APPENDIX D

EMERGENCY EVACUATION ROUTE ANALYSIS

BACKGROUND

Assembly Bill (AB) 747[1], passed in August of 2019, requires the City to update the Safety Element of their General Plan to identify evacuation routes and assess the capacity, safety, and viability of those routes under a range of emergency scenarios. Senate Bill (SB) 99[2] similarly requires the City to identify residential developments in hazard areas that do not have at least two emergency evacuation routes. Authoritative state guidance has not yet been developed to determine the type and level of analysis needed under AB 747 and SB 99.

This supplemental evacuation analysis was prepared in support of the 2020 Local Hazard Mitigation Plan. It utilizes a methodology described below and identifies residential developments without sufficient evacuation routes, and evaluates the efficacy of existing evacuation routes under various hazard scenarios in compliance with these two statutes.

HAZARD SCENARIOS

Evacuation route viability is largely determined by the location of the hazard. Because the City of Watsonville is surrounded by moderate and high wildfire risk areas, the Planning Team considered three wildfire scenarios to evaluate the safety and capacity of evacuation routes for residents. A total of five hazard scenarios are considered in this analysis:

1. Baseline (no hazard location specified)
2. Wildfire originating in the area north of the City
3. Wildfire originating to the east of the City
4. Wildfire originating to the south of the City
5. Flood
6. Earthquake

DATA, ASSUMPTIONS & DEFINITIONS

The evacuation route analysis utilizes updated parcel data from CoreLogic, a leading provider of real estate data in the United States and 2017 TIGER road data from the U.S. Census, which includes all roads in the U.S. Census Bureau's Master Address File Integrated Geographic Encoding and Referencing database. This includes primary roads, secondary roads, local neighborhood roads, rural roads, city streets, vehicular trails, ramps, service drivers, walkways, stairways, alleys, and private roads.

[1] An act to add Section 65302.15 to the Government Code.
[2] An act to amend Section 65302 of the Government Code.

To develop a methodology that effectively evaluates the safety and capacity of evacuation routes, and identifies residential areas that lack two evacuation routes, the following definitions and assumptions apply:

1. "Evacuation route vulnerability" refers to the reduced ability of people to evacuate under emergency conditions. Evacuation route vulnerability scores are calculated for each residential parcel. Lower values indicate lower levels of vulnerability, while higher values indicate greater evacuation route vulnerability.
2. "Capacity" is defined by the ability of a road to accommodate traffic volume. In this analysis, road type (local, collector, arterial, or highway/freeway) is used as an indicator of road capacity. "Local" roads are streets that are primarily used to gain access to property. Proximity to local roads was not considered a significant determinant of evacuation vulnerability. "Collector" roads are considered low-to-moderate capacity roads which serve to move traffic from local streets to arterial roads. An "arterial" road is a high-capacity urban road. The primary function of an arterial road is to deliver traffic from collector roads to highways/freeways, which are the highest capacity evacuation route.
3. Evacuation proceedings are primarily reliant on "outbound" roads—roads that transport drivers away from the city. Outbound roads are either freeways or arterials. Outbound roads begin at the intersection closest to the City boundary.
4. "Proximity" is defined by the distance from a residential parcel to nearest road (for collector roads) or "nodes" —the nearest intersection on the following road types: arterial, out-bound, or highway/freeway.
5. All roads have a potential role in evacuations. Closer proximity to higher capacity roads and outbound roads reduce evacuation vulnerability.
6. Hazard scenarios influence the direction people evacuate (away from the hazard area).
7. Segments of roads with bridges under an earthquake scenario are not viable.

METHODOLOGY

Evacuation route vulnerability scores were assigned to each residential property based on several factors including proximity, capacity, and viability. The geospatial analysis included the following steps:

1. Map all residential parcels within the City, and all collector, arterial, outbound roads, and freeways.
2. Create nodes at the intersection of collector and local roads to arterial roads, and all intersections on out-bound roads, including on-ramps for highways/freeways.
3. Determine the proximity of each residential parcel to the nearest evacuation route (highway/freeway or outbound road) by:
   a. Calculate the distance from the parcel to the nearest collector road.
   b. Calculate the distance to the nearest arterial, outbound road, or highway/freeway node.[3]

[3] To account for the assumption that drivers would take the route that leads them out of the City most efficiently, if the distance from a parcel to a higher capacity road is less than the distance to a lower capacity road, the distance to the lower capacity road is assigned a value of 0.

c. Each distance value is weighted (see step 4). Add weighted distance values together to calculate the "Evacuation Route Vulnerability Score". Lower values indicate lower levels of evacuation route vulnerability; higher values indicate greater vulnerability.

4. Apply the following weights to the road capacity (type) as follows to reflect the higher vulnerability of lower capacity roads and roads with bridges:

Road Type	Vulnerability Weight
Freeway	1
Outbound Road	2
Arterial Road	3
Collector Road	4
Road segment with bridge	10

5. For each hazard scenario[4], identify residential parcels whose evacuation route vulnerability has changed (increased or decreased) from the baseline, and determine if there are less than two evacuation routes for residential areas.

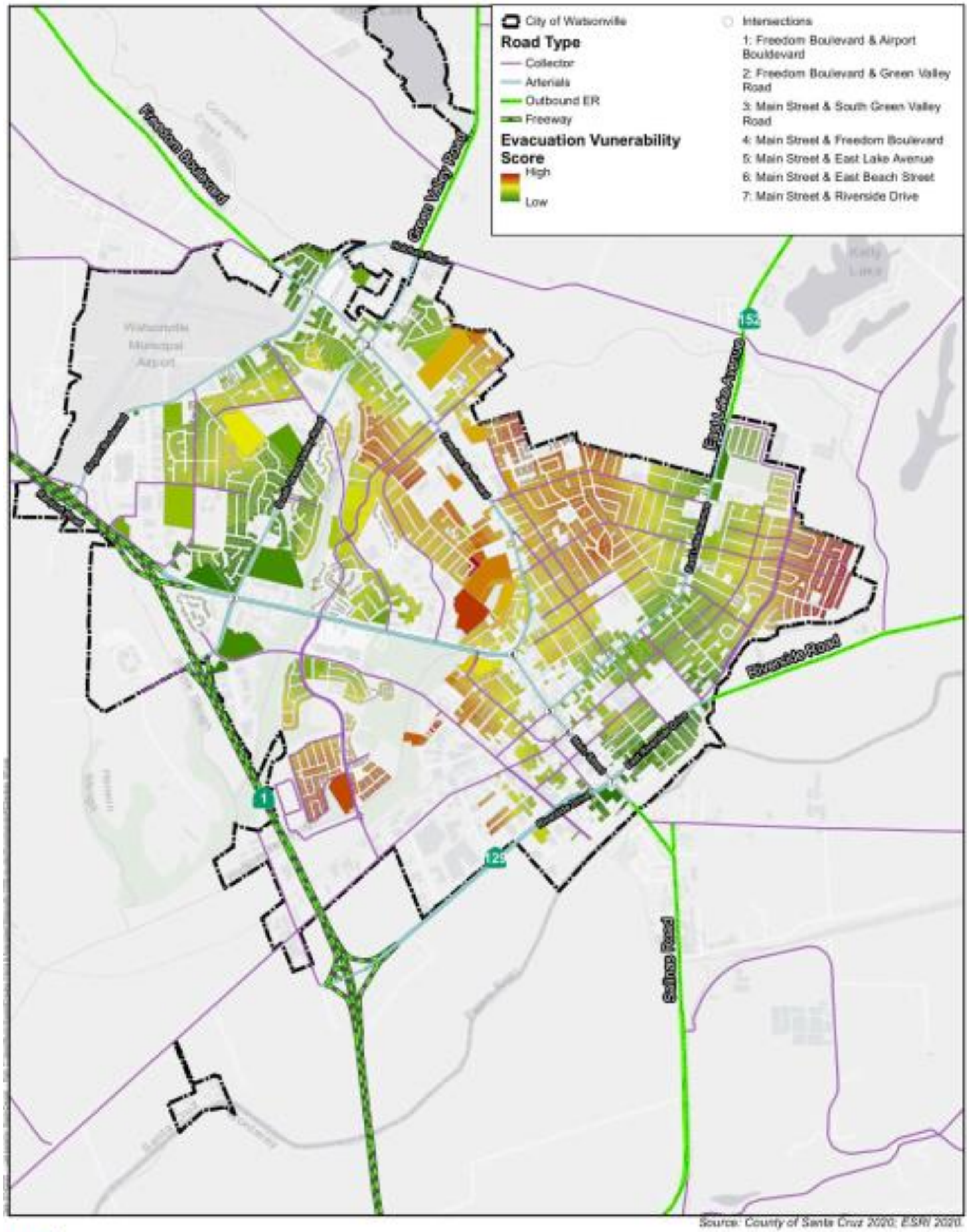
RESULTS

1. Baseline

The baseline scenario evaluates the evacuation route vulnerability of residential parcels absent a hazard event. In the baseline scenario, all outbound roads are available to residents for evacuation. Key intersections within the City boundary (where arterial roads connect) are labeled on the map below. These intersections are necessary to efficiently route residents to outbound roads. Residential parcels with the highest evacuation route vulnerability score are highlighted in red. Assuming all evacuation routes are viable, residents in the city center have the highest evacuation route vulnerability, as they have the furthest to travel to access outbound evacuation routes. The Pajaro Village and Stone Creek Apartment locations also show evacuation vulnerability in this scenario.

In addition to considering evacuation route vulnerability, the vulnerability of residents should be considered in determining which areas may need to be prioritized by first responders during an evacuation. Areas within the City with a greater percentage of elderly people, disabled people, households that do not own a vehicle (i.e. transit dependent populations), and institutionalized populations require greater levels of support during an evacuation. For example, the following areas have the highest percentage of elderly (over 65): (a) southeast portion of the City between Salsipuedes Creek, East Lake Ave. and Beck St.; (b) the Northeast corner between Corralitos Creek, Freedom Blvd. and Airport Blvd; (c) and the area between Main St., South Green Valley Rd., and the Struve Slough. Areas with a higher percent of institutionalized people include: (a) the western boundary and southwest corner of the City; and (b) the city center near the Portola Heights Mobile Home Park. Other vulnerable groups should be examined relative to evacuation route vulnerability.

[4] Except Earthquake scenario, which follows its own methodology as described on page 217.



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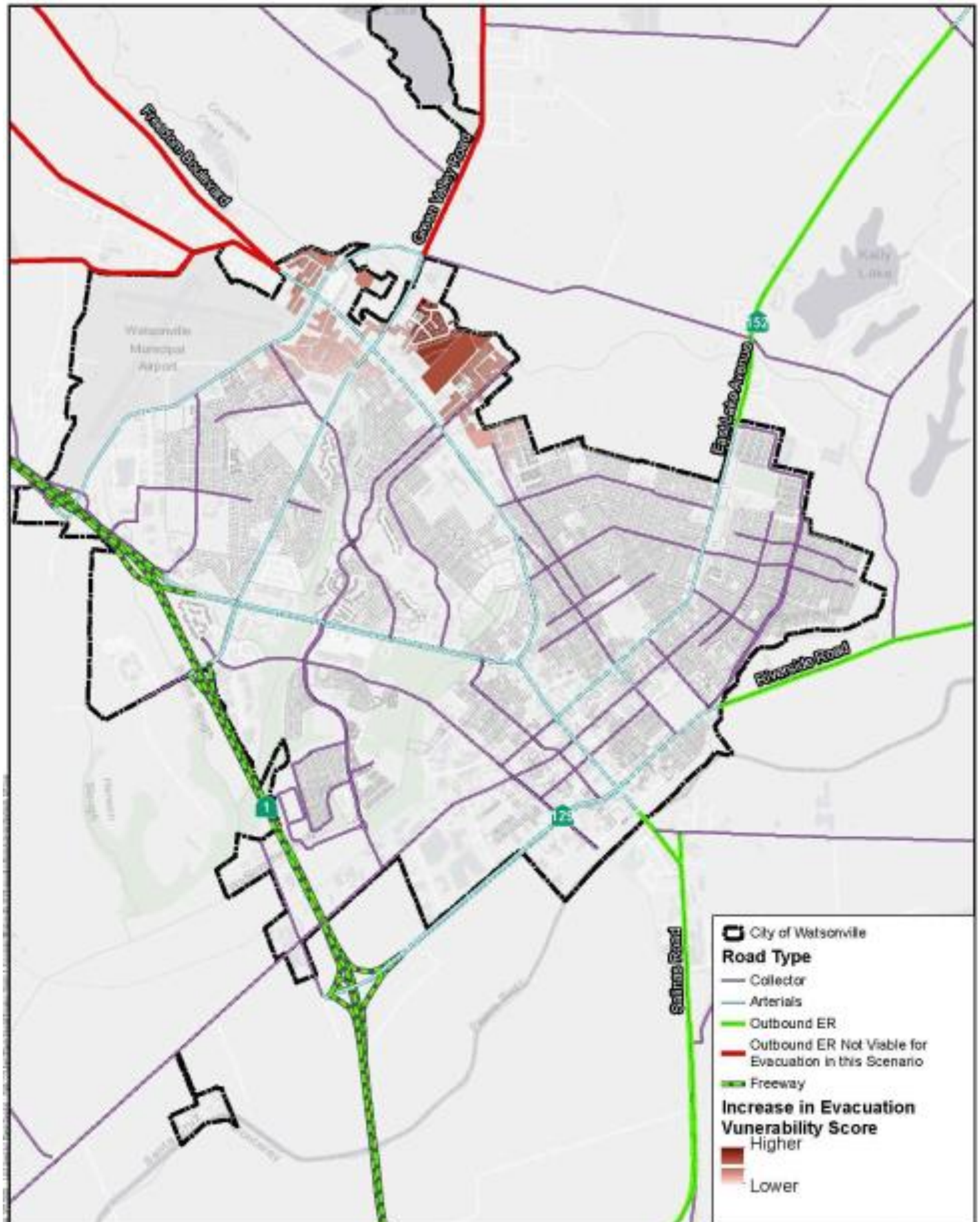
Residential Evacuation Vunerability Score
for All Directions

2. Wildfire (North)

This scenario assumes a wildfire north of the City. Outbound roads leading north are not viable, including Freedom Boulevard and Green Valley Road. Evacuation route vulnerability scores are recalculated to account for the increased distance to the next closest, viable outbound road. The map below highlights residential parcels with evacuation route vulnerability scores that increased as a result of the two northbound evacuation routes being closed. It is likely that the most utilized evacuation routes will be Highway 1 and Salinas Road, because eastbound outbound roads lead to other high fire risk areas. Parcels highlighted on the map will likely depend on South Green Valley Road to access Highway 1, or Freedom Blvd. to access the Salinas Rd. evacuation routes. The intersections of Main St./S. Green Valley Rd., Main St./Freedom Blvd, and Main St./Riverside Dr. may get congested as residents try to access Highway 1 and Salinas Rd. evacuation routes. Emergency responders should consider activating evacuation traffic management at these intersections and as contra-flow lane reversal on the highway to allow both lanes to be used for southbound evacuation, though this requires extensive coordination and should be reserved for extreme wildfire threats.



Source: County of Santa Cruz 2020; ESRI 2020.

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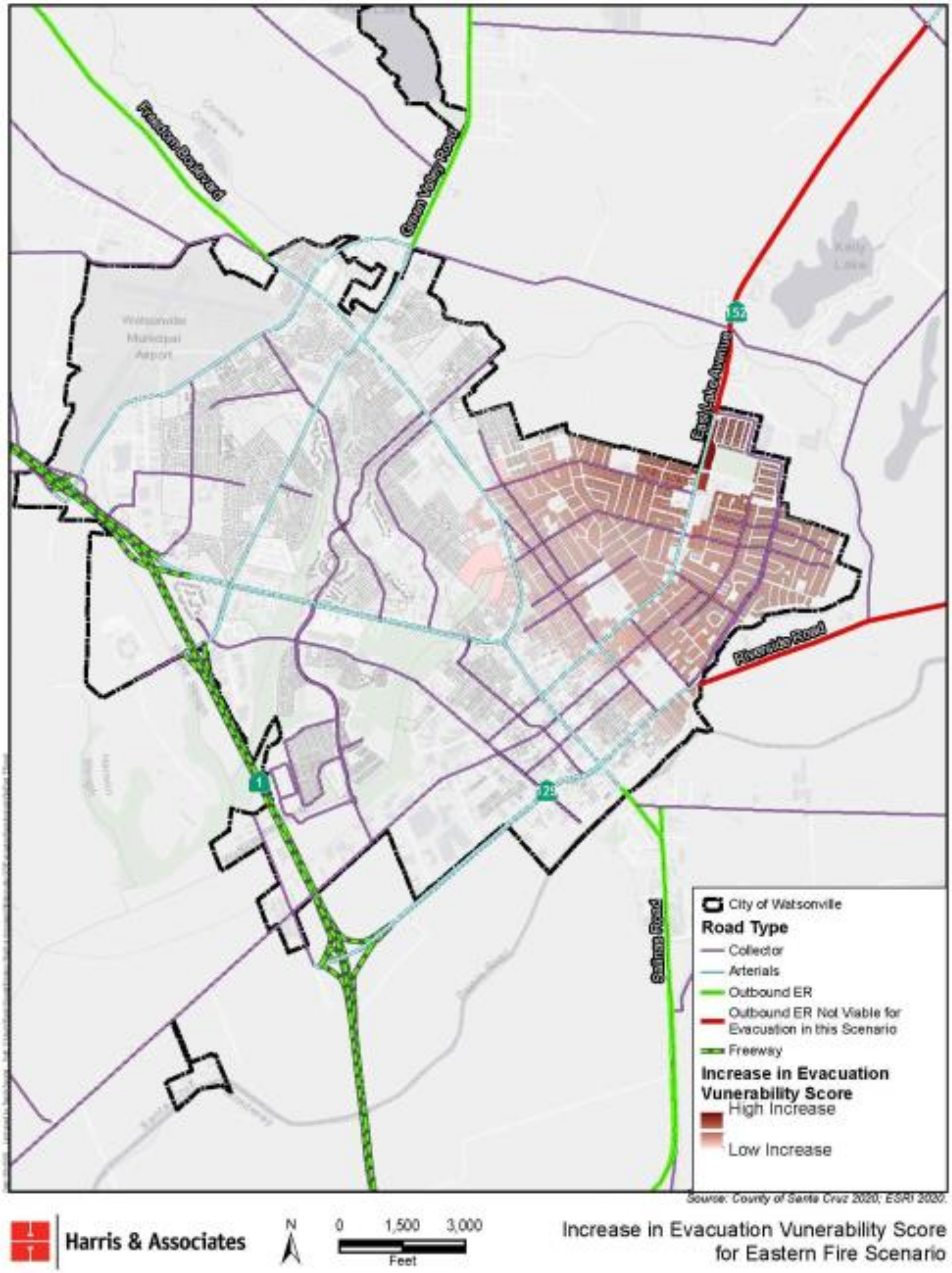
Increase in Evacuation Vunerability Score for Northern Fire Scenario

3. Wildfire (East)

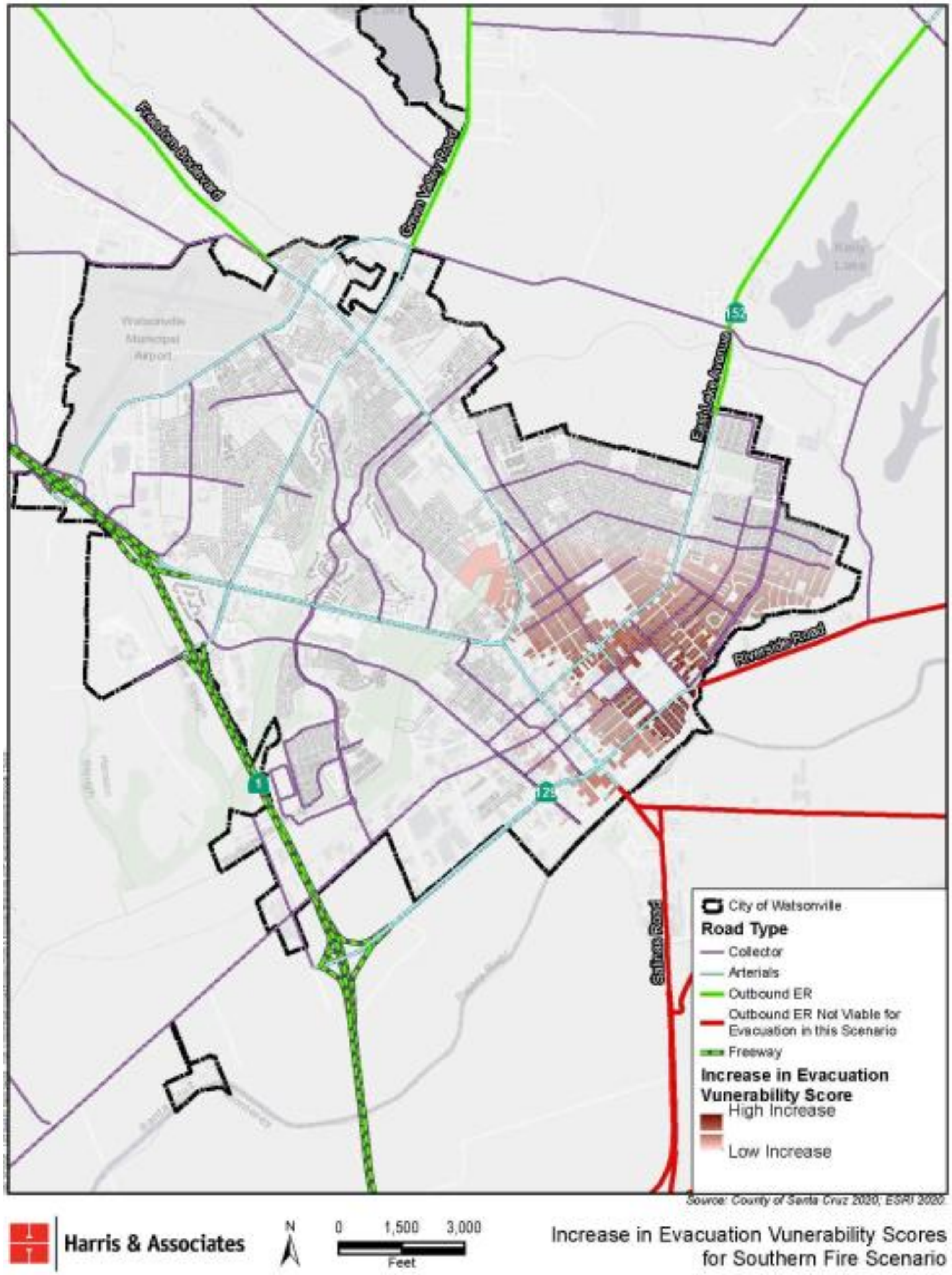
This scenario assumes a wildfire east of the City. Outbound roads leading East are not viable, including East Lake Ave. and Riverside Road. Evacuation vulnerability scores are re-calculated to account for the increased distance to the next closest, viable outbound road. The map below highlights residential parcels with evacuation route vulnerability score that increased as a result of the two eastbound evacuation routes being closed. Freedom Blvd., Salinas Rd., and Highway 1 are the outbound roads most likely to be utilized in this scenario, because eastbound outbound roads lead to other high fire risk areas. Both directions of Highway 1 (North/South) are likely to be viable under this scenario, which increases overall evacuation capacity. However, it may take more resources to evacuate those in the Pajaro Village area because of the reduced mobility of the population that resides in those neighborhoods. The critical intersections in this scenario are likely to be Main Street and Freedom Blvd., Main Street and East Riverside Drive.



Increase in Evacuation Vunerability Score for Eastern Fire Scenario

4. Wildfire (South)

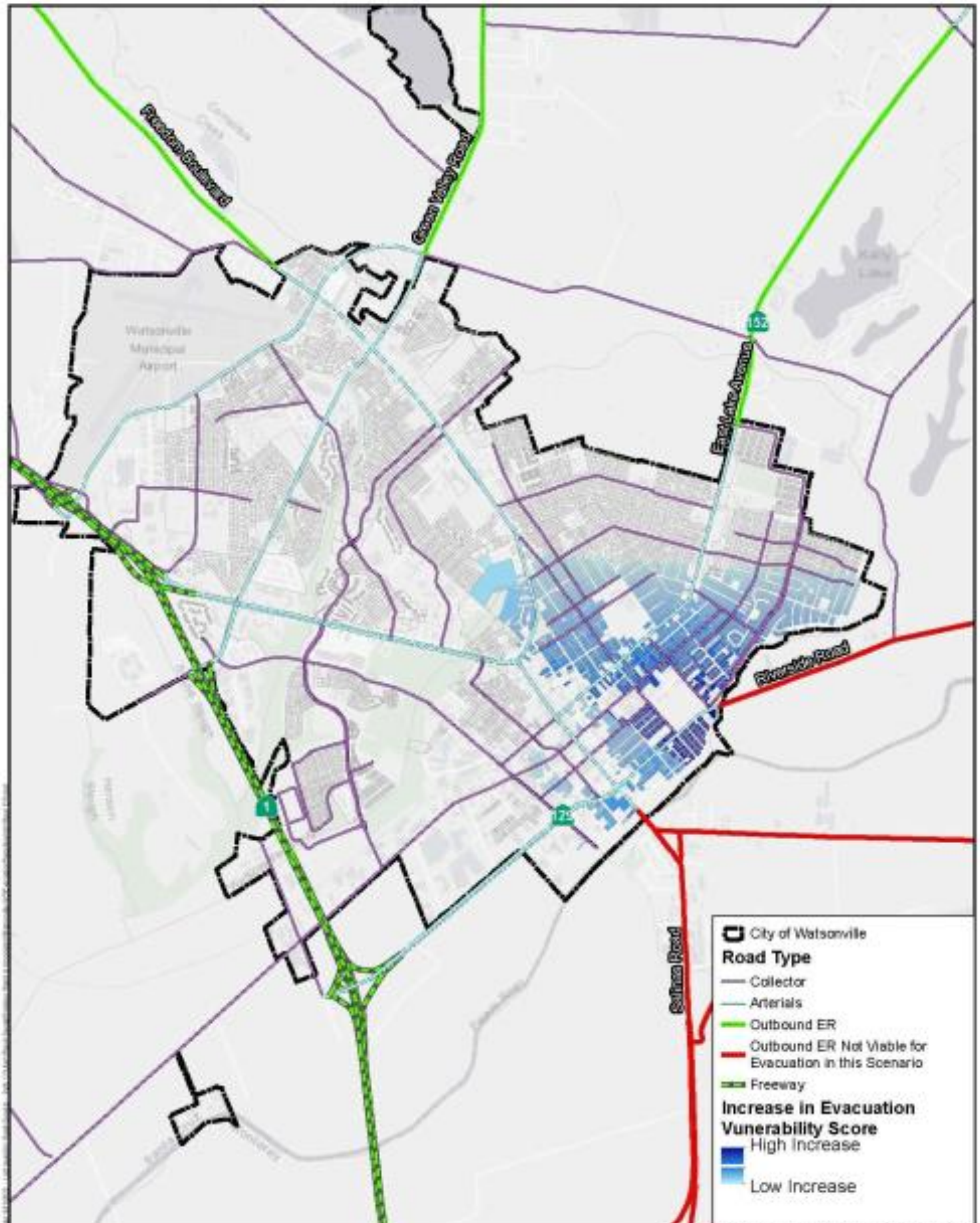
This scenario assumes a wildfire to the south of the City. Outbound roads leading South are not viable, including Riverside Road and Salinas Road. Evacuation route vulnerability scores are re-calculated to account for the increased distance to the next closest, viable outbound road. The map below highlights residential parcels with evacuation route vulnerability score that increased as a result of the two southbound evacuation routes being closed. Freedom Blvd and northbound Highway 1 are the outbound roads most likely to be utilized in this scenario, because eastbound outbound roads lead to other high fire risk areas. The intersections of Main St./S. Green Valley Rd., Main St./Freedom, and Freedom/Green Valley Rd. may get congested as residents try to access Highway 1 and Freedom Rd. evacuation routes. Emergency responders should consider activating evacuation traffic management at these intersections and as contra-flow lane reversal on the highway to allow both lanes to be used for northbound evacuation, though this requires extensive coordination and should be reserved for extreme wildfire threats.



Increase in Evacuation Vunerability Scores for Southern Fire Scenario

5. Flood

The flood scenario assumes that people will evacuate away from the flood zone. Since the flood zone is along the South side of the City along the Pajaro River, the two Southbound evacuation routes are assumed to be non-viable. Therefore, the results are the same as Scenario #4. The time it takes to evacuate is not as critical during a flood event because it is a slower-onset hazard. However, it may be more difficult for first responders to access vulnerable populations that need to be evacuated once the water inundates the area. Roads may be inundated, further hampering evacuation. Residents may not need to evacuate out of the City but only away from the flood zone. Therefore, there is likely to be less evacuation route congestion compared to other hazard scenarios.



Source: County of Santa Cruz 2020; ESRI 2020.

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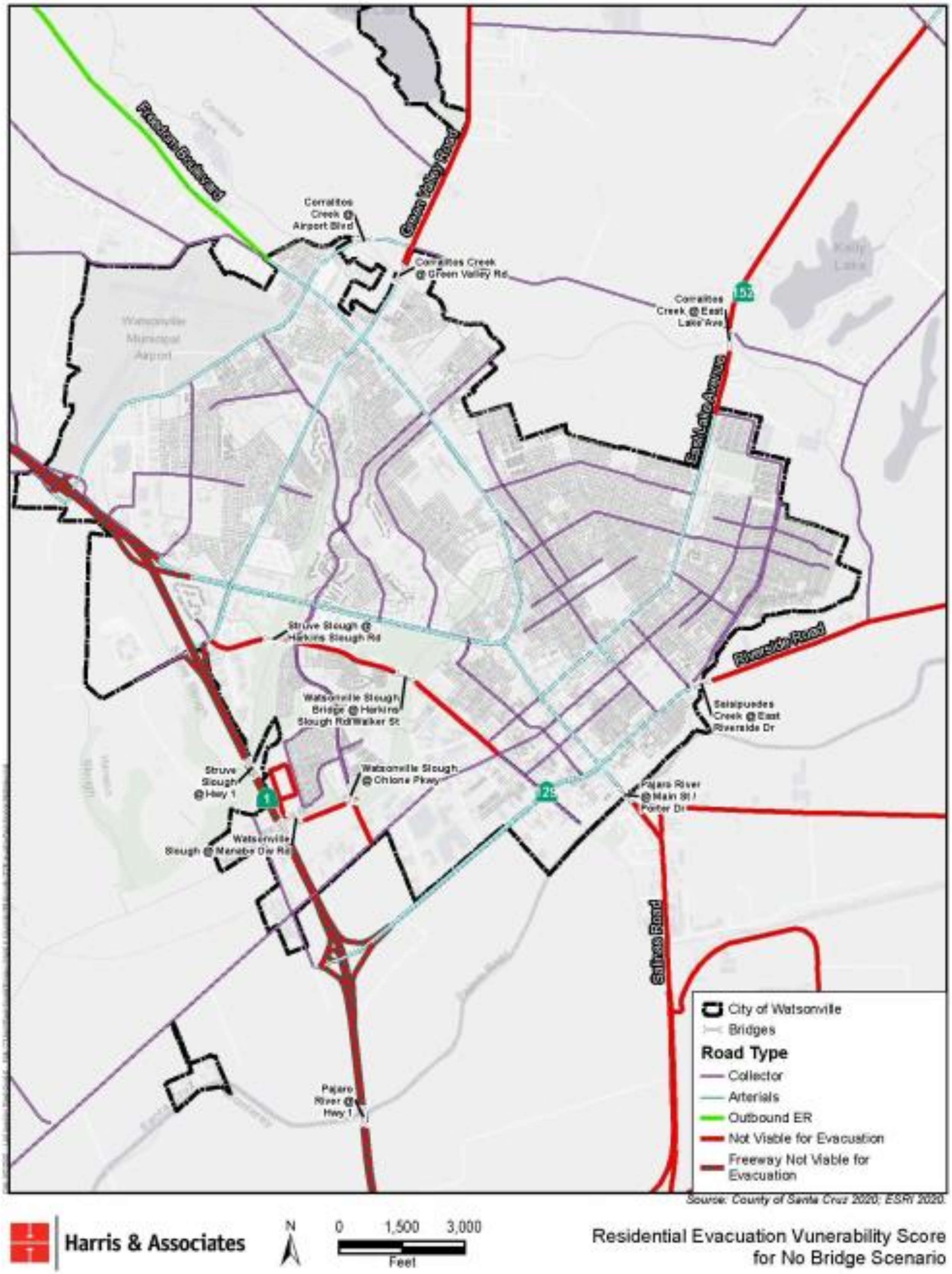
Increase in Evacuation Vunerability Scores for Flood Scenario

6. Earthquake

Unlike other scenarios, earthquakes have the potential to damage any part of the City. For this reason, it is difficult to predict which evacuation routes will be available post-earthquake. Because earthquakes can damage bridges, one key assumption was made for evaluating evacuation route capacity: outbound roads that require a bridge crossing may not be viable evacuation routes after an earthquake. This assumption removes all but one evacuation route from the analysis—Freedom Blvd. All the other outbound roads have bridge crossings. Though emergency responders should consider the possibility of bridge failure, it is unlikely that all bridges would fail in the event of an earthquake occurrence. While it is likely two evacuation routes will still be available under this scenario, it is theoretically possible that all bridges are damaged and less than two emergency evacuation routes are available to residents in the event of a severe earthquake. Post-earthquake, emergency responders should be prepared to inspect bridges efficiently and effectively in the event of an earthquake event so that evacuation routes can be established and communicated safely and quickly.



Residential Evacuation Vunerability Score for No Bridge Scenario

CONCLUSION & RECOMMENDATIONS

The evacuation route analysis did not identify any residential parcels that lack two evacuation routes (it remains theoretically possible, but highly unlikely, that all evacuation routes are blocked in the event of a severe earthquake). The baseline scenario suggests that residents closest to the city center are most vulnerable given the distance they would need to travel to access an outbound road. The results for the five hazard scenarios were as expected: residential parcels located near outbound roads that were assumed to be non-viable under the hazard scenario saw an increase in their evacuation route vulnerability score, reflecting the greater distance residents would travel to access the next nearest outbound evacuation route. There are a greater percentage of socially vulnerable groups in the southwest, southeast, and northwest corner of the city, as well as pockets of vulnerability around the Watsonville Slough that may require a greater level of assistance during evacuation proceedings.

The analysis suggests that emergency responders must be flexible in emergency scenarios, considering the location and extent of a hazard may disrupt established evacuation routes. Given the potential for congestion when certain evacuation routes are closed, emergency responders should consider contraflow lane reversal as one strategy to efficiently evacuate residents. All but one outbound evacuation routes rely on a bridge. These bridges should be inspected prior and post hazard events to ensure the evacuation routes remain viable. Social vulnerability indicators, including age, disability, and other mobility factors should be further examined to determine other potential barriers to evacuation besides distance to and capacity of evacuation routes. These recommended strategies require advanced coordination across departments to ensure an efficient and well-communicated process for evacuation in response to various hazard scenarios.