or have long detour routes. That is why more weight is placed on the material metric for this asset-hazard combination.

3. **Calculate prioritization scores for each hazard**: After the weights were applied, the next step was to calculate prioritization scores for each individual hazard. This was done by first summing the products of the weights and scaled values for all the metrics relevant to the particular asset-hazard combination being studied (i.e., summing up the products for each column in Table 3). Since there are different numbers of metrics used to calculate the score for each asset-hazard combination, these values were then re-scaled to range from zero to 100 with zero representing the lowest priority asset and 100 the highest priority asset. These interim scores provide useful information for understanding asset vulnerability to each specific hazard.

4. **Calculate cross-hazard prioritization scores:** While the prioritization scores for each hazard provide useful information, they do not provide the full picture on the threats posed to each asset. It was decided that the final scores used as the basis for prioritization need to look holistically across all the hazards analyzed. This cross-hazard perspective provides a better view of the collective threats faced by each asset and a better basis for prioritization. To calculate the cross-hazard scores, the scores for each hazard analyzed for the asset were summed. These

[23] Note that the scour rating metric is weighted somewhat higher than the other condition related assets because of its more direct connection to asset failure.

[24] Within the traffic volume related metrics, note that slightly more weight is given to AADT as opposed to truck AADT given that most of the traffic on a roadway is non-truck. Thus, it was reasoned that the total volume should factor in somewhat more heavily than the truck volume. One exception to this was for temperature impacts to pavement. This asset-hazard combination is unique in that the traffic volume information is not just an indicator of how many users may be affected by necessary pavement repairs but also an indicator of how much damage may occur to the pavement should temperatures exceed binder grade design thresholds. Given that, for this asset-hazard combination, more weight is given to truck volumes since trucks do disproportionately more damage to temperature-weakened pavement.

were then re-scaled yet again to a zero to 100 scale since different asset types have different numbers of hazards. As before, the higher the score, the higher the adaptation priority of that asset. These cross-hazard scores represent the final scores calculated for each asset during the technical assessment portion of the methodology.

5. **Assign priority levels**: The final step in the technical assessment was to group together assets into different priority levels based on their cross-hazard scores. This was done to make the outputs more oriented to future actions, decrease the tendency to read too much into minor differences in the cross-hazard scores, and better facilitate dialogue at the workshop with District 4 staff. Five priority levels were developed (Priority 1, 2, 3, 4, and 5) and assets were assigned to those groups on a district-wide basis. An equal number of assets were assigned to each priority level to help facilitate administration of the facility-level adaptation assessments that will follow this study.

3.5. Adjustments to Prioritization

A workshop will be held with the district on June 9th, 2020 to explain the scoring methodology and go over the preliminary results. District 4 staff will then be given the opportunity to make recommendations on adjusting asset priorities. After the district staff has had a chance to review, they can adjust or accept the prioritization as-is with no adjustments to the rankings.

4. DISTRICT ADAPTATION PRIORITIES

This chapter presents Caltrans' priorities for undertaking detailed adaptation assessments of assets exposed to climate change in District 4. The material presented in this chapter reflects the results of the technical analysis and the coordination with District 4 staff described in the previous chapter. The information is broken out by asset type with priorities for bridges discussed in the first section, followed by those for large culverts, small culverts, and roadways.

4.1. Bridges

A total of 313 bridges were assessed for vulnerability to sea level rise, storm surge, coastal cliff retreat, and enhanced riverine flooding associated with climate change. All these bridges should eventually undergo detailed adaptation assessments. However, due to resource limitations, this will not be possible to do all at once. Instead, the bridges will be analyzed over time according to the priorities presented here.

FLOODING UNDER HIGHWAY RAMPS

Figure 2 provides a map of all the District 4 bridges assessed for riverine flooding, sea level rise, storm surge, and cliff retreat exposure. The color of the points corresponds to the priority assigned to each bridge; darker red colors indicate higher priority assets. The map shows that high priority bridges are scattered throughout the district. That said, the highest priority bridges are generally located around the San Francisco Bay because of potential sea level rise and surge impacts, and high traffic volumes. Other high priority bridges el are located along the coast and in the Delta due to sea level rise and surge impacts and long detour routes. The clusters of high priority bridges are in the San Francisco, Marin County, and Oakland areas. Bridges along US Route 101, Interstate 80, and Interstate 880 between San Francisco and Oakland, including the San Francisco—Oakland Bay Bridge and the Golden Gate Bridge, are given high priority scores due to high traffic volumes. In addition, a cluster of high priority bridges occurs in Sonoma County along Coast Highway and State Route 116. This cluster is vulnerable due to coastal cliff retreat and a lack of convenient detours. Without exception, every bridge that crosses the San Francisco Bay is assessed as high priority.

Table 4 presents a summary of all the 63 Priority 1 bridges in District 4 sorted by their cross-hazard prioritization scores. A complete listing of all bridges ranked by their prioritization scores appears in Table 8 in the appendix.[25]

[25] Photo from the California Department of Transportation, 2015. All rights reserved.

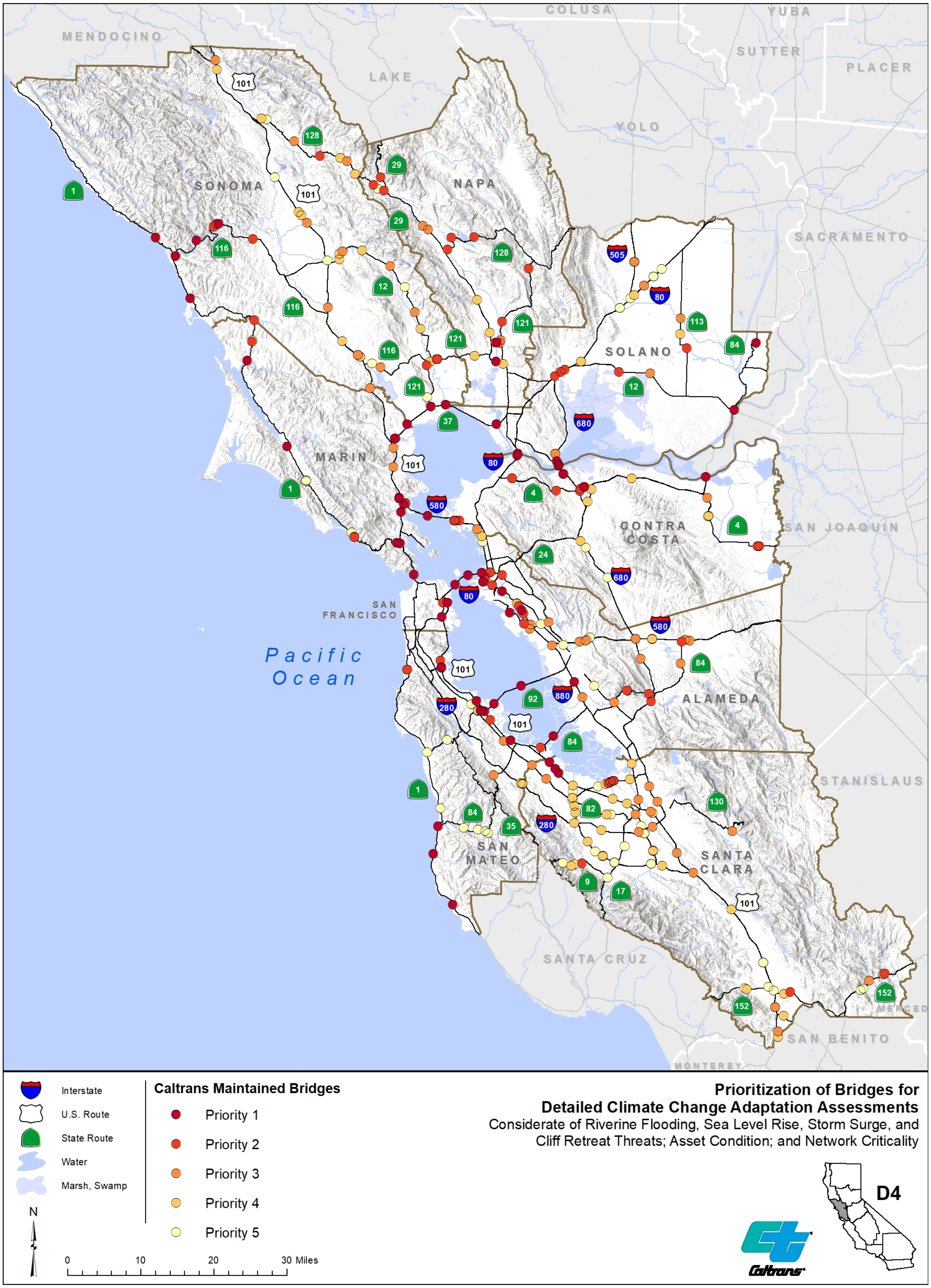


FIGURE 2: PRIORITIZATION OF BRIDGES FOR DETAILED ADAPTATION ASSESSMENTS

TABLE 4: PRIORITY 1 BRIDGES

Priority	Bridge Number	County [26]	Route	Feature Crossed	Postmile	Cross-Hazard Prioritization Score
1	27 0011R	MRN	STATE ROUTE 37 EB	NOVATO CREEK	11.96	100.00
1	23 0035	SOL	STATE ROUTE 84	MINER SLOUGH	12.09	94.28
1	34 0100	SF	INTERSTATE 280	CHINA BASIN VIADUCT	R6.61	92.23
1	28 0100	CC	INTERSTATE 580	RICHMOND-SAN RAFAEL BRIDGE	6.22	86.98
1	27 0013	MRN	STATE ROUTE 37	PETALUMA RIVER	14.47	86.71
1	34 0006	SF	INTERSTATE 80	SFOBB EAST SPAN	R7.91	86.23
1	23 0024	SOL	STATE ROUTE 12	SACRAMENTO RIVER (RIO VISTA)	26.24	85.12
1	33 0609R	ALA	INTERSTATE 880 NB	7TH STREET UNDERCROSSING	R33.5	84.29
1	28 0352L	CC	INTERSTATE 80 WB	WB CARQUINEZ (AL ZAMPA MEMORIAL) BRIDGE	13.8	84.17
1	33 0142	ALA	INTERSTATE 880	DAMON SLOUGH	26.53	83.41
1	35 0013	SM	U.S. HIGHWAY 101	SAN FRANCISQUITO CREEK	0.01	81.76
1	23 0064	SOL	STATE ROUTE 37	NAPA RIVER	R7.39	80.60
1	23 0063	SOL	STATE ROUTE 37	SONOMA CREEK	R.01	78.86
1	28 0009	CC	SR 160	SAN JOAQUIN RIVER (ANTIOCH)	0.82	78.27
1	33 0609L	ALA	INTERSTATE 880 SB	7TH STREET UNDERCROSSING	R33.5	77.86
1	34 0003	SF	INTERSTATE 80	SFOBB WEST BAY	6.35L	77.82
1	33 0086	ALA	STATE ROUTE 61	SAN LEANDRO BAY	18.55	77.14
1	20 0090	SON	STATE ROUTE 37	TOLAY CREEK	4.04	76.77
1	35 0054	SM	STATE ROUTE 92	SAN MATEO-HAYWARD BRIDGE	R14.44	76.74
1	27 0018	MRN	STATE ROUTE 1	COYOTE CREEK	0.42	74.97
1	35 0189	SM	STATE ROUTE 92	FOSTER CITY LAGOON	R13.83	74.75
1	27 0035R	MRN	U. S. HIGHWAY 101	SAN RAFAEL VIADUCT	10.72	74.69
1	21 0108R	NAP	SR 121 EB IMOLA AV	NAPA RIVER (W IMOLA AVE)	R5.3	74.68
1	27 0052	MRN	U.S. HIGHWAY 101	GOLDEN GATE BRIDGE	L.01	74.65
1	23 0015R	SOL	INTERSTATE 80 EB	CARQUINEZ BOH	0.01	74.63
1	27 0008	MRN	U.S. HIGHWAY 101	CORTE MADERA CREEK	8.47	73.27
1	27 0011L	MRN	STATE ROUTE 37 WB	NOVATO CREEK	11.96	72.67
1	27 0010	MRN	U.S. HIGHWAY 101	RICHARDSON BAY BR & SEP	4.03	72.55
1	28 0240R	CC	STATE ROUTE 4 EB	WALNUT CREEK	R13.4	72.03
1	28 0240L	CC	STATE ROUTE 4 WB	WALNUT CREEK	R13.4	71.90
1	33 0754	ALA	I 880	5TH AVENUE OVERHEAD	30.38	71.79
1	20 0195	SON	SR 1	RUSSIAN RIVER	19.72	71.62

[26] ALA = Alameda, CC = Contra Costa, MRN = Marin, NAP = Napa, SF = San Francisco, SM = San Mateo, SCL = Santa Clara, SOL = Solano, SON = Sonoma

Priority	Bridge Number	County 26	Route	Feature Crossed	Postmile	Cross-Hazard Prioritization Score
1	20 0070	SON	STATE ROUTE 1	RUSSIAN GULCH	24.5	70.76
1	35 0140	SM	U.S. HIGHWAY 101	BOREL CREEK	11.67	70.30
1	35 0252L	SM	SR 92 WB & RAMPS	ROUTE 92/101 SEPARATION	R11.78	70.07
1	35 0252R	SM	SR 92 EB & RAMPS	ROUTE 92/101 SEPARATION	R11.78	70.03
1	35 0145	SM	U.S. HIGHWAY 101	REDWOOD CREEK	6.2	70.00
1	35 0038	SM	STATE ROUTE 84	DUMBARTON BRIDGE	R29.25	69.79
1	35 0010	SM	U.S. HIGHWAY 101	SAN MATEO CREEK	13.44	68.51
1	33 0612E	ALA	I 80-I 880 CONN	PORT OF OAKLAND CONNECTOR VIADUCT	2.44	67.64
1	27 0007	MRN	U.S. HIGHWAY 101	CALIFORNIA PARK OVERHEAD	9.63	67.51
1	28 0153R	CC	INTERSTATE 680 NB	BENICIA-MARTINEZ BRIDGE & OH	R25.04R	66.47
1	27 0023	MRN	STATE ROUTE 1	LAGUNITAS CREEK	28.51	66.23
1	35 0051	SM	STATE ROUTE 1	GAZOS CREEK	5.73	66.08
1	28 0153L	CC	INTERSTATE 680 SB	BENICIA-MARTINEZ BOH	25.04L	65.96
1	27 0035L	MRN	U.S. HIGHWAY 101	SAN RAFAEL VIADUCT	10.72	65.96
1	21 0049	NAP	STATE ROUTE 29	NAPA RIVER BOH	R6.99	65.85
1	23 0215R	SOL	INTERSTATE 680 NB	BENICIA-MARTINEZ APPROACH	N.9R	65.84
1	35 0255L	SM	INTERSTATE 380 WB	ROUTE 380/101 SEPARATION	6.33	65.55
1	35 0255R	SM	INTERSTATE 380 EB	ROUTE 380/101 SEPARATION	6.32	65.55
1	35 0030	SM	STATE ROUTE 1	SAN GREGORIO CREEK	17.9	64.84
1	27 0026	MRN	STATE ROUTE 1	WALKER CREEK	44.45	64.07
1	20 0191	SON	STATE ROUTE 1	SALMON CREEK	12.49	63.89
1	28 0171L	CC	INTERSTATE RTE 680	MOCOCO OH	24.26	63.81
1	20 0254	SON	STATE ROUTE 116	RUSSIAN RIVER	R12.19	62.59
1	37 0174	SCL	U.S. HIGHWAY 101	ADOBE CREEK	50.66	62.50
1	34 0046	SF	INTERSTATE 280	SOUTHERN FREEWAY VIADUCT	R4.4L	62.46
1	20 0012	SON	STATE ROUTE 116	AUSTIN CREEK	4.93	62.08
1	28 0356R	CC	INTERSTATE RTE 680	MOCOCO OH	24.26	61.74
1	35 0028	SM	STATE ROUTE 1	PESCADERO CREEK	14	57.15
1	37 0040	SCL	U.S. HIGHWAY 101	MATADERO CREEK	51.37	55.29
1	33 0251	ALA	STATE ROUTE 880	WARD CREEK	14.18	55.19

4.2. Large Culverts

A total of 61 large culverts were assessed for vulnerability to sea level rise, storm surge, coastal cliff retreat, and more severe riverine flooding associated with climate change. Figure 3 provides a map of all the large culverts potentially exposed to these stressors in the district and colored by their priority level. There are 13 Priority 1 large culverts scattered throughout District 4. The highest priority large culverts are around San Francisco Bay due to sea level rise, surge impacts, and riverine flooding. These culverts are also located in high traffic volumes areas. Specific areas of note with high priority large culverts are along the coastline, following State Route 1, and along US Route 101 in San Mateo County and along Interstate 80 in Contra Costa County. These large culverts are subject to sea level rise inundation and riverine flooding and are in high-traffic areas for north-south travel.

Table 5 presents a summary of all the Priority 1 large culverts in District 4 sorted by their cross-hazard prioritization scores. A complete listing of all large culverts ranked by their prioritization scores appears in Table 9 in the appendix. [27]

DAMAGED CULVERT UNDER REPAIR IN DISTRICT 4

[27] Photo from the California Department of Transportation, 2016. All rights reserved.

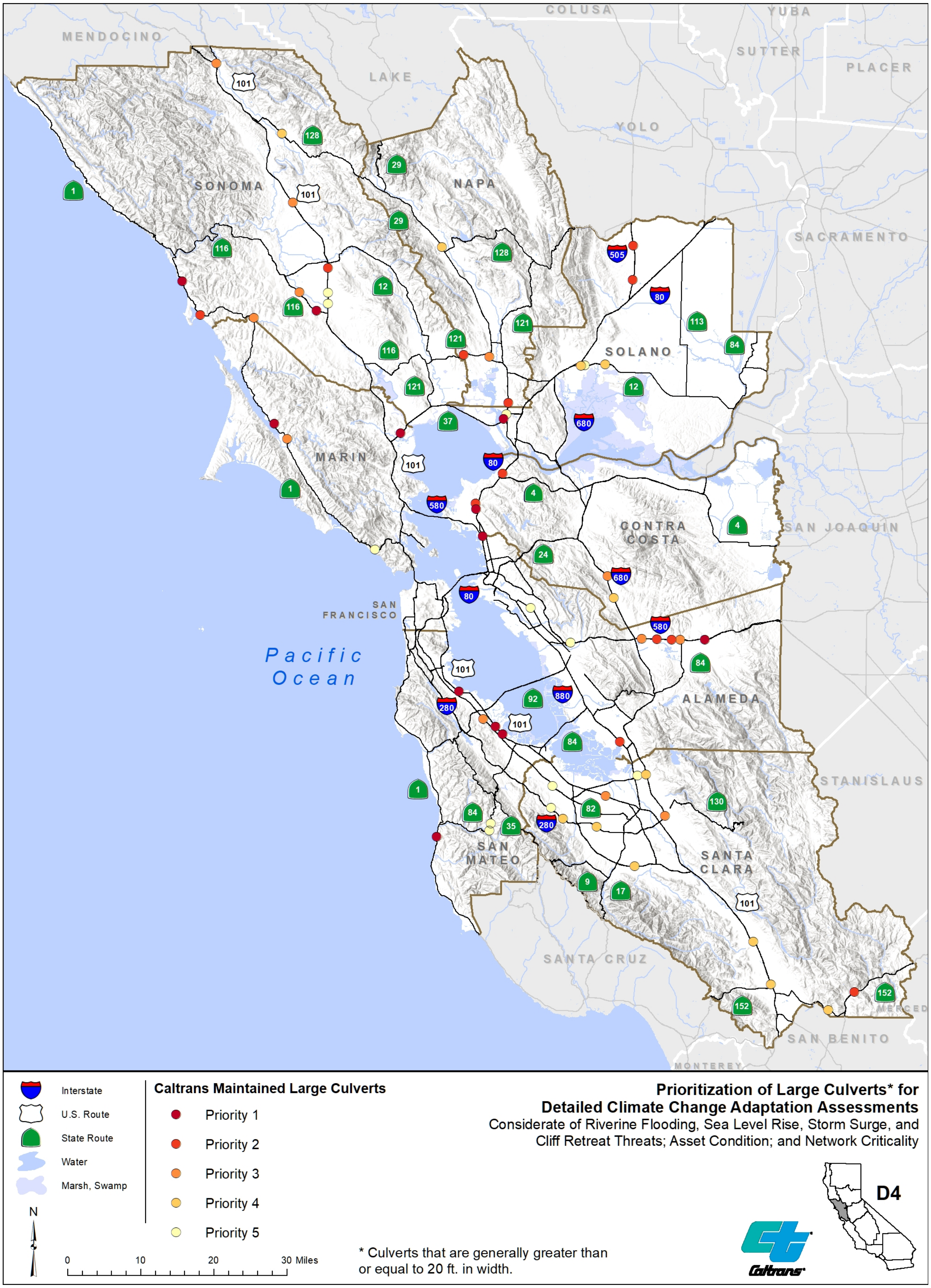


FIGURE 3: PRIORITIZATION OF LARGE CULVERTS FOR DETAILED ADAPTATION ASSESSMENTS

TABLE 5: PRIORITY 1 LARGE CULVERTS

Priority	Bridge Number	County[28]	Route	Feature Crossed	Postmile	Cross-Hazard Prioritization Score
1	35 0017	SM	U.S. HIGHWAY 101	TRANSMISSION CANAL	16.4	100.00
1	27 0012	MRN	STATE ROUTE 37	SIMONDS SLOUGH	13.04	97.04
1	35 0056	SM	U.S. HIGHWAY 101	PULGAS CREEK	7.66	83.04
1	27 0114	MRN	STATE ROUTE 1	MILLERTON GULCH	33.4	78.49
1	20 0198	SON	STATE ROUTE 1	SCOTTY CREEK	15.3	76.31
1	35 0018	SM	U.S. HIGHWAY 101	BELMONT CREEK	9.11	62.95
1	23 0238	SOL	STATE ROUTE 37	WHITE SLOUGH	8.91	56.22
1	20 0104	SON	STATE ROUTE 116	GOSSAGE CREEK	33.37	40.24
1	35 0029	SM	STATE ROUTE 1	POMPONIO CREEK	16.44	40.22
1	28 0136	CC	INTERSTATE 80	CERRITO CREEK	0.01	39.07
1	33 0066	ALA	INTERSTATE 580	ARROYO SECO	11.04	37.06
1	28 0175	CC	INTERSTATE 80	WILDCAT CREEK	3.99	33.58

4.3. Small Culverts

A total of 335 small culverts were assessed for vulnerability to sea level rise, storm surge, coastal cliff retreat, wildfire, and more severe riverine flooding associated with climate change.

Figure 4 provides a map of all the small culverts potentially exposed to more severe riverine flooding and wildfire in the district. There are 67 small culverts that are highest priority in District 4. On the map the culverts are colored according to priority level. The figure indicates that there are many clusters of high priority small culverts. Notable clusters of high priority small culverts can be found along several different roadways in Sonoma and Marin Counties, particularly along State Route 1, where the highway travels along cliffs exposing small culverts to sea level rise, surge, and coastal cliff retreat. These culverts are also exposed to high riverine flooding and wildfires. State Route 152 in Santa Clara County along the border between District 4 and Merced has a large concentration of high priority small culverts that are subject to high riverine flooding and wildfires. The detours to avoid the flooding or issues in this area are also fairly long. State Route 116 in western Sonoma County and State Route 128 between Silverado Trail and the District 4 boundary also include clusters of high priority small culverts that are threatened by high riverine flooding and wildfire, and loss of these assets cause long detours.

Table 6 presents a summary of all the Priority 1 small culverts in District 4 sorted by their cross-hazard prioritization scores. A complete listing of all small culverts ranked by their prioritization scores appears in Table 10 in the appendix.

[28] ALA = Alameda, CC = Contra Costa, MRN = Marin, NAP = Napa, SF = San Francisco, SM = San Mateo, SCL = Santa Clara, SOL = Solano, SON = Sonoma

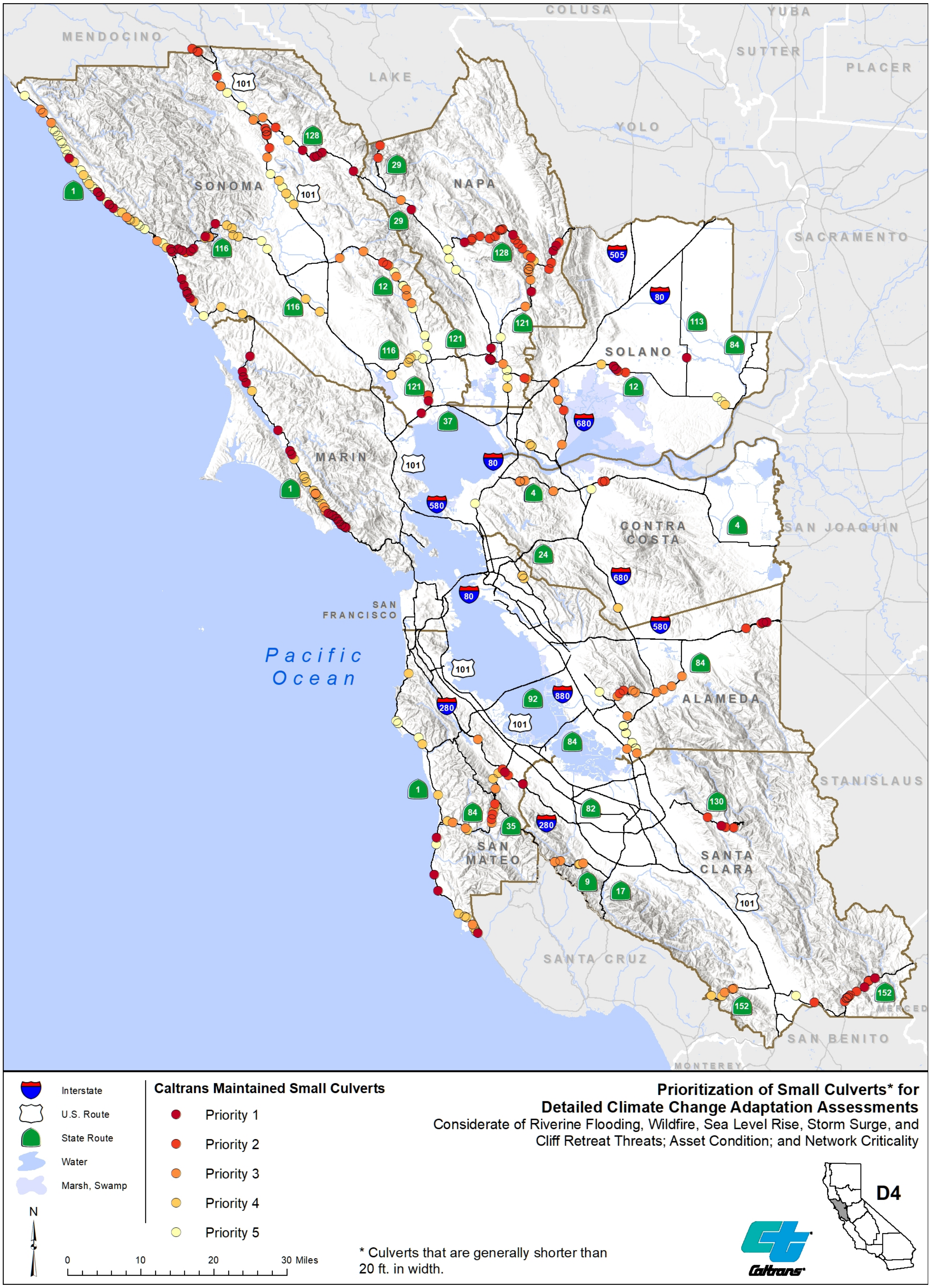


FIGURE 4: PRIORITIZATION OF SMALL CULVERTS FOR DETAILED ADAPTATION ASSESSMENTS

TABLE 6: PRIORITY 1 SMALL CULVERTS

Priority	Culvert System Number	County[29]	Route	Postmile	Cross-Hazard Prioritization Score
1	200010001565	SON	1	15.65	100.00
1	200010004541	SON	1	45.41	94.33
1	200010001346	SON	1	13.46	89.52
1	270010001606	MRN	1	16.06	87.36
1	270010001536	MRN	1	15.36	85.58
1	200010002071	SON	1	20.71	80.89
1	200010003819	SON	1	38.19	76.23
1	200010003824	SON	1	38.24	76.23
1	200374000245	SON	37	2.45	74.02
1	200010001321	SON	1	13.21	73.57
1	270014001486	MRN	1	14.86	73.54
1	231130000538	SOL	113	5.38	73.15
1	270014001349	MRN	1	13.49	71.31
1	350010001637	SM	1	16.37	71.30
1	270010001647	MRN	1	16.47	71.18
1	270014001431	MRN	1	14.31	69.94
1	270014001369	MRN	1	13.69	69.90
1	200010002126	SON	1	21.26	68.46
1	200014001241	SON	1	12.41	67.88
1	201214000090	SON	121	0.9	64.22
1	350010000030	SM	1	0.3	62.42
1	201164000300	SON	116	3	61.99
1	200010003534	SON	1	35.34	61.66
1	201164000113	SON	116	1.13	61.20
1	270010003220	MRN	1	32.2	59.10
1	201164000645	SON	116	6.45	58.41
1	270010001695	MRN	1	16.95	55.81
1	200010003544	SON	1	35.44	54.43
1	270010004268	MRN	1	42.68	53.28
1	270010004171	MRN	1	41.71	53.15
1	371524002917	SCL	152	29.17	53.14
1	270010004513	MRN	1	45.13	51.97
1	200010001457	SON	1	14.57	50.59
1	201164000348	SON	116	3.48	48.92
1	200010003724	SON	1	37.24	47.19
1	270010002792	MRN	1	27.92	46.61

[29] ALA = Alameda, CC = Contra Costa, MRN = Marin, NAP = Napa, SF = San Francisco, SM = San Mateo, SCL = Santa Clara, SOL = Solano, SON = Sonoma

Priority	Culvert System Number	County[29]	Route	Postmile	Cross-Hazard Prioritization Score
1	270010002716	MRN	1	27.16	44.52
1	201284001685	SON	128	16.85	42.56
1	201284001624	SON	128	16.24	42.45
1	201284002349	SON	128	23.49	41.82
1	201280001789	SON	128	17.89	41.58
1	270010004075	MRN	1	40.75	41.42
1	201164000165	SON	116	1.65	41.04
1	352800100295	SM	280	2.95	41.03
1	200014003461	SON	1	34.61	40.28
1	350010001106	SM	1	11.06	39.97
1	350010000872	SM	1	8.72	39.24
1	201284001388	SON	128	13.88	37.73
1	230124000802	SOL	12	8.02	37.36
1	230120000746	SOL	12	7.46	37.03
1	230120000746	SOL	12	7.46	37.03
1	210294000779	NAP	29	7.79	36.93
1	372804102058	SCL	280	20.58	36.07
1	211280000952	NAP	128	9.52	35.74
1	201164001159	SON	116	11.59	35.16
1	210294000807	NAP	29	8.07	35.09
1	335804100233	ALA	580	2.33	34.79
1	211284003056	NAP	128	30.56	34.59
1	211280002932	NAP	128	29.32	34.56
1	371304001310	SCL	130	13.1	34.56
1	210294003213	NAP	29	32.13	34.45
1	211214001672	NAP	121	16.72	34.27
1	335804100181	ALA	580	1.81	34.25
1	211284001896	NAP	128	18.96	33.98
1	210290000949	NAP	29	9.49	33.78
1	371524002703	SCL	152	27.03	33.77

4.4. Roadways

A total of 4,134 roadway segments were assessed for vulnerability to sea level rise, storm surge, coastal cliff retreat, and temperature changes that affect pavement performance. To make the analysis as detailed as possible, the original segments were short, with beginning and end points at intersections with other streets (including smaller local streets) in the roadway network. Once the vulnerability scores were processed, smaller segments sharing the same priority score as their neighbors on the same route were consolidated into longer segments to simplify the presentation of the results. This reduced the number of segments to the 610 segments presented in this report.

Figure 5 provides a map of all the consolidated roadway segments potentially exposed to pavement degrading temperature changes and coastal impacts (sea level rise, storm surge, and cliff retreat) in the district. In the map, each segment of roadway is colored according to priority level. Of the roadways evaluated, 141 were identified as the highest Priority 1 level. Figure 5 shows that roadways in and around San Francisco Bay tend to have the highest cross-hazard prioritization scores. This is due largely to sea level rise and storm surge exposure, coupled with high traffic volumes on these highways. Some of the highest priority highway segments are in this area and include: State Route 260, State Route 109, State Route 37, Interstate 880, and State Route 92, among others. Roadways in the Delta portion of District 4 also have high prioritization scores due to sea level rise and storm surge exposure, such as State Route 84. Segments of State Route 1 in Sonoma, Marin, and San Mateo Counties receive Priority 1 scores due to sea level rise, surge, and cliff retreat. Inland roadways in Alameda, Contra Costa, and Solano Counties have high prioritization scores due to temperature impacts on binder grade. Additionally, Interstate 80 and State Route 113 in Solano County receive particularly high priority scores due to their temperature exposure and high traffic volumes.

Table 7 presents a summary of all the Priority 1 roadways in District 4 sorted by their cross-hazard prioritization scores. A complete listing of all roadways ranked by their prioritization scores appears in Table 11 in the appendix.

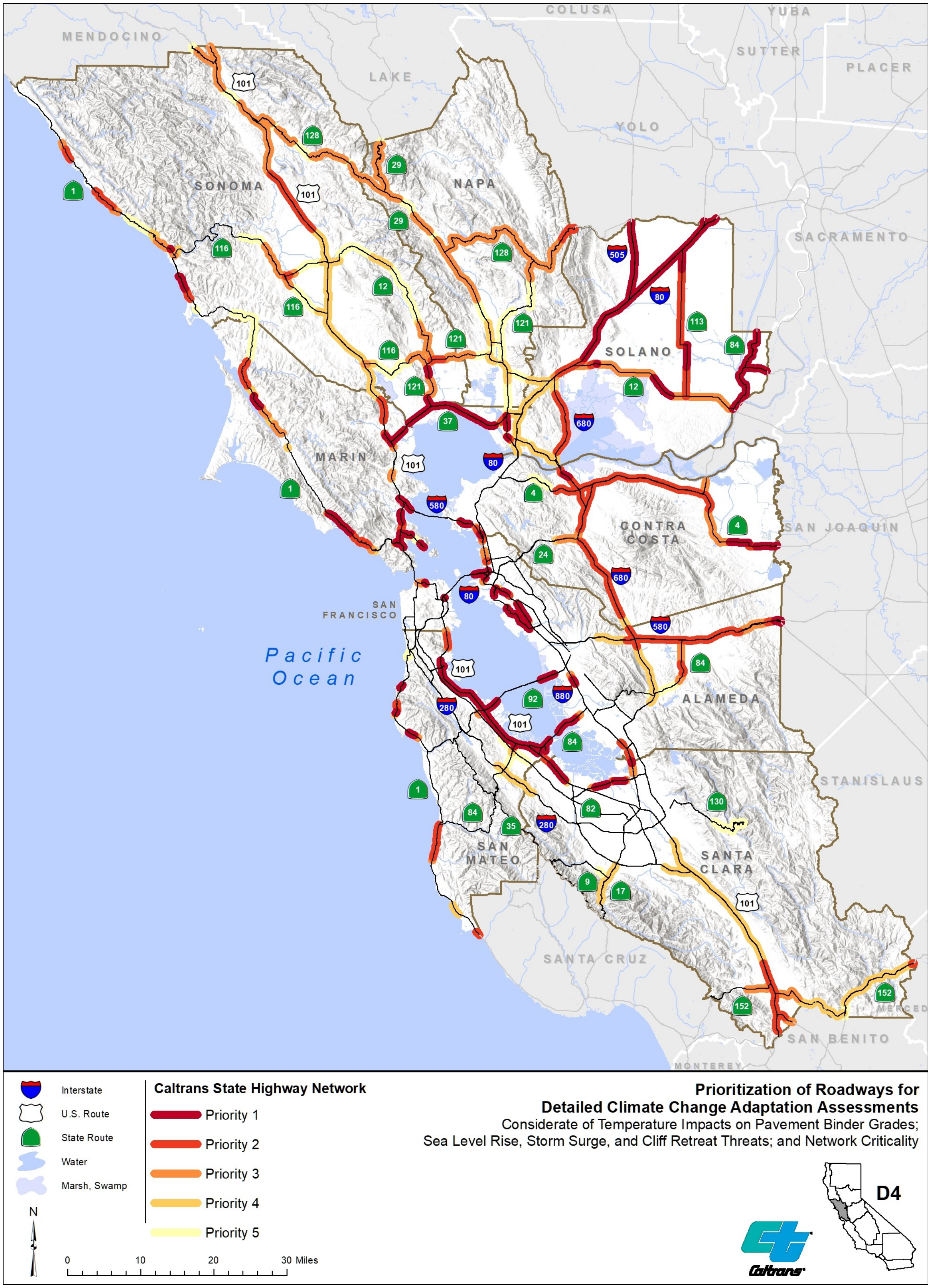


FIGURE 5: PRIORITIZATION OF ROADWAYS FOR DETAILED ADAPTATION ASSESSMENTS

TABLE 7: PRIORITY 1 ROADWAYS

Priority	Route	Carriageway[30]	From County & Postmile / To County & Postmile[31]	Average Cross-Hazard Prioritization Score[32]
1	260	P	ALA 260 R0.64 / ALA 260 R1.723R	75.11
1	109	S	SM 109 1.103 / SM 109 1.87	74.21
1	109	P	SM 109 1.103 / SM 109 1.87	73.30
1	37	P	MRN 37 14.503 / SON 37 R6.058	73.00
1	37	P	MRN 37 R11.2 / MRN 37 R11.354	73.00
1	37	P	MRN 37 R11.456 / MRN 37 13.758	73.00
1	37	P	SOL 37 R0.163 / SOL 37 R7.301	73.00
1	880S	P	ALA 880S 1.234R / ALA 880S 1.069R	72.90
1	37	S	MRN 37 14.501 / SON 37 3.78	72.88
1	37	S	MRN 37 R11.246 / MRN 37 R11.349	72.88
1	37	S	MRN 37 R11.453 / MRN 37 13.732	72.88
1	37	S	SOL 37 R0.163 / SOL 37 R7.324	72.88
1	37	S	SON 37 4.001 / SON 37 R6.058	72.88
1	260	S	ALA 260 R0.64 / ALA 260 R1.702L	69.88
1	92	S	SM 92 R12.384 / ALA 92 R4.453	64.71
1	92	P	SM 92 R12.496 / ALA 92 R4.17	64.34
1	580	S	ALA 580 46.946L / ALA 580 46.52L	64.20
1	580	S	ALA 580 L0.984L / SJ 580 15.334L	64.20
1	580	S	CC 580 R3.807 / CC 580 R2.841	64.20
1	580	S	MRN 580 4.512 / MRN 580 3.318	64.20
1	580	S	MRN 580 4.782 / MRN 580 4.521	64.20
1	280	S	SF 280 T7.424 / SF 280 T7.542	63.51
1	61	S	ALA 61 16.013 / ALA 61 14.8	62.68
1	61	S	ALA 61 17.068 / ALA 61 16.023	62.68
1	61	S	ALA 61 18.552 / ALA 61 18.359	62.68
1	61	S	ALA 61 18.949 / ALA 61 18.891	62.68
1	61	S	ALA 61 19.529 / ALA 61 19.44	62.68
1	114	S	SM 114 5.256 / SM 114 5.921	62.36
1	880S	S	ALA 880S 0.456L / ALA 880S 0.008L	62.26
1	880S	S	ALA 880S 1.257L / ALA 880S 1.131L	62.26
1	114	P	SM 114 5.259 / SM 114 5.922	61.40
1	380	P	SM 380 6.676 / SM 380 6.76	61.24
1	380	S	SM 380 6.684 / SM 380 6.76	61.23

[30] Caltrans' alignment codes designate the carriageway on divided roadways: "P" always represents northbound or eastbound carriageways whereas "S" always represents southbound or westbound carriageways. Undivided roadways are always indicated with a "P".

[31] ALA = Alameda, CC = Contra Costa, MRN = Marin, NAP = Napa, SF = San Francisco, SM = San Mateo, SCL = Santa Clara, SOL = Solano, SON = Sonoma

[32] These values represent the average of the cross-hazard prioritization scores amongst all the abutting small segments on the same route sharing a common priority level that were aggregated to form the longer segments listed in this table.

Priority	Route	Carriageway[30]	From County & Postmile / To County & Postmile[31]	Average Cross-Hazard Prioritization Score[32]
1	280	P	SF 280 T7.422 / SF 280 T7.542	60.23
1	131	P	MRN 131 0.842 / MRN 131 R1.047	59.20
1	131	P	MRN 131 1.72 / MRN 131 1.86	59.20
1	131	P	MRN 131 3.721 / MRN 131 4.392	59.20
1	61	P	ALA 61 16.011 / ALA 61 14.8	58.55
1	61	P	ALA 61 18.895 / ALA 61 16.022	58.55
1	61	P	ALA 61 19.53 / ALA 61 18.906	58.55
1	84	P	SM 84 25.319 / SM 84 25.654	58.28
1	84	P	SM 84 R25.933 / ALA 84 R3.732	58.28
1	84	P	SOL 84 0.134 / SOL 84 12.08	58.28
1	84	P	SOL 84 12.172 / YOL 84 0.004	58.28
1	220	P	SOL 220 0.005 / SOL 220 3.196	56.91
1	131	S	MRN 131 0.665 / MRN 131 R1.051	56.85
1	131	S	MRN 131 1.719 / MRN 131 1.86	56.85
1	131	S	MRN 131 4.127 / MRN 131 4.392	56.85
1	101	P	MRN 101 18.882 / MRN 101 19.087	55.67
1	101	P	MRN 101 19.883 / MRN 101 R20.193	55.67
1	101	P	MRN 101 3.343 / MRN 101 4.047	55.67
1	101	P	MRN 101 4.561 / MRN 101 5.425	55.67
1	101	P	MRN 101 7.166 / MRN 101 8.036	55.67
1	101	P	MRN 101 8.088 / MRN 101 8.584	55.67
1	101	P	MRN 101 9.743 / MRN 101 10.882	55.67
1	101	P	SCL 101 49.349 / SCL 101 52.371	55.67
1	101	P	SF 101 8.266R / SF 101 8.341R	55.67
1	101	P	SM 101 11.15 / SM 101 15.122	55.67
1	101	P	SM 101 16.135 / SM 101 21.561	55.67
1	101	P	SM 101 2.109 / SM 101 3.594	55.67
1	101	P	SM 101 3.79 / SM 101 9.547	55.67
1	101	P	SM 101 9.585 / SM 101 11.143	55.67
1	580	P	ALA 580 46.946R / ALA 580 46.617R	54.87
1	580	P	ALA 580 L1.045R / ALA 580 0.092R	54.87
1	580	P	CC 580 0.406 / CC 580 0.238	54.87
1	580	P	CC 580 R2.889 / CC 580 R2.645	54.87
1	580	P	CC 580 R3.931 / CC 580 R2.943	54.87
1	580	P	MRN 580 4.509 / MRN 580 3.303	54.87
1	580	P	MRN 580 4.782 / MRN 580 4.518	54.87
1	101	S	MRN 101 18.882 / MRN 101 19.085	54.49
1	101	S	MRN 101 3.348 / MRN 101 3.909	54.49
1	101	S	MRN 101 4.561 / MRN 101 5.483	54.49
1	101	S	MRN 101 7.153 / MRN 101 8.032	54.49

Priority	Route	Carriageway[30]	From County & Postmile / To County & Postmile[31]	Average Cross-Hazard Prioritization Score[32]
1	101	S	MRN 101 8.119 / MRN 101 8.588	54.49
1	101	S	MRN 101 9.748 / MRN 101 10.884	54.49
1	101	S	MRN 101 R20.188 / MRN 101 R20.196	54.49
1	101	S	SCL 101 49.432 / SCL 101 52.178	54.49
1	101	S	SM 101 11.153 / SM 101 21.696	54.49
1	101	S	SM 101 2.08 / SM 101 3.573	54.49
1	101	S	SM 101 3.598 / SM 101 5.386	54.49
1	101	S	SM 101 5.393 / SM 101 9.55	54.49
1	101	S	SM 101 9.56 / SM 101 11.145	54.49
1	1	P	MRN 1 0 / MRN 1 0.759	54.33
1	1	P	MRN 1 12.591 / MRN 1 17.06	54.33
1	1	P	MRN 1 36.487 / MRN 1 38.408	54.33
1	1	P	SM 1 32.022 / SM 1 32.857	54.33
1	1	P	SM 1 36.387 / SM 1 36.634	54.33
1	1	P	SM 1 40.756 / SM 1 41.274	54.33
1	1	P	SON 1 14.103 / SON 1 14.368	54.33
1	1	P	SON 1 14.82 / SON 1 16.348	54.33
1	1	P	SON 1 21.139 / SON 1 21.226	54.33
1	84	S	SM 84 25.314 / SM 84 25.653	52.54
1	84	S	SM 84 R25.998 / ALA 84 R3.749	52.54
1	680	P	CC 680 23.434 / CC 680 24.37	51.32
1	121	P	SON 121 0.597 / SON 121 1.424	51.15
1	121	P	SON 121 5.203 / SON 121 6.13	51.15
1	4	S	CC 4 45.327 / CC 4 47.348	49.28
1	4	S	CC 4 R39.732 / CC 4 R39.953	49.28
1	4	S	CC 4 R41.752 / CC 4 R41.96	49.28
1	680	S	CC 680 23.437 / CC 680 24.399	48.36
1	237	P	SCL 237 6.778 / SCL 237 7.74	45.08
1	237	P	SCL 237 R3.795 / SCL 237 R5.486	45.08
1	237	S	SCL 237 6.619 / SCL 237 7.911	44.94
1	237	S	SCL 237 R3.79 / SCL 237 R5.466	44.94
1	880	S	ALA 880 14.443 / ALA 880 14.548	44.66
1	880	S	ALA 880 24.974 / ALA 880 27.519	44.66
1	880	S	ALA 880 29.67 / ALA 880 30.475	44.66
1	880	S	ALA 880 R34.04L / ALA 880 R34.423L	44.66
1	880	S	SCL 880 10.413 / ALA 880 R0.266	44.66
1	205	S	ALA 205 L0.076 / SJ 205 L0.005	43.76
1	205	P	ALA 205 L0.11 / SJ 205 L0.005	43.76
1	880	P	ALA 880 14.031 / ALA 880 14.533	43.54
1	880	P	ALA 880 25.067 / ALA 880 27.419	43.54

Priority	Route	Carriageway[30]	From County & Postmile / To County & Postmile[31]	Average Cross-Hazard Prioritization Score[32]
1	880	P	ALA 880 29.687 / ALA 880 30.474	43.54
1	880	P	SCL 880 10.408 / ALA 880 R0.153	43.54
1	4	P	CC 4 45.327 / CC 4 48.392	41.46
1	4	P	CC 4 R39.34 / CC 4 R41.96	41.46
1	80	S	ALA 80 2.521 / ALA 80 3.241	41.20
1	80	S	SF 80 R8.149 / ALA 80 2.438	41.20
1	80	S	SOL 80 17.905 / SOL 80 R43.985	41.20
1	80	S	SOL 80 R44.666 / SOL 80 R44.715	41.20
1	80	P	ALA 80 2.535 / ALA 80 3.181	40.44
1	80	P	SF 80 R8.093 / ALA 80 2.445	40.44
1	80	P	SOL 80 17.702 / SOL 80 R44.72	40.44
1	29	S	SOL 29 3.117 / SOL 29 4.689	39.56
1	12	S	SOL 12 R14.939 / SOL 12 15.07	38.32
1	12	S	SOL 12 R5.094 / SOL 12 5.151	38.32
1	29	P	SOL 29 1.642 / SOL 29 1.805	38.29
1	29	P	SOL 29 3.08 / SOL 29 4.733	38.29
1	113	P	SOL 113 18.592 / SOL 113 21.24	34.41
1	113	P	SOL 113 21.24 / YOL 113 R0.001	34.41
1	113	P	SOL 113 4.052 / SOL 113 5.565	34.41
1	113	P	SOL 113 5.862 / SOL 113 7.021	34.41
1	505	P	SOL 505 R0 / SOL 505 R10.626	34.09
1	505	S	SOL 505 R0.012 / SOL 505 R10.622	34.00
1	113	S	SOL 113 19.22 / SOL 113 19.538	33.32
1	113	S	SOL 113 19.586 / SOL 113 20.051	33.32
1	113	S	SOL 113 21.12 / SOL 113 21.165	33.32
1	113	S	SOL 113 R21.653L / YOL 113 R0.012	33.32
1	12	P	SOL 12 13.64 / SOL 12 R17.109	33.14
1	112	P	ALA 112 R0 / ALA 112 R0.028	32.30

5. NEXT STEPS

This report has identified the bridge, large culvert, small culvert, and roadway assets exposed to a variety of climate hazards in District 4 and assigned them priority levels for detailed assessments based on their vulnerability rating. Caltrans' next step will be to begin undertaking detailed adaptation assessments for the identified assets starting with the highest priority (Priority 1) assets first and then proceeding to lower priority assets thereafter. These detailed adaptation assessments will take a closer look at the exposure to each asset using more localized climate projections and more detailed engineering analyses. The benefit of performing these detailed adaptation assessments is determining the bounds of the studies, including whether and how to amalgamate the individual exposed assets prioritized in this study into a facility level assessment that considers multiple exposed assets simultaneously. If impacts are verified, Caltrans will develop and evaluate adaptation options for the asset to ensure that it is able to withstand future climate changes. Importantly, the detailed adaptations assessments will include coordination with key stakeholder groups whose actions affect or are affected by the asset and its adaptation.[33]

Another next step will be to integrate the prioritization measures into the asset management system used in the district. Caltrans already has projects underway to address impacts from hazards, such as storm damage in Marin County, Sonoma County, and San Mateo County; this report will help Caltrans to identify other areas to prioritize for repairs or preventative measures. This will ensure that climate change is a consideration in the identification of future projects alongside traditional asset condition

COASTAL EROSION IMPACTS IN DISTRICT 4

[33] Photo from the California Department of Transportation, 2016. All rights reserved.

metrics. As noted previously, assets identified for capital investments, especially those flagged as being a high priority for climate change, should then undergo detailed climate change assessments prior to project nomination and programming.

In addition, district staff can use the results of this study as a useful starting point to begin discussions with various important stakeholders in the district about addressing climate change and its impacts. This includes state and federal environmental resource agencies, local permitting agencies, and any major landowners in the district whose actions directly affect the State Highway System. Multi-agency stakeholder coordination and involvement of the private sector are essential because the impacts from climate change, and ability to effectively address those impacts, cross both jurisdictional and ownership boundaries. For example, Caltrans could increase the size of a culvert to accommodate higher stormwater and debris flows while the more cost-effective solution may be better land management in the adjacent drainage area. The approach to climate change cannot just be Caltrans-centric. A common framework across all state agencies must be established for truly effective long-term solutions to be achieved.

6. APPENDIX

TABLE 8: PRIORITIZATION OF BRIDGES FOR DETAILED CLIMATE CHANGE ADAPTATION ASSESSMENTS

Priority	Bridge Number	County[34]	Route	Feature Crossed	Postmile	Cross-Hazard Prioritization Score
1	27 0011R	MRN	STATE ROUTE 37 EB	NOVATO CREEK	11.96	100.00
1	23 0035	SOL	STATE ROUTE 84	MINER SLOUGH	12.09	94.28
1	34 0100	SF	INTERSTATE 280	CHINA BASIN VIADUCT	R6.61	92.23
1	28 0100	CC	INTERSTATE 580	RICHMOND-SAN RAFAEL BRIDGE	6.22	86.98
1	27 0013	MRN	STATE ROUTE 37	PETALUMA RIVER	14.47	86.71
1	34 0006	SF	INTERSTATE 80	SFOBB EAST SPAN	R7.91	86.23
1	23 0024	SOL	STATE ROUTE 12	SACRAMENTO RIVER (RIO VISTA)	26.24	85.12
1	33 0609R	ALA	INTERSTATE 880 NB	7TH STREET UNDERCROSSING	R33.5	84.29
1	28 0352L	CC	INTERSTATE 80 WB	WB CARQUINEZ (AL ZAMPA MEMORIAL) BRIDGE	13.8	84.17
1	33 0142	ALA	INTERSTATE 880	DAMON SLOUGH	26.53	83.41
1	35 0013	SM	U.S. HIGHWAY 101	SAN FRANCISQUITO CREEK	0.01	81.76
1	23 0064	SOL	STATE ROUTE 37	NAPA RIVER	R7.39	80.60
1	23 0063	SOL	STATE ROUTE 37	SONOMA CREEK	R.01	78.86
1	28 0009	CC	SR 160	SAN JOAQUIN RIVER (ANTIOCH)	0.82	78.27
1	33 0609L	ALA	INTERSTATE 880 SB	7TH STREET UNDERCROSSING	R33.5	77.86
1	34 0003	SF	INTERSTATE 80	SFOBB WEST BAY	6.35L	77.82
1	33 0086	ALA	STATE ROUTE 61	SAN LEANDRO BAY	18.55	77.14
1	20 0090	SON	STATE ROUTE 37	TOLAY CREEK	4.04	76.77
1	35 0054	SM	STATE ROUTE 92	SAN MATEO-HAYWARD BRIDGE	R14.44	76.74
1	27 0018	MRN	STATE ROUTE 1	COYOTE CREEK	0.42	74.97
1	35 0189	SM	STATE ROUTE 92	FOSTER CITY LAGOON	R13.83	74.75
1	27 0035R	MRN	U. S. HIGHWAY 101	SAN RAFAEL VIADUCT	10.72	74.69
1	21 0108R	NAP	SR 121 EB IMOLA AV	NAPA RIVER (W IMOLA AVE)	R5.3	74.68
1	27 0052	MRN	U.S. HIGHWAY 101	GOLDEN GATE BRIDGE	L.01	74.65
1	23 0015R	SOL	INTERSTATE 80 EB	CARQUINEZ BOH	0.01	74.63
1	27 0008	MRN	U.S. HIGHWAY 101	CORTE MADERA CREEK	8.47	73.27
1	27 0011L	MRN	STATE ROUTE 37 WB	NOVATO CREEK	11.96	72.67
1	27 0010	MRN	U.S. HIGHWAY 101	RICHARDSON BAY BR & SEP	4.03	72.55
1	28 0240R	CC	STATE ROUTE 4 EB	WALNUT CREEK	R13.4	72.03

[34] ALA = Alameda, CC = Contra Costa, MRN = Marin, NAP = Napa, SF = San Francisco, SM = San Mateo, SCL = Santa Clara, SOL = Solano, SON = Sonoma

Priority	Bridge Number	County[34]	Route	Feature Crossed	Postmile	Cross-Hazard Prioritization Score
1	28 0240L	CC	STATE ROUTE 4 WB	WALNUT CREEK	R13.4	71.90
1	33 0754	ALA	I 880	5TH AVENUE OVERHEAD	30.38	71.79
1	20 0195	SON	SR 1	RUSSIAN RIVER	19.72	71.62
1	20 0070	SON	STATE ROUTE 1	RUSSIAN GULCH	24.5	70.76
1	35 0140	SM	U.S. HIGHWAY 101	BOREL CREEK	11.67	70.30
1	35 0252L	SM	SR 92 WB & RAMPS	ROUTE 92/101 SEPARATION	R11.78	70.07
1	35 0252R	SM	SR 92 EB & RAMPS	ROUTE 92/101 SEPARATION	R11.78	70.03
1	35 0145	SM	U.S. HIGHWAY 101	REDWOOD CREEK	6.2	70.00
1	35 0038	SM	STATE ROUTE 84	DUMBARTON BRIDGE	R29.25	69.79
1	35 0010	SM	U.S. HIGHWAY 101	SAN MATEO CREEK	13.44	68.51
1	33 0612E	ALA	I 80-I 880 CONN	PORT OF OAKLAND CONNECTOR VIADUCT	2.44	67.64
1	27 0007	MRN	U.S. HIGHWAY 101	CALIFORNIA PARK OVERHEAD	9.63	67.51
1	28 0153R	CC	INTERSTATE 680 NB	BENICIA-MARTINEZ BRIDGE & OH	R25.04R	66.47
1	27 0023	MRN	STATE ROUTE 1	LAGUNITAS CREEK	28.51	66.23
1	35 0051	SM	STATE ROUTE 1	GAZOS CREEK	5.73	66.08
1	28 0153L	CC	INTERSTATE 680 SB	BENICIA-MARTINEZ BOH	25.04L	65.96
1	27 0035L	MRN	U.S. HIGHWAY 101	SAN RAFAEL VIADUCT	10.72	65.96
1	21 0049	NAP	STATE ROUTE 29	NAPA RIVER BOH	R6.99	65.85
1	23 0215R	SOL	INTERSTATE 680 NB	BENICIA-MARTINEZ APPROACH	N.9R	65.84
1	35 0255L	SM	INTERSTATE 380 WB	ROUTE 380/101 SEPARATION	6.33	65.55
1	35 0255R	SM	INTERSTATE 380 EB	ROUTE 380/101 SEPARATION	6.32	65.55
1	35 0030	SM	STATE ROUTE 1	SAN GREGORIO CREEK	17.9	64.84
1	27 0026	MRN	STATE ROUTE 1	WALKER CREEK	44.45	64.07
1	20 0191	SON	STATE ROUTE 1	SALMON CREEK	12.49	63.89
1	28 0171L	CC	INTERSTATE RTE 680	MOCOCO OH	24.26	63.81
1	20 0254	SON	STATE ROUTE 116	RUSSIAN RIVER	R12.19	62.59
1	37 0174	SCL	U.S. HIGHWAY 101	ADOBE CREEK	50.66	62.50
1	34 0046	SF	INTERSTATE 280	SOUTHERN FREEWAY VIADUCT	R4.4L	62.46
1	20 0012	SON	STATE ROUTE 116	AUSTIN CREEK	4.93	62.08
1	28 0356R	CC	INTERSTATE RTE 680	MOCOCO OH	24.26	61.74
1	35 0028	SM	STATE ROUTE 1	PESCADERO CREEK	14	57.15
1	37 0040	SCL	U.S. HIGHWAY 101	MATADERO CREEK	51.37	55.29
1	33 0251	ALA	STATE ROUTE 880	WARD CREEK	14.18	55.19
2	35 0141	SM	U.S. HIGHWAY 101	LAUREL CREEK	10.25	53.73

Priority	Bridge Number	County[34]	Route	Feature Crossed	Postmile	Cross-Hazard Prioritization Score
2	21 0108L	NAP	SR 121 WB IMOLA AV	NAPA RIVER (W IMOLA AVE)	R5.3	53.17
2	37 0244L	SCL	STATE ROUTE 237 WB	GUADALUPE RIVER	R6.41	51.97
2	28 0032	CC	STATE ROUTE 4	KELLOGG CREEK	45.56	51.37
2	23 0040	SOL	STATE ROUTE 113	BARKER SLOUGH	6.58	48.82
2	20 0049	SON	STATE ROUTE 116	HULBERT CREEK	11.16	47.39
2	27 0105	MRN	STATE ROUTE 1	SIDEHILL VIADUCT NO. 1	11.62	46.56
2	23 0007	SOL	INTERSTATE 80	SUISUN CREEK	14.55	46.56
2	28 0033	CC	STATE ROUTE 4	KENDALL CREEK OVERFLOW	45.84	45.26
2	33 0611R	ALA	INTERSTATE 880 NB	EAST BAY VIADUCT	R34R	44.90
2	27 0073R	MRN	STATE ROUTE 580	BELLAM BLVD UC	4.5	44.43
2	20 0121	SON	STATE ROUTE 121	BRANCH ARROYO SECO	8.51	41.78
2	37 0470R	SCL	EB STATE ROUTE 237	SOUTH ALVISO OVERHEAD	R6.1	40.32
2	33 0611L	ALA	INTERSTATE 880 SB	EAST BAY VIADUCT	R34.5L	39.98
2	35 0118	SM	U.S. HIGHWAY 101	COLMA CREEK	21.61	39.97
2	35 0291	SM	STATE ROUTE 84	RAYCHEM UNDERCROSSING	R27.62	37.65
2	27 0073L	MRN	STATE ROUTE 580	BELLAM BOULEVARD UC	4.5	37.07
2	20 0023	SON	STATE ROUTE 121	ARROYO SECO	8.43	36.62
2	33 0616L	ALA	INTERSTATE 880 SB	5TH & 6TH STREET VIADUCT	R32.2	35.22
2	33 0113	ALA	INTERSTATE 880	ELMHURST CREEK	25.97	34.70
2	37 0244R	SCL	STATE ROUTE 237 EB	GUADALUPE RIVER	R6.41	34.30
2	33 0660	ALA	ROUTE 61	AIRPORT DRIVE UC	15.9	34.09
2	35 0021L	SM	STATE ROUTE 1 SB	CLARENDON ROAD UC	R43.74	33.95
2	35 0021R	SM	STATE ROUTE 1 NB	CLARENDON ROAD UC	R43.74	33.78
2	33 0143	ALA	INTERSTATE 880	EAST CREEK SLOUGH	27.23	33.49
2	37 0470L	SCL	WB STATE ROUTE 237	SOUTH ALVISO OVERHEAD	R6.1	32.76
2	27 0027	MRN	STATE ROUTE 1	STEMPLE CREEK	47.41	32.21
2	28 0180	CC	INTERSTATE 680	GRAYSON CREEK	20.89	31.43
2	33 0061R	ALA	W580-E&W80 CONNCTR	DISTRIBUTION STRUCTURE	46.5R	31.09
2	34 0088	SF	ST RTE 101 (5TH ST	BAYSHORE VIADUCT	4.12	29.41
2	27 0028	MRN	STATE ROUTE 1	ESTERO AMERICANO	50.47	29.33
2	23 0006	SOL	INTERSTATE 80	DAN WILSON CREEK	13.92	27.84
2	28 0056L	CC	I 580 EB	RAILROAD AVENUE OH	R4.82	27.65
2	28 0216L	CC	STATE ROUTE 4 WB	ALHAMBRA WAY UC	R8.75	27.45
2	28 0277	CC	INTERSTATE 580	SOUTH SECOND STREET OH	R4.09	27.10

Priority	Bridge Number	County[34]	Route	Feature Crossed	Postmile	Cross-Hazard Prioritization Score
2	37 0033	SCL	STATE ROUTE 152	SOUTH FORK PACHECO CREEK	30.65	26.68
2	23 0004	SOL	INTERSTATE 80	GREEN VALLEY CREEK	12.91	26.33
2	37 0078	SCL	STATE ROUTE 9	SARATOGA CREEK	6.7	25.76
2	37 0026	SCL	STATE ROUTE 152	JOHNSON CREEK	12.58	25.50
2	33 0724	ALA	SR 84 (ISABEL AVE)	ARROYO LAS POSITAS	M27.74	25.18
2	28 0278	CC	INTERSTATE 580	CANAL BOULEVARD UC	R4.64	25.12
2	21 0019	NAP	STATE ROUTE 128	HOPPER SLOUGH	5.12	24.76
2	20 0021	SON	STATE ROUTE 121	YELLOW CREEK	6.52	24.41
2	20 0092	SON	STATE ROUTE 116	GREEN VALLEY CREEK	18.66	24.25
2	21 0018	NAP	STATE ROUTE 29	NAPA RIVER	37.03	24.16
2	21 0008	NAP	STATE ROUTE 121	SARCO CREEK	9.3	23.86
2	28 0066L	CC	STATE ROUTE 4 WB	GRAYSON CREEK	12.9	22.82
2	21 0074	NAP	STATE ROUTE 128	SAGE CREEK	11.26	22.76
2	28 0056R	CC	I 580 WB	RAILROAD AVENUE OH	R4.81	21.27
2	33 0285	ALA	ROUTE 580	BROADWAY-RICHMOND BLVD UC	44.51	21.23
2	21 0021	NAP	STATE ROUTE 128	CONN CREEK	R7.41	21.07
2	21 0005	NAP	STATE ROUTE 29	GARNETT CREEK	39.08	21.06
2	33 0036	ALA	U.S. HIGHWAY 84	ALAMEDA CREEK	13.33	21.02
2	20 0292	SON	STATE ROUTE 128	MAACAMA CREEK	17.25	20.51
2	33 0047	ALA	INTERSTATE 680	ALAMEDA CREEK	R10.15	20.32
2	23 0134	SOL	STATE ROUTE 12	UNION CREEK	8.54	20.15
2	21 0112	NAP	STATE ROUTE 121	CAPELL CREEK	20.29	19.14
2	28 0038R	CC	STATE ROUTE 4 EB	RODEO CREEK	R1.96R	19.02
2	20 0089	SON	STATE ROUTE 116	FIFE CREEK	11.82	18.84
2	21 0068	NAP	STATE ROUTE 128	BLOSSOM CREEK	2.8	18.81
2	33 0061L	ALA	E&W80-E580 CONNCTR	DISTRIBUTION STRUCTURE	46.5L	18.58
2	33 0043	ALA	STATE ROUTE 84	ARROYO DE LA LAGUNA	17.22	18.57
2	37 0159R	SCL	STATE ROUTE 237 EB	SAN TOMAS AQUINO CREEK	R5.68	18.50
3	37 0159L	SCL	STATE ROUTE 237 WB	SAN TOMAS AQUINO CREEK	R5.68	18.50
3	21 0077	NAP	STATE ROUTE 121	TULUCAY CREEK (CAYETANO CREEK)	R5.71	18.48
3	23 0029L	SOL	INTERSTATE 505 SB	SWEENEY CREEK	R5.2	18.40
3	37 0018	SCL	STATE ROUTE 82	SAN FRANCISQUITO CREEK	26.36	18.36
3	20 0162L	SON	U.S. ROUTE 101 SB	LYNCH CREEK	5.19	17.89
3	37 0039	SCL	U.S. HIGHWAY 101	COYOTE CREEK	36.69	17.76
3	20 0162R	SON	U.S. ROUTE 101 NB	LYNCH CREEK	5.19	17.69
3	21 0017	NAP	STATE ROUTE 29	YORK CREEK	29.29	17.65

Priority	Bridge Number	County[34]	Route	Feature Crossed	Postmile	Cross-Hazard Prioritization Score
3	21 0003	NAP	STATE ROUTE 121	TULUCAY CREEK	6.42	17.61
3	23 0143R	SOL	INTERSTATE 680 NB	BENICIA VIADUCT	R1.33	17.48
3	37 0008R	SCL	NB US HIGHWAY 101	CARNADERO CREEK	4.2	17.20
3	37 0008L	SCL	SB US HIGHWAY 101	CARNADERO CREEK	4.2	17.05
3	23 0143L	SOL	INTERSTATE 680 SB	BENICIA VIADUCT	R1.33	17.05
3	28 0389L	CC	STATE ROUTE 4 WB	CONTRA COSTA CANAL	R31.28	16.97
3	20 0015	SON	US HIGHWAY 101	COPELAND CREEK	13.51	16.77
3	20 0033	SON	STATE ROUTE 128	OAT VALLEY CREEK	L4.64	16.59
3	33 0003	ALA	STATE ROUTE 238	ALAMEDA CREEK	3.46	16.41
3	33 0016L	ALA	INTERSTATE 580 EB	ALAMO CANAL	20.56	15.95
3	20 0027	SON	STATE ROUTE 12	SONOMA CREEK	25.82	15.60
3	37 0102L	SCL	SB US HIGHWAY 101	COYOTE CREEK	29.83	15.46
3	35 0001	SM	STATE ROUTE 82	CORDILLERAS CREEK	5.15	15.08
3	37 0176	SCL	INTERSTATE 880	GUADALUPE RIVER	3.15	14.95
3	23 0012L	SOL	INTERSTATE 80 WB	GIBSON CANYON CREEK	31.12	14.40
3	37 0282	SCL	INTERSTATE 280	COYOTE CREEK	R1.08	14.28
3	35 0044	SM	STATE ROUTE 84	WEST UNION CREEK	19.89	14.18
3	37 0032	SCL	STATE ROUTE 152	PACHECO CREEK	30.37	13.73
3	33 0616R	ALA	INTERSTATE 880 NB	5TH & 6TH STREET VIADUCT	R32.2	13.57
3	23 0029R	SOL	INTERSTATE 505 NB	SWEENEY CREEK	R5.2	13.53
3	33 0082	ALA	STATE ROUTE 112	MULFORD OVERHEAD	R.06	13.42
3	20 0019R	SON	U.S. ROUTE 101 NB	SAN ANTONIO CREEK	0.01	13.32
3	33 0007	ALA	INTERSTATE 580	SAN LEANDRO CREEK	R34.55	13.31
3	20 0040	SON	STATE ROUTE 128	SAUSAL CREEK	12.19	12.86
3	37 0006R	SCL	NB U.S. HWY 101	SARGENT BRIDGE & OH	R.81	12.83
3	37 0299	SCL	INTERSTATE 680	BERRYESSA CREEK	M5.81	12.77
3	33 0382	ALA	INTERSTATE 680	ARROYO DE LA LAGUNA	R17.19	12.71
3	23 0236	SOL	STATE ROUTE 113	ULATIS CREEK	11.67	12.71
3	37 0636	SCL	INTERSTATE 880	COYOTE CREEK BRIDGE & UC	5.34	12.60
3	20 0293	SON	STATE ROUTE 128	REDWOOD CREEK	21.78	12.57
3	27 0004	MRN	U.S. HIGHWAY 101	MILLER CREEK	15.35	12.53
3	33 0203	ALA	INTERSTATE 580	ARROYO LAS POSITAS	13.13	12.38
3	33 0012	ALA	INTERSTATE 580	ARROYO LAS POSITAS	13.82	12.27
3	33 0250	ALA	INTERSTATE 880	PATTERSON SLOUGH	11.8	11.87
3	27 0003	MRN	U.S. HIGHWAY 101	ARROYO DE SAN JOSE	18.15	11.83

Priority	Bridge Number	County[34]	Route	Feature Crossed	Postmile	Cross-Hazard Prioritization Score
3	33 0175	ALA	INTERSTATE 880	SAN LORENZO CREEK	20.11	11.79
3	20 0110	SON	STATE ROUTE 116	ELLIS CREEK	37.49	11.71
3	37 0294	SCL	INTERSTATE 680	UPPER PENITENCIA CREEK	M3.45	11.59
3	21 0016	NAP	STATE ROUTE 29	SULPHUR CREEK	28.43	11.49
3	37 0606	SCL	STATE ROUTE 130	SMITH CREEK	15.8	11.42
3	28 0091	CC	STATE ROUTE 580	STEGE DRAIN	1.17	11.28
3	20 0180	SON	U.S. ROUTE 101 SB	MARK WEST CREEK	26.1	11.18
3	37 0346R	SCL	NB US HIGHWAY 101	COYOTE CREEK	R26.47	11.10
3	33 0016R	ALA	INTERSTATE 580 WB	ALAMO CANAL	20.56	11.07
3	37 0030L	SCL	STATE ROUTE 152 WB	CEDAR CREEK	R28.17	11.02
3	20 0030	SON	STATE ROUTE 12	HOOKER CREEK	33.31	10.90
3	37 0017	SCL	STATE ROUTE 82	MATADERO CREEK	23.63	10.78
3	20 0029	SON	STATE ROUTE 12	BRUSH CREEK	18.37	10.46
3	23 0136	SOL	STATE ROUTE 12	DENVERTON CREEK	12.92	10.28
3	33 0100	ALA	INTERSTATE 880	SAN LEANDRO BOH	24.18	10.27
3	33 0230L	ALA	INTERSTATE 580	SAN LORENZO CREEK UC	R27.69	10.22
3	37 0265L	SCL	INTERSTATE 280 SB	LOS GATOS CREEK	R3.19	10.20
3	33 0232L	ALA	INTERSTATE 580 EB	CROW CREEK	R28.57	10.19
3	33 0710	ALA	ST RTE 84 (ISABEL)	ARROYO DEL VALLE CREEK	R25.45	10.10
4	37 0097	SCL	US HIGHWAY 101	SILVER CREEK	36.37	10.08
4	37 0034	SCL	U.S. HIGHWAY 101	STEVENS CREEK	48.04	10.02
4	37 0582	SCL	INTERSTATE 880	PENITENCIA CREEK	10.38	9.88
4	37 0041	SCL	U.S. HIGHWAY 101	SAN TOMAS AQUINO CREEK	42.25	9.77
4	37 0037	SCL	U.S. HIGHWAY 101	GUADALUPE RIVER	40.19	9.76
4	21 0002	NAP	STATE ROUTE 121	CARNEROS CREEK	2.4	9.64
4	33 0015R	ALA	INTERSTATE 580	TASSAJARA CREEK	18.32	9.50
4	20 0181	SON	U.S. ROUTE 101 NB	PRUITT CREEK	27.39	9.49
4	33 0732L	ALA	I880 SB	HIGH STREET SEPERATION & OH	27.63	9.49
4	20 0163L	SON	US HIGHWAY 101 SB	WASHINGTON STREET CREEK	4.77	9.35
4	20 0161	SON	U.S. ROUTE 101 NB	WILLOW BROOK	8.05	9.32
4	33 0015L	ALA	INTERSTATE 580	TASSAJARA CREEK	18.32	9.29
4	37 0171	SCL	STATE ROUTE 237	CALABAZAS CREEK	M5.28	9.24
4	28 0038L	CC	STATE ROUTE 4 WB	RODEO CREEK	R1.9L	9.22
4	37 0412L	SCL	SB STATE ROUTE 85	CANOAS CREEK	4.28	9.21
4	35 0009L	SM	STATE ROUTE 280 SB	ALPINE ROAD UC	R.01	9.19

Priority	Bridge Number	County[34]	Route	Feature Crossed	Postmile	Cross-Hazard Prioritization Score
4	37 0237	SCL	INTERSTATE 280	STEVENS CREEK	11.2	9.19
4	35 0009R	SM	STATE ROUTE 280 NB	ALPINE ROAD UC	R.01	9.18
4	37 0074	SCL	STATE ROUTE 9	SARATOGA CREEK	4.85	9.18
4	28 0147	CC	STATE ROUTE 242	HOLBROOK CHANNEL	R2.65	9.15
4	37 0417R	SCL	NB STATE ROUTE 87	CANOAS CREEK	1.92	8.99
4	37 0417L	SCL	SB STATE ROUTE 87	CANOAS CREEK	1.92	8.98
4	37 0665	SCL	STATE RTE 152	UVAS CREEK BRIDGE	6.37	8.91
4	20 0182	SON	U.S. ROUTE 101 NB	POOL CREEK	27.97	8.88
4	35 0234L	SM	STATE ROUTE 280 SB	SAN FRANCISQUITO CREEK	R.3	8.87
4	20 0288	SON	STATE ROUTE 128	RUSSIAN RIVER	5.44	8.85
4	37 0210	SCL	INTERSTATE 280	LAWRENCE EXPRESSWAY UC	7.12	8.84
4	37 0201L	SCL	STATE ROUTE 237 WB	STEVENS CREEK	R.32	8.75
4	37 0201R	SCL	STATE ROUTE 237 EB	STEVENS CREEK	R.32	8.74
4	20 0236	SON	STATE ROUTE 12	MATANZAS CREEK	T17.77	8.73
4	20 0163R	SON	US HIGHWAY 101 NB	WASHINGTON STREET CREEK	4.77	8.65
4	28 0163	CC	STATE ROUTE 242 SB	WILLOW PASS ROAD UC	R.87	8.58
4	28 0372R	CC	STATE ROUTE 4 EB	SAND CREEK	M34.4	8.52
4	20 0044	SON	STATE ROUTE 128	BIDWELL CREEK	24.01	8.47
4	37 0185	SCL	STATE ROUTE 85	STEVENS CREEK	R20.02	8.40
4	37 0007	SCL	U.S. HIGHWAY 101	PAJARO RIVER	0.03	8.33
4	23 0008R	SOL	INTERSTATE 80 EB	LEDGEWOOD CREEK	17.02	8.27
4	23 0171	SOL	STATE ROUTE 113	ALAMO CREEK	9.58	8.19
4	37 0156	SCL	STATE ROUTE 25	CARNADERO CREEK	1.57	8.15
4	37 0084L	SCL	STATE ROUTE 237 WB	COYOTE CREEK	8.72	8.11
4	37 0189	SCL	STATE ROUTE 85	STEVENS CREEK	R20.96	7.99
4	20 0024	SON	SR 12	AGUA CALIENTE CREEK	35.75	7.89
4	37 0524L	SCL	SB STATE ROUTE 85	SAN TOMAS AQUINO CREEK	R12.68	7.89
4	23 0073R	SOL	INTERSTATE 80 EB	HORSE CREEK	29.25	7.84
4	37 0527L	SCL	STATE ROUTE 85	CALABAZAS CREEK	R15.4	7.78
4	28 0093R	CC	STATE ROUTE 4 EB	CONTRA COSTA CANAL	R20.32	7.68
4	37 0524R	SCL	NB STATE ROUTE 85	SAN TOMAS AQUINO CREEK	R12.68	7.67

Priority	Bridge Number	County[34]	Route	Feature Crossed	Postmile	Cross-Hazard Prioritization Score
4	20 0028	SON	SR 12	SANTA ROSA CREEK	21.45	7.51
4	21 0071L	NAP	STATE ROUTE 29 SB	SUSCOL CREEK	R6.08	7.49
4	37 0024	SCL	STATE ROUTE 152	LLAGAS CREEK	11.33	7.43
4	33 0156	ALA	INTERSTATE 580	CERRITO CREEK	48.04	7.43
4	21 0022L	NAP	STATE ROUTE 29 SB	NAPA CREEK	11.65	7.39
4	20 0238	SON	STATE ROUTE 12	SANTA ROSA CREEK	T18.51	7.36
4	35 0157L	SM	WB STATE ROUTE 92	HAYWARD PARK OVERHEAD	R11.38	7.31
4	35 0157R	SM	EB STATE ROUTE 92	HAYWARD PARK OVERHEAD	R11.38	7.31
4	20 0042	SON	STATE ROUTE 128	FOOTE CREEK	20.72	7.29
4	37 0349L	SCL	SB US HIGHWAY 101	COYOTE CREEK	R19.21	7.22
4	28 0372L	CC	STATE ROUTE 4 WB	SAND CREEK	M34.4	7.19
4	20 0252R	SON	US 101 NB	FIRST STREET UC	R52.06	7.19
4	37 0013	SCL	STATE ROUTE 82	CALABAZAS CREEK	13.66	7.18
4	28 0162	CC	INTERSTATE 680	LAS TRAMPAS CREEK	13.72	7.04
4	21 0014	NAP	STATE ROUTE 29	DRY CREEK	16.48	7.01
4	20 0022	SON	STATE ROUTE 121	SONOMA CREEK	R7.3	6.95
5	37 0422L	SCL	SB STATE ROUTE 87	WILLOW STREET VIADUCT	4.55	6.93
5	33 0114	ALA	STATE ROUTE 185	SAN LORENZO CREEK	1.61	6.83
5	37 0331R	SCL	U.S. HWY 101 (NB)	LLAGAS CREEK	R10.63	6.83
5	37 0014	SCL	STATE ROUTE 82	STEVENS CREEK	18.96	6.67
5	37 0491L	SCL	SB STATE ROUTE 85	LOS GATOS CREEK	R10.8	6.65
5	37 0430L	SCL	STATE ROUTE 152 WB	PACHECO CREEK	R26.3	6.58
5	37 0431R	SCL	STATE ROUTE 152 EB	PACHECO CREEK	R26.7	6.55
5	20 0026	SON	SR 12	CALABAZAS CREEK	29.41	6.55
5	37 0134	SCL	STATE ROUTE 17	LOS GATOS CREEK	12.03	6.46
5	37 0467L	SCL	SB STATE ROUTE 85	GUADALUPE RIVER	5.59	6.41
5	37 0467R	SCL	NB STATE ROUTE 85	GUADALUPE RIVER	5.59	6.41
5	20 0039	SON	STATE ROUTE 128	ROCKAWAY CREEK	6.44	6.39
5	33 0005	ALA	STATE ROUTE 238	DRY CREEK	7.19	6.31
5	20 0273R	SON	US 101 NB	RUSSIAN RIVER	33.78	6.30
5	33 0235L	ALA	INTERSTATE 580	EAST CASTRO VALLEY BLVD UC	R27	6.29

Priority	Bridge Number	County[34]	Route	Feature Crossed	Postmile	Cross-Hazard Prioritization Score
5	37 0491R	SCL	NB STATE ROUTE 85	LOS GATOS CREEK	R10.8	6.28
5	20 0020	SON	STATE ROUTE 121	TOLAY CREEK	1.53	6.22
5	37 0500L	SCL	SB STATE ROUTE 85	SARATOGA CREEK	R13.91	6.19
5	28 0059	CC	INTERSTATE 680	RUDGEAR ROAD UC	R12.61	6.18
5	23 0052R	SOL	INTERSTATE 80 EB	ULATIS CREEK	R26.61	6.18
5	37 0327L	SCL	U.S. HWY 101 (SB)	RONAN DIVERSION CHANNEL	R6.57	6.18
5	23 0084L	SOL	INTERSTATE 80 WB	MC CUNE CREEK	34.48	6.14
5	23 0052L	SOL	INTERSTATE 80 WB	ULATIS CREEK	R26.61	6.12
5	37 0138	SCL	STATE ROUTE 9	LOS GATOS CREEK	11.3	6.09
5	28 0197	CC	INTERSTATE 680	SAN RAMON CREEK	R7.43	6.08
5	33 0115	ALA	STATE ROUTE 185	SAN LEANDRO CREEK	5.82	6.06
5	20 0062	SON	STATE ROUTE 116	ADOBE CREEK CATTLEPASS	36.19	6.05
5	37 0073	SCL	STATE ROUTE 9	WEST BRANCH SARATOGA CREEK	3.6	6.00
5	27 0021	MRN	STATE ROUTE 1	OLEMA CREEK	22.96	5.96
5	37 0012	SCL	STATE ROUTE 82	SARATOGA CREEK	13.07	5.94
5	37 0075	SCL	STATE ROUTE 9	SARATOGA CREEK	R5.5	5.86
5	37 0331L	SCL	U.S. HWY 101 (SB)	LLAGAS CREEK	R10.63	5.69
5	33 0230R	ALA	INTERSTATE 580	SAN LORENZO CREEK UC	R27.53	5.63
5	27 0020	MRN	STATE ROUTE 1	OLEMA CREEK	22.81	5.52
5	23 0012R	SOL	INTERSTATE 80 EB	GIBSON CANYON CREEK	31.12	5.27
5	27 0054	MRN	STATE ROUTE 1	FALLON CREEK	47.6	5.25
5	35 0139L	SM	STATE ROUTE 1 SB	PILARCITOS CREEK	28.92	5.12
5	37 0046	SCL	STATE ROUTE 152	BODFISH CREEK	6.1	4.79
5	20 0276	SON	U.S. HIGHWAY 101	SANTA ROSA CREEK	19.99	4.70
5	35 0047	SM	STATE ROUTE 82	SAN MATEO CREEK	11.82	4.46
5	23 0011L	SOL	INTERSTATE 80 WB	HORSE CREEK	R28.57	4.31
5	23 0008L	SOL	INTERSTATE 80 WB	LEDGEWOOD CREEK	17.02	4.05
5	37 0308	SCL	STATE ROUTE 87	GUADALUPE RIVER VIADUCT	5.67	3.77
5	35 0015	SM	STATE ROUTE 92	PILARCITOS CREEK	3.3	3.74
5	37 0009	SCL	STATE ROUTE 152	MILLER SLOUGH	M9.62	3.61
5	27 0077	MRN	STATE ROUTE 1	ESKOOT CREEK	12.37	3.53
5	23 0083R	SOL	INTERSTATE 80 EB	SWEENEY CREEK	32.9	3.45
5	23 0083L	SOL	INTERSTATE 80 WB	SWEENEY CREEK	32.9	3.38
5	37 0004	SCL	STATE ROUTE 237	SUNNYVALE EAST CHANNEL	R4.16	3.11
5	35 0166	SM	STATE ROUTE 84	SAN GREGORIO CREEK	7.55	2.89
5	21 0027	NAP	STATE ROUTE 128	CYRUS CREEK	3.74	2.86
5	33 0051L	ALA	INTERSTATE 80 WB	EL CERRITO SEPARATION & OH	R7.2	2.86

Priority	Bridge Number	County[34]	Route	Feature Crossed	Postmile	Cross-Hazard Prioritization Score
5	37 0197	SCL	STATE ROUTE 85	STEVENS CREEK	R22.95	2.69
5	37 0422R	SCL	NB STATE ROUTE 87	WILLOW STREET VIADUCT	4.55	2.47
5	33 0732R	ALA	I880 NB	HIGH STREET SEPARATION&OH	27.63	2.32
5	35 0031	SM	STATE ROUTE 1	TUNITAS CREEK	20.82	1.42
5	37 0471R	SCL	EB STATE ROUTE 237	GREAT AMERICA PARKWAY UC	R5.83	0.85
5	35 0167	SM	STATE ROUTE 84	LA HONDA CREEK	8.1	0.33
5	35 0165	SM	STATE ROUTE 84	SAN GREGORIO CREEK	6.18	0.05
5	27 0106	MRN	STATE ROUTE 1	SIDEHILL VIADUCT NO. 2	11.63	0.00
5	28 0090	CC	STATE ROUTE 580	RUST DRAIN	0.72	0.00
5	35 0163	SM	STATE ROUTE 84	EL CORTE DE MADERA CREEK	3.92	0.00

TABLE 9: PRIORITIZATION OF LARGE CULVERTS FOR DETAILED CLIMATE CHANGE ADAPTATION ASSESSMENTS

Priority	Bridge Number	County[35]	Route	Feature Crossed	Postmile	Cross-Hazard Prioritization Score
1	35 0017	SM	U.S. HIGHWAY 101	TRANSMISSION CANAL	16.4	100.00
1	27 0012	MRN	STATE ROUTE 37	SIMONDS SLOUGH	13.04	97.04
1	35 0056	SM	U.S. HIGHWAY 101	PULGAS CREEK	7.66	83.04
1	27 0114	MRN	State Route 1	MILLERTON GULCH	33.4	78.49
1	20 0198	SON	STATE ROUTE 1	SCOTTY CREEK	15.3	76.31
1	35 0018	SM	U.S. HIGHWAY 101	BELMONT CREEK	9.11	62.95
1	23 0238	SOL	STATE ROUTE 37	WHITE SLOUGH	8.91	56.22
1	20 0104	SON	STATE ROUTE 116	GOSSAGE CREEK	33.37	40.24
1	35 0029	SM	STATE ROUTE 1	POMPONIO CREEK	16.44	40.22
1	28 0136	CC	INTERSTATE 80	CERRITO CREEK	0.01	39.07
1	33 0066	ALA	INTERSTATE 580	ARROYO SECO	11.04	37.06
1	28 0175	CC	INTERSTATE 80	WILDCAT CREEK	3.99	33.58
2	20 0196	SON	U.S. ROUTE 101	COLGAN CREEK	18.88	31.83
2	37 0060	SCL	STATE ROUTE 152	KILLDEER CREEK	R25.36	29.57
2	23 0028	SOL	INTERSTATE 505	GIBSON CANYON CREEK	R2.7	29.19
2	21 0040	NAP	STATE ROUTE 29	AMERICAN CANYON CREEK	0.56	28.98
2	23 0031	SOL	INTERSTATE 505	DRY ARROYO	R7.5	28.89
2	21 0001	NAP	STATE ROUTE 121	HUICHICA CREEK	0.75	28.25
2	33 0291	ALA	INTERSTATE 880	ARROYO DE LA LAGUNA CREEK	3.67	28.14
2	28 0107	CC	INTERSTATE 80	SAN PABLO CREEK	4.81	26.60
2	20 0189	SON	STATE ROUTE 1	CHENEY GULCH	9.16	26.22
2	28 0194	CC	INTERSTATE 80	RODEO CREEK	10.73	25.87
2	33 0014	ALA	INTERSTATE 580	RANCHO DRAIN	17.57	25.64
2	33 0013	ALA	INTERSTATE 580	COTTONWOOD CREEK	15.63	25.49
3	20 0185	SON	U.S. ROUTE 101	WINDSOR CREEK	29.5	25.36
3	35 0105	SM	STATE ROUTE 82	LAUREL CREEK	9.24	25.25
3	33 0501	ALA	INTERSTATE 580	COLLIER CANYON CREEK	14.44	24.58
3	20 0186	SON	STATE ROUTE 1	POCOLIMI CREEK	0.33	24.54
3	27 0056	MRN	STATE ROUTE 1	TOMASINI CANYON	29.85	24.09
3	20 0103	SON	STATE ROUTE 116	BLUCHER CREEK	29.83	23.28
3	33 0474	ALA	INTERSTATE 580	CHABOT CANAL	19.72	22.94
3	37 0320	SCL	INTERSTATE 680	SILVER CREEK	M1.13	22.66
3	37 0399	SCL	US 101, FRONTAGE RD	CALABAZAS CREEK	43.32	22.07
3	28 0270	CC	INTERSTATE 680	GREEN VALLEY CREEK	R7.64	21.69

[35] ALA = Alameda, CC = Contra Costa, MRN = Marin, NAP = Napa, SF = San Francisco, SM = San Mateo, SCL = Santa Clara, SOL = Solano, SON = Sonoma

Priority	Bridge Number	County[35]	Route	Feature Crossed	Postmile	Cross-Hazard Prioritization Score
3	20 0265	SON	U.S. HIGHWAY 101	OAT VALLEY CREEK	R53.06	21.24
3	21 0098	NAP	STATE ROUTE 29	STANLEY CREEK	R8.33	20.87
4	37 0405	SCL	INTERSTATE 280	CALABAZAS CREEK	7.93	20.82
4	28 0057	CC	INTERSTATE 680	SAN RAMON CREEK	R4.46	20.07
4	20 0130	SON	STATE ROUTE 128	GIRD CREEK	9.75	19.19
4	37 0469	SCL	SR 85 & CAMDEN AVE	ROSS CREEK	8.15	16.98
4	37 0234	SCL	INTERSTATE 280	PERMANENTE CREEK	12.93	16.96
4	37 0377	SCL	INTERSTATE 680	ARROYO COCHES	M7.46	16.59
4	37 0028	SCL	STATE ROUTE 152	HOLSTEIN CREEK	R19.32	16.14
4	37 0392	SCL	US HIGHWAY 101	LITTLE LLAGAS CREEK	R13.87	15.78
4	37 0463	SCL	STATE ROUTE 152	WEST BRANCH LLAGAS CREEK	M10.2	14.57
4	23 0017	SOL	STATE ROUTE 12	MCCOY CREEK	6.28	13.90
4	23 0228	SOL	STATE HWY 12	ALONZO DRAIN	L2.94	13.49
4	21 0106	NAP	SR 29	BALE SLOUGH	25.4	13.44
5	20 0174	SON	U.S. ROUTE 101	NORTH BRANCH LAGUNA DE SANTA RSA	15.52	13.14
5	20 0082	SON	U.S. HIGHWAY 101	HINEBAUGH CREEK	14.02	12.78
5	33 0675	ALA	INTERSTATE 580	LAKE CHABOT CULVERT	30.1	12.38
5	23 0229	SOL	STATE HWY 12	LEDGEWOOD CREEK	R3.41	12.24
5	37 0379	SCL	STATE ROUTE 237	PENITENCIA CREEK	T9.85	11.79
5	23 0237	SOL	STATE ROUTE 29	CHABOT CREEK	4.9	11.78
5	37 0661	SCL	STATE ROUTE 82	ADOBE CREEK	22.34	10.95
5	37 0336	SCL	INTERSTATE 280	ADOBE CREEK	15.17	8.45
5	27 0019	MRN	STATE ROUTE 1	REDWOOD CREEK	6.02	7.16
5	33 0109	ALA	STATE ROUTE 185	ARROYO VIEJO	8.64	6.81
5	35 0169	SM	STATE ROUTE 84	LA HONDA CREEK	9.67	2.75
5	35 0168	SM	STATE ROUTE 84	LA HONDA CREEK	8.46	0.00

TABLE 10: PRIORITIZATION OF SMALL CULVERTS FOR DETAILED CLIMATE CHANGE ADAPTATION ASSESSMENTS

Priority	Culvert System Number	County[36]	Route	Postmile	Cross-Hazard Prioritization Score
1	200010001565	SON	1	15.65	100.00
1	200010004541	SON	1	45.41	94.33
1	200010001346	SON	1	13.46	89.52
1	270010001606	MRN	1	16.06	87.36
1	270010001536	MRN	1	15.36	85.58
1	200010002071	SON	1	20.71	80.89
1	200010003819	SON	1	38.19	76.23
1	200010003824	SON	1	38.24	76.23
1	200374000245	SON	37	2.45	74.02
1	200010001321	SON	1	13.21	73.57
1	270014001486	MRN	1	14.86	73.54
1	231130000538	SOL	113	5.38	73.15
1	270014001349	MRN	1	13.49	71.31
1	350010001637	SM	1	16.37	71.30
1	270010001647	MRN	1	16.47	71.18
1	270014001431	MRN	1	14.31	69.94
1	270014001369	MRN	1	13.69	69.90
1	200010002126	SON	1	21.26	68.46
1	200014001241	SON	1	12.41	67.88
1	201214000090	SON	121	0.9	64.22
1	350010000030	SM	1	0.3	62.42
1	201164000300	SON	116	3	61.99
1	200010003534	SON	1	35.34	61.66
1	201164000113	SON	116	1.13	61.20
1	270010003220	MRN	1	32.2	59.10
1	201164000645	SON	116	6.45	58.41
1	270010001695	MRN	1	16.95	55.81
1	200010003544	SON	1	35.44	54.43
1	270010004268	MRN	1	42.68	53.28
1	270010004171	MRN	1	41.71	53.15
1	371524002917	SCL	152	29.17	53.14
1	270010004513	MRN	1	45.13	51.97
1	200010001457	SON	1	14.57	50.59
1	201164000348	SON	116	3.48	48.92
1	200010003724	SON	1	37.24	47.19

[36] ALA = Alameda, CC = Contra Costa, MRN = Marin, NAP = Napa, SF = San Francisco, SM = San Mateo, SCL = Santa Clara, SOL = Solano, SON = Sonoma

Priority	Culvert System Number	County[36]	Route	Postmile	Cross-Hazard Prioritization Score
1	270010002792	MRN	1	27.92	46.61
1	270010002716	MRN	1	27.16	44.52
1	201284001685	SON	128	16.85	42.56
1	201284001624	SON	128	16.24	42.45
1	201284002349	SON	128	23.49	41.82
1	201280001789	SON	128	17.89	41.58
1	270010004075	MRN	1	40.75	41.42
1	201164000165	SON	116	1.65	41.04
1	352800100295	SM	280	2.95	41.03
1	200014003461	SON	1	34.61	40.28
1	350010001106	SM	1	11.06	39.97
1	350010000872	SM	1	8.72	39.24
1	201284001388	SON	128	13.88	37.73
1	230124000802	SOL	12	8.02	37.36
1	230120000746	SOL	12	7.46	37.03
1	230120000746	SOL	12	7.46	37.03
1	210294000779	NAP	29	7.79	36.93
1	372804102058	SCL	280	20.58	36.07
1	211280000952	NAP	128	9.52	35.74
1	201164001159	SON	116	11.59	35.16
1	210294000807	NAP	29	8.07	35.09
1	335804100233	ALA	580	2.33	34.79
1	211284003056	NAP	128	30.56	34.59
1	211280002932	NAP	128	29.32	34.56
1	371304001310	SCL	130	13.1	34.56
1	210294003213	NAP	29	32.13	34.45
1	211214001672	NAP	121	16.72	34.27
1	335804100181	ALA	580	1.81	34.25
1	211284001896	NAP	128	18.96	33.98
1	210290000949	NAP	29	9.49	33.78
1	371524002703	SCL	152	27.03	33.77
2	211280002643	NAP	128	26.43	33.69
2	371524002812	SCL	152	28.12	33.67
2	371524002574	SCL	152	25.74	33.63
2	230124000840	SOL	12	8.4	33.52
2	371524002806	SCL	152	28.06	33.23
2	211280001058	NAP	128	10.58	32.88
2	280044001651	CC	4	16.51	32.87
2	211280001086	NAP	128	10.86	32.87
2	280044001612	CC	4	16.12	32.83

Priority	Culvert System Number	County[36]	Route	Postmile	Cross-Hazard Prioritization Score
2	280044001632	CC	4	16.32	32.76
2	201164000170	SON	116	1.7	32.20
2	200124002545	SON	12	25.45	32.18
2	230124000792	SOL	12	7.92	32.01
2	201284000826	SON	128	8.26	31.88
2	210294004276	NAP	29	42.76	31.84
2	371300001688	SCL	130	16.88	31.62
2	211280002000	NAP	128	20	31.56
2	211284002162	NAP	128	21.62	31.49
2	371524002430	SCL	152	24.3	31.48
2	211284001368	NAP	128	13.68	31.47
2	211284003137	NAP	128	31.37	31.46
2	371524002430	SCL	152	24.3	31.39
2	201214000176	SON	121	1.76	31.31
2	210294000779	NAP	29	7.79	31.17
2	371524002465	SCL	152	24.65	31.14
2	211284002318	NAP	128	23.18	31.13
2	211284001483	NAP	128	14.83	31.08
2	371524001683	SCL	152	16.83	30.99
2	371524002403	SCL	152	24.03	30.49
2	201014104060	SON	101	40.6	30.43
2	371524002403	SCL	152	24.03	30.42
2	352804100233	SM	280	2.33	30.36
2	210294004745	NAP	29	47.45	30.22
2	201014104060	SON	101	40.6	29.98
2	371304001440	SCL	130	14.4	29.92
2	230124000948	SOL	12	9.48	29.90
2	200124002471	SON	12	24.71	29.55
2	201014103826	SON	101	38.26	29.52
2	236804100755	SOL	680	7.55	29.44
2	352800100348	SM	280	3.48	29.42
2	211284001713	NAP	128	17.13	29.32
2	211280001685	NAP	128	16.85	29.31
2	201014104115	SON	101	41.15	29.28
2	211280001666	NAP	128	16.66	29.14
2	210124000255	NAP	12	2.55	29.08
2	352804002066	SM	280	20.66	29.00
2	371300001045	SCL	130	10.45	28.86
2	335804100497	ALA	580	4.97	28.83
2	330844001298	ALA	84	12.98	28.78

Priority	Culvert System Number	County[36]	Route	Postmile	Cross-Hazard Prioritization Score
2	350840001050	SM	84	10.5	28.74
2	201018104007	SON	101	40.07	28.50
2	330844001238	ALA	84	12.38	28.46
2	335802100262	ALA	580	2.62	28.41
2	211284002061	NAP	128	20.61	28.39
2	201284000192	SON	128	1.92	28.30
2	201280000138	SON	128	1.38	28.29
2	201280000044	SON	128	0.44	28.22
2	211280002744	NAP	128	27.44	27.73
2	201018104004	SON	101	40.04	27.41
2	211681102963	NAP	168	29.63	27.07
2	350840001334	SM	84	13.34	26.88
2	210294000807	NAP	29	8.07	26.86
2	201164000220	SON	116	2.2	26.82
2	201010105110	SON	101	51.1	26.25
2	350840001152	SM	84	11.52	26.07
2	371524002355	SCL	152	23.55	26.05
2	211284001213	NAP	128	12.13	26.01
3	211214001980	NAP	121	19.8	25.92
3	211214002020	NAP	121	20.2	25.83
3	236804101159	SOL	680	11.59	25.82
3	330844001533	ALA	84	15.33	25.76
3	201014104042	SON	101	40.42	25.69
3	211210002081	NAP	121	20.81	25.69
3	211280002266	NAP	128	22.66	25.68
3	211214002011	NAP	121	20.11	25.68
3	280044000379	CC	4	3.79	25.68
3	350840000979	SM	84	9.79	25.61
3	350844000216	SM	84	2.16	25.56
3	330844001188	ALA	84	11.88	25.42
3	330844002083	ALA	84	20.83	25.33
3	201014104042	SON	101	40.42	25.30
3	211214001859	NAP	121	18.59	25.04
3	280044000320	CC	4	3.2	24.98
3	371524000438	SCL	152	4.38	24.87
3	371524000453	SCL	152	4.53	24.82
3	200124002570	SON	12	25.7	24.54
3	210290000601	NAP	29	6.01	24.50
3	270015201753	MRN	1	17.53	24.47
3	210294003416	NAP	29	34.16	24.10

Priority	Culvert System Number	County[36]	Route	Postmile	Cross-Hazard Prioritization Score
3	350844000423	SM	84	4.23	24.07
3	201014104304	SON	101	43.04	23.71
3	211214001349	NAP	121	13.49	23.63
3	236804100914	SOL	680	9.14	23.56
3	201014104980	SON	101	49.8	23.47
3	236804100914	SOL	680	9.14	23.46
3	280040000839	CC	4	8.39	23.45
3	280040000839	CC	4	8.39	23.45
3	350010000178	SM	1	1.78	23.38
3	330844002294	ALA	84	22.94	23.33
3	330844001486	ALA	84	14.86	23.18
3	201014104980	SON	101	49.8	23.11
3	201014003697	SON	101	36.97	23.06
3	370090000695	SCL	9	6.95	22.78
3	330844001975	ALA	84	19.75	22.73
3	200124002754	SON	12	27.54	22.71
3	350840001206	SM	84	12.06	22.67
3	201164000711	SON	116	7.11	22.55
3	280042000321	CC	4	3.21	22.54
3	200010001167	SON	1	11.67	22.43
3	330844001843	ALA	84	18.43	22.42
3	370090000137	SCL	9	1.37	22.41
3	200120001795	SON	12	17.95	22.29
3	200124003080	SON	12	30.8	22.18
3	200124002167	SON	12	21.67	22.17
3	200124002984	SON	12	29.84	22.02
3	200124003192	SON	12	31.92	21.89
3	336800800086	ALA	680	0.86	21.64
3	236804100253	SOL	680	2.53	21.45
3	210124000294	NAP	12	2.94	21.44
3	371524000307	SCL	152	3.07	21.21
3	200010002382	SON	1	23.82	21.05
3	201284000584	SON	128	5.84	21.04
3	200010005324	SON	1	53.24	20.89
3	200010005396	SON	1	53.96	20.82
3	352800000900	SM	280	9	20.56
3	332380000111	ALA	238	1.11	20.46
3	270010001817	MRN	1	18.17	20.37
3	200010003137	SON	1	31.37	20.26
3	370090000297	SCL	9	2.97	20.23

Priority	Culvert System Number	County[36]	Route	Postmile	Cross-Hazard Prioritization Score
3	200010005152	SON	1	51.52	20.18
3	338806100225	ALA	880	2.25	20.17
3	350844001758	SM	84	17.58	20.04
3	270010002053	MRN	1	20.53	19.93
3	270010002066	MRN	1	20.66	19.93
4	370094000625	SCL	9	6.25	19.93
4	270010002033	MRN	1	20.33	19.93
4	350010000300	SM	1	3	19.92
4	350010004312	SM	1	43.12	19.49
4	350840001291	SM	84	12.91	19.24
4	350844002057	SM	84	20.57	19.23
4	350010000307	SM	1	3.07	19.09
4	200010000247	SON	1	2.47	18.97
4	371524000234	SCL	152	2.34	18.95
4	350010002277	SM	1	22.77	18.39
4	201016002920	SON	101	29.2	18.37
4	200010003081	SON	1	30.81	18.36
4	200010003100	SON	1	31	18.28
4	200010002990	SON	1	29.9	18.27
4	350010000064	SM	1	0.64	18.17
4	200010003245	SON	1	32.45	18.16
4	270010001800	MRN	1	18	17.69
4	201164001437	SON	116	14.37	17.57
4	270010001994	MRN	1	19.94	17.46
4	270010002106	MRN	1	21.06	17.46
4	286804000298	CC	680	2.98	17.43
4	270010002326	MRN	1	23.26	17.36
4	270010002369	MRN	1	23.69	17.35
4	270010001867	MRN	1	18.67	17.31
4	201164000660	SON	116	6.6	17.29
4	286804100241	CC	680	2.41	17.22
4	270010002650	MRN	1	26.5	17.21
4	201164000623	SON	116	6.23	17.13
4	237800000486	SOL	780	4.86	17.10
4	237800000486	SOL	780	4.86	17.10
4	350844001924	SM	84	19.24	17.02
4	350010000429	SM	1	4.29	16.96
4	201164000433	SON	116	4.33	16.92
4	201284001105	SON	128	11.05	16.76
4	350844000142	SM	84	1.42	16.49

Priority	Culvert System Number	County[36]	Route	Postmile	Cross-Hazard Prioritization Score
4	371524000021	SCL	152	0.21	16.37
4	330130000682	ALA	13	6.82	16.24
4	330134000719	ALA	13	7.19	16.22
4	350010003029	SM	1	30.29	16.13
4	330134000719	ALA	13	7.19	15.99
4	200010000568	SON	1	5.68	15.84
4	350844000460	SM	84	4.6	15.72
4	201164001348	SON	116	13.48	15.69
4	200010004455	SON	1	44.55	15.49
4	230124000576	SOL	12	5.76	15.42
4	370090000627	SCL	9	6.27	15.40
4	210294000260	NAP	29	2.6	15.31
4	201164004369	SON	116	43.69	15.23
4	230120002510	SOL	12	25.1	15.23
4	237801200520	SOL	780	5.2	15.16
4	270010002267	MRN	1	22.67	15.04
4	201160003908	SON	116	39.08	14.76
4	201160001642	SON	116	16.42	14.72
4	370094000640	SCL	9	6.4	14.72
4	201164003114	SON	116	31.14	14.62
4	201164001552	SON	116	15.52	14.49
4	200010002184	SON	1	21.84	14.33
4	200010004013	SON	1	40.13	14.24
4	350010000122	SM	1	1.22	14.19
4	201160004276	SON	116	42.76	14.17
4	200010004236	SON	1	42.36	14.03
4	270010003930	MRN	1	39.3	13.95
4	201160003940	SON	116	39.4	13.82
4	211280002396	NAP	128	23.96	13.67
4	201160003388	SON	116	33.88	13.40
4	201010003305	SON	101	33.05	13.33
4	201016003103	SON	101	31.03	13.19
5	200010004306	SON	1	43.06	12.93
5	350014001540	SM	1	15.4	12.86
5	200010002283	SON	1	22.83	12.82
5	210294000260	NAP	29	2.6	12.80
5	200010004811	SON	1	48.11	12.68
5	350010003131	SM	1	31.31	12.57
5	200010004131	SON	1	41.31	12.52
5	200010000861	SON	1	8.61	12.34

Priority	Culvert System Number	County[36]	Route	Postmile	Cross-Hazard Prioritization Score
5	201016003453	SON	101	34.53	12.22
5	336800800550	ALA	680	5.5	11.38
5	282420000265	CC	242	2.65	11.18
5	201010003201	SON	101	32.01	11.02
5	200010004618	SON	1	46.18	11.00
5	201016003103	SON	101	31.03	10.75
5	200010004832	SON	1	48.32	10.70
5	201014003022	SON	101	30.22	10.64
5	201164002131	SON	116	21.31	10.61
5	210294002354	NAP	29	23.54	10.57
5	211284000511	NAP	128	5.11	10.54
5	336806800394	ALA	680	3.94	10.45
5	201010003201	SON	101	32.01	10.33
5	336806800394	ALA	680	3.94	10.29
5	201014003022	SON	101	30.22	10.27
5	200010003963	SON	1	39.63	10.19
5	336808800249	ALA	680	2.49	10.06
5	210294002162	NAP	29	21.62	10.05
5	210290000403	NAP	29	4.03	9.99
5	200010004100	SON	1	41	9.92
5	336800800140	ALA	680	1.4	9.57
5	280800000477	CC	80	4.77	9.51
5	336800800140	ALA	680	1.4	9.41
5	200010004924	SON	1	49.24	9.05
5	200010005033	SON	1	50.33	9.00
5	210290000507	NAP	29	5.07	8.64
5	210290000507	NAP	29	5.07	8.36
5	201280700518	SON	128	5.18	8.28
5	236804101159	SOL	680	11.59	8.16
5	230120002365	SOL	12	23.65	8.12
5	336800800550	ALA	680	5.5	8.11
5	230124002438	SOL	12	24.38	8.01
5	200010003320	SON	1	33.2	7.91
5	371524001384	SCL	152	13.84	7.57
5	200010003587	SON	1	35.87	7.50
5	201014104556	SON	101	45.56	7.40
5	201018105146	SON	101	51.46	7.06
5	211210000687	NAP	121	6.87	6.71
5	200010002774	SON	1	27.74	6.64
5	201014104830	SON	101	48.3	6.48

Priority	Culvert System Number	County[36]	Route	Postmile	Cross-Hazard Prioritization Score
5	200010002900	SON	1	29	6.40
5	200124003706	SON	12	37.06	6.10
5	200010002863	SON	1	28.63	6.06
5	332380000597	ALA	238	5.97	5.57
5	200120003884	SON	12	38.84	5.33
5	201160004567	SON	116	45.67	5.30
5	200010004697	SON	1	46.97	5.22
5	200010004517	SON	1	45.17	5.15
5	350010003475	SM	1	34.75	4.77
5	200124002680	SON	12	26.8	4.73
5	200124003274	SON	12	32.74	4.59
5	200124002910	SON	12	29.1	4.59
5	200124002924	SON	12	29.24	4.52
5	350010003515	SM	1	35.15	4.32
5	200010005688	SON	1	56.88	3.49
5	200010004997	SON	1	49.97	3.49
5	200010003897	SON	1	38.97	2.49
5	201164004443	SON	116	44.43	2.12
5	201164001988	SON	116	19.88	0.00

TABLE 11: PRIORITIZATION OF ROADWAYS FOR
DETAILED CLIMATE CHANGE ADAPTATION ASSESSMENTS

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
1	260	P	ALA 260 R0.64 / ALA 260 R1.723R	75.11
1	109	S	SM 109 1.103 / SM 109 1.87	74.21
1	109	P	SM 109 1.103 / SM 109 1.87	73.30
1	37	P	MRN 37 14.503 / SON 37 R6.058	73.00
1	37	P	MRN 37 R11.2 / MRN 37 R11.354	73.00
1	37	P	MRN 37 R11.456 / MRN 37 13.758	73.00
1	37	P	SOL 37 R0.163 / SOL 37 R7.301	73.00
1	880S	P	ALA 880S 1.234R / ALA 880S 1.069R	72.90
1	37	S	MRN 37 14.501 / SON 37 3.78	72.88
1	37	S	MRN 37 R11.246 / MRN 37 R11.349	72.88
1	37	S	MRN 37 R11.453 / MRN 37 13.732	72.88
1	37	S	SOL 37 R0.163 / SOL 37 R7.324	72.88
1	37	S	SON 37 4.001 / SON 37 R6.058	72.88
1	260	S	ALA 260 R0.64 / ALA 260 R1.702L	69.88
1	92	S	SM 92 R12.384 / ALA 92 R4.453	64.71
1	92	P	SM 92 R12.496 / ALA 92 R4.17	64.34
1	580	S	ALA 580 46.946L / ALA 580 46.52L	64.20
1	580	S	ALA 580 L0.984L / SJ 580 15.334L	64.20
1	580	S	CC 580 R3.807 / CC 580 R2.841	64.20
1	580	S	MRN 580 4.512 / MRN 580 3.318	64.20
1	580	S	MRN 580 4.782 / MRN 580 4.521	64.20
1	280	S	SF 280 T7.424 / SF 280 T7.542	63.51
1	61	S	ALA 61 16.013 / ALA 61 14.8	62.68
1	61	S	ALA 61 17.068 / ALA 61 16.023	62.68
1	61	S	ALA 61 18.552 / ALA 61 18.359	62.68
1	61	S	ALA 61 18.949 / ALA 61 18.891	62.68
1	61	S	ALA 61 19.529 / ALA 61 19.44	62.68
1	114	S	SM 114 5.256 / SM 114 5.921	62.36
1	880S	S	ALA 880S 0.456L / ALA 880S 0.008L	62.26
1	880S	S	ALA 880S 1.257L / ALA 880S 1.131L	62.26
1	114	P	SM 114 5.259 / SM 114 5.922	61.40

[37] Caltrans' alignment codes designate the carriageway on divided roadways: "P" always represents northbound or eastbound carriageways whereas "S" always represents southbound or westbound carriageways. Undivided roadways are always indicated with a "P".
[38] ALA = Alameda, CC = Contra Costa, MRN = Marin, NAP = Napa, SF = San Francisco, SM = San Mateo, SCL = Santa Clara, SOL = Solano, SON = Sonoma
[39] The average of the cross-hazard prioritization scores amongst all the abutting small segments on the same route sharing a common priority level that were aggregated to form the longer segments listed in this table.

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
1	380	P	SM 380 6.676 / SM 380 6.76	61.24
1	380	S	SM 380 6.684 / SM 380 6.76	61.23
1	280	P	SF 280 T7.422 / SF 280 T7.542	60.23
1	131	P	MRN 131 0.842 / MRN 131 R1.047	59.20
1	131	P	MRN 131 1.72 / MRN 131 1.86	59.20
1	131	P	MRN 131 3.721 / MRN 131 4.392	59.20
1	61	P	ALA 61 16.011 / ALA 61 14.8	58.55
1	61	P	ALA 61 18.895 / ALA 61 16.022	58.55
1	61	P	ALA 61 19.53 / ALA 61 18.906	58.55
1	84	P	SM 84 25.319 / SM 84 25.654	58.28
1	84	P	SM 84 R25.933 / ALA 84 R3.732	58.28
1	84	P	SOL 84 0.134 / SOL 84 12.08	58.28
1	84	P	SOL 84 12.172 / YOL 84 0.004	58.28
1	220	P	SOL 220 0.005 / SOL 220 3.196	56.91
1	131	S	MRN 131 0.665 / MRN 131 R1.051	56.85
1	131	S	MRN 131 1.719 / MRN 131 1.86	56.85
1	131	S	MRN 131 4.127 / MRN 131 4.392	56.85
1	101	P	MRN 101 18.882 / MRN 101 19.087	55.67
1	101	P	MRN 101 19.883 / MRN 101 R20.193	55.67
1	101	P	MRN 101 3.343 / MRN 101 4.047	55.67
1	101	P	MRN 101 4.561 / MRN 101 5.425	55.67
1	101	P	MRN 101 7.166 / MRN 101 8.036	55.67
1	101	P	MRN 101 8.088 / MRN 101 8.584	55.67
1	101	P	MRN 101 9.743 / MRN 101 10.882	55.67
1	101	P	SCL 101 49.349 / SCL 101 52.371	55.67
1	101	P	SF 101 8.266R / SF 101 8.341R	55.67
1	101	P	SM 101 11.15 / SM 101 15.122	55.67
1	101	P	SM 101 16.135 / SM 101 21.561	55.67
1	101	P	SM 101 2.109 / SM 101 3.594	55.67
1	101	P	SM 101 3.79 / SM 101 9.547	55.67
1	101	P	SM 101 9.585 / SM 101 11.143	55.67
1	580	P	ALA 580 46.946R / ALA 580 46.617R	54.87
1	580	P	ALA 580 L1.045R / ALA 580 0.092R	54.87
1	580	P	CC 580 0.406 / CC 580 0.238	54.87
1	580	P	CC 580 R2.889 / CC 580 R2.645	54.87
1	580	P	CC 580 R3.931 / CC 580 R2.943	54.87
1	580	P	MRN 580 4.509 / MRN 580 3.303	54.87
1	580	P	MRN 580 4.782 / MRN 580 4.518	54.87

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
1	101	S	MRN 101 18.882 / MRN 101 19.085	54.49
1	101	S	MRN 101 3.348 / MRN 101 3.909	54.49
1	101	S	MRN 101 4.561 / MRN 101 5.483	54.49
1	101	S	MRN 101 7.153 / MRN 101 8.032	54.49
1	101	S	MRN 101 8.119 / MRN 101 8.588	54.49
1	101	S	MRN 101 9.748 / MRN 101 10.884	54.49
1	101	S	MRN 101 R20.188 / MRN 101 R20.196	54.49
1	101	S	SCL 101 49.432 / SCL 101 52.178	54.49
1	101	S	SM 101 11.153 / SM 101 21.696	54.49
1	101	S	SM 101 2.08 / SM 101 3.573	54.49
1	101	S	SM 101 3.598 / SM 101 5.386	54.49
1	101	S	SM 101 5.393 / SM 101 9.55	54.49
1	101	S	SM 101 9.56 / SM 101 11.145	54.49
1	1	P	MRN 1 0 / MRN 1 0.759	54.33
1	1	P	MRN 1 12.591 / MRN 1 17.06	54.33
1	1	P	MRN 1 36.487 / MRN 1 38.408	54.33
1	1	P	SM 1 32.022 / SM 1 32.857	54.33
1	1	P	SM 1 36.387 / SM 1 36.634	54.33
1	1	P	SM 1 40.756 / SM 1 41.274	54.33
1	1	P	SON 1 14.103 / SON 1 14.368	54.33
1	1	P	SON 1 14.82 / SON 1 16.348	54.33
1	1	P	SON 1 21.139 / SON 1 21.226	54.33
1	84	S	SM 84 25.314 / SM 84 25.653	52.54
1	84	S	SM 84 R25.998 / ALA 84 R3.749	52.54
1	680	P	CC 680 23.434 / CC 680 24.37	51.32
1	121	P	SON 121 0.597 / SON 121 1.424	51.15
1	121	P	SON 121 5.203 / SON 121 6.13	51.15
1	4	S	CC 4 45.327 / CC 4 47.348	49.28
1	4	S	CC 4 R39.732 / CC 4 R39.953	49.28
1	4	S	CC 4 R41.752 / CC 4 R41.96	49.28
1	680	S	CC 680 23.437 / CC 680 24.399	48.36
1	237	P	SCL 237 6.778 / SCL 237 7.74	45.08
1	237	P	SCL 237 R3.795 / SCL 237 R5.486	45.08
1	237	S	SCL 237 6.619 / SCL 237 7.911	44.94
1	237	S	SCL 237 R3.79 / SCL 237 R5.466	44.94
1	880	S	ALA 880 14.443 / ALA 880 14.548	44.66
1	880	S	ALA 880 24.974 / ALA 880 27.519	44.66
1	880	S	ALA 880 29.67 / ALA 880 30.475	44.66

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
1	880	S	ALA 880 R34.04L / ALA 880 R34.423L	44.66
1	880	S	SCL 880 10.413 / ALA 880 R0.266	44.66
1	205	S	ALA 205 L0.076 / SJ 205 L0.005	43.76
1	205	P	ALA 205 L0.11 / SJ 205 L0.005	43.76
1	880	P	ALA 880 14.031 / ALA 880 14.533	43.54
1	880	P	ALA 880 25.067 / ALA 880 27.419	43.54
1	880	P	ALA 880 29.687 / ALA 880 30.474	43.54
1	880	P	SCL 880 10.408 / ALA 880 R0.153	43.54
1	4	P	CC 4 45.327 / CC 4 48.392	41.46
1	4	P	CC 4 R39.34 / CC 4 R41.96	41.46
1	80	S	ALA 80 2.521 / ALA 80 3.241	41.20
1	80	S	SF 80 R8.149 / ALA 80 2.438	41.20
1	80	S	SOL 80 17.905 / SOL 80 R43.985	41.20
1	80	S	SOL 80 R44.666 / SOL 80 R44.715	41.20
1	80	P	ALA 80 2.535 / ALA 80 3.181	40.44
1	80	P	SF 80 R8.093 / ALA 80 2.445	40.44
1	80	P	SOL 80 17.702 / SOL 80 R44.72	40.44
1	29	S	SOL 29 3.117 / SOL 29 4.689	39.56
1	12	S	SOL 12 R14.939 / SOL 12 15.07	38.32
1	12	S	SOL 12 R5.094 / SOL 12 5.151	38.32
1	29	P	SOL 29 1.642 / SOL 29 1.805	38.29
1	29	P	SOL 29 3.08 / SOL 29 4.733	38.29
1	113	P	SOL 113 18.592 / SOL 113 21.24	34.41
1	113	P	SOL 113 21.24 / YOL 113 R0.001	34.41
1	113	P	SOL 113 4.052 / SOL 113 5.565	34.41
1	113	P	SOL 113 5.862 / SOL 113 7.021	34.41
1	505	P	SOL 505 R0 / SOL 505 R10.626	34.09
1	505	S	SOL 505 R0.012 / SOL 505 R10.622	34.00
1	113	S	SOL 113 19.22 / SOL 113 19.538	33.32
1	113	S	SOL 113 19.586 / SOL 113 20.051	33.32
1	113	S	SOL 113 21.12 / SOL 113 21.165	33.32
1	113	S	SOL 113 R21.653L / YOL 113 R0.012	33.32
1	12	P	SOL 12 13.64 / SOL 12 R17.109	33.14
1	112	P	ALA 112 R0 / ALA 112 R0.028	32.30
2	113	P	SOL 113 0.007 / SOL 113 4.052	31.89
2	113	P	SOL 113 5.565 / SOL 113 5.862	31.89
2	113	P	SOL 113 7.021 / SOL 113 18.592	31.89
2	128	P	NAP 128 31.909 / YOL 128 0	31.77

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
2	13	P	ALA 13 13.785R / ALA 13 13.708	31.64
2	13	P	ALA 13 13.906R / ALA 13 13.905R	31.64
2	131	P	MRN 131 0.666 / MRN 131 0.842	30.31
2	61	S	ALA 61 19.578 / ALA 61 19.529	30.20
2	29	P	SOL 29 1.297 / SOL 29 1.642	29.63
2	112	S	ALA 112 R0 / ALA 112 R0.116	28.73
2	880	P	ALA 880 14.533 / ALA 880 14.806	28.60
2	880	P	ALA 880 27.419 / ALA 880 27.802	28.60
2	880	P	ALA 880 29.194 / ALA 880 29.687	28.60
2	880	P	ALA 880 3.016 / ALA 880 3.261	28.60
2	880	P	ALA 880 R0.153 / ALA 880 R1.549	28.60
2	205	S	ALA 205 L0.026 / ALA 205 L0.076	28.43
2	237	S	SCL 237 7.911 / SCL 237 7.99	27.72
2	37	P	SOL 37 8.482 / SOL 37 R9.243	27.52
2	237	P	SCL 237 7.74 / SCL 237 7.991	26.99
2	237	P	SCL 237 R6.239 / SCL 237 6.778	26.99
2	37	S	SOL 37 8.471 / SOL 37 R9.389	26.98
2	1	P	MRN 1 11.133 / MRN 1 12.209	26.83
2	1	P	MRN 1 40.407 / MRN 1 44.422	26.83
2	1	P	MRN 1 7.937 / MRN 1 10.651	26.83
2	1	P	SCR 1 37.45 / SM 1 0.605	26.83
2	1	P	SM 1 13.578 / SM 1 18.193	26.83
2	1	P	SM 1 36.634 / SM 1 37.927	26.83
2	1	P	SON 1 12.413 / SON 1 14.103	26.83
2	1	P	SON 1 14.368 / SON 1 14.82	26.83
2	1	P	SON 1 34.859 / SON 1 35.592	26.83
2	1	P	SON 1 35.619 / SON 1 35.888	26.83
2	1	P	SON 1 36.24 / SON 1 36.544	26.83
2	1	P	SON 1 37.02 / SON 1 37.416	26.83
2	1	P	SON 1 38.025 / SON 1 38.71	26.83
2	1	P	SON 1 45.549 / SON 1 47.058	26.83
2	580	S	ALA 580 48.038 / ALA 580 R47.625	26.75
2	580	S	ALA 580 R1.792L / ALA 580 L0.975L	26.75
2	580	S	ALA 580 R21.735 / ALA 580 R5.972L	26.75
2	580	S	CC 580 1.216 / CC 580 0.244	26.75
2	580	S	CC 580 R2.841 / CC 580 R2.645	26.75
2	580	S	CC 580 R4.044 / CC 580 R3.807	26.75
2	580	P	ALA 580 R1.773R / ALA 580 L1.045R	26.66

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
2	580	P	ALA 580 R21.823 / ALA 580 R5.979R	26.66
2	580	P	CC 580 0.238 / ALA 580 R47.608	26.66
2	580	P	CC 580 0.944 / CC 580 0.406	26.66
2	580	P	CC 580 R2.943 / CC 580 R2.889	26.66
2	80	P	ALA 80 2.445 / ALA 80 2.535	26.51
2	80	P	ALA 80 3.181 / ALA 80 3.186	26.51
2	80	P	SOL 80 13.739 / SOL 80 17.702	26.51
2	80	S	ALA 80 2.438 / ALA 80 2.521	26.38
2	80	S	SOL 80 13.635 / SOL 80 17.905	26.38
2	121	P	SON 121 7.459 / SON 121 8.12	25.39
2	121	P	SON 121 8.21 / SON 121 9.12	25.39
2	680	S	ALA 680 R19.08 / ALA 680 R21.681	24.68
2	680	S	CC 680 15.632 / CC 680 23.437	24.68
2	680	S	CC 680 24.529 / CC 680 25.06L	24.68
2	680	S	CC 680 R1.903 / CC 680 13.682	24.68
2	680	S	SOL 680 R1.528 / SOL 680 R10.021	24.68
2	680	P	ALA 680 R18.98 / ALA 680 R21.653	24.68
2	680	P	CC 680 15.835 / CC 680 23.434	24.68
2	680	P	CC 680 24.477 / SOL 680 R0.669	24.68
2	680	P	CC 680 R1.9 / CC 680 13.68	24.68
2	680	P	SOL 680 R1.302 / SOL 680 R9.769	24.68
2	880	S	ALA 880 13.864 / ALA 880 14.443	24.44
2	880	S	ALA 880 14.548 / ALA 880 14.555	24.44
2	880	S	ALA 880 29.208 / ALA 880 29.67	24.44
2	880	S	ALA 880 3.163 / ALA 880 3.567	24.44
2	880	S	ALA 880 R0.266 / ALA 880 R1.527	24.44
2	84	S	ALA 84 R3.758 / ALA 84 R4.026	22.03
2	4	P	CC 4 R41.96 / CC 4 45.327	21.97
2	4	P	CC 4 R8.771 / CC 4 R32.955	21.97
2	12	P	SOL 12 26.245 / SOL 12 26.275	21.95
2	12	P	SOL 12 R4.213 / SOL 12 R4.651	21.95
2	12	P	SOL 12 R4.829 / SOL 12 R5.15	21.95
2	12	P	SON 12 9.326 / SON 12 9.844	21.95
2	4	S	CC 4 R41.96 / CC 4 45.327	21.95
2	4	S	CC 4 R8.795 / CC 4 R32.948	21.95
2	112	P	ALA 112 R0.028 / ALA 112 R0.123	21.89
2	101	P	MRN 101 19.087 / MRN 101 19.548	21.85
2	101	P	MRN 101 5.916 / MRN 101 7.166	21.85

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
2	101	P	MRN 101 R20.193 / MRN 101 R20.471	21.85
2	101	P	MRN 101 R22.318 / MRN 101 25.132	21.85
2	101	P	SCL 101 R0.917 / SCL 101 R10.497	21.85
2	101	P	SF 101 8.054 / SF 101 8.266R	21.85
2	101	P	SM 101 11.143 / SM 101 11.15	21.85
2	101	P	SM 101 15.122 / SM 101 16.135	21.85
2	101	P	SM 101 21.561 / SM 101 21.695	21.85
2	101	P	SM 101 23.929 / SM 101 25.537	21.85
2	101	P	SM 101 3.63 / SM 101 3.79	21.85
2	101	P	SM 101 9.547 / SM 101 9.585	21.85
2	101	P	SON 101 25.033 / SON 101 34.563	21.85
2	242	P	CC 242 L0.17 / CC 242 R3.398	21.76
2	242	S	CC 242 L0 / CC 242 R3.354	21.75
2	101	S	MRN 101 19.085 / MRN 101 R20.188	21.55
2	101	S	MRN 101 6.487 / MRN 101 7.153	21.55
2	101	S	MRN 101 R20.196 / MRN 101 R20.505	21.55
2	101	S	MRN 101 R22.279 / MRN 101 25.392	21.55
2	101	S	SCL 101 52.178 / SM 101 0.871	21.55
2	101	S	SCL 101 R0.888 / SCL 101 R10.602	21.55
2	101	S	SF 101 8.055 / SF 101 8.364L	21.55
2	101	S	SM 101 11.145 / SM 101 11.153	21.55
2	101	S	SM 101 9.55 / SM 101 9.56	21.55
2	101	S	SON 101 25.164 / SON 101 34.556	21.55
2	84	P	ALA 84 23.204 / ALA 84 23.239	21.06
2	84	P	ALA 84 23.543 / ALA 84 R24.826	21.06
2	84	P	ALA 84 R3.754 / ALA 84 R3.97	21.06
2	84	P	SM 84 R25.883 / SM 84 R25.933	21.06
2	25	P	SCL 25 1.32 / SCL 25 1.701	19.34
2	25	P	SCL 25 1.985 / SCL 25 2.508	19.34
2	12	S	SOL 12 R4.3 / SOL 12 R4.571	19.14
2	12	S	SOL 12 R4.654 / SOL 12 R5.094	19.14
2	152	S	SCL 152 R34.862 / SCL 152 R35.145	19.08
2	152	P	SCL 152 R34.864 / MER 152 R0	19.08
3	37	P	MRN 37 R11.354 / MRN 37 R11.456	18.70
3	580	P	ALA 580 R5.979R / ALA 580 R1.773R	18.64
3	37	S	MRN 37 R11.349 / MRN 37 R11.453	17.83
3	37	S	SOL 37 8.464 / SOL 37 8.471	17.83
3	152	P	SCL 152 6.451 / SCL 152 9.427	17.65

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
3	152	P	SCL 152 M9.43 / SCL 152 M9.787	17.65
3	152	P	SCL 152 M9.787 / SCL 152 M10.277	17.65
3	152	P	SCL 152 M9.787 / SCL 152 M9.787	17.65
3	152	P	SCL 152 M9.787 / SCL 152 M9.787	17.65
3	152	P	SCL 152 R9.914 / SCL 152 14.368	17.65
3	12	P	SOL 12 L1.801 / SOL 12 R4.213	17.60
3	12	P	SOL 12 R17.109 / SOL 12 26.245	17.60
3	12	P	SOL 12 R4.651 / SOL 12 R4.829	17.60
3	12	P	SOL 12 R5.15 / SOL 12 13.64	17.60
3	12	P	SON 12 35.213 / SON 12 41.36	17.60
3	12	P	SON 12 9.23 / SON 12 9.326	17.60
3	12	P	SON 12 9.844 / SON 12 10.652	17.60
3	25	S	SCL 25 1.701 / SCL 25 1.985	17.59
3	4	P	CC 4 R32.955 / CC 4 R39.34	17.52
3	25	P	SCL 25 0 / SCL 25 1.32	17.43
3	25	P	SCL 25 1.701 / SCL 25 1.985	17.43
3	25	P	SCL 25 2.508 / SCL 25 2.56	17.43
3	101	S	MRN 101 13.936 / MRN 101 14.543	17.36
3	101	S	MRN 101 18.63 / MRN 101 18.882	17.36
3	101	S	SM 101 23.685 / SF 101 0.039	17.36
3	101	S	SON 101 34.556 / SON 101 R46.018	17.36
3	101	S	SON 101 R49.318 / MEN 101 R0.112	17.36
3	4	S	CC 4 M38.83 / CC 4 R39.289	17.35
3	4	S	CC 4 R32.948 / CC 4 R35.824	17.35
3	4	S	CC 4 R37.666 / CC 4 R38.255	17.35
3	84	S	ALA 84 23.239 / ALA 84 23.543	17.29
3	84	S	ALA 84 R22.167 / ALA 84 23.204	17.29
3	84	S	ALA 84 R24.971 / ALA 84 N28.154	17.29
3	84	S	SM 84 25.058 / SM 84 25.314	17.29
3	12	S	SOL 12 12.45 / SOL 12 12.591	17.29
3	12	S	SOL 12 13.507 / SOL 12 13.64	17.29
3	12	S	SOL 12 19.099 / SOL 12 19.25	17.29
3	12	S	SOL 12 25.534 / SOL 12 26.245	17.29
3	12	S	SOL 12 5.151 / SOL 12 7.84	17.29
3	12	S	SOL 12 L1.807 / SOL 12 R4.3	17.29
3	12	S	SOL 12 R17.109 / SOL 12 R17.227	17.29
3	12	S	SON 12 35.214 / SON 12 35.531	17.29
3	12	S	SON 12 36.114 / SON 12 36.475	17.29

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
3	12	S	SON 12 36.59 / SON 12 37.4	17.29
3	12	S	SON 12 37.57 / SON 12 38.056	17.29
3	12	S	SON 12 9.844 / SON 12 10.429	17.29
3	152	S	SCL 152 8.182 / SCL 152 9.163	17.23
3	152	S	SCL 152 9.425 / SCL 152 M9.787	17.23
3	152	S	SCL 152 M9.787 / SCL 152 M10.276	17.23
3	152	S	SCL 152 R10.051 / SCL 152 11.474	17.23
3	84	P	ALA 84 23.239 / ALA 84 23.543	17.15
3	84	P	ALA 84 R22.169 / ALA 84 23.204	17.15
3	84	P	ALA 84 R24.826 / ALA 84 N28.154	17.15
3	84	P	ALA 84 R3.97 / ALA 84 R4.684	17.15
3	84	P	SM 84 25.059 / SM 84 25.319	17.15
3	116	P	SON 116 20.776 / SON 116 28.222	16.92
3	116	P	SON 116 35.077 / SON 116 35.39	16.92
3	116	P	SON 116 R43.216 / SON 116 46.755	16.92
3	101	P	MRN 101 13.838 / MRN 101 14.36	16.90
3	101	P	MRN 101 18.203 / MRN 101 18.882	16.90
3	101	P	SF 101 L8.477R / SF 101 9.289	16.90
3	101	P	SM 101 25.537 / SM 101 25.929	16.90
3	101	P	SON 101 34.563 / SON 101 35.171	16.90
3	101	P	SON 101 36.02 / SON 101 R46.016	16.90
3	101	P	SON 101 R49.319 / SON 101 R56.219	16.90
3	29	P	NAP 29 16.626 / NAP 29 26.568	16.79
3	29	P	NAP 29 28.109 / NAP 29 31.226	16.79
3	29	P	NAP 29 34.489 / NAP 29 47.919	16.79
3	29	P	SOL 29 3.015 / SOL 29 3.08	16.79
3	116	S	SON 116 44.072 / SON 116 44.303	16.73
3	116	S	SON 116 R23.679 / SON 116 25.396	16.73
3	116	S	SON 116 R26.651L / SON 116 27.792	16.73
3	121	P	NAP 121 18.772 / NAP 121 22.083	16.61
3	121	P	SON 121 0.118 / SON 121 0.597	16.61
3	121	P	SON 121 1.57 / SON 121 2.68	16.61
3	121	P	SON 121 2.694 / SON 121 5.203	16.61
3	121	P	SON 121 6.13 / SON 121 7.459	16.61
3	121	P	SON 121 8.12 / SON 121 8.21	16.61
3	121	P	SON 121 9.12 / NAP 121 1.989	16.61
3	29	S	NAP 29 16.629 / NAP 29 19.544	16.41
3	29	S	NAP 29 28.11 / NAP 29 28.421	16.41

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
3	29	S	SOL 29 4.689 / SOL 29 4.723	16.41
3	160	S	CC 160 L0.081L / CC 160 0.83	16.34
3	160	P	CC 160 L0R / CC 160 0.83	16.30
3	237	S	SCL 237 3.262 / SCL 237 R3.79	16.24
3	237	S	SCL 237 7.99 / SCL 237 8.317	16.24
3	237	S	SCL 237 R6.252 / SCL 237 6.619	16.24
3	260	P	ALA 260 R1.723R / ALA 260 R1.784R	16.22
3	880	S	ALA 880 14.555 / ALA 880 15.372	16.22
3	880	S	ALA 880 2.957 / ALA 880 3.163	16.22
3	880	S	ALA 880 24.748 / ALA 880 24.974	16.22
3	880	S	ALA 880 27.519 / ALA 880 27.801	16.22
3	880	S	ALA 880 R33.522 / ALA 880 R34.04L	16.22
3	880	S	SCL 880 9.072 / SCL 880 10.105	16.22
3	128	P	NAP 128 4.56 / NAP 128 31.909	16.04
3	128	P	SON 128 1.237 / SON 128 L4.859	16.04
3	128	P	SON 128 15.799 / SON 128 21.452	16.04
3	128	P	SON 128 22.606 / NAP 128 4.55	16.04
3	128	P	SON 128 8.57 / SON 128 12.127	16.04
3	128	P	SON 128 L4.86 / SON 128 7.339	16.04
3	61	P	ALA 61 19.621 / ALA 61 19.53	16.03
3	113	P	SOL 113 0 / SOL 113 0.007	16.02
3	580	S	ALA 580 R47.625 / ALA 580 R47.373	15.92
3	580	S	ALA 580 R5.972L / ALA 580 R1.792L	15.92
3	580	S	CC 580 0.244 / ALA 580 48.038	15.92
3	580	S	CC 580 1.465 / CC 580 1.216	15.92
3	82	S	SM 82 10.305 / SM 82 10.135	15.36
3	13	P	ALA 13 13.905R / ALA 13 13.785R	15.30
3	13	S	ALA 13 13.77L / ALA 13 13.708	15.18
3	114	P	SM 114 5.148 / SM 114 5.259	14.79
3	1	P	MRN 1 0.759 / MRN 1 0.869	14.76
3	1	P	MRN 1 17.06 / MRN 1 17.2	14.76
3	1	P	MRN 1 31.017 / MRN 1 33.211	14.76
3	1	P	MRN 1 34.786 / MRN 1 36.487	14.76
3	1	P	MRN 1 6.971 / MRN 1 7.392	14.76
3	1	P	SM 1 13.133 / SM 1 13.578	14.76
3	1	P	SM 1 31.415 / SM 1 32.022	14.76
3	1	P	SON 1 20.101 / SON 1 21.139	14.76
3	1	P	SON 1 21.787 / SON 1 23.958	14.76

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
3	1	P	SON 1 36.185 / SON 1 36.24	14.76
3	1	P	SON 1 36.544 / SON 1 36.727	14.76
3	1	P	SON 1 37.416 / SON 1 38.025	14.76
3	1	P	SON 1 47.058 / SON 1 48.111	14.76
3	1	P	SON 1 R33.264 / SON 1 34.762	14.76
3	880	P	ALA 880 24.831 / ALA 880 25.067	14.60
3	880	P	ALA 880 3.261 / ALA 880 3.546	14.60
3	880	P	SCL 880 9.149 / SCL 880 10.401	14.60
3	680	P	CC 680 14.18 / CC 680 15.608	12.40
3	680	S	CC 680 14.201 / CC 680 15.63	12.40
3	80	P	ALA 80 3.186 / ALA 80 3.286	12.35
3	80	P	CC 80 0.013 / CC 80 0.233	12.35
3	80	P	SOL 80 12.84 / SOL 80 13.739	12.35
3	80	S	ALA 80 4.452 / ALA 80 5.833	12.26
3	80	S	ALA 80 5.838 / ALA 80 6.027	12.26
3	80	S	CC 80 0.045 / CC 80 0.237	12.26
3	80	S	SOL 80 12.843 / SOL 80 13.635	12.26
3	82	P	SM 82 10.37 / SM 82 10.03	12.00
3	237	P	SCL 237 3.264 / SCL 237 R3.795	11.44
3	237	P	SCL 237 7.991 / SCL 237 8.304	11.44
3	24	S	CC 24 R6.528 / CC 24 9.684	10.50
3	24	P	CC 24 R6.526 / CC 24 9.336	10.50
4	24	S	CC 24 R5.99 / CC 24 R6.528	10.15
4	24	P	CC 24 R6.048 / CC 24 R6.526	10.15
4	580	S	ALA 580 R25.866 / ALA 580 R21.735	10.13
4	131	P	MRN 131 R1.52 / MRN 131 1.72	9.51
4	131	S	MRN 131 R1.518 / MRN 131 1.719	9.00
4	580	P	ALA 580 R25.92 / ALA 580 R21.823	8.17
4	580	P	CC 580 1.208 / CC 580 0.944	8.17
4	580	P	CC 580 1.457 / CC 580 1.22	8.17
4	880	S	ALA 880 30.878 / ALA 880 31.09	7.64
4	880	S	SCL 880 10.105 / SCL 880 10.321	7.64
4	1	P	MRN 1 12.538 / MRN 1 12.591	7.24
4	1	P	MRN 1 28.284 / MRN 1 28.49	7.24
4	1	P	MRN 1 33.419 / MRN 1 34.786	7.24
4	1	P	MRN 1 38.408 / MRN 1 40.407	7.24
4	1	P	MRN 1 6.373 / MRN 1 6.971	7.24
4	1	P	SM 1 36.157 / SM 1 36.239	7.24

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
4	1	P	SM 1 4.164 / SM 1 5.777	7.24
4	1	P	SON 1 20.046 / SON 1 20.101	7.24
4	1	P	SON 1 23.958 / SON 1 26.378	7.24
4	1	P	SON 1 35.592 / SON 1 35.619	7.24
4	280	P	SCL 280 18.674 / SM 280 R4.241	7.04
4	280	S	SCL 280 18.72 / SM 280 R4.423	7.00
4	80	S	ALA 80 7.826 / CC 80 0.045	6.92
4	80	S	CC 80 13.807 / SOL 80 12.843	6.92
4	80	P	ALA 80 4.452 / ALA 80 4.754	6.80
4	80	P	ALA 80 5.837 / ALA 80 6.052	6.80
4	80	P	ALA 80 R7.626 / ALA 80 R0.013	6.80
4	80	P	CC 80 13.76 / SOL 80 12.84	6.80
4	101	P	MRN 101 14.36 / MRN 101 14.708	6.39
4	101	P	MRN 101 25.616 / SON 101 25.033	6.39
4	101	P	SCL 101 52.371 / SM 101 0.708	6.39
4	101	P	SCL 101 R10.497 / SCL 101 R15.063	6.39
4	101	P	SCL 101 R15.442 / SCL 101 31.69	6.39
4	101	P	SM 101 3.594 / SM 101 3.63	6.39
4	680	S	ALA 680 R21.681 / CC 680 R1.903	6.37
4	680	S	ALA 680 R9.94 / ALA 680 R19.08	6.37
4	680	S	CC 680 13.682 / CC 680 14.201	6.37
4	680	S	CC 680 15.63 / CC 680 15.632	6.37
4	680	S	SOL 680 1.033L / SOL 680 R0.998	6.37
4	680	S	SOL 680 N0.786L / SOL 680 0.979L	6.37
4	680	S	SOL 680 R1.299 / SOL 680 R1.528	6.37
4	680	S	SOL 680 R10.021 / SOL 680 13.119	6.37
4	101	S	MRN 101 13.723 / MRN 101 13.936	6.32
4	101	S	MRN 101 14.543 / MRN 101 14.709	6.32
4	101	S	MRN 101 25.629 / SON 101 25.164	6.32
4	101	S	SCL 101 48.99 / SCL 101 49.432	6.32
4	101	S	SCL 101 R10.602 / SCL 101 R15.067	6.32
4	101	S	SCL 101 R15.42 / SCL 101 31.354	6.32
4	101	S	SF 101 8.467 / SF 101 8.971	6.32
4	101	S	SM 101 5.386 / SM 101 5.393	6.32
4	680	P	ALA 680 R21.653 / CC 680 R1.9	6.23
4	680	P	ALA 680 R9.93 / ALA 680 R18.98	6.23
4	680	P	CC 680 13.68 / CC 680 14.18	6.23
4	680	P	CC 680 15.608 / CC 680 15.835	6.23

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
4	680	P	SOL 680 M1.063R / SOL 680 R0.996	6.23
4	680	P	SOL 680 R9.769 / SOL 680 13.126	6.23
4	85	S	SCL 85 3.946 / SCL 85 0	5.57
4	17	S	SCL 17 3.333 / SCL 17 9.031	5.51
4	85	P	SCL 85 3.918 / SCL 85 0	5.36
4	17	P	SCL 17 3.335 / SCL 17 9.099	5.24
4	92	P	ALA 92 R4.17 / ALA 92 R4.479	5.09
4	37	S	SOL 37 R9.678 / SOL 37 R11.998L	4.69
4	880	P	ALA 880 14.806 / ALA 880 15.355	4.63
4	880	P	ALA 880 30.596 / ALA 880 31.089	4.63
4	84	S	ALA 84 R4.026 / ALA 84 R4.694	4.20
4	84	S	SM 84 21.529 / SM 84 21.723	4.20
4	84	S	SM 84 24.348 / SM 84 25.058	4.20
4	116	P	SON 116 0.041 / SON 116 1.058	4.06
4	116	P	SON 116 33.605 / SON 116 34.002	4.06
4	116	P	SON 116 34.445 / SON 116 34.882	4.06
4	116	P	SON 116 35.04 / SON 116 35.077	4.06
4	116	P	SON 116 35.39 / SON 116 36.366	4.06
4	37	P	SOL 37 R8.154 / SOL 37 8.482	4.04
4	37	P	SOL 37 R9.667 / SOL 37 R11.745R	4.04
4	84	P	SM 84 21.533 / SM 84 21.725	3.84
4	84	P	SM 84 24.348 / SM 84 25.059	3.84
4	12	S	SON 12 R15.034 / SON 12 R16.662	3.82
4	12	S	SON 12 R16.946 / SON 12 T17.643	3.82
4	82	S	SM 82 10.377 / SM 82 10.305	3.75
4	82	S	SM 82 3.437 / SM 82 3.342	3.75
4	12	P	SOL 12 0.11 / SOL 12 R2.794	3.65
4	12	P	SON 12 23.113 / SON 12 25.755	3.65
4	12	P	SON 12 34.8 / SON 12 35.111	3.65
4	12	P	SON 12 41.36 / NAP 12 0.176	3.65
4	12	P	SON 12 R15.085 / SON 12 R16.659	3.65
4	12	P	SON 12 R16.95 / SON 12 T17.648	3.65
4	29	P	NAP 29 3.609 / NAP 29 R6.192	3.51
4	29	P	NAP 29 R10.385 / NAP 29 13.049	3.51
4	29	P	NAP 29 R7.371 / NAP 29 R8.653	3.51
4	29	P	SOL 29 1.805 / SOL 29 1.921	3.51
4	29	S	NAP 29 10.306 / NAP 29 13.056	3.24
4	29	S	NAP 29 3.609 / NAP 29 R6.196	3.24

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
4	29	S	NAP 29 R7.371 / NAP 29 R8.651	3.24
4	152	S	SCL 152 R23.422 / SCL 152 R34.862	3.24
4	82	P	SM 82 3.438 / SM 82 3.375	3.12
4	152	P	SCL 152 14.368 / SCL 152 R16.519	3.00
4	152	P	SCL 152 R16.577 / SCL 152 R16.901	3.00
4	152	P	SCL 152 R16.941 / SCL 152 R18.338	3.00
4	152	P	SCL 152 R18.342 / SCL 152 R18.384	3.00
4	152	P	SCL 152 R18.46 / SCL 152 R18.652	3.00
4	152	P	SCL 152 R18.752 / SCL 152 R19.5	3.00
4	152	P	SCL 152 R19.698 / SCL 152 21.829	3.00
4	152	P	SCL 152 R23.419 / SCL 152 R34.864	3.00
4	780	S	SOL 780 4.959 / SOL 780 0.446L	2.87
4	780	S	SOL 780 7.168 / SOL 780 6.004	2.87
4	780	P	SOL 780 4.96 / SOL 780 0.547R	2.87
4	780	P	SOL 780 7.167 / SOL 780 5.999	2.87
4	121	S	NAP 121 R4.47 / NAP 121 R4.499	2.86
4	121	P	NAP 121 R4.47 / NAP 121 R4.5	2.86
5	680	S	SOL 680 0.979L / SOL 680 1.033L	2.56
5	4	P	CC 4 R4.551 / CC 4 R7.275	2.50
5	4	S	CC 4 R4.663 / CC 4 R7.278	2.50
5	101	S	SON 101 R46.018 / SON 101 R49.318	2.40
5	101	P	MRN 101 19.548 / MRN 101 19.883	2.28
5	101	P	SON 101 35.171 / SON 101 36.02	2.28
5	101	P	SON 101 R46.016 / SON 101 R49.319	2.28
5	37	S	SOL 37 R8.183 / SOL 37 8.464	2.25
5	37	S	SOL 37 R9.389 / SOL 37 R9.636	2.25
5	37	S	SON 37 3.78 / SON 37 4.001	2.25
5	37	P	SOL 37 R11.745R / SOL 37 R12.011R	2.22
5	37	P	SOL 37 R9.243 / SOL 37 R9.646	2.22
5	221	S	NAP 221 0 / NAP 221 2.682	2.12
5	221	P	NAP 221 0 / NAP 221 2.682	2.09
5	29	S	NAP 29 13.056 / NAP 29 16.629	1.86
5	29	S	NAP 29 28.017 / NAP 29 28.11	1.86
5	29	S	NAP 29 R6.196 / NAP 29 R7.371	1.86
5	29	S	NAP 29 R8.651 / NAP 29 10.306	1.86
5	29	S	SOL 29 0 / SOL 29 0.78	1.86
5	29	S	SOL 29 4.723 / NAP 29 3.609	1.86
5	84	S	ALA 84 21.02 / ALA 84 R22.167	1.81

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
5	84	S	ALA 84 R18 / ALA 84 T18.539	1.81
5	84	S	ALA 84 R19.529 / ALA 84 20.012	1.81
5	84	S	SM 84 21.442 / SM 84 21.529	1.81
5	84	S	SM 84 21.723 / SM 84 24.348	1.81
5	84	S	SM 84 25.653 / SM 84 25.72	1.81
5	82	P	SM 82 3.375 / SM 82 0.861	1.80
5	82	P	SM 82 5.627 / SM 82 3.438	1.80
5	82	S	SM 82 3.342 / SM 82 0.863	1.75
5	82	S	SM 82 5.629 / SM 82 3.437	1.75
5	780	S	SOL 780 0.446L / SOL 780 0.145L	1.74
5	780	S	SOL 780 6.004 / SOL 780 4.959	1.74
5	780	S	SOL 780 7.441 / SOL 780 7.168	1.74
5	12	S	NAP 12 0.176 / SOL 12 0.11	1.73
5	12	S	SON 12 10.429 / SON 12 11.036	1.73
5	12	S	SON 12 12.389 / SON 12 R15.034	1.73
5	12	S	SON 12 26.974 / SON 12 27.043	1.73
5	12	S	SON 12 29.816 / SON 12 30.24	1.73
5	12	S	SON 12 30.545 / SON 12 30.781	1.73
5	12	S	SON 12 35.111 / SON 12 35.214	1.73
5	12	S	SON 12 R16.662 / SON 12 R16.946	1.73
5	12	S	SON 12 T17.643 / SON 12 22.027	1.73
5	156	P	SBT 156 R18.429 / SCL 156 M0.602	1.69
5	84	P	ALA 84 17.287 / ALA 84 17.987	1.69
5	84	P	ALA 84 R17.987 / ALA 84 R22.169	1.69
5	84	P	SM 84 20.695 / SM 84 21.533	1.69
5	84	P	SM 84 21.725 / SM 84 24.348	1.69
5	84	P	SM 84 25.654 / SM 84 25.72	1.69
5	780	P	SOL 780 0.547R / SOL 780 0.204R	1.68
5	780	P	SOL 780 5.999 / SOL 780 4.96	1.68
5	780	P	SOL 780 7.437 / SOL 780 7.167	1.68
5	131	P	MRN 131 2.73 / MRN 131 3.031	1.61
5	131	P	MRN 131 R1.047 / MRN 131 R1.52	1.61
5	29	P	NAP 29 13.049 / NAP 29 16.626	1.58
5	29	P	NAP 29 26.568 / NAP 29 28.109	1.58
5	29	P	NAP 29 31.226 / NAP 29 34.489	1.58
5	29	P	NAP 29 47.919 / NAP 29 48.579	1.58
5	29	P	NAP 29 R6.192 / NAP 29 R7.371	1.58
5	29	P	NAP 29 R8.653 / NAP 29 R10.385	1.58

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
5	29	P	SOL 29 0 / SOL 29 1.297	1.58
5	29	P	SOL 29 4.733 / NAP 29 3.609	1.58
5	12	P	NAP 12 0.176 / SOL 12 0.11	1.56
5	12	P	SON 12 10.652 / SON 12 R15.085	1.56
5	12	P	SON 12 25.755 / SON 12 34.8	1.56
5	12	P	SON 12 35.111 / SON 12 35.213	1.56
5	12	P	SON 12 R16.659 / SON 12 R16.95	1.56
5	12	P	SON 12 T17.648 / SON 12 23.113	1.56
5	9	P	SCL 9 9.692 / SCL 9 11.448	1.53
5	9	S	SCL 9 9.592 / SCL 9 11.448	1.52
5	152	P	SCL 152 21.829 / SCL 152 R23.419	1.47
5	152	P	SCL 152 R19.5 / SCL 152 R19.698	1.47
5	152	S	SCL 152 21.829 / SCL 152 R23.422	1.47
5	152	S	SCL 152 R19.5 / SCL 152 R19.698	1.47
5	156	S	SCL 156 0.295 / SCL 156 M0.602	1.26
5	121	P	NAP 121 1.989 / NAP 121 R4.469	1.13
5	121	P	NAP 121 14.301 / NAP 121 18.772	1.13
5	121	P	NAP 121 6.016 / NAP 121 11.673	1.13
5	121	P	NAP 121 R4.5 / NAP 121 R5.885	1.13
5	121	P	SON 121 0 / SON 121 0.118	1.13
5	121	P	SON 121 1.424 / SON 121 1.57	1.13
5	121	P	SON 121 2.68 / SON 121 2.694	1.13
5	121	S	NAP 121 R3.942 / NAP 121 R4.469	1.13
5	121	S	NAP 121 R4.499 / NAP 121 R5.879	1.13
5	121	S	NAP 121 R5.879 / NAP 121 6.316	1.13
5	121	S	NAP 121 R5.879 / NAP 121 R5.879	1.13
5	121	S	NAP 121 R5.879 / NAP 121 R5.885	1.13
5	116	S	SON 116 20.508 / SON 116 20.776	0.99
5	116	S	SON 116 34.002 / SON 116 34.445	0.99
5	116	S	SON 116 34.882 / SON 116 35.03	0.99
5	116	S	SON 116 R43.031 / SON 116 R43.216	0.99
5	116	P	SON 116 16.782 / SON 116 20.776	0.97
5	116	P	SON 116 28.222 / SON 116 33.605	0.97
5	116	P	SON 116 34.002 / SON 116 34.445	0.97
5	116	P	SON 116 34.882 / SON 116 35.03	0.97
5	116	P	SON 116 36.366 / SON 116 R43.216	0.97
5	1	S	SM 1 R45.492 / SM 1 R46.47	0.42
5	1	P	MRN 1 44.422 / SON 1 3.974	0.31

Priority	Route	Carriageway[37]	From County & Postmile / To County & Postmile[38]	Average Cross-Hazard Prioritization Score[39]
5	1	P	SM 1 R45.441 / SM 1 R46.372	0.31
5	1	P	SON 1 10.089 / SON 1 10.269	0.31
5	1	P	SON 1 26.378 / SON 1 31.406	0.31
5	131	S	MRN 131 R1.051 / MRN 131 R1.518	0.15
5	128	P	MEN 128 50.902 / SON 128 1.237	0.10
5	128	P	SON 128 12.127 / SON 128 15.799	0.10
5	128	P	SON 128 21.452 / SON 128 22.606	0.10
5	128	P	SON 128 7.339 / SON 128 8.57	0.10
5	130	P	SCL 130 11.621 / SCL 130 22.503	0.00

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