REDDING AREA BUS AUTHORITY ZERO-EMISSION BUS IMPLEMENTATION PLAN

FINAL

DECEMBER 2025

PREPARED FOR:

Redding Area Bus Authority

RABA

Caltrans®

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EXECUTIVE SUMMARY

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The Redding Area Bus Authority (RABA) Zero-Emission Bus (ZEB) Implementation Plan provides a data-driven, phased approach to transition RABA's fixed-route transit fleet (vehicles above 14,000 lbs. gross vehicle weight rating) to 100% zero-emission operations by 2040 in compliance with the California Air Resources Board (CARB) Innovative Clean Transit (ICT). This Plan focuses exclusively on transit buses and does not include cutaway buses, as RABA intends to replace those vehicles with vans below the 14,000-pound GVWR threshold specified in CARB's ICT Regulation.

Developed in coordination with Redding Electric Utility (REU) and local and regional partners, the Plan identifies an optimal mix of battery-electric buses (BEBs) and hydrogen fuel cell electric buses (FCEBs), aligned with RABA's route profiles, facility capacities, and local power infrastructure. It also addresses workforce readiness, funding strategies, and resiliency measures to ensure a reliable and sustainable transition.

KEY ACTIONS AND RECOMMENDATIONS

The following recommendations provide clear, actionable steps for RABA to achieve a zero-emission fleet by 2040 through coordinated planning, phased infrastructure investment, and strong utility and industry partnerships.

- **Adopt a Blended Fleet:** Transition to a combination of battery-electric buses (BEBs) and hydrogen fuel cell electric buses (FCEBs) to balance cost, flexibility, and operational reliability. Maintain both fuel types to ensure resiliency and service continuity in case of grid outages or hydrogen-supply interruptions.
- **Phase Infrastructure Investments:** Implement charging and refueling infrastructure in phases to align with fleet replacement cycles and avoid early overinvestment.
- **Strengthen Utility Coordination:** Work closely with Redding Electric Utility (REU) to plan for electrical load growth, coordinate transformer upgrades, and establish electric rate structures that minimize demand charges.
- **Manage Costs Strategically:** Recognize that while ZEB procurement costs are higher than diesel, total lifecycle costs, including infrastructure and operations, are expected to be comparable or lower over time, particularly as fuel and maintenance savings grow.
- **Leverage Funding Opportunities:** Actively pursue state and federal grant programs such as HVIP, LCFS, and FTA Low-No to support vehicle purchases, infrastructure installation, and workforce development.
- **Train and Prepare Staff:** Implement a structured workforce training program using resources from FTA, APTA, CTE, and bus manufacturers to prepare operators and maintenance personnel for ZEB technologies.
- **Retain Limited Diesel Backup:** Maintain a small number of diesel buses through 2040 to ensure service continuity during emergencies or transition phases.
- **Monitor Technology Advancements:** Continue evaluating emerging BEB and FCEB technologies to refine procurement schedules, charging strategies, and operational procedures as the market evolves.

BEB Deployment

Routes:
1, 4, 7, 11, 14, 15, 17, 19

- Moderate to high daily energy demand
- Mid-day layover charging at DRTC
- One extra bus needed on Route 4 to maintain consistent service

FCEB Deployment

Routes:
3, 9, 99X (Amtrak)

- Longer, higher speed routes with higher daily energy demand
- Refuel in the evening at end of block
- Greater range, no mid-day refueling needed

ZEB IMPLEMENTATION PATHWAY - PHASING AND INFRASTRUCTURE RECOMMENDATIONS

RABA should implement the ZEB transition in phased steps that align fleet growth with infrastructure readiness and available funding. This approach ensures a reliable, cost-effective transition while maintaining uninterrupted service.

CHARGING & REFUELING STRATEGY

- **Deploy BEBs on Local Routes:** Operate BEBs on Routes 1, 4, 7, 11, 14, 15, 17, and 19, using overnight depot charging at the Maintenance Facility and on-route inductive charging during layovers at the Downtown Redding Transit Center (DRTC).
- **Assign FCEBs to Long-Distance Routes:** Operate FCEBs on longer, higher-demand routes (3, 9, and 99X) and refuel at the Ellis Street property using a mobile hydrogen delivery and dispensing system managed by a third-party provider.

FLEET TRANSITION SCHEDULE

The transition should occur in stages as follows:

- Four BEBs by 2030.
- Six ZEBs (four BEBs + two FCEBs) by 2035.
- Two cutaway ZEBs by 2035 (contingency option).
- Eight ZEBs (six BEBs + two FCEBs) by 2040.

- This will result in a total of 20 ZEBs in RABA's fleet by 2040, matching the current fleet size of 18 transit buses and motor coaches (17 diesel and 1 BEB) and two cutaway buses used on fixed routes 44X and 299X (contingency option).

Figure ES1 below provides a detailed overview of bus purchases and retirements from 2025 through 2040.

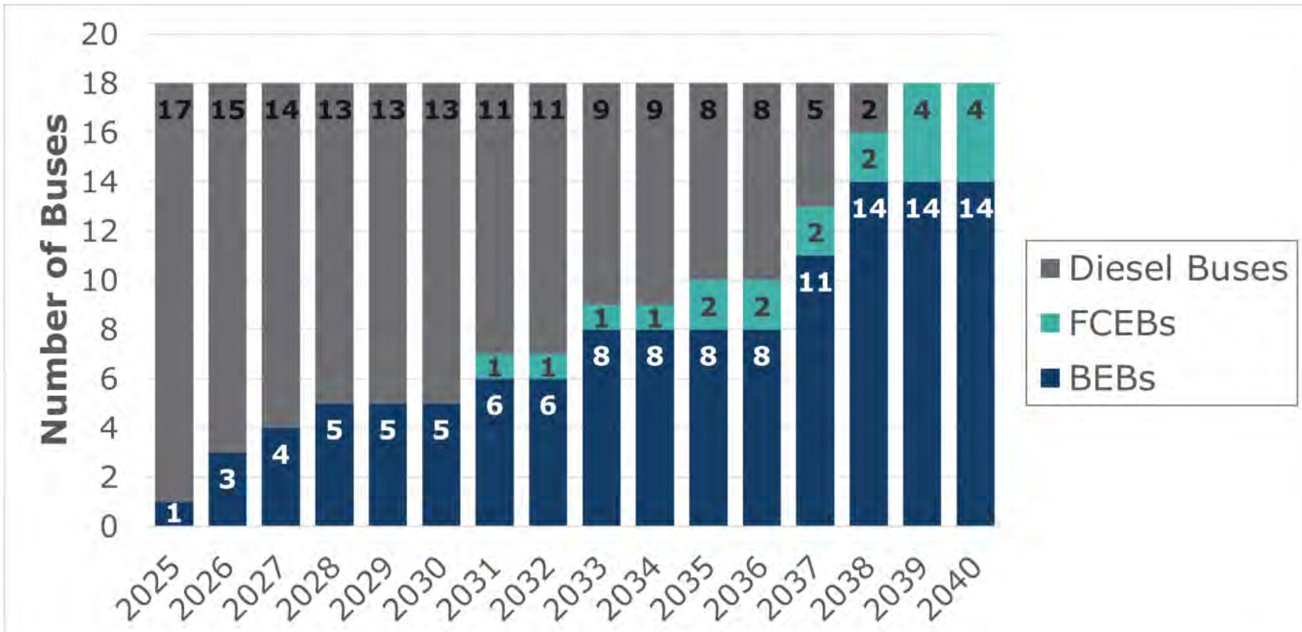

FIGURE ES1. ZEB ADOPTION SCHEDULE WITH RETIRING DIESEL FLEET

INFRASTRUCTURE PHASING

To match infrastructure growth with fleet expansion, RABA should follow this two-phase installation plan:

- **Phase 1 (2025–2033):** Install 6 of 10 DC chargers (50 kW each) at the depot and 4 inductive pads (up to 300 kW each) at DRTC.
- **Phase 2 (2034 onward):** Add 4 more DC depot chargers and 3 additional inductive pads at the DRTC.

GRID COORDINATION

RABA should continue to collaborate with REU to secure capacity upgrades, explore EV-specific rate structures, and manage demand charges.

BLOCK SCHEDULE CHANGES

To integrate BEBs into RABA's operations, a few block schedule modifications are required. Most RABA routes are currently operated by one bus per day ("one block per route"). These modifications preserve that structure wherever possible while ensuring adequate mid-day charging at the DRTC.

ZEB TRANSITION COSTS

Table ES1 below summarizes estimated costs associated with ZEB purchases, infrastructure deployment, and ongoing fuel and energy use. These estimates provide a planning-level cost range and will continue to be refined as RABA advances into design and procurement phases.

TABLE ES1. RABA ZEB TRANSITION COST SUMMARY

ZEB TYPE	CATEGORY	ESTIMATED COST
BEBs & CHARGING OPERATIONS	Bus Purchases	$11.0 million
	Charging Infrastructure Deployment	$4.6 million
	Electricity Purchases	$490,000 per year
FCEBs & H_2 REFUELING OPERATIONS	Bus Purchases	$3.6 million
	Hydrogen Refueling Infrastructure Installations	– *(no permanent H2 refueling station construction recommended)*
	Fuel Purchases	$150,000-$620,000 per year
TOTAL	**Bus Purchases**	**$14.6 million**
	Infrastructure Deployment	**$4.6 million**
	Electricity & Fuel	**$640,000-$1,110,000 per year**

CHAPTER 1: INTRODUCTION

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As the successor to the Zero-Emission Bus Rollout Plan, the Redding Area Bus Authority (RABA) Zero Emissions Bus Implementation Plan (Plan) establishes a phased and data-driven approach to guide the transition of RABA's fleet to zero-emission operations. This chapter provides an overview of the project background, purpose, goals and objectives, and the regulatory framework that RABA must comply with as part of this transition. It also includes a brief guide on how to navigate and use this document effectively.

PROJECT BACKGROUND

RABA was awarded funding for the preparation of the Zero Emissions Implementation Plan as part of the Sustainable Communities Strategy grant from the California Department of Transportation (Caltrans). The California Air Resources Board (CARB) requires all transit agencies in California to convert their fleets to zero-emission vehicles through the Innovative Clean Transit (ICT) regulation by 2040 to combat climate change and reduce Greenhouse Gas (GHG) emissions. RABA is dedicated to enhancing air quality and reducing emissions within the community by actively exploring a transition to zero-emission buses as part of its future sustainability efforts.

RABA has been demonstrating a proactive approach to modernize its fleet. In 2019, RABA incorporated the first electric bus (Proterra battery technology) in its fleet marking the agency's initial step towards sustainable and clean transportation. RABA's Zero-Emission Bus Rollout Plan (August 2023) serves as a high-level roadmap that evaluates the feasibility of transitioning to 100% zero-emissions fleet.

This Plan evaluates the feasibility of battery and hydrogen fuel cell propulsion transit systems, including how the conversion to clean transit technology would impact transit services and determine the upgrades to RABA's facilities for fueling/charging and vehicle maintenance. This plan builds upon relevant plans such as RABA's Zero-Emission Bus Rollout Plan and Short-Range Transit Plan; Shasta Regional Transportation Agency's (SRTA) Long-Range Transit Plan, Regional Transportation Plan, and ShastaConnect Zero-Emission Fleet Transition Rollout Plan. This Plan is a collaborative effort performed in close coordination with stakeholders such as City of Redding Public Works, City of

Redding Development Services, SRTA, Transdev, Caltrans, City of Anderson Public Works, City of Shasta Lake Public Works, Shasta County Public Works to ensure compliance with local land use provisions and electric system upgrades.

PROJECT GOALS AND OBJECTIVES

The Zero-Emissions Bus Implementation Plan provides a comprehensive and structured approach with clear directions to facilitate the transition of the agency's fleet to zero-emissions. The goals and objectives of the Plan include:

- Ensuring 100% conversion of RABA's full-size, fixed-route transit fleet to Zero-Emissions Buses (ZEB) by 2040 to be compliant with CARB's ICT regulation and enhancing transit services to provide environmental benefits including reduction of harmful PM 2.5, NO_x, and GHG emissions.
- Collecting baseline data and information that will help inform the Plan
- Incorporating the work completed as part of relevant planning documents
- Assessing existing and planned RABA facilities' capacity to support charging infrastructure and supply, including coordination and consultation with Redding Electric Utility (REU) on their capacity to provide service and required infrastructure at identified charging locations
- Ensuring RABA's proposed vehicle replacement and ZEB conversion schedule provides funded and programmed transit system improvements and meets ICT regulations
- Conducting analysis of operating costs and feasibility of ZEB options to determine the best alternative for RABA
- Identifying the opportunities and constraints of RABA's conversion to a 100% ZEB fleet by 2040
- Identifying ZEB maintenance requirements and impact on facilities and staff including workforce availability and training

This Plan will support RABA in achieving full conversion of its full-size, fixed-route transit bus fleet by 2040 through coordinated infrastructure planning with REU and other stakeholders, analysis of fleet and facility capacity, evaluation of zero-emission technologies, and strategies to ensure regulatory compliance, workforce readiness, and long-term sustainability.

PROJECT PROCESS

The purpose of the RABA ZEB Implementation Plan is to provide clear direction to RABA for the provision of a 100% zero-emission fleet system in the future. The Plan examines how baseline operations can be modeled and identify the viability of appropriate clean technology for RABA's daily operations. The Plan serves as the guiding document for RABA through the process of fleet conversion to ZEB. Figure 2 shows the project process, including outreach, stakeholder meetings, and document development.

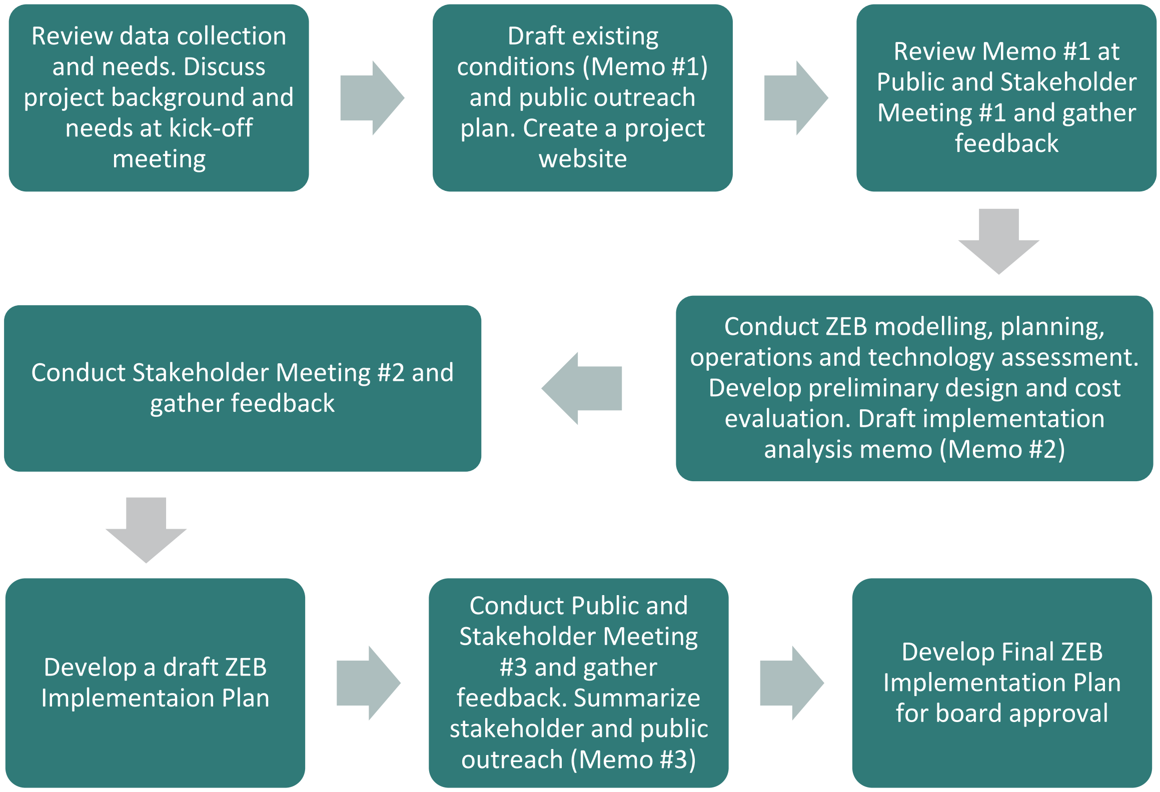

FIGURE 2. PROJECT PROCESS

PROJECT SCHEDULE

Figure 3 below outlines the project timeline and key milestones for the RABA Zero Emission Bus Implementation Plan, illustrating the sequence of major tasks from data collection and existing conditions assessment to stakeholder engagement, alternatives evaluation, conceptual design, and preparation of the final plan, spanning from January through Fall 2025.

Data Collection and Gathering
January 2025

Existing Conditions Assessment
Spring 2025

Public + Stakeholder Meeting #1
Spring 2025

ZEB Modeling and Implementation Analysis - Alternatvies Evaluation
Summer 2025

Stakeholder Meeting #2
Summer 2025

Recommended Pathway - Conceptual Design and Cost Estimation
Fall 2025

Public + Stakeholder Meeting #3
Fall 2025

Draft and Final Plan
Fall 2025

FIGURE 3. PROJECT SCHEDULE

RELEVANT REGULATIONS

RABA's transition to a zero-emission fleet is guided primarily by the California Air Resources Board (CARB) Innovative Clean Transit (ICT) Regulation, which requires all public transit agencies to achieve 100% zero-emission bus fleets by 2040. As a small transit agency, RABA must ensure that 25% of new bus purchases are zero-emission by 2026, increasing to 100% by 2029. The regulation also requires agencies to prepare Zero Emission Bus Rollout Plans, identify funding sources, and train operators and maintenance staff to support the transition.

In June 2025, Governor Gavin Newsom issued Executive Order N-27-25 in response to federal actions seeking to limit California's authority to regulate vehicle emissions. The order reaffirms the State's commitment to accelerate the deployment of zero-emission technologies consistent with existing targets under Executive Order N-79-20 and directs CARB, the California Energy Commission (CEC), the California State Transportation Agency (CalSTA), the Governor's Office of Business and Economic Development (GO-Biz), and other agencies to recommend strategies that make clean transportation more affordable, reliable, and accessible and expand zero-emission vehicle deployment across all vehicle classes, including buses.

Other state programs such as Advanced Clean Cars II, Advanced Clean Trucks, and Advanced Clean Fleets complement this effort by supporting broader zero-emission vehicle adoption across California. Executive Order N-27-25 explicitly reaffirms the State's intent to continue implementing these programs even in the face of federal efforts to revoke California's Clean Air Act waiver

At the federal level, there are currently no requirements mandating zero-emission transit vehicles.

A detailed summary of all applicable federal and state regulations is provided in *Appendix B: Relevant Regulations*

STAKEHOLDER COORDINATION AND PUBLIC OUTREACH

OVERVIEW

Stakeholder coordination and public outreach played a key role in shaping the Plan. Three stakeholder meetings, two open to the public and one stakeholder-only session, were held to introduce the project, review ZEB technology alternatives, and present the recommended implementation pathway, including funding, workforce training, and infrastructure needs. Key partners such as Redding Electric Utility (REU), SRTA, Caltrans, and local jurisdictions provided input on charging capacity, site feasibility, and regional coordination. Additional meetings with vendors, including First Public Hydrogen and InductEV, helped evaluate hydrogen refueling and inductive charging options, which informed cost estimates and infrastructure recommendations. The project team also coordinated closely with REU to assess electrical capacity at major facilities and align planning with future utility upgrades.

A presentation to the RABA Board in September 2025 summarized project progress and the preferred pathway, with plan adoption scheduled for January 2026.

Public outreach included a project website, fact sheet, and social media campaign to share updates and promote engagement, with all materials and meeting recordings translated into Spanish to ensure accessibility for limited-English-proficient community members.

KEY TAKEAWAYS

Based on the stakeholder and public outreach conducted throughout the project, the following key takeaways summarize the input and insights that informed development of the Plan:

Early discussions highlighted the need for coordination on utility capacity, and regional collaboration to support future charging and refueling infrastructure.

Stakeholders emphasized aligning infrastructure planning with available grid capacity and ensuring system resilience for power outages and emergency operations.

Evaluation of the four implementation alternatives led to broad support for a mixed-fleet approach, balancing the advantages of battery-electric and hydrogen fuel cell technologies.

Coordination with REU, First Public Hydrogen, and InductEV informed charging capacity assumptions, hydrogen delivery feasibility, and cost estimates used in the Plan.

A RABA Board presentation in September 2025 reviewed the project background, alternatives, and recommended pathway, with formal plan adoption scheduled for January 2026.

A detailed overview is provided in *Appendix C: Stakeholder Coordination and Public Outreach.*

HOW TO USE THIS DOCUMENT

This Plan is organized to guide the reader through RABA's transition to a zero-emission fleet, from background context and existing conditions to technology evaluation, stakeholder coordination, and implementation recommendations. The document is intended for RABA staff, partner agencies, and decision-makers to reference throughout planning, design, and implementation.

- ***The Executive Summary*** provides a high-level overview of the purpose, process, key findings, and recommended implementation pathway.
- ***Chapter 1: Introduction*** outlines the project background, purpose, and planning process, along with the project schedule and a summary of relevant regulations RABA must comply with.
- ***Chapter 2: Existing Fleet and Facilities Overview*** describes RABA's current services, fleet characteristics, major operations and maintenance facilities, and electricity usage at each site, as well as the existing fleet replacement schedule.
- ***Chapter 3: ZEB Market and Hydrogen Considerations*** presents a technology review of zero-emission bus (ZEB) options, including battery-electric (BEB) and fuel cell electric (FCEB) buses. It discusses infrastructure needs such as depot, opportunity, and layover charging, hydrogen supply options, and both near-term and long-term technology considerations.
- ***Chapter 4: ZEB Implementation Pathway*** details the recommended charging and refueling infrastructure, implementation phasing, cost estimates, and risk considerations for the selected alternative. It also describes the methodology and analysis used to develop and evaluate the four alternatives, and includes discussion of funding and financing options, workforce training, resiliency strategies, and greenhouse gas (GHG) reduction benefits.

Readers can refer to individual chapters for specific areas of interest whether seeking technical details on fleet conversion, regulatory context, or guidance for implementation, or review the Plan sequentially for a comprehensive understanding of RABA's transition to a zero-emission fleet.

CHAPTER 2: EXISTING FLEET AND FACILITIES

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This chapter provides a high-level overview of RABA's fleet and facilities. This defines the set of assets that need to be prepared for ZEB adoption and to accommodate charging/refueling infrastructure needs. *Appendix A: Existing Conditions* provides more details.

SERVICE AREA OVERVIEW

RABA is a regional transit provider serving Shasta County through a collaboration between Redding, Shasta Lake, Anderson, and the county government. Operating 13 fixed and flexible routes, on demand paratransit services and vanpool services. RABA also offers a bikeshare subsidy and Uber subsidy to cover last miles. With a fleet of 38 buses and vans, the system facilitates approximately 504,000 passenger trips annually. Transit operations are managed through a partnership with MTM Transit[1] and Dignity Health Connected Living (DHCL) for both fixed bus and demand response operations and scheduling.

Figure 4, Figure 5, and Figure 6 illustrate RABA's overall rural service area (Shasta County), urban service area (routes servicing Redding, Shasta Lake, and Anderson) and routes, stops and transit centers in downtown Redding, CA.

[1] Until June 2025, this partnership was with Transdev Services, Inc.

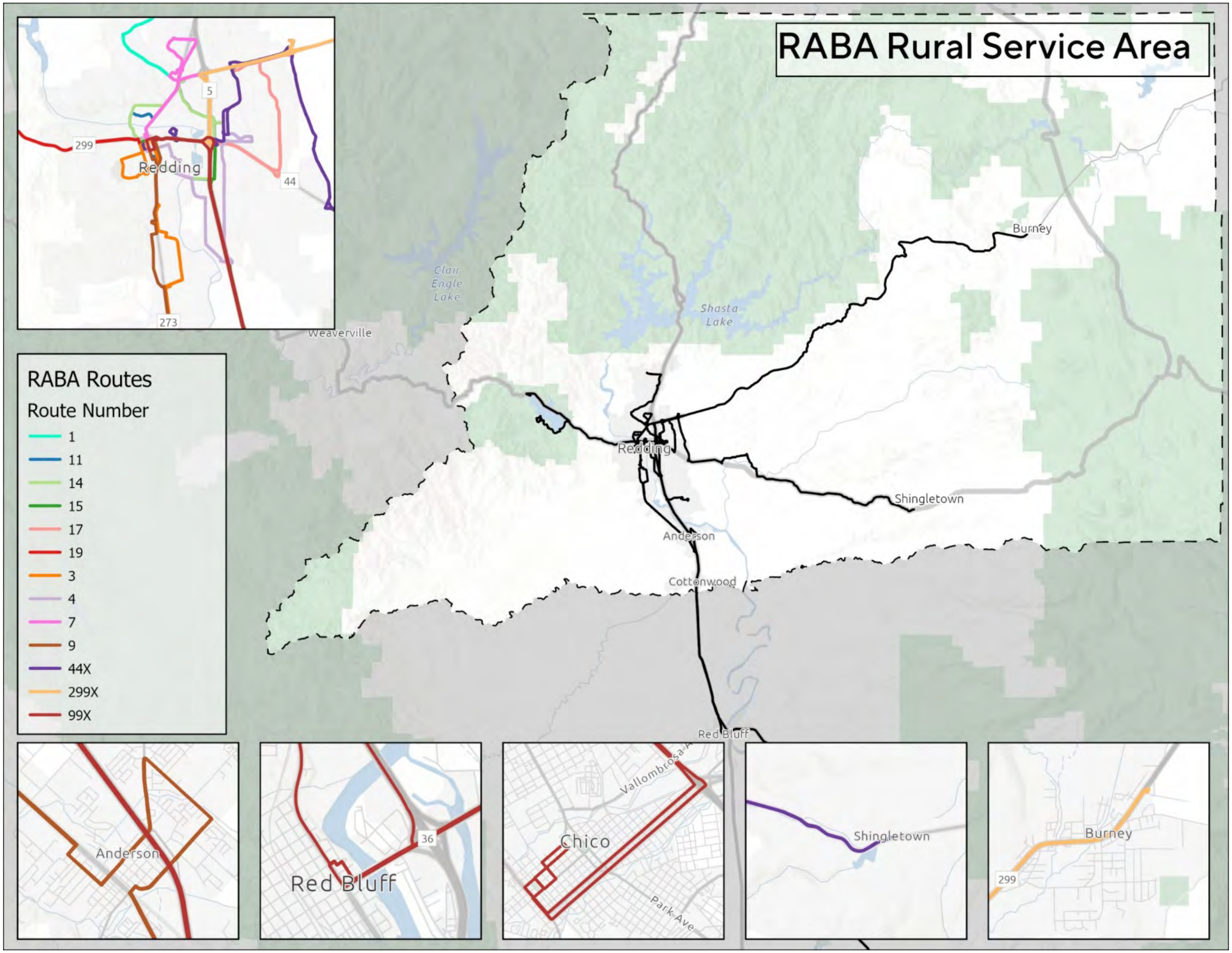

FIGURE 4. RABA RURAL SERVICE AREA

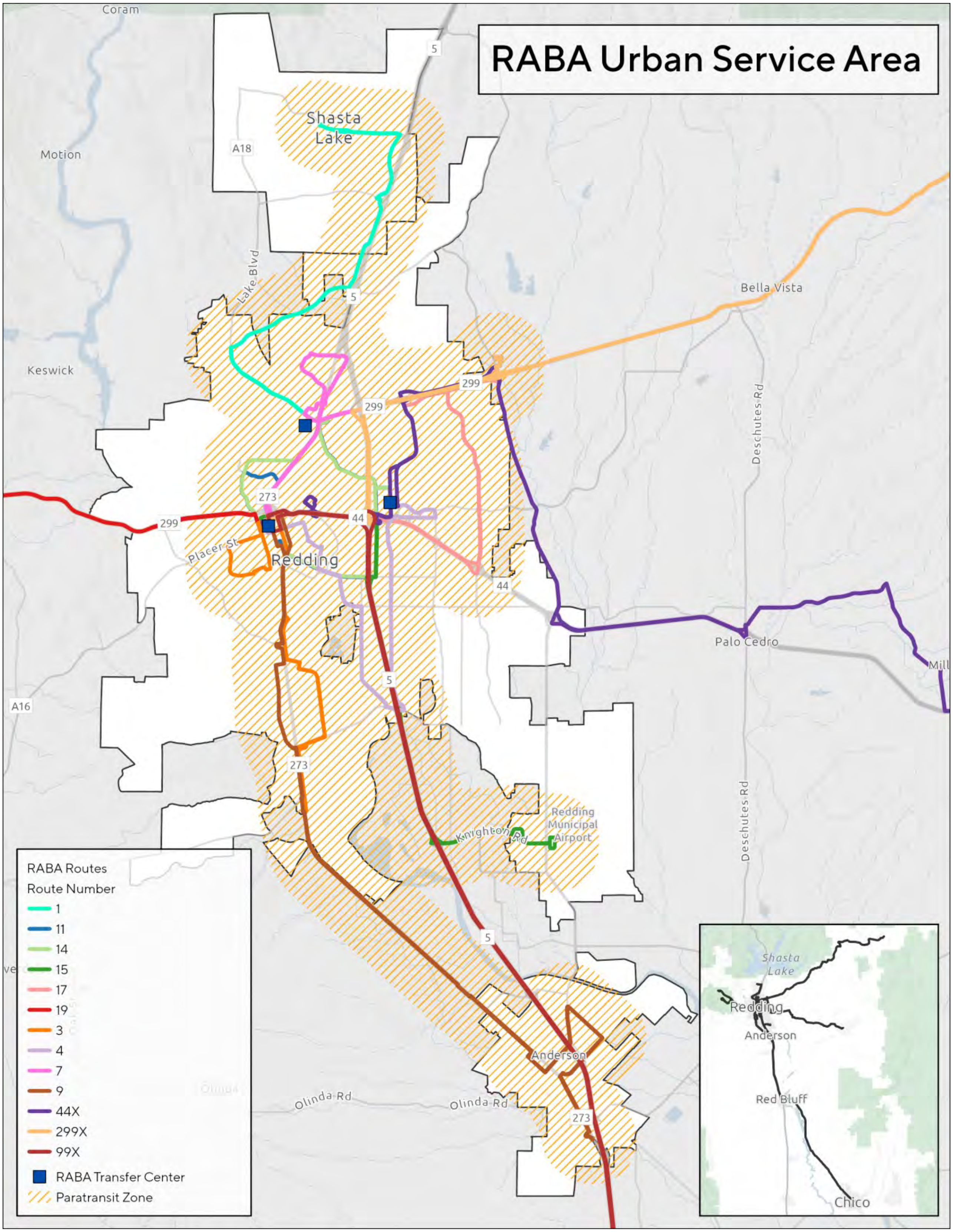

FIGURE 5. RABA URBAN SERVICE AREA

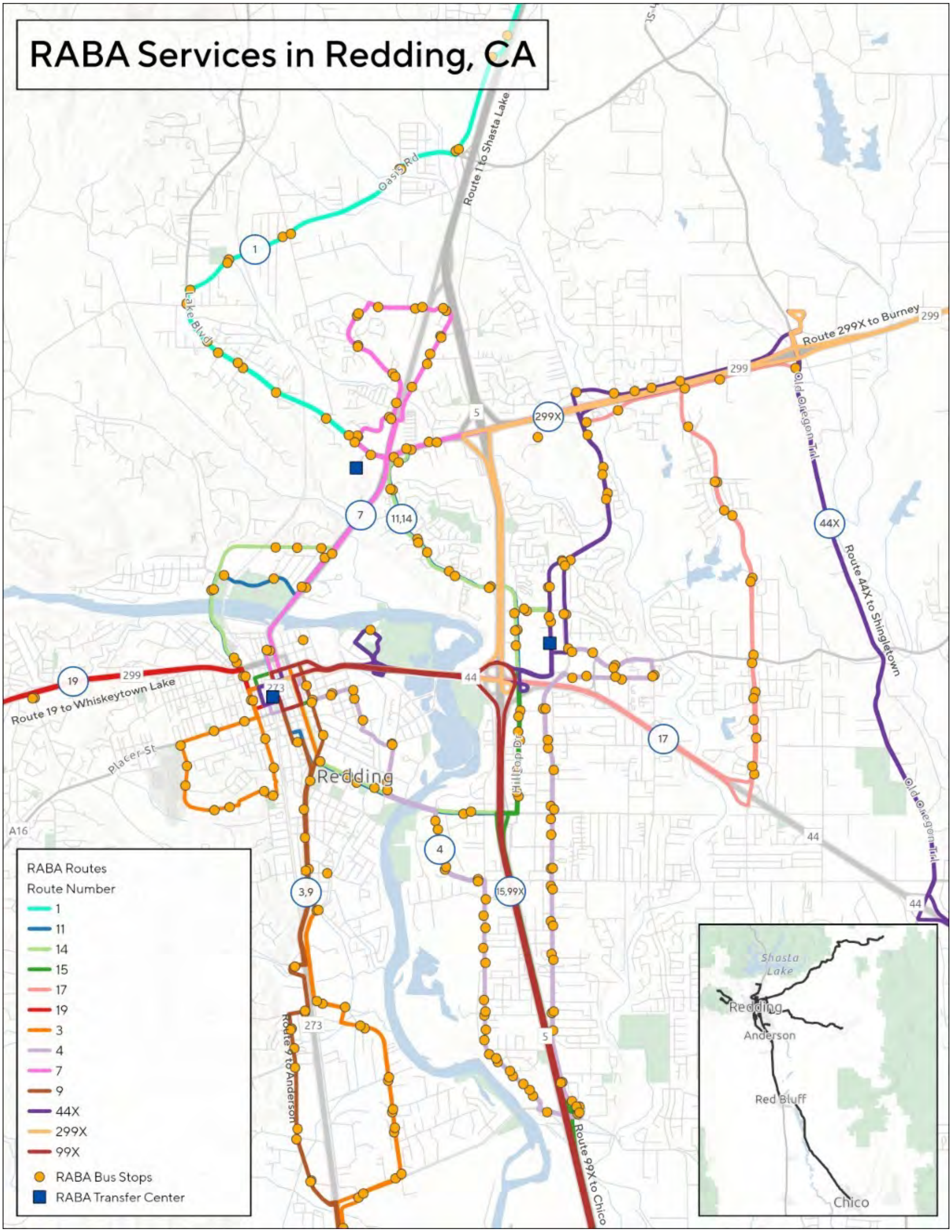

FIGURE 6. RABA SERVICES IN REDDING, CA

OVERVIEW OF EXISTING SERVICES

This section provides an overview of existing vehicle operations as they relate to each of the transit services offered by RABA. Each of RABA's services as well as the group of non-revenue vehicles (NRVs) is addressed separately to account for the distinct vehicle technical and operational requirements of each.

In 2025, RABA took over the ShastaConnect service, which has previously been operated by Dignity Health Connected Living (DHCL) and funded and supported by the Shasta Regional Transportation Agency (SRTA). For that, RABA signed a memorandum of understanding to manage the ShastaConnect fleet under RABA. Hence, while not previously operated by RABA, ShastaConnect is in scope for this project and thus addressed in this section.

Figure 7 below summarizes RABA's fleet of a total of **54** vehicles. The agency's fixed-route bus service is supported by the greatest number of vehicles (a total of 20), predominantly 35-ft. buses and coaches. RABA Demand Response is run using a total of 18 vehicles, comprising mostly cutaway buses. These same vehicles are also used for RABA Runabout, a service launched in 2024. ShastaConnect relies on 8 vehicles in total. Finally, while not providing passenger service, RABA operates 8 non-revenue vehicles.

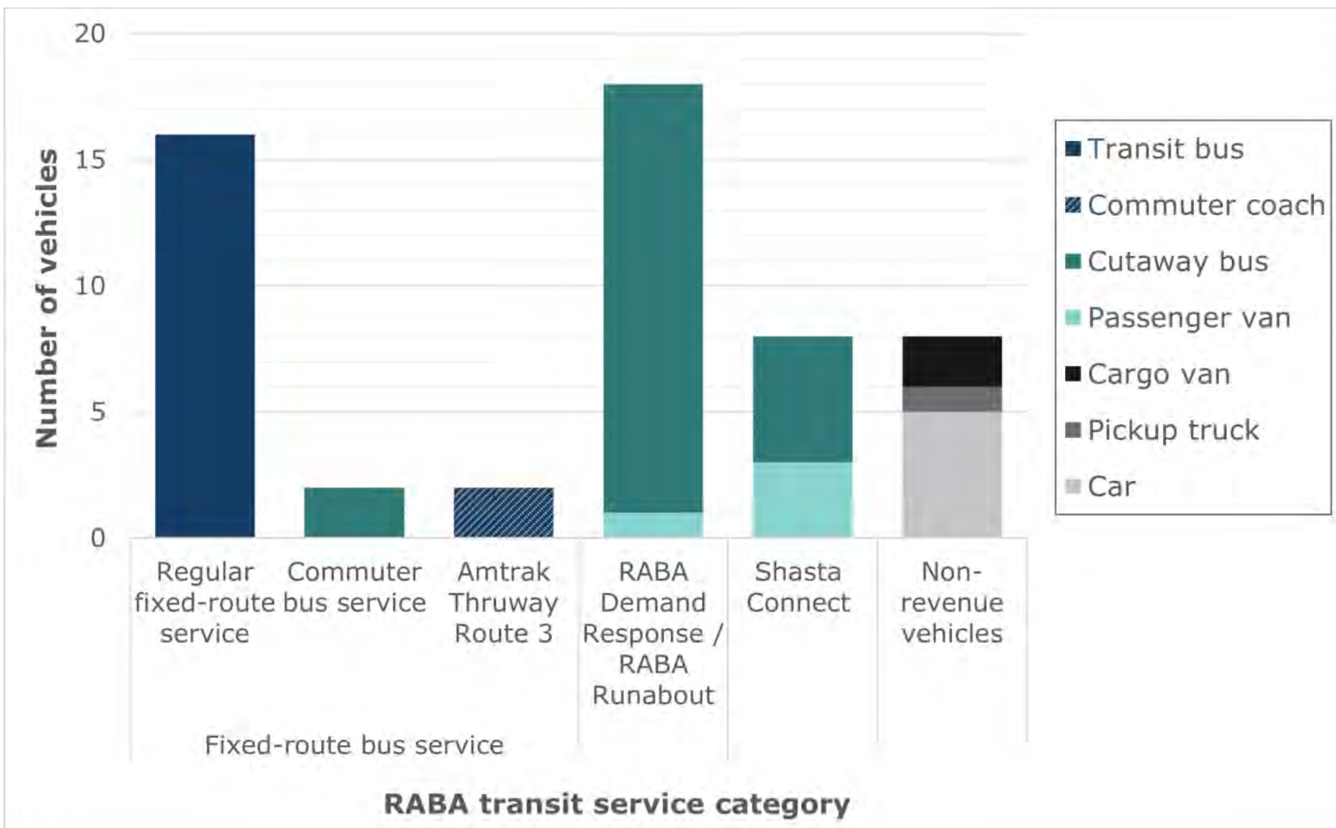

FIGURE 7. RABA FLEET VEHICLE SUMMARY

The following overview provides a high-level summary of RABA's services and vehicle composition. More detailed explanations of the nature of these services and related vehicle operations is included in *Appendix A: Existing Conditions*.

This Plan focuses exclusively on transit buses and does not include cutaway buses, as RABA intends to replace those vehicles with vans below the 14,001-pound GVWR threshold specified in CARB's ICT Regulation.

RABA Fixed-Route Bus Service:

- *Fleet:* 16 transit buses (15 diesel Gillig, 1 battery-electric Proterra; mostly 35-ft.) + 2 commuter coaches (for Amtrak Thruway service to Red Bluff & Chico) + 2 medium-duty cutaway buses (for Commuter Express service on routes 44X and 299X) = **20** vehicles
- *Description of service:* Regular bus transit service with schedule and fixed routes. Covers all of Shasta County (theoretically), though routes are highly concentrated in and around Redding.
- *Weblink with public information:* https://rabaride.com/services/bus.php

RABA Demand Response:

- *Fleet:* **18** vehicles (17 medium-duty cutaway buses, 1 battery-electric passenger van)
- *Description of service:* RABA's ADA paratransit service, i.e. origin-to-destination, shared ride, advanced reservation service for persons with disabilities. Service is provided within a ¾-mile zone along each fixed route.
- *Weblink with public information:* https://rabaride.com/services/paratransit.php

RABA Runabout:

- *Fleet:* This service is provided via the same vehicles as used for RABA Demand Response.
- *Description of service:* Reservation-based, customized point-to-point trips within five designated zones. Operating hours vary by zone.
- *Weblink with public information:* https://rabaride.com/services/runabout.php

ShastaConnect:

- *Fleet:* **8** vehicles (5 medium-duty cutaway buses, 3 passenger vans)
- *Description of service:* As stated above, this service was taken over by RABA and is thus in project scope. Covers Shasta County areas outside of RABA's service area.
- *Weblink with public information:* https://www.shastaconnect.org/

Non-revenue vehicles:

- *Fleet:* **7** vehicles (mostly light-duty)
- *Description of service:* These do not provide a public-facing transit service, but are used to support the revenue vehicle fleet and RABA's facilities, including bus stops.

FLEET REPLACEMENT SCHEDULE

Figure 8 below shows the projected replacement schedule resulting from RABA's latest (February 2025) fleet replacement plan. This schedule serves as the basis for ZEB implementation considerations and related charging/refueling infrastructure installation recommendations.

It should be noted that this plan is limited to revenue transit buses, i.e. excluding RABA's NRVs (for which RABA does not currently have projected replacement years) and cutaway buses.

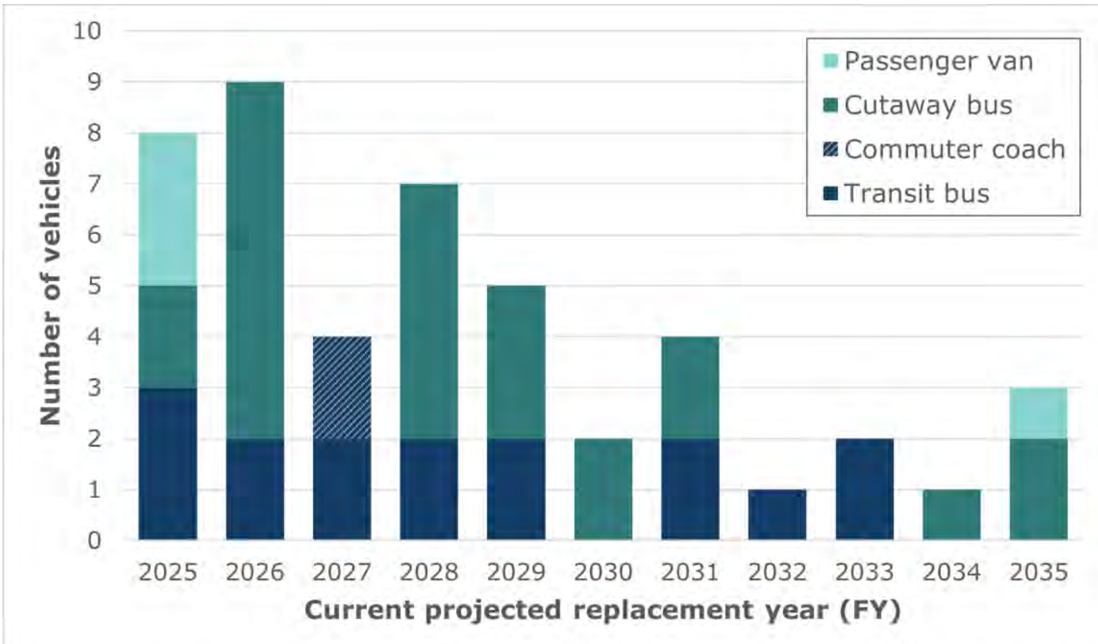

FIGURE 8. CURRENT PROJECTED REPLACEMENT SCHEDULE BASED ON RABA'S FEB. 2025 FLEET REPLACEMENT PLAN

Table 1 below lists the IDs of individual vehicles scheduled for replacement in each fiscal year. Additionally, the sum of original purchase prices is provided to serve as a measure of the anticipated relative magnitude of replacement costs in each upcoming fiscal year. Based on this schedule, a total of 17 vehicles are planned for replacement in this and the next fiscal year (eight in FY 2024-2025 and nine in 2026-2027).

In accordance with the ICT regulation, beginning in 2026, 25% of new purchases must be ZEBs. Beginning in 2029, 100% of new purchases must be ZEBs. To support this Plan, the project team worked with RABA staff and other involved stakeholders to determine a suitable ZEB adoption phasing over time. Details on the resulting transition schedule are included in Chapter 4.

TABLE 1. CURRENT PROJECTED REPLACEMENT SCHEDULE BASED ON RABA'S FEBRUARY 2025 FLEET REPLACEMENT PLAN

FISCAL YEAR	NUMBER OF SCHEDULED REPLACEMENTS	VEHICLE IDS OF SCHEDULED REPLACEMENTS	SUM OF ORIGINAL PURCHASE PRICES
2024-2025	8	• Transit buses: 51, 52, 53 • Cutaway buses (Demand Response): 266, 267 • Passenger vans (ShastaConnect): SC 11, SC 12, SC 13	$1,590,376
2025-2026	9	• Transit buses: 54, 55 • Cutaway buses (Demand Response): 260, 264, 265, 268, 269, 270, 271	$1,439,677
2026-2027	4	• Transit buses: 56, 57 • Commuter coach: 5701, 5702	$858,222

2027-2028	7	• Transit buses: 58, 59
		• Cutaway buses:
		  ◦ Fixed-route service: 308, 309
		  ◦ ShastaConnect: SC 1, SC 2, SC 3
			$1,026,346

2028-2029	5	• Transit buses: 60, 61
		• Cutaway buses:
		  ◦ Demand Response: 272
		  ◦ ShastaConnect: SC 14, SC 15
			$1,110,441

2029-2030	2	• Cutaway buses (Demand Response): 273, 274	$196,738
2030-2031	4	• Transit buses: 62, 63 • Cutaway buses (Demand Response): 275, 276	$1,149,614
2031-2032	1	• Transit buses: 64	$819,371
2032-2033	2	• Transit buses: 65, 66	$958,476
2033-2034	1	• Cutaway buses (Demand Response): 277	$168,371
2034-2035	3	• Cutaway buses (Demand Response): 278, 279 • Passenger van (Demand Response): 280	$738,106
TOTAL	**46**		**$10,055,738**

MAJOR FACILITIES

This section provides a summary of each of RABA's major facilities, especially the Downtown Redding Transit Center and the Maintenance Facility, focusing on existing site conditions. Any recommendations related to infrastructure needs at these facilities are discussed in Chapter 4.

DOWNTOWN REDDING TRANSIT CENTER

Site description

The Downtown Redding Transit Center (DRTC), also known as the RABA Passenger Terminal, is located at 1530 Yuba Street in Redding. The transit center serves as the primary transit hub in Shasta County, providing essential connections for both local and interregional transportation services. Designed for passenger convenience, the center features twelve gates for efficient boarding, customer service windows for assistance, and canopied waiting areas with benches to enhance comfort. Additional amenities include passenger restrooms, designated parking, vending machines, and bike racks, ensuring accessibility for all travelers. The facility plays a crucial role in supporting the region's transit network, offering a well-equipped and centrally located hub for seamless mobility.

All fixed bus routes originate/end or have one stop at this location.

Site layout

As shown in Figure 9, the bus terminal can be accessed from both Yuba Street and Tehama Street, allowing flexible circulation for entering and exiting vehicles. The site includes twelve (12) bus bays designated for passenger loading and unloading, as well as one additional angled stall located to the north for bus parking or layover use. A public parking lot is located across the street on the north side of Tehama Street.

FIGURE 9. DRTC SITE LAYOUT

Electricity usage

Review of Redding Electric Utility (REU) billing data indicates that the site currently does not experience significant electrical demand, with peak usage remaining below 75 kW.

However, any installation of layover bus charging infrastructure at this location would be expected to require significant capacity expansion. This increase would likely exceed the existing service capability and therefore necessitate major electrical service upgrades including potential transformer or distribution improvements in coordination with REU. More information is provided in Chapter 4 and *Appendix G: Site-Specific BEB Charger Installation Recommendations.*

MAINTENANCE FACILITY (BASE)

Site description

The RABA Maintenance Facility supports bus maintenance and operations and is located at 3333 S Market Street in Redding. This location has offices for administration and dispatch, a training room, restrooms, a maintenance bay with storage for parts, a bus wash, and ample parking in a fenced lot. The contractor administrative staff, dispatch staff, and maintenance staff operate from this location.

While not directly on the property, the fixed bus routes 3 and 9 stop on S Market Street adjacent to this facility.

Site layout

The site as shown in Figure 10, consists of the main Administrative and Maintenance Building, which is situated on the southwest end of the site along Ellis St, a bus wash facility near the center of the yard, and a covered parking area for transit buses. There is also additional parking at the north end of the site for cutaway buses. Staff and visitor parking are provided along the south and east ends of the site. The site can be accessed from both Ellis St and S Market St via gated entrances, supporting efficient circulation for buses entering and existing the facility.

To the east of the main site, across Mark St., RABA owns an additional parcel referred to by staff as the Ellist St. Lot. The lot is currently undeveloped, but RABA is in the design phase of a site improvement project to pave and prepare the site for future use.

The site improvement project would also integrate the Ellis Street Lot with the existing Maintenance Center to form a consolidated facility. Given its proximity to the Maintenance Center, the Ellis Street Lot may serve as a suitable temporary location for a hydrogen fueling station or other interim operational use. However, due to ongoing planning and uncertainties surrounding the future site reconfiguration project, no permanent structures are recommended at this time.

FIGURE 10. MAINTENANCE FACILITY EXISTING SITE LAYOUT

Electricity usage

The existing REU transformer is located at the south end of the site, by Ellis St, and the existing switchgear is located on the exterior of the east wall of the Admin/Shop building. The existing Redding Electric Utility (REU) billing data indicates that the site currently does not experience significant electrical demand, with peak usage remaining below 75 kW.

However, the installation of any major bus depot charging system at this location would be expected to require significant additional capacity that would likely exceed the existing service capability and therefore necessitate major electrical service upgrades including potential transformer or distribution improvements in coordination with REU.

CANBY ROAD TRANSFER FACILITY AT MT. SHASTA MALL

Site description

Canby Transfer Facility is a sheltered waiting area behind the Mt Shasta Mall with two shelters, benches, and a drinking fountain area.

The following fixed bus routes stop at this location: 4, 11, 14, 44X.

Site layout

The entrance for the buses is from Canby Rd as shown in Figure 11.

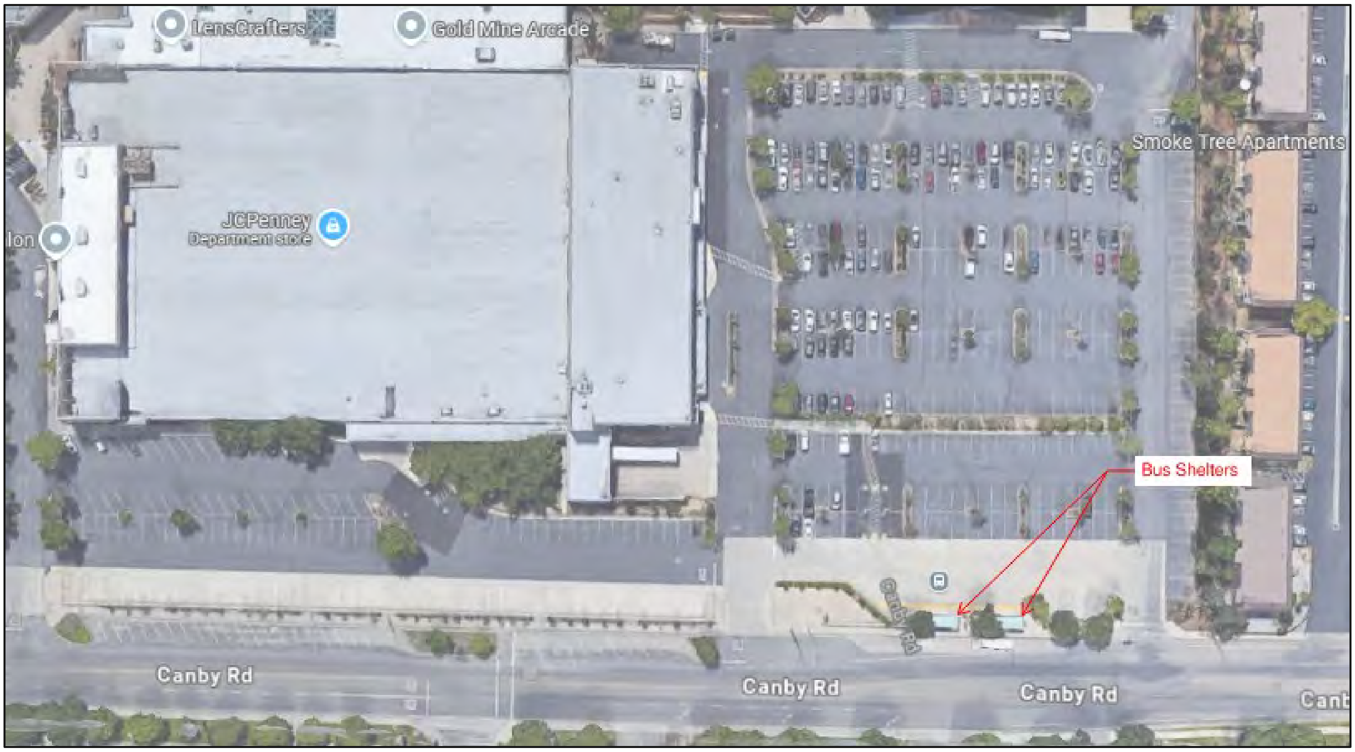

FIGURE 11. CANBY TRANSFER FACILITY SITE LAYOUT

Electricity usage

No information on the existing electrical infrastructure at this site was provided. However, based on a remote review of site conditions, any electric infrastructure can be assumed to be minimal (likely restricted to lighting only).

Based on site layout, the existing electrical infrastructure would likely not support any bus charging at this site as any on-route charger is expected to consume at least 125 kW, which would trigger peak demand charges and impact the site's electrical infrastructure.

CHAPTER 3: ZEB MARKET AND HYDROGEN CONSIDERATIONS

CHAPTER 3: ZEB MARKET AND HYDROGEN CONSIDERATIONS

This chapter discusses the state of the ZEB technology market, including the respective market readiness of BEBs and hydrogen FCEBs for both full-size transit buses and medium-duty cutaway buses. Furthermore, hydrogen market supply considerations are included to provide context for the ZEB implementation recommendations made in Chapter 4.

ZEB TECHNOLOGY REVIEW SUMMARY

As summarized in Chapter 1 and documented in *Appendix B: Relevant Regulations*, RABA must comply with California's Innovative Clean Transit (ICT) rule, requiring 100% ZEB purchases by 2029 and full fleet conversion by 2040. This section and the accompanying *Appendix D: ZEB Technology Review* evaluate available and upcoming battery-electric and hydrogen fuel cell buses (35-40' and cutaway types) to guide RABA's procurement strategy, while emphasizing models eligible for HVIP incentives ($60k for cutaways, $120k for full-size buses).

The two ZEB technologies allowed under ICT include both battery and fuel cell electric buses. Battery buses (BEBs) have relatively limited range due to the weight and bulk of the batteries they carry which are time-consuming to recharge and have therefore been predominantly used on urban or suburban routes that have frequent stops and starts, high idle times, lower average speeds, and a daily range of 100-200 miles or less. Fuel cell buses (FCEBs) store their energy in the form of hydrogen which has higher energy density and rapid fueling capability, making them better suited when additional range and faster fueling is needed, such as on long distance regional, express, and commuter routes with sustained speeds of 40mph and more, substantial altitude changes, extreme climates, and 8+ hours of continuous operation. Table 2 compares performance of conventional, battery, and fuel cell buses, in this case a 40' New Flyer.

The technology for BEBs and FCEBs is still maturing when compared to conventional fuels, and both ZEBs continue to improve reliability, durability, and range. The purchase price of both ZEB technologies are currently about twice that of a conventional bus, although decreased operating costs can close the total cost of ownership (TCO) delta over time.

TABLE 2. COMPARISON OF NEW FLYER DIESEL, BATTERY, AND FUEL CELL BUSES

ATTRIBUTE	CONVENTIONAL	BATTERY ELECTRIC	FUEL CELL ELECTRIC
FUEL/ENERGY	Diesel	Batteries	Hydrogen & Batteries
ENERGY CONVERSION	Combustion	Batteries	Fuel Cells
TRANSMISSION	Gearbox	Direct Drive	Direct Drive
TRACTION	Engine	Electric Motor	Electric Motor

ATTRIBUTE	CONVENTIONAL	BATTERY ELECTRIC	FUEL CELL ELECTRIC
POWER TO ACCESSORIES	Engine	Batteries	Batteries
HEATING	Engine waste heat	Heat pump	Fuel cell waste heat/heat pump
RANGE BETWEEN FUELING[2]	~400 miles	~175-215 miles[3]	~350 miles

Sources: New Flyer, Altoona Bus Testing Center

CUTAWAY BUSES (UNDER 30')

Battery-Electric Options

Several manufacturers (Endera, GreenPower, Micro Bird, Motiv, Optimal-EV, Phoenix Motorcars) offer Buy America-compliant, Altoona-tested battery-electric shuttles. These Class 4-5 vehicles (12-24 passengers) typically achieve 100-150 miles per charge, sufficient for most paratransit operations. Prices range from $250k-$300k, with incentives reducing costs to ~$240k. They provide 75-80% savings in maintenance and fuel, and infrastructure needs are limited to depot chargers. Battery size customization and improved chassis supply should enhance availability by 2025.

Hydrogen Fuel Cell Options

No commercial hydrogen fuel cell cutaway buses currently exist in the U.S. market. Barriers include high integration costs, low demand, limited fueling infrastructure and uncertain hydrogen fuel supply and cost. RABA should monitor market developments and may consider retrofits from gasoline cutaways (~$350k each) or future commercial models (post-2030) for long rural routes. Advancements in compact, affordable fuel cells could create opportunities for hydrogen fuel cell-based solutions in this vehicle segment in the 2030s.

TRANSIT BUSES (35' AND 40')

Battery-Electric Options

Proven BEBs from Gillig, New Flyer, Proterra (Phoenix), BYD, and GreenPower offer 150-300+ mile ranges with 490-738 kWh batteries. Costs average $800k–$950k before incentives. HVIP can offset as much as $120k of the purchase cost. BEBs may reduce maintenance by ~40% and energy costs to $0.45/mi vs. ~$1.00/mi for diesel, though these reductions are highly variable based on local conditions. These models are well-tested and have been supported by FTA Low-No and EnergIIZE programs in the past.

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[2] New Flyer 40' bus Altoona Orange County test range (seated load)

[3] Varies varies based on battery size

Hydrogen Fuel Cell Options

FCEBs such as New Flyer Xcelsior CHARGE H_2 and ENC Axess-FC deliver 250-350 miles per fill and refueling times of 10-15 minutes. Costs are typically $1.0–$1.2M per bus and can be as low as $900k after incentives. They are ideal for long-range routes, offering diesel-like operations but far higher fuel costs, subject to volatile hydrogen unit costs and availability. Infrastructure is capital-intensive ($2-8M for permanently installed stations).

INFRASTRUCTURE AND SUPPORT CONSIDERATIONS

BEB CHARGING INFRASTRUCTURE

Battery-electric bus (BEB) charging infrastructure has matured significantly, and a wide range of proven solutions is available on the market to meet the needs of many transit systems. The two primary charging approaches used by transit agencies are depot (overnight) charging and opportunity (on-route or layover) charging, each serving distinct operational roles.

Depot Charging

Depot or "plug-in" charging typically occurs overnight when buses are parked and out of service. Chargers range from AC Level 2 (~20 kW) units suitable for smaller vehicles with longer dwell times, to medium- and high-output DC fast chargers (50-450 kW) that can fully recharge a bus within a few hours or less. These systems are generally well suited for agencies like RABA, where most buses return to a central maintenance facility at the end of each service day. Depot chargers can be installed as wall-mounted or pedestal units or ceiling mounted under solar canopies. Such chargers are often paired with shared power cabinets and load management systems that optimize available electrical capacity and minimize utility demand charges.

A variety of vendors offering matured hardware and software solutions is available on the market. Common bus charging vendors include Siemens (known for its depot solutions), ABB (various transit DC charging systems), Kempower (modular cabinets/satellites suited to depots), and ChargePoint (Express Plus platform for scalable fleet DC charging), among others.

Opportunity and Layover Charging

For routes requiring longer service spans or higher daily mileage, on-route "opportunity" charging can extend range without disrupting operations. This includes pantograph systems (bus connects to an overhead gantry arm) or inductive charging pads (wireless, ground-mounted systems) installed at major layover or transit centers. These systems can deliver 150-450 kW or more, providing substantial charge in a 5-15 minute layover period and maintaining service continuity on high-utilization routes.

Pantograph-down (inverted mast) and pantograph-up (vehicle-mounted) systems are offered by ABB, Siemens, and Heliox. These system's interfaces often align with open standards including SAE J3105 for cross-OEM compatibility.

Industry-leading providers of inductive (wireless) bus charger technology include InductEV (formerly Momentum Dynamics) and WAVE.

System Integration and Scalability

Modern bus charging technologies are supported by the following interoperability standards:

- **SAE J1772 and CCS** for plug-in AC and DC charging
- **SAE J3105** for overhead gantry charging
- **SAE J2954** for inductive charging
- **ISO 15118** as a communication protocol between electric vehicles and charging equipment, supporting advanced features like smart and bidirectional charging (V2G)
- **OCPP (1.6, 2.0.1, or 2.1)** as a communication protocol between charging equipment and the charging network provider's charging management system (CMS)

Charge management software enables smart scheduling, peak demand control, and integration with battery energy storage systems (BESS) or onsite solar PV, helping optimize cost and resiliency.

In summary, multiple commercially mature BEB charging solutions are currently available. These systems can be scaled and configured to meet RABA's operational profile. With more details provided in Chapter 4, this can be achieved by combining overnight depot charging with opportunity charging at RABA's high-demand layover point, the Downtown Redding Transit Center (DRTC), providing a reliable, flexible foundation for the agency's transition to a fully electrified fleet.

HYDROGEN SUPPLY

Current and Planned Hydrogen Production and Distribution

Hydrogen is plentiful in the atmosphere but bound to other molecules - CH4, H2O, C2OH6. Producing hydrogen means separating from other molecules, something that's been done for at least 90 years. Figure 12 shows the common methods of producing hydrogen.

FIGURE 12. COMMON METHODS OF PRODUCING HYDROGEN

Source: U.S. Department of Energy

Hydrogen production, including steam methane reforming (SMR), is a chemical process that does not produce criteria air pollutants. It does, however, generate greenhouse gas emissions. In California, the emphasis is on hydrogen produced from renewable resources. In other locations, the emphasis is on carbon capture and storage, hydrogen from nuclear power, or hydrogen from industrial off gases.

The nearest existing stations are located in the San Francisco Bay Area and Sacramento, which are approximately 160 to 200 miles south of Redding. Transporting hydrogen over such distances can lead to logistical challenges, including increased costs and hydrogen losses due to boil-off during transit.

Locally, the Redding Rancheria Tribe partnered with the H2 Energy Group to build a facility to produce up to 30 tons of hydrogen per day from biomass. H2 Energy Group is one of several companies that focuses on converting woody biomass - trees, branches, shrubs, and other materials that reduce wildfire risk or are remains of a fire into hydrogen. Several of these projects were co-funded by the California Department of Conservation. Other hydrogen production projects have been discussed, including the City of Redding’s interest in converting green waste to hydrogen for fuel.

Before being used for fuel, hydrogen must be “scrubbed” to remove contaminants and then distributed to the dispensing site/equipment. Figure 13 shows the options for hydrogen distribution and storage: delivered as a liquid[4] and converted to a gas, delivered as compressed gas, or produced on site and delivered via a pipeline.

[4] Hydrogen must be cooled to a cryogenic temperature to become a liquid. At atmospheric temperature and pressure, hydrogen is a gas.

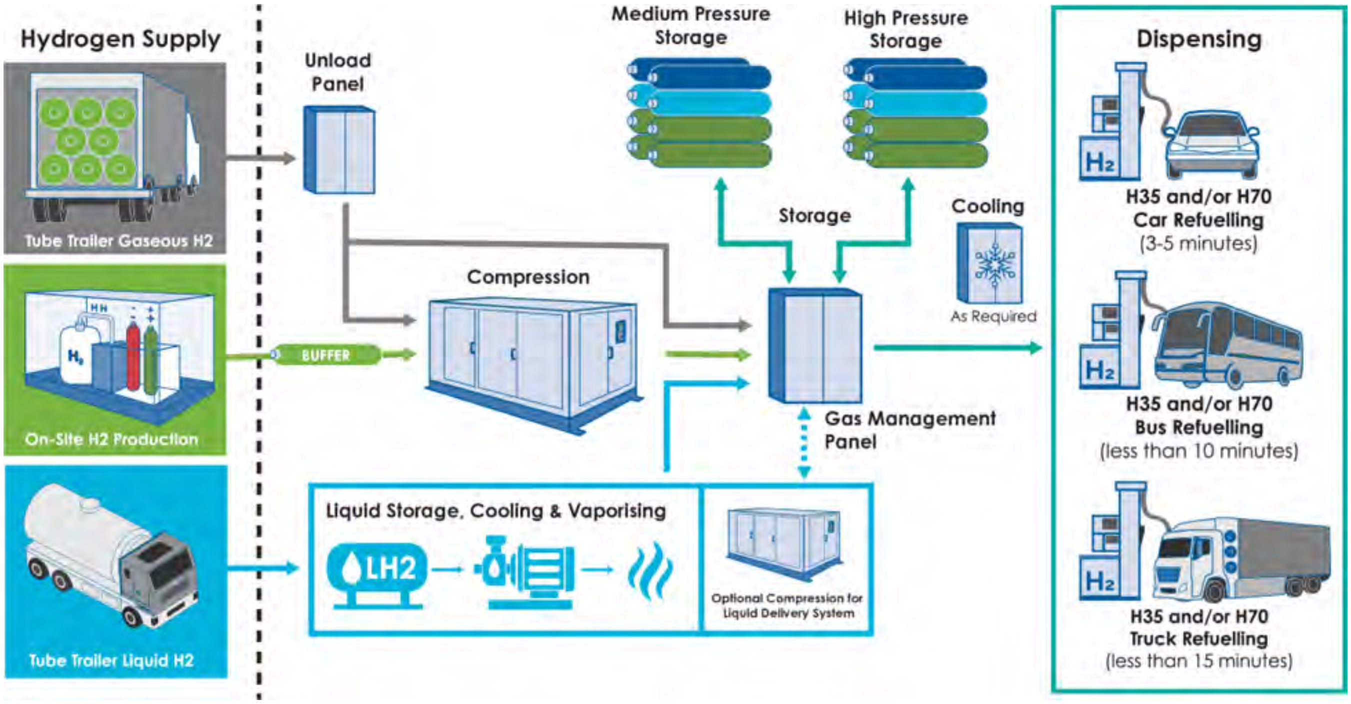

FIGURE 13. HYDROGEN DISTRIBUTION AND STORAGE

Source: Gilbarco Veeder-Root

Near and Longer-Term Hydrogen Opportunities

Codes and standards for hydrogen (H_2) stations are established and adopted in California. Engineers who design and build H_2 stations know the codes and how to work with local authorities. However, like all construction projects, adding a H_2 station to an existing facility or undeveloped parcel can take several years for design, approval, and construction. Hydrogen fueling facilities also require significantly larger capital investments than BEB charging facilities. To jump start hydrogen bus roll out and minimize up front investments, transit agencies across the county are purchasing hydrogen from vendors using mobile fueling stations, as seen in Figure 14.

FIGURE 14. ANTELOPE VALLEY TRANSIT AGENCY FCED AT A BAYOTECH MOBILE HYDROGEN STATION

Source: BayoTech

BayoTech is one of several companies that has temporary or portable hydrogen fueling. Other examples include Air Products, PlugPower, and Powertech Labs. The two containers in Figure 14 have cylinders of compressed hydrogen and a hydrogen fueling nozzle attached to the trailer. One FCEB at a time refills from the trailer in about 15 minutes. Third-party operators like BayoTech monitor the amount of hydrogen available and, when low, replace the trailer with one that has full canisters. The hydrogen fueling operator charges the transit agency for hydrogen used, its delivery, and use of the trailer. Potential near, mid and long-term arrangements with third-party hydrogen fueling operators are outlined below.

Near-term: RABA could contract with one of the companies that offer temporary hydrogen fueling to deliver hydrogen trailers to RABA in Redding and understand the frequency that the trailer will need to be swapped.

Mid-term: In 2024, the states of California, Oregon, and Washington were jointly awarded a $102 million grant to develop public charging and hydrogen stations for freight, and Redding is one of the key locations identified in the proposal. Each hydrogen fueling station will have a minimum of two nozzles and 1,000 kg of H_2 per day of fueling capacity. Caltrans will issue RFP for station development, although the timeline for the RFP is uncertain. The project team recommends that

RABA provide a letter of support to developers that will apply for funding and work with the developer to ensure both the site and the station design can support transit buses.

Longer-term: Under more favorable market conditions than today and supported by sufficient funding, RABA may wish to build a permanent hydrogen station that could also be shared with other transit buses and/or with fuel cell trucks. While this Plan focuses on hydrogen fuel use by RABA specifically (and potentially government fleets), if substantial demand from non-governmental fleets and users emerges, RABA could look at allowing private fueling as a revenue source, if applicable. Figure 15 is a rendering of the hydrogen hub that Sacramento RT is building along with a state-of-the-art maintenance facility.[5] SacRT expects to open the hydrogen station to other agencies' FCEBs.

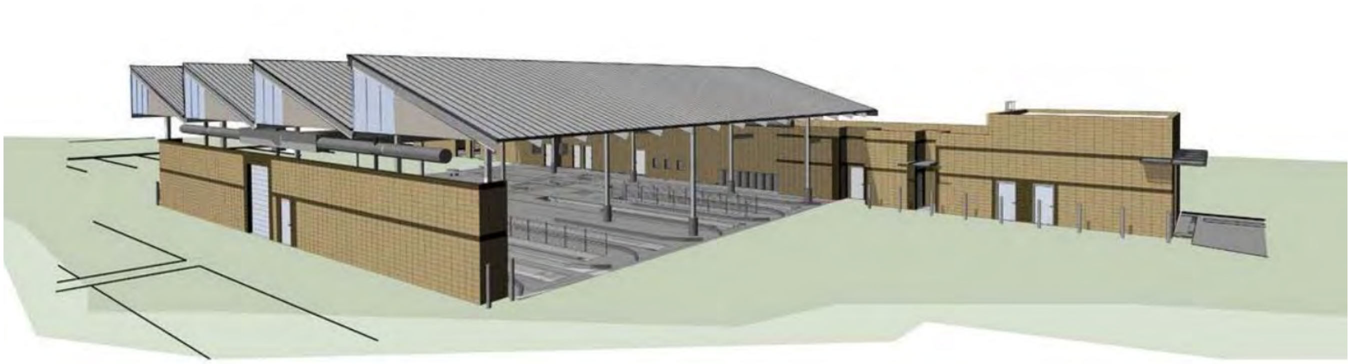

FIGURE 15. ARTIST RENDITION OF SACRT HYDROGEN FUEL STATION

Source: SacRT

[5] https://www.sacrt.com/newbusfacility/

CHAPTER 4: ZERO-EMISSION BUS IMPLEMENTATION PATHWAY

CHAPTER 4: ZERO-EMISSION BUS IMPLEMENTATION PATHWAY

ZEB IMPLEMENTATION RECOMMENDATIONS

OVERVIEW

Based on all available information about RABA's fleet, its facilities, its service schedule and route network, the state of ZEB technologies and ZEB charging/refueling solutions, the unique local geography of the Redding area (including topography and climate), the project team recommends a blended mix of both battery-electric buses for most and hydrogen fuel cell electric buses for some of RABA's fixed routes.

The following subsections provide details on different elements of this recommendation, including the recommended routes for BEB and FCEB deployment, charging and refueling operations, infrastructure needs, implementation phasing, cost, operational considerations, and possible risks.

The recommended implementation pathway for RABA's zero-emission fleet includes a combination of battery-electric buses for most routes and hydrogen fuel cell electric buses for select fixed routes.

Note that RABA currently does not intend to transition cutaways to zero emissions. Instead, RABA plans to downsize them, i.e. replace them with passenger vans that will fall below the ICT weight threshold of 14,000 lbs. GVWR and hence would not be mandated to transition to zero emissions. This is why the described implementation pathway is limited to RABA's sixteen 35-ft. transit buses and the two 45-ft. motor coaches.

Fuel Mix Breakdown

To best match available vehicle technology with route characteristics, operational needs, and facility capabilities, the following breakdown of routes by recommended ZEB type as also shown in Figure 16 and Figure 17 was developed by the project team with input from RABA staff and stakeholders:

Battery-electric buses (BEBs) are recommended for the majority of RABA's local, circulation-style routes that operate with frequent layovers at the Downtown Redding Transit Center (DRTC). These include routes 1, 4, 7, 11, 14, 15, 17, and 19. Based on the block energy modeling discussed in greater detail below, these routes have projected daily energy needs ranging from approximately 210 to 800 kWh. The associated blocks serving these routes have hourly layovers at the DRTC with durations of roughly three to thirteen minutes each. These short windows are essential for opportunity charging to ensure that all BEBs can complete their scheduled blocks and operate for the full service day. Currently, three buses serve Route 4 simultaneously on staggered schedules; to enable full BEB operations as proposed, one additional bus would need to be deployed on a new block covering select Route 4 trips. Details on required block schedule changes are provided further below.

Hydrogen fuel cell electric buses (FCEBs) are recommended for deployment on Routes 3, 9, and 99X (Amtrak). Based on RABA's block schedule and route profiles, these routes are best suited for hydrogen-fueled operation due to their relatively high daily energy demands – generally in the range of 510 to 800 kWh per block – and higher average operating speeds, particularly for Routes 9 and 99X. These routes also feature layovers at the DRTC that are less frequent and not well aligned with other routes, making opportunity charging less feasible. FCEBs, with their greater range and rapid refueling capability, are therefore a better fit for these service profiles by being able to maintain full-day operation without significant schedule modifications.

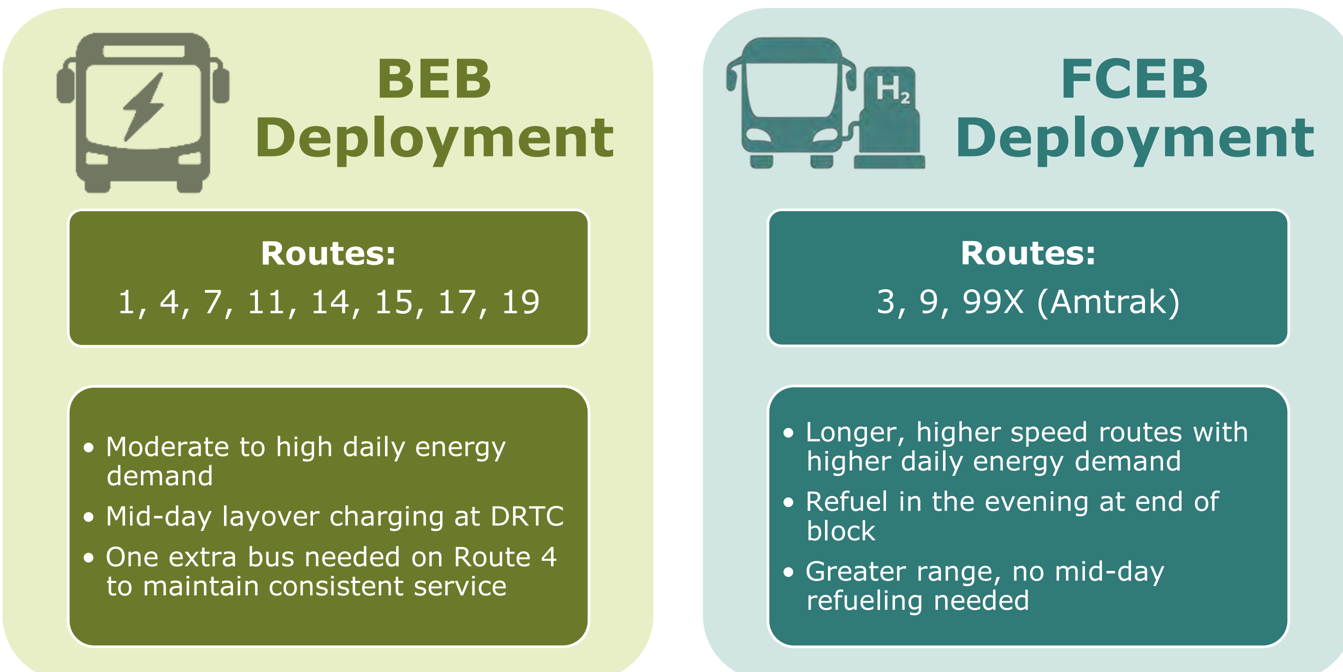

FIGURE 16. RECOMMENDED ZEB FUEL MIX FOR RABA'S TRANSIT SYSTEM

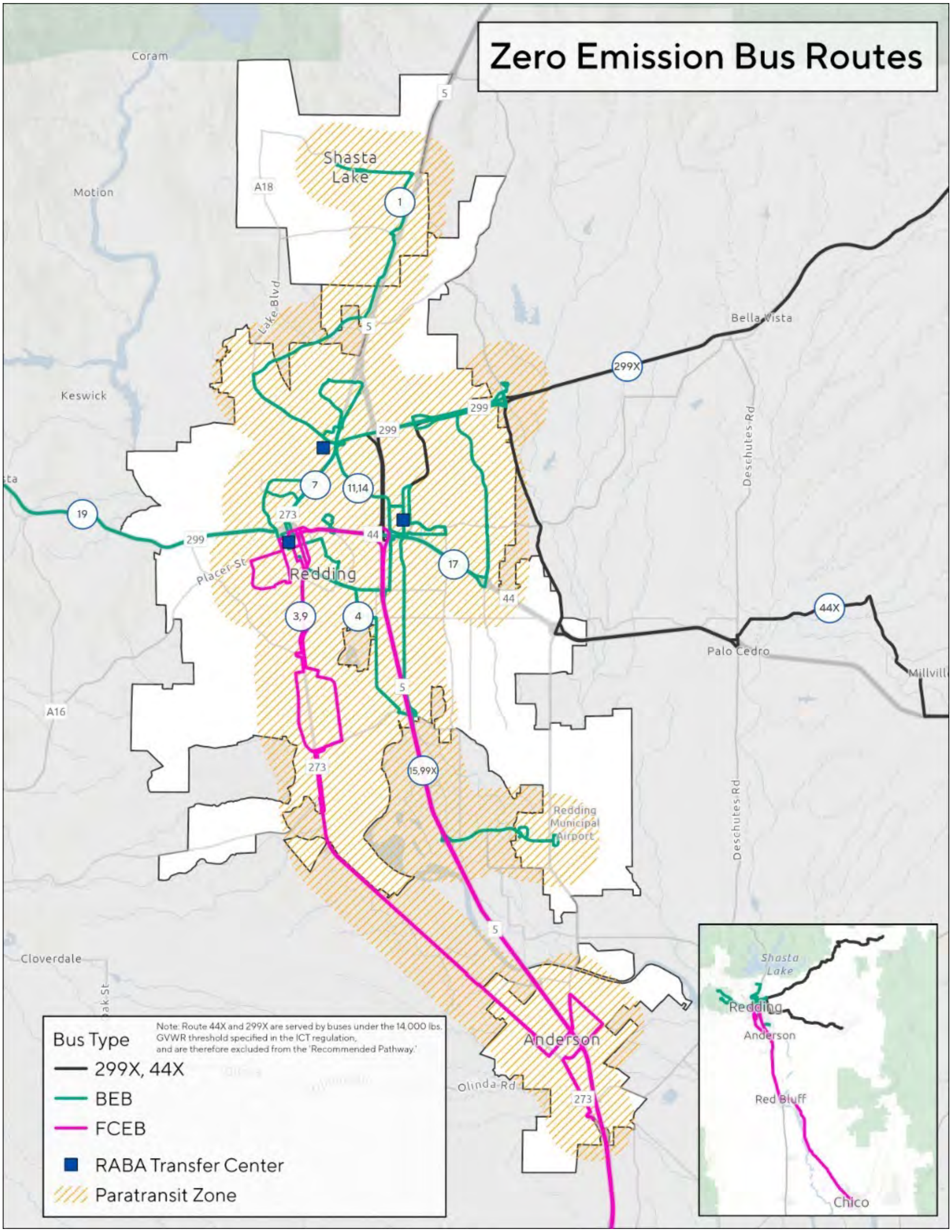

FIGURE 17. RABA ZEB ROUTES

Charging/Refueling Operations Strategy

To support BEB operations, RABA should rely on a combination of overnight depot charging at the Maintenance Facility and layover charging at the DRTC. Specifically, high-powered inductive chargers are recommended for installation at the DRTC to enable rapid charging during short layover periods. Inductive charging, rather than overhead gantry or plug-in systems, is more suited for RABA's system for several key reasons:

- **High power capability:** Inductive systems support fast charging rates upwards of 150 kW, sufficient to restore meaningful range during brief layovers.
- **Minimal connection time:** Power transfer typically begins within 2-5 seconds, maximizing the limited dwell time available at the DRTC. Overhead gantry systems generally require 20-30 seconds for bus-to-charger connection – valuable time lost given RABA's short layovers.
- **No obstructive infrastructure:** Inductive systems use charging pads installed both on the bus underside and flush within the pavement, requiring no additional above-ground equipment. This maintains clear passenger and vehicle circulation areas while reducing exposure to wear and vandalism. Overhead gantry systems would be difficult to reconcile with the DRTC's constrained physical space.
- **Reduced maintenance and downtime:** With no external moving parts, inductive systems are less susceptible to mechanical failure and public interference.
- **Space efficiency:** Overhead gantry systems would be difficult to install due to the DRTC's constrained physical space.
- **Operational simplicity and safety:** Plug-in corded systems would require operators to manually connect and disconnect vehicles, creating inefficiencies and potential safety risks while occupying limited and sensitive bay space.

To support FCEB operations, hydrogen refueling is proposed to occur on RABA's Ellis Street property, adjacent to the Maintenance Facility. Because FCEBs have sufficient range to complete a full day of service, there is no need for mid-day refueling. All refueling can therefore be centralized at this single site. Under this approach, FCEBs would return to the Ellis Street facility at the end of their daily blocks, refuel (typically requiring about 6-12 minutes), and park overnight at the adjacent Maintenance Facility with full tanks, ready for the next day of service. The Ellis Street location offers sufficient space and proximity to the Maintenance Facility to efficiently support consolidated refueling operations. Details on the proposed fuel supply business model are included below.

RABA should support battery-electric bus operations through a combination of overnight depot charging at the Maintenance Facility and layover charging at the Downtown Redding Transit Center, allowing efficient rapid charging without the need for plug-in or overhead systems

Benefits of the Recommended ZEB Implementation Pathway

The recommended ZEB implementation pathway, which combines BEBs and hydrogen-powered FCEBs, offers RABA a balanced, resilient, and cost-effective approach to fleet electrification. This dual-technology strategy aligns vehicle capabilities with route profiles, optimizing operational performance while managing infrastructure and cost considerations. Benefits of this approach are described in Figure 18 below.

Enhanced system resiliency

Maintaining both ZEB fuel types in RABA's future fleet increases overall system resiliency. In the event of unforeseen disruptions – such as grid power outages or interruptions to the hydrogen supply – service can be maintained at least partially by operating the unaffected vehicle type. Further strategies to strengthen system reliability are discussed in the "Resiliency" section below.

Operational flexibility and efficiency

Deploying FCEBs on RABA's most demanding routes allows the agency to benefit from hydrogen's longer range and faster refueling capabilities, ensuring uninterrupted service even on blocks with higher energy requirements and limited layover durations. BEBs, conversely, are well-suited for local routes with predictable layover opportunities and shorter daily distances.

Optimized infrastructure investment

By using FCEBs on select high-demand routes, RABA can limit the need for even more extensive charging infrastructure expansion compared with a scenario that relies solely on BEBs. This approach reduces spatial and electrical load constraints at the Downtown Redding Transit Center (DRTC) and the depot while maintaining full operational coverage.

Managed transition risk

During the transition period through 2040, RABA can continue to rely on existing diesel buses as contingency resources to ensure service reliability during the phased rollout of ZEB infrastructure and vehicles.

Cost-effectiveness and technology maturity

BEBs are generally a more mature and cost-effective technology than FCEBs, both in terms of vehicle procurement and operational expenses such as fuel and maintenance (also see Appendix D). Predominantly relying on BEBs – while strategically incorporating FCEBs where operationally advantageous – enables RABA to minimize total transition costs, reduce implementation risk, and maintain flexibility as technologies evolve.

FIGURE 18. BENEFITS OF THE RECOMMENDED ZEB IMPLEMENTATION PATHWAY

ZEB CHARGING & REFUELING INFRASTRUCTURE NEEDS

This section discusses the BEB charging and FCEB refueling infrastructure needs to support RABA's planned transition to ZEBs.

Charging Infrastructure

To enable the integration of BEBs into its operations, RABA will need to expand its charging infrastructure at its two key facilities, the main depot and the DRTC.

Depot Charging Infrastructure

At RABA's main maintenance and operations facility, the charging infrastructure will primarily support overnight depot charging for full-size battery-electric buses. The recommended permanent installations – to be deployed and owned by RABA – include the following elements:

- **Ten (10) 50 kW DC charging ports**, ceiling-mounted beneath the existing solar canopy where buses are parked overnight. These chargers will support regular overnight charging for the BEB fleet.
- **One (1) dual-port 150 kW DC fast charging station**, suitable for supplemental charging of both transit buses and RABA's smaller electric vans and non-revenue vehicles.
- **Existing and planned chargers** will remain in service, including:
    - One ChargePoint 125 kW DC fast charger located on the south end of the solar canopy
    - One GrizzlE and one Tellus Level 2 charger around the main building
    - Four GrizzlE Level 2 chargers located on the north end of the solar canopy

The total connected electrical load from all proposed charging infrastructure at the depot is estimated at approximately 800 kW. This level of demand can be accommodated within the existing site's electrical capacity, pending coordination with Redding Electric Utility (REU) during final design.

A high-level conceptual site layout visualizing these charger installation recommendations is shown in Figure 19. Detailed drawings for each proposed installation phase and site are included in *Appendix G: Site-Specific BEB Charger Installation Recommendations.*

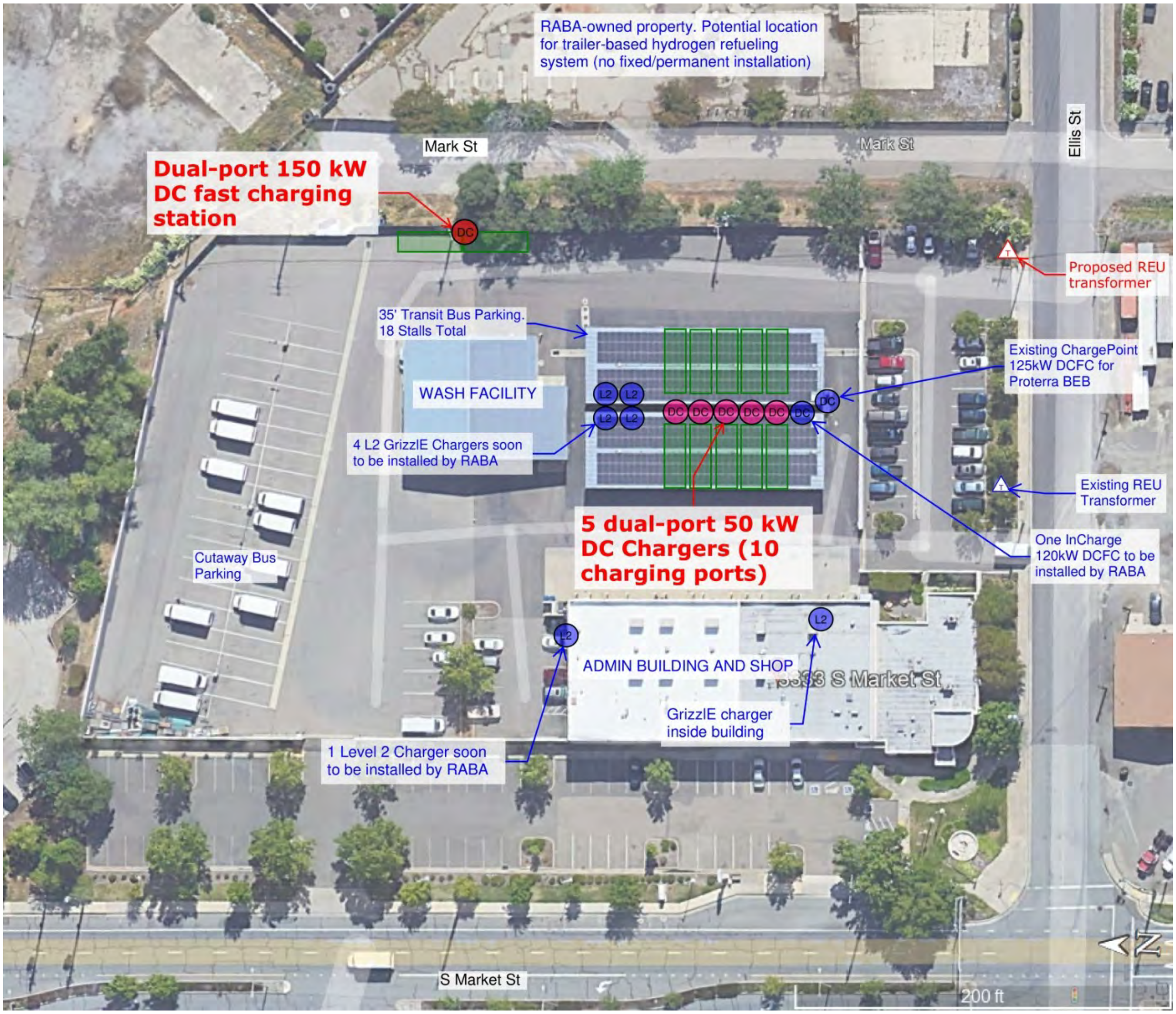

FIGURE 19. MAINTENANCE FACILITY SIMPLIFIED CONCEPTUAL CHARGER LAYOUT

DRTC Charging Infrastructure

At the DRTC, **high-speed inductive charging systems** are proposed to enable efficient layover charging during short dwell times between trips. The recommended configuration includes:

- **Seven (7) inductive charging pads** installed in separate bus bays, each capable of providing up to 300 kW of power.
- **Three (3) associated power cabinets**, each designed to supply 300 kW.

Individual buses can receive the full 300 kW output when no other chargers on the same cabinet are active; when multiple chargers are in use simultaneously, power is automatically shared between them. This setup will allow all operational charging needs to be met while limiting the total proposed connected load to 900 kW, keeping the new electrical service required from REU to a manageable level compared to a solution with even more chargers.

It should be noted that, based on route energy modeling, a minimum of three bays equipped with 150 kW inductive chargers would technically be sufficient to meet the fleet's operational needs. However, the installation of seven pads is recommended to ensure reliable operations under adverse weather conditions, schedule delays, or other real-world variations, and to reduce the number of required bus-bay assignments (described further below).

A high-level conceptual site layout visualizing these charger installation recommendations is shown in Figure 20. Detailed drawings for each proposed installation phase and site are included in *Appendix G: Site-Specific BEB Charger Installation Recommendations.*

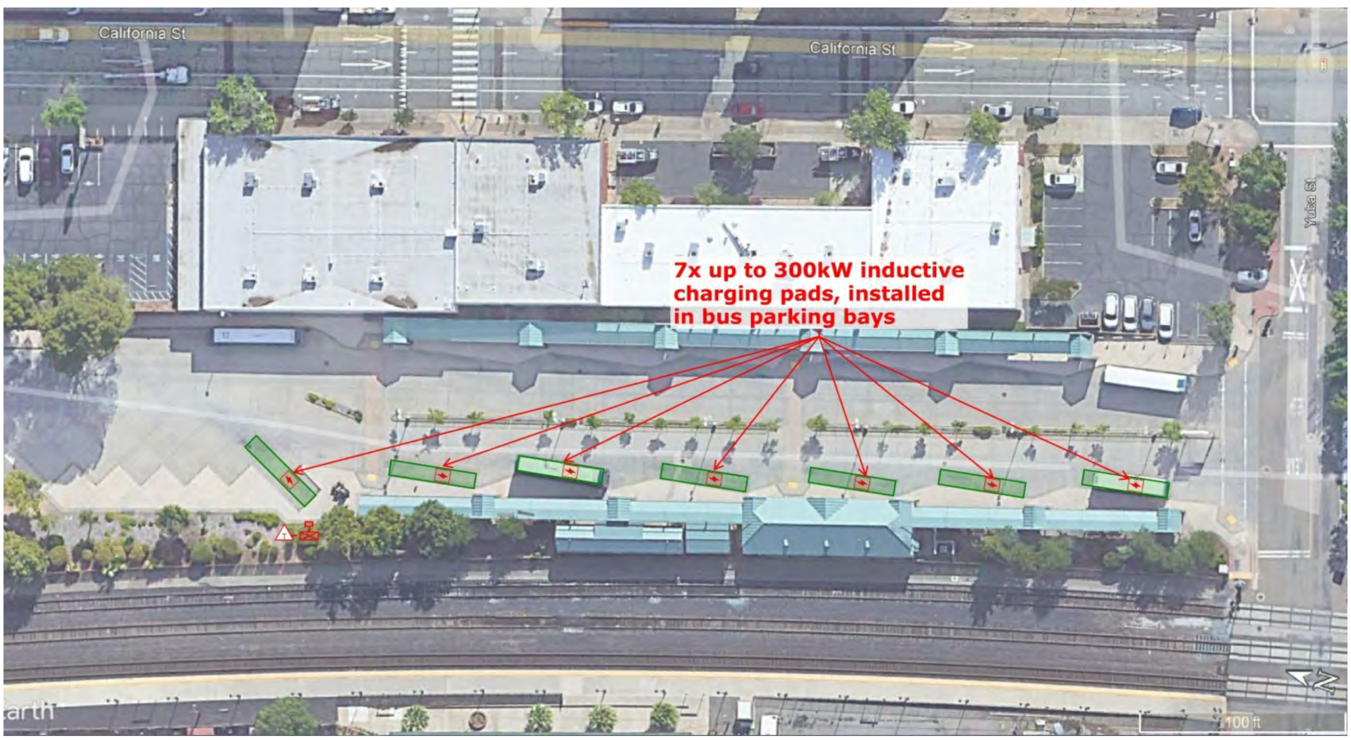

FIGURE 20. DRTC SIMPLIFIED CONCEPTUAL CHARGER LAYOUT

As mentioned in the section, "Meetings with Third Parties" in *Appendix C: Stakeholder Coordination and Public Outreach*, the project team held multiple meetings with REU to review power requirements for both the depot and the DRTC. This early engagement during the ZEB implementation planning phase served two key purposes:

1. To notify REU of the expected additional electrical loads associated with RABA's ZEB implementation
2. To gain an initial understanding of REU's ability and anticipated timeline to provide the required power service

While REU cannot formally confirm or process load requests until project applications are submitted and circuit studies are completed, initial discussions indicated that sufficient capacity exists at the distribution circuit level to accommodate the proposed infrastructure. Site-specific design considerations, such as the placement and cost of upgraded service transformers will need to be addressed during the detailed design and engineering phase.

Ellis St Lot Hydrogen Fueling Recommendations

Per the previous findings discussed in Chapter 2, construction of a permanent H_2 refueling station is not recommended at this time. Instead, a mobile hydrogen fueling system should be used at the Ellis St Lot, adjacent to RABA's Maintenance Facility. This could be achieved using a mobile fueling system supported by regular hydrogen deliveries via tube trailers.

RABA has completed design work for the Ellis Street Site Improvements Project, which will repave the Ellis Street lot and integrate it with the existing Maintenance Center to create a single unified facility. Figure 21 illustrates the overall layout of the existing Maintenance Center and the Ellis Street lot in relation to one another. As shown in the plan, the existing fencing, trees, and any conflicting utilities or structures on the Ellis Street parcel will be removed, and the lot, along with the existing Mark Street driveway, will be repaved and connected to the primary Maintenance Center site.

Detailed drawings including vehicle turning analysis for the Ellis St property are included in *Appendix G: Site-Specific BEB Charger Installation Recommendations.*

FIGURE 21. MAINTENANCE CENTER AND ELLIS ST LOT OVERALL SITE LAYOUT

IMPLEMENTATION PHASING AND COST

This section presents how bus purchases and infrastructure improvements should be phased over time and how each of these implementation actions affect the total transition cost to a ZEB-based system for RABA.

Bus Purchase Schedule & Cost

Table 3 provides a detailed overview of bus purchases and retirements from 2025 through 2040. The resulting fleet transition from diesel buses to ZEBs is visualized in Figure 22. The timing of these procurements is based on the targeted replacement years identified in RABA's most recent Fleet Replacement Plan (from February 2025) for both transit buses and motor coaches. This proposed purchase schedule aligns ZEB adoption with RABA's ongoing fleet turnover cycle, allowing for a gradual and cost-effective transition to zero-emission operations.

Based on the proposed schedule:

- **By 2030**, RABA would purchase 4 ZEBs (all BEBs) and retire 4 diesel buses.
- **By 2035**, an additional 8 ZEBs (4 BEBs, 2 FCEBs, 2 battery-electric cutaways) would be procured, with 4 more diesel buses retired.
- **By 2040**, RABA would acquire another 8 ZEBs (6 BEBs, 2 FCEBs) and retire the remaining 9 diesel buses.

ZEB Purchase Cost Assumptions

For the purpose of this Plan, battery-electric buses (BEBs) are estimated at approximately $750,000 per vehicle, while fuel cell electric buses (FCEBs) are estimated at about $900,000 per vehicle. These figures are consistent with recent price data published by industry sources such as the Washington State DES Cooperative Contract and procurement cost summaries from California transit agencies including AC Transit, Foothill Transit, and Sonoma County.

It is important to distinguish between base vehicle pricing and the "all-in" procurement cost of a fully equipped bus. The all-in cost includes additional systems such as ADA-compliant equipment, automatic passenger counters (APCs), fareboxes, security cameras, and telematics systems, as well as contract price escalation allowances and warranty provisions. These add-ons can increase the total per-vehicle cost by approximately 10-20% or more over base pricing.

In addition, all BEBs will require inductive charging pads to enable mid-day opportunity charging at the DRTC. These systems add cost on the order of tens of thousands of dollars per bus, depending on supplier and installation details.

Lastly, the estimated cost factor in the potential for RABA to leverage HVIP vouchers, which provide effective cost reductions for eligible zero-emission bus purchases. Current voucher values are $110-$156k for 40-ft. battery-electric transit buses, and up to $312k for transit FCEBs, substantially reducing upfront capital requirements.

Battery-electric cutaway buses are estimated at about $250,000, based on applicable market research and data.

This will result in a total of 20 ZEBs in RABA's fleet by 2040, matching the current fleet size of 18 transit buses and motor coaches (17 diesel and 1 BEB) and two cutaway buses used on fixed routes 44X and 299X.

To maintain operational flexibility during this transition, RABA should plan to procure 9 diesel buses between 2025 and 2028 as transitional vehicles. This approach will allow the agency to monitor ongoing technological improvements, such as advances in BEB range, charging performance, and hydrogen fuel supply, and observe market cost trends for both ZEB types and supporting infrastructure before definitively committing to specific ZEB fuel type mix for all its vehicles.

The cost to purchase 14 BEBs is estimated at $11.0 million and for the 4 FCEBs at $3.6 million, totaling $14.6 million for all future ZEBs in RABA's fleet.

Battery-Electric Cutaway Buses for Routes 44X and 299X: While not a core component of this Plan's recommendations, the procurement cost schedule shown in Table 3 includes the purchase of two battery-electric cutaway buses in 2035 for potential use on routes 44X (to/from Shingletown) and 299X (to/from Burney). RABA's current stated intent is to serve these routes with (gasoline-powered) vans that are below the 14,000-lbs. GVWR threshold of the ICT regulation. The cost for two battery-electric cutaways is thus only included as a contingency option. These buses would need to charge overnight at the depot and (if necessary) during the day at the depot (150 kW DCFC) or at public charging locations, if the DRTC only features inductive fast charging infrastructure not usable by these vehicles.

TABLE 3. RECOMMENDED ZEB PROCUREMENT SCHEDULE AND COSTS

YEAR	DIESEL BUS PURCHASES		DIESEL BUS RETIREMENTS		BEB PURCHASES			FCEB PURCHASES			TOTAL ZEB PURCHASES		ZEB % OF ALL NEW BUS PURCHASES	
	Quantity	Notes	Quantity	Notes	Quantity	Notes	Cost	Quantity	Notes	Cost	Quantity	Cost	Based on This Plan	CARB ICT Requirement
2025	3	Replace units 51, 52, 53 with new diesel transit buses	-	-	-	-	-	-	-	-	-	-	0%	0%
2026	-	-	2	Units 54, 55	2	Replace units 54, 55, use new BEBs on routes 11 & 14	$1,500,000	-	-	-	2	$1,500,000	100%	25%
2027	3	Replace units 5701, 5702 with diesel motor coaches, replace unit 57 with diesel transit bus	1	Unit 56	1	Replace unit 56, use new BEB on route 17	$750,000	-	-	-	1	$750,000	25%	25%
2028	3	Replace units 59, 60, 61 with diesel transit buses	1	Unit 58	1	Replace unit 58, use new BEB on route 19	$750,000	-	-	-	1	$750,000	25%	25%
2029	-	-	-	-	-	-	-	-	-	-	-	-	-	100%
2030	-	-	-	-	-	-	-	-	-	-	-	-	-	100%
2031	-	-	2	Units 62, 63	1	Replace unit 62, use new BEB on route 7	$750,000	1	Replace unit 63, use new FCEB on route 3	$900,000	2	$1,650,000	100%	100%
2032	-	-	-	-	-	-	-	-	-	-	-	-	-	100%
2033	-	-	2	Units 65, 66	3	Replace units 64 (existing Proterra), 65, 66, use new BEBs on route 1 and two as spares	$2,250,000	-	-	-	3	$2,250,000	100%	100%
2034	-	-	-	-	-	-	-	-	-	-	-	-	-	100%
2035	-	-	-	-	2	Purchase two battery-electric cutaway buses for potential use on routes 44X and 299X	$500,000	1	Purchase FCEB as spare for route 3	$900,000	1	$900,000	100%	100%
2036	-	-	-	-	-	-	-	-	-	-	-	-	-	100%
2037	-	-	2	Units 51, 52	3	Replace units 51, 52 (last replaced in 2025 based on this schedule), use these new BEBs on route 4 (blocks 401, 402) Also purchase one BEB as a spare	$2,250,000	-	-	-	3	$2,250,000	100%	100%
2038	-	-	2	Units 53, 57	3	Replace units 53 (last replaced in 2025 based on this schedule) and 57 (last replaced in 2027 based on this schedule), use new BEBs on route 4 (blocks 403 and a new block 400) Also purchase one BEB as a spare	$2,250,000	-	-	-	3	$2,250,000	100%	100%
2039	-	-	2	Units 5701, 5702	-	-	-	2	Replace units 5701, 5702 (last replaced in 2027 based on this schedule), use new FCEBs (motor coaches) on route 99X and as a spare vehicle	$1,800,000	2	$1,800,000	100%	100%
2040	-	-	3	Units 59, 60, 61	-	-	-	-	-	-	-	-	-	100%
TOTAL	**9 Intermediate Diesel Purchases**		**18 Retired Diesels**		**14 BEBs**		**$11,000,000**	**4 FCEBs**		**$3,600,000**	**18 ZEBs**	**$14,600,000**	**Compliant in All Years**	

Notes: Procurement cost estimates included in table above are based on current (2025) typical BEB and FCEB market costs, not accounting for future price trends (technology improvements, inflation, etc.). All bus quantities refer to 35-ft. transit buses, unless otherwise noted (in the case of the two 45-ft. motor coaches).

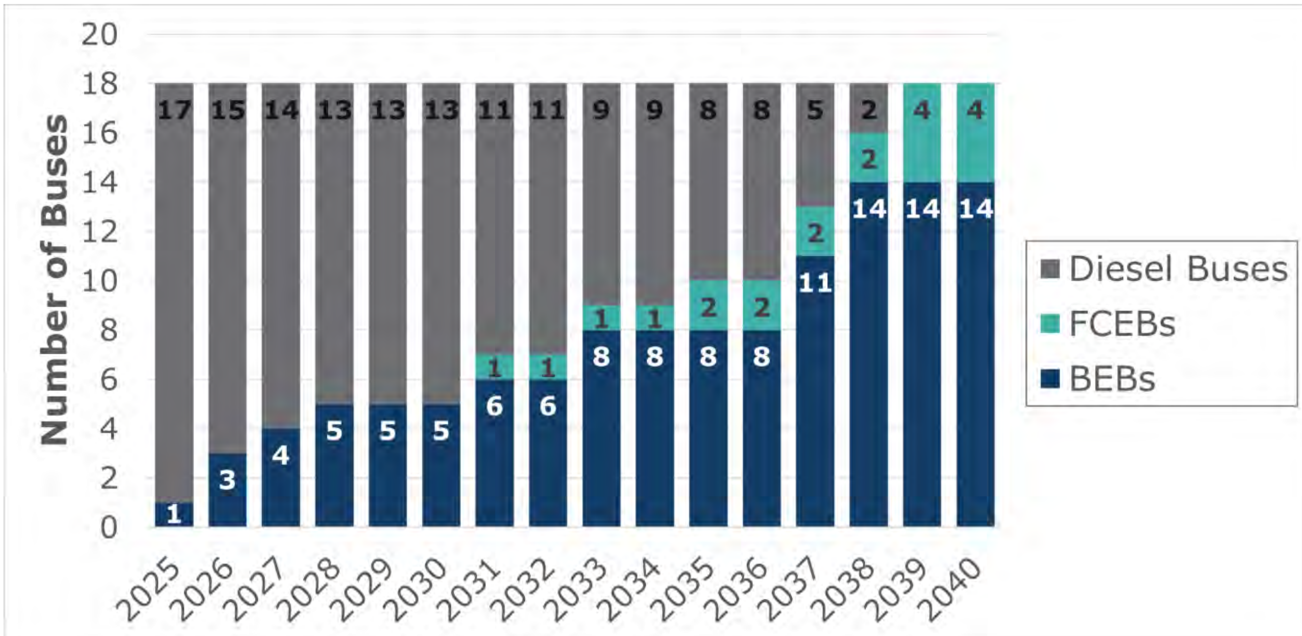

FIGURE 22. ZEB ADOPTION SCHEDULE WITH RETIRING DIESEL FLEET (LIMITED TO FULL-SIZE BUSES)

Charging Infrastructure Installation Phasing & Cost

To ensure a cost-effective and scalable transition to zero-emission operations, RABA's charging infrastructure installations are proposed to occur in two implementation phases. This phased approach avoids overbuilding during the early years of ZEB deployment while ensuring that adequate charging capacity is available as additional BEBs are introduced into service.

Phase 1: Initial Charging Installations (Through ~2033)

Phase 1 will address RABA's BEB charging needs through approximately 2033 and provide sufficient capacity to support the first rounds of ZEB procurements described in the previous section. The recommended installations include:

- **Depot:** Install six (6) of the ten planned 50 kW DC charging ports beneath the existing solar canopy, along with the dual-port 150 kW DC fast charging station for supplemental use by buses, electric vans, and non-revenue vehicles.
- **DRTC:** Install four (4) inductive charging pads at designated bus bays to support mid-day opportunity charging for BEB routes.

This phase establishes the foundational charging capacity required for RABA's initial fleet of BEBs while minimizing capital expenditure in the early years of transition.

Phase 2: Expansion to Support Full Fleet Transition

Beginning around 2034, Phase 2 will address the additional charging demand that arises as RABA's BEB fleet expands in the later stages of the ZEB transition. The recommended installations for this phase include:

- **Depot:** Installation of the remaining four (4) 50 kW DC charging ports to complete the planned total of ten depot chargers.
- **DRTC:** Installation of three (3) additional inductive charging pads at bus bays to expand on-site charging capacity and accommodate additional BEBs in circulation.

Together, these installations will provide the full complement of chargers required to support the fleet once fully transitioned by 2040.

Capital Costs and Supporting Information

Planning-level estimated capital costs for the proposed charger installations are summarized in Table 4 (Depot, estimated at $1.5 million total) and Table 5 (DRTC, estimated at $3.1 million total). These cost estimates include electrical infrastructure, charger equipment, and installation work, as well as various soft costs that come with typical public agency procurement processes. Detailed conceptual layouts, electrical equipment locations, and itemized cost breakdowns are provided in *Appendix G: Site-Specific BEB Charger Installation Recommendations*. Additionally, *Appendix H: Cost Estimates Assumptions* lists all items considered and any assumptions behind these cost estimates.

Charging infrastructure installations to support BEB operations in RABA's future decarbonized transit system are estimated to cost a total of $4.6 million.

TABLE 4. CHARGER INSTALLATION IMPLEMENTATION PHASING RECOMMENDATIONS AND COST ESTIMATES FOR MAINTENANCE FACILITY

		PHASE 1: 2025-2033	PHASE 2: 2034 ONWARDS	TOTAL
CHARGER INSTALLATIONS		• 3 dual-port 50kW medium-output DC Stations • 1 dual-port 150kW DCFC	• 2 dual-port 50kW medium-output DC Stations	• 5 dual-port 50kW medium-output DC Stations • 1 dual-port 150kW DCFC
CAPEX	**CORE PROJECT COSTS**	$731,000	$133,000	$864,000
	SUPPORTING/SOFT COSTS	$512,000	$93,000	$605,000
	TOTAL	**$1,243,000**	**$226,000**	**$1,469,000**

Note: CAPEX estimates rounded to nearest $1,000. More detailed cost breakdowns are included in *Appendix G: Site-Specific BEB Charger Installation Recommendations*.

TABLE 5. CHARGER INSTALLATION IMPLEMENTATION PHASING RECOMMENDATIONS AND COST ESTIMATES FOR DRTC

		PHASE 1: 2025-2033	PHASE 2: 2034 ONWARDS	TOTAL
CHARGER INSTALLATIONS		• 4 Inductive Charging Pads, 2x 300 kW Power Cabinets	• 3 Inductive Charging Pads, 1x 300 kW Power Cabinet	• **7 Inductive Charging Pads, 3x 300 kW Power Cabinets**
CAPEX	**CORE PROJECT COSTS**	$1,204,000	$634,000	$1,838,000
	SUPPORTING/SOFT COSTS	$843,000	$444,000	$1,287,000
	TOTAL	**$2,047,000**	**$1,078,000**	**$3,125,000**

Note: CAPEX estimates rounded to nearest $1,000. More detailed cost breakdowns are included in *Appendix G: Site-Specific BEB Charger Installation Recommendations*.

Operational (Fuel) Costs

Projected operational (fuel) costs for RABA's future zero-emission fleet are based on the Redding Electric Utility (REU) rate schedule for commercial customers and a range of assumed hydrogen supply costs.

Table 6 lists the projected annual fuel costs for RABA at full ZEB implementation (by 2040), estimated using the applicable REU rates and a range of assumed hydrogen supply costs between $5 and $20 per kilogram, visualized in Figure 23. Based on these projections, RABA can expect to incur total annual fuel costs of approximately $640,000 to $1,110,000 for a fully decarbonized fleet. For comparison, RABA's current annual fuel expenditures for gasoline and diesel are approximately $820,000[6], although this value fluctuates year to year based on prevailing fuel prices. This means that, depending on hydrogen pricing, RABA may be able to achieve either substantial fuel cost savings in a ZEB-based system compared to diesel buses, or be subject to increased annual expenditure.

Redding Electric Utility's (REU) Rate Schedule for Commercial Customers

Under REU's current **General Service rate**, the applicable charges include:

- **Fixed charge:** $95.00 per meter per month
- **Energy charge:** $0.1086 per kWh
- **Demand charge:** $21.50 per peak kW

More details are available on REU's Rates & Fees website.

[6] Based on FY23-24 fuel expenditure records provided by RABA.

TABLE 6. PROJECTED ANNUAL FUEL COSTS BY SITE

ANNUAL USAGE AND COST	DRTC	MAINTENACE FACILITY	ELLIS ST LOT (HYDROGEN)	TOTAL
PROJECTED ENERGY USE	~450,400 kWh	~914,500 kWh	-	**~1,364,900 kWh**
PROJECTED PEAK SITE POWER DEMAND	~900 kW	~420 kW	-	**~1,320 kW**
REU ENERGY CHARGE ($0.1086/KWH)	$48,920	$99,320	-	**$148,240**
REU DEMAND CHARGE ($21.50/KW)	$232,200	$107,830	-	**$340,030**
HYDROGEN FUEL COST	-	-	$154,750 (at $5/kg) $278,550 (at $9/kg) $371,400 (at $12/kg) $619,000 (at $20/kg)	**$154,750 (at $5/kg) $278,550 (at $9/kg) $371,400 (at $12/kg) $619,000 (at $20/kg)**
TOTAL	**$281,120**	**$207,150**	**$154,750 (at $5/kg) $278,550 (at $9/kg) $371,400 (at $12/kg) $619,000 (at $20/kg)**	**$643,020 (at $5/kg) $766,820 (at $9/kg) $859,670 (at $12/kg) $1,107,270 (at $20/kg)**

Note: Projections assume that two-thirds (about 67%) of RABA's future BEB fleet's energy demand (kWh) will be provided at the Maintenance Facility and one-third (33%) at the DRTC during layover opportunity charging sessions. While this split affects the relative cost difference between electricity expenses incurred at these two facilities, it does not affect the total electricity cost, as the per-kWh price charged by REU is the same at both sites.

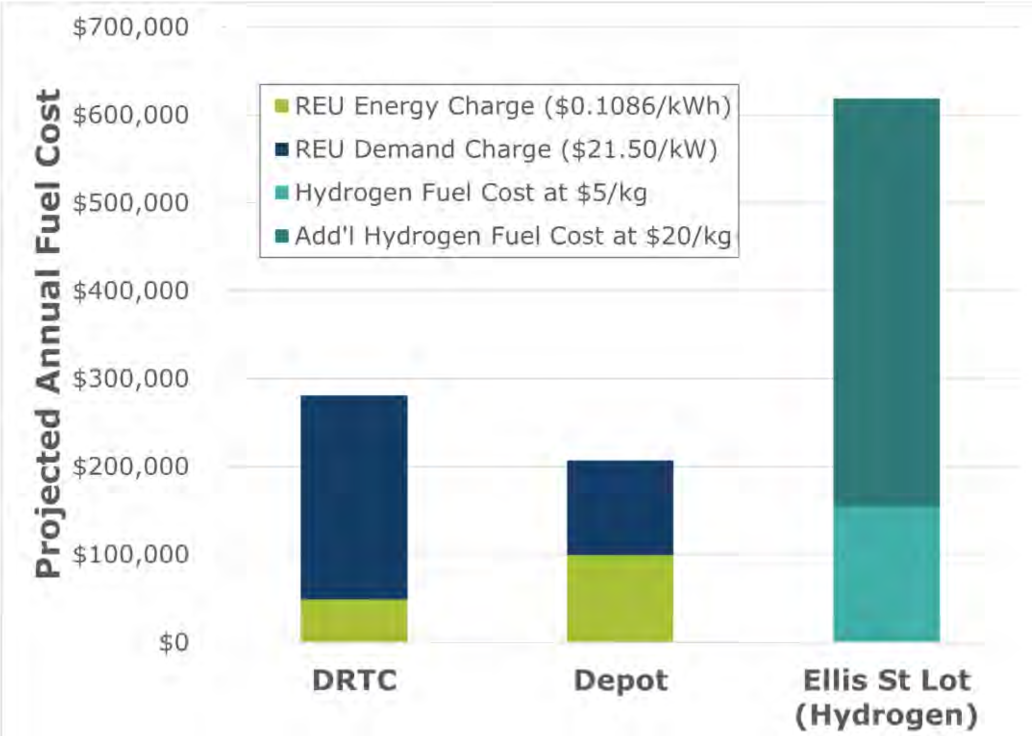

FIGURE 23. PROJECTED ANNUAL FUEL COSTS BY SITE

Hydrogen Fuel Price Unpredictability

The wide range of projected ZEB fuel costs primarily reflects the substantial uncertainty surrounding future hydrogen supply availability and pricing. As noted in Table 3, RABA's first hydrogen FCEB is not scheduled for deployment until 2031, six years from the creation of this plan. In a very nascent market like mobile hydrogen supply for use as transportation fuel, it is impossible to accurately predict the availability and price for that timeframe.

Figure 24 shows hydrogen fuel unit costs ($/kg) that Alameda Contra Costa Transit District (AC Transit) reports for its own FCEB fleet's hydrogen supply. AC Transit has been a national leader in zero-emission transit, serving as an early adopter of FCEBs and contributing essential experience that has informed technology development and implementation statewide. As can be seen in the figure, the cost has increased from about $8/kg to almost $11/kg over four years. By comparison, retail hydrogen prices at commercial stations in California averaged $34.55 per kg in October 2024.[7] While initiatives such as the First Public Hydrogen Authority (FPH2) aim to achieve much lower unit costs and establish a reliable statewide supply, the timeline and feasibility of such outcomes remain uncertain. The market reference points provided above underscore that affordable hydrogen is unlikely to be available to RABA in the near term.

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[7] https://www.spglobal.com/commodity-insights/en/news-research/latest-news/energy-transition/100124-california-hydrogen-pump-prices-for-light-duty-vehicles-reach-new-highs

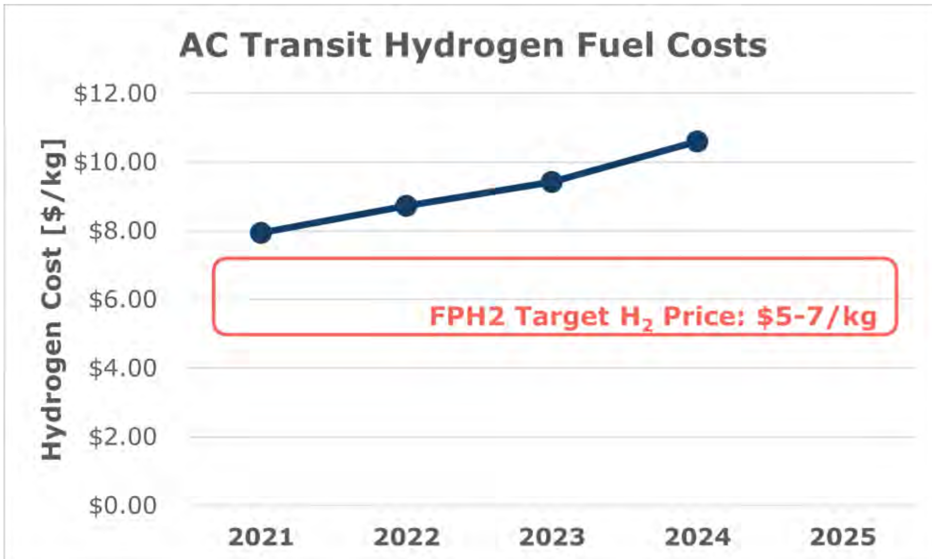

FIGURE 24. ALAMEDA CONTRA COSTA TRANSIT DISTRICT HISTORIC HYDROGEN FUEL UNIT COSTS, COMPARED TO FPH2'S TARGET PRICE RANGE FOR STATEWIDE HYDROGEN FUEL SUPPLY

Under REU's current rate structure, hydrogen would need to be supplied to RABA at a cost of approximately $6.90/kg to achieve cost parity with electricity. Under potential REU rate structures tailored to EV or BEB charging (with lower demand charges or time-of-use pricing), hydrogen would need to be even less expensive to remain cost-competitive. Since this is unlikely to be achievable in the near term, the operational cost comparison of BEBs and FCEBs represents another reason why the recommended ZEB implementation pathway predominantly relies on battery-electric technology.

It should also be noted that the hydrogen unit costs used in RABA's projections are intended represent "all-in" delivered costs, assuming RABA would contract with a third-party supplier for both hydrogen delivery and the provision of a mobile storage and dispensing unit located at RABA's Ellis Street property.

Site-Specific Electricity Costs

Most (67%) of RABA's future BEB fleet's energy demand (kWh) is expected to be provided at the Maintenance Facility and only one-third (33%) at the DRTC during layover opportunity charging sessions. However, due to its higher anticipated peak demand – estimated at 900 kW, compared to roughly 420 kW at the depot – leading to a significant annual demand charge by REU of approximately $230,000 (or about $19,000 per month), the DRTC would account for 58% of RABA's total annual charging expenditure.

At full zero-emission implementation, RABA's annual fuel costs are projected between $640,000 and $1.1 million – comparable to or below current diesel costs – with electricity offering the most stable and cost-effective path forward. REU's demand charges and hydrogen unit costs are the key contributors to these costs.

Engagement with REU on Rate Structures

This analysis is based on REU's current rate schedules including demand charges. As part of the utility engagement for this project, REU has been informed that the current demand charge rate contributes a substantial portion to RABA's anticipated transit fleet charging electricity expenditure (about 69%). As such, the currently available rate schedule would cause a smaller cost benefit of BEB operational costs compared to diesel fuel cost than otherwise possible. An increasing number of utilities in California and beyond have been and are adopting rate plans that are tailored to EV charging, with lower demand charges and, for some, time-of-use (TOU) rate components. RABA's operational cost outlook would benefit from such rate plans.

Revenue from Low Carbon Fuel Standard (LCFS) Credits

RABA can further offset electricity costs by participating in California's Low Carbon Fuel Standard (LCFS) program, which provides tradable credits for low-carbon transportation fuels such as electricity and hydrogen.

For example, Rocky Mountain Institute noted that with average 2023 credit prices (~$75/ton), LCFS revenue covered about 20-30% of average electricity costs for EV charging.[8] In contrast, if credit prices were at the maximum ($200/ton), credits could theoretically offset as much as 50-80% of charging costs, depending on the local electricity rates.[9] A transit-specific study for Eastern Sierra Transit Authority indicated that LCFS credits could make up around 23% of the projected fuel costs (combined for BEBs and FCEBs).[10]

For RABA, these projections could translate into multiple hundreds of thousands of dollars of savings by participating in the LCFS program and ensuring generated credits are sold and turned into revenue. For example, at a projected total ZEB fuel cost of about $860,000 per year[11], revenue from the sale of LCFS credits could amount to more than $170,000.[12] RABA should continue monitoring and leveraging the LCFS program as its zero-emission fleet expands, since LCFS credit revenues may provide growing cost savings over time.

Cost Summary

All estimated costs that RABA can expect to incur as part of its transition to ZEBs and associated infrastructure are summarized in

Table 7, grouped by vehicle purchases, infrastructure installations, and fuel costs for both BEBs and FCEBs.

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[8] https://rmi.org/understanding-californias-low-carbon-fuel-standards-regulation/

[9] See article in previous footnote.

[10] Own calculation based on total cost of ownership (TCO) analysis results included in Table B1 of the 2024 Eastern Sierra Transit Authority Zero-Emission Bus Feasibility Study.

[11] This estimate is yielded at a hydrogen unit price of $12/kg.

[12] Assuming a conservative assumption that LCFS revenue can offset about 20% of the direct electricity cost.

TABLE 7. RABA ZEB TRANSITION COST SUMMARY

ZEB TYPE	CATEGORY	ESTIMATED COST
BEBs & CHARGING OPERATIONS	Bus Purchases	$11.0 million
	Charging Infrastructure Deployment	$4.6 million
	Electricity Purchases	$490,000 per year
FCEBs & H_2 REFUELING OPERATIONS	Bus Purchases	$3.6 million
	Hydrogen Refueling Infrastructure Installations	– *(no permanent H2 refueling station construction recommended)*
	Fuel Purchases	$150,000-$620,000 per year
TOTAL	**Bus Purchases**	**$14.6 million**
	Infrastructure Deployment	**$4.6 million**
	Electricity & Fuel	**$640,000-$1,110,000 per year**

OPERATIONAL IMPLEMENTATION OF ZEBS

This section discusses recommendations for the integration of ZEBs into RABA's operational schedule and bus-to-bay assignment at the DRTC.

Block Schedule Changes

To enable the integration of BEBs into RABA's transit system and operational schedule, a few changes to the existing block schedule are necessary. This schedule determines which vehicle operates on which route during which parts of the day. Most of RABA's routes are served by one and the same vehicle throughout the day (one block per route). The block modifications described below aim to maintain this principle to the greatest extent possible, while ensuring sufficient mid-day layover charging windows for each BEB at the DRTC.

Figure 25 illustrates these changes. The first three rows in the diagram represent the routes that should transition to hydrogen FCEBs. These routes will not require mid-day refueling and instead will fuel up at the end of the day at the Ellis Street property.

Of the remaining routes and blocks (to be served by BEBs), certain buses will require mid-day charging at the DRTC. To ensure that all buses have sufficient battery state of charge to safely complete their daily service, a few trips from select blocks should be shifted to other blocks. Specifically, the following changes are proposed, as visualized in the figure:

- Deploy one additional bus, which will take on some trips from the three buses serving on route 4. This can be done using one of RABA's spare buses (as assumed in this plan), or through a net increase of RABA's fleet size by one vehicle.
- The three buses serving on route 4 will take on one roundtrip each from the bus serving route 7.
- The bus serving route 17 will take on three trips from the bus serving route 1.

These block adjustments will ensure that all BEBs have sufficient time for mid-day opportunity charging while maintaining RABA's existing service levels and minimizing operational disruption.

Bus-Bay Assignment at DRTC

The block schedule modifications described above would translate into corresponding bus parking assignments at the DRTC. These rules define which vehicle is scheduled to use each bus bay at specific times of the day. The recommended inductive charger installations are intended to simplify these assignments while avoiding the need to equip every bay with charging infrastructure, thereby limiting capital costs for RABA.

Figure 26 visualizes a conceptual implementation of such bus-bay assignment rules. As shown in the figure, most routes would continue to use the same bay throughout the day whenever they stop or lay over at the DRTC. This approach closely resembles RABA's current operating practice and would result in minimal changes for passengers, bus operators, and other operational staff.

However, some routes will need to use different bays at certain times of the day. Figure 27 presents sample bay usage rules for both bus operators and passengers, indicating which bay each vehicle should use under varying operating conditions. For example, the 400, 401, 402, and 403 blocks in the chart correspond to Route 4 and include a few trips from Route 7. Buses serving these blocks would stop in either Bay A or Bay B, depending on availability.

The usage rules are designed to ensure that sufficient bays are available at all times of day, allowing each bus to access a bay and receive adequate charging as needed. Signage or electronic passenger guidance should indicate where each route stops so that passengers can easily identify the correct boarding location.

It should be noted that the letter designations for individual bays are placeholders established by the project team and do not currently correspond to any existing naming convention used by RABA staff or passengers. These assignments can be reconfigured as needed, provided that the charger-equipped bays are utilized efficiently. For example, Routes 1 and 17 could switch their assignments between Bay D and Bay E without affecting operational feasibility or passenger access.

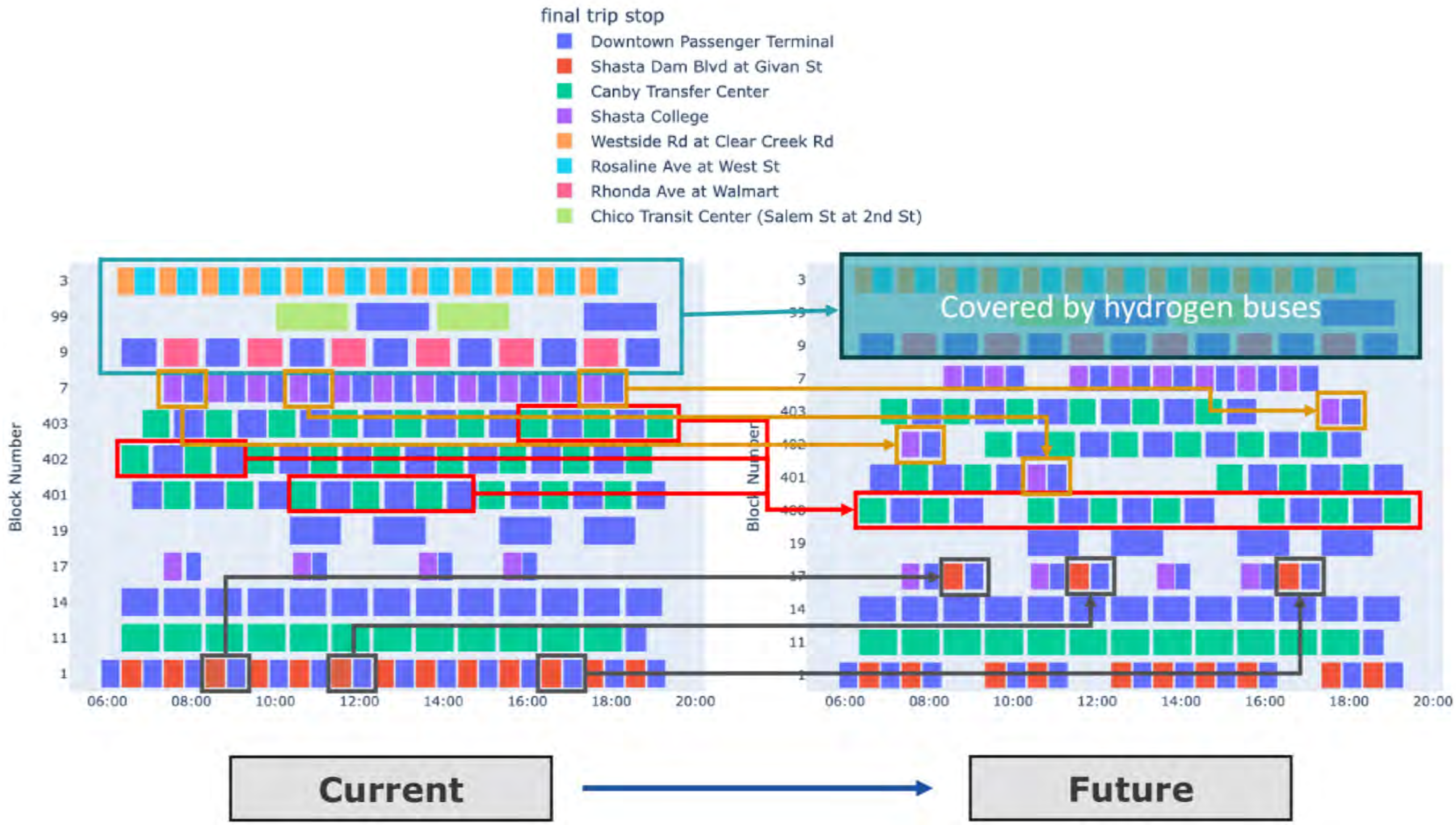

FIGURE 25. REQUIRED BLOCK SCHEDULE CHANGES FOR ZEB IMPLEMENTATION

FIGURE 26. CONCEPTUAL BUS-BAY ASSIGNMENT AT DRTC

Sample Bay Usage Rules (DRTC)
Use Bay G
Use Bay H
Use Bay I
Use Bay C
Use available space in A or B
Use available space in A or B
Use available space in A or B
Use available space in A or B
Use Bay F
Use Bay D
Use Bay F before 10am, L after 10am
Use Bay F before 10am, L after 10am
Use Bay E

FIGURE 27. PROPOSED BLOCK SCHEDULE WITH CONCEPTUAL BUS BAY USAGE RULES

Charging Load Profile at DRTC

Figure 28 shows the anticipated charging power load profile throughout the day for buses at the DRTC. Two alternative scenarios are included:

- **Unmanaged:** If each bus charges at 300 kW whenever the available charging bays are used, peak site load would reach 900 kW.
- **Managed:** If charging hardware and software optimize the load, peak site load could be as low as 450 kW, while using the same number of bays is equipped with charging infrastructure and upholding all schedule & service needs.

This illustrates the potential to significantly reduce peak site load by managing charging sessions. This is possible as, based on all route energy needs and the layover times in RABA's schedule, buses do not need to charge each time they stop at the DRTC. Reducing the peak site load from 900 kW to 450 kW by carefully governing charging session initiations would yield a potential demand charge reduction at this site of $9,675 per month or $116,100 per year. This would lower RABA's projected total electricity expenditure (after full ZEB transition) by about 24%. These are enormous savings that RABA should capitalize on by implementing an adequate load management system from available providers of transit BEB charging control software.

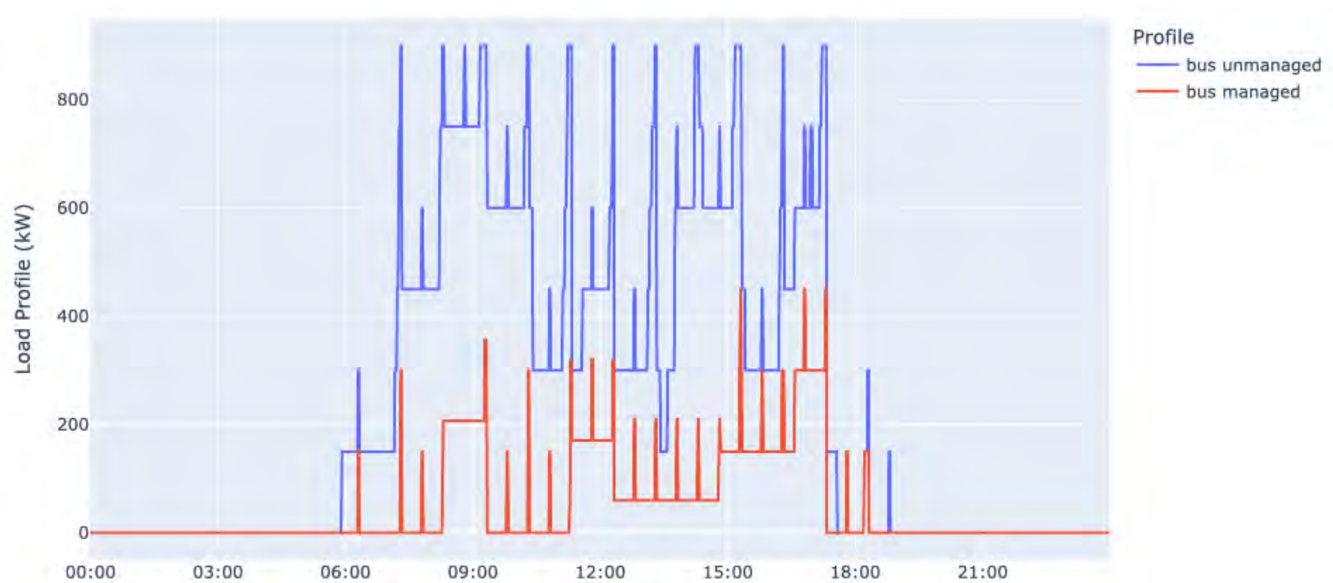

FIGURE 28. CHARGING LOAD PROFILE FOR BUSES AT DRTC

POSSIBLE RISKS AND OTHER FACTORS TO CONSIDER

As zero-emission bus technology and associated charging and hydrogen refueling systems continue to evolve in this still-maturing market, certain factors that may affect RABA's ZEB transition remain unknown or even unknowable at this time:

- **Uncertainty around hydrogen fuel availability and cost:** Among these factors are current and future hydrogen procurement costs. As discussed above, Figure 24 illustrates hydrogen fuel costs as experienced by AC Transit, a leading transit agency in the state and country with respect to FCEB adoption. Initiatives such as the First Public Hydrogen Authority (FPH2) target much lower hydrogen unit costs and aim to establish a reliable statewide supply. However, the timeline and feasibility of achieving a cost-competitive and dependable hydrogen fuel source for RABA remains uncertain.
- **BEB and FCEB technology improvements:** Additionally, the exact speed of battery-electric bus and hydrogen fuel cell electric bus technology improvements and associated bus purchase cost changes over time cannot be predicted with certainty.
- **Multi-day, citywide grid power outages:** According to REU, any Public Safety Power Shutoffs (PSPS) it may use would be limited to specific high-risk outskirts of Redding (over 95% of customers would not be impacted) and PSPS events are not expected to be common.[13] So, while multi-day, citywide outages are not normal inside the City of Redding, any such occurrences would have the potential to impact ZEB operations, as both BEB charging stations as well as FCEB fueling stations depend on grid power. Ways to mitigate the impact of such events are discussed further below under "Resiliency".
- **Market and regulatory changes:** Given the rapidly evolving zero-emission transportation market and regulatory landscape, RABA should continually monitor state and federal policies, incentive programs, and emerging compliance requirements to remain adaptive and cost-effective in its ZEB deployment strategy. One possible result of this may be to reconsider certain recommendations made in this ZEB Implementation Plan based on updated knowledge, market conditions, or regulatory requirements.

METHODOLOGY AND ANALYSIS

This section provides background information on the various analysis steps that informed the development of recommendations included in the previous section. The analyses summarized below provided the technical foundation for route-level energy modeling, charging infrastructure design, and the recommended operational strategies to support RABA's future ZEB fleet.

ROUTE ENERGY MODELING

To project energy needs for each block comprising RABA's service, the project team used Microgrid Labs' EVopt model, a specialized simulation tool that optimizes fleet electrification strategies for transit agencies. The model used General Transit Feed Specification (GTFS) data to represent RABA's routes, schedules, and block structures. This allowed for accurate estimation of energy use based on real-world service patterns.

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[13] https://cityofredding.gov/government/departments/redding_electric_utility/in_our_community/public_safety_power_shutoffs.php

Modeling assumptions and methodology included the following:

- **Energy consumption rate:** Based on measured energy usage data from RABA's existing Proterra bus, an energy consumption rate for BEB operations of 2.58 kWh/mi was assumed.[14] This provided a localized estimate that considers terrain and climate of the Redding area.
- **Battery degradation:** The model incorporated assumptions regarding battery capacity loss over time to ensure that charging and range requirements can be met even for aging BEBs.
- **Overnight charging window:** A minimum of 10 hours of available charging time was assumed for all BEBs, given that most arrive back at the depot between 6:45-8:00pm and depart in the morning between approximately 5:45-7:00am.
- **Vehicle technology assignment:** BEB versus FCEB assignment was determined based on projected daily energy demand, typical layover durations at the DRTC, and the ability to stagger opportunity charging sessions across multiple bays.
- **Quantification of hydrogen demand:** The projected electrical energy demand (kWh) was translated to hydrogen demand (kg) for blocks recommended for fuel cell electric buses (FCEBs) by using a conversion factor of 23 kWh/kg.[15] The resulting estimates were cross-referenced with ones derived by converting daily block mileages to kilograms of hydrogen using a typical FCEB efficiency of 0.125 kg/mi.[16] Results were highly consistent between both methods. Additionally, a 20% buffer was added to ensure the resulting projections are less likely to underestimate demand.

Table 8 lists all analyzed blocks and their associated characteristics prior to implementing schedule adjustments.

EVopt™ by Microgrid Labs

EVopt is a cloud-based modeling and optimization platform developed by Microgrid Labs and designed to support fleet electrification and ZEB planning. The tool simulates vehicle operations, charging needs, and infrastructure requirements based on actual route and schedule data (e.g., GTFS).

Key capabilities:

- Models route-level energy demand, range, and charging profiles for each block.
- Optimizes charger sizing, placement, and power distribution across depots and layover sites.
- Evaluates multiple technology and fueling scenarios (e.g., BEB vs. FCEB).
- Estimates total cost of ownership, infrastructure phasing, and grid impacts.
- Provides actionable data to guide cost-effective, reliable ZEB implementation.

EVopt enables transit agencies like RABA to design and test transition strategies before major capital investment, reducing uncertainty and improving long-term planning outcomes.

[14] This value was derived based on charger utilization data (indicating the annual energy consumed by RABA's Proterra bus) and odometer readings (indicating its annual mileage).

[15] https://ahdb.org.uk/knowledge-library/hydrogen-electrolysis

[16] Ballard Hydrogen Fueling Whitepaper for Fuel Cell Bus Fleets in North America (2023)

TABLE 8. BLOCK-LEVEL ENERGY DEMAND ANALYSIS AND RESULTS

BLOCK ID	DESCRIPTION	DEPOT DEPART TIME	DEPOT ARRIVE TIME	TIME FROM BLOCK END TO START (OVERNIGHT) [HOURS]	VEHICLE TYPE	DAILY MILEAGE [MI]	PROJECTED DAILY ENERGY DEMAND [KWH]	RECOMMENDED ZEB TYPE	DAILY HYDROGEN DEMAND IF SERVED BY FCEB
1	Shasta Lake	05:21 AM	07:48 PM	9.6	Transit	310	799	BEB	42
3	South Redding	05:46 AM	06:36 PM	11.2	Transit	197	507	FCEB	26
401 (ROUTE 4)	Hartnell/Bechelli/Churn Creek	06:06 AM	07:46 PM	10.3	Transit	213	548	BEB	29
402 (ROUTE 4)	Hartnell/Bechelli/Churn Creek	05:51 AM	07:27 PM	10.4	Transit	213	550	BEB	29
403 (ROUTE 4)	Hartnell/Bechelli/Churn Creek	06:21 AM	07:57 PM	10.4	Transit	213	550	BEB	29
7	Shasta College	06:53 AM	06:43 PM	12.2	Transit	209	540	BEB	28
9	Anderson	05:50 AM	07:39 PM	10.2	Transit	229	590	FCEB	31
11	Central Redding Loop (Clockwise)	05:51 AM	07:18 PM	10.6	Transit	143	368	BEB	19
14	Central Redding Loop (Counter Clockwise)	05:50 AM	07:42 PM	10.1	Transit	151	390	BEB	20
17	Shasta View/Shasta College	06:56 AM	04:37 PM	14.3	Transit	80	207	BEB	11
19	Beach Bus	09:57 AM	06:57 PM	15.0	Transit	160	412	BEB	21
99X	Amtrak Thruway Route 3 (to Red Bluff/Chico)	09:44 AM	07:22 PM	14.4	Motor coach	310	799	FCEB	42
TOTAL				**Average: 11.5**		**Average: 202 Total: 2,426**	**Average: 520 Total: 6,260**		**Average: Total: 327**

LAYOVER CHARGING SESSION MODELING

The project team also modeled charging session timing and energy replenishment patterns using RABA's route schedules to identify available layover charging windows at the DRTC. This analysis informed both the recommendation to add one additional bus (Block 400) and the block schedule modifications described in the preceding section (see Figure 26 and Figure 27).

Figure 29 shows the battery state of charge (SOC) throughout a typical weekday for all buses operating under the modified block schedule. The figure visualizes how battery levels decline during service and increase during layover charging events.

This modeling assumed a conservative scenario in which BEBs operate with heavily degraded batteries, each having a remaining usable capacity of 375 kWh. Most modern BEBs in the 35-40 ft length range are equipped with batteries of at least 500 kWh (also see *Appendix D: ZEB Technology Review*). The analysis demonstrated that even under these conservative assumptions, RABA's future BEBs would be able to receive sufficient charge during mid-day layover sessions to complete their scheduled blocks without exhausting battery capacity.

Battery Degradation

Modern EV batteries degrade at an average rate of 1.8% per year, due to a combination of charge cycles, high temperatures, and time itself. The exact degradation greatly differs by vehicle type, battery chemistry, battery management system, and typical charging speeds.

For a BEB with an initial usable battery capacity of 550 kWh, this average degradation value would suggest a remaining usable capacity of about 430 kWh after 12 years (FTA useful life for transit buses) or about 380 kWh after 17 years (RABA's typical useful life for transit buses). This is still above the assumed minimum useful capacity of 375 kWh in the analysis.

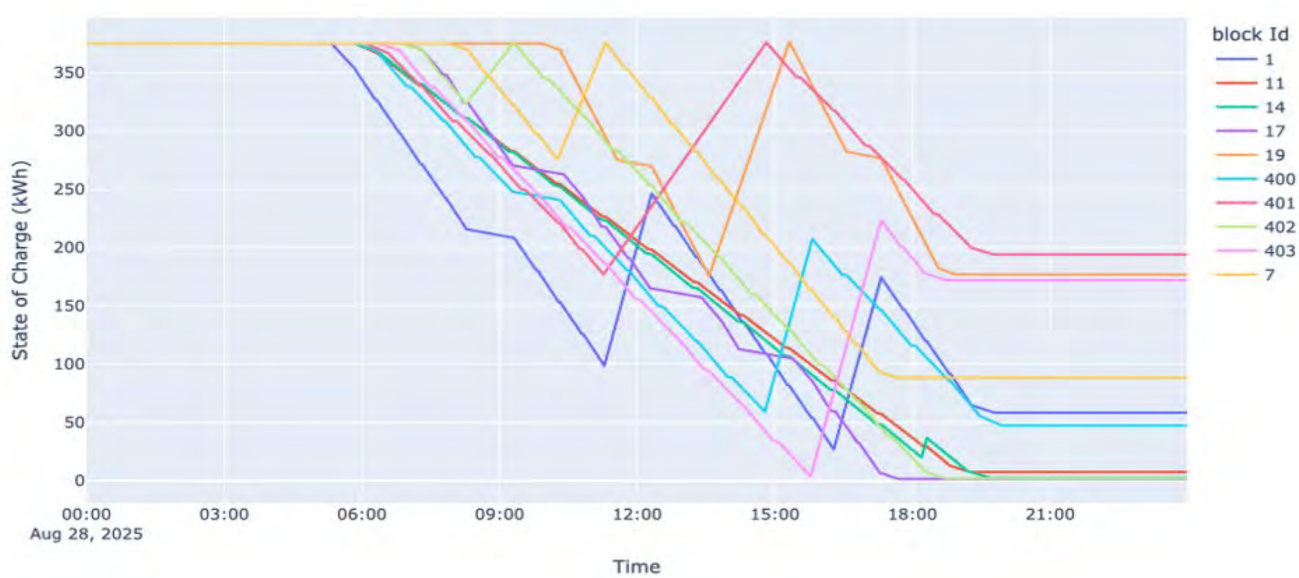

FIGURE 29. TRANSIT BUS STATE-OF-CHARGE THROUGH A REGULAR WEEKDAY BY BLOCK ID

It should also be noted that the illustrated SOC profiles represent an optimized operating scenario, in which each bus charges only during a subset of its layovers at the DRTC. In actual practice, RABA would have flexibility to initiate additional charging events as needed, providing further assurance that vehicles maintain sufficient state of charge throughout the day. More details on this are included in the "Charging Load Profile at DRTC" section further above.

FUNDING AND FINANCING RECOMMENDATIONS

As of October 12, 2025, the status of federal funding for grants and incentives remains unclear. The Department of Transportation budget may include reauthorization of the Low- or No-Emission, BUILD, and 5339 Formula Program that were available in FY 2025. On July 25, Sec. Duffy expanded the Low-No program to include conventionally fueled buses,[17] and future funding may also include (or exclude) fuels and technologies.

Several of the California funding programs rely on Federal funding for all or part of the available funds. The California Grants Portal lists active and upcoming grants, including those that RABA and SRTA already use. In October 2025, the Portal did not list any upcoming opportunities.

Appendix E: Funding and Financing has additional details on three forms of funding that public agencies commonly use: Pay-As-You-Go, debt, and public-private partnerships. Although RABA has not used debt financing in the past, the Transportation Infrastructure Finance and Innovation Act (TIFIA)[18] may be a low-risk method of financing part of the cost for installing charging stations or developing a hydrogen station.

Partnerships, which can be like a Power Purchase Agreement (PPA) or an "X-as-a-Service" agreement are both methods of financing a project with a private developer. Each partner has different terms, but the basic agreement is that the partner pays all the up-front costs and usually claims all credits, including selling carbon credits. The agency pays a small premium on each kilowatt or kilogram of fuel consumed and/or a monthly partnership fee. Either party may also sell fuel to other customers. These agreements carry risk, and RABA needs to carefully evaluate the risk and reward.

Most financial analysis tools for zero emission fleet transition model the return on investment (ROI) or total cost of ownership (TCO) of the transition to zero emission vehicles look at buses and infrastructure as a discrete system. For example, measuring the ROI of buying and installing 12 charging stations for 12 buses. A lifecycle cost method looks at the total system; 12 chargers for 12 current buses, 12 future buses, and the avoided future cost or maintaining a diesel fuel island. In 2011, USDOT created the *Bus Lifecycle Cost Model for Federal Land Management Agencies,* a spreadsheet-based planning tool that estimates capital, operating, and maintenance costs for various bus types over the full lifecycle of the vehicle.[19] Although the spreadsheet doesn't include ZEBs and

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17 https://www.transportation.gov/briefing-room/us-transportation-secretary-duffy-unleashes-american-energy-saves-american-public

18 https://www.transportation.gov/buildamerica/financing/tifia

19 https://rosap.ntl.bts.gov/view/dot/9548

infrastructure, the format is helpful in accessing the total financial impact of transitioning to ZEBs and can be useful to evaluate other service changes, like moving to cutaways or on-demand services.

Per the Staff Report prepared by RABA on November 17, 2025, SRTA was awarded $8.641 million in Transit and Intercity Rail Capital Program (TIRCP) Cycle 3 funds to support the purchase of up to seven zero-emission intercity buses intended for the Salmon Runner service between Redding and Sacramento. These funds may be made available to RABA at no local match requirement and may also cover a portion of the associated charging infrastructure costs. Based on current pricing through the Washington State bus contract, this grant could fund five 35-ft battery-electric suburban buses or five 45-ft battery-electric motorcoaches, each costing up to $1.75 million per bus, plus approximately $500,000 for five chargers. RABA may also pursue additional incentives through California's HVIP program, which offers up to $312,000 per bus to further offset capital costs.

The report notes that RABA's 2010 diesel motorcoaches are at the end of their useful life, with increasing maintenance and operational costs, reinforcing the need for timely replacement and making the TIRCP funding a critical near-term resource.

WORKFORCE TRAINING RECOMMENDATIONS

Both BEBs and FCEBs introduce new training needs for technicians (high-voltage systems, battery management, fuel cell systems, etc.). RABA could leverage programs like the FTA's ZEB Training (likely through CALSTART or a tech school) to get their staff up to speed. Many bus manufacturers provide training with bus purchases. For example, Gillig and New Flyer have online and in-person courses for electric bus maintenance. Safety protocols for first responders and in-house staff also need updates (for instance, procedures for de-energizing a bus, or handling a hydrogen leak alarm). Fortunately, by the time RABA scales up its ZEB fleet, there will be a decade of industry knowledge to draw on.

Although battery and fuel cell buses (collectively ZEBs) have been in operation for more than a decade, both technologies are evolving rapidly, and so is the body of knowledge about maintenance needs. ZEB manufacturers and charging station vendors provide training about their products that include high voltage systems, direct-drive motors, heating/cooling systems, and replacing commonly worn parts. They also provide training to run diagnostics and analyze data to identify problems.

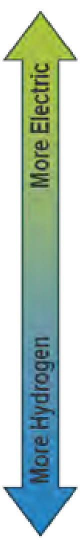
In addition to training, mechanics and technicians can benefit from basic education about batteries and high voltage. Heartland Community College in Michigan offers Battery Technology microcertification, a short course that teaches battery chemistries, DC characteristics, safely handling cells and battery packs, manufacturing practices of battery packs and installation of battery packs in a variety of applications. A partnership with Shasta Community College could offer a similar class for RABA technicians and drivers so that they understand the fundamentals of electric systems, many of which also apply to hydrogen fuel cells. Refer to *Appendix A: Existing Conditions* and *Appendix F: Workforce Training* for more details.

ALTERNATIVES CONSIDERED BUT NOT SELECTED

Figure 30 illustrates the four zero-emission fleet alternatives evaluated for RABA's transition to a 100% zero-emission fleet. Each scenario varies in the balance between battery-electric buses (BEBs) and hydrogen fuel cell electric buses (FCEBs). Alternatives were assessed based on cost, infrastructure needs, operational feasibility, and technology risk.

- **Alternative 1:** 100% Battery-Electric Fleet – All routes operated by BEBs. While simplest to implement, it lacks flexibility and poses range and charging constraints on longer routes, requiring costly infrastructure expansion.
- **Alternative 2:** Mixed Fleet (~25% Hydrogen, 75% Electric) – Hydrogen used on longer routes (3, 9, and 99X) and BEBs on all others. Provides the best balance of cost, resiliency, and operational flexibility. *(This represents the recommended pathway.)*
- **Alternative 3:** Expanded Hydrogen (~50% Hydrogen, 50% Electric) – Adds Routes 19, 299X, and 44X to hydrogen service. Increases range but also cost, infrastructure needs, and hydrogen supply risks. Not recommended due to high uncertainty.
- **Alternative 4:** 100% Hydrogen Fleet – All fixed routes served by FCEBs. Offers range benefits but lacks flexibility, carries significant fuel and infrastructure cost, and exceeds RABA's operational needs.

In summary, Alternatives 1 and 4 were dismissed due to their reliance on a single technology and limited adaptability, while Alternative 3 was eliminated due to high hydrogen-related risks. Alternative 2, which is a blended BEB and FCEB fleet, was identified as the most cost-effective, reliable, and flexible pathway for RABA's zero-emission transition.



1. 100% Electric		Battery-electric for all fixed routes & variable services
2. ~25% H_2 Fixed Routes, Rest Electric		Hydrogen for some fixed routes (transit buses, motor coaches), battery-electric for all variable services (cutaways, vans) • H_2 routes: 3, 9, 99X (Amtrak) • Currently exploring Route 3 transition to H_2
3. ~50% H_2 Fixed Routes, Rest Electric		Hydrogen for some fixed routes (transit buses, motor coaches, cutaways), battery-electric for all variable services (cutaways, vans) • H_2 routes: 3, 9, 19, 299X (Burney), 99X (Amtrak), 44X (Shingletown)
4. 100% H_2 Fixed Routes, Rest Electric		Hydrogen for all fixed routes (transit buses, motor coaches, cutaways), battery-electric for all variable services (cutaways, vans)

FIGURE 30. ZEB IMPLEMENTATION ALTERNATIVES CONSIDERED FOR THIS PLAN

RESILIENCY

Fleets powered by electricity supplied by the power grid are vulnerable to grid interruptions due to extreme weather events like windstorms, ice storms as well as other disasters such as wildfire, landslides and earthquakes. The grid is also increasingly strained as facilities transition from fossil fuels like gasoline, diesel, and natural gas to electricity and hydrogen increasing the risk of brownouts and public safety power shutoffs events. For all these reasons, the need for back-up power is growing rapidly for both vehicles and facilities, a critical concern for transit agencies operating fleets of battery buses. Industry has only recently begun to react to this demand with a variety of innovative resiliency solutions, many of which are novel and unproven.

As for any fleet transitioning from primarily fossil fuel to primarily electric, RABA will need to determine its appropriate level of resiliency. Does it need to continue to operate its full schedule, or can it pause or scale back operations of certain routes due to a temporary power outages? Other critical questions are the likely frequency and maximum duration of service reduction. The answer to these will inform the approach the agency takes to providing backup power. The more backup power provided either in terms of generation and/or storage, the higher the capital investments as well as commitment of physical space dedicated to production facilities such as generators and solar PV panels and/or storage batteries.

Fortunately for RABA, multi-day, citywide power outages are not normal inside the City of Redding as previously noted in Chapter 4 reducing the need for significant resiliency investments at either transit facility.

The simplest way for RABA to ensure resiliency is through diversification of fuel types, including diesel, BEBs and FCEVs as doing so will ensure service continuity in case of diesel supply shortages, grid outages or hydrogen-supply constraints. As the fleet becomes increasingly electrified, limited duration power constraints preventing BEB operations can be addressed by temporarily replacing BEBs with fossil-fuel powered vans and buses until power resumes. This could be achieved using existing coaches RABA maintains as spares. As diesel buses are replaced by BEBs between now and 2040, RABA should consider retaining at least a few retired diesel buses as extra coaches to provide service when power is down or curtailed. This operationally simple and relatively low-cost strategy should be viable until 2040 after which ICT mandates full ZEB operations. During this time, improvements to battery storage and power management are expected to increase resiliency options and lower the per kWh cost of battery energy storage systems (BESS).

In terms of kWh dispensed, the majority of BEB charging will occur at the Maintenance Facility where BEBs will be charged overnight. The total nightly energy demand for this is estimated to be approximately 2,920 kWh. This amount of power could be provided on-site, by either a generator, BESS or a hybrid of the two known as a microgrid.

At the DRTC, the corresponding daily energy demand would be approximately 1,440 kWh. Storing this amount of power would require a BESS nearly as large as a 40’ shipping container.[20] The landscaped area located at the northwest corner of the DRTC appears to have sufficient space for both a generator and/or BESS along with the electrical infrastructure needed to supply the chargers at this facility.

Because RABA will operate BEB charging at both the DRTC and the Maintenance Facility, each with unique site conditions and power demands, RABA may need to deploy a variety of approaches, rather than selecting a specific technology. For example, BESS augmented by solar may make sense at the depot where physical space is less constrained and existing solar could be augmented with additional

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[20] https://microgreen.ca/solar-storage-solutions/containerized-energy-storage

panels mounted on the maintenance facility roof and on the adjacent Ellis St. property. The DRTC by contrast is highly space-constrained, and therefore limited to an onsite generator or temporary mobile power sources. Resiliency technology is changing rapidly and RABA should continue to monitor improvements to energy generation and storage as it improves and standardizes and make purchases as needed during implementation of this plan.

Current options for providing back-up power to supply BEB charging including backup generators, hydrogen fuel cells, BESS and onsite solar are summarized below. Since hydrogen for three routes would be provided by a vendor, hydrogen is not addressed.

BACKUP GENERATORS

The conventional approach to energy resiliency is the use of fossil fuel-powered backup generators, which are available in sizes up to 2,000 kW. These generators can be permanently installed at facilities for dependability and ease of operations or can be mounted on trailers to provide greater flexibility for fleet operators.

FIGURE 31: TRAILER-MOUNTED 625-680 KVA MOBILE GENERATOR

Source: HIPOWER

Backup generators can be powered by diesel fuel or other liquid fuel sources like natural gas or propane. To help achieve RABA's carbon reduction goals, renewable diesel which is a hydrocarbon diesel fuel produced by hydro-processing of fats, vegetable oils, and waste cooking oils could be substituted for standard petroleum diesel. According to industry sources like Neste, which is available from two distributors in Stockton[21], such a substitution reduces lifecycle emissions by up to 80% compared to petroleum diesel.

[21] https://www.neste.com/en-us/products-and-innovation/neste-my-renewable-diesel/find-fuel-locator

An alternative to traditional internal combustion powered generators are linear generators, which follow a more fuel-agnostic approach. Linear generators can typically run on a range of fuels including natural gas, biogas, hydrogen, ammonia, and syngas. They are functionally different to conventional generators in that they utilize a flameless compression reaction of the fuel gas in use. The expansion of the gas upon reaction drives the generation of electricity in the linear generator.

Clarifying Diesel, Biodiesel, and Renewable Diesel

The terms clean diesel, biodiesel, and renewable diesel refer to distinct fuels with different properties and implications for emissions and generator performance:

Clean Diesel: An informal term, typically referring to ultra-low sulfur diesel (ULSD), the standard petroleum diesel sold in California since 2006. It is not a renewable or low-carbon fuel; rather, it has reduced sulfur content to enable modern emission-control technologies.

Biodiesel (e.g., B20, B100): A fatty-acid methyl ester (FAME) fuel produced from of vegetable oils, animal fats, or waste oils. It is commonly blended with petroleum diesel (e.g., B20 = 20% biodiesel, 80% diesel). Biodiesel can reduce lifecycle greenhouse gas emissions but has different chemical properties from petroleum diesel, which may limit its use in some backup generators without manufacturer approval.

Renewable Diesel (RD100 or R-99): Renewable diesel is a hydrotreated (HCN/HVO) fuel chemically similar to petroleum diesel and is fully "drop-in" compatible with diesel engines and generators. It offers operational performance equivalent to conventional diesel while providing significant lifecycle GHG reductions, often cited as up to 50-80% lower depending on feedstock and carbon intensity.

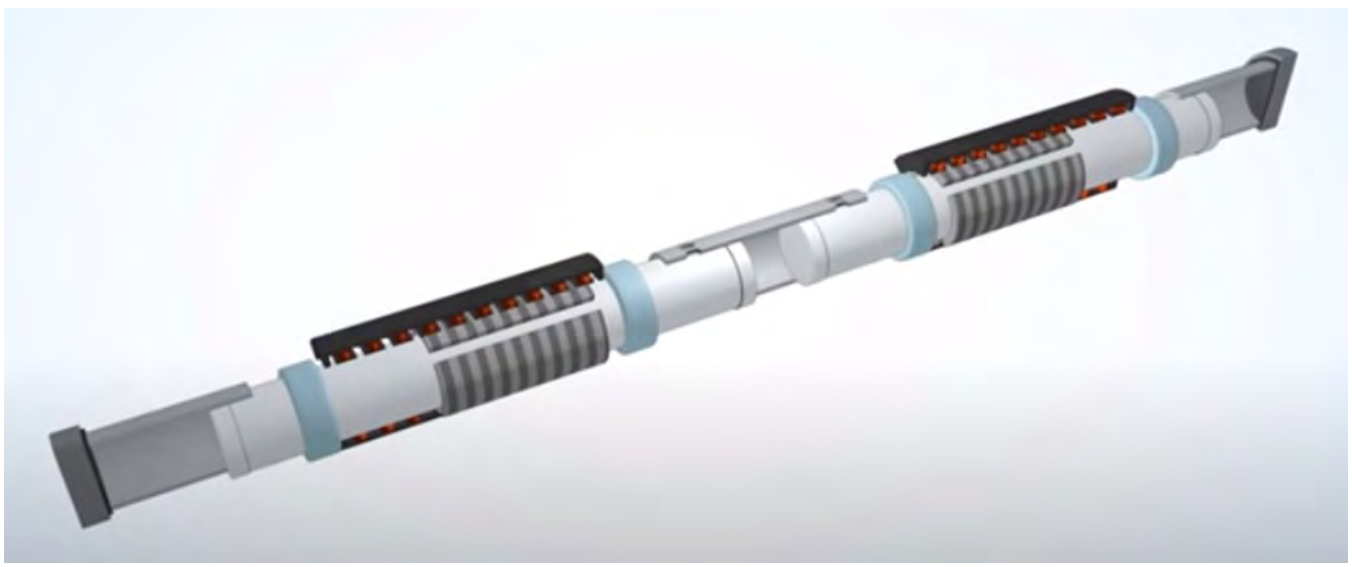

FIGURE 32. MAINSPRING LINEAR GENERATOR

Mainspring[22] offers a scalable product that can provide 480-V output voltage starting at an output power of 230 kW which could easily power a DC Fast Charger at the DRTC. In an existing configuration, the linear generator runs on natural gas or biogas with a hydrogen blend of up to 30%, but the system is capable of running 100% on either hydrogen or ammonia. An example of linear

[22] https://www.mainspringenergy.com/product/

generators deployed in California include a new installation to power charging for Prologis's drayage fleet.

HYDROGEN FUEL CELLS

Fuel cells are a rapidly growing form of grid-independent generation that can, depending on the energy feedstock and conversion process, be environmentally sustainable. Fuel cells combine the fuel (typically hydrogen) with oxygen to shed electrons and generate an electric current. In the case of hydrogen fuel cells, the only byproducts of this process are electrical current, water (H2O), and heat. There are several major companies that can provide this type of generation, including Bloom Energy and Kaizen Clean Energy. Their technology is stackable, scalable, and requires only limited physical space. If RABA operates three hydrogen-powered bus routes, the same hydrogen supplier could serve as the fuel provider for back-up power.

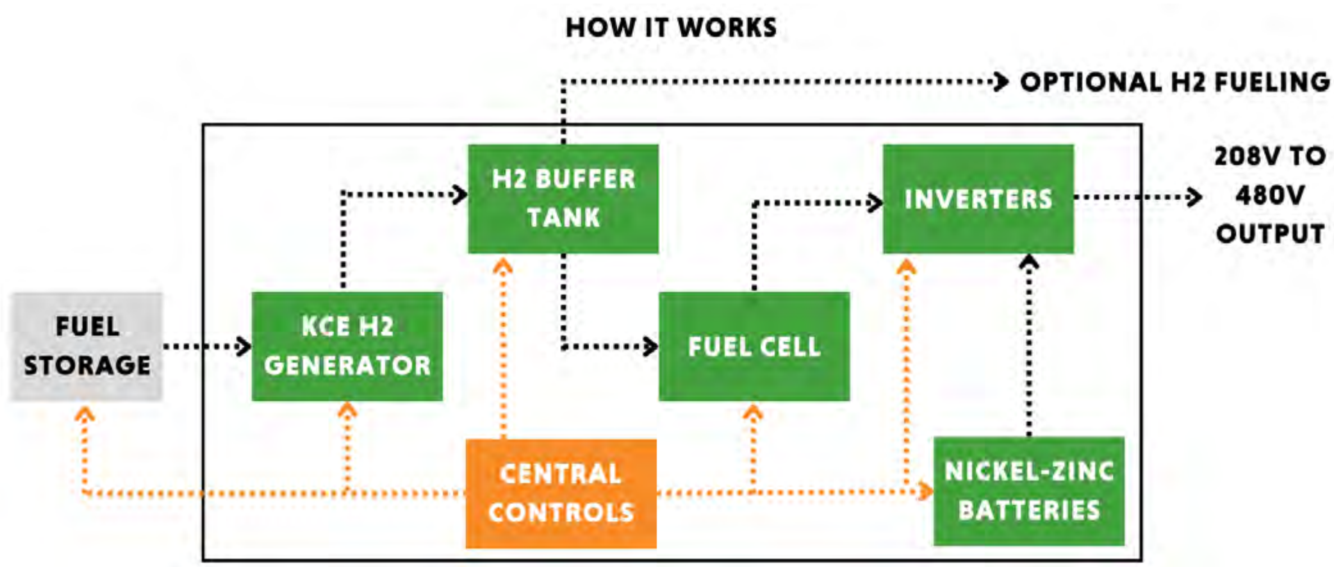

FIGURE 33. SCHEMATIC OF HYDROGEN FUELCELL POWERED CHARGERS

Source: Kaizen Clean Energy

The capital investment required for a fuel cell's initial infrastructure and the cost of hydrogen can be expensive; however, compared to the footprint and efficiency of other forms of power generation such as generators, solar PV or wind turbines, they can be a useful alternative or complementary technology.

BATTERY ENERGY STORAGE

Battery storage is a technology that enables electrical energy to be stored for later use. A battery energy storage system (BESS) is an electrochemical device that charges (or collects energy) from the grid and then discharges that energy when needed such as during a power outage or to reduce demand on the grid. Like generators, a BESS can be permanently installed or be portable. Examples range from chargers are battery-buffered/integrated DCFCs like those provided by Electric Era and XCharge, to small portable units, like the Dannar Mobile Power Station, to on- and off-site grid-scale storage battery facilities, like Joule's modular battery system.

Improvements in energy storage technology have improved space efficiency too. For example, Joule’s battery modules are only 4’ wide, 4’ high and 8’ long and available with up to 300kWh of storage capacity. Therefore, a single standard parking stall would provide sufficient space for up to four adjacent modules with 1,200kWh of storage capacity. Since these are stackable, a second row of battery modules would double this capacity to 2,400kWh which would be sufficient to fully charge 40 typical light duty EVs. As battery technologies continue to improve in terms of energy density and lower cost, the use of BESS will become increasingly viable.

FIGURE 34. JOULE'S MODULAR, STACKABLE, CHAINABLE BATTERY SYSTEM (LEFT), DANNAR MOBILE POWER STATION (RIGHT)

One of the main distinctions of types of BESS is whether it is designed to be installed permanently or whether it is a portable or temporary solution. Permanently installed BESS can provide backup power for spontaneous grid outages (blackouts and brownouts, or partial outages) as well as mitigate the daily peak charging demand by replacing all or parts of the power draw from the existing utility service with its own electricity. Mobile or temporary BESS, on the other hand, provide a flexible solution for fleet applications in which less certainty exists around where and when additional or backup power will be needed. Mobile battery systems could be deployed at specific sites such as the DRTC on short notice and moved to a different location like the depot when needed.

Some third-party charging-as-a-service providers offer large mobile batteries delivered by truck that can power onsite chargers. One startup is StorEdgeAI[23] which will offer a mobile battery-based charging supply solution at less than half the cost of gasoline fueling. StorEdgeAI hopes to deliver bulk electricity daily, independent of the utility grid, directly from large renewable plants to EV charging locations such as fleet depots. StorEdgeAI’s technology enables one mobile battery unit (with several MWh onboard on a 30’ shipping container) to fulfill the daily energy needs for over 100 light-duty EVs. Mobile battery fleet size scales incrementally with demand (as fleet electrification grows), removing upfront investment risk. Such solutions require no utility grid upgrades or onsite utility distribution infrastructure.

[23] https://storedge-ai.com/

SOLAR

Instead of or in addition to back-up generators or batteries, EV charging operations can be protected from power supply interruptions by on-site renewable generation like photovoltaic solar panels coupled with on-site energy storage batteries.

FIGURE 35. BEAM EV ARC SOLAR-POWERED EV CHARGER WITH BUILT-IN BACKUP ENERGY STORAGE

Source: BEAM

Solar power is becoming an increasingly viable source of power for EV charging because of improvements in energy collection and storage technology. Solar technologies provide environmental benefits due to a lack of carbon emissions and resiliency benefits from an ability to operate with independence from the electrical grid during disruptions or emergencies.

One example of this is a transportable turnkey vehicle charging station called EV ARC powered by a tracking solar canopy and lithium-ion battery storage developed by Beam, formerly Envision Solar International, that may be very appropriate for multiple fleet applications. This modular solar charging platform is designed to be operated independently from the grid or it can be grid-buffered. They require no construction nor ground disturbance and therefore can be installed and set up quickly at the charging site without permitting and essentially no operating cost. The company has recently developed an upgraded version of the company's existing standard EV ARC shown in Figure 35, the High Powered EV ARC, which can be equipped with 38-51kWh of battery storage, 40 Amp power supply, and an 8.4-kW Level 2 charger or a 12.5kW DC charger. The charger can split dynamically among as many as six J1772 charging plugs. The high-powered EV ARC is able to be daisy chained or stacked with surface cabling to support 50kW DC fast charging, which is able to produce 1,000 miles of EV driving range per day on average, depending on site location and amount of sunlight.

Another solar powered charger option is Paired Power's Pair Tree, consisting of a 5kW solar canopy with bi-facial modules coupled with a 43kWh storage battery for charging when the sun isn't shining. Each Pair Tree contains dual 5kW Level 2 charging ports, LED lighting and parking bollards, a software app for full charging control including reservations via smartphone.

Solar powered EV chargers such as Beam's EV ARC or Paired Power's Pair Tree can be islanded (no grid connection) to simplify installation. However, they can also be connected to the grid.

Table 9 summarizes the advantages and disadvantages of these backup power alternatives.

TABLE 9. COMPARISON OF BACKUP POWER OPTIONS

TECHNOLOGY	ADVANTAGES	DISADVANTAGES
Generators	• Flexibility • Can be mobile • Availability through purchase or lease	• Noisy when running • Fuel consumption • Potential emissions • Occupies physical space
Fuel Cells	• Zero emissions • Silent operations • Flexibility	• Fuel consumption • Occupies physical space
Battery Energy Storage	• Zero emissions • Silent operations • Flexibility • Can be mobile • Availability through purchase or lease	• Needs power supply • Occupies physical space
Solar	• Zero emissions • Silent operations • Can be independent of power grid	• Daylight only or requires battery energy storage • Needs solar access • Requires large open area

ENVIRONMENTAL BENEFITS

Transitioning to ZEBs will provide a cleaner bus fleet, benefiting local health and the climate. Both BEBs and FCEBs have no tailpipe emissions, meaning they don't emit carbon monoxide, lead, nitrogen dioxide, ground-level ozone, particulate matter, or sulfur dioxide (collectively classified by the EPA as Criteria Air Pollutants) from their tail pipes. Eliminating these pollutants will help local communities in Shasta County by reducing mortality, cancer, and instances of chronic lung and heart disease.

ZEBs also don't emit greenhouse gases (GHG) in the upper atmosphere that trap heat and create a greenhouse effect on the surface. Although GHGs are naturally occurring, most scientists agree that burning fossil fuels for transportation and electricity dramatically increased GHGs. According to the National Oceanic and Atmospheric Administration (NOAA), each year, humans emit roughly double the amount of GHGs that Earth's natural systems can absorb.[24]

Although riding a bus with other people reduces GHG emissions when compared to driving in a single passenger car, FTA estimates that, on a national level, the average transit system emits 0.45 lbs. CO_2 per passenger mile.[25] RABA's FY-23-24 total fuel consumption was about 125,900 gallons of

[24] https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide

[25] https://www.apta.com/wp-content/uploads/Standards_Documents/APTA-SUDS-CC-RP-001-09_Rev-1.pdf

diesel and 63,100 gallons of gasoline[26], corresponding to annual CO_2 emissions of about 1,840 metric tons.[27] Transitioning to ZEBs can eliminate GHGs associated with driving and idling buses.

By reducing GHG emissions, RABA can help to:

- **Improve health:** Reducing GHGs can reduce mortality, instances of chronic lung and heart disease, and cancer.
- **Slow global temperature rise:** Reducing GHGs can minimize the weather effects of rising temperatures that include heatwaves, drought, flooding, sea level rise, severe snowstorms.
- **Reduce property damage:** Reducing GHGs can decrease the conditions for poor harvests and wildfires and the resulting property damage.

[26] Based on fuel consumption data provided by RABA.

[27] This results is based on converting the gallons of fuel consumed to CO_2 emissions, using a gasoline conversion factor of 0.008887 t-CO_2/gal and a diesel conversion factor of 0.010180 t-CO_2/gal, per U.S. EPA, https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator-calculations-and-references.


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APPENDICES

APPENDICES

- **Appendix A:** Existing Conditions
- **Appendix B:** Relevant Regulations
- **Appendix C:** Stakeholder Coordination and Public Outreach
- **Appendix D:** ZEB Technology Review
- **Appendix E:** Funding and Financing
- **Appendix F:** Workforce Training
- **Appendix G:** Site-Specific BEB Charger Installation Recommendations
- **Appendix H:** Cost Estimates Assumptions

APPENDIX A: EXISTING CONDITIONS

SUMMARY OF RELEVANT PLANNING DOCUMENTS

RABA ZERO-EMISSION BUS ROLLOUT PLAN

The RABA Zero-Emission Bus Rollout Plan outlines the agency's compliance strategy for CARB's ICT regulation and constitutes the ZEB rollout plan required by ICT. This plan demonstrates a structured approach to achieving a zero-emission bus fleet by 2040, focusing on fleet assessment, infrastructure development, financial planning, workforce training, and equitable service deployment. The document primarily focuses on analyzing feasibility of replacing conventional gasoline and diesel fleet with battery-electric buses (BEBs) and fuel cell electric buses (FCEBs) for RABA, including zero-emission bus technology and charging/fueling infrastructure. Various factors such as availability of utility distribution capacity, required infrastructure upgrades, and charging stations were taken into consideration.

The plan also identifies potential funding sources to support the procurement of zero emission buses and emphasizes the implementation of training plans and schedules for ZEB operators and maintenance and repair staff.

SRTA SHASTACONNECT ZERO-EMISSION FLEET TRANSITION ROLLOUT PLAN

Similar to RABA's ZEB Rollout Plan, SRTA's ShastaConnect Zero-Emission Fleet Transition Rollout Plan underscores the need to transition to zero-emission buses (ZEBs) by 2040, in compliance with CARB's ICT regulation. Based on its analysis, the plan recommends preparing for a full transition to a zero-emission fleet by 2039, contingent on funding availability. The transition strategy begins with a mixed fleet approach, starting with battery-electric vehicles (BEVs) and incorporating fuel cell electric buses (FCEBs) in later years once hydrogen-powered cutaway buses become commercially viable.

The plan highlights the importance of collaboration with RABA and regional partners to develop a hydrogen fueling station, which will support early transit needs and other local government medium- and heavy-duty zero-emission vehicles. Additionally, it stresses the need to work closely with Dignity Health Connected Living (DHCL) or any future ShastaConnect operator to ensure eligibility for Federal Transit Administration (FTA) grants beyond the Section 5310 program.

To support early adoption, the plan proposes securing competitive funding for a zero-emission pilot project between 2025 and 2028, including the procurement of a battery-electric bus. Overall, the ShastaConnect Zero-Emission Fleet Transition Rollout Plan outlines a phased approach to integrating zero-emission technologies while balancing operational needs, technological advancements, and financial feasibility. By starting with BEVs and strategically incorporating FCEBs, SRTA aims to achieve a sustainable and adaptable transition to a fully zero-emission fleet.

RABA SHORT RANGE TRANSIT PLAN

RABA's 2024-2029 Short Range Transit Plan (SRTP) is a five-year plan designed to improve transit efficiency, expand service coverage, and transition toward a more sustainable and technologically advanced transportation system. The plan focuses on route optimization, microtransit adoption, fare simplification, rural service expansion, technological advancements, and fleet electrification.

The plan proposes to realign or replace underperforming routes such as Routes 18, 9, and 6; introduce on-demand app-based system to allow passengers to request rides in zones with lower demand areas; adopt a simplified, flat-rate fare system to replace the current zone-based pricing; explore partnerships with ride-sharing companies like Uber and Lyft to supplement transit options; extend services to rural communities and coordinate with other regional public transit systems such as Trinity Transit, Sage State, and Tehama Rural Area eXpress (TRAX); develop a mobile app to facilitate ride requests, real-time tracking, and fare payments; and also touches on the need to align with California's broader sustainability goals to transition to zero-emission vehicles. The Plan prioritizes public input and actively gathered feedback through surveys, workshops, and public hearings.

The Plan recommends purchasing a total of 31 zero-emission vehicles to replace the aging vehicles as part of the Capital Improvement Plan.

SRTA LONG-RANGE TRANSIT PLAN

SRTA's Long-Range Transit Plan (LRTP) was adopted in 2021 and serves as a strategic framework to enhance the region's public transportation system over the next 20 years. As part of the Plan, SRTA conducted extensive public outreach to gather input on current travel behaviors and future transportation preferences. Three scenarios/alternatives namely, current trends (relative share of funding expended to support alternative mobility remains the same as today), the next steps (new funding opportunities will allow for limited long-term implementation of new mobility alternatives), a giant leap (new funding is available from federal, state, and local sources and local funding decisions prioritize local funds for mobility options) were explored to understand how the population and employment growth may occur in the region and how funding availability may impact transportation services in the future.

The Plan identifies near-, mid-, and long-term improvements such as improving the frequency, reliability, and coverage of fixed-route transit; collaborating with local jurisdictions to promote land use patterns that support transit usage, investing in pedestrian and bicycle infrastructure; accelerating transition to clean energy by investing in ZEBs and supporting fueling or charging infrastructure etc. SRTA views the implementation of these improvements as an iterative and flexible process dependent on the best information available at any given time and needs of the communities.

SRTA REGIONAL TRANSPORTATION PLAN

SRTA's Regional Transportation Plan (RTP) aims to encourage and promote a safe and efficient intermodal transportation system linked with appropriate land use planning that will serve the mobility of goods and people.

The RTP incorporates California's Sustainable Communities Strategy (SCS) that outlines integrated land use, housing, and transportation planning to reduce greenhouse gas emissions. The plan also emphasizes the development of a multimodal transportation system and employs performance measures to evaluate the effectiveness of transportation investments. The planning process included extensive public participation to gather input from residents, stakeholders and local agencies to ensure that the RTP reflects the community's needs and priorities.

BASELINE CONDITIONS

The following section describes the baseline conditions of RABA's transit services, fleet, and facilities.

SERVICE AREA OVERVIEW

RABA is a regional transit provider serving Shasta County through a collaboration between Redding, Shasta Lake, Anderson, and the county government. Operating 13 fixed routes, RABA also offers vanpool services, a bikeshare subsidy, and paratransit options. With a fleet of 38 buses and vans, the system facilitates approximately 504,000 passenger trips annually. Transit operations are managed through partnerships with Transdev Services, Inc. (bus and demand response).

Figures A1, A2, A3 illustrate RABA's overall rural service area (Shasta County), urban service area (routes servicing Redding, Shasta Lake, and Anderson) and routes, stops and transit centers in downtown Redding, CA.

FIGURE A1: RABA RURAL SERVICE AREA

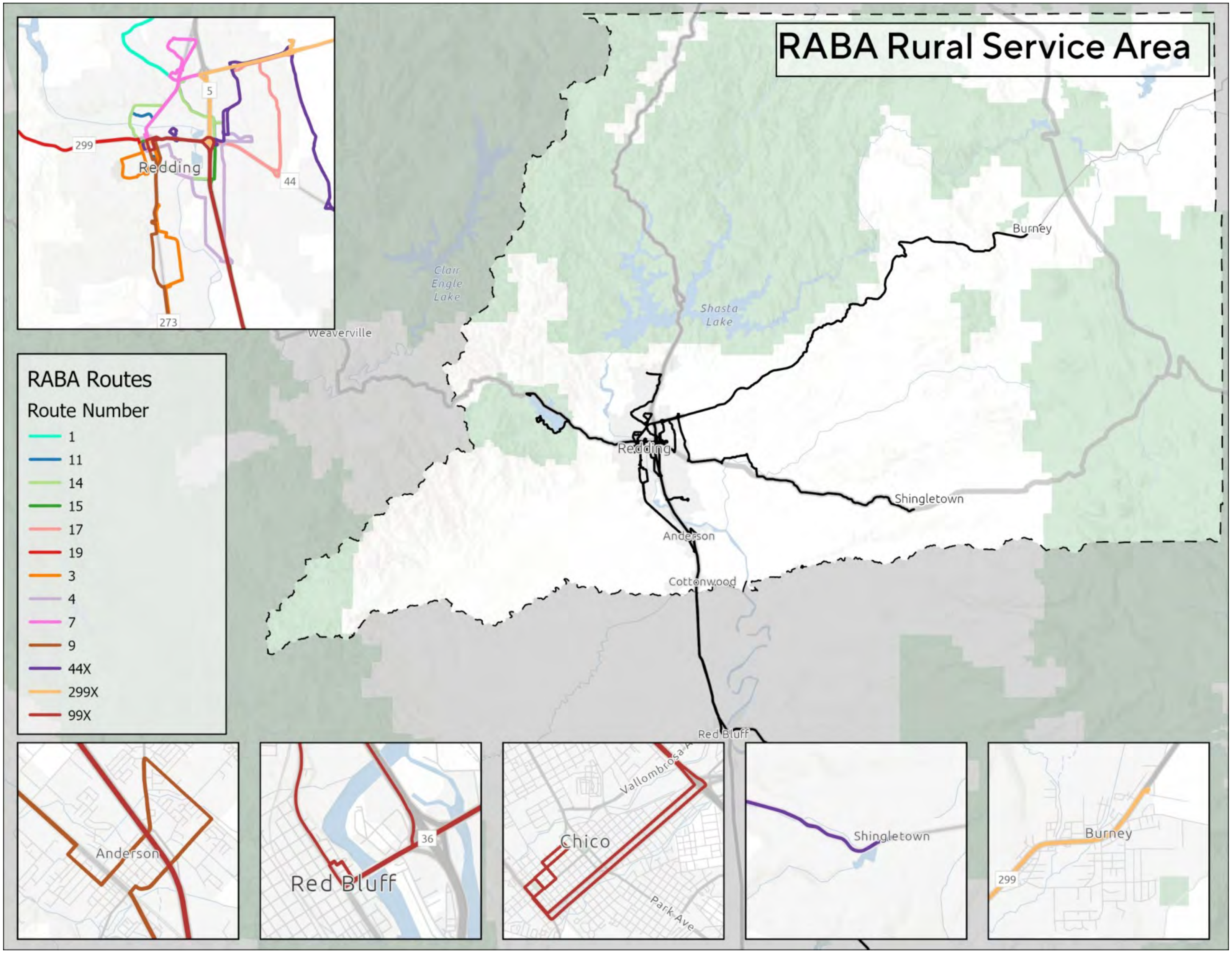


FIGURE A2. RABA URBAN SERVICE AREA

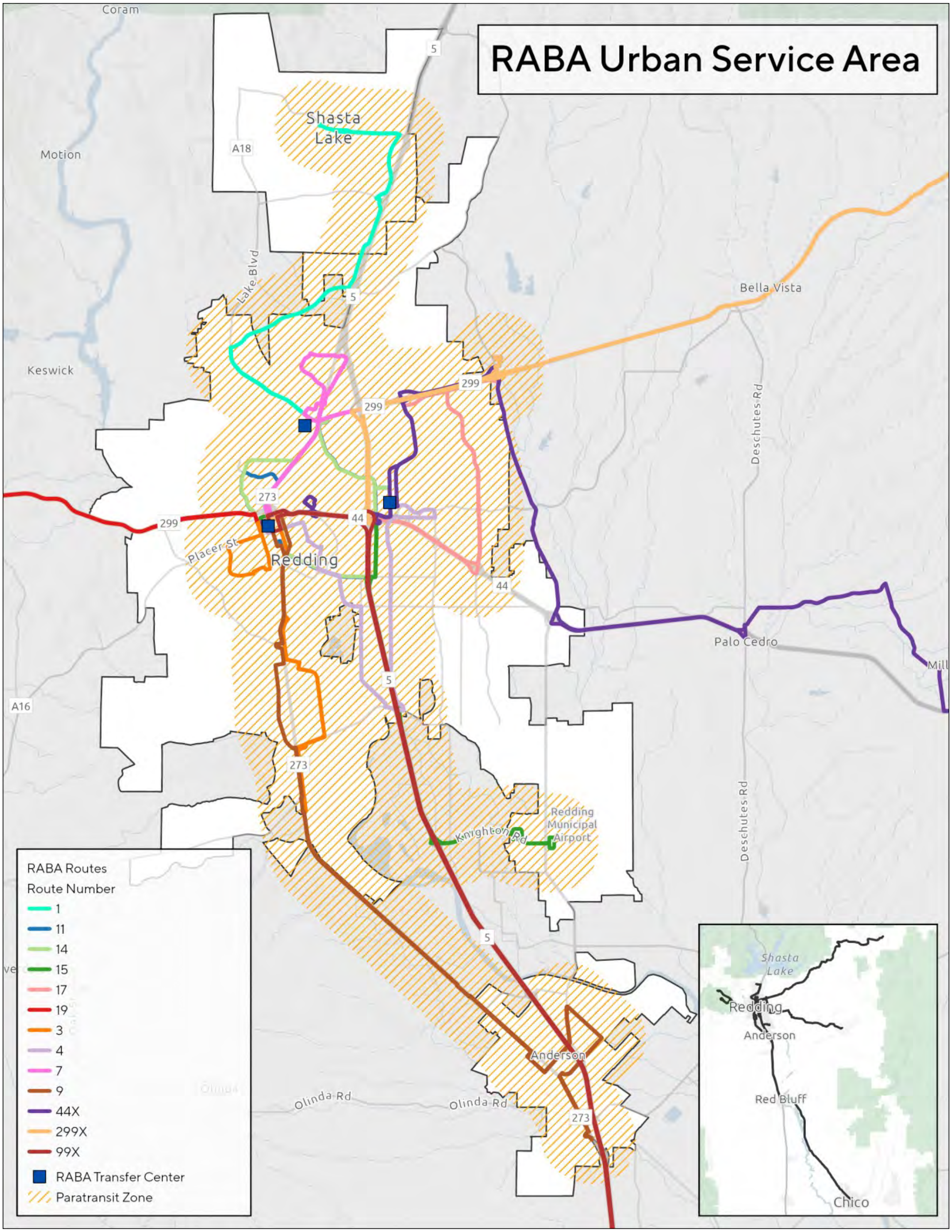
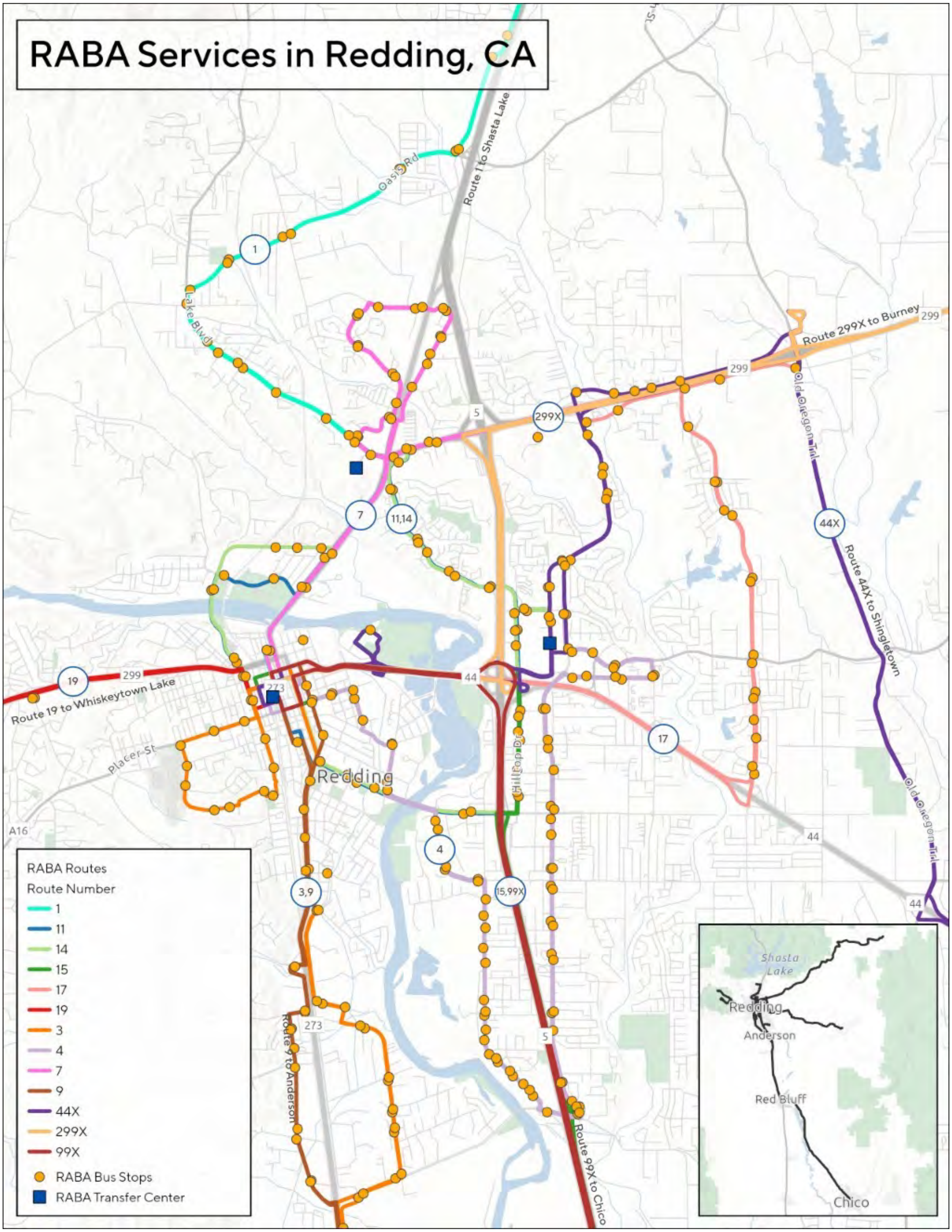


FIGURE A3. RABA SERVICES IN REDDING, CA



SOCIO-ECONOMIC CHARACTERISTICS

The following section provides a detailed demographic overview of transportation-disadvantaged populations in RABA's rural and urban service areas, using United States Census Bureau[8] data on age, income, minority status, disabilities, and other relevant factors.

TRANSPORTATION DISADVANTAGED POPULATIONS

Age

Figure A4 through Figure A7 illustrates the proportion of youth (people under age 18) and seniors (people older than 65) by block group within the RABA service area. Shasta County as a whole has a lower percentage of persons under 18. The density of persons under 18 is highest in the block group area around Burney; east of Shasta Lake; and south of Anderson. In the RABA urban service area, there is a higher concentration of younger populations in central Redding, northern Shasta Lake, and southern parts of Anderson.

As shown in the figures, Shasta County has a much higher percentage of seniors compared to the statewide average. The density of seniors in the RABA rural service area is higher in the eastern and northern regions whereas the density of seniors in the RABA urban service area is higher in the periphery of Redding, Shasta Lake, and Anderso

FIGURE A4. PERCENTAGE OF YOUTH (AGES 18 AND UNDER) BY BLOCK GROUP – RABA RURAL SERVICE AREA

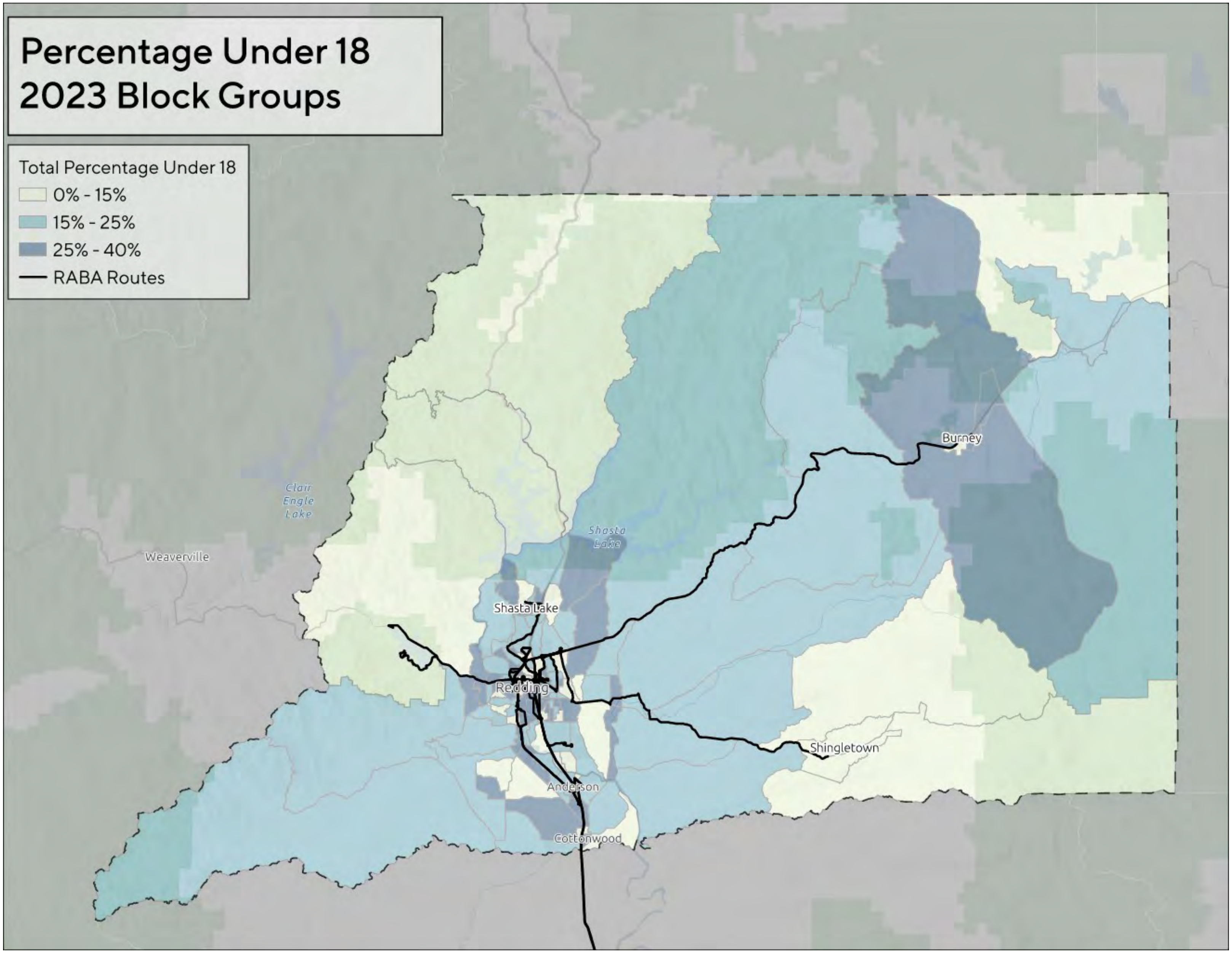


FIGURE A5. PERCENTAGE OF YOUTH (AGES 18 AND UNDER) BY BLOCK GROUP – RABA URBAN SERVICE AREA

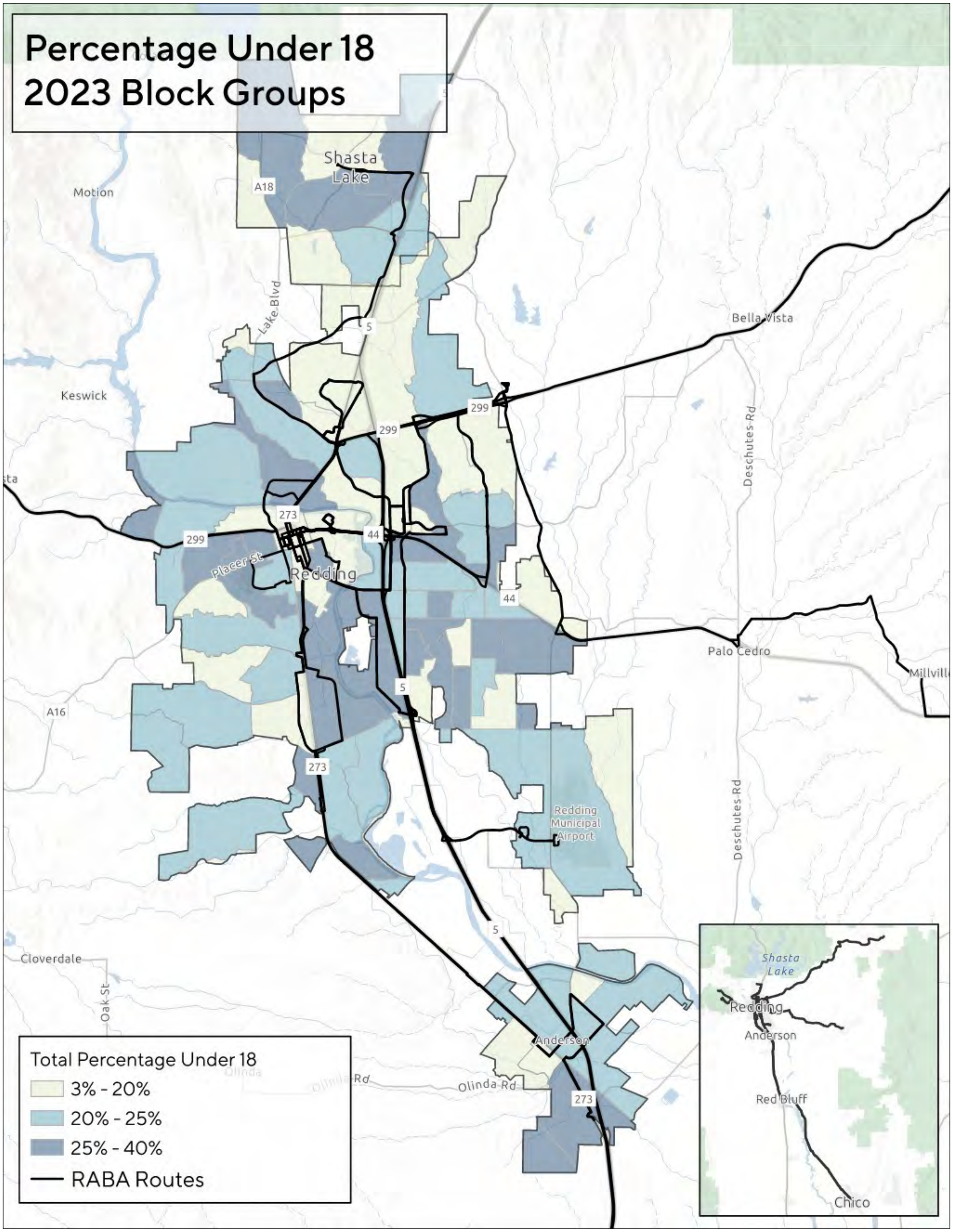


FIGURE A6. PERCENTAGE OF SENIORS (AGES 65 AND OLDER) BY BLOCK GROUP – RABA RURAL SERVICE AREA

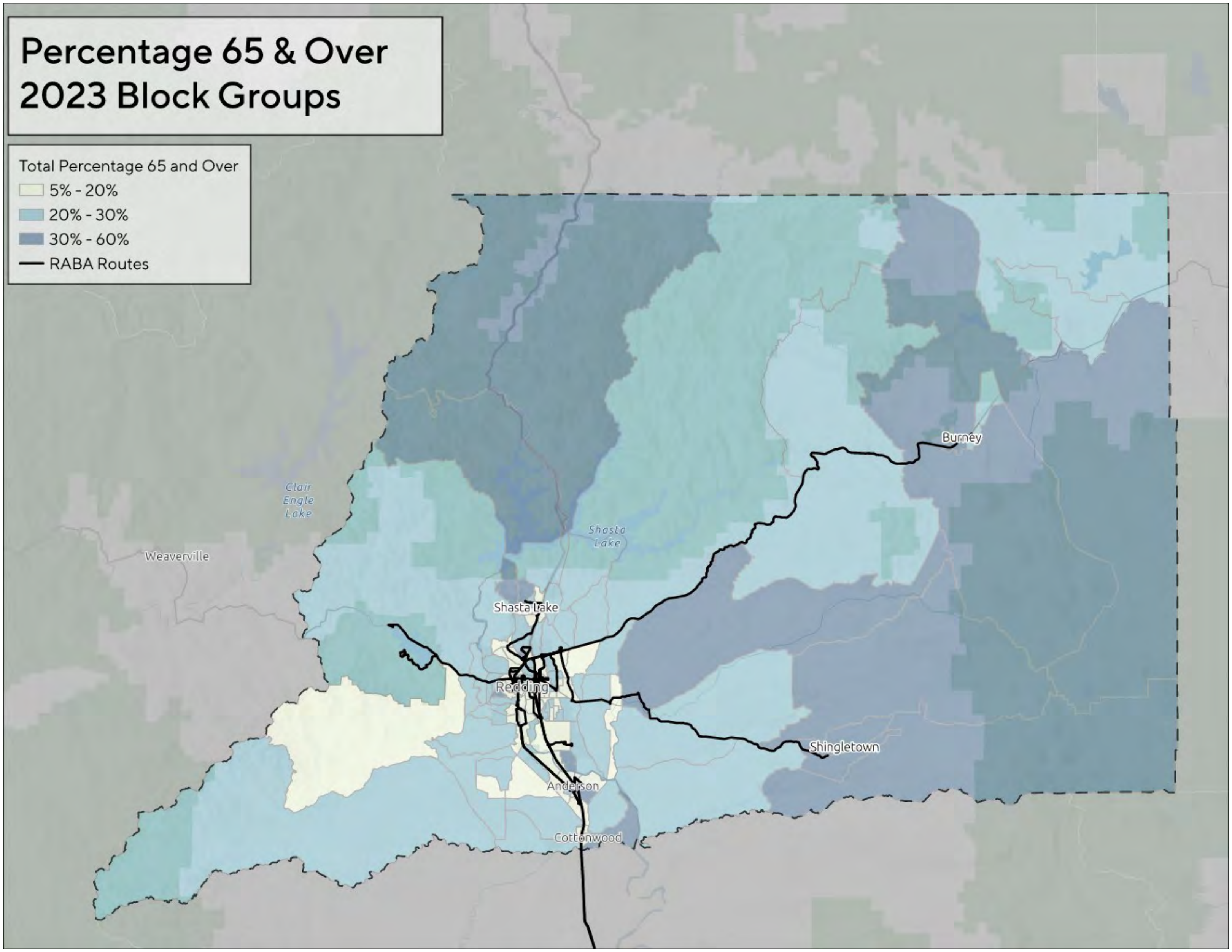
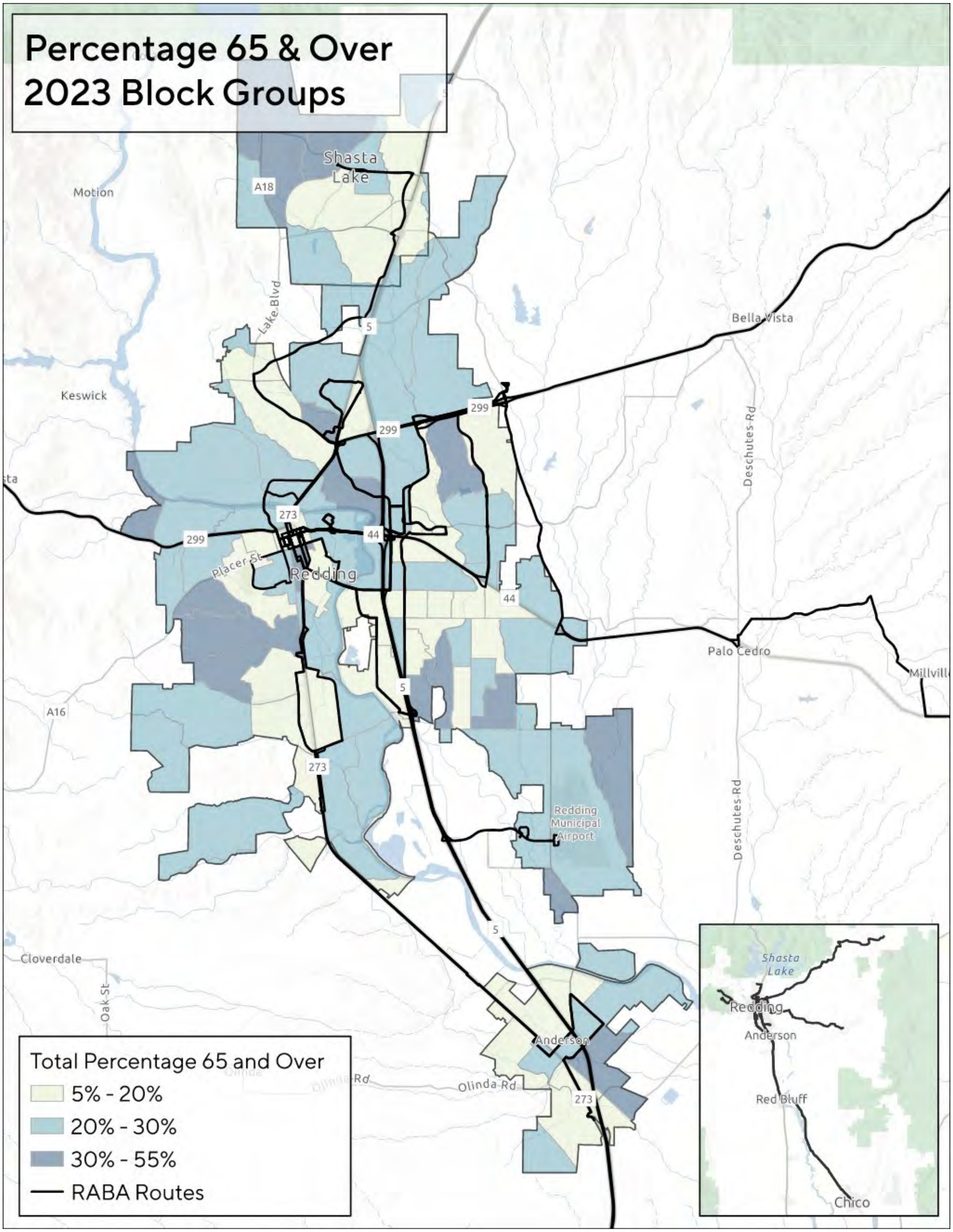


FIGURE A7. PERCENTAGE OF SENIORS (AGES 65 AND OLDER) BY BLOCK GROUP – RABA URBAN SERVICE AREA



Income

Figure A8 and Figure A9 illustrate the percentage of population living below the poverty line by block group within the RABA service area. About 5-20% of populated areas to the eastern parts of Shasta County live below the poverty line whereas more than 20% of the population just north of Shasta Lake and south of Anderson live below the poverty line.

As shown, a few areas in RABA's urban service area live below the poverty line – these include areas in the northeast region in Shasta Lake; northern and central parts of Redding; and most parts of Anderson.

FIGURE A8. PERCENTAGE OF POPULATION UNDER THE POVERTY LINE – RABA RURAL SERVICE AREA

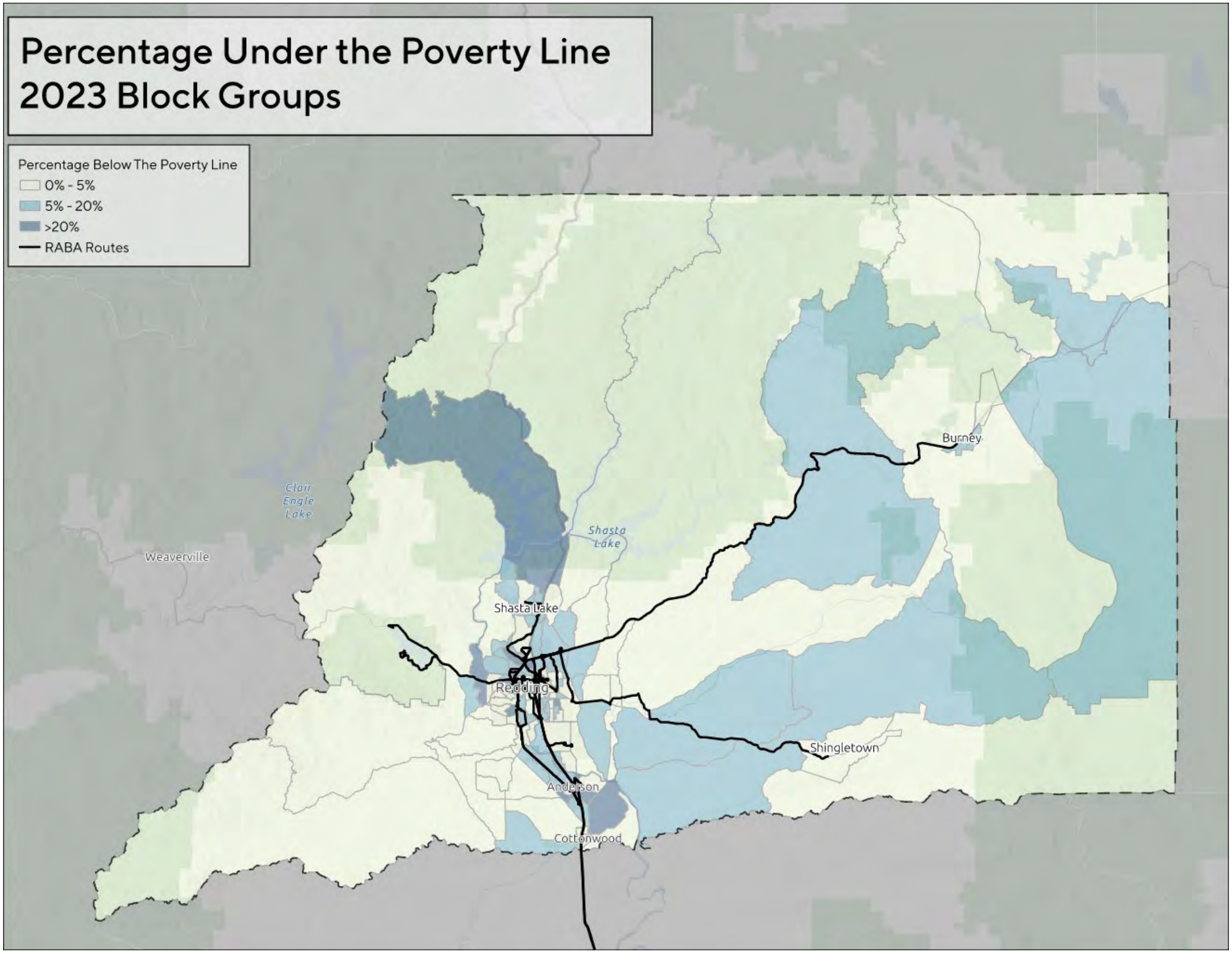
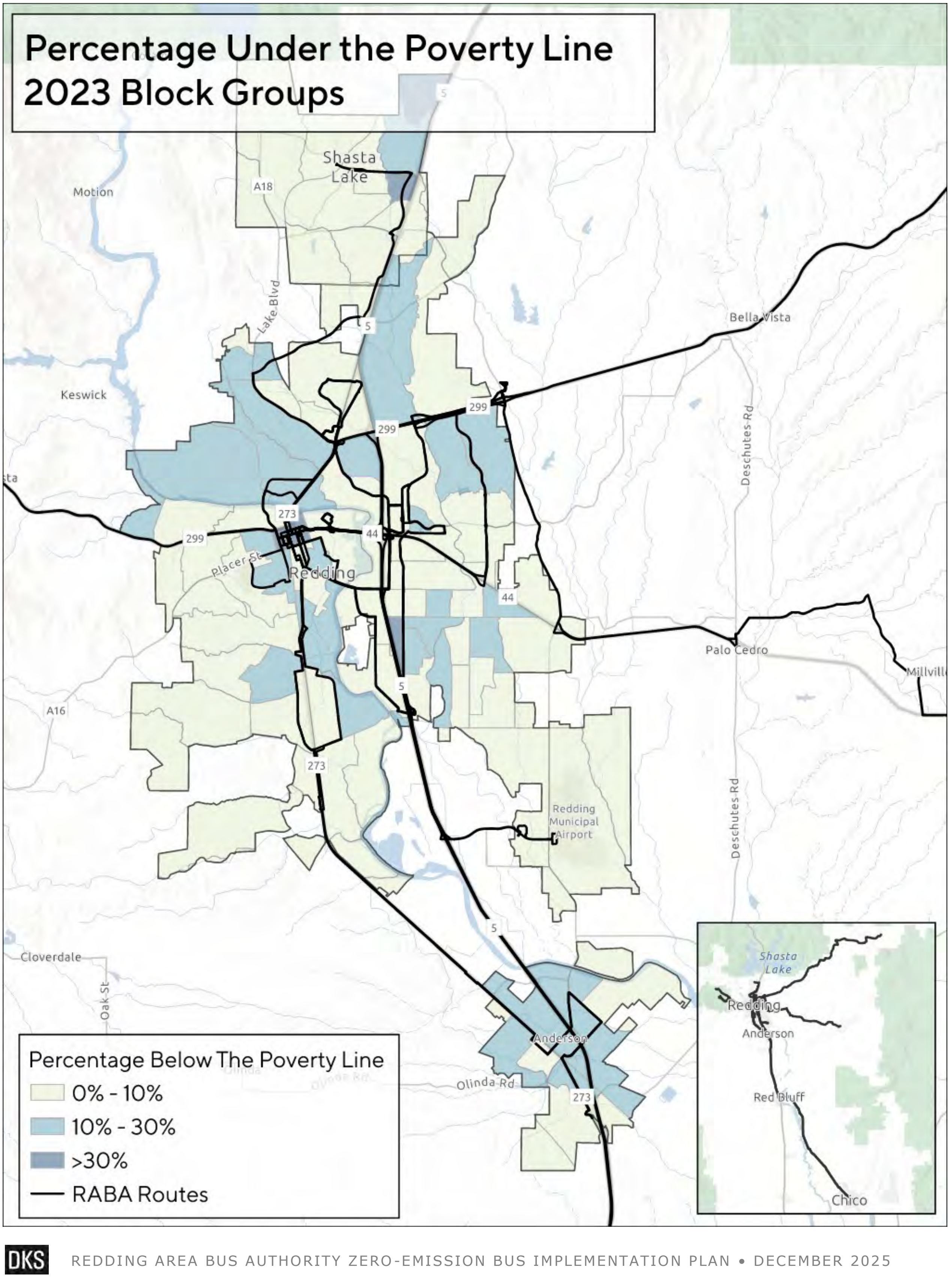


FIGURE A9. PERCENTAGE OF POPULATION UNDER THE POVERTY LINE – RABA URBAN SERVICE AREA



Minorites

Figure A10 and Figure A11 illustrate the percentage of minority populations by block group within the RABA service area. Overall, minority populations in Shasta County are concentrated in the northeastern parts of the county.

Within RABA's urban service area, the percentage of minority populations are higher in Redding and Anderson in comparison to Shasta Lake, with higher concentrations throughout Redding and northern parts of Anderson.

FIGURE A10. PERCENTAGE OF MINORITY POPULATIONS – RABA RURAL SERVICE AREA

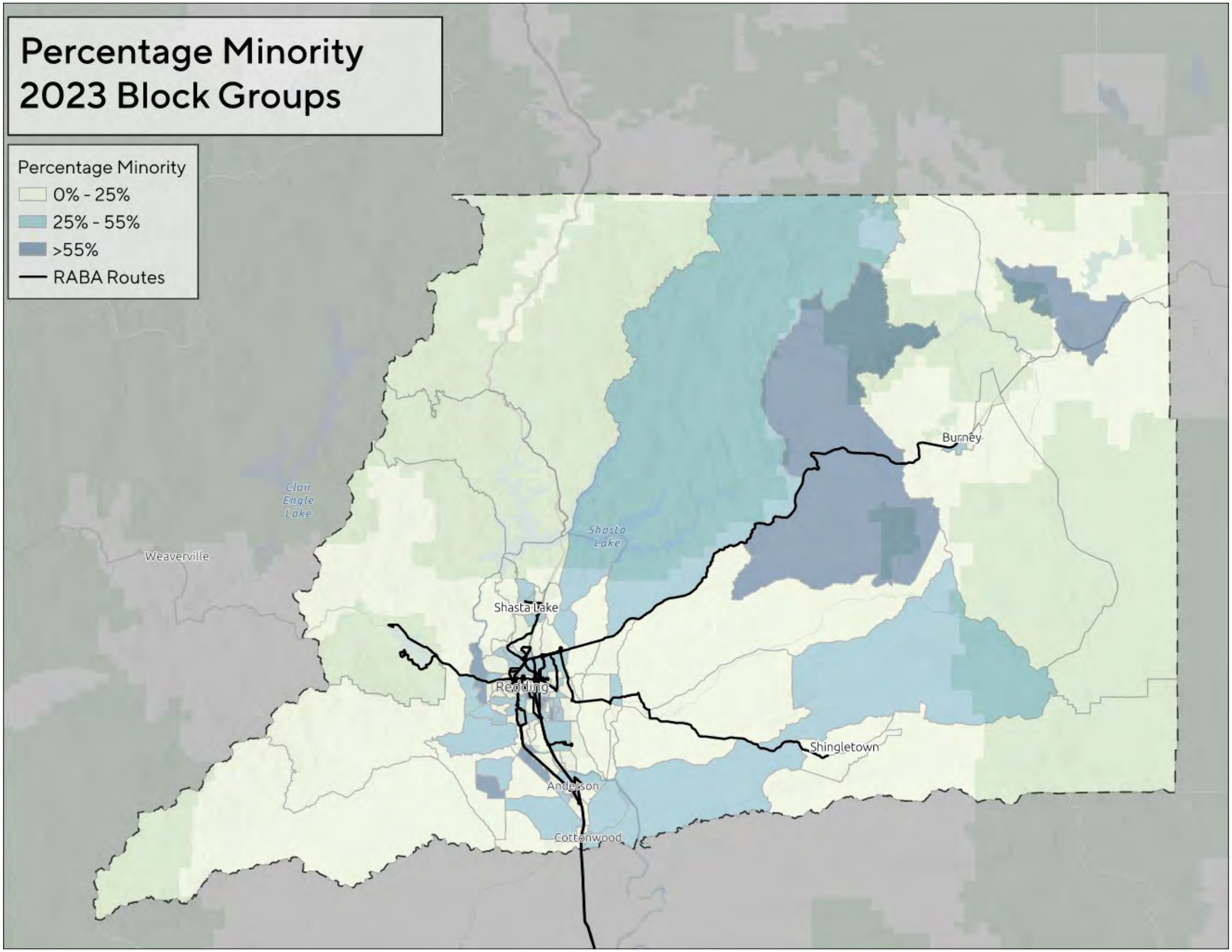
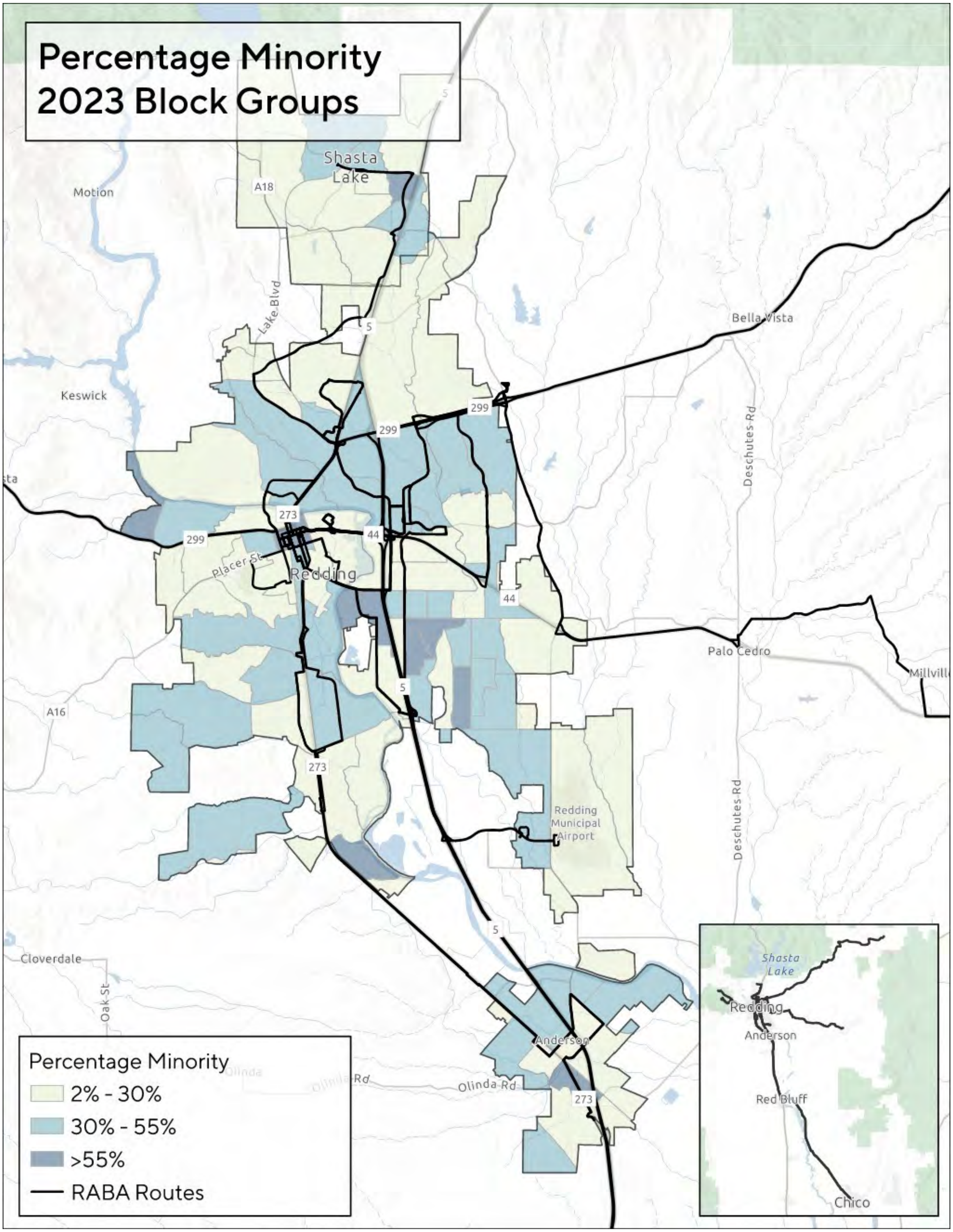


FIGURE A11. PERCENTAGE OF MINORITY POPULATIONS – RABA URBAN SERVICE AREA



Disability

Figure A12 and Figure A13 illustrate the percentage of populations with disabilities by census tracts within the RABA service area. As shown, majority of Shasta County has 20% to 30% populations with disabilities with higher concentrations in the northern and southern areas of the County.

Within RABA's urban service area, populations with disabilities are concentrated in central Redding, northern Shasta Lake, and most areas of Anderson.

FIGURE A12. PERCENTAGE OF DISABLED POPULATIONS – RABA RURAL SERVICE AREA

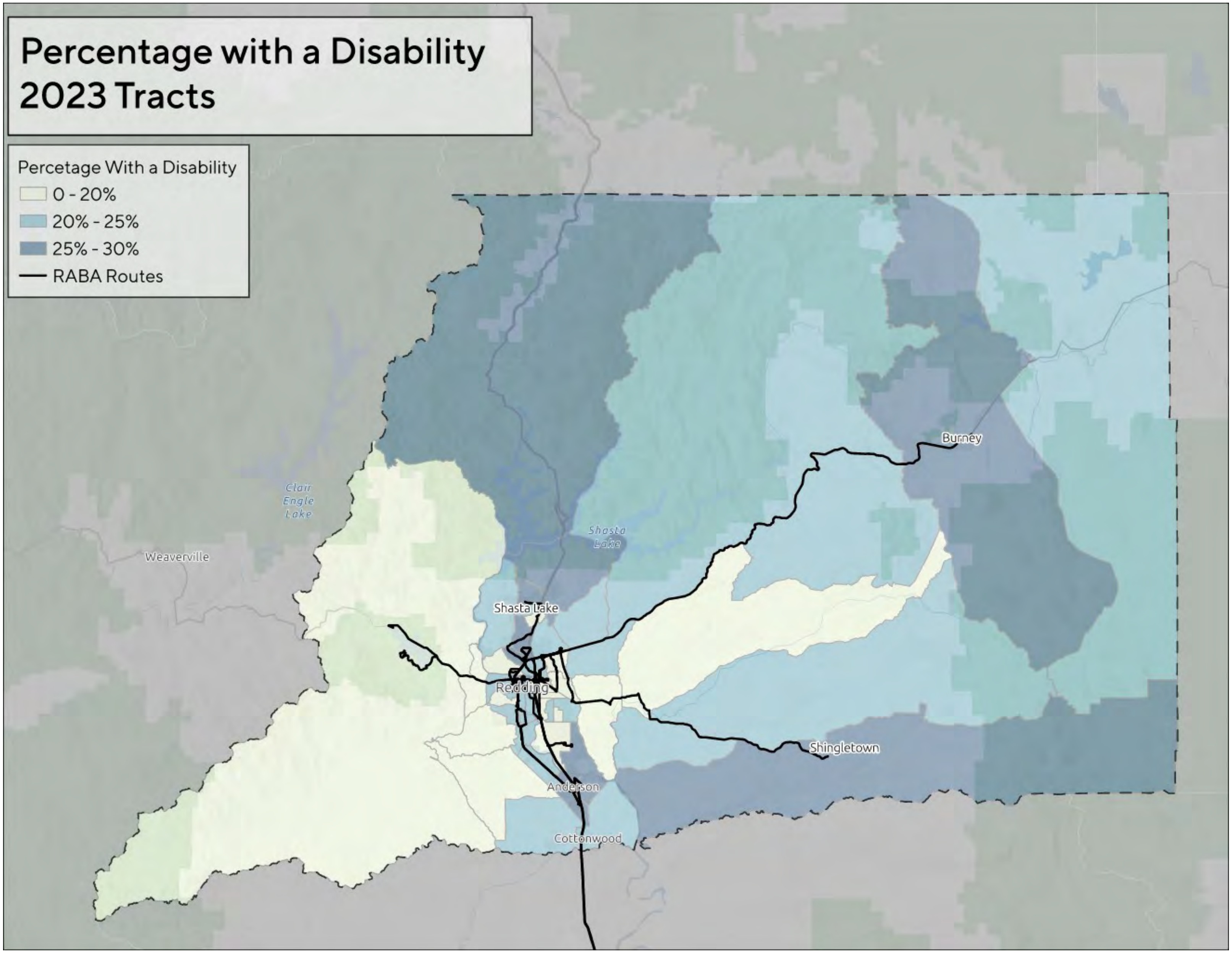
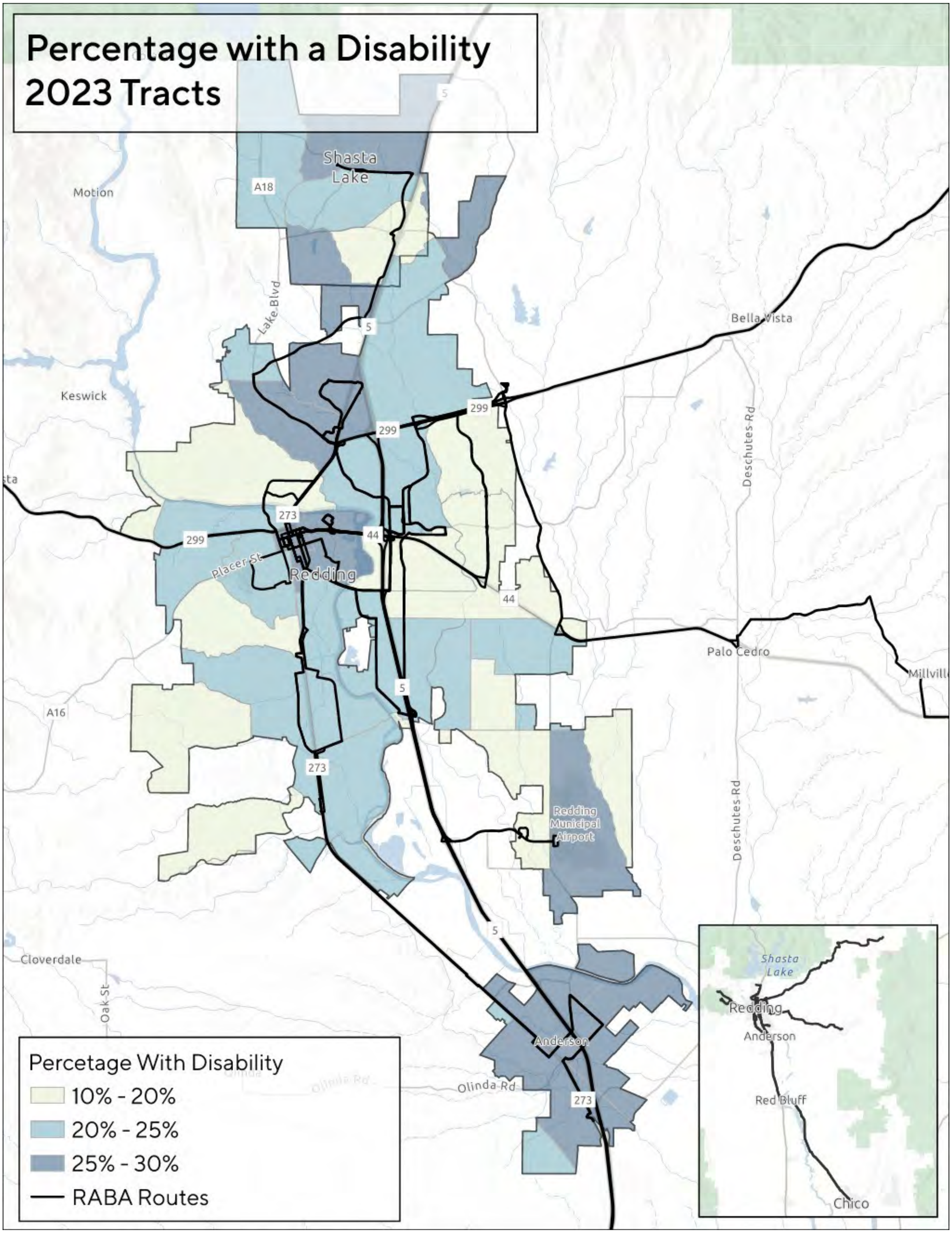


FIGURE A13. PERCENTAGE OF DISABLED POPULATIONS – RABA URBAN SERVICE AREA



Justice40 Areas

The Justice40 Initiative is a U.S. federal government effort to ensure that at least 40% of the benefits from federal investments in climate, energy, health, housing, transportation, legacy pollution, water and wastewater, and workforce development go to disadvantaged communities. There are 21 disadvantaged tracts in Shasta County and 3,081 disadvantaged tracts in California.

Figure A14 and Figure A15 show communities within the RABA service area that are disadvantaged in the above-mentioned categories. As shown, census tracts to the north and east of Redding (around Burney and Shingletown) are disadvantaged in about 2-3 categories of the 8 categories.

Within RABA's urban service area, there are multiple disadvantaged communities within Shasta Lake and Anderson while in Redding, most disadvantaged communities are concentrated in the central region.

FIGURE A14. JUSTICE 40 AREAS – RABA RURAL SERVICE AREA

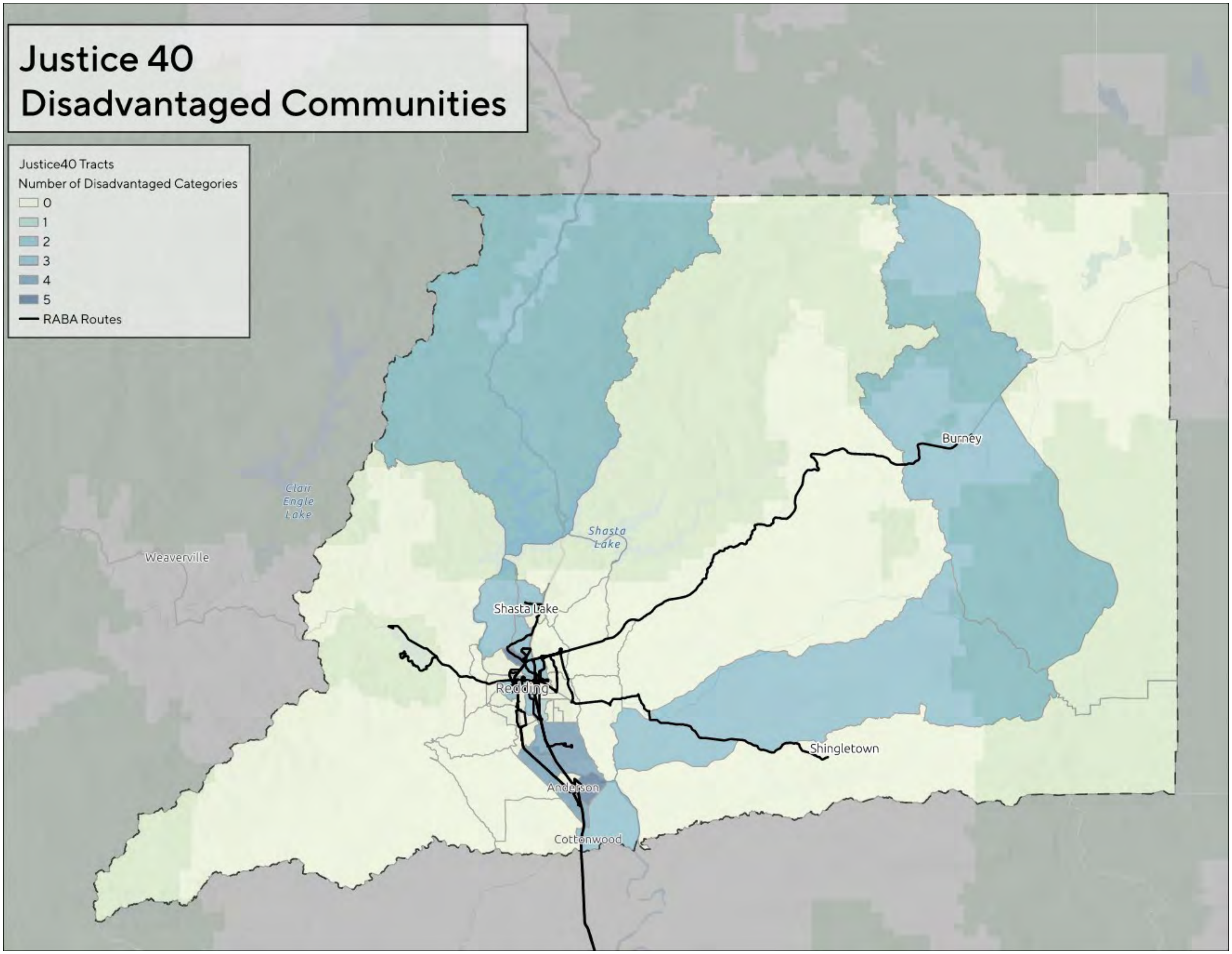
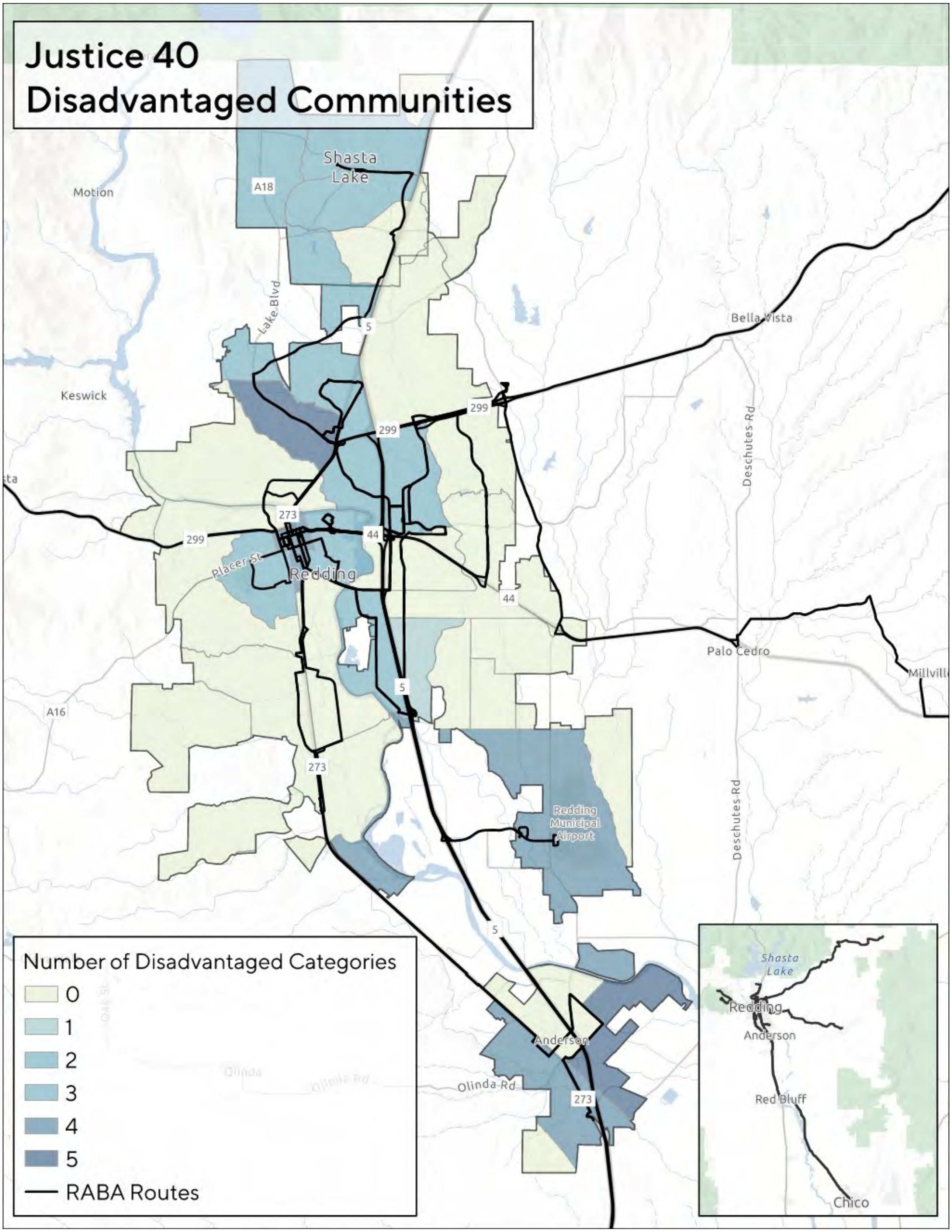


FIGURE A15. JUSTICE 40 AREAS – RABA URBAN SERVICE AREA



Fire Hazard Severity Zones

Figure A16 shows the fire hazard severity zones[28] by the California Department of Forestry and Fire Protection in the RABA urban service area. According to Government Code 51178, the State Fire Marshal is responsible for designating areas within the state as moderate, high, and very high fire hazard severity zones. These classifications are determined using consistent statewide criteria and are based on the anticipated severity of fire hazards in each area.

The designation of fire hazard severity zones considers several factors, including fuel loading, slope, fire weather, and other relevant conditions. Additionally, areas where winds have been identified as a significant factor in wildfire spread, as determined by the Office of the State Fire Marshal, are also included in this assessment.

As illustrated, the majority of Shasta Lake, along with the northeastern, northwestern, and western areas of Redding, and the southwestern portion of Anderson, are classified as very high fire hazard severity zones.

Zoning

Figure A17 shows the zoning classification in Redding, CA. The zoning map of Redding, CA, shows a mix of commercial, industrial, residential, and open space areas distributed throughout the city. Commercial and mixed-use zones are concentrated along major roads and highways, while industrial areas are primarily located near key transportation corridors. Single-family residential zones dominate much of the city, with higher-density housing near commercial centers, and open space and rural lands are more prevalent on the outskirts.

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[28] Fire Hazard Severity Zones, in SRA Effective April 1, 2024 with LRA Recommended 2007-2011 - Overview

FIGURE A16. FIRE HAZARD SEVERITY ZONES - RABA URBAN SERVICE AREA

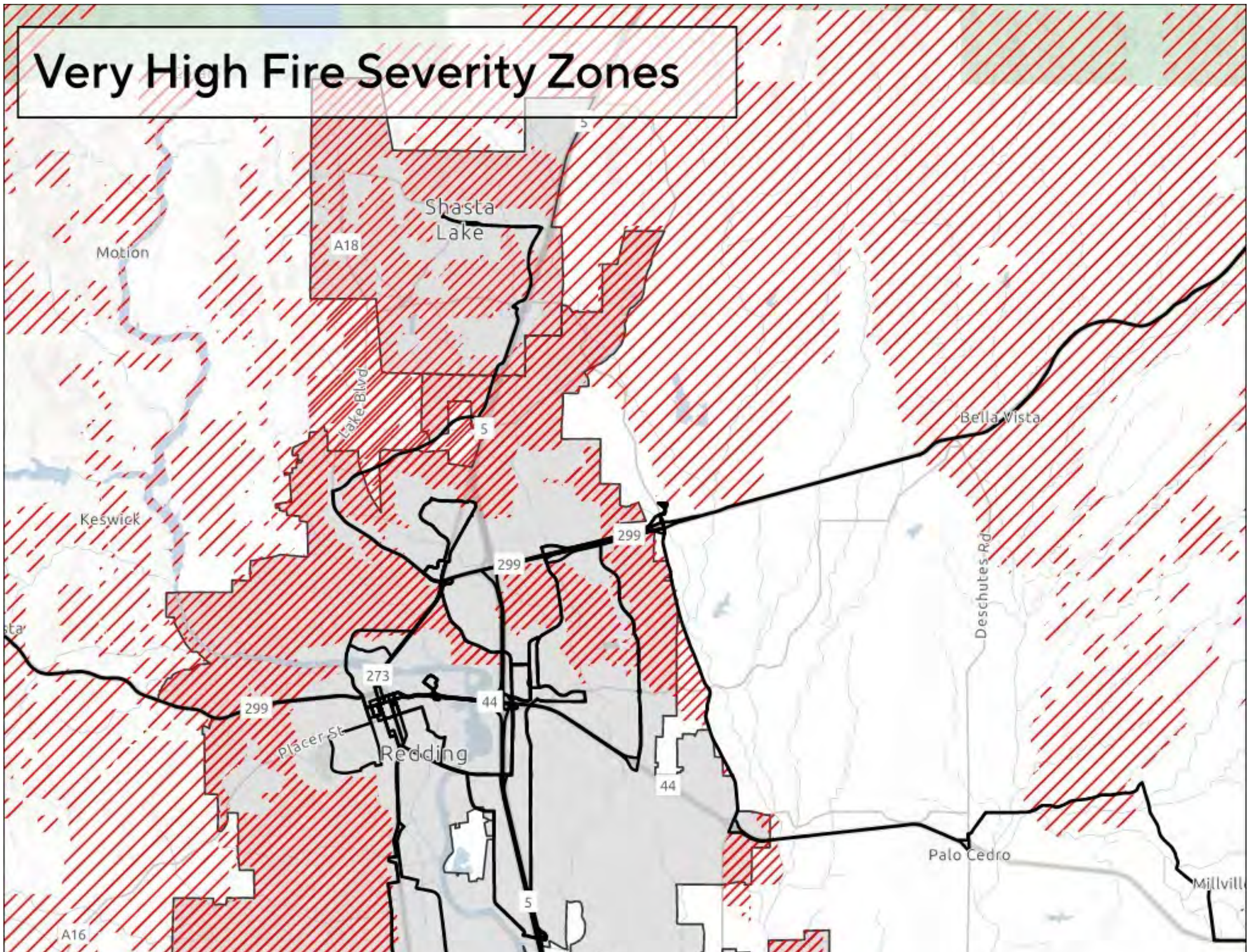
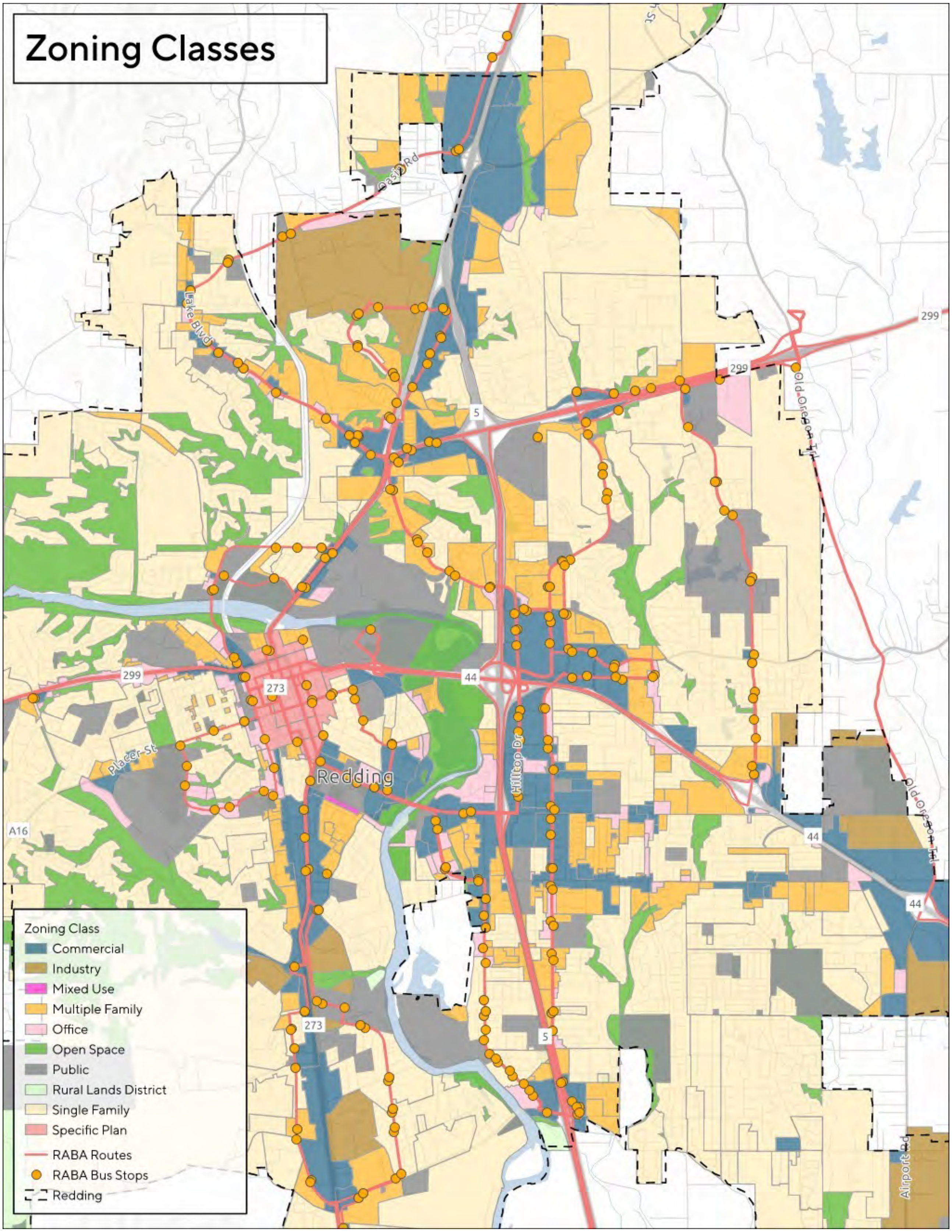


FIGURE A17. ZONING – REDDING, CA



OVERVIEW OF EXISTING SERVICES

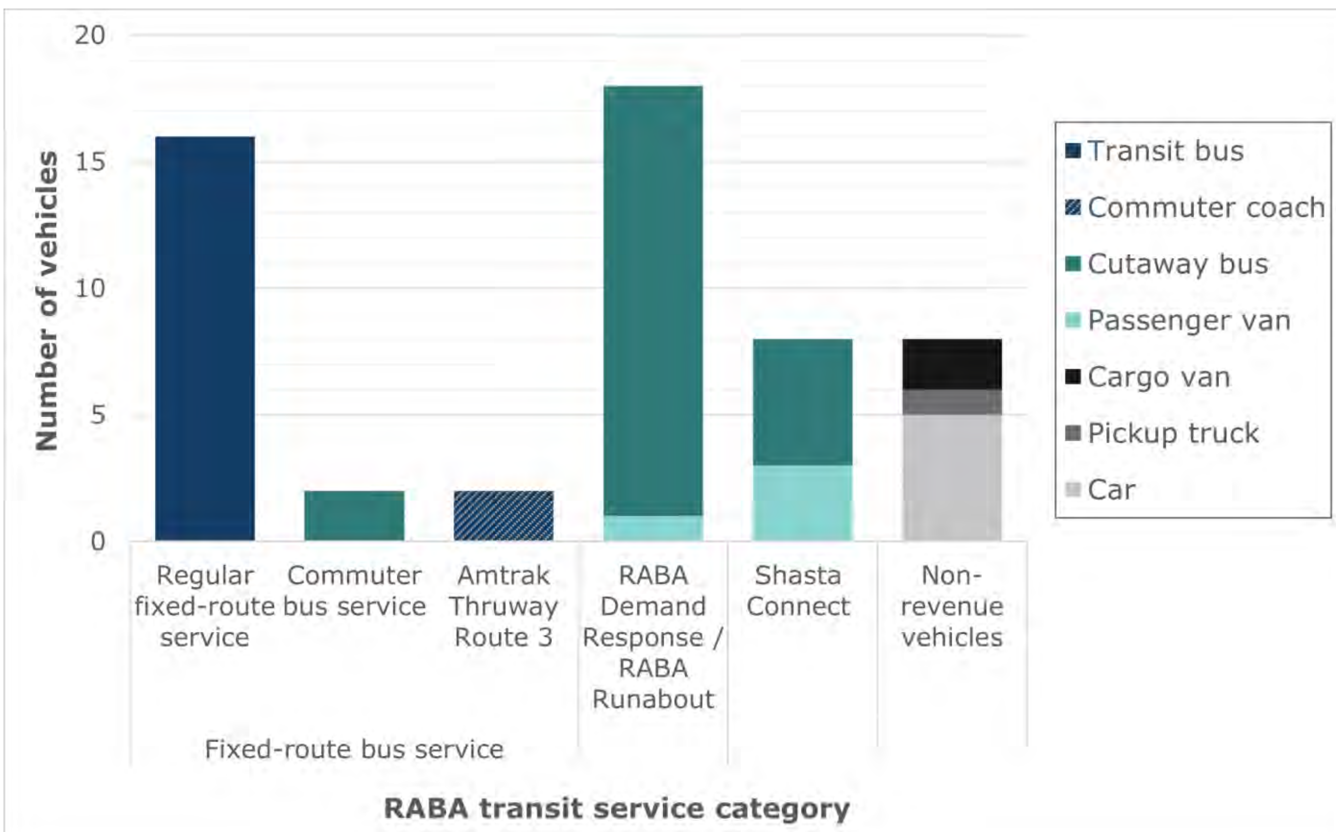
This section provides an overview of existing vehicle operations as they relate to each of the transit services offered by RABA. Each of RABA's services as well as the group of non-revenue vehicles (NRVs) is addressed separately to account for the distinct vehicle technical and operational requirements of each.

In 2025, RABA took over the ShastaConnect service, which has so far been operated by Dignity Health Connected Living (DHCL) and funded and supported by the Shasta Regional Transportation Agency (SRTA). For that, RABA signed a memorandum of understanding to manage the ShastaConnect fleet under RABA. Hence, ShastaConnect is in scope for this project and thus addressed in this memo.

FLEET SUMMARY

Figure A18 below summarizes RABA's fleet of a total of **53** vehicles. The agency's fixed-route bus service is supported by the greatest number of vehicles (a total of 20), predominantly 35-ft. buses or coaches. RABA Demand Response is run using a total of 18 vehicles, comprising mostly cutaway buses. These same vehicles are also used for RABA Runabout, a service launched in 2024. ShastaConnect relies on 8 vehicles in total. Finally, while not providing passenger service, RABA operates 7 non-revenue vehicles.

FIGURE A18. RABA FLEET VEHICLE SUMMARY



The following overview provides a high-level summary of RABA's services and vehicle composition. The subsequent sections explain the nature of these services and the related vehicle operations in more detail.

RABA Fixed-Route Bus Service:

- *Fleet:* 16 transit buses (15 diesel Gillig, 1 battery-electric Proterra; mostly 35-ft.)
  + 2 commuter coaches (for Amtrak Thruway service to Red Bluff & Chico)
  + 2 medium-duty cutaway buses (for Commuter Express service on routes 44X and 299X)
  = **20** vehicles
- *Description of service:* Regular bus transit service with schedule and fixed routes. Covers all of Shasta County (theoretically), though routes are highly concentrated in and around Redding.
- *Weblink with public information:* https://rabaride.com/services/bus.php

RABA Demand Response:

- *Fleet:* **18** vehicles (17 medium-duty cutaway buses, 1 battery-electric passenger van)
- *Description of service:* RABA's ADA paratransit service, i.e. origin-to-destination, shared ride, advanced reservation service for persons with disabilities. Service is provided within a ¾-mile zone along each fixed route.
- *Weblink with public information:* https://rabaride.com/services/paratransit.php

RABA Runabout:

- *Fleet:* This service is provided via the same vehicles as used for RABA Demand Response.
- *Description of service:* Reservation-based, customized point-to-point trips within five designated zones. Operating hours vary by zone.
- *Weblink with public information:* https://rabaride.com/services/runabout.php

ShastaConnect:

- *Fleet:* **8** vehicles (5 medium-duty cutaway buses, 3 passenger vans)
- *Description of service:* As stated above, this service was taken over by RABA and is thus in project scope. Covers Shasta County areas outside of RABA's urban paratransit service area.
- *Weblink with public information:* https://www.shastaconnect.org/

Non-revenue vehicles:

- *Fleet:* **7** vehicles (mostly light-duty)
- *Description of service:* These do not provide a public-facing transit service, but are used to support the revenue vehicle fleet and RABA's facilities, including bus stops.

Table A1 below summarizes RABA's fleet showing quantity and types of vehicles by transit service category along with key metrics on mileage, fuel use, and vehicle purchase prices. RABA's fixed-route bus service is estimated to contribute about 69% of RABA's total fuel (gasoline and diesel) consumption each year. Vehicle operations to support RABA Demand Response make up for an estimated 22% of total fuel use. Fuel use from ShastaConnect services is estimated to be about 6% of the total, though future ShastaConnect operations under RABA will need to show if vehicle utilization changes. At roughly 2%, NRVs are estimated to be responsible for a relatively small portion of the total annual fuel consumption. Each of RABA's transit buses consumes almost twice as much fuel each year as all seven NRVs combined. These comparisons show that focusing RABA's efforts on electrifying its mostly utilized assets, i.e. its fixed-route bus fleet, will provide the highest benefits in terms of fuel consumption, greenhouse gas (GHG) emission, and local air pollution reductions to RABA and the communities in its service area.

TABLE A1: RABA FLEET VEHICLE SUMMARY WITH KEY METRICS

TRANSIT SERVICE CATEGORY & VEHICLE TYPE	NO. OF VEHICLES	AVG. ANNUAL MILEAGE [MI/YEAR]	AVG. EST. ANNUAL FUEL USE [GAL/YEAR]	TOTAL EST. ANNUAL FUEL USE [GAL/YEAR]	EST. % OF FLEETWIDE FUEL USE	AVG. ORIGINAL PURCHASE PRICE
FIXED-ROUTE BUS SERVICE	**20**	**40,360**	**7,590**	**151,710**	**69%**	**$417,570**
Transit bus	16	39,820	7,790	124,680	57%	$443,560
Commuter coach	2	38,890	8,120	16,240	7%	$528,270
Cutaway bus	2	46,120	5,400	10,790	5%	$98,970
RABA DEMAND RESPONSE	**18**	**22,170**	**2,710**	**48,800**	**22%**	**$129,060**
Cutaway bus	17	23,320	2,870	48,800	22%	$116,530
Passenger van	1	2,640	0	0	0%	$342,160
SHASTA CONNECT	**8**	**14,590**	**1,760**	**14,080**	**6%**	**$71,960**
Cutaway bus	5	10,580	1,280	6,380	3%	$72,680
Passenger van	3	21,270	2,570	7,700	4%	$70,750
NON-REVENUE VEHICLES	**7**	**4,600**	**520**	**3,650**	**2%**	**$29,260**
Car	4	3,510	130	510	<1%	$30,480
Cargo van	2	7,570	1,450	2,890	1%	$25,100
Pickup truck	1	3,010	250	250	<1%	$32,690
GRAND TOTAL	**53**	**25,510**	**4,110**	**217,860**	**100%**	**$216,130**

Note: Fuel consumption data was provided for FY2023-2024 and FY2024-2025. Data from FY2023-2024 was used to estimate annual fuel use by vehicle since FY2024-2025 data does not comprise one full year at the time of writing. For vehicles with missing fuel consumption data (a total of 16 of the 53 vehicles in scope of this project), annual fuel usage is estimated using these vehicles' annual mileage and proxy fuel efficiencies from similar vehicles in RABA's fleet.

RABA FIXED-ROUTE BUS SERVICES

Overview

Fixed-route bus services are provided by RABA in the City of Redding and select routes outside of the City limits. RABA operates a total of 13 routes, including ten regular fixed routes (1, 3, 4, 7, 9, 11, 14, 15, 17, and 19), two commuter bus routes (44X and 299X), and one Amtrak Thruway bus service between Redding, Red Bluff, and Chico for connections to Sacramento, Stockton, and beyond (99X). Table A2 below provides an overview of these routes, including start and end locations. All routes originate/end at the Downtown Redding Transit Center (all routes except 3, 11, and 14) or stop at it along the route (routes 3, 11, and 14). The Downtown Redding Transit Center (DRTC) is thus the key facility in RABA's system for passenger boardings and bus schedule alignment and will be considered as part of this project for on-route opportunity charging of BEBs during as well as outside service hours.

RABA's fixed-route bus services are provided using a total of 20 individual transit buses (more fleet details below). Services are provided under contract with Transdev Services, Inc.

TABLE A2: RABA FIXED-ROUTE BUS ROUTES

ROUTE	TYPE	DESCRIPTION	TO/FROM	FIRST TRIP START TIME	LAST TRIP START TIME	TYPICAL HEADWAY	LAYOVER DURATION & LOCATION	ROUTE LENGTH [MI]	NUMBER OF STOPS	RIDER-SHIP FY23-24
1	Fixed-Route Bus Service	Shasta Lake	DRTC ↔ Shasta Lake	5:51 am (SB) 6:20 am (NB)	6:51 pm (SB) 6:20 pm (NB)	1 hr	2 mins @ DRTC	22	52	52,544
3	Fixed-Route Bus Service	South Redding	Westside Rd @ Clear Creek Rd ↔ Mercy Medical Center Redding	6:14 am (SB) 6:39 am (NB)	5:14 pm (SB) 5:39 pm (NB)	1 hr	5 mins @ DRTC	16	38	63,023
4	Fixed-Route Bus Service	Hartnell/Bechelli/ Churn Creek	DRTC ↔ Canby Road Transfer Facility	6:35 am (SB) 6:20 am (NB)	6:35 pm (SB) 6:50 pm (NB)	30 mins	2 mins @ DRTC	24	59	39,904
7	Fixed-Route Bus Service	Shasta College	DRTC ↔ Shasta College	7:20 am (EB) 7:49 am (WB)	5:20 pm (EB) 5:49 pm (WB)	1 hr	3 mins @ DRTC	19	20	29,108
9	Fixed-Route Bus Service	Anderson	DRTC ↔ Anderson	7:20 am (SB) 6:20 am (NB)	5:20 pm (SB) 6:20 pm (NB)	2 hrs	10 mins @ DRTC	33	54	22,048
11	Fixed-Route Bus Service	Central Redding Loop (Clockwise)	*Loop covering central Redding*	6:20 am	6:20 pm	1 hr	5 mins @ DRTC	11	22	72,015
14	Fixed-Route Bus Service	Central Redding Loop (Counter Clockwise)	*Loop covering central Redding*	6:20 am	6:20 pm	1 hr	5 mins @ DRTC	11	29	72,181
15	Fixed-Route Bus Service	Crosstown/Churn Creek/Knighton/ Airport	DRTC ↔ Redding Regional Airport	5:10 am (SB) 6:20 am (NB)	5:00 pm (SB) 5:25 pm (NB)	2 hrs	13 mins @ DRTC	26	13	1,143
17	Fixed-Route Bus Service	Shasta View/Shasta College	DRTC ↔ Shasta College	7:20 am (EB) 7:52 am (WB)	3:25 pm (EB) 3:52 pm (WB)	3 hrs	0-5 mins @ Shasta College	19	19	1,025

ROUTE	TYPE	DESCRIPTION	TO/FROM	FIRST TRIP START TIME	LAST TRIP START TIME	TYPICAL HEADWAY	LAYOVER DURATION & LOCATION	ROUTE LENGTH [MI]	NUMBER OF STOPS	RIDER-SHIP FY23-24
19	Fixed-Route Bus Service	Beach Bus	DRTC ↔ Brandy Creek Beach	10:20 am (WB) 11:02 am (EB)	5:20 pm (WB) 6:02 pm (EB)	2 hrs; 3 hrs btwn. AM & PM trips)	45 mins/ 1 hr 45 mins @ DRTC	39	6	1,009
99X	Amtrak Thruway Route 3	Redding, Red Bluff, and Chico	DRTC ↔ Red Bluff/Chico	10:00 am (SB) 11:55 am (NB)	1:50 pm (SB) 4:20 pm (NB)	3 hrs 50 mins	15 mins @ Chico (AM trip), 10 mins @ DRTC (midday), 50 mins @ Chico (PM trip)	152	4	n.a.
44X	Commuter Bus Service	Shingletown Flex Express	DRTC ↔ Shingletown	6:10 am (WB) 11:20 am (EB)	6:30 pm (WB) 5:20 pm (EB)	~6 hrs	~4 hours @ DRTC 14 mins midday, 4 mins in evening @ Shingletown PnR	77	7	n.a.
299X	Commuter Bus Service	Burney Express	DRTC ↔ Burney	5:50 am (WB) 10:25 am (EB)	3:50 pm (WB) 5:35 pm (EB)	5 hrs 30 mins	Varying	111	9	6,398

Notes: First and last trip start times refer to weekday (Monday through Friday) schedule. Saturday service spans for fewer hours of the day for most routes. Route IDs are color-coded to denote the following categories (RABA-defined): Green = Local routes (3, 4, 7, 11, 14, 15, 17), Gray = Intercity routes (1, 9), Yellow = Rural route (19), Purple = Commuter services (99X, 44X, 299X).

Service Hours Summary

- *General schedule:* Buses generally run Monday through Friday from 5:00 am to 7:30 pm and Saturdays from 7:00 am to 7:00 pm. Specific routes' schedules may vary from this.
- *Exceptions to Saturday service:* There is no Saturday service on routes 11, 17, 44X, and 299X.
- *Holiday service:* There is no service on New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, or Christmas Day. Saturday service operates on the following holidays: Dr. Martin Luther King Jr. Day; Presidents Day; Cesar Chavez Day; Juneteenth; Veterans Day; the day after Thanksgiving; & Christmas Eve on Routes 1, 3, 4, 7, 9, 14, 15, and 99X.
- *Evening/Sunday service:* On weekday evenings after 6:20 p.m., Saturday evenings after 5:20 p.m., or Sundays, riders are encouraged to use RABA Runabout in lieu of regular fixed-route bus service. RABA Runabout launched in 2024 and replaced both ShastaConnect Sunday service as well as RABA's routes 2, 5, and 6. Detailed information on RABA Runabout is provided in a separate section further below.
- *Real-time information:* RABA provides an interactive map with real-time bus departure and arrival information for all routes, directions, and bus stops on its website.[29]

Fixed-Route Service Types

The vast majority of RABA's total ridership (more than 90%) is distributed across the agency's fixed-route services.[30] These services are divided into the following categories:

- *Regular fixed-route bus service:*
  - RABA's regular bus services provide public transportation on fixed schedules and routes within Redding and along select corridors outside of Redding.
  - A total of 16 35/40-ft. transit buses across the 13 routes are used to provide this service. Particularly for routes 44X and 299X, cutaway buses are also used. More details on the bus fleet are included below.
  - Based on recommendations made in RABA's 2024 SRTP, routes 2, 5, and 6 were eliminated in 2024 and replaced by RABA Runabout.
  - Additionally, the recommendations from the SRTP led to multiple schedule changes and minor route adjustments.
- *Commuter bus service:*
  - RABA also operates a commuter bus service on routes 44X and 299X. The main purpose of this service is to provide reliable transportation connections between Redding and outlying communities in Shingletown and Burney.
  - These routes run along the two primary west-east connections in Shasta County, SR-44 and SR-299. They are designed to facilitate daily commutes for work, education, and other essential activities, bridging the gap between urban and rural areas in the County.
  - This service is provided by two dedicated medium-duty cutaway vehicles with seating capacities of up to 12 passengers or up to four wheelchairs.

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[29] https://rabaride.com/plan_your_trip/real_time_map/index.php

[30] 2024 RABA Short Range Transit Plan, page 22, Figure 5.

- *Amtrak Thruway Route 3:*
  - This route is offered as part of a partnership between Amtrak, the San Joaquin Joint Powers Authority (SJJPA), and RABA. Stretching along SR-99, it is referred to as RABA's route 99X and constitutes a part of Amtrak's Thruway Route 3, which connects Northern California to the Central Valley, Bay Area, and Southern California. Amtrak's Thruway Route 3 runs from Redding via Red Bluff and Chico to Sacramento and Stockton (among other stops and destinations). RABA is contracted with the SJJPA to provide this service.
  - The service is provided using two 45-ft. MCI (Motor Coach International, model year 2010) coaches which were purchased used from Yuba-Sutter Transit Authority.
  - Two roundtrips per day, seven days per week are provided, departing Redding at 10:00 am and 1:50 pm and returning at 1:40 pm and 6:05 pm, respectively.

Existing Fleet Summary

RABA operates a total of 20 vehicles to support its fixed-route bus services. This includes 16 transit buses with a length of 35 feet each, providing regular service along fixed routes. Another two (2) commuter coaches from Motor Coach International (MCI) are used to run the contracted Amtrak Thruway Route 3 (RABA route 99X). Finally, two medium-duty cutaway buses are used for routes 44X and 299X, providing service between Redding and Shingletown and Burney, respectively.

Table A3 below lists RABA's vehicles used for its fixed-route bus service.

Makes & configurations:

- Virtually all the 16 regular transit buses in RABA's fleet are 35 feet long.[31] Of these, 15 are diesel-powered and from Gillig. Up to model year 2015, the model is referred to as G27. Starting with 2017 buses in RABA's fleet, the models are referred to as Gillig Low Floor. One of RABA's regular transit buses is fully-electric, a 2019 Proterra Catalyst E2.
- Two MCI D-4500 commuter coaches support RABA's route 99X. These coaches are 2010 model years and were acquired by RABA in 2024 to provide this service as part of an agreement between the agency, Amtrak, and SJJPA. Both coaches have a seating capacity of 57 and are 45 feet long, the longest vehicles in RABA's fleet.
- Two medium-duty (FHWA Class 4) cutaway buses operate on routes 44X and 299X. Both are Glaval Bus outfits on 2019 Ford E-450 chassis, featuring a seating capacity of either 12 (when using two wheelchair positions) or six (when using four wheelchair positions). Both vehicles are 24 feet long.

Funding & purchase prices:

- All 16 regular transit buses in RABA's fleet were funded through FTA grants. The average purchase price of the 15 diesel transit buses in the fleet is $418,500. While the five 2010-2011 model year buses in RABA's fleet cost an average of $392,600, the two 2020 buses were about $479,200 each (+22% compared to 2010-2011 model year buses).
- The one all-electric Proterra bus cost about $819,400 (+71% compared to 2020 Gillig diesel buses).

[31] The oldest transit bus in RABA's fleet (a 2010 Gillig) is 40 feet long.

- The two MCI commuter coaches used for route 99X were purchased with the help of California SB 125 funding.
- The two cutaways used for routes 44X and 299X were purchased using California State of Good Repair (SGR) funding.

Utilization:

- Vehicles used for RABA's fixed routes drive an average of about 40,000 miles per year, with some variances by vehicle type and route assignment. Serving RABA's longest routes (other than the contracted Amtrak Thruway service), the two medium-duty cutaway buses drive an average of more than 46,000 miles per year.
- It is estimated that vehicle usage for RABA's fixed-route service is responsible for about 69% of RABA's total fuel use (see Table A1). The vast majority of that (57% of RABA's total fuel use) stems from the regular transit buses on fixed routes.
- The two 2010 MCI commuter coaches serving the Amtrak Thruway service were purchased used in 2024. Their odometer reading was about 540,000 miles each. These coaches will likely require replacement in the next 1-2 years, though RABA intends to invest in frames to extend these vehicles' useful life.

Current projected replacement schedule:

- In February 2025, RABA completed a fleet replacement plan that projects suitable replacement years for all of its buses and other fleet vehicles based on lifetime mileage, FTA useful life requirements, desired[32] spare ratios, and service growth.
- Half of all vehicles used for RABA's fixed-route services (transit buses, commuter coaches, cutaway buses) have an odometer reading of 475,000 miles or more. These are all vehicles of model year 2013 and older. Based on RABA's replacement plan, each of these are due for replacement in the next two fiscal years.
- A comprehensive review of RABA's current fleet replacement schedule based on its latest fleet replacement plan is included further below.

Existing battery-electric Proterra bus:

- A model year 2019 and having entered revenue service in May 2020, RABA has been operating one battery-electric 35-ft. transit bus (Proterra Catalyst E2, ID 64) for almost five years. Since then, the vehicle has driven about 74,000 miles, or approximately 15,900 miles per year (about 60% less than the average annual mileage of RABA's transit buses). This indicates that this bus's assignment to individual routes often differs from that of RABA's diesel bus fleet, largely due to frequent breakdowns and lack of service support from the manufacturer.
- RABA currently uses this bus on routes 1, 3, 4, 7, 9, 11, and 14. The bus gets charged every night from about 9:30pm until operations commence again the next morning using a 125-kW ChargePoint DC fast charger at RABA's Maintenance Facility. Charging stops as soon as the bus'

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[32] The FTA sets guidance for the number of spare vehicles in transit fleets of 50 or more fixed-route revenue vehicles not to exceed 20% of the number of vehicles operated in maximum fixed-route service. Since RABA's revenue fleet comprises less than 50 vehicles, this guidance is not applicable here. However, RABA tracks its vehicle spare ratio and orientates itself toward the 20% FTA guidance.

state-of-charge (SOC) reaches 100%. RABA typically assigns the bus to routes a bit later in the day so that it will hold enough charge to complete the route through the evening.

- In RABA's current fleet replacement plan, this bus is scheduled for replacement in fiscal year 2032.
- In the one year spanning from 2/27/2024 to 2/24/2025, the bus used a total of 40,847 kWh. Combined with the estimated annual mileage of 14,800 mi, the bus is estimated to consume about 2.76 kWh/mi on average during operations. This energy consumption rate can substantially vary by assigned route, traffic conditions, passenger load, and ambient temperature.

TABLE A3: FIXED-ROUTE BUS SERVICE FLEET OVERVIEW

ID	MODEL YEAR	MAKE	MODEL	VEHICLE TYPE	VEHICLE CLASS	DUTY CLASS	FUEL TYPE	SUPPORTED SERVICE	LENGTH [FT]	SEATING CAPACITY	WHEEL-CHAIR POSITIONS	ORIGINAL PURCHASE PRICE	FUNDING SOURCE	FTA USEFUL LIFE [YEARS]	CURRENT PROJECTED REPLACEMENT YEAR	ODOMETER READING [MI]	AVERAGE ANNUAL MILEAGE [MI/YEAR]	FY2023-2024 FUEL USE [GAL]
51	2010	Gillig	G27D102	Transit bus	Class 7	HD	Diesel	Regular fixed-route service	40	37	2	$411,828	FTA 066	12	2024-2025	556,638	38,300	6,872
52	2011	Gillig	G27D102	Transit bus	Class 7	HD	Diesel	Regular fixed-route service	35	32	3	$387,791	FTA 801	12	2024-2025	511,345	40,100	9,062
53	2011	Gillig	G27D102	Transit bus	Class 7	HD	Diesel	Regular fixed-route service	35	32	3	$387,791	FTA 801	12	2024-2025	534,204	41,800	8,836
54	2011	Gillig	G27D102	Transit bus	Class 7	HD	Diesel	Regular fixed-route service	35	32	3	$387,791	FTA 801	12	2025-2026	541,792	42,300	9,242
55	2011	Gillig	G27D102	Transit bus	Class 7	HD	Diesel	Regular fixed-route service	35	32	3	$387,790	FTA 801	12	2025-2026	526,272	41,200	6,484
56	2013	Gillig	G27D103	Transit bus	Class 7	HD	Diesel	Regular fixed-route service	35	32	3	$399,111	FTA 913	12	2026-2027	488,565	43,100	8,747
57	2013	Gillig	G27D104	Transit bus	Class 7	HD	Diesel	Regular fixed-route service	35	32	3	$399,111	FTA 913	12	2026-2027	475,493	42,000	7,906
58	2013	Gillig	G27D105	Transit bus	Class 7	HD	Diesel	Regular fixed-route service	35	32	3	$399,111	FTA 913	12	2027-2028	485,942	42,900	9,855
59	2015	Gillig	G27B102N4	Transit bus	Class 7	HD	Diesel	Regular fixed-route service	35	30	3	$417,235	FTA Z071	12	2027-2028	412,346	42,000	8,596
60	2015	Gillig	G27B102N4	Transit bus	Class 7	HD	Diesel	Regular fixed-route service	35	30	3	$417,235	FTA Z071	12	2028-2029	408,072	41,300	6,893
61	2017	Gillig	GLFoor17	Transit bus	Class 7	HD	Diesel	Regular fixed-route service	35	30	3	$441,437	FTA Z278	12	2028-2029	291,978	40,500	6,779
62	2017	Gillig	GLFoor17	Transit bus	Class 7	HD	Diesel	Regular fixed-route service	35	30	3	$441,437	FTA Z278	12	2030-2031	291,714	40,500	9,728
63	2017	Gillig	GLFoor17	Transit bus	Class 7	HD	Diesel	Regular fixed-route service	35	30	3	$441,437	FTA Z278	12	2030-2031	307,316	42,800	9,541
64	2019	Proterra	Catalyst E2	Transit bus	Class 8	HD	Electric	Regular fixed-route service	35	26	3	$819,371	FTA Low-No	12	2031-2032	74,014	15,900	40,847 kWh
65	2020	Gillig	GLFoor17	Transit bus	Class 7	HD	Diesel	Regular fixed-route service	35	30	3	$479,238	FTA 5339	12	2032-2033	197,587	43,400	8,715

ID	MODEL YEAR	MAKE	MODEL	VEHICLE TYPE	VEHICLE CLASS	DUTY CLASS	FUEL TYPE	SUPPORTED SERVICE	LENGTH [FT]	SEATING CAPACITY	WHEEL-CHAIR POSITIONS	ORIGINAL PURCHASE PRICE	FUNDING SOURCE	FTA USEFUL LIFE [YEARS]	CURRENT PROJECTED REPLACEMENT YEAR	ODOMETER READING [MI]	AVERAGE ANNUAL MILEAGE [MI/YEAR]	FY2023-2024 FUEL USE [GAL]
66	2020	Gillig	GLFoor17	Transit bus	Class 7	HD	Diesel	Regular fixed-route service	35	30	3	$479,238	FTA 5339	12	2032-2033	177,603	39,000	7,430
5701	2010	MCI	D-4500	Commuter coach	Class 8	HD	Diesel	Amtrak Thruway Route 3	45	57	2	$528,267	SB125	12	2026-2027	539,774	38,600	*n.a.*
5702	2010	MCI	D-4500	Commuter coach	Class 8	HD	Diesel	Amtrak Thruway Route 3	45	57	2	$528,267	SB125	12	2026-2027	549,189	39,200	*n.a.*
308	2019	Glaval	E450	Cutaway bus	Class 4	MD	Gasoline	Commuter bus service	24	12 or 6	2 or 4	*$98,970*	SGR	5	2027-2028	201,090	46,500	6,505
309	2019	Glaval	E450	Cutaway bus	Class 4	MD	Gasoline	Commuter bus service	24	12 or 6	2 or 4	*$98,970*	SGR	5	2027-2028	194,321	45,800	4,288

Note: Original purchase price for the two MCI motor coaches (IDs 5701 and 5702) refers to the price paid by the Yuba-Sutter Transit Authority for the original purchase. RABA purchased these two coaches used from the Yuba-Sutter Transit Authority in 2024 for $30,000 each. Odometer readings are as of 1/27/2025. Average annual mileage is estimated by dividing the odometer reading by the difference of the odometer reading date and revenue service start date and rounding the result to the nearest 100 mi. For the battery-electric Proterra bus (ID 64), the total electricity consumption between 2/27/2024 and 2/24/2025 is provided in lieu of fuel use.

RABA DEMAND RESPONSE

Overview

RABA's Demand Response is the agency's ADA paratransit service, offering origin-to-destination, shared ride, advanced reservation service for individuals with disabilities who are functionally unable to use the fixed-route bus service. To use Demand Response, riders must be either certified by RABA based on a functional disability (local residents) or provide documentation of ADA paratransit eligibility from their home transit agency (visitors). The service area extends a ¾-mile distance on each side and each end of RABA's fixed routes as shown in Figure A2. This area is subject to change in accordance with changes to the fixed routes.

Demand Response service is provided using a total of 18 vehicles, including 17 medium-duty cutaway buses and one battery-electric passenger van (more fleet details below).

Service Hours Summary

Generally, RABA Demand Response service hours are similar to the fixed-route service hours: from 5:50 am to 7:30 pm on weekdays and from 8:50 am-7:00 pm on Saturdays. For service on weekday and Saturday evenings until 10 pm as well as on Sundays, riders are requested to use RABA Runabout, for which details are provided further below. Saturday service by RABA Demand Response is only provided if the closest fixed-route has Saturday service too.

No service through RABA Demand Response is provided on New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day. Saturday service is offered on select holidays along specific routes (1, 3, 4, 7, 9, 14, and 15).

Reservations are required at least one day in advance and can be made via phone or the RABA & ShastaConnect app. Service is provided from one prearranged location and time to another prearranged location. RABA commits to a 30-minute pick-up window for each ride and allows for a maximum pickup duration of five minutes.

Existing Fleet Summary

RABA Demand Response relies on a fleet of 18 vehicles, mostly cutaways. The same vehicle fleet is also used to provide the RABA Runabout service. Details on the nature of that service are provided further below.

Table A4 below lists the vehicles used for RABA Demand Response and RABA Runabout.

Makes & configurations:

- Almost all vehicles in this part of RABA's fleet are gas-powered.
- The 13 El Dorado and Glaval buses are custom outfits on Ford E-450 platforms. Of these, the five El Dorado buses are 25 feet long and feature a seating capacity of either 16 (when using two wheelchair positions) or eight (when using four wheelchair positions). They are model years 2011 (1 vehicle) and 2017 (4). The eight Glaval buses are model years 2019 (2) and 2021 (6). These are 24 feet long and have a seating capacity of either 12 (two wheelchair positions) or six (four wheelchair positions).

- The two ARBOC buses are based on Chevrolet Express platforms. These are 24 feet long, have a seating capacity of 16 passengers, and have two wheelchair positions. They are model year 2023.
- The two New England Wheels Frontrunner buses are technically considered light-duty (Class 2) and are custom outfits on Ram ProMaster 3500 platforms. They are 23 feet long and have a seating capacity of nine passengers and two wheelchairs. They are model year 2024.
- One 2024 Ram ProMaster passenger van (20 feet long), the only electric vehicle in the Demand Response fleet, completes the lineup.

Funding & purchase prices:

- Most vehicles were funded through various FTA grants, including FTA CARES Act funding for several 2021 model year vehicles.
- The average purchase price for medium-duty cutaway buses has increased over time. The one 2011 El Dorado bus cost $78,714, while 2023 ARBOC models were priced at $168,371 each (+114% compared to the 2011 model).
- The electric Ram ProMaster van, funded by LCTOP, had the highest purchase price at $342,156 (+73% compared to the most expensive gas-powered cutaway bus in RABA's fleet).

Utilization:

- The average estimated annual mileage for these vehicles ranges from 16,700 to 38,900 miles per year, with newer vehicles generally showing higher utilization. This represents about 53-124 miles per day on average.[33]
- The 2011 El Dorado Ford (ID 260) has the highest odometer reading at 278,899 miles, reflecting its long service life.
- It is estimated that vehicle usage for RABA's Demand Response service is responsible for about 22% of RABA's total fuel use (see Table A1). Since these estimates rely on FY2023-2024 fuel data and RABA Runabout was only established in August 2024, this proportion may change as Runabout services ramp up and potentially increase utilization of these vehicles. The average gas-powered cutaway bus in this part of RABA's fleet consumes about 37% of the fuel used by each of its transit buses on fixed-route services.

Operations:

- The cutaway buses used for RABA's Demand Response service are domiciled (parked) at its Maintenance Facility, both overnight and during the day when not in use. They are used for specific trips based on requested rides and thus rotate in and out of the facility throughout the day.

Current projected replacement schedule:

- Based on the RABA useful life of 10 years for most vehicles, RABA has a staggered replacement schedule for vehicles used on its Demand Response and Runabout services, ranging from fiscal year 2024-2025 to 2034-2035.
- A comprehensive review of RABA's current fleet replacement schedule based on its latest fleet replacement plan is included further below.

[33] This and the following daily mileage estimates assume 313 annual operating days, given that RABA Demand Response operates Mondays through Saturdays.

Existing battery-electric Ram ProMaster passenger van:

- The electric Ram ProMaster (ID 280) shows the lowest annual mileage at 2,600 miles. The van is used for RABA Runabout services.
- It gets placed on a Level 2 charger whenever it returns to RABA's Maintenance Facility. Before leaving at night, the closing dispatcher takes it off the charger.
- So far, operations have shown that the van only has sufficient charge for a few hours of continuous operation. Additionally, the van is less spacious inside than desired and the wheelchair position is only sufficiently large for one standard manual chair.

TABLE A4: RABA DEMAND RESPONSE AND RUNABOUT FLEET OVERVIEW

ID	MODEL YEAR	MAKE	MODEL	VEHICLE TYPE	VEHICLE CLASS	DUTY CLASS	FUEL TYPE	LENGTH [FT]	SEATING CAPACITY	WHEEL-CHAIR POSITIONS	ORIGINAL PURCHASE PRICE	FUNDING SOURCE	FTA USEFUL LIFE [YEARS]	CURRENT PROJECTED REPLACEMENT YEAR	ODOMETER READING [MI]	AVERAGE ANNUAL MILEAGE [MI/YEAR]	AVERAGE DAILY MILEAGE [MI/DAY]	FY2023-2024 FUEL USE [GAL]
260	2011	El Dorado Ford	Aerotech 240	Cutaway bus	Class 4	Medium-duty	Gas	23	16	4	$78,714	FTA 066	5	2025-2026	278,899	20,500	66	3,044
264	2017	El Dorado Ford	Aerotech 240	Cutaway bus	Class 4	Medium-duty	Gas	25	16 or 8	2 or 4	$95,352	FTA Z182/Z278	5	2025-2026	127,199	17,300	55	2,407
265	2017	El Dorado Ford	Aerotech 240	Cutaway bus	Class 4	Medium-duty	Gas	25	16 or 8	2 or 4	$95,352	FTA Z182/Z278	5	2025-2026	137,383	18,800	60	1,047
266	2017	El Dorado Ford	Aerotech 240	Cutaway bus	Class 4	Medium-duty	Gas	25	16 or 8	2 or 4	$95,352	FTA Z182/Z278	5	2024-2025	139,257	19,100	61	1,159
267	2017	El Dorado Ford	Aerotech 240	Cutaway bus	Class 4	Medium-duty	Gas	25	16 or 8	2 or 4	$95,352	FTA Z182/Z278	5	2024-2025	144,278	19,900	64	859
268	2019	Glaval	E450	Cutaway bus	Class 4	Medium-duty	Gas	24	12 or 6	2 or 4	$98,970	FTA	5	2025-2026	73,394	16,800	54	4,108
269	2019	Glaval	E450	Cutaway bus	Class 4	Medium-duty	Gas	24	12 or 6	2 or 4	$98,970	FTA	5	2025-2026	72,416	16,700	53	4,891
270	2021	Glaval	E450	Cutaway bus	Class 4	Medium-duty	Gas	24	12 or 6	2 or 4	$98,369	FTA CARES	5	2025-2026	69,297	21,300	68	3,124
271	2021	Glaval	E450	Cutaway bus	Class 4	Medium-duty	Gas	24	12 or 6	2 or 4	$98,369	FTA CARES	5	2025-2026	67,714	21,500	69	3,515
272	2021	Glaval	E450	Cutaway bus	Class 4	Medium-duty	Gas	24	12 or 6	2 or 4	$98,369	FTA CARES	5	2028-2029	69,749	21,400	69	4,001
273	2021	Glaval	E450	Cutaway bus	Class 4	Medium-duty	Gas	24	12 or 6	2 or 4	$98,369	FTA CARES	5	2029-2030	66,932	21,200	68	3,800
274	2021	Glaval	E450	Cutaway bus	Class 4	Medium-duty	Gas	24	12 or 6	2 or 4	$98,369	FTA 192	5	2029-2030	83,600	26,600	85	4,119
275	2021	Glaval	E450	Cutaway bus	Class 4	Medium-duty	Gas	24	12 or 6	2 or 4	$98,369	FTA 192	5	2030-2031	83,057	26,900	86	4,233
276	2023	ARBOC	Spirit of Mobility	Cutaway bus	Class 4	Medium-duty	Gas	24	16	2	$168,371	FTA	5	2030-2031	29,081	38,900	124	1,315
277	2023	ARBOC	Spirit of Mobility	Cutaway bus	Class 4	Medium-duty	Gas	24	16	2	$168,371	FTA	5	2033-2034	24,839	34,700	111	570
278	2024	New England Wheels	Frontrunner	Cutaway bus	Class 2	Light-duty	Gas	23	9	2	$197,975	FTA	5	2034-2035	14,888	32,000	102	*n.a.*
279	2024	New England Wheels	Frontrunner	Cutaway bus	Class 2	Light-duty	Gas	23	9	2	$197,975	FTA	5	2034-2035	9,583	22,900	73	*n.a.*
280	2024	RAM	ProMaster	Passenger van	Class 2	Light-duty	Electric	20	8	2	$342,156	LCTOP	4	2034-2035	1,517	2,600	8	-

Note: Odometer readings are as of 1/27/2025. Average annual mileage is estimated by dividing the odometer reading by the difference of the odometer reading date and revenue service start date and rounding the result to the nearest 100 mi. The average daily mileage is estimated assuming a total of 313 operating days (i.e. Mondays through Saturdays).

RABA RUNABOUT

Overview

RABA Runabout is a micro-transit service launched in 2024 to provide flexible, on-demand transportation in the Redding area. Through the service, riders have access to reservation-based, customized point-to-point trips within five designated zones. RABA Runabout initially replaced the ShastaConnect Sunday Transit service, starting from September 1, 2024. This new service operates on Sundays from 8:00 am to 4:00 pm in Redding, Shasta Lake, and Anderson. Later, on December 2, 2024, RABA expanded the Runabout service to replace its regular fixed-route bus routes 2, 5, and 6. This new service and its expansion was part of the provisions made in RABA's 2024 Short Range Transit Plan.

Service Hours Summary

Passengers can request rides same day using the RABA & ShastaConnect app or via phone. There are no advance reservations possible. Passengers are picked up within 30 minutes of their scheduled time and dropped at their chosen address.

Service is provided within five designated zones. Figure A19 through Figure A24 illustrates the runabout service zones. If a passenger's travel extends beyond a designated zone, they would need to take Runabout to a transit center or a bus stop to take a fixed route bus to their final destination or another Runabout zone. The five zones and their respective times of service are listed in Table A5.

TABLE A5: RABA RUNABOUT ZONES AND SERVICE TIMES

ZONE NAME	SERVICE DAYS & HOURS
SHASTA LAKE/MOUNTAIN GATE	• Monday-Friday: 5:20 am – 6:20 pm
EAST REDDING	• Monday-Friday: 6:20 am – 6:20 pm • Saturday: 9:20 am – 5:20 pm
CENTRAL/WEST REDDING	• Monday-Friday: 6:20 am – 6:20 pm • Saturday: 9:20 am – 5:20 pm
ANDERSON	• Monday, Wednesday, & Friday: 9:00 am – 4:00 pm
ANDERSON/SOUTH COUNTY	• Tuesday & Thursday: 9:00 am – 4:00 pm
REDDING URBANIZED ZONE*	• Monday-Friday: 6:20 am – 6:20 pm • Saturday: 5:20 pm – 9:20 pm • Sunday: 8:00 am – 4:00 pm

* This zone comprises the Redding Urbanized Area Zone (i.e. the Central/West Redding and East Redding zones), with service offered in evenings and on Sundays in addition to the service in the five regular zones.

FIGURE A19. SHASTA LAKE/MOUNTAIN GATE ZONE

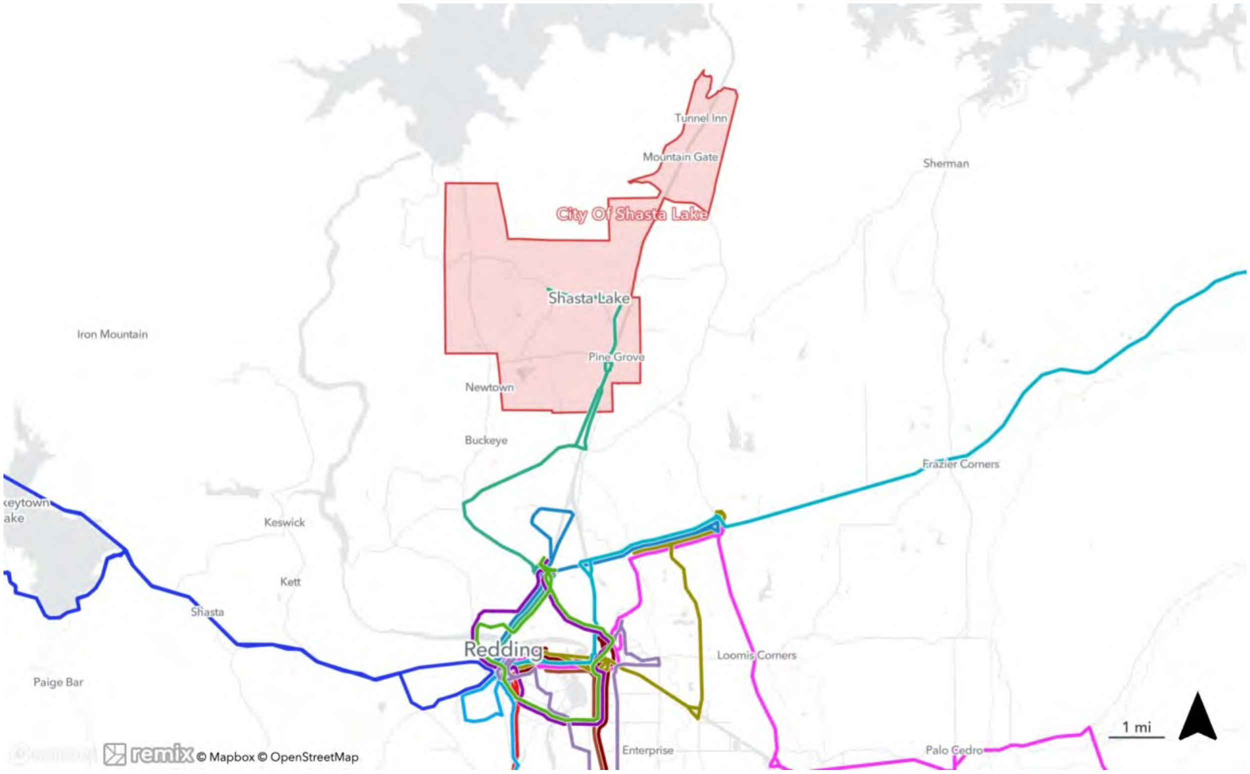


FIGURE A20. EAST REDDING ZONE

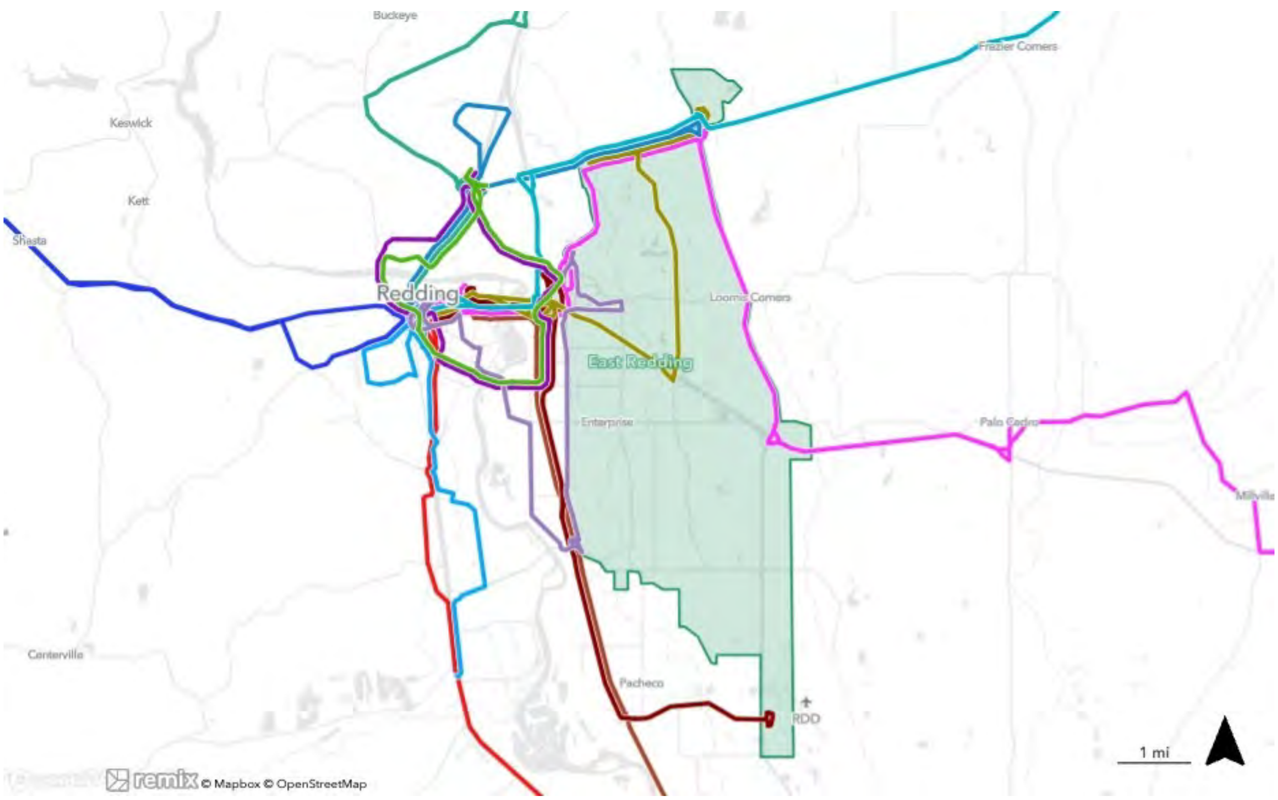


FIGURE A21. CENTRAL/WEST REDDING ZONE

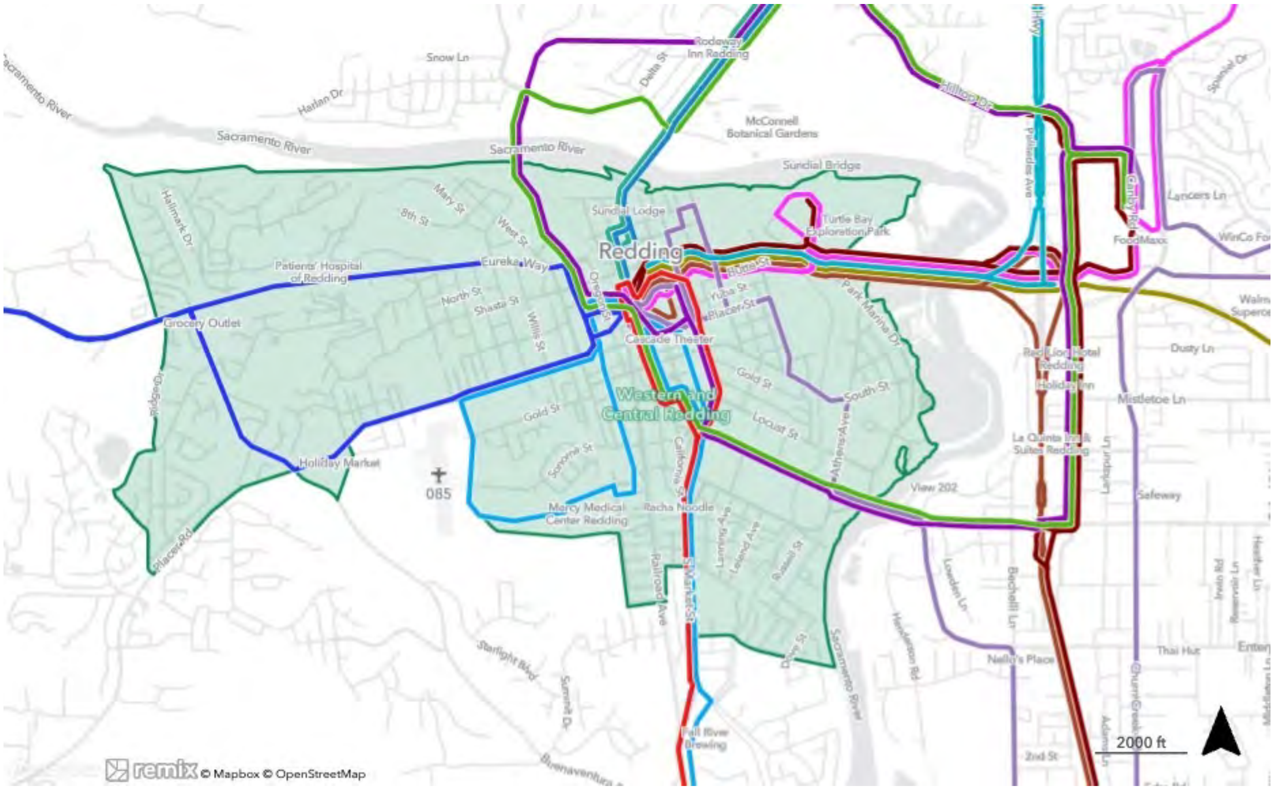


FIGURE A22. ANDERSON ZONE

FIGURE A23. ANDERSON/SOUTH COUNTY ZONE

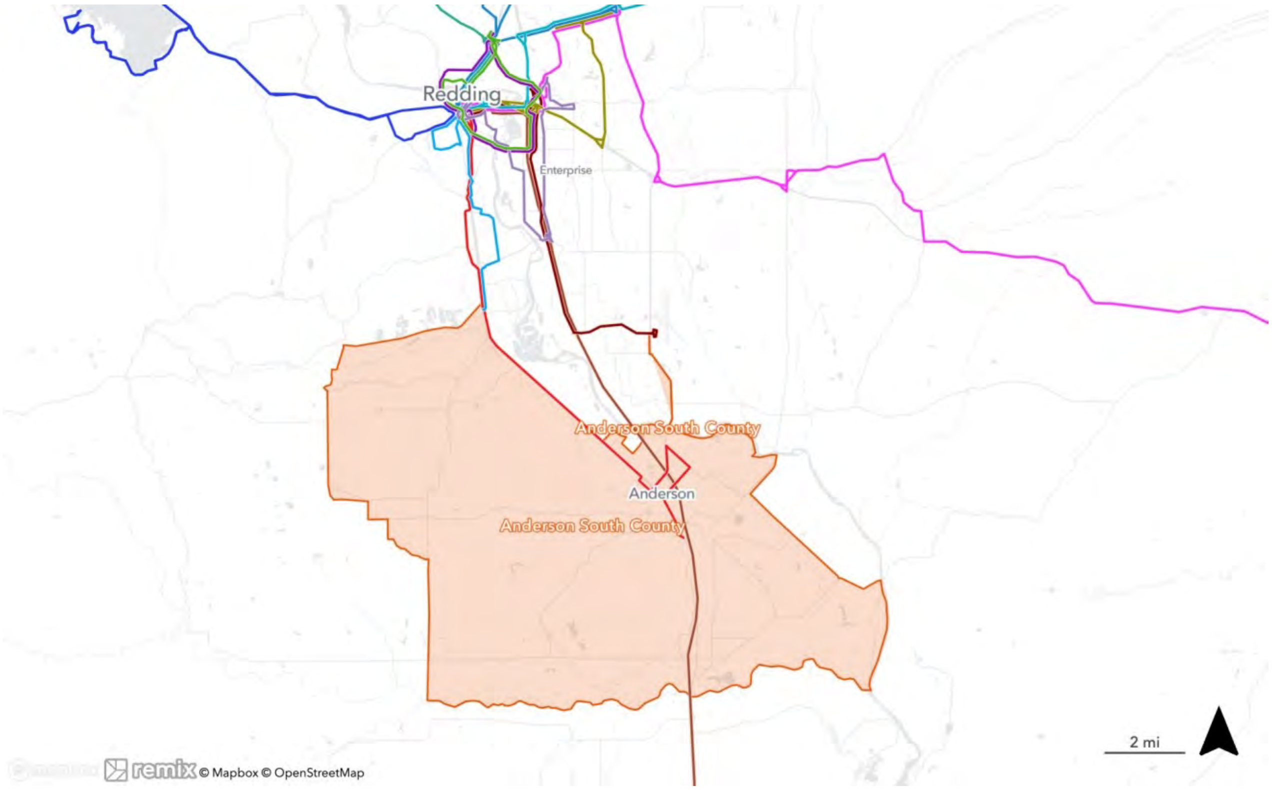
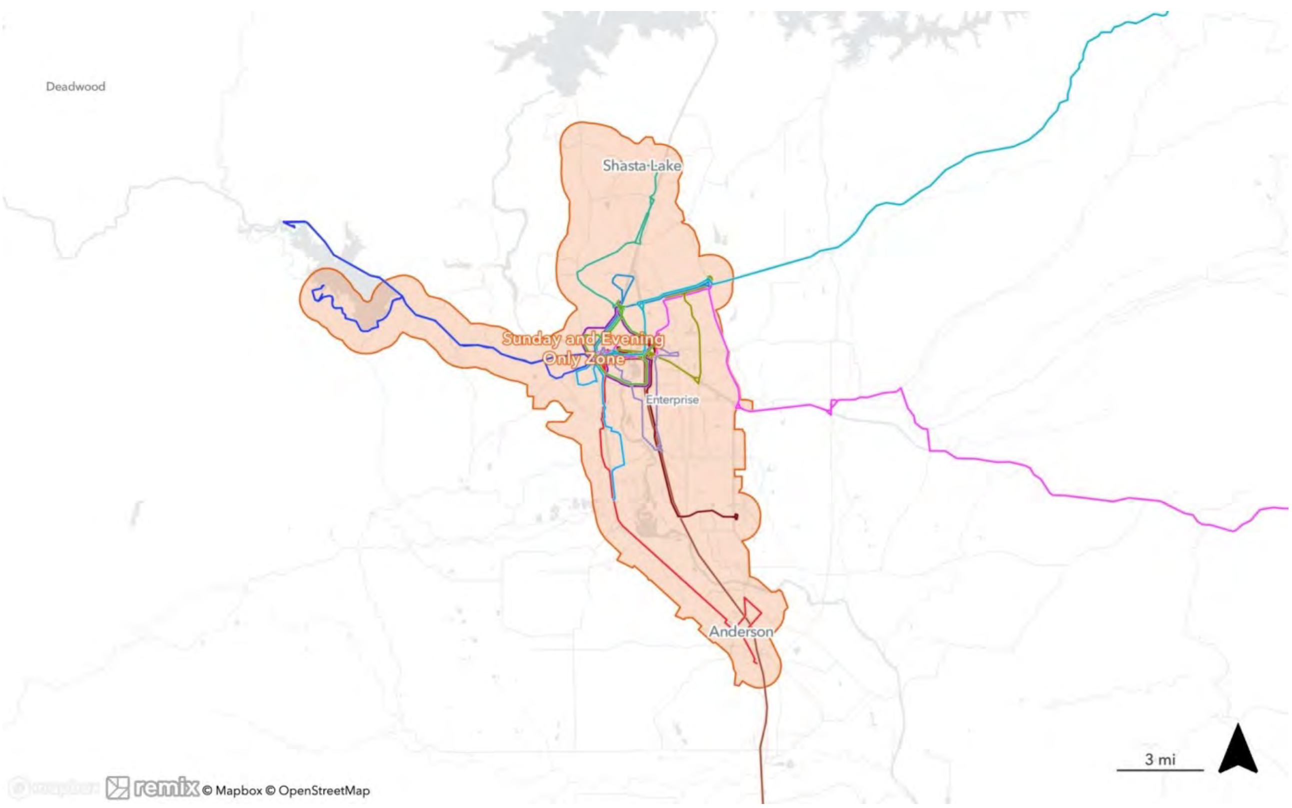


FIGURE A24. REDDING URBANIZED ZONE



Existing Fleet Summary

RABA Runabout operates using the same vehicles (mostly medium-duty cutaway buses) as used for RABA Demand Response. For detailed information on that fleet, see the existing fleet summary and Table A4 further above.

SHASTACONNECT

Overview

ShastaConnect is a specialized on-demand, point-to-point transit service offered in rural parts of Shasta County. ShastaConnect has been operated by Dignity Health Connected Living (DHCL) and funded and supported by the Shasta Regional Transportation Agency (SRTA). Effective July 1, 2025, the DHCL contract for ShastaConnect services was transferred to RABA. This transition is part of a larger regional transit consolidation effort based on recommendations from recent transportation plans. RABA has requested to be designated as the Consolidated Transportation Services Agency (CTSA) for the region meeting both California state CTSA requirements as well as federal transit operations requirements starting in fiscal year 2025/26.[34]

Hence, while currently not yet operated by RABA, ShastaConnect is in scope for this project and thus addressed in this memo.

Service Hours Summary

- Rides are provided Monday through Friday from 8:00 am to 3:30 pm.
- Reservations are typically required 24 hours in advance, but same-day requests can sometimes be accommodated, depending on schedule.
- Rides can be booked by phone or through the RABA & ShastaConnect app.

Existing Fleet Summary

RABA will use a fleet of eight vehicles including cutaway buses and passenger vans to provide the ShastaConnect service. These vehicles are used to provide demand-response transit services in Shasta County.

Table A6 below lists the vehicles used for ShastaConnect.

Makes & configurations:

- All vehicles in ShastaConnect's fleet are gas-powered.
- Five vehicles are cutaway buses on a Ford E-450 platform. Three are model year 2018, and two are from 2019. The bus outfit provider was Starcraft. These buses were Caltrans acquisitions.
- Three Ford Transit passenger vans, all model year 2019, complement the cutaway buses. These vans are 20 feet long.
- Seating capacities vary from 6-12, and each vehicle has two wheelchair positions.

Funding & purchase prices:

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[34] https://www.srta.ca.gov/DocumentCenter/View/9753/15_Amend_4_DHCL

- The 2018 cutaway buses were funded through the FTA 5310 program, each costing $70,000.
- The 2019 cutaway buses were also funded through the FTA 5310 program, with a slightly higher cost of $76,700 each (+10% compared to the 2018 models).
- The three Ford Transit vans were funded through the SGR program, each priced at $70,754.

Utilization:

- The 2019 Ford Transit vans (SC 11, SC 12, SC 13) show the highest utilization, with annual mileages between 18,200 and 23,500 miles. This represents about 70-90 miles per day on average.[35]
- The 2018 cutaway buses (SC 1, SC 2, SC 3) have moderate utilization, with annual mileages between about 11,500 and 13,700 miles. This represents about 44-51 miles per day on average.
- The 2019 cutaway buses (SC 14, SC 15) show the lowest utilization, with annual mileages of 4,700-6,700 miles. This represents about 18-26 miles per day on average.
- If vehicle utilization for ShastaConnect continues at similar levels once RABA assumes operation of the service, the associated fuel use is estimated to be around 6% of RABA's total fuel use (see Table A1). The average gas-powered cutaway bus or passenger in the ShastaConnect fleet annually consumes about 23% of the fuel used by each of RABA's transit buses for fixed-route services.

Current projected replacement schedule:

- The FTA useful life for the cutaway buses is 5 years, while the passenger vans have a 4-year useful life.
- The replacement schedule is staggered, with the earliest replacements planned for 2024-2025 (Ford Transit vans) and the latest for 2028-2029 (2019 Ford E-Series Chassis cutaways).
- A comprehensive review of RABA's current fleet replacement schedule based on its latest fleet replacement plan is included further below.

[35] This and the following daily mileage estimates assume 261 annual operating days, based on ShastaConnect operating from Mondays through Fridays.

TABLE A6: SHASTACONNECT FLEET OVERVIEW

ID	MODEL YEAR	MAKE	MODEL	VEHICLE TYPE	VEHICLE CLASS	DUTY CLASS	FUEL TYPE	LENGTH [FT]	SEATING CAPACITY	WHEEL-CHAIR POSITIONS	ORIGINAL PURCHASE PRICE	FUNDING SOURCE	FTA USEFUL LIFE [YEARS]	CURRENT PROJECTED REPLACEMENT YEAR	ODOMETER READING [MI]	AVERAGE ANNUAL MILEAGE [MI/YEAR]	AVERAGE DAILY MILEAGE [MI/DAY]	ANNUAL FUEL USE ESTIMATE [GAL]
SC 1	2018	Ford	E-Series Chassis	Cutaway bus	Class 4	Medium-duty	Gas	*n.a.*	*n.a.*	*2*	$70,000	5310	5	2027-2028	75,710	11,500	44	1,388
SC 2	2018	Ford	E-Series Chassis	Cutaway bus	Class 4	Medium-duty	Gas	*n.a.*	*n.a.*	*2*	$70,000	5310	5	2027-2028	90,097	13,700	52	1,651
SC 3	2018	Ford	E-Series Chassis	Cutaway bus	Class 4	Medium-duty	Gas	*n.a.*	*n.a.*	*2*	$70,000	5310	5	2027-2028	86,808	13,200	51	1,591
SC 11	2019	Ford	20' Transit	Passenger van	Class 3	Medium-duty	Gas	20	*6*	*2*	$70,754	SGR	4	2024-2025	123,486	22,100	85	2,669
SC 12	2019	Ford	20' Transit	Passenger van	Class 3	Medium-duty	Gas	20	*6*	*2*	$70,754	SGR	4	2024-2025	101,580	18,200	70	2,195
SC 13	2019	Ford	20' Transit	Passenger van	Class 3	Medium-duty	Gas	20	*6*	*2*	$70,754	SGR	4	2024-2025	131,063	23,500	90	2,832
SC 14	2019	Ford	E-Series Chassis	Cutaway bus	Class 4	Medium-duty	Gas	*n.a.*	*n.a.*	*2*	$76,700	5310	5	2028-2029	26,166	4,700	18	565
SC 15	2019	Ford	E-Series Chassis	Cutaway bus	Class 4	Medium-duty	Gas	*n.a.*	*n.a.*	*2*	$76,700	5310	5	2028-2029	37,404	6,700	26	808

Note: Odometer readings are as of 1/27/2025. Average annual mileage is estimated by dividing the odometer reading by the difference of the odometer reading date and revenue service start date and rounding the result to the nearest 100 mi. The average daily mileage is estimated assuming a total of 261 operating days (i.e. Mondays through Fridays). Given that FY2023-2024 fuel consumption data was not available for ShastaConnect vehicles, annual fuel use is estimated based on each vehicle's average annual mileage estimate and the average fuel efficiency (miles per gallon) of the cutaway buses used for RABA's Demand Response service.

NON-REVENUE VEHICLES

While not a fleet component providing direct revenue service to RABA's residents and visitors, the non-revenue vehicle (NRV) fleet plays an integral part in RABA's operations and facilities management. RABA operates seven NRVs for various administrative, maintenance, and operational functions. This includes staff transportation, supporting maintenance activities for revenue vehicles and facilities, supervisory functions for monitoring and managing bus operations, as well as emergency response and incident management.

Table A7 below lists RABA's NRVs.

Makes & configurations:

- The fleet includes a mix of mostly light-duty vehicles, including cars, cargo vans, and a pickup truck.
- The majority of vehicles are gas-powered, with three hybrids (two Ford Fusions and one Toyota Camry) and one EV (Chevrolet Bolt EV).

Funding & purchase prices:

- All vehicles were funded through various FTA grants.
- Purchase prices range from $20,832 for the oldest vehicle (2008 Chevrolet Express) to $34,867 for the newest vehicle (2023 Toyota Camry).
- The electric Chevy Bolt EV was purchased for $34,009 using FTA CARES Act funding.

Utilization:

- Annual mileage varies significantly, from 800 miles for the Chevy Bolt EV to 7,700 miles for the 2008 Chevrolet Express.
- Most of RABA's NRVs are estimated to travel between 10 and 30 miles per day.
- The fuel consumption per vehicle generally is in the range of a couple to a few hundred gallons per year. The 2008 Chevrolet Express is an outlier to that, at more than 2,100 gallons in FY2023-2024, possibly due to significant idling during its various duties.

Current projected replacement schedule:

- The FTA useful life listed for RABA's NRVs is 4 years. However, as evidenced by four of the NRVs being more than 10 years old, RABA typically operates NRVs for longer, based on vehicle condition, operational requirements, and availability of replacement funding.
- RABA does not currently have specific replacement years projected for its NRV

TABLE A7: NON-REVENUE VEHICLE FLEET OVERVIEW

ID	MODEL YEAR	MAKE	MODEL	VEHICLE TYPE	VEHICLE CLASS	DUTY CLASS	FUEL TYPE	ORIGINAL PURCHASE PRICE	FUNDING SOURCE	FTA USEFUL LIFE [YEARS]	CURRENT PROJECTED REPLACEMENT YEAR	ODOMETER READING [MI]	AVERAGE ANNUAL MILEAGE [MI/YEAR]	AVERAGE DAILY MILEAGE [MI/DAY]	FY2023-2024 FUEL USE [GAL]
15	2020	Ford	F-350	Pickup truck	Class 3	Medium-duty	Gas	$32,687	FTA CARES	4	*n.a.*	10,518	3,000	12	251
506	2008	Chevrolet	Express	Cargo van	Class 2	Light-duty	Gas	$20,832	FTA 693	4	*n.a.*	112,881	7,500	29	2,164
507	2014	Ford	Fusion	Car	Class 1	Light-duty	Hybrid	$26,531	FTA 801	4	*n.a.*	55,863	5,400	21	212
508	2014	Ford	Fusion	Car	Class 1	Light-duty	Hybrid	$26,531	FTA 801	4	*n.a.*	65,511	6,400	24	210
509	2023	Chevrolet	Express	Cargo van	Class 2	Light-duty	Gas	$29,360	FTA 5339a	4	*n.a.*	9,598	7,700	29	727
510	2023	Toyota	Camry	Car	Class 1	Light-duty	Hybrid	$34,867	FTA 5339a	4	*n.a.*	1,327	1,400	6	84
801	2020	Chevy	Bolt EV	Car	Class 1	Light-duty	Electric	$34,009	FTA CARES	4	*n.a.*	2,670	800	3	0

- **Note:** Odometer readings are as of 6/30/2024. Average annual mileage is estimated by dividing the odometer reading by the difference of the odometer reading date and service start date and rounding the result to the nearest 100 mi. The average daily mileage is estimated assuming a total of 261 operating days (i.e. Mondays through Fridays). For 2020 Ford F-350 (ID 15), annual fuel use is estimated using its annual mileage estimate and an assumed fuel efficiency of 12 mpg. For all other vehicles, FY2023-2024 fuel consumption data is listed in the table.

EXISTING FLEET REPLACEMENT SCHEDULE

Figure A25 below shows the projected replacement schedule resulting from RABA's latest (February 2025) fleet replacement plan. It should be noted that this plan is limited to revenue vehicles, i.e. excluding RABA's NRVs (for which RABA does not currently have projected replacement years).

FIGURE A25. CURRENT PROJECTED REPLACEMENT SCHEDULE BASED ON RABA'S FEB. 2025 FLEET REPLACEMENT PLAN

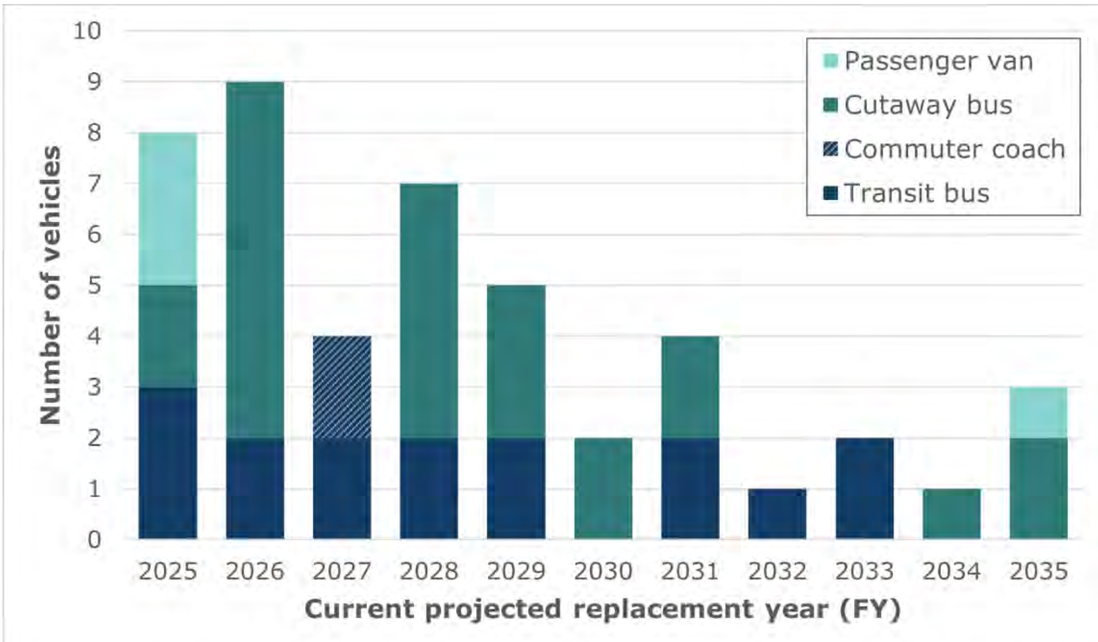


Table A8 below lists the IDs of individual vehicles scheduled for replacement in each fiscal year. Additionally, the sum of original purchase prices is provided to serve as a measure of the anticipated relative magnitude of replacement costs in each upcoming fiscal year. Based on this schedule, a total of 17 vehicles are planned for replacement in this and the next fiscal year (eight in FY 2024-2025 and nine in 2026-2027).

In accordance with the ICT regulation, beginning in 2026, 25% of new purchases must be ZEBs. Beginning in 2029, 100% of new purchases must be ZEBs. The project team will work with RABA project partners and other involved stakeholders to determine if any changes are needed to the current replacement plan. The resulting plan, i.e. the RABA Zero-Emission Bus Implementation Plan, will lay out a replacement schedule in alignment with ICT requirements and other constraints related to vehicle age, condition, and budget availability.

TABLE A8: CURRENT PROJECTED REPLACEMENT SCHEDULE BASED ON RABA'S FEB. 2025 FLEET REPLACEMENT PLAN

FISCAL YEAR	NUMBER OF SCHEDULED REPLACEMENTS	VEHICLE IDS OF SCHEDULED REPLACEMENTS	SUM OF ORIGINAL PURCHASE PRICES
2024-2025	8	• Transit buses: 51, 52, 53 • Cutaway buses (Demand Response): 266, 267 • Passenger vans (ShastaConnect): SC 11, SC 12, SC 13	$1,590,376
2025-2026	9	• Transit buses: 54, 55 • Cutaway buses (Demand Response): 260, 264, 265, 268, 269, 270, 271	$1,439,677
2026-2027	4	• Transit buses: 56, 57 • Commuter coach: 5701, 5702	$858,222

2027-2028	7	• Transit buses: 58, 59
		• Cutaway buses
		  ◦ Fixed-route service: 308, 309
		  ◦ ShastaConnect: SC 1, SC 2, SC 3
			$1,026,346

2028-2029	5	• Transit buses: 60, 61
		• Cutaway buses:
		  ◦ Demand Response: 272
		  ◦ ShastaConnect: SC 14, SC 15
			$1,110,441

2029-2030	2	• Cutaway buses (Demand Response): 273, 274	$196,738
2030-2031	4	• Transit buses: 62, 63 • Cutaway buses (Demand Response): 275, 276	$1,149,614
2031-2032	1	• Transit buses: 64	$819,371
2032-2033	2	• Transit buses: 65, 66	$958,476
2033-2034	1	• Cutaway buses (Demand Response): 277	$168,371
2034-2035	3	• Cutaway buses (Demand Response): 278, 279 • Passenger van (Demand Response): 280	$738,106
TOTAL	**46**		**$10,274,545**

DOWNTOWN REDDING TRANSIT CENTER

Site description

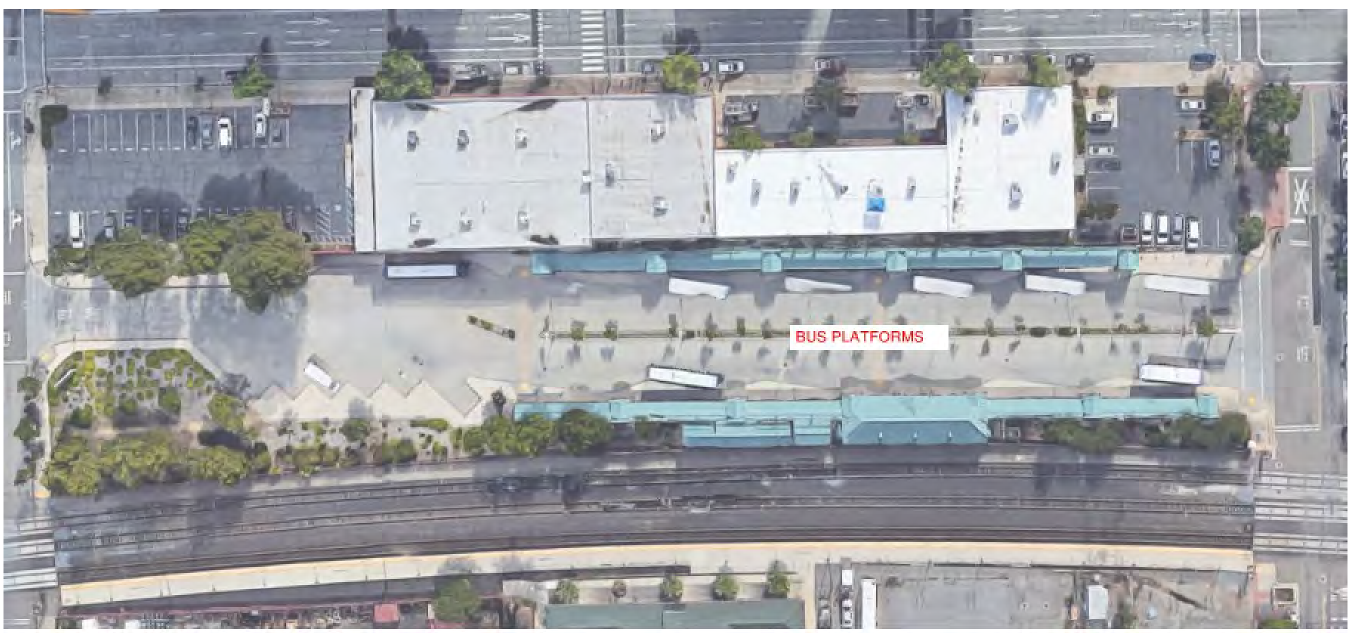
The Downtown Redding Transit Center, also known as the RABA Passenger Terminal, is located at 1530 Yuba Street in Redding. The transit center serves as the primary transit hub in Shasta County, providing essential connections for both local and interregional transportation services. Designed for passenger convenience, the center features twelve gates for efficient boarding, customer service windows for assistance, and canopied waiting areas with benches to enhance comfort. Additional amenities include passenger restrooms, designated parking, vending machines, and bike racks, ensuring accessibility for all travelers. The facility plays a crucial role in supporting the region's transit network, offering a well-equipped and centrally located hub for seamless mobility.

All fixed bus routes originate/end or have one stop at this location.

Site layout

There is a public parking across the street on north side of the Tehama St. The buses can enter and exit the terminal from Yuba Street and Tehama St.

FIGURE A26. CONCEPTUAL SITE LAYOUT - DOWNTOWN REDDING TRANSIT CENTER



If this site is identified for potential BEB chargers, they would need to be installed along the bus platform near to the columns to avoid tripping hazards.

Electricity usage

Due to the lack of availability of electrical drawings for this site, the exact location and type of electrical service will be verified during field visits. Per the review of the Redding Electric Utility

(REU) bills indicates that the site does not currently experience peak demand, with electricity usage remaining below 75 kW.

However, any layover bus charger at this location is expected to consume at least 125 kW, which would trigger peak demand charges and impact the site's electrical infrastructure.

MAINTENANCE FACILITY (BASE)

Site description

The RABA maintenance and operations facility is located at 3333 S. Market Street in Redding. This location has offices for administration and dispatch, a training room, restrooms, a maintenance bay with storage for parts, a bus wash, and ample parking in a fenced lot. The contractor administrative staff, dispatch staff, and maintenance staff operate from this location.

While not directly on the property, the following fixed bus routes stop on S. Market Street adjacent to this facility: 3, 9.

Site layout

The entrance to the facility is from Ellis St and is gated. There is public parking along the Market and Ellis St. A conceptual layout plan of this site and the property owned by RABA immediately to the east is shown in Figure A27.

A ChargePoint 125kW charger has been installed to support the charging needs of the recently acquired electric bus. The facility features one existing single-port Level 2 charger (Grizzl-E) inside the main building. Additionally, RABA will soon install one more Level 2 charger (Tellus Power) on the outside.

FIGURE A27. CONCEPTUAL LAYOUT PLAN OF MAINTENANCE FACILITY AND ADJACENT PROPERTY

Electricity usage

Due to the lack of availability of electrical drawings for this site, the exact location and type of electrical service will be verified during field visits. Per the review of the Redding Electric Utility (REU) bills indicates that the site triggers the peak electrical demand, with maximum electricity usage of approximately 120 kW.

CANBY ROAD TRANSFER FACILITY AT MT. SHASTA MALL

Site description

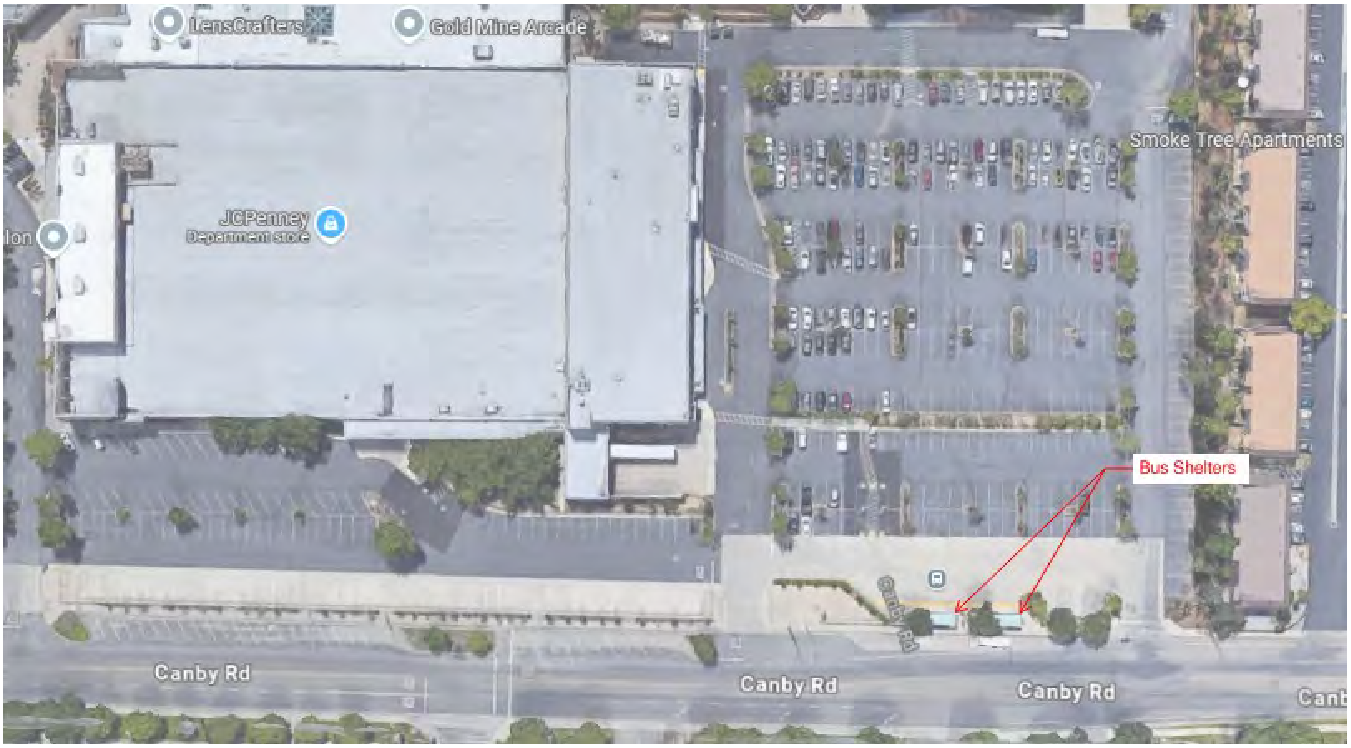
Canby Transfer Facility is a sheltered waiting area behind the Mt Shasta Mall with two shelters, benches, and a drinking fountain area.

The following fixed bus routes stop at this location: 4, 11, 14, 44X.

Site layout

The entrance for the buses is from Canby Rd.

FIGURE A28. CONCEPTUAL SITE LAYOUT OF CANBY ROAD TRANSFER FACILITY



Electricity usage

No information on the existing electrical infrastructure at this site was provided. However, based on a remote review of site conditions, any electric infrastructure can be assumed to be minimal (likely restricted to lighting only).

Based on site layout, the existing electrical infrastructure would likely not support any bus charging at this site as any on-route charger is expected to consume at least 125 kW, which would trigger peak demand charges and impact the site’s electrical infrastructure.

GRID INFORMATION

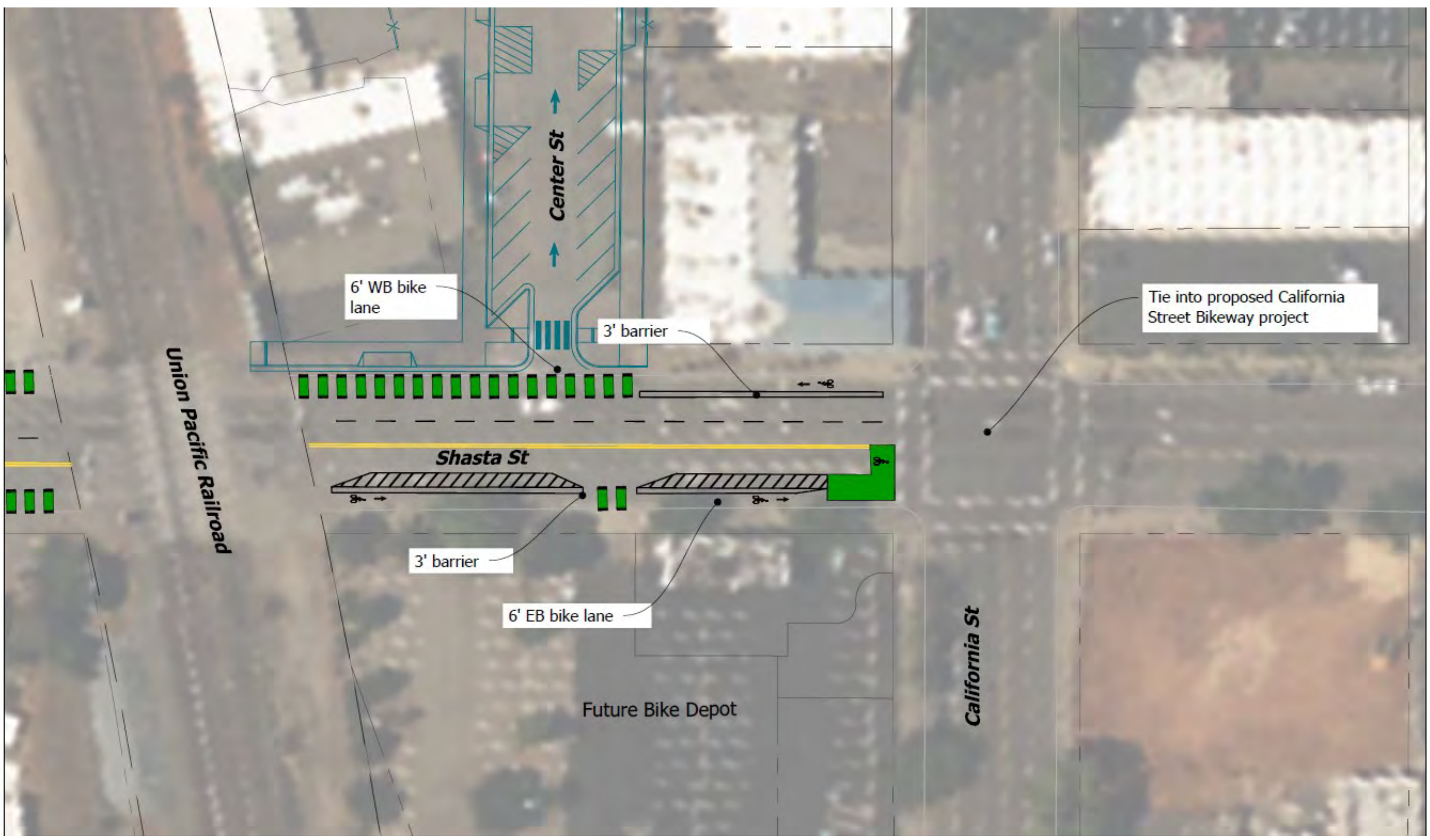
Based on the quantity and type of recommended DC fast chargers for bus charging, DKS will coordinate with REU to determine the appropriate electrical service required based on the total power demand from the chargers. Additionally, DKS will explore solutions such as solar power or battery energy storage systems to mitigate any potential grid constraints and help offset ongoing operational expenses.

ACTIVE TRANSPORTATION NETWORK

SRTA's GoShasta Regional Active Transportation Plan[36] (2019) outlines projects and action lists for Shasta County and the incorporated cities of Anderson and Shasta Lake. Developed jointly, the GoShasta ATP and the City of Redding Active Transportation Plan[37] (2018) aim to enhance regional connectivity and ensure coordinated active transportation policies and programs across the area. SRTA adopts a corridor-based approach to bicycle and pedestrian planning by integrating bike and pedestrian infrastructure into broader corridor planning efforts. This strategy enables SRTA to pursue Caltrans Active Transportation Program (ATP) grants for funding. The most recent plan, Cycle 6, was submitted in 2023 and included:

- Butte Street Boogie (Redding), a multi-use path that connects to Shasta Street, Mesa Street, and Butte Street. It includes a proposed California Street Bikeway and a Bike Depot.

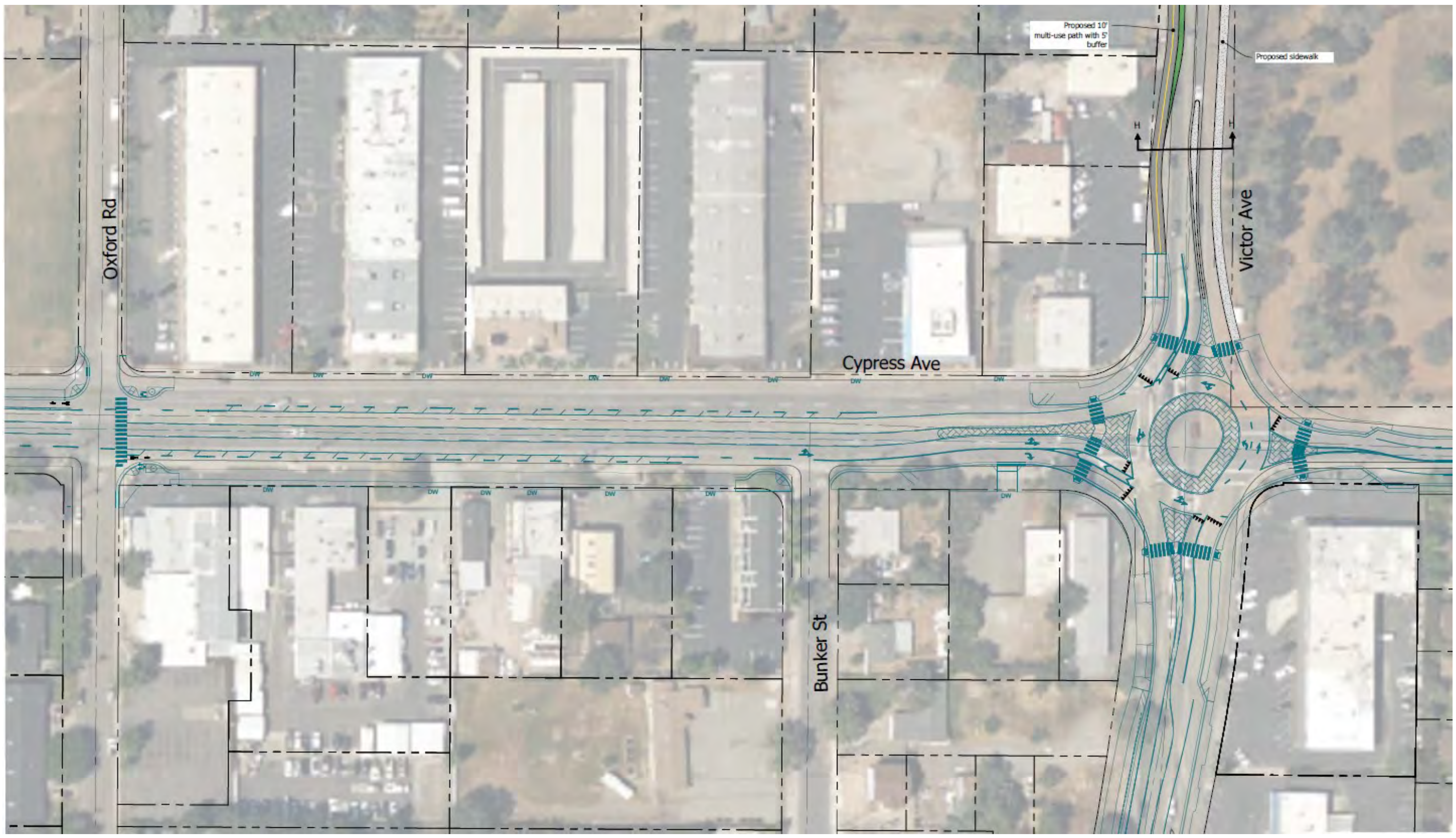
FIGURE A29. MULTI-USE PATH IN BUTTE STREET BOOGIE (REDDING)



[36] https://srta.ca.gov/DocumentCenter/View/4773/GoShasta_Regional_ATP_with_appendices_8-2020?bidId=

[37] https://files.cityofredding.gov/Document%20Center/Departments/Development%20Services/Planning/City%20of%20Redding%20Active%20Tra.pdf

- Traffic calming and bike and pedestrian crossings on Victor Avenue and East Cypress in Redding.

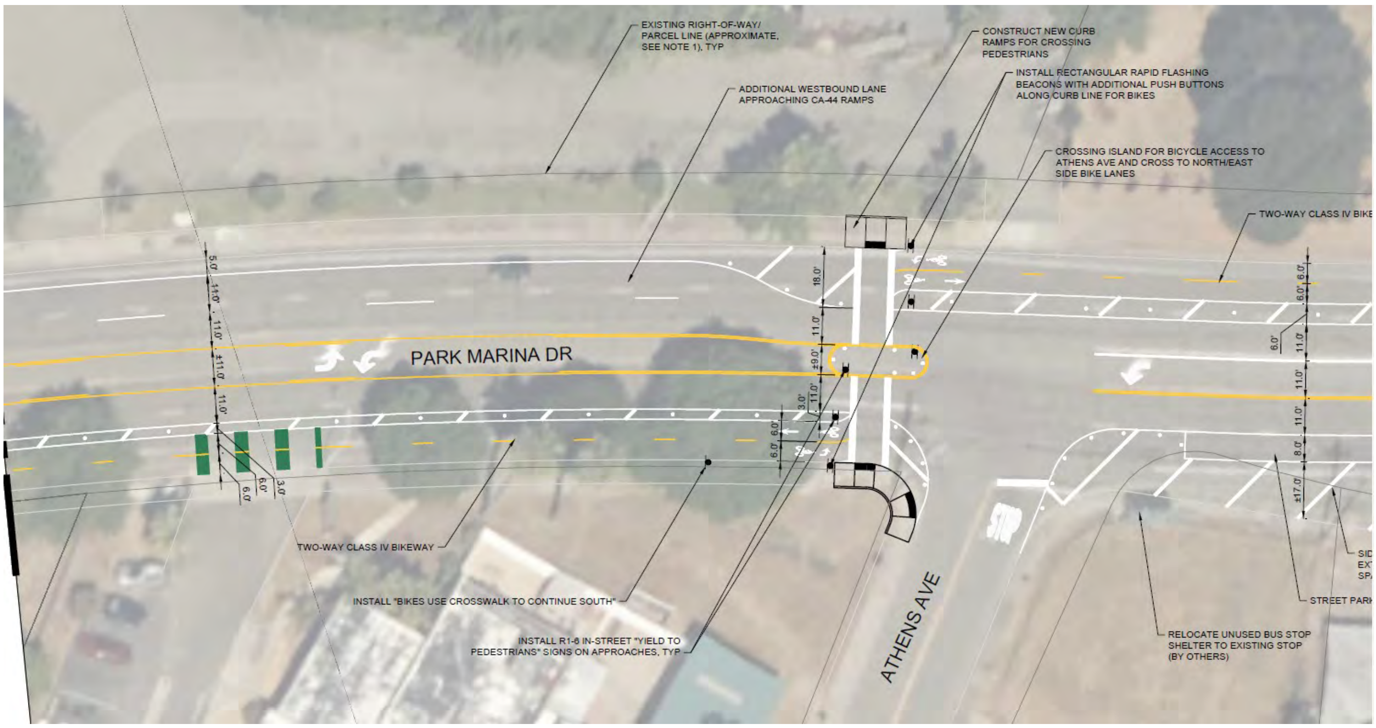


- Adding a separated or buffered bike lane to Hilltop Drive in Redding.

FIGURE A31. SEPARATED OR BUFFERED BIKE LANE TO HILLTOP DRIVE IN REDDING

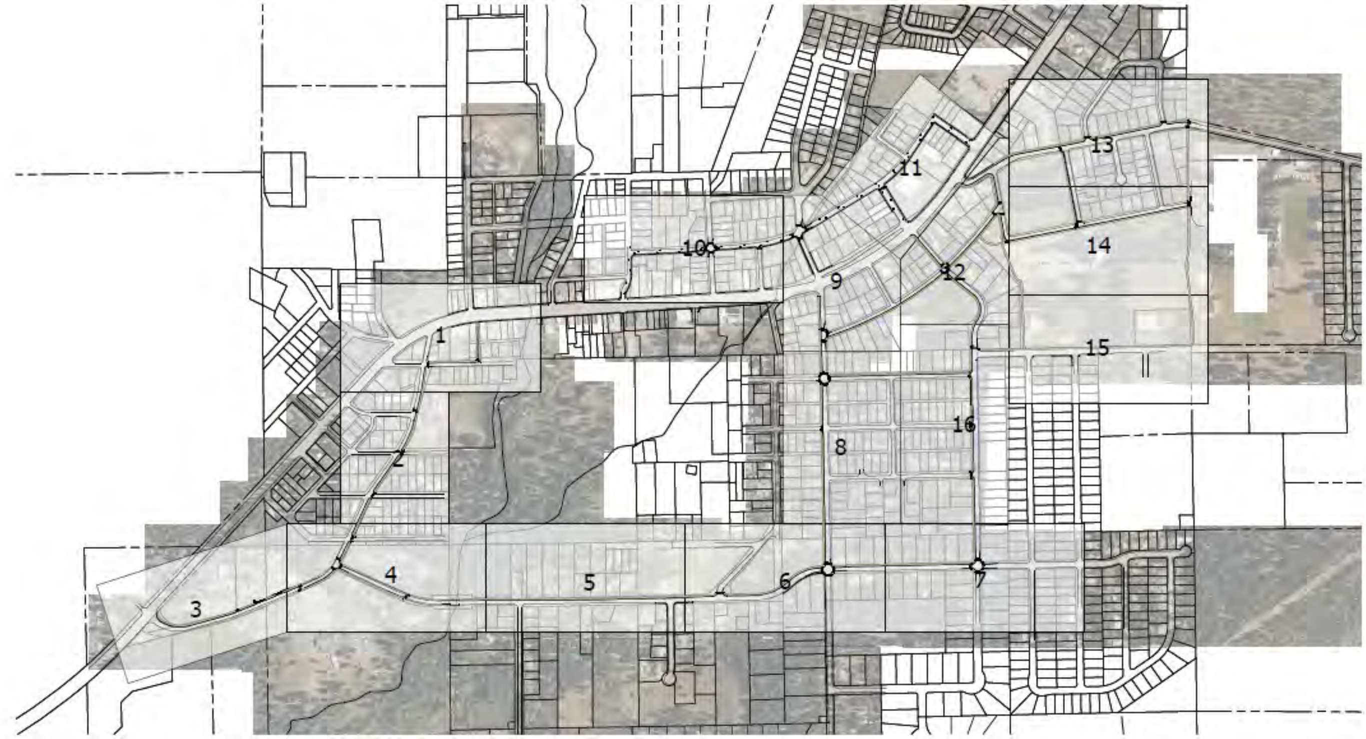
- Adding protected bike lanes, pedestrian crossings, and protected car turn lanes to Park Marina Drive in Redding

FIGURE A32. PROTECTED BIKE LANES, PEDESTRIAN CROSSINGS, AND PROTECTED CAR TURN LANES TO PARK MARINA DRIVE IN REDDING



- Pit River Tribe/Burney Munik'Chun Walking + Biking Network in Burney that would add separated bike lanes and improved sidewalks throughout the city.

FIGURE A33. PIT RIVER TRIBE/BURNEY MUNIK’CHUN WALKING + BIKING NETWORK



Comprehensive maps and project details are available on SRTA’s GoShasta website[38]. As a new project cycle begins, RABA has the opportunity to provide input on Cycle 8 ATP projects, helping shape future active transportation initiatives.

EXISTING HYDROGEN-RELATED ACTIVITIES

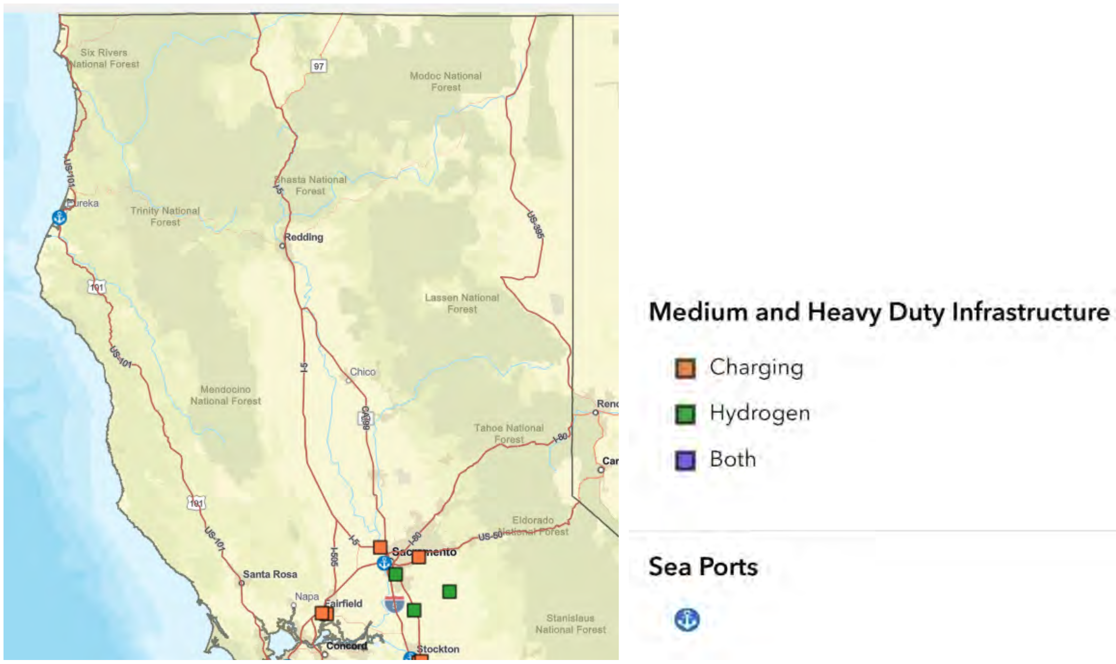
EXISTING HYDROGEN PRODUCTION, DISTRIBUTION, AND DELIVERY IN THE STUDY AREA

The California Energy Commission’s statewide medium- and heavy-duty Charging and Hydrogen ZEV Fueling Positions map shows no hydrogen or charging stations for trucks and buses, and no hydrogen fueling stations north of Sacramento.[39]

[38] https://srta.ca.gov/286/GoShasta-Plan-Active-Transportation-Docu

[39] https://experience.arcgis.com/experience/f951c1433f804daea7f4c33c271aa935/

FIGURE A34. MEDIUM-AND HEAVY-DUTY ZERO EMISSION VEHICLE STATION DASHBOARD



Source: https://experience.arcgis.com/experience/f951c1433f804daea7f4c33c271aa935/

Redding Rancheria announced a partnership with H2 Energy Group to produce hydrogen and electricity from forest biomass.[40] The proposed facility would be built in Red Bluff, about 30 miles south of Redding. This is a future project that is still in the planning phases.

In late 2023, the Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES) completed a contract with the Department of Energy for a Hydrogen Hub award. The contract called for $1.25 billion in Federal investment that will be matched with $11.3 billion in state and private funding. ARCHES planned to use this funding to produce hydrogen throughout the state from a variety of renewable sources and natural gas, and use the hydrogen for transportation, at ports, and for electric power generation. Most ARCHES projects were planned for Southern California and in the Central Valley. The ARCHES map shows one north state project that will use hydrogen for electricity generation. ARCHES had invited proposals for additional projects, which could include hydrogen production from biomass, like the Redding Rancheria project, or natural methane from wastewater and landfills.

However, in October 2025 DOE officially cancelled its federal cost-share commitment to the ARCHES hub and other hydrogen hub awards, placing the ARCHES program in a state of suspension.[41] For RABA's planning, this change means that while the vision of a hydrogen-based heavy-duty and transit fuel ecosystem in Northern California remains aspirational, the federal funding pathway through ARCHES can no longer be counted on as reliable.

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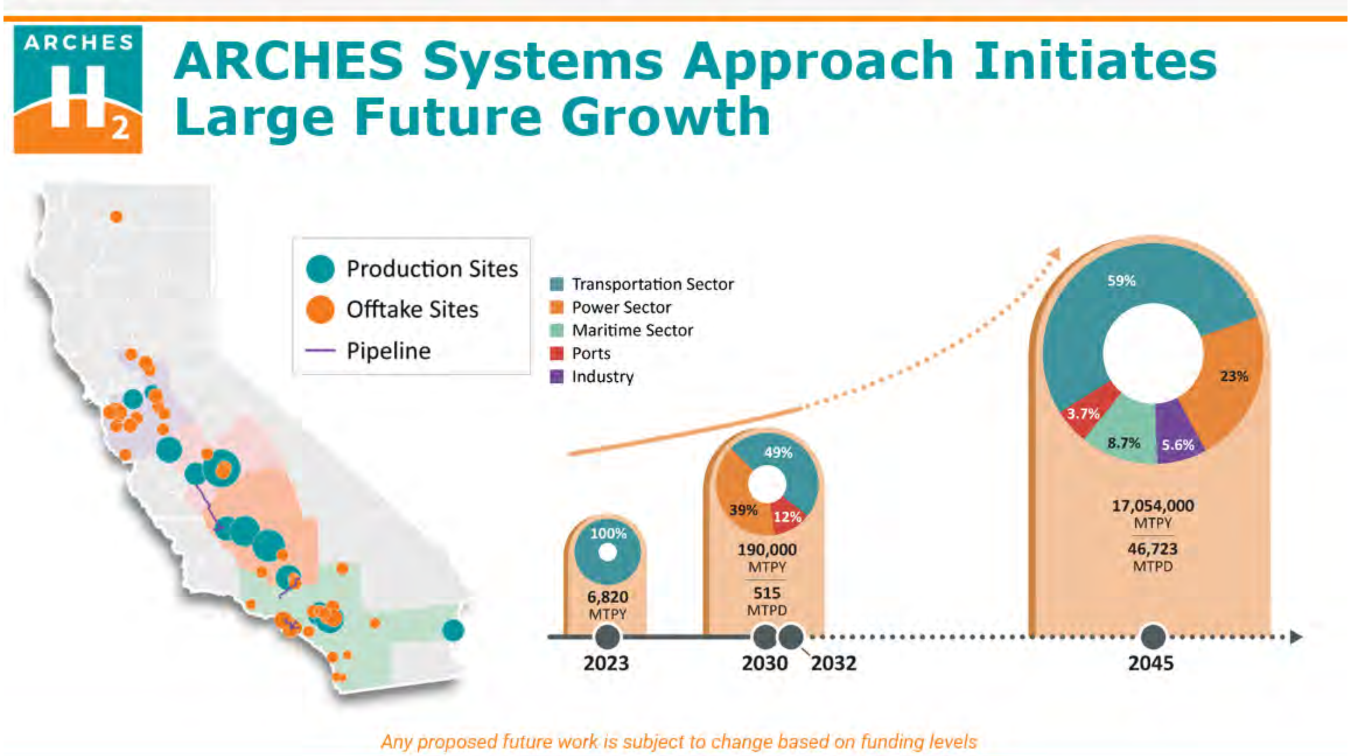
[40] https://www.reddingrancheria-nsn.gov/wp-content/uploads/2024/01/RRH2ECO-Press-Release-Final.pdf

[41] https://www.gov.ca.gov/2025/10/01/governor-newsom-statement-on-trump-administrations-decision-to-cut-hydrogen-hub-funding/

FIGURE A35. ARCHES FUTURE GROWTH



Source:
https://www.hydrogen.energy.gov/docs/hydrogenprogramlibraries/pdfs/review24/oced001_galiteva_2024_o.pdf?sfvrsn=f835161f_3

RABA HYDROGEN RFI OVERVIEW AND KEY RESULTS

In late 2024, RABA solicited responses to a request for information (RFI), seeking market input on possible private-sector development of a hydrogen refueling station (HRS) that would have the ability to fuel FCEBs and potentially other users in Shasta County. The goals included understanding viable business models, market preferences, and regional hydrogen demand/supply dynamics.

Over 125 stakeholders and potential respondents were contacted to ensure sufficient market awareness of this effort; 11 written responses and 3 verbal feedback submissions were received, primarily from developers, equipment suppliers, and hydrogen producers.

Summary of results:

- **Market interest:** Multiple vendors expressed general interest in supporting RABA's potential hydrogen fueling needs, and multiple respondents indicated their willingness to pursue a "fueling-as-a-service" model or more traditional delivery models.
- **Feasibility:** No immediate "red flags" were raised about the requirements stated in the RFI, though respondents noted that RABA's small fleet size and consequently relatively small hydrogen demand would likely result in higher per-kg costs and overall less efficient operations.

- **Infrastructure timelines:** According to the respondents, permanent HRS development typically requires 24–36 months (including permitting and construction), while temporary/mobile solutions can be deployed in weeks to 6 months.
- **Site and access:** No major concerns were raised regarding RABA's proposed site (parcel immediately east of RABA's Maintenance Facility), but vendors highlighted the importance of access, maneuverability, and future-proofing.
- **Cost and scale:** Most vendors indicated that costs for a transit-only HRS would range from $2.5–$7 million, with larger heavy-duty retail stations (that would be open to e.g. commercial fleets) costing more. Achieving optimal cost-efficiency typically requires throughput of about 400+ kg/day.
- **Contracting preferences:** Vendors generally seek predictable, multi-year contracts with clear demand commitments, and flexibility in commercial terms.
- **Barriers:** Key barriers identified include small project scale, uncertain long-term hydrogen supply, lengthy permitting processes, and the complexity of public procurement and contracting.

Pathways forward: Three potential approaches were identified:

- **Path 1 (Permanent Fueling-as-a-Service):** Several vendors are open to developing, owning, and operating an HRS, with RABA paying an all-in price per kg of hydrogen. This model transfers most responsibility and risk to the vendor but may be more expensive on a per-kh basis for RABA.
- **Path 2 (Opportunistic Wait-and-See):** There is interest in temporary or mobile fueling as a bridge solution, and in leveraging future large-scale regional stations (e.g., for freight along I-5) if/when they materialize. This alternative would effectively buy additional time before committing to being a customer at a large-scale, permanent station that could be developed in different places, by different entities.
- **Path 3 (Traditional Public Owner/Operator):** Some vendors prefer a design-build approach, with RABA owning the station and contracting separately for fuel and O&M. In this scenario, RABA would own and operate its own station and pay for the station costs up front.

POTENTIAL HYDROGEN PROVISION OPTIONS FOR RABA

Generally, there are multiple possible pathways for procuring hydrogen fuel for RABA's potential future FCEB fleet:

- **First Public Hydrogen Authority (FPH2):**
    - FPH2 is a new public hydrogen utility (founded in early 2025 led by the cities of Lancaster and Industry, California) designed to aggregate hydrogen demand among public agencies, enabling bulk purchasing of green, affordable, and reliable hydrogen fuel. FPH2 aims to facilitate transactions, optimize delivery and infrastructure, de-risk the hydrogen market, and leverage public sector competitive pricing.
    - **Membership and non-exclusivity:** Transit agencies can become advisory members; current/potential members include the Valley Transportation Authority (VTA), Monterey-Salinas Transit District, Foothill Transit, and others. Membership does not require any upfront cost or purchase obligation. Furthermore, any potential contracting for hydrogen provision through FPH2 would be non-exclusive, i.e. RABA can also contract with other suppliers.
    - **Funding:** FPH2 is currently funded by the City of Lancaster but will transition to a mark-up of roughly $0.25/kg as its revenue model.

- **Pricing:** Initial projections for hydrogen unit prices are $5.25/kg for gaseous and $7/kg for liquid hydrogen, plus delivery costs. Given Redding's relatively isolated location more than 150 miles north of Sacramento, delivery fees may be substantial if no nearby hydrogen production facility can be established. Pricing will be determined more accurately through an ongoing RFP process that FPH2 launched in late April 2025. By June, binding price ranges may be available from this process, which could inform planning for this ZEB implementation project.
- **Infrastructure:** FPH2 can provide or help finance permanent or skid-mounted (trailer-based) fueling stations and can manage operations and maintenance if desired.

- **Private hydrogen suppliers:**
  - **Direct contracting:** RABA could contract directly with private hydrogen suppliers for fuel and/or fueling infrastructure. This model is used by several California agencies to secure fixed-price contracts and avoid retail price volatility (e.g., Golden Empire Transit's $8–$9/kg contract for liquid hydrogen[42]).
  - **Retail stations:** Use of retail hydrogen stations is possible but presents operational risks due to potential supply interruptions and higher costs. Most retail stations are designed for light-duty vehicles and may not meet heavy-duty FCEB needs. There are also currently no public hydrogen refueling stations in or near Redding, with the closes being in the Sacramento metropolitan area.[43]
- **On-site hydrogen production**
  - RABA could invest in on-site hydrogen production using electrolysis (from renewable electricity; "green hydrogen", i.e. carbon-neutral) or steam methane reforming (SMR; "gray hydrogen", i.e. carbon-intensive). This reduces transportation costs but requires significant upfront commitment, capital investment (multiple millions of dollars), permitting, construction activities, and operational expertise. SunLine Transit Agency operates such a facility for its FCEB fleet, though significant challenges citing unstable hydrogen production have been reported.[44]
- **Public-Private Partnerships (PPPs):**
  - **Hybrid ownership/development:** RABA and a private partner could co-invest in an HRS, possibly with public grants or incentives. The private partner may handle operations and maintenance, while RABA retains some ownership or control.
  - **Advantages:** This model may help share risk and investment and allows for more agency input in station design and operations.
  - **Challenges:** PPPs with shared investment/operations typically require more complex agreements, including on clearly specifying each partner's roles and responsibilities as well as revenue/cost sharing.

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[42] https://www.spglobal.com/commodity-insights/en/news-research/latest-news/energy-transition/061423-california-transit-agencies-establishing-road-map-for-hydrogen-fuel-cell-use-in-buses

[43] https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics-collection/hydrogen

[44] https://www.masstransitmag.com/bus/vehicles/hybrid-hydrogen-electric-vehicles/article/53078267/sunline-transit-agency-shares-struggles-with-hydrogen-fueling-station

WORKFORCE TRAINING

The *Zero-Emission Bus Implementation Guidebook for California Transit Fleets* provided an overview of real-world training practices and experience.[45] Agencies reported that bus manufacturers (OEMs) provided operator and technician training with the initial bus purchase agreements. Transit agencies reported mixed experiences with OEMs' training programs; most were focused on acceleration and braking and how driving ZEBs is different than conventional buses in terms of achieving the highest fuel economy and, for fuel cell buses, additional training about hydrogen safety and recognizing potential hazards (e.g., dashboard warnings, unusual noises.)

Mechanic training varied by agency:

- A two-phase plan that included eight hours (Phase 1) and 24 hours of technical training on (Phase 2) with modules for ZEB familiarization, high-voltage system safety, charging infrastructure, and arc flash electrical safety
- One hour of basic safety training followed for all technicians and a five-week program for preventive maintenance.
- Pairing experienced ZEB technicians with those that are less experienced so they can train each other.
- Extensive multimedia training (e.g., self-paced training, videos, webinars) that included computer-aided design (CAD) drawings, posters, and mock-ups of key mechanical systems.

All agencies reported that mechanics and technicians were able to handle most maintenance issues, however, the early ZEBs required specialized diagnostic systems (laptops and test stations) that did not integrate with the diagnostic equipment that the agency used and that technicians were familiar with. Agencies reported that they needed additional training or software that could be integrated with existing diagnostics.

DRIVER TRAINING

RABA currently provides driver training for its 2019 Proterra BEB via its transit operator Transdev. The training is structured into two primary components:

1. **Classroom instruction:** This includes approximately 2 hours of training time based on Proterra's Driver's Manual. The training focuses on familiarizing operators with onboard systems, control interfaces, and warning/caution lights. It emphasizes safety and efficiency, particularly in relation to regenerative braking and energy conservation strategies.
2. **Hands-On and Road Training:** Operators are physically introduced to vehicle controls and taken through real-world driving scenarios. Instruction includes efficient driving techniques unique to BEBs, such as maximizing use of regenerative braking to extend range and battery life. Training sessions are often delivered in group settings to optimize scheduling and coverage.

[45] https://rosap.ntl.bts.gov/view/dot/67205/dot_67205_DS1.pdf

In contrast to this, training on the ProMaster battery-electric passenger van is more simplified with a one-on-one explanation of the vehicle systems and lift controls. In both cases, charging procedures are demonstrated, although the actual charging operations (daily connecting/disconnecting) is handled by the Maintenance Department.

MAINTENANCE TRAINING

Transdev' training for servicing electric buses, including for RABA, has so far focused on safety procedures and routine maintenance activities:

- **High-voltage safety protocols:** Mechanics are trained to visually identify and avoid high-voltage components (e.g. orange cables). One mechanic is trained to safely disconnect the high-voltage battery packs if that is required, which has not been the case so far. This person has proper personal protective equipment (PPE) to guard against electrocution and arc flash hazards.
- **Routine maintenance activities:** Most repairs to date have involved the low-voltage electrical system. Exterior control modules susceptible to dirt accumulation are cleaned using compressed air, not water or pressure washing, to avoid damage to electrical systems.

High-voltage battery maintenance or potential replacement is not currently performed in-house and would be addressed by the OEM (Proterra) under the vehicle's 12-year battery warranty.

ZERO EMISSION BUS TRAINING PROCEDURES CHECKLIST

The following checklist is based on best practices, research, and manufacturer recommendations that continue to evolve as experience with ZEBs grows. Steps are not always sequential, and RABA should determine the best course for its own training procedures.

Review and Identify

Before or when taking delivery, review the purchase or lease agreements to identify the training that is included and what might be needed to source.

TABLE A9: REVIEW AND IDENTIFICATION CHECKLIST

TASKS	COMPLETED	DATE COMPLETED	COMPLETED BY	NOTES
IDENTIFY EACH OF THE VENDORS AND THEIR ROLE IN YOUR PROJECT	☐			
IDENTIFY ALL TRAINING SERVICES INCLUDED IN VENDOR CONTRACT(S))	☐			*Examples:* *Operator: driving, charging/fueling, safety inspections* *Mechanic: Basic electrical, high-voltage, safety, emergency response*

TASKS	COMPLETED	DATE COMPLETED	COMPLETED BY	NOTES
				Software: Diagnostics, data collection, data analysis, system integration
IDENTIFY SERVICES THAT ARE NEEDED AND NOT COVERED BY THE CONTRACT(S)	☐			
IDENTIFY COMPONENTS INCLUDED IN CHARGING STATION CONTRACTS (E.G., CORD MANAGEMENT, REPLACEMENT CORDS, SOFTWARE SUBSCRIPTIONS)	☐			*If the agency will perform any maintenance, does the vendor provide training?*
IDENTIFY COMPONENTS INCLUDED IN HYDROGEN STATION CONTRACTS (E.G., TRANSPORT, LCFS REPORTING, SOFTWARE SUBSCRIPTIONS)				*If the agency will perform any operation, does the vendor provide training?*
IDENTIFY KEY PERSONNEL THAT WILL BE INVOLVED WITH TRAINING, DEPLOYMENT, AND UPDATING POLICIES AND PROCESSES	☐			
CONTACT PROVIDERS OF CURRENT SOFTWARE SYSTEMS (E.G., TELEMATICS, MAINTENANCE, ASSET TRACKING, ONLINE TRAINING) TO DETERMINE IF THEIR SYSTEMS HAVE MODULES FOR ZEBS, CHARGING, AND/OR ENERGY MANAGEMENT	☐			

TASKS	COMPLETED	DATE COMPLETED	COMPLETED BY	NOTES
SAFETY GUIDE(S) FOR BUSES AND CHARGING/HYDROGEN STATIONS REVIEWED	☐			
MANUFACTURERS' EMERGENCY RESPONSE GUIDES (ERGS) OBTAINED	☐			

Training

Conducting proper training will help your drivers and technicians feel comfortable with the ZEB and fuel type before route operations.

TABLE A10: TRAININGS CHECKLIST

POTENTIAL TRAININGS TO CONDUCT	COMPLETED	DATE COMPLETED	COMPLETED BY	NOTES
DRIVER AND SUPPORT STAFF TRAINING				
IDENTIFY DRIVERS AND SUPPORT STAFF FOR INITIAL TRAINING	☐			
IDENTIFY A STAFF MEMBER THAT WILL LEAD OR SUPERVISE TRAINING	☐			
INTEGRATE ZEB TRAINING WITH CURRENT TRAINING SOFTWARE	☐			
PROVIDE VIDEOS AND TRAINING MATERIALS IN A CENTRAL LOCATION	☐			*One of the most important materials is the dashboard and warning lights, which are different from bus to bus.*
CONDUCT HANDS-ON TRAINING SESSION(S) WITH ZEB AND CHARGING STATION FOLLOWING THE TRAINING GUIDE	☐			*Usually from the OEM and includes pre- and post-trip inspections, powering on/off, dashboard display,*

POTENTIAL TRAININGS TO CONDUCT	COMPLETED	DATE COMPLETED	COMPLETED BY	NOTES
				warning lights and sounds, acceleration, braking, turning, emergency shut off on bus and at stations.
TECHNICIAN TRAINING				
IDENTIFY TECHNICIANS FOR INITIAL TRAINING	☐			
IDENTIFY A STAFF MEMBER THAT WILL LEAD OR SUPERVISE TRAINING	☐			
INTEGRATE ZEB TRAINING WITH CURRENT TRAINING SOFTWARE	☐			
CONDUCT HANDS-ON ZEB TRAINING SESSION(S) FOLLOWING THE TRAINING GUIDE	☐			*Usually from the OEM and includes safety inspections, working with electrical systems, high voltage disconnect, diagnostic and error codes.*
CONDUCT HANDS-ON CHARGING STATION TRAINING SESSION(S) FOLLOWING THE TRAINING GUIDE	☐			*Usually from the OEM and includes safety inspections, working with electrical systems, emergency shut off, diagnostic and error codes. May include replacing components.*
CONDUCT HANDS-ON TRAINING FOR CHARGING STATION PHYSICAL INSPECTIONS	☐			*See example inspection checklist*
FIRST AND SECOND RESPONDER TRAINING				
CONTACT THE CHIEF FIRE OFFICIAL AND OFFER A WALK-AROUND OF THE ZEB(S) AND CHARGING/HYDROGEN	☐			

POTENTIAL TRAININGS TO CONDUCT	COMPLETED	DATE COMPLETED	COMPLETED BY	NOTES
STATION(S) AND THE ERGS PROVIDED BY MANUFACTURERS				
CONTACT THE TOWING COMPANY AND OFFER A WALK-AROUND OF THE ZEB AND THE ERGS PROVIDED BY MANUFACTURERS	☐			
ADMINISTRATIVE TRAINING				
RESPONDING TO QUESTIONS AND COMMENTS FROM COMMUNITY MEMBERS; CRISIS COMMUNICATIONS	☐			*Integrate messaging into existing public information and crisis communication plans*
DATA COLLECTION AND ADMINISTRATION	☐			*Software providers may not provide training in the contract. Grantors may have limited training about how to use their data reporting system.*

Identify Leads

Identify the person who has responsibility for implementing processes to make training and operations go smoothly.

TABLE A11: LEADS CHECKLIST

PROCEDURE	POSITION OR TITLE OF LEAD PERSON	COMPLETE	DATE COMPLETED	COMPLETED BY
ESTABLISH A SCHEDULE FOR INSPECTING THE PHYSICAL CONDITION OF THE CHARGING STATIONS/HYDROGEN STATION		☐		

PROCEDURE	POSITION OR TITLE OF LEAD PERSON	COMPLETE	DATE COMPLETED	COMPLETED BY
ESTABLISH A SCHEDULE FOR CHARGING STATION PREVENTATIVE MAINTENANCE		☐		*Usually provided by OEM*
ESTABLISH A SCHEDULE FOR ZEB PREVENTATIVE MAINTENANCE		☐		*Usually provided by OEM*
ESTABLISH A METHOD FOR DRIVERS AND OTHER STAFF TO REPORT PROBLEMS WITH A STATION		☐		
ESTABLISH BACK-UP BUS PROCEDURES FOR ZEBS THAT MAY HAVE LOW OR NO CHARGE AT THE START OF THE ROUTE		☐		*Should be similar to procedures in place for regular buses*
ESTABLISH RESCUE PROCEDURES FOR ZEBS THAT HAVE LOW OR NO CHARGE IN THE FIELD		☐		*Should be similar to procedures in place for regular buses*
ESTABLISH OR UPDATE PRE- AND POST-TRIP INSPECTION CHECKLISTS TO INCLUDE ZEB-SPECIFIC INFORMATION AND REMOVE ITEMS THAT DON’T APPLY (E.G., CHECK ENGINE OIL LEVEL)		☐		*See example in next section*
ESTABLISH A METHOD AND TIMELINE FOR COLLECTING AND REPORTING DATA REQUIRED BY GRANTORS		☐		
DETERMINE ADDITIONAL DATA THAT COULD		☐		

PROCEDURE	POSITION OR TITLE OF LEAD PERSON	COMPLETE	DATE COMPLETED	COMPLETED BY
INFLUENCE OPERATION DECISIONS				

Testing

Before the ZEB begins daily routes with riders, test the bus under a range of conditions to understand how its performance is impacted. Testing before training can identify strengths and gaps. Testing after training can point to needs for additional information or training sessions.

TABLE A12: TESTING CHECKLIST

TASKS	COMPLETED	DATE COMPLETED	NAME	NOTES
ASSIGN RADIO UNITS AND TEST FUNCTION ON BOTH FREQUENCIES	☐			
CONDUCT MULTIPLE TEST DRIVES WITH DIFFERENT DRIVERS WITH AN EMPTY BUS SO THAT DRIVERS GET USED TO CONTROLS, ACCELERATION, AND BRAKING	☐			
CONDUCT MULTIPLE TEST DRIVES WITH DIFFERENT DRIVERS WITH A FULL BUS (E.G., ADULT STAFF) AND MULTIPLE CONDITIONS TO GAUGE REAL-WORLD RANGE	☐			
USE INSTALLED EQUIPMENT, LIKE WHEELCHAIR LIFTS, IN THE YARD AND ON ROUTE TO DETERMINE IMPACT ON RANGE	☐			
TRACK ACTUAL RANGE COMPARED TO EXPECTED RANGE	☐			*If range differs greatly, review driver training about breaking and acceleration.*
CONFIRM THAT CHARGING STATIONS AND BUSES ARE TRANSMITTING ERROR MESSAGES (E.G., PUTTING THE	☐			

TASKS	COMPLETED	DATE COMPLETED	NAME	NOTES
BUS IN GEAR WHILE STILL PLUGGED IN)				
CONFIRM THAT PROGRAMMABLE SYSTEMS WORK (E.G., PRECONDITIONING, LOAD MANAGEMENT)	☐			

ZERO EMISSION BUS INSPECTION CHECKLIST

This list includes items that are specific to electric vehicles and charging stations to include in your existing pre- and post-trip inspection checklists.

High-Voltage Safety First: Always ensure the ZEB is powered down and the parking brake is engaged before inspection. Look for the safety disconnect status and never touch orange high-voltage cables without proper training and PPE.

Pre-trip

- Charging port door closed and secure
- Charging cable properly stored and undamaged
- High-voltage disconnect switch in proper position
- Battery state of charge sufficient for route
- Hydrogen tank is full for route
- No warning lights or fault codes on dashboard; no audible alarms
- Estimated range display functioning and adequate
- Regenerative braking system indicator functional
- Battery temperature within normal range
- Motor temperature within normal parameters
- Battery/fuel cell cooling system operational (listen for the sound of fans)
- No unusual odors from battery compartment
- No unusual sounds from electric motors
- Winter: Heater is operational
- Winter: Pre-conditioning of batteries and cabin before routes

Post-trip

- High-voltage disconnect switch in proper position

- Battery state of charge indicates charging is needed
- Hydrogen tank level indicates refueling is needed
- No warning lights or fault codes on dashboard; no audible alarms
- Motor temperature within normal parameters
- Battery cooling system operational (listen for the sound of fans)
- No unusual odors from battery compartment
- No unusual sounds from electric motors
- Bus plugged in and charging connection is secured (for BEBs)
- Cord is secured and not causing a tripping hazard (for BEBs)
- Road debris is removed from wheel wells with compressed air (not water) or a dry cloth

Detailed Inspection (Daily or Weekly)

- Inspect high-voltage cable routing and protection
- Check emergency disconnect switch accessibility
- Verify high-voltage warning labels are visible and intact
- Ensure battery compartment is properly sealed
- Start vehicle and listen for smooth motor operation
- Test acceleration in safe area - should be smooth and quiet
- Verify regenerative braking engages when releasing accelerator
- Check for any vibration or unusual noise during operation
- Check coolant levels for battery thermal management
- Test all ZEV-specific warning systems

Monthly Battery Health Review

- Download and review battery health reports
- Check for any battery degradation patterns
- Verify battery balancing is occurring properly
- Update driver(s) on any changes in range or SOC

NEXT STEPS

The project team will assess baseline data and operations of the fleet summarized in this memorandum. This data will be used to model and simulate route energy analyses and charging and infrastructure sizing which will inform the implementation of zero-emission fleet for RABA.

APPENDIX B: RELEVANT REGULATIONS

FEDERAL

Current federal regulations do not require zero-emission vehicles, including transit buses. As of October 2025, the administration has proposed eliminating or relaxing regulations that reduce greenhouse gas emissions (GHG). Most notably, the administration has proposed repealing the 2009 EPA "endangerment finding," that concluded that greenhouse gases pose a threat to public health and welfare. Eliminating this finding would remove the legal basis for all subsequent greenhouse gas regulations under the Clean Air Act, including those that increase engine efficiency and reduce tailpipe emissions.[46]

If the endangerment finding is repealed, legal expert Holland & Knight expects the soonest the finding could be submitted is early 2026, followed by a year of legal hearings and appeals and a final ruling in mid-2027.[47]

The EPA endangerment finding is the bedrock for several State of California zero-emission vehicle (ZEV) regulations (summarized below). If endangerment is repealed by 2028, it will start another round of legal challenges. It is not likely that California's AEV regulations will change before 2030.

STATE

California's regulatory landscape for transportation electrification is shaped by a long-standing commitment to reducing emissions, expanding zero-emission vehicle deployment, and supporting public agencies in transitioning away from fossil-fuel-powered fleets. Transit agencies operate within a coordinated framework led primarily by the California Air Resources Board (CARB), which administers major zero-emission regulations, including the Innovative Clean Transit (ICT) regulation for buses, Advanced Clean Cars, Advanced Clean Trucks, and Advanced Clean Fleets. In June 2025, Governor Newsom issued Executive Order N-27-25, reaffirming California's authority to implement these regulations and directing state agencies to accelerate strategies that expand clean transportation, enhance affordability and reliability, and bolster infrastructure deployment. This executive directive strengthens and reinforces the relevance of the regulations summarized in this appendix, underscoring the continued expectation that public transit agencies will transition to zero-emission fleets in alignment with California's broader climate and air quality goals.

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[46] https://www.congress.gov/crs-product/R48168

[47] https://www.hklaw.com/en/insights/publications/2025/08/up-in-the-air-epa-opens-comment-on-repealing-endangerment-finding

INNOVATIVE CLEAN TRANSIT (ICT)

Regulated parties: California Public Transit Agencies

Effective date: December 2018

The California Air Resources Board (CARB) adopted the Innovative Clean Transit (ICT) regulation[48] in December 2018. This regulation requires all public bus transit agencies in the state to gradually transition to a complete zero-emission bus (ZEB) fleet by 2040. This regulation is in accordance with preceding state policies SB375 and SB350. SB375, the Sustainable Communities, and Climate Protection Program, creates initiatives for increased development of transit-oriented communities, better-connected transportation, and active transportation. Relatedly, SB350 supports widespread transportation electrification through collaboration between CARB and the California Public Utilities Commission (CPUC).

ICT also states that all transit agencies are required to produce ZEB rollout plans that describe how each agency is planning to achieve a full transition to ZE fleets by 2040 as well as outlining reporting and record-keeping requirements. Specific elements required in the rollout plan include:

- A full explanation of how each transit agency will transition to ZEBs by 2040 without early retirement of conventional internal combustion engine buses.
- Identification of the ZEB technology each transit agency intends to deploy.
- How each transit agency will deploy ZEBs in disadvantaged communities.
- Identification of potential funding sources.
- A training plan and schedule for ZEB operators and maintenance staff.
- Schedules for bus purchase and lease options (including fuel type, number of buses, and bus type).
- Construction of associated facilities and infrastructure (including location, type of infrastructure, and timeline)

CARB defines large transit agencies as operating in “an urbanized area with a population of at least 200,000 as last published by the Bureau of Census before December 31, 2017, and has at least 100 buses in annual maximum service.” Agencies that do not meet this definition, such as RABA and SRTA, are categorized as small transit agencies.

The ICT regulation requires transit agencies to submit annual compliance reports from 2021 to 2050. The reports must include information on the agency's fleet, each bus owned or leased, ZEB mobility options, and renewable fuel usage. The first report must include data from December 31, 2017.

The total new ZEB purchase requirement for heavy-duty transit vehicles (traditional 35-ft. or 40-ft. buses unless otherwise stated) of small transit agencies is 25% for 2026-2028 and then moves to

[48] https://ww2.arb.ca.gov/our-work/programs/innovative-clean-transit

100% for 2029 and beyond. Specific vehicle types, such as over-the road motor coaches, cutaways, double-deckers, and 60-ft. vehicles, are exempt from this purchase schedule until 2026 or later (dependent on Altoona testing being completed). Whereas large agencies are required to start purchasing ZEBs in 2023, small agencies (such as RABA) are exempt until 2026, when 25% of new bus purchases must be zero emission.

The ICT regulation applies to all transit revenue service vehicles with a gross vehicle weight rating (GVWR) greater than 14,000 lbs. This includes full-size transit buses, cutaway buses, and passenger vans that meet the GVWR requirement.

TABLE B1. ZERO EMISSION BUS PURCHASE SCHEDULE (ZEB % OF TOTAL NEW BUS PURCHASE)

YEAR	LARGE TRANSIT	SMALL TRANSIT
2023	25%	N/A
2024	25%	N/A
2025	25%	N/A
2026	50%	25%
2027	50%	25%
2028	50%	25%
2029	100%	100%

Source: https://ww2.arb.ca.gov/zero-emission-regulation-deadline-schedules-truckstop

Purchases of cutaway, over-the-road, double-decker, or articulated buses are subject to the ZEB purchase requirements listed above from 2026 onwards if there is a zero-emission model available that has undergone Altoona testing.

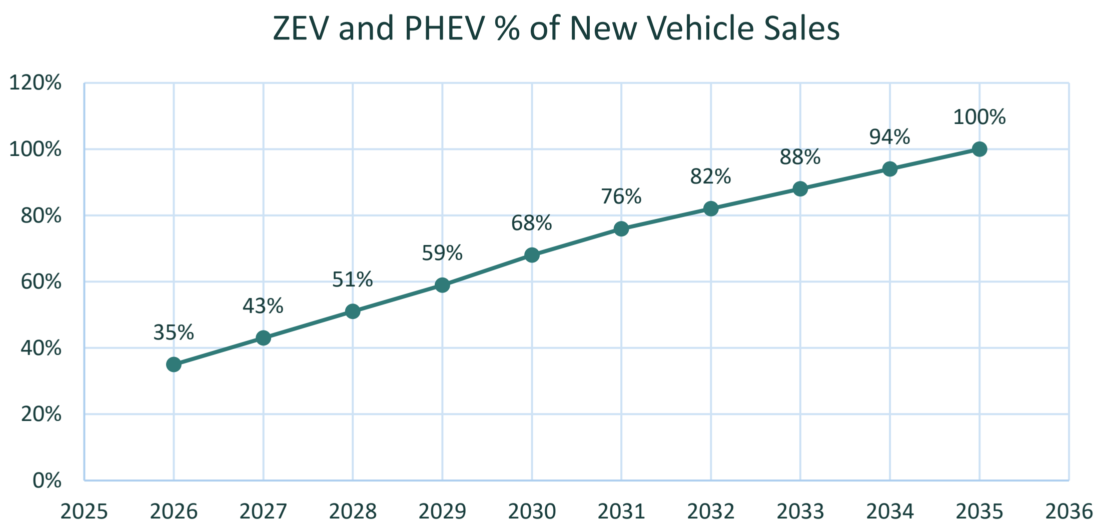
ADVANCED CLEAN CARS II

Regulated parties: Manufacturers and dealers of light-duty vehicles (passenger cars, SUVs, vans, light pickup trucks).

Effective date: November 30, 2022

CARB Advanced Clean Car II (ACC II) regulation[49] is a landmark policy aimed at accelerating the transition to zero-emission vehicles (ZEVs) in California. It requires that an increasing percentage of new vehicle sales are ZEVs (BEVs, FCEVs, and PHEVs) each year between 2026 and 2034. In 2035, all new light-duty vehicles sold will be ZEVs.

FIGURE B1. ANNUAL PERCENTAGE OF NEW LIGHT DUTY SALES THAT MUST BE ZEVS IN ACC II.



Source: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/advanced-clean-cars-ii

ADVANCED CLEAN TRUCKS

Regulated parties: Manufacturers and dealers of medium- and heavy-duty on-road vehicles (vehicles with a GVWR of 8,500 pounds or more).

Effective date: March 15, 2021

CARB's Advanced Clean Trucks regulation[50] requires the sale of ZEV or NZEV trucks starting with the manufacturer-designated model year 2024. Sales requirements are defined separately for three vehicle groups: Class 2b-3 trucks and vans, Class 4-8 rigid trucks, and Class 7-8 tractor trucks. The regulation is structured as a credit and deficit accounting system. A manufacturer accrues deficits based on the total volume of on-road heavy duty truck sales within California in a given model year. These deficits must be offset with credits generated by the sale of ZEVs or NZEVs.

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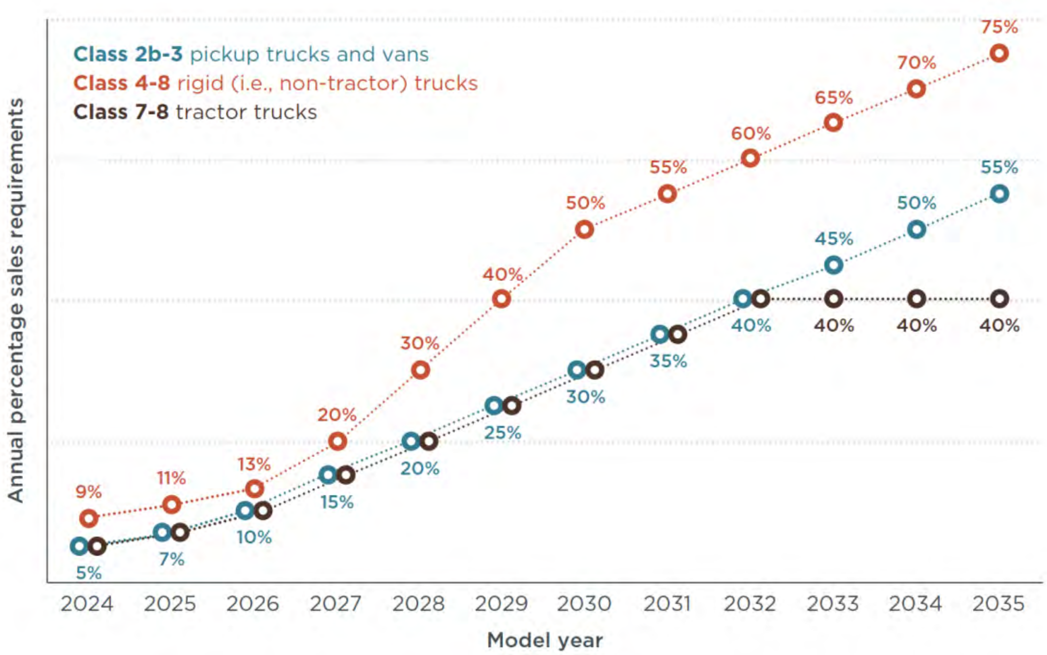
49 https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/advanced-clean-cars-ii

50 https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-trucks-fact-sheet

This does not apply to transit buses dealers but may apply to converted chassis or upfit to passenger buses/vans.

FIGURE B2. ZERO-EMISSION SALES PERCENTAGE SCHEDULE BY VEHICLE GROUP AND MODEL YEAR



Source: https://theicct.org/wp-content/uploads/2021/06/CA-HDV-EV-policy-update-jul212020.pdf

ADVANCED CLEAN FLEETS

<u>Regulated parties:</u> Local and state government fleets (public fleets)

<u>Effective date:</u> January 1, 2024

The Advanced Clean Fleets regulation[51] works in conjunction with the Advanced Clean Trucks and requires that medium and heavy-duty vehicles added to the fleet are ZEV or NZEVs. Compliance is slightly different for each regulated party. The regulation also has exceptions, exemptions, and extensions. It does not apply to transit buses that are covered by ICT.

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51 https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets/advanced-clean-fleets-fact-sheets

ADVANCED CLEAN CARS III

On June 2, 2025, Governor Newsom directed state agencies to strengthen the State's commitment to ZEVs, and directed CARB to start work on Advanced Clean Cars III. CARB has started the public input process, and the final regulation may unite Advanced Clean Cars, Advanced Clean Trucks, and Advanced Clean Fleets into one regulation.

APPENDIX C: STAKEHOLDER COORDINATION AND PUBLIC OUTREACH

Stakeholder and community coordination was a key component of the RABA Zero Emission Bus (ZEB) Implementation Plan. The planning process emphasized collaboration among agency partners, local jurisdictions, utility providers, and private-sector experts to ensure a smooth and equitable transition toward a 100% zero-emission fleet by 2040.

Three stakeholder coordination meetings were conducted, including two combined public and stakeholder meetings and one stakeholder-only session. These meetings were designed to gather input from agency partners, community members, and technical experts on ZEB technologies, infrastructure needs, and potential community impacts. Participating entities included Redding Electric Utility (REU), the Cities of Redding, Anderson, and Shasta Lake, Shasta County, the Shasta Regional Transportation Agency (SRTA), and Caltrans. Technical partners included third-party vendors such as InductEV, specializing in inductive charging technology, and hydrogen fueling providers who offered insights into delivery logistics and refueling feasibility for the Ellis lot.

STAKEHOLDER + PUBLIC MEETING #1

The first stakeholder and public meeting was held virtually via Zoom on April 29, 2025, with 12 stakeholders in attendance, and was also open to members of the public. The purpose of this meeting was to introduce the RABA ZEB Implementation Plan, provide background on the CARB ICT Regulation, and outline the goals and purpose of the project.

During the meeting, participants were presented with an overview of RABA's existing operations and maintenance facilities, along with a summary of initial findings from route and energy modeling conducted to assess vehicle range, charging requirements, and technology feasibility. The session served as an opportunity to share the project's foundational information, set expectations for future engagement, and gather early input from agency partners and stakeholders on key issues related to RABA's zero-emission transition.

STAKEHOLDER MEETING #2

The second stakeholder meeting was held on August 19, 2025, with approximately eight stakeholders in attendance. This meeting was intended for agency and technical partners only and was not open to the public. The primary focus of the discussion was to present and review the four implementation alternatives developed for RABA's transition to a zero-emission fleet. The alternatives ranged from a 100% BEB fleet to a 100% FCEB fleet, with two mixed-fleet options that combined both technologies.

Stakeholders were presented with the advantages and challenges associated with each alternative, including high-level cost estimates, operational considerations, and fleet replacement schedules. The meeting provided an opportunity for participants to evaluate trade-offs between the different technology pathways and offer feedback on the feasibility and long-term sustainability of each option. Topics such as route modeling, fleet transition phasing, cost implications, and risk management strategies were discussed. Participants also discussed backup power solutions, cold-weather performance, and the use of solar or microgrid systems to enhance system reliability.

STAKEHOLDER + PUBLIC MEETING #3

The third stakeholder and public meeting was held on October 1, 2025, with 12 participants in attendance, including representatives from partner agencies, and community organizations. The purpose of this meeting was to present the selected implementation pathway, as documented in Chapter 4 of this Plan, and to discuss key supporting elements related to funding, financing, and workforce training.

During the meeting, participants were walked through the recommended zero-emission transition strategy, including the phased fleet replacement approach, anticipated infrastructure investments, and coordination needs with Redding Electric Utility and other partners. The draft report outline was also shared to provide an overview of the Plan structure and to solicit final feedback from stakeholders before completion of the draft Plan. This session marked the conclusion of the stakeholder and public engagement process.

Through extensive coordination with utility partners, local jurisdictions, regional agencies, industry experts, and the public, the planning process established a collaborative framework to guide RABA's zero-emission transition. These discussions informed infrastructure siting, technology selection, workforce planning, and community benefit strategies, ensuring that the ZEB Implementation Plan is aligned with RABA's long-term sustainability goals.

RABA BOARD MEETINGS

A presentation was delivered to the RABA Board of Directors on September 15, 2025, to provide an update on the Plan. The presentation covered the project background, an overview of the public and stakeholder engagement process, a summary of the four implementation alternatives, and the recommended pathway forward for RABA's transition to a zero-emission fleet. Board members were given an opportunity to review the findings, discuss key considerations, and provide input on next steps.

A follow-up presentation is planned for November 2025, during which the final Plan will be presented for formal adoption by the Board.

MEETINGS WITH THIRD PARTIES

The project team met with several third-party vendors and technology providers, including the First Public Hydrogen Authority (FPH2) and InductEV, throughout the summer of 2025. These meetings helped evaluate equipment options, fueling approaches, and site feasibility for both charging and hydrogen refueling infrastructure. Discussions with InductEV focused on the applicability of inductive charging systems at RABA facilities, while meetings with hydrogen suppliers assessed infrastructure design, delivery logistics, and refueling requirements for the Ellis Lot. These industry engagements directly informed the cost estimates, conceptual layouts, and the recommended technology pathway outlined in Chapter 4.

RABA also coordinated closely with REU through multiple meetings to discuss electrical infrastructure capacity, power delivery constraints, and potential charging locations. REU provided circuit capacity data for key sites, including South Market Street (1 MW), Yuba Street (2 MW), and Eastside Road (4 MW), noting that circuit access would be managed on a first-come, first-served basis. This coordination ensured that charging infrastructure planning is aligned with REU’s operational priorities and upgrade timelines, supporting both near-term deployment and long-term system resiliency.

> *Coordination with REU was essential in shaping the Plan’s recommendations related to infrastructure capacity, potential charging locations, and fleet conversion scheduling.*

PUBLIC OUTREACH

Public outreach for the Plan was designed to share project information widely and provide accessible opportunities for community input. Outreach activities included development of a project website, creation of a fact sheet summarizing key project elements, and social media updates to promote awareness and participation. All outreach materials were also translated into Spanish to ensure accessibility and to encourage engagement from populations that are often underrepresented in public processes. See below for additional details on each outreach component.

PROJECT WEBSITE

A project website (Figure C2) was developed and hosted within the RABA website to serve as the central hub for project information and updates. The website documents the project background, timeline, and key milestones, and provides access to meeting materials, including recordings of stakeholder and public meetings. It also highlights social media outreach efforts and other coordination activities conducted throughout the planning process. The website has been regularly updated as the project progressed to ensure that stakeholders and community members had access to the most current information and opportunities for participation.

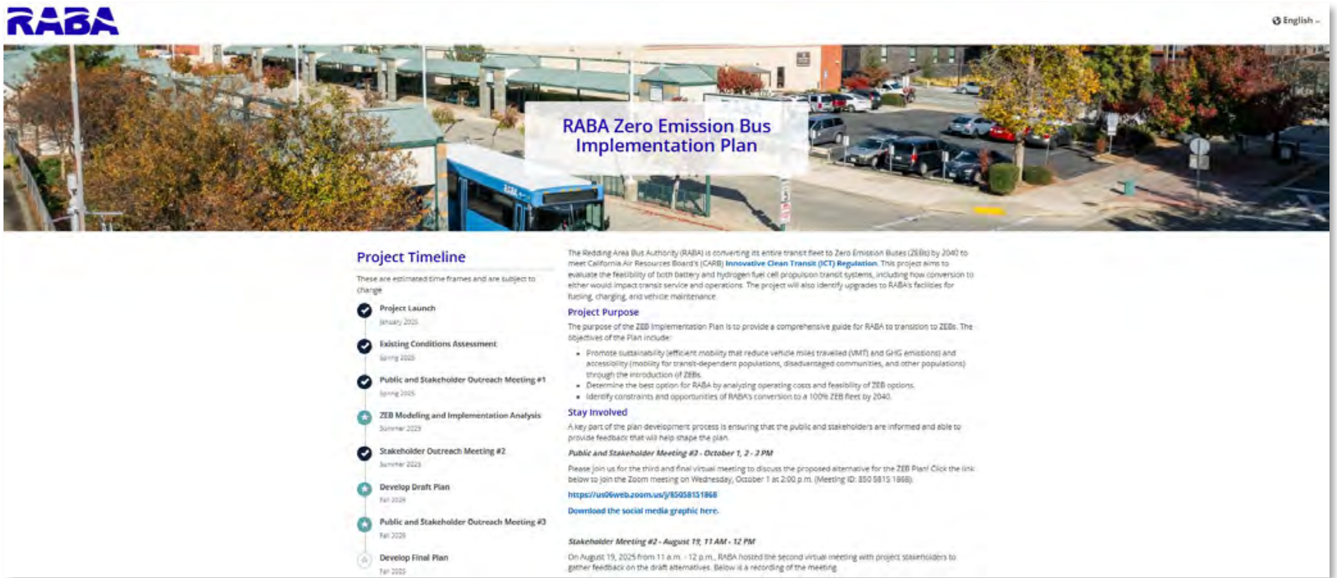

FIGURE C2. PROJECT WEBSITE

PROJECT FACT SHEET

A public-facing fact sheet was developed to provide stakeholders and community members with a clear and accessible overview of the Plan. The fact sheet summarizes key elements including the project background, recommended strategies and steps for achieving a zero-emission transition, and the selected implementation pathway. It also outlines estimated costs, proposed charging and hydrogen refueling facilities, and the anticipated benefits for disadvantaged and low-income communities within the RABA service area.

SOCIAL MEDIA OUTREACH

As part of the public engagement strategy, a series of social media graphics and outreach materials were developed to raise awareness about the Plan and encourage participation in the planning process. The graphics were shared on the project website, the RABA website, and across various social media platforms including Facebook, X, and Instagram, as well as circulated among partner agencies and stakeholders. These posts provided information about upcoming public meetings, and opportunities for community engagement, helping raise awareness throughout the planning process.

FIGURE C3. STAKEHOLDER + PUBLIC MEETING #1

FIGURE C4. STAKEHOLDER + PUBLIC MEETING #3

SPANISH TRANSLATION

To ensure accessibility and inclusive participation, all stakeholder and public meeting recordings were translated into Spanish and made available on the project website. The website itself includes a built-in language translation feature, allowing users to switch between English and Spanish for ease of navigation and understanding. In addition, the project fact sheet was translated into Spanish to provide essential project information to Spanish-speaking residents. These efforts were undertaken to ensure that limited-English-proficient populations within the RABA service area could fully engage with the project, and access materials in their preferred language.

APPENDIX D: ZEB TECHNOLOGY REVIEW

INTRODUCTION

This appendix provides a detailed overview of 35/40 foot and cutaway ZEBs available now or expected in the near future (through 2037), focusing on battery-electric and hydrogen fuel cell models. It highlights key specifications including capacity, range, charging or fueling needs – along with pricing, infrastructure considerations, availability, and alignment with ICT compliance timelines. Priority is given to options eligible for California's HVIP incentive program which currently offers up to $60k for shuttle or cutaway buses and $120k for full-size buses, while also noting other emerging models.

BATTERY-ELECTRIC CUTAWAY BUSES (UNDER 30')

OVERVIEW

Cutaway or shuttle buses are typically built on van or truck chassis (e.g. Ford E-450) with a passenger shuttle body. They are classified as medium-duty (Class 4-5) vehicles with GVWR >14,000 lbs. and usually seat about 12–24 passengers. These are used for paratransit, dial-a-ride, and low-ridership routes. Many battery-electric cutaways have ranges of up to ~150 miles per charge, which is sufficient for typical daily demand-response duty cycles so they can be recharged overnight. Several models have recently passed Altoona testing (a prerequisite for federal funding) and are HVIP-eligible, making them ready for agency procurement. Table D1 compares key specifications of leading battery-electric cutaway shuttles from manufacturers including Endera, GreenPower, Micro Bird, Motiv, Optimal-EV, and Phoenix Motorcars.

FIGURE D1. MICRO BIRD G5 ELECTRIC BUS BATTERY ELECTRIC BUS (SOURCE: CALIFORNIA HVIP)

TABLE D110. REPRESENTATIVE BATTERY-ELECTRIC CUTAWAY/SHUTTLE BUSES (CLASS 4-5, <30')

MANUFACTURER & MODEL	CHASSIS BASE	SEATING CAPACITY	BATTERY	RANGE (EST.)	CHARGING	HVIP ELIGIBLE
ENDERA B-SERIES **(B4/B5)**	Ford E-450	~16–20 + 2 WC (varies)	Up to 144–150 kWh	~130 miles (130-mile option)	25–50 kW DC standard (80% in ~30 min)	Yes (Class 4, $60k)
GREENPOWER EV STAR	Purpose-built EV	Up to 19 + 2 WC	118 kWh	~150 miles i	11 kW AC (8h) or 61 kW DC (2h)	Yes (Class 4, $60k)
MICRO BIRD G5 ELECTRIC	Ford E-450	Up to 25–30 (Type A)	88 kWh (175 kWh opt.)	~100 mi (88 kWh) up to 200 mi (175 kWh)	Up to 100 kW DC fast (≈2 hr full)	Yes (Class 4/5, $60k)
MOTIV EPIC E-450 SHUTTLE	Ford E-450 (Electric)	~14–20 (varies)	127 kWh	~100+ miles (typical)	23 kW AC / 50+ kW DC (varies by builder)	Yes (Class 4, $60k)
OPTIMAL-EV S1LF (LOW-FLOOR)	Ford E-450 (mod.)	~14 + 2 WC (low-floor)	113 kWh	~125 miles	19.2 kW AC (8h), ~60 kW DC (≤2h)	Yes (Class 4, $60k)
PHOENIX MOTORCARS Z400	Ford E-450	~14–22 (varies)	94–156 kWh options	115–130 miles (125 kWh pack)	50 kW DC (2–3 hours for full charge)	Yes (Class 4/5, $60k)

Sources: Manufacturer spec sheets and CARB HVIP data californiahvip.org californiahvip.org microbird.com afdc.energy.gov chargedevs.com (ranges are nominal/"up to" values).

All of the above models are Buy America compliant and Altoona tested. Optimal-EV's S1LF was the first low-floor EV shuttle to pass Altoona testing in 2024. Passenger capacity varies with layout (e.g. number of wheelchair positions). Most models support flexible configurations – e.g. Endera offers multiple floorplans (airport shuttle vs. ADA transit). A 130-mile range is commonly viewed as meeting most cutaway shuttle routes' needs, and indeed RABA's plan notes electric shuttles have ~150-mile range today. Battery capacity can often be tailored: Micro Bird's G5e, for instance, offers two battery sizes (88 kWh or ~175 kWh) with the larger yielding 200+ miles under ideal conditions. In practice, range will depend on the duty cycle, climate (A/C or heat usage), and passenger loads – but these shuttles can typically cover a full day of demand-response service on a single charge.

DEPLOYMENT AND AVAILABILITY

Battery-electric cutaways are a relatively new market but growing fast. Manufacturers like Phoenix Motorcars and Motiv have been delivering electric shuttles for over a decade. Endera and Optimal-EV are newer entrants (both ramping up production in the early 2020s) with Altoona-tested models by 2024. Many California agencies have begun deploying these for paratransit – often leveraging HVIP vouchers (e.g. $60k off per vehicle). Lead times for cutaway EVs can be shorter than for heavy-duty buses since they are built on common chassis. However, chassis availability (Ford, GM, etc.) can sometimes be a constraint. Supply is expected to improve, and multiple body builders (e.g. shuttle bus manufacturers like *Turtle Top* using Optimal's E1 chassis or *Diamond Coach* using Motiv's powertrain) offer options. Pricing for battery shuttles is currently around $250–$300k per bus before incentives. RABA's Rollout Plan assumed roughly $240,000 per electric cutaway after applying HVIP incentives which is about triple the cost of a comparable diesel shuttle but substantially offset by fuel and maintenance savings.[52] Electric shuttles cut maintenance costs by ~75% and fuel costs by ~80% in case studies.[53] Lower total cost of ownership (TCO) is increasingly achievable as incentives and scale bring purchase prices down.

HYDROGEN FUEL CELL CUTAWAY BUSES

As of 2025, no commercial manufacturer produces a commercially available hydrogen fuel cell cutaway shuttle that is Altoona-tested and buy-America compliant. This is an area of active research and pilot projects. For example, Hawaii's HNEI and US Hybrid converted three gasoline shuttles to fuel cell electric (FCEV) operation, achieving ~150 miles range per fill. Those 2012–2014 Ford E-450 shuttles, retrofitted with 30–40 kW fuel cells and small batteries, now serve as a testbed on the big island of Hawaii. The converted 21-passenger shuttle has a 40-kW fuel cell and is refueled at a 65-kg/day hydrogen station that supports a fleet of three buses.[54] Some of the possible reasons for the ongoing lack of hydrogen fuel cell cutaway buses include:

- **Cost and Complexity:** Integrating hydrogen fuel cell systems into a smaller cutaway chassis presents challenges in terms of space, weight distribution, and cost-effectiveness. The economies of scale that benefit larger buses don't translate well to smaller vehicles, making development less financially viable for manufacturers.
- **Market Demand:** The demand for hydrogen-powered cutaway buses is currently limited. Transit agencies often find battery-electric cutaways sufficient for typical routes, reducing the immediate need for hydrogen alternatives in this segment.
- **Infrastructure Limitations:** Hydrogen refueling infrastructure is less developed compared to electric charging networks, especially in areas where cutaway buses operate. This lack of infrastructure further diminishes the practicality of deploying hydrogen cutaways.

While there are no commercial models available now, the industry continues to explore advancements in hydrogen technology. It's possible that as fuel cell systems become more compact and cost-effective, and as hydrogen infrastructure availability expands, manufacturers may introduce hydrogen fuel cell cutaway buses in the future.

If hydrogen cutaways emerge later (perhaps in the 2030s), they could serve long rural routes without the charging downtime required by BEBs. RABA had previously expressed its intention to retrofit a few existing shuttles to fuel cell as a bridge, budgeting about $350k per conversion.[55] This cost was roughly on par with a new battery shuttle, since current fuel cell systems for shuttles are expensive but expected to drop over time. Small FCEVs can be filled with the same 350 bar hydrogen as transit buses but with smaller vehicles, care must be taken with fill speed and tank design. By 2030+, some

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[52] cms3.revize.com

[53] chargedevs.com

[54] busride.com

[55] cms3.revize.com

manufacturers (perhaps in partnership with fuel cell integrators like Ballard or Plug Power) may offer turn-key hydrogen shuttles, especially as California expands hydrogen fueling infrastructure beyond just transit agencies. However, with the current administration, these plans may get postponed or put off entirely. Also, the rapid advancements of charging speeds will diminish the refueling time advantages with FCEVs.

BATTERY-ELECTRIC TRANSIT BUSES (35’ AND 40’ CLASSES)

FIGURE D2. GILLIG LOW FLOOR BATTERY ELECTRIC BUS (SOURCE: CALIFORNIA HVIP)

Battery-electric transit buses (BEBs) are available in both 35-foot “midi” and full 40-foot heavy-duty configurations. These transit vehicles are commonly deployed on standard fixed routes and are built to meet the 12-year/500,000-mile durability standard. The 35-foot models are typically used where lower capacity or tighter maneuverability is needed, while 40-foot buses serve higher ridership routes and have greater seating and standing capacity.

Leading manufacturers like Gillig, New Flyer, Proterra (acquired by Phoenix Motorcars), BYD, and GreenPower offer BEBs in both lengths with a range of battery capacities and charging configurations. These BEBs have matured significantly since the late 2010s and now routinely achieve real-world ranges of 150–300+ miles depending on the model, battery size, climate, and terrain.

TABLE D211. BATTERY-ELECTRIC BUS COMPARISON TABLE (35’ AND 40’ MODELS)

MANUFACTURER & MODEL	LENGTH	CAPACITY	BATTERY OPTIONS	RANGE (NOMINAL)	CHARGING OPTIONS	HVIP ELIGIBLE
GILLIG LOW FLOOR BEB	35’/40’	32–40 seats	490–686 kWh	150–220+ miles	Depot CCS or OppCharge overhead	Yes ($120k)
NEW FLYER XCELSIOR CHARGE NG (XE35/40)	35’/40’	Up to 70 total passenger	345–550 kWh	180–250+ miles	Depot CCS or OppCharge	Yes ($120k)
PROTERRA ZX5+ (PHOENIX)	35’/40’	29–40 seats	440–738 kWh	172–300+ miles	CCS fast charge, optional overhead	Yes ($120k)*
BYD K8M / K9M	35’/40’	32–40 seats	324–435 kWh (LFP)	150–250 miles (est.)	CCS (80–150 kW typical)	Yes ($120k)**

MANUFACTURER & MODEL	LENGTH	CAPACITY	BATTERY OPTIONS	RANGE (NOMINAL)	CHARGING OPTIONS	HVIP ELIGIBLE
GREENPOWER EV300 / EV350	35’/40’	32–40 seats (est.)	350–500+ kWh (planned)	150–200+ miles (proj.)	CCS depot charging	In development ***

* Proterra’s eligibility: Proterra’s 35’ Catalyst/ZX5 were previously HVIP-eligible; the 40’ ZX5 is listed.

** BYD’s eligibility: BYD buses have been HVIP-eligible historically (e.g. K8, K9 models), but note that federal funds cannot be used for BYD due to 2019 NDAA restrictions.

*** GreenPower EV300**:** GreenPower offers a 30’ (EV250) and 40’ (EV350) bus; a 35’ EV300 is in their lineup but not yet widely deployed.[56]

PERFORMANCE AND OPERATIONAL CONSIDERATIONS

Modern BEBs are equipped with modular battery systems that allow agencies to scale battery capacity based on range requirements. Gillig’s high-capacity 686 kWh system, for example, provides over 200 miles per charge and has set reliability benchmarks in Altoona testing. New Flyer’s Charge NG series similarly supports large battery options up to 550 kWh, suitable for full day use on medium or long routes.

Proterra’s ZX5 platform (now licensed through Phoenix Motorcars) supports up to 738 kWh in its 40’ variant, among the largest in the market, provides 250-300+ miles of range. BYD’s buses use LFP batteries, offering strong cycle life with somewhat lower energy density. Despite this, their K9M and K8M models have been used in major fleets like Antelope Valley Transit Authority with reported ranges around 150-200 miles. All models support standard CCS plug-in charging (typically 50-150 kW), with some offering pantograph or inductive wireless charging for on-route boosts as discussed in previous chapters.

COST AND INCENTIVES

Battery-electric 35’ and 40’ buses generally cost $800,000 to $950,000 before incentives. After applying California’s HVIP voucher (up to $120,000), net prices can drop to the $700k range, however this can vary significantly depending on configuration. BEBs may be eligible for additional support from FTA’s Low-No program and CARB’s EnergIIZE infrastructure grants.

BEBs offer significant savings over time. The National Renewable Energy Laboratory (NREL) conducted an evaluation of Foothill Transit's BEB fleet and found that the energy cost was approximately $0.45 per mile. In contrast, their compressed natural gas (CNG) fleet had a fuel cost of about $0.28 per mile during the same period. While this study focused on CNG buses, diesel fuel costs are generally higher than CNG, often around $1.00 per mile, depending on fuel prices and bus efficiency.

Additionally, maintenance costs for BEBs are typically lower than those for diesel buses. This is due to fewer moving parts and the presence of regenerative braking systems in electric buses, which reduce wear on braking components. A report by the U.S. Department of Transportation indicated

[56] https://greenpowermotor.com/

that battery-electric buses reduced maintenance costs per mile by approximately 44.1% compared to diesel buses.[57]

These findings suggest that, over time, BEBs can offer significant savings in both fuel and maintenance costs compared to their diesel counterparts.

DEPLOYMENT HISTORY AND MARKET CONFIDENCE

BEBs are well-proven with hundreds of units in service across the U.S. Gillig has deployments in Alaska, Washington, Florida, and other states, demonstrating satisfactory performance in diverse climates. New Flyer's XE35 and XE40 models are widespread and well-supported. Proterra's ZX5 platform, though its original company filed for bankruptcy, remains in service and continues via Phoenix Motorcars. BYD's buses are in use in California but must be procured with state/local funds due to federal restrictions. GreenPower's larger models are more recent entries to the transit market but are expected to grow in presence by 2030.

With proven performance, evolving battery capacities, and strong funding support, both 35′ and 40′ BEBs are viable for RABA's bus routes and duty cycles.

HYDROGEN FUEL CELL ELECTRIC BUSES (30–35′ AND 40′)

FIGURE D3: NEW FLYER XHE40 FUEL CELL ELECTRIC BUS (SOURCE: CALIFORNIA HVIP)

Hydrogen fuel cell electric buses (FCEBs) use compressed hydrogen gas and a fuel cell stack to generate electricity on-board, powering an electric drive motor. They have the advantage of long range and fast refueling mimicking diesel bus operations more closely than BEBs. A transit FCEB typically can run 250–350 miles per fill and refuel in 10–15 minutes. The trade-offs are higher vehicle purchase and fuel costs and the need for hydrogen fueling and maintenance infrastructure. In the 30–35 ft size range, FCEB offerings are currently limited. Most fuel cell buses in service are 40-foot or 60-foot articulated models. Here are the current FCEB options that could meet RABA's needs:

- **New Flyer Xcelsior CHARGE H_2:** New Flyer offers the XHE40, a 40′ fuel cell electric bus (shown in Figure 41) with a Ballard fuel cell and about 35 kg of H_2 storage at 350 bar. It also includes a small battery (around 100–135 kWh) for hybrid operations and regenerative braking. This bus can

[57] ITSKRS

achieve 300+ miles range (AC Transit reportedly gets 300 miles in service from their NFI fuel cell fleet) and can be refueled in roughly 10 minutes. While New Flyer does not list a 35′ fuel cell (XHE35) on the HVIP roster, they have indicated the platform is modular. It is likely possible to produce a 35′ fuel cell Xcelsior if an agency requests it, using fewer tanks. (AC Transit's earliest fuel cell buses in 2010 were 40′ Van Hools, but SunLine Transit has tested an ENC 32′ fuel cell shuttle in the past, showing smaller fuel cell buses are viable.) For now, any RABA fuel cell procurement in the late 2020s would likely be a 40′ model to leverage proven designs. That said, a slightly smaller 35′ could be considered if available by then.

- **ElDorado National (ENC) Axess-FC:** ENC (now part of REV Group) produces the Axess 40′ low-floor bus and has built fuel cell versions in partnership with Ballard. One such bus has been in service at SunLine Transit in Palm Desert. The Axess-FC has ~30 kg H_2 storage, a 150 kW Ballard fuel cell, and has demonstrated ~260 miles range in SunLine's use. ENC also manufactures a 35′ Axess, so a 35′ fuel cell configuration could be offered (though the 40′ is more common). RABA's ZEB Rollout Plan specifically referenced the ElDorado Axess FC as a potential FCEB candidate.[58] ENC's fuel cell buses are Altoona tested and HVIP-eligible as well.
- **Future 30′ FCEBs:** It's anticipated that by the early 2030s, manufacturers may introduce fuel cell versions of smaller transit buses. Gillig, for example, has not yet sold fuel cell buses, but has shown interest in hydrogen and could potentially partner to offer a fuel cell 35′ FCEB to agencies that require extended range ZEBs without needing to charge mid-day. Likewise, GreenPower or other emerging OEMs might create a 30′ fuel cell model (especially for the cutaway replacement market in 2030+ when CARB may expect paratransit vehicles to also be zero-emission). For now, though, agencies like RABA planning mid-2030s fuel cell adoption are assuming the use of 35–40′ transit FCEBs for longer fixed routes, rather than hydrogen cutaways for demand-response.

RANGE AND PERFORMANCE

- A 35–40′ FCEB can typically carry 30–50 kg of hydrogen (at 350 bar pressure, stored in roof tanks). With fuel cell efficiency around 8–10 miles per kg, this yields 250–300 miles range. This capability means an FCEB can handle even RABA's longest day blocks without refueling. In fact, RABA's Rollout Plan views FCEBs as "drop-in" replacements for diesel buses in terms of range and daily operation. Another advantage is that fueling can be done quickly during layovers or at the end of the day, avoiding the need to recharge for hours. On the flip side, the efficiency of FCEBs is considerably lower. The fuel cell process plus hydrogen production losses means overall energy efficiency is lower than BEBs. RABA previously assumed hydrogen fuel at about $18/kg delivered, translating to roughly $1.80 per mile fuel cost (versus <$0.50/mi for electricity).
- **Efficiency of Electrolysis**: Traditional commercial electrolyzers typically operate at efficiencies ranging from 50% to 72%, meaning that a substantial portion of the input energy is lost as heat or through other inefficiencies. This implies that more energy is required to produce hydrogen than the energy the hydrogen can deliver.

INFRASTRUCTURE

Implementing FCEBs requires the installation of a hydrogen fueling station or using a delivered fueling service. Typically, a transit hydrogen station consists of on-site storage (often supplied by

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[58] cms3.revize.com

tanker truck deliveries or generated on site), compression to 350 bar, and one or more dispenser pumps similar to a CNG station in appearance. Such a station can be a multi-million dollar project. For example, AC Transit's large hydrogen stations cost $6–$8 million to construct (including electrolyzers). Smaller-scale setups (e.g. to fuel <10 buses) might be on the order of $2–$4 million. RABA's plan identifies a portion of its maintenance facility yard as the potential site for a hydrogen fueling station by 2027–2028, in time for their first FCEB deployments around 2030. [59] RABA could seek state support for this from California Energy Commission's "EV Jump Start" and Hydrogen funding lane through the EnergIIZE grant program which was designed specifically to help transit agencies build charging or H_2 infrastructure. State funding of hydrogen stations through HVIP or CEC grants is critical to making fuel cell buses viable for smaller agencies like RABA. If RABA only has a few FCEBs, it would be better to coordinate fueling with a regional partner or use mobile fueling trailers to defer the full capital expense until more FCEVs are added.

COSTS

Fuel cell buses are more expensive per unit than BEBs. RABA's previous cost analysis assumed $900,000 per 30–35′ hydrogen bus (after incentives). This suggests an unsubsidized price around $1.0–$1.2 million each (current quotes for a 40′ fuel cell bus are often ~$1.2M). HVIP does provide incentives for FCEBs (though capped at the same $120k as battery buses in the base program). Additional funding like FTA Low-No grants may cover a portion of the premium. Maintenance costs of FCEBs are somewhat higher than BEBs due to the fuel cell stack and hydrogen system upkeep and can even be higher than diesel maintenance. AC Transit's fuel cell fleet has achieved over a million miles, with some fuel cell stacks lasting 25,000+ hours. [60] By 2035, fuel cell replacement and hydrogen fuel may both become cheaper, improving the lifecycle economics.

Sources: RABA ZEB Rollout Plan; CARB ICT Regulation; Manufacturer and HVIP data as cited above.

[59] cms3.revize.com

[60] https://h2fcp.org/buses_trucks#:~:text=AC%20Transit

APPENDIX E: FUNDING AND FINANCING

Most ZEV cost analysis tools focus on the Total Cost of Ownership (TCO) that uses upfront procurement costs and short-term operational costs. Many organizations have TCO analysis tools, including [Pacific Gas & Electric's (PG&E) online tool for fleet TCO]() (Figure E1).

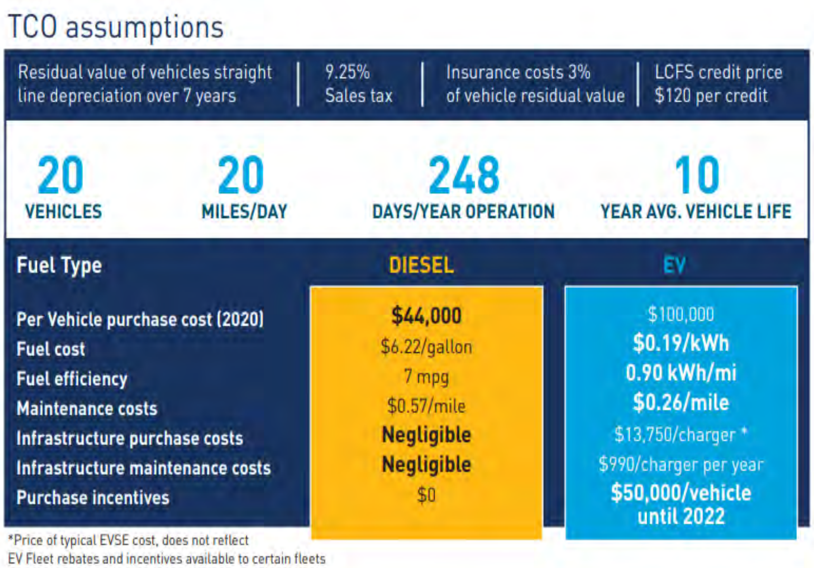

FIGURE E1: PG&E'S TCO ANALYSIS FOR MEDIUM-DUTY TRUCK

TCO analysis often includes incentives, assumed costs for routine maintenance, and projected revenue from carbon credits, like California's Low Carbon Fuel Standard. Other tools, like AFLEET, also show savings from greenhouse gas emission reduction. Agencies see the largest gains in TCO when:

- The cost of conventional fuels is high
- The cost of electricity is low
- Fuel use (conventional and electricity) is middle-to-high
- Several vehicles use the same charging station or hydrogen station daily (high throughput)
- Incentives reduce the cost capital costs

Government agencies often use Life Cycle Cost Accounting for direct and indirect costs capital investments that include procuring, owning, operating, and disposing a project. It's used for strategic decisions that will have long-term implications. Figure E2 shows the major components of LCCA. Some agencies also include benefits to a community, often represented as Net Present Value (NPV) like economic development, job creation, quality of life improvement, and long-term cost reduction. This method can justify the expense of a new park or fire station, or improvements to water and sewer infrastructure. It's also used for major projects, like highway expansion, improving ports, or adding airport terminals.

FIGURE E2: LCCA COMPONENTS

A key difference between the two is that TCO looks at new buses and infrastructure has a decreet system and LCCA looks at it as part of the total system. For example, adding ZEV infrastructure now can discount the future cost of expanding or rehabbing a diesel depot. Training mechanics on ZEB technology now can decrease training costs of future employees.

In 2011, USDOT created the *Bus Lifecycle Cost Model for Federal Land Management Agencies,* a spreadsheet-based planning tool that estimates capital, operating, and maintenance costs for various bus types over the full lifecycle of the vehicle.[61] Although the spreadsheet doesn't include ZEBs and infrastructure, the format is helpful in accessing the total financial impact of transitioning to ZEBs and can be useful to evaluate other service changes, like moving to cutaways or on-demand services.

61 https://rosap.ntl.bts.gov/view/dot/9548

FINANCING MODELS FOR CAPITAL PROJECTS

Agencies typically pay for capital projects using one of these methods:

- Pay-as-you-go (PAYGO) uses general fund revenues to pay for capital projects, allowing governments to place funds leftover after operating expenditures into a "capital reserve account" and essentially save for future procurement
- Debt, which includes a variety of tools, is particularly useful for infrastructure projects with long service lives. It allows agencies to pay costly projects that have long-term benefits without disrupting the operating budget.
- Public-Private Partnerships (P3s) can reduce financial risk by leveraging private capital to deliver public goods and services. P3s can help to reduce risk, cut costs, and improve efficiency for capital and non-capital projects, but may have complexities and lack of transparency.

Table E1 compares the benefits and trade-offs of these common funding types.

TABLE E1: COMPARISON OF FUNDING TYPES

FINANCING TYPE	BENEFIT	TRADE-OFF
PAYGO	• Future funds are not tied up in servicing debt payments • Interest savings can be put toward other projects • Greater budget transparency • Avoids the risk of default	• Long wait time for new infrastructure • Large projects may exhaust an agency's entire budget for capital projects • Inflation risk
DEBT	• Infrastructure is delivered when needed • Spreads cost over the useful life of the asset • Increases capacity to Invest • Capital investment's beneficiaries pay for projects	• Potentially high borrowing rate • Debt payments limit future budget flexibility, commonly known as "Debt Service," one of the costliest impacts on a government's operating budget • Diminishes the choices of the future • Future generations may be forced to service debt requirements
P3	• Risk transfer • Accelerated project delivery • External funding • Lower operating costs, and higher revenues • Improved user experience	• Loss of operational control • Changes delay project delivery or impose additional costs • Law or regulation changes can disrupt services • Potential loss of revenue (e.g., loss of future parking revenue)

PAY-AS-YOU-GO (PAYGO)

RABA and SRTA use PAYGO for fleet procurement and operating costs, and for facility improvements. The 2024-2025 budget and seven-year financial plan that all new buses are procured through grant funding, as shown in Figure E3.

Redding Area Bus Authority
Long-Term Capital Plan

Capital Expense Item		Year 1 2024-25	Year 2 2025-26	Year 3 2026-27	Year 4 2027-28	Year 5 2028-29	Year 6 2029-30	Year 7 2030-31
Purchase Buses	Number	2	2	2	2	2	0	0
	Cost	$ 2,412,000	$ 1,934,000 F	$ 3,844,000 F	$ 2,054,000 F	$ 2,116,000 F	$ -	$ -
Replacement Vans	Number	2	4	0	2	2	2	2
	Cost	$ 682,000	$ 1,408,000	$ - F	$ 748,000 F	$ 1,326,000 F	$ 1,366,000 F	$ 1,408,000 F
Property Expansion	Cost	$ -	$ -	$ 2,188,260	$ -	$ -	$ -	$ -
Fare Equipment	Cost	$ -	$ 320,000	$ -	$ -	$ -	$ -	$ -
Electric Vehicle Chargers	Cost	$ 100,000	$ -	$ -	$ -	$ -	$ -	$ -
Miscellaneous Capital Projects	Cost	$ 480,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000	$ 300,000
Total Capital Costs		**$3,674,000**	**$3,962,000**	**$6,332,260**	**$3,102,000**	**$3,742,000**	**$1,666,000**	**$1,708,000**

Fund Source							
5307 Federal (Capital Asst.)	$ -	$ -	$ -	$ -	$ -	$ -	$ -
5339a Federal (Bus & Fac.)	$ -	$ 1,547,200	$ 1,731,200	$ 1,883,200	$ 1,932,800	$ 240,000	$ 240,000
5339c Federal (Low/No)	$ -	$ -	$ -	$ -	$ -	-	-
Capital Funds (TDA)	$ -	$ 446,000	$ -	$ -	$ -	$ 273,200	$ 281,600
LCTOP	$ 100,000	$ -	$ -	$ -	$ -	$ -	$ -
SGR	$ 50,000	$ 64,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000
Planning Grant, Clean California, FHWA	$ -	$ -	$ -	$ -	$ -	$ -	$ -
5310 Federal	$ -	$ 1,126,400	$ -	$ 598,400	$ 1,060,800	$ 1,092,800	$ 1,126,400
SB125	$ 3,524,000	$ 778,400	$ 4,541,060	$ 560,400	$ 688,400	$ -	$ -
Total Capital Revenues	**$3,674,000**	**$3,962,000**	**$6,332,260**	**$3,102,000**	**$3,742,000**	**$1,666,000**	**$1,708,000**

Capital Item Cost	24-25	25-26	26-27	27-28	28-29	29-30	29-30
Fixed Route Bus	$ 587,000	$ 605,000	$ 624,000	$ 643,000	$ 663,000	$ 683,000	$ 704,000
Electric Bus	$ 1,438,000	$ 1,482,000	$ 1,527,000	$ 1,573,000	$ 1,621,000	$ 1,670,000	$ 1,721,000
Hybrid Bus	$ 937,884	$ 967,000	$ 997,000	$ 1,027,000	$ 1,058,000	$ 1,090,000	$ 1,123,000
Gasoline Cutaways	$ 220,000	$ 227,000	$ 234,000	$ 242,000	$ 250,000	$ 258,000	$ 266,000
Electric Vans	$ 341,000	$ 352,000	$ 363,000	$ 374,000	$ 386,000	$ 398,000	$ 410,000

FIGURE E3: LONG-TERM CAPITAL PLAN FROM FY 2024-25 BUDGET

The following are considerations for using PAYGO funding for ZEBs and infrastructure:

- Create a Vehicle Replacement budget that is funded by the sale of LCFS credits and revenue from selling rolling stock. Although it is a relatively small amount of revenue each year, dedicated funding can create an allocation that serves as cost share in future grants.
- Alter the transition plan to replace the vehicles with the greatest surplus value first. Exceeding the expected surplus value of rolling stock could close the cost delta between EVs and conventional vehicles.

DEBT

RABA and SRTA currently do not carry debt, however, loans and bonds can be used to pay for capital improvements.

Bonds

Certificates of Participation (COPs) are tax-exempt bonds issued by state entities usually secured with revenue from an equipment or facility lease. COPs enable governmental entities to finance capital projects without technically issuing long-term debt. This can be advantageous, as the issuance of long-term debt is commonly subject to voter approval and other state constitutional and statutory requirements.

Federal Loan Programs

The Transportation Infrastructure Finance and Innovation Act (TIFIA) program provides credit assistance for qualified projects of regional and national significance, including transit.[62] TIFIA has three types of credit products:

- **Secured (direct) loan** - Offers flexible repayment terms and provides combined construction and permanent financing of capital costs. Maximum term of 35 years from substantial completion. Repayments can start up to five years after substantial completion to allow time for facility construction and ramp-up.
- **Loan guarantee** - Provides full-faith-and-credit guarantees by the Federal Government and guarantees a borrower's repayments to non-Federal lender. Loan repayments to lender must commence no later than five years after substantial completion of project.
- **Standby line of credit** - Represents a secondary source of funding in the form of a contingent Federal loan to supplement project revenues, if needed, during the first 10 years of project operations, available up to 10 years after substantial completion of project.

TIFIA credit products for transit agencies:

- Can finance up to 49% of eligible project costs
- Requires dedicated revenue stream
- Flexible amortization, up to 35 years
- Repayment can be deferred for 5 years
- No pre-payment penalty

State Loan Programs

California's IBank offers the ISRF Loan Fund program, which provides low-cost, direct loans to local governments and nonprofits sponsored by public agencies for a wide variety of public infrastructure and economic expansion. IBank focuses on small and mid-/moderate-sized local governments and special districts, and public transit is one of the target areas for loans.

CalRecycle administers the Greenhouse Gas Reduction (GHG) loan program to assist recycling manufacturers in financing machinery, equipment, and ancillary costs to site and expand in California. This is targeted to recycling manufacturers, but might be an avenue to pursue funding to make hydrogen from waste materials with a company like H2 Enterprises or Raven SR.

[62] In July 2025, The Secretary of Transportation announced changes to TIFIA to "modernize" the program. Details were not available in October 2025

PUBLIC-PRIVATE PARTNERSHIP (P3)

“X” as a Service (XaaS) is a long-term agreement between a provider and the client and an increasingly common PPP. The “X” can be solar, energy storage, infrastructure, vehicles, or any combination of those. RABA could establish a contract with the XaaS vendor for a set period, usually at least 10 years. The XaaS vendor pays all the upfront costs for procurement and construction and establishes a monthly fee that covers all the costs and has a rate of return for project inventors.

Many agencies deploy solar and energy storage using a Power Purchase Agreement (PPA). Under a PPA, a third-party company installs, maintains, and operates a solar energy system on the county's property at no upfront cost to the county. The county then purchases the electricity generated by the system at a fixed rate, often lower than the utility rate but greater than the actual cost of electricity. At the end of the pay-back period, the county owns the solar and storage and pays actual costs.

The following are examples of XaaS from specific vendors. The project team does not advocate for these vendors, rather they are listed due to familiarity with their offerings.

- Renewable Properties (RP) builds charging hubs that combine large scale solar, battery storage, Level 2 and DCFC. They establish contracts with the utility to buy the power not used at the charging stations, which creates revenue during the early years when fewer vehicles are charging. RP pays all the upfront costs and collects all the LCFS credits. They charge a monthly fee for fleet charging and, ideally, collect revenue from other users, which could be from public charging or another fleet. A similar partnership could build a charging hub that RABA could share with Shasta County, City of Redding, Greyhound/FlixBus, Amtrak Thruway, and other bus operators.
- Mitra EV leases EV vans and charging stations to entities that own their own property. Mitra charges a monthly fee for each GM BrightDrop van (see Figure E4), and the fee is comparable to leasing a gas-powered cargo van. The lease includes a Level 2 charging station for each van, and a DCFC that is available to the public. Mitra lessees can reserve charging times at others’ DCFCs and pay a reduced fee to use the charging station. The DCFC is also available to the public. Mitra shares the revenue from the charging stations with the lessee. This could be a way to provide ODT and dial-a-ride vans charging stations at various locations throughout the service area.
- Since 2014, Sustainability Partners has been funding government and university infrastructure ranging from energy upgrades for schools to EVs for every government agency in Hawaii.[63] SP and the agency determine the period of investment and payback, typically measured in decades.

FIGURE E4: GM BRIGHTDROP VAN LEASED BY SIERRA PACIFIC

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[63] SP Hawaii https://www.sp-hawaii.com/

SP provides the capital and facilitates the installation, delivery, training, and ongoing maintenance of infrastructure and collects a monthly fee that can be a set amount that increases annually or a variable amount as the number of assets increases. At any time, the client can pay back the investors and take control of the assets. Table E2 (from SP) compares X as a service to other types of financing.

TABLE E2: COMPARISON OF FINANCING MECHANISMS FROM SUSTAINABILITY PARTNERS

	TERM	USER BASED COST	AGREEMENT COMPLEXITY	IS IT CAPEX?	CONTINUALLY MAINTAINED	PENALTIES TO CANCEL	ON BALANCE SHEET	REQUIRED GUARANTEES
X AS A SERVICE	Monthly	Yes	10 pages	No	Yes	No	No	No
LOAN	5-20 Years	No	75 pages	Yes	No	Yes	Yes	Yes
LEASE	5-10 Years	No	50 pages	Yes	No	Yes	Yes	Yes
PPP	3-10 Years	No	1,000 pages	Yes	No	Yes	Yes	Yes
SHARED SAVINGS AGREEMENT	10+ Years	No	100 pages	Yes	No	Yes	Yes	Yes

GRANTS AND INCENTIVES

FEDERAL GRANT PROGRAMS

Executive Order 14154 "Unleashing American Energy" directed Federal agencies to align funding programs for alternative fuels and clean energy with the administration's priorities. In H.R. 1 One Big Beautiful Bill Act, some long-standing funding programs, like the Diesel Emissions Reduction Act (DERA) were eliminated. Other federal grant programs are authorized annually and as of October 30, 2025, the Federal government had not passed the Fiscal Year (FY) 2026 budget.

The following highlights federal grant programs that were authorized in FY 2025 and were relevant to RABA's ZEB transition.

- The Low- or No-Emission competitive program provides funding to state and local governmental authorities to purchase or lease zero-emission and low-emission transit buses and for acquisition, construction, and leasing of required supporting facilities. In FY2025, the funding opportunity also included buses and bus facilities.

a. On July 25, Sec. Duffy expanded the Low-No program to include conventionally fueled buses. FTA regional offices are empowered to make changes to grant terms.[64]

- Better Utilizing Investments to Leverage Development (BUILD) Grants (formerly known as Rebuilding American Infrastructure with Sustainability and Equity (RAISE) and Transportation Investment Generating Economic Recovery (TIGER) discretionary grants) funded transportation projects eligible under Chapter 53 of Title 49, United States Code
- Grants for Buses and Bus Facilities Formula Program - 5339(a) is provides funding to states and transit agencies through a statutory formula to replace, rehabilitate and purchase buses and related equipment and to construct bus-related facilities.

STATE GRANTS AND INCENTIVES

The California Energy Commission is the source of state grants for infrastructure. As of August 2025, CEC did not list any upcoming grant opportunities. Subscribe to CEC's listserv to receive notices about upcoming opportunities.

Caltrans' annual Sustainable Transportation Planning Grant is accepting applications until November 21, 2025 and will likely have a similar deadline in 2026. The Planning Grants are in two categories:

- **Sustainable Communities Grants** to encourage local and regional planning that supports state goals, implements Regional Transportation Plan (RTP) Sustainable Communities Strategies to reduce GHG emissions.

- **Strategic Partnerships Grants** to identify and address statewide, interregional, or regional transportation deficiencies on the State highway system in partnership with Caltrans. A sub-category funds transit-focused planning projects that address multimodal transportation deficiencies.

These are competitive planning grants (not deployment) and require 11.47% local match.

The California Grants Portal lists active and upcoming grants, including those that RABA and SRTA already use. In October 2025, the Portal did not list any upcoming opportunities.

Hybrid Vehicle Incentive Program (HVIP) is California's voucher program for medium- and heavy-duty vehicles, including transit buses and cutaways. The voucher amount (up to $125,000) is deducted from the purchase price. Voucher applications open in "waves," and the next wave date is not available. Join the priority notification list to be among the first to know when new funding becomes available.

Subscribe to the Northern California Clean Cities email list to receive regular updates about funding, training, and changing vehicle regulations.

LOCAL GRANTS AND INCENTIVES

None were available in October 2025.

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[64] https://www.transportation.gov/briefing-room/us-transportation-secretary-duffy-unleashes-american-energy-saves-american-public

APPENDIX F: WORKFORCE TRAINING

PURPOSE: Review RABA's current bus operations and maintenance training programs and recommend changes to ensure RABA employees have the training necessary to operate and maintain ZEB's and associated charging infrastructure. Consider lack of existing workforce and appropriate pay scales for needed skill sets and cost of living

RABA has experience with a Proterra battery electric bus and the training the Proterra provided. In a memo, Frank Cantwell, the Transdev Maintenance Manager, noted that:

- Mechanics know to stay away from the orange-colored high voltage cables
- To use compressed air, not water, to clean dirt from the battery models and electronics
- One mechanic knows how to disconnect the high-voltage battery and has the proper PPR
- Proterra's warranty obligates Proterra to perform battery replacement

Although battery and fuel cell buses (collectively ZEBs) have been in operation for more than a decade, both technologies are evolving rapidly and so is the body of knowledge about maintenance needs. A 2021 FTA research report, *Identifying Current and Future Training Needs of the Public Transportation Industry,* collected responses from 1,720 people who work for transit agencies across the country.[65]

Relevant to this memo, the report's key results included:

- **Partnerships predominate.** Most agencies work with external partners on training, including educational partners. Partners include other transit agencies; federal, state, and local governments; community colleges; vocational schools; and four-year colleges.
- **Resources and available training time are scarce.** Many reported challenges to provide training, particularly the difficulty of scheduling time for employees to train. Also reported was a lack of resources, which may be why the public transportation industry devotes only about 0.1% of resources to training (compared to the private sector's 4–6%).
- **Rapidly changing technologies are a challenge.** Training to understand rapidly changing technologies cuts across many job duties. This includes administrative positions such as executive/management, procurement and purchasing, and transit service planning. New technologies are also affecting operations positions including dispatchers, first-line supervisors, and vehicle operators. Many respondents mentioned the need to fully understand requirements for battery-electric buses, which some agencies are deploying. Only a few mentioned directing attention to the role autonomous vehicle technology may play in the industry

IDENTIFY STRENGTHS AND GAPS

The International Transportation Learning Center partnered with the FTA to develop *Element 6: Workforce Evaluation Tool* that has eight questions for transit agencies to answer. Each question is a separate web page that has detailed instructions, examples, and resources to help RABA:

[65] https://rosap.ntl.bts.gov/view/dot/55684

1. Identify skills, training, and credentials
2. Assess current skills and the number of impacted workers
3. Identify skills gaps
4. Describe a transition training plan
5. Identify training partners and metrics
6. Identify the difference between training new hires and retaining existing workers
7. Engage the current workforce
8. Identify how training will be paid for

The following are training resources that are available at no or low cost, and most are available online.

TRAINING RESOURCES FOR ZEB BUS MAINTENANCE

- **Zero-Emission Bus Maintenance Training**: APTA created a recommended practice for ZEB Maintenance Training, which is aimed at agencies, training institutions, and training developers. It is an excellent resource for RABA to use to determine training needs. For example, all operators and staff may need Level 1 training, which is general familiarity with ZEB systems (battery and fuel cells), and only maintenance staff need Level 3 training maintenance, which is about troubleshooting and repairs.
- **Zero Emission Bus Conference**: CTE produces ZEB CON, a biannual conference about zero emission buses, and offers group and one-on-one training about battery and fuel cell buses. The sessions are targeted at managers and operations staff, rather than hands-on training for mechanics and technicians.

TRAINING FROM LEADING ZEB MANUFACTURERS

- New Flyer Institute offers classroom, online, and customized training on all its bus platforms including FCEBs and BEBs. The online Learning Management System (LMS) is available to New Flyer customers for free and has courses for technicians, drivers, and parts teams.
- GILLIG offers a Battery Electric Bus Safety and Familiarization program that is tailored for each customer and delivered via webinar. A PowerPoint for GoDurham is available online.

TRAINING RESOURCE FOR HYDROGEN SAFETY

- **Hydrogen Safety for First Responders**: The Center for Hydrogen Safety has a free online course aimed at first responders. The multimedia tutorial covers topics that are important for transit agencies, bus operators, and mechanics to know as well, including hydrogen's basic properties and how it compares to other familiar fuels; hydrogen use in fuel cells for transportation and stationary power; potential hazards; initial protective actions should an incident occur.

TRAINING RESOURCES FOR CHARGING STATION INSTALLATION AND MAINTENANCE

- SkillFusion offers online training and certification for EV charging station installation and repair. The $500 certification course is aimed at people who are not electricians.

- Electric Vehicle Infrastructure Training Program (EVITP) is a national certification program for licensed electricians. The course is $275 for 20 hours of online, self-paced training followed by a proctored, in-person test. Many state-funded incentives and all past federal funding require that charging stations be installed by an EVITP-certified electrician.

PAY SCALES FOR ZEB AND CHARGING INFRASTRUCTURE TECHNICIANS

The U.S. Bureau of Labor Statistics (BLS) reports that the statewide hourly mean wage for Bus and Truck Mechanics and Diesel Engine Specialists is $33.58 and the annual mean wage is $69,850. BLS doesn't have a separate reporting category for EV technicians. Information about wages for ZEV and changing station technicians is limited, but a study by NYSERDA showed comparable wages for EV technicians.

The NYSERDA study also found that mechanics preferred working on EVs because the work is cleaner and they are less likely to have cuts and burns from the engine. When interviewing AC Transit's fuel cell mechanics several years ago, they made similar statements about having clean hands, not ruining their clothes, and not smelling like oil and diesel at the end of the day.

Appendix A provides more details regarding workforce training.

APPENDIX G: SITE-SPECIFIC BEB CHARGER INSTALLATION RECOMMENDATIONS

This appendix presents the infrastructure installations needs for the two RABA sites at which permanent ZEB infrastructure installations are recommended. The charging recommendations for each location are described, along with the basis of recommendations, including fleet characteristics and vehicle energy requirements. Finally, this appendix addresses implementation phasing and capital (CAPEX) as well as operations and maintenance (OPEX) cost estimates by phase. The full 11x17 PDF versions of the conceptual charger layout plans can be found at the end of this appendix.

DOWNTOWN REDDING TRANSIT CENTER

FLEET CHARACTERISTICS AND ENERGY REQUIREMENTS

No fleet vehicles are domiciled at this location as this site is a transit center supporting short-term layovers for fixed-route buses between service runs. Buses typically dwell at this site for a few minutes during layovers for passenger loading, unloading, and operator breaks.

Given RABA's route schedule, expected energy needs by block, and short dwell times, high-fast inductive charging is recommended at this site to allow for quick charging throughout the day without removing vehicles from service.

CHARGING INFRASTRUCTURE AND ELECTRICAL RECOMMENDATIONS

Seven (7) inductive fast charging stations[66] are recommended for this site. Each station will consist of a ground-mounted inductive charging pad where a bus parks for opportunity charging. The seven pads will be supplied by three (3) 300 kW power cabinets configured with a power-sharing system. This configuration would allow each pad to be capable of up to 300kW output when operating individually, while load management software would dynamically allocate power among multiple pads when used concurrently. Under the proposed setup, two of the power cabinets will each serve two charging stations, while the third cabinet will serve three stations. This system design provides the high-power, short-duration charging necessary to maintain route reliability and operational efficiency for the transit fleet.

The total connected load of proposed chargers is approximately 1,125 kVA.

It should be noted that InductEV, the inductive charging vendor engaged by the project team, does not currently offer a commercial power-sharing solution as described. However, the vendor has

[66] Note: In this section, the term "inductive charging station" (or "charging stall") refers to each individual bus charging location equipped with an inductive charging pad. Three shared power cabinets will supply a total of seven stations through a power-sharing configuration.

confirmed that a next-generation product with integrated power-sharing capability is in development and expected to be available within approximately two years, aligning with RABA's projected implementation timeline.

The inductive charging stations should be installed along the 6 bus bays along the west side of the transit center, and the final station should be installed in the angled parking space to the north of the bays. The three power cabinets should be installed along the back of the station platforms (see conceptual layout plans for exact proposed locations). To power the proposed chargers, a new 2000A, 480/277V switchgear should be installed within the landscaping area at the northwest end of the site. Additionally, a new REU service transformer or an upgrade to the existing transformer is required. Final transformer sizing, location and configuration should be confirmed through detailed load analysis and coordination with REU during the design phase.

IMPLEMENTATION PHASING

RABA plans to transition its existing gasoline- and diesel-powered fleet to electric vehicles over the next 15 years. At the Downtown Redding Transit Center (DRTC), the installation of charging infrastructure is recommended to occur in two implementation phases.

The first phase (2026–2033) will focus on deploying sufficient charging infrastructure to support the initial wave of electric bus replacements and ensure reliable operations during the early transition period. The second phase (2034–2040) will complete the full build-out of charging infrastructure required to support a fully electric transit fleet.

Phase 1: Four (4) inductive charging stations, powered by two (2) 300kW power cabinets, should be installed in Phase 1. One charging station is recommended to be installed in the angled parking space north of the bus bays, and three stations should be installed at the northwestern-most bus bays. The new REU electrical service and 2000A switchgear should also be installed in Phase 1 to power all charging infrastructure. Figure G1 below shows the conceptual charger layout for Phase 1 installations.

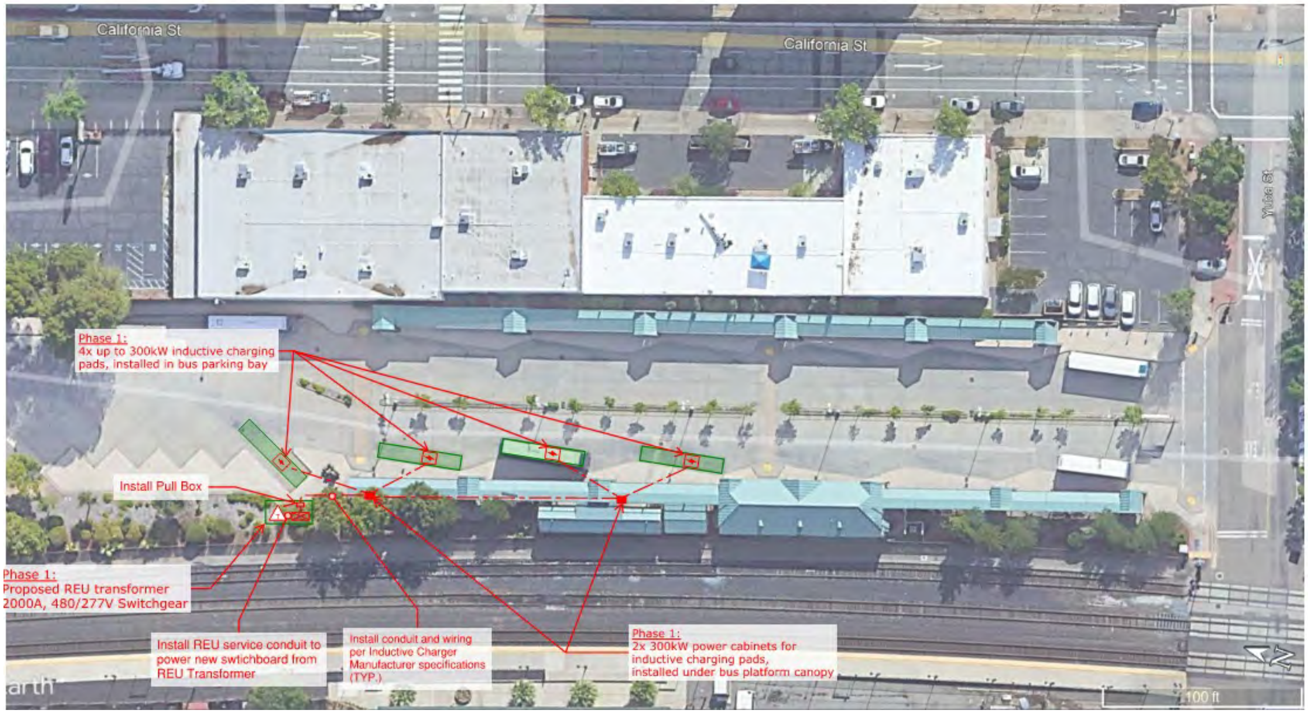


FIGURE G1: DRTC PHASE 1 CONCEPTUAL CHARGER LAYOUT

Phase 2: Three (3) inductive charging stations, powered by one (1) 300 kW power cabinet, should be installed in Phase 2. The three charging stations should be installed in the remaining 3 bus bays along the west platforms. Figure G2 below shows the conceptual charger layout for Phase 2 installations.

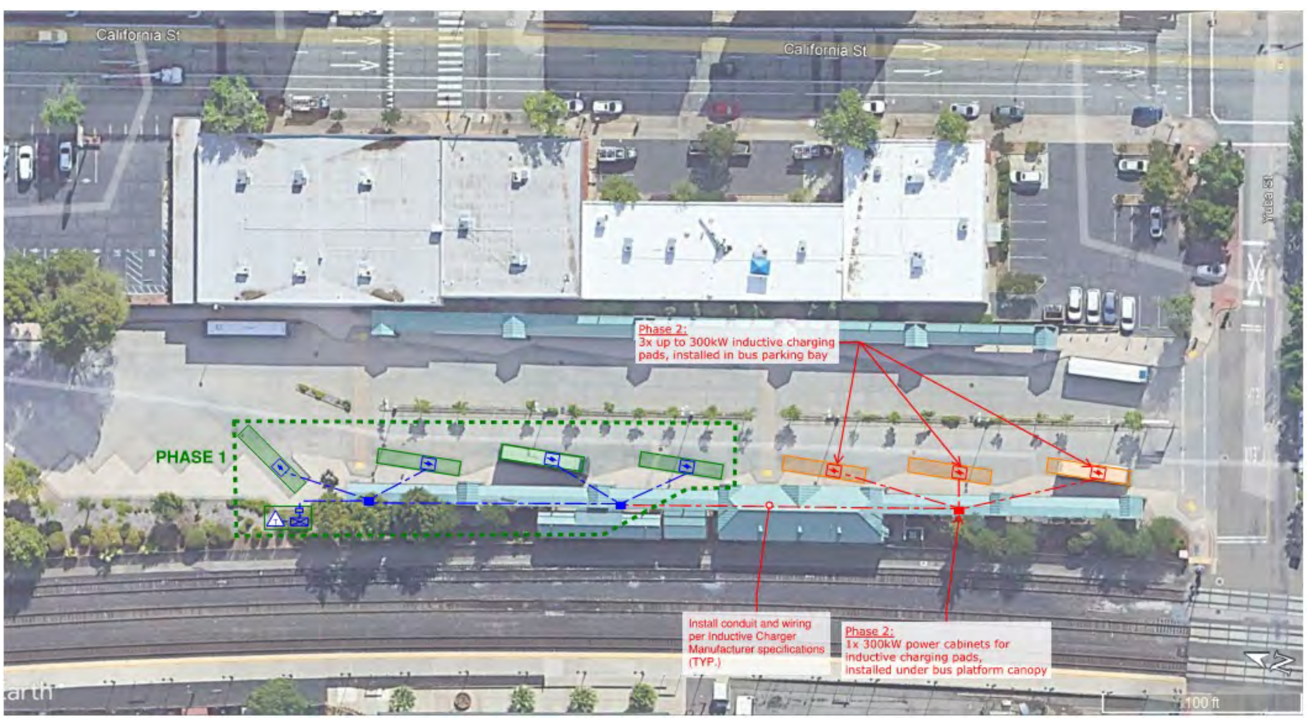


FIGURE G2: DRTC PHASE 2 CONCEPTUAL CHARGER LAYOUT

COST ESTIMATES

Table G1 below summarizes the charger recommendations and CAPEX and OPEX estimates by phase for the DRTC.

TABLE G1. DETAILED CHARGER INSTALLATION IMPLEMENTATION PHASING RECOMMENDATIONS AND COST ESTIMATES FOR DRTC

		PHASE 1: 2025-2033	PHASE 2: 2034 ONWARDS	TOTAL
CHARGER INSTALLATIONS		• 4 Inductive Charging Pads, 2x 300 kW Power Cabinets	• 3 Inductive Charging Pads, 1x 300 kW Power Cabinet	• **7 Inductive Charging Pads, 3x 300 kW Power Cabinets**
CAPEX	**CHARGERS**	$946,680	$603,680	**$1,550,360**
	MATERIALS	$104,050	$15,590	**$119,640**
	CIVIL/LANDSCAPING	$30,000	$15,000	**$45,000**
	PERMITS	$6,000	$0	**$6,000**
	UTILITY UPGRADES	$117,210	$0	**$117,210**
	SUBTOTAL	**$1,203,940**	**$634,270**	**$1,838,210**
	DESIGN & ENGINEERING	$240,790	$126,850	**$367,640**
	PRE-CONSTRUCTION ACTIVITIES	$60,200	$31,710	**$91,910**
	CONSTRUCTION MANAGEMENT	$60,200	$31,710	**$91,910**
	MOBILIZATION & COMMISSIONING	$120,390	$63,430	**$183,820**
	ADMIN & SALARY	$60,200	$31,710	**$91,910**
	CONTINGENCIES	$300,990	$158,570	**$459,560**
	SUBTOTAL SOFT COSTS	**$842,770**	**$443,980**	**$1,286,750**
	TOTAL **PER CHARGING STALL**	**$2,046,710**	**$1,078,250**	**$3,124,960** $446,420

MAINTENANCE FACILITY (DEPOT)

FLEET CHARACTERISTICS AND ENERGY REQUIREMENTS

The RABA Maintenance and Operations Facility serves as the primary domicile location for the agency's fixed-route and paratransit fleets. There are a total of 16 35' buses, 28 cutaway buses and passenger vans, two 45’ motor coaches, and 7 light-duty non-revenue vehicles domiciled at this site for a total of 53 vehicles. Vehicles at this site typically have overnight dwell time that can be used for charging.

Given the daily mileage by block, projected energy demands, and the expected battery size of BEBs, overnight charging using medium-output DC chargers, with supplemental DCFC charging, should be sufficient to charge future BEBs at this site.

CHARGING INFRASTRUCTURE AND ELECTRICAL RECOMMENDATIONS

Existing Chargers: The RABA Maintenance Facility currently includes both installed and soon-to-be-installed electric vehicle charging equipment. For the purpose of this analysis, all chargers that are either operational or in active design/procurement by RABA are considered existing infrastructure, and are assumed to be fed from existing building power or a new electrical service separate from the scope of this project. At present, one 125 kW ChargePoint DC fast charger (DCFC) is installed at the south end of the covered bus parking area for bus charging, and one Grizzl-E Level 2 charger is installed inside the shop building for light-duty use.

RABA is in the process of procuring and installing additional chargers, including one 50-amp Level 2 Tellus charger to be located at the northeast corner of the shop building, four Grizzl-E Level 2 chargers under the covered bus parking area, and one 120 kW InCharge DCFC to be installed adjacent to the existing 125 kW ChargePoint unit.

Proposed Chargers: Five (5) 50 kW dual-port DC Charging Stations and one (1) 150 kW dual-port DCFC Station is recommended for installations at this site. The five 50 kW units should be pad-mounted and installed under the solar canopy bus parking area, adjacent to the existing DCFC units. Each dual-port station will be configured to serve two opposing bus stalls, with one charging port designated for the east-facing stall and the other for the west-facing stall. This layout provides efficient cable reach and charging flexibility while minimizing equipment footprint. The 150 kW DCFC, also pad-mounted, should be installed along the fencing near the northeast corner of the site. This location for the DCFC will allow for two pull-through spaces for bus charging.

The total connected load of proposed chargers is approximately 1,000 kVA.

To power the proposed chargers, a new 2000A, 480/277V switchgear should be installed along the north end of the property, near the northern entrance gate. Additionally, a new REU service transformer or an upgrade to the existing transformer is required. The landscaping area near the northwest corner of the site, by Ellis St., has been identified as a possible location for the REU transformer. However, final transformer sizing, location and configuration should be confirmed through detailed load analysis and coordination with REU during the design phase.

It should be noted that the proposed charger locations are based on the current site layout, existing circulation patterns, and available spatial dimensions. RABA has indicated that the site may be reconfigured to incorporate the adjacent vacant Ellis St. lot across Mark Street, which is also owned by RABA.

If significant modifications to the site footprint occur, such as removal or relocation of walls, fencing, or access gates, or the addition of new driveways or circulation routes, the recommended charger locations and associated electrical infrastructure layouts will need to be reassessed and potentially revised. At this time, no site plans or layouts for the potential reconfiguration have been provided, and therefore this note serves as a planning-level consideration for future design coordination.

IMPLEMENTATION PHASING

At the Maintenance Facility, the existing gasoline- and diesel-powered fleet will be transitioned to electric vehicles over the next 15 years. The installation of charging infrastructure is recommended to occur in two implementation phases: the first phase (2026-2033) will focus on charging infrastructure to support the initial wave of electric bus replacements and ensure reliable operations during the early transition period. The second phase (2034-2040) will complete the full build-out of charging infrastructure required to support a fully electric transit fleet.

Phase 1: Three (3) 50 kW DC Charging Stations should be installed in Phase 1 under the solar canopy, beginning at the southernmost parking stalls directly adjacent to the existing DC fast chargers. The new REU transformer and 200A switchgear should be installed in Phase 1 to power all charging infrastructure. Electrical conduit and feeders will be routed from the switchgear to the charging stations via open trenching.

To streamline future expansion, make-ready infrastructure, including pull boxes, conduit connections, and stub-outs, should also be installed in Phase 1 for the two (2) remaining 50 kW DC charging stations planned for Phase 2. This will minimize future surface disruption and simplify subsequent charger installation.

In addition, the 150 kW dual-port DC fast charging (DCFC) station should be installed during Phase 1, powered from the new 2000A switchgear. Electrical conduit and feeders should be extended via open trenching from the switchgear to the DCFC location along the northwest perimeter of the site.

Figure G3 below shows the conceptual charger layout for Phase 1 installations.

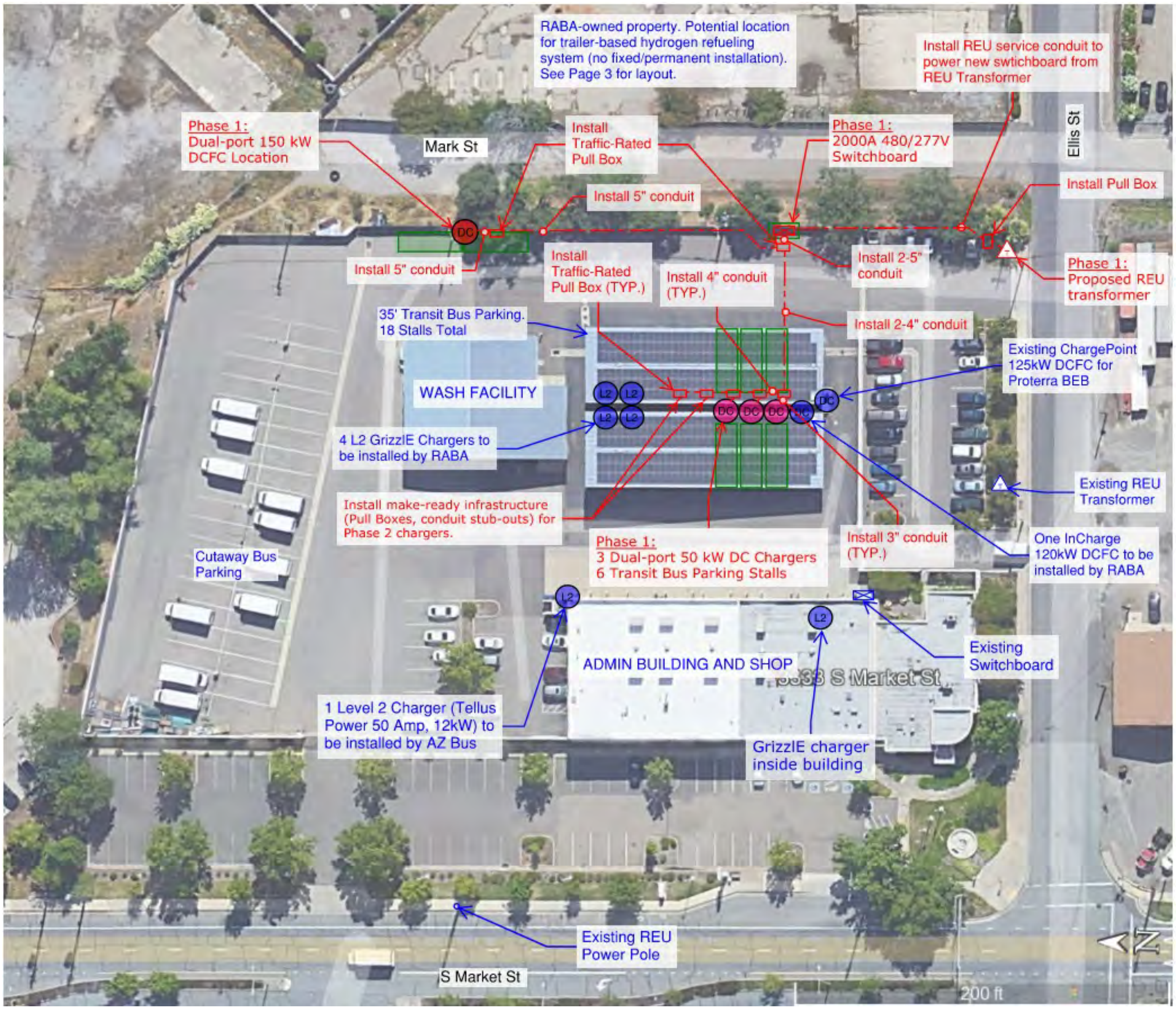


FIGURE G3: MAINTENANCE FACILITY PHASE 1 CONCEPTUAL CHARGER LAYOUT

Phase 2: The remaining two (2) 50 kW DC Charging Stations should be installed in Phase 2, extending north from the row of chargers installed in Phase 1. The make-ready infrastructure installed in Phase 1 should be utilized to connect the new stations to the electrical system. Figure G4 below shows the conceptual charger layout for Phase 2 installations.

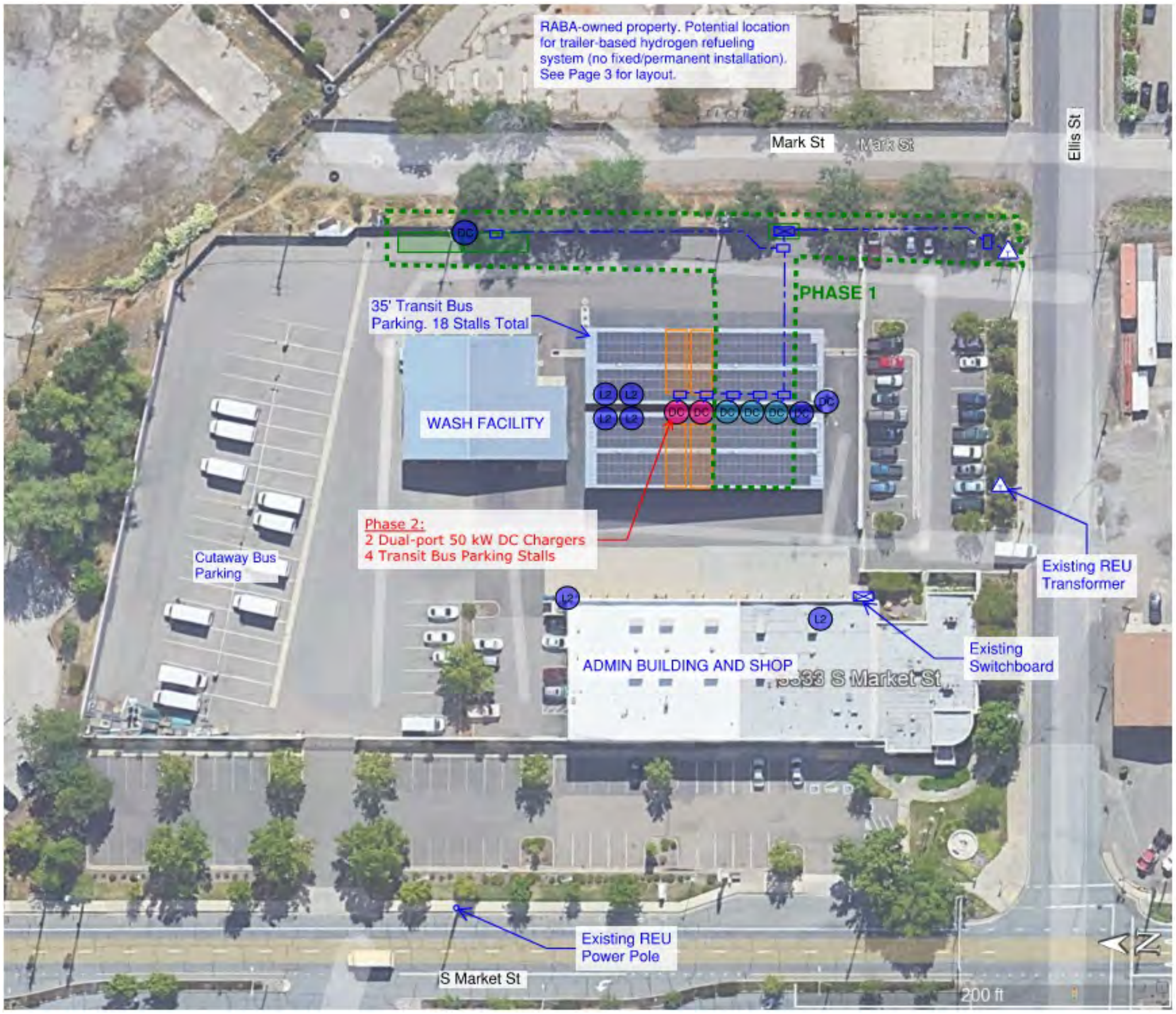


FIGURE G4: MAINTENANCE FACILITY PHASE 2 CONCEPTUAL CHARGER LAYOUT

VEHICLE TURNING PATH ANALYSIS

A vehicle turning path (swept path) analysis was conducted using the AutoTURN software to verify that 35' buses can safely maneuver into and out of the designated parking stalls and charging positions and avoid conflicting with the proposed 150 kW DCFC and electrical equipment to be installed along the east side of the site.

The analysis focused on movements where potential conflicts were identified, including:

1. Southeast end of bus parking spaces under solar canopy – evaluated to ensure that buses exiting the southernmost parking stalls can turn left out of their spaces without encroaching on or conflicting with the proposed electrical equipment. As shown in Figure G5, the turning paths for the two southernmost parked buses clear the proposed equipment and adjacent structures with adequate margins.

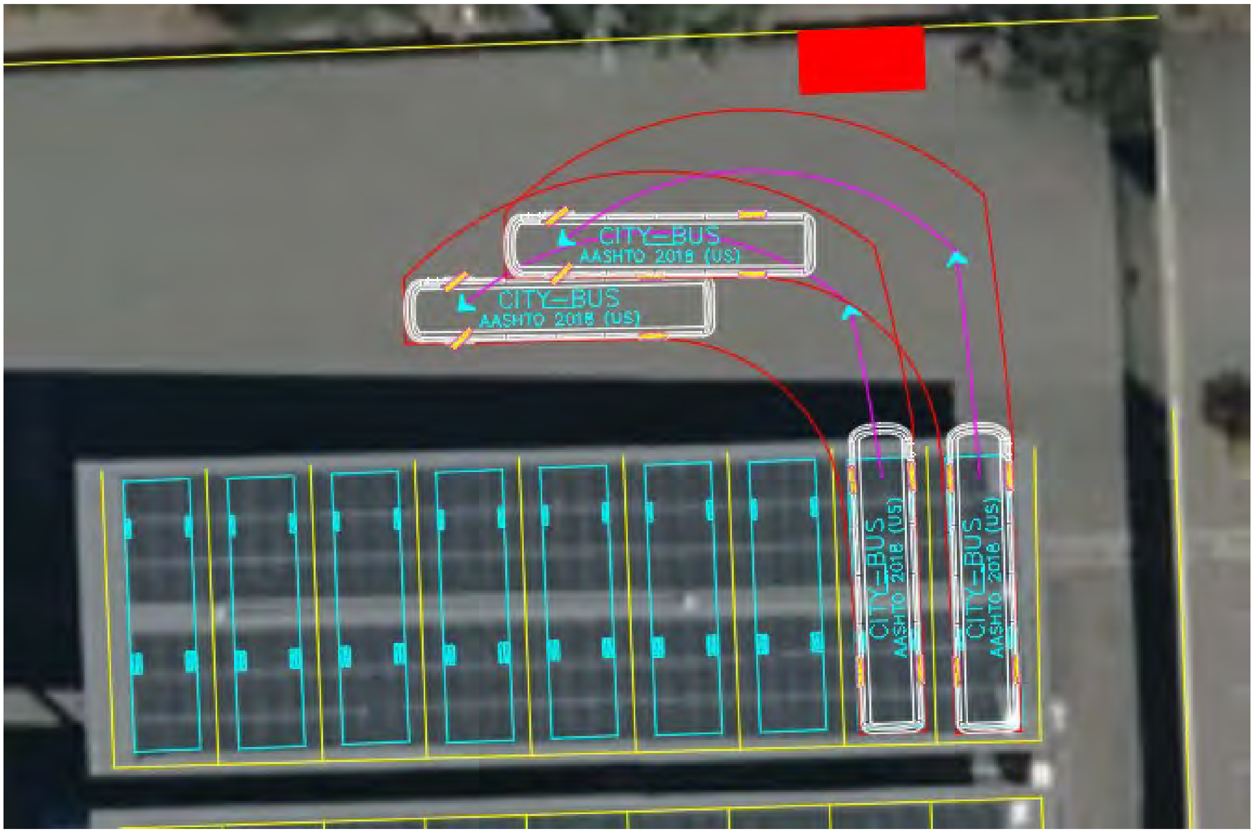


FIGURE G5: VEHICLE TURNING PATH ANALYSIS FOR SOUTH CANOPY STALLS

2. Northeast area near the proposed 150 kW DCFC – analyzed to confirm that a bus parked north of the charging station can execute a left-turn departure without conflict with the cutaway bus parking area. Additionally, the turning movement of the northernmost bus parked under the solar canopy was analyzed to ensure it would not interfere with a bus positioned at the DCFC for charging. As shown in Figure G6, there are no conflicts with either turning movements.

FIGURE G6: VEHICLE TURNING PATH ANALYSIS FOR DCFC AREA

Overall, the analysis confirmed that all evaluated maneuvers can be completed safely within the available pavement area, with no conflicts observed with proposed charging or electrical infrastructure.

COST ESTIMATES

Table G2 below summarizes the charger recommendations and CAPEX and OPEX estimates by phase for the RABA Maintenance Facility.

TABLE G2. DETAILED CHARGER INSTALLATION IMPLEMENTATION PHASING RECOMMENDATIONS AND COST ESTIMATES FOR MAINTENANCE FACILITY

		PHASE 1: 2025-2033	PHASE 2: 2034 ONWARDS	TOTAL
CHARGER INSTALLATIONS		• 3 dual-port 50kW medium-output DC Stations • 1 dual-port 150kW DCFC	• 2 dual-port 50kW medium-output DC Stations	• 5 dual-port 50kW medium-output DC Stations • 1 dual-port 150kW DCFC
CAPEX	CHARGERS	$330,300	$108,150	**$438,450**
	MATERIALS	$253,640	$21,870	**$275,510**
	CIVIL/LANDSCAPING	$24,000	$3,000	**$27,000**
	PERMITS	$6,000	$0	**$6,000**
	UTILITY UPGRADES	$117,210	$0	**$117,210**
	SUBTOTAL	**$731,150**	**$133,020**	**$864,170**
	DESIGN & ENGINEERING	$146,230	$26,600	**$172,830**
	PRE-CONSTRUCTION ACTIVITIES	$36,560	$6,650	**$43,210**
	CONSTRUCTION MANAGEMENT	$36,560	$6,650	**$43,210**
	MOBILIZATION & COMMISSIONING	$73,120	$13,300	**$86,420**
	ADMIN & SALARY	$36,560	$6,650	**$43,210**
	CONTINGENCIES	$182,790	$33,260	**$216,050**
	SUBTOTAL SOFT COSTS	**$511,820**	**$93,110**	**$604,930**
	TOTAL PER CHARGING PORT	**$1,242,970**	**$226,130**	**$1,469,100** $122,430

ELLIS ST LOT

Figure G7 below presents the conceptual site layout for the proposed hydrogen refueling system on RABA's Ellis St lot adjacent to the Maintenance Facility. The layout is shown over the Civil Paving Plan from the "Ellis St Site Improvement Project" which accurately reflects the future site conditions for when hydrogen refueling equipment may be used, beginning around 2031 in accordance with the bus procurement schedule shown in Table 3.

The main hydrogen fueling equipment should be centrally located on the lot, near the diagonal northeast property line. The footprint of the hydrogen infrastructure, including protection barriers, H_2 storage trailer, and dispenser, is approximately 18' x 45'. A minimum 40-foot setback should be maintained between all hydrogen system components and any adjacent property lines or structures to meet safety and code compliance requirements. The bus fueling parking space should be located west of the hydrogen station, allowing efficient access for vehicles during refueling operations.

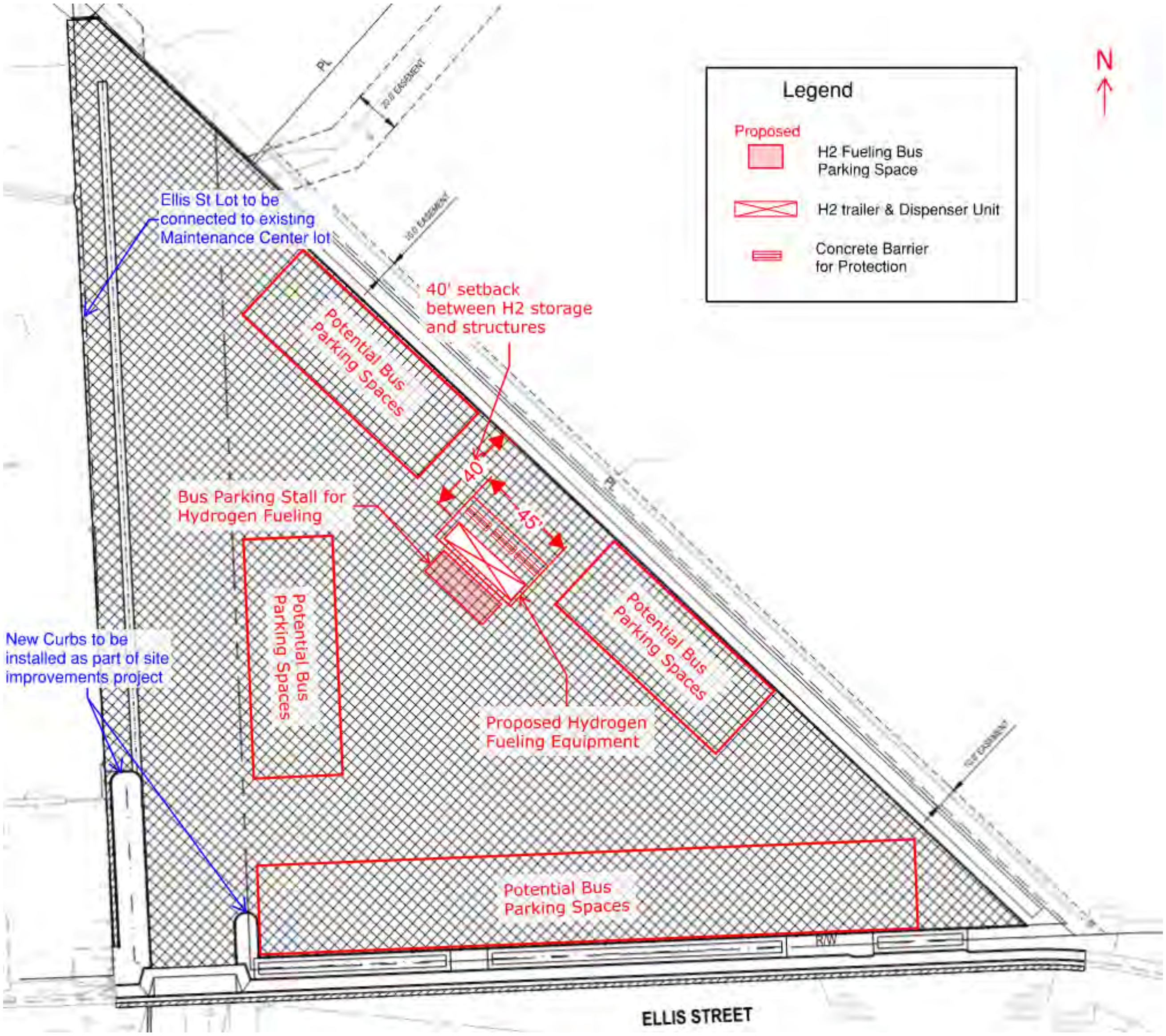


FIGURE G7. ELLIS ST LOT HYDROGEN REFUELING STATION LAYOUT

Potential bus parking spaces are shown for planning purposes only, and detailed site civil design and additional engineering and analysis are required prior to final implementation. Based on the parking layout as shown, a vehicle turning path (swept path) analysis was conducted using the AutoTURN software to verify that:

1. Buses can safely maneuver into and out of the hydrogen fueling spot and turn into the existing Maintenance Center lot.
2. Adjacent parked buses will be able to enter and leave their stalls without conflicting with the proposed equipment or any buses in the process of being refueled.

As shown in Figure G8 and Figure G9, all turning paths identified for potential conflicts show no issues and clear the adjacent equipment/parking spaces with adequate margins.

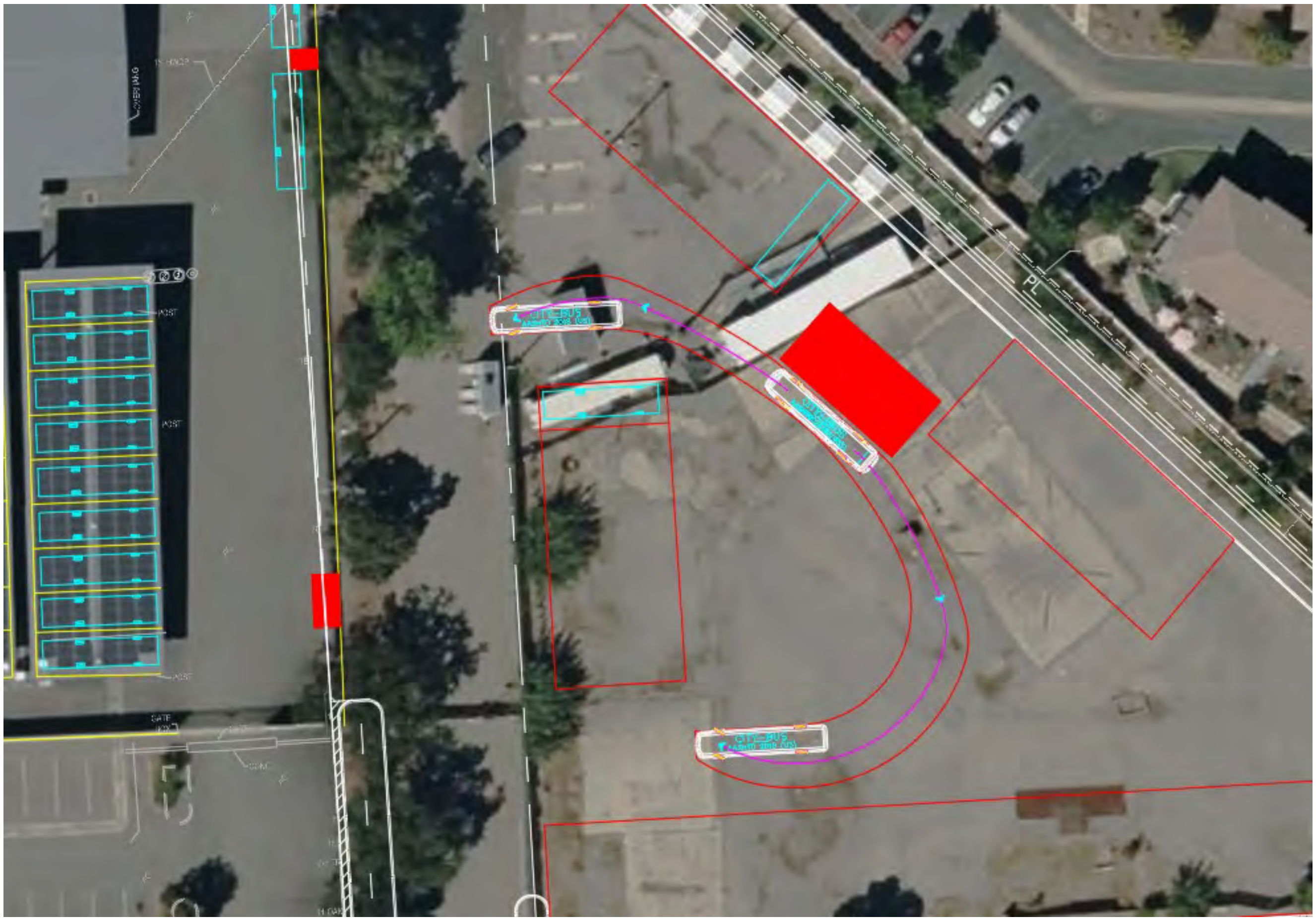


FIGURE G8. VEHICLE TURNING PATH ANALYSIS FOR HYDROGEN FUELING SPACE INTO MAINTENANCE CENTER

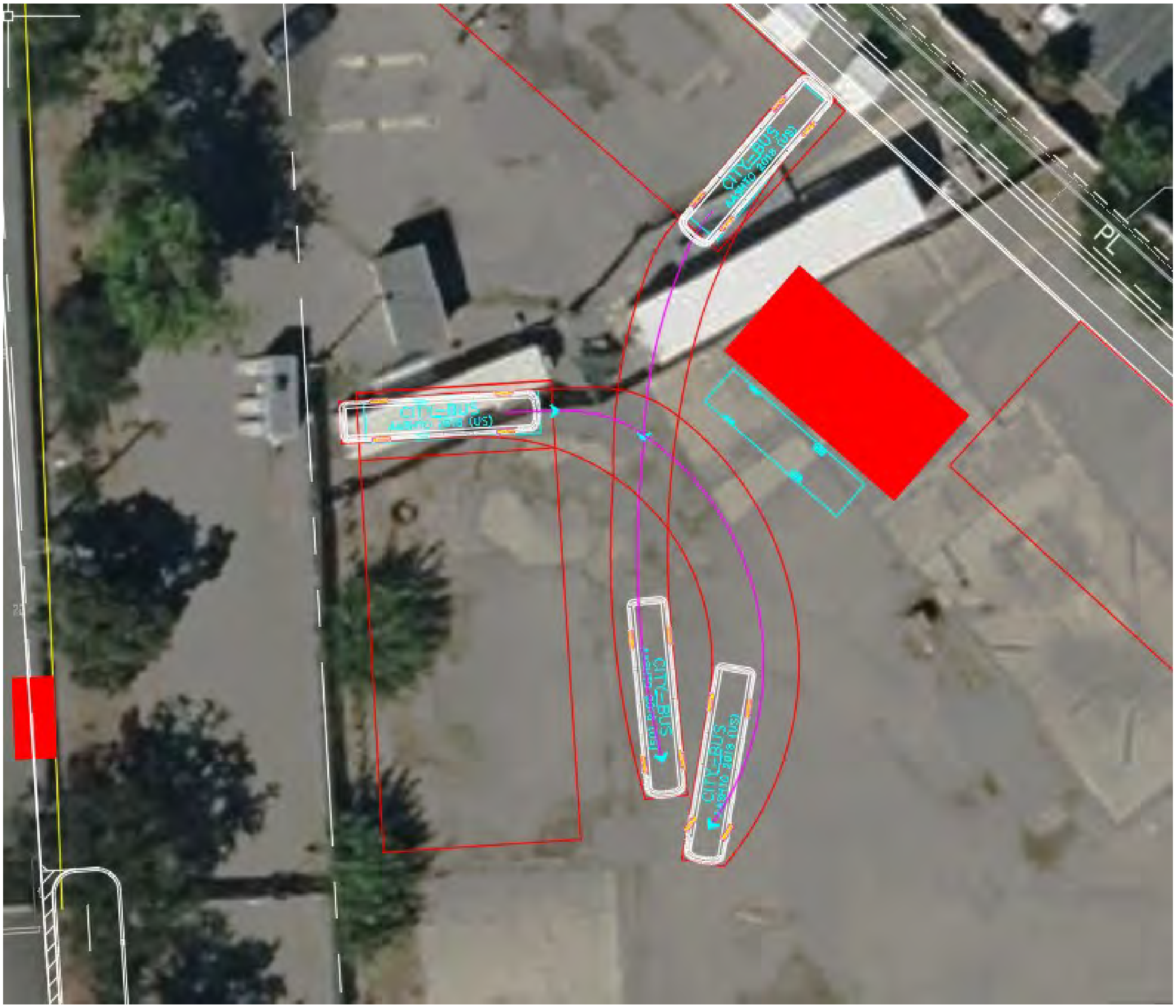
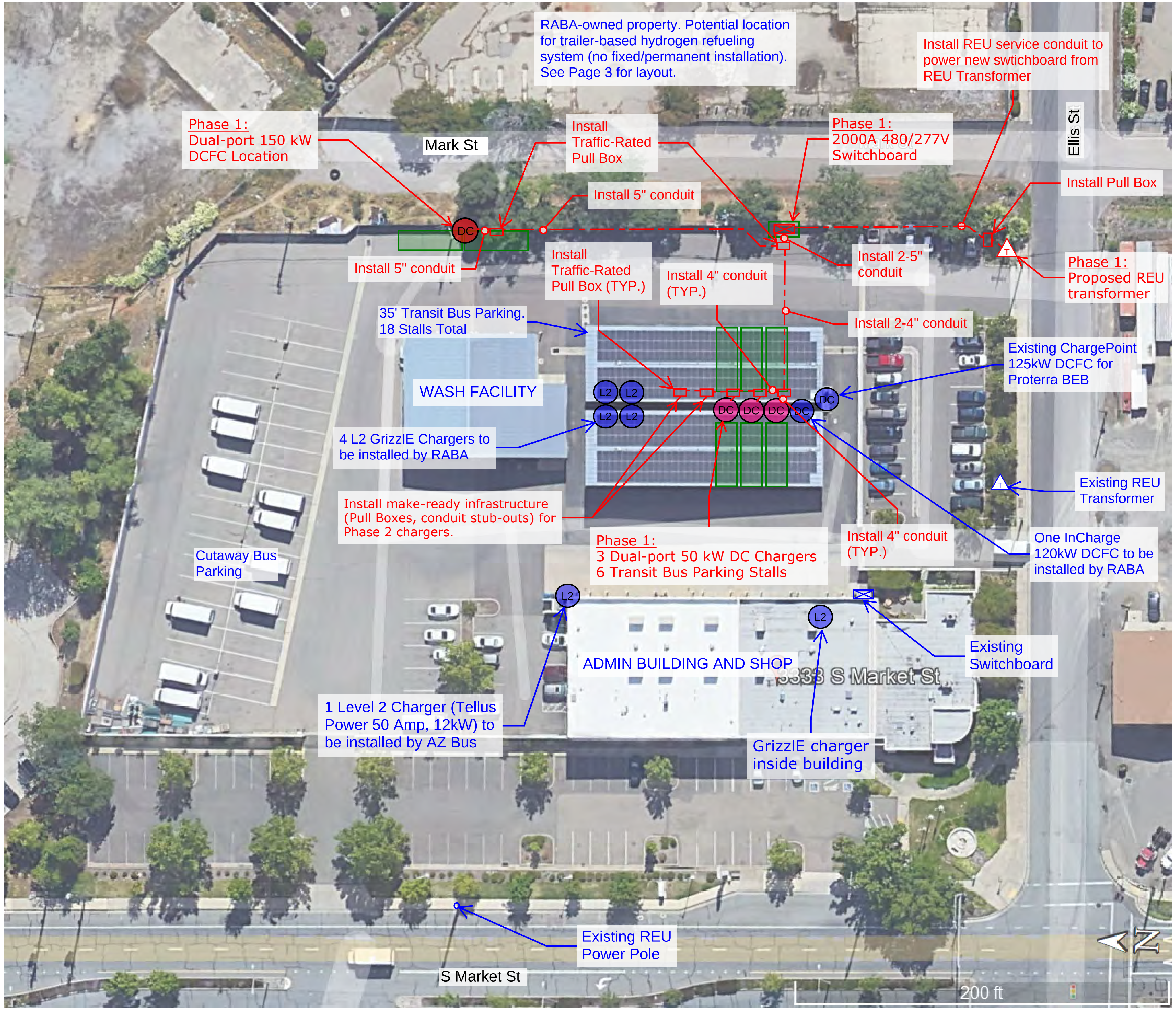


FIGURE G9. VEHICLE TURNING PATH ANALYSIS FOR ADJACENT PARKING STALLS



No. Vehicles				
Transit Buses	Cutaway Buses	Passenger Vans	Commuter Coaches	NRVs, Class 1-3
16	24	4	2	7
Total: 53				

	50 kW DC Dual-Port	150 kW DCFC Dual-port
Phase 1	3	1
Phase 2	2	0
Total # of Chargers	5	1
Total # of Ports	10	2

# OF VEHICLES THAT CAN BE CHARGED SIMULTANEOUSLY	12

Construction Phases

Phase 1: 2025-2033
Phase 2: 2034 Onward

Proposed Connected Load **(kW): 800**
Proposed Connected Load **(kVA): 1,000**

Legend

Existing	Proposed	
T	T	Utility Transformer
		Switchboard
N/A	DC	50 kW DC Charger
DC	DC	DC Fast Charger
L2	N/A	Level 2 Charger
		Conduit for EV Charging
		Pull-box/Surface Mounted Box

Green = Implementation Phase 1
Orange = Implementation Phase 2

NOTES:

1. PARKING STALLS TO BE STRIPPED STATING "EV CHARGING ONLY"
2. INSTALL BOLLARDS TO PROTECT EV CHARGERS AND NEW ELECTRICAL EQUIPMENT.
3. CHARGERS IDENTIFED AS EXISTING IN PHASE 1, INCLUDING THOSE CURRENTLY UNDER PROCUREMENT BY RABA, ARE ASSUMED TO BE FED FROM EXISTING BUILDING POWER OR A NEW ELECTRICAL SERVICE SEPARATE FROM THIS SCOPE.

REVISIONS

REV	DATE	BY	DESCRIPTION

RABA

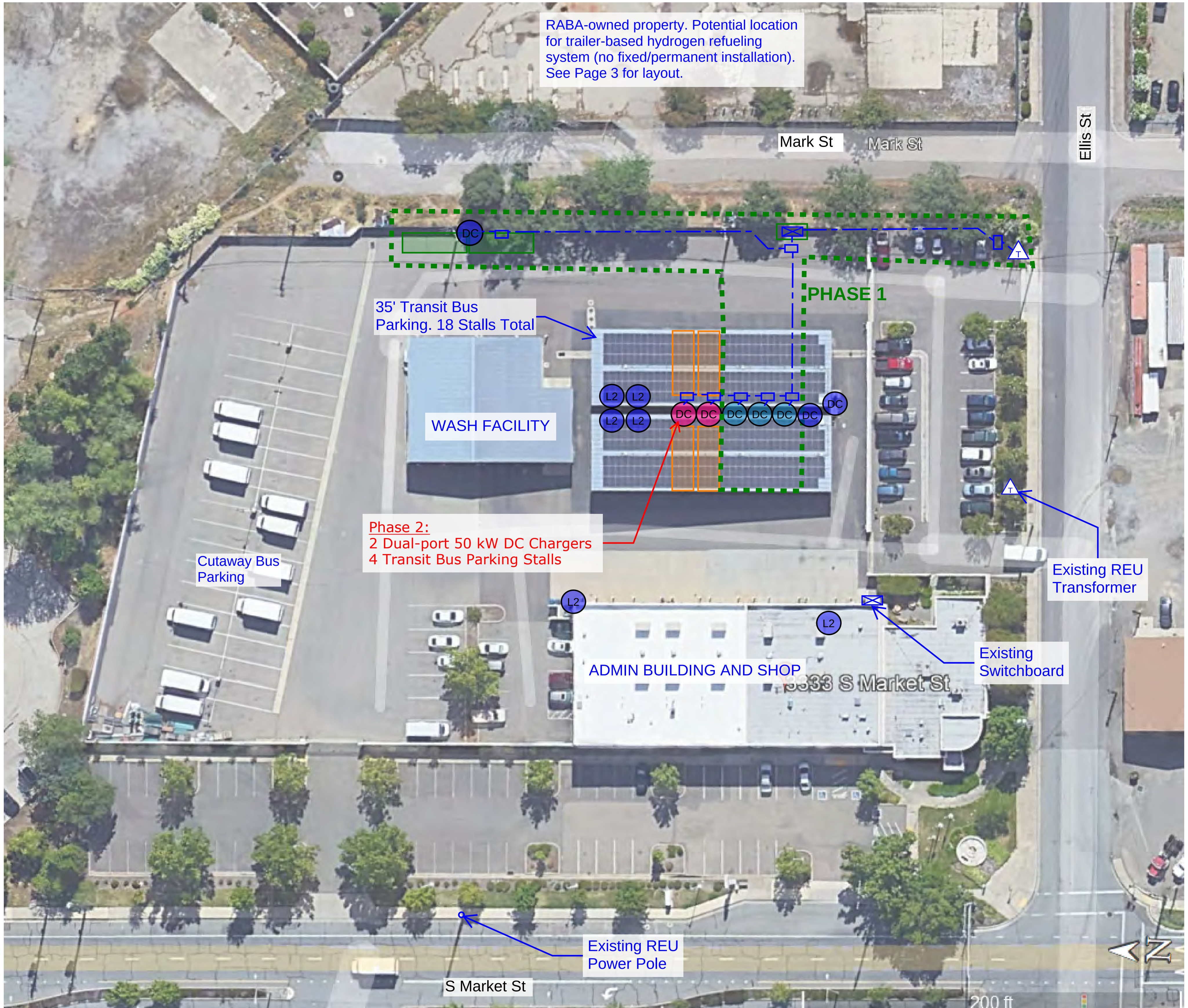
DESIGNED: OXW
DRAWN: OXW
CHECKED: GSA
DATE: 10/24/2025
FILE NO.:

PREPARED BY:
DKS
428 J Street, Suite 340
Sacramento, California 95814
Tel.: 916-368-2000

REDDING AREA BUS AUTHORITY
3333 S Market St, Redding, CA 96001

ELECTRIC VEHICLE CHARGING INFRASTRUCTURE
Maintenance Center
3333 S Market St, Redding, CA 96001
PHASE 1 - CONCEPTUAL PLAN

SHEET



No. Vehicles				
Transit Buses	Cutaway Buses	Passenger Vans	Commuter Coaches	NRVs, Class 1-3
16	24	4	2	7
Total: 53				

	50 kW DC Dual-Port	150 kW DCFC Dual-port
Phase 1	3	1
Phase 2	2	0
Total # of Chargers	5	1
Total # of Ports	10	2

# OF VEHICLES THAT CAN BE CHARGED SIMULTANEOUSLY	12

Construction Phases

Phase 1: 2025-2033
Phase 2: 2034 Onward

Proposed Connected Load **(kW): 800**
Proposed Connected Load **(kVA): 1,000**

Legend

Existing	Proposed	
		Utility Transformer
		Switchboard
N/A	DC	50 kW DC Charger
DC	DC	DC Fast Charger
L2	N/A	Level 2 Charger
		Conduit for EV Charging
		Pull-box/Surface Mounted Box

Green = Implementation Phase 1
Orange = Implementation Phase 2

NOTES:

1. PARKING STALLS TO BE STRIPPED STATING "EV CHARGING ONLY"
2. INSTALL BOLLARDS TO PROTECT EV CHARGERS AND NEW ELECTRICAL EQUIPMENT.

REVISIONS			
REV	DATE	BY	DESCRIPTION

RABA

DESIGNED: OXW
DRAWN: OXW
CHECKED: GSA
DATE: 10/24/2025
FILE NO.:

PREPARED BY:
DKS
428 J Street, Suite 340
Sacramento, California 95814
Tel.: 916-368-2000

REDDING AREA BUS AUTHORITY
3333 S Market St, Redding, CA 96001

ELECTRIC VEHICLE CHARGING INFRASTRUCTURE
Maintenance Center
3333 S Market St, Redding, CA 96001
PHASE 2 - CONCEPTUAL PLAN

SHEET

REVISIONS			
REV	DATE	BY	DESCRIPTION

RABA

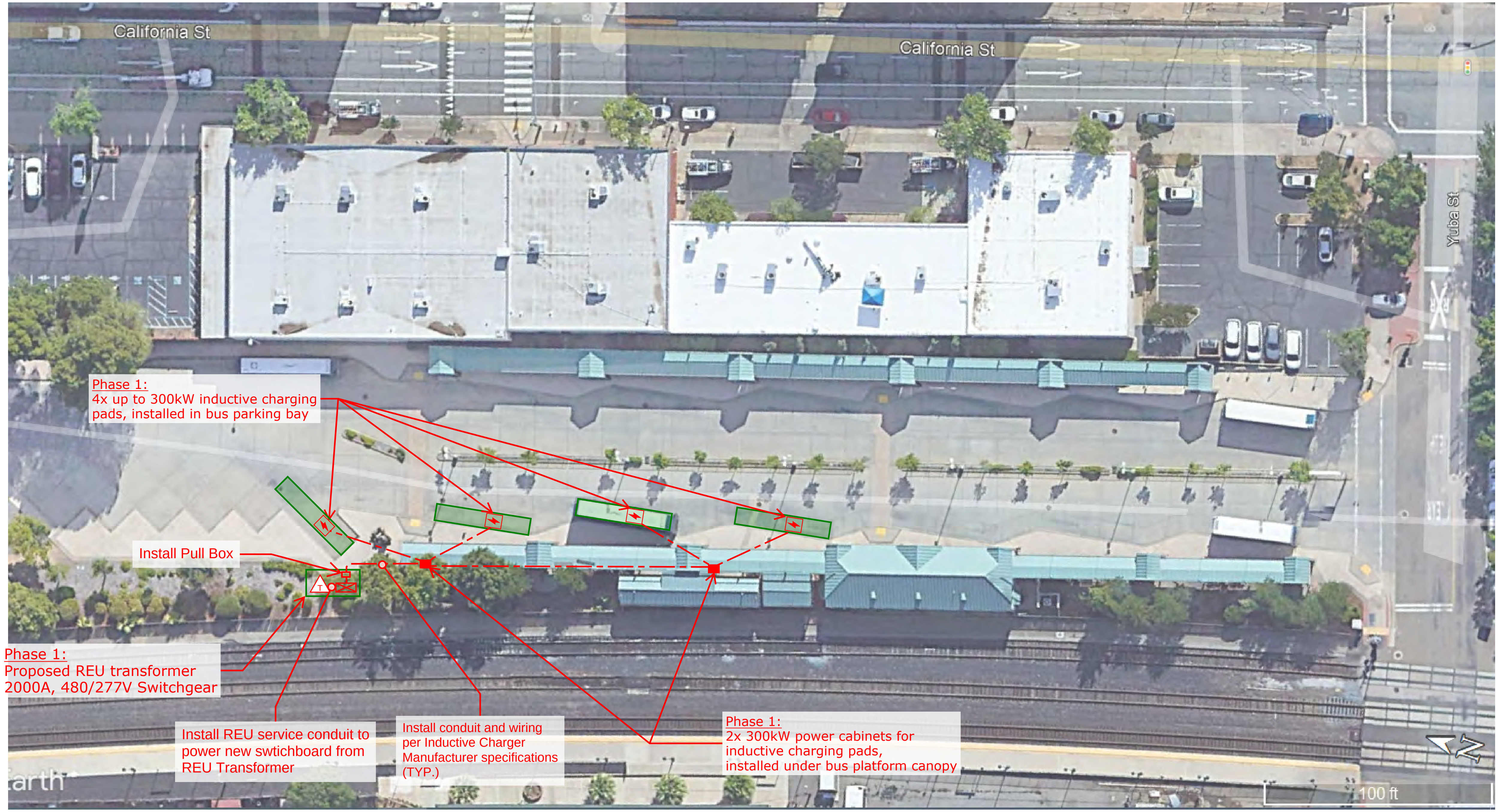
DESIGNED: OXW
DRAWN: OXW
CHECKED: GSA
DATE: 10/24/2025
FILE NO.:

PREPARED BY:
DKS
428 J Street, Suite 340
Sacramento, California 95814
Tel.: 916-368-2000

REDDING AREA BUS AUTHORITY
3333 S Market St, Redding, CA 96001

ELECTRIC VEHICLE CHARGING INFRASTRUCTURE
Maintenance Center - Ellis St Lot
3333 S Market St, Redding, CA 96001
CONCEPTUAL PLAN

SHEET
3 of 5



	300 kW Inductive Charger
Phase 1	3
Phase 2	3
Total # of Chargers	6

# OF VEHICLES THAT CAN BE CHARGED SIMULTANEOUSLY	6

Construction Phases

Phase 1: 2025-2033
Phase 2: 2034 Onward

Proposed Connected Load **(kW): 900**
Proposed Connected Load **(kVA): 1,125**

Legend

Existing	Proposed	
N/A		Utility Transformer
N/A		Switchgear
		Inductive Charger Power Cabinet
		Inductive Charging Pad
		Conduit for EV Charging
		Pull-box/Surface Mounted Box

Green Text = Implementation Phase 1
Orange Text = Implementation Phase 2

NOTES:

1. INDUCTIVE CHARGING PADS TO BE FED FROM SHARED POWER CABINETS WITH INTEGRATED LOAD MANAGEMENT SYSTEM. EACH PAD CAPABLE OF UP TO 300 KW OUTPUT WHEN OPERATING INDIVIDUALLY; LOAD AUTOMATICALLY DISTRIBUTED AMONG MULTIPLE PADS WHEN USED CONCURRENTLY BASED ON DEMAND AND ENERGY NEEDS.

REVISIONS

REV	DATE	BY	DESCRIPTION

RABA

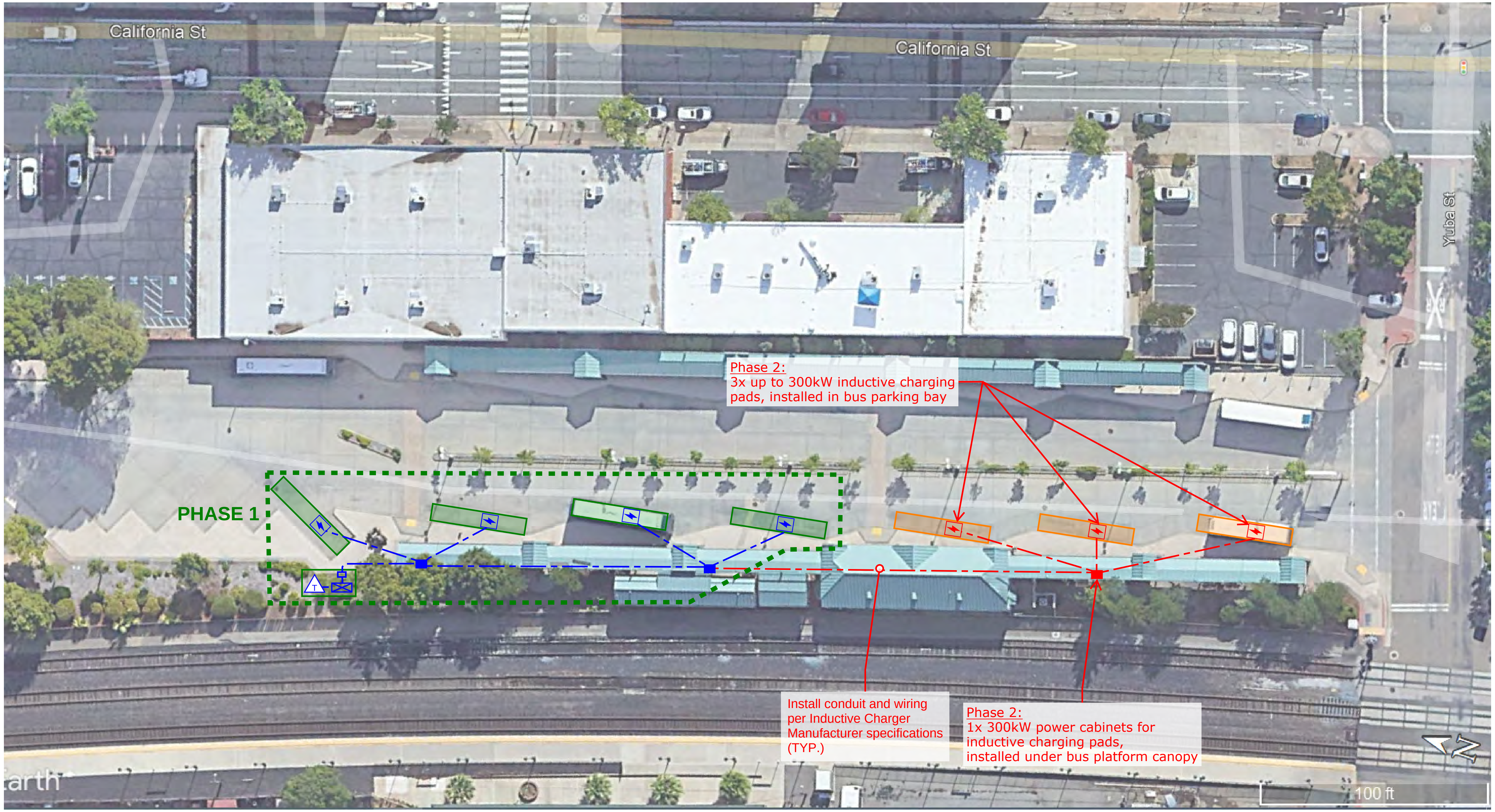
DESIGNED: OXW
DRAWN: OXW
CHECKED: GSA
DATE: 10/24/2025
FILE NO.:

PREPARED BY:
DKS
428 J Street, Suite 340
Sacramento, California 95814
Tel.: 916-368-2000

REDDING AREA BUS AUTHORITY
3333 S Market St, Redding, CA 96001

ELECTRIC VEHICLE CHARGING INFRASTRUCTURE
DOWNTOWN REDDING TRANSIT CENTER
1530 Yuba St, Redding, CA 96001
PHASE 1 - CONCEPTUAL PLAN

SHEET
4 of 5



	300 kW Inductive Charger
Phase 1	3
Phase 2	3
Total # of Chargers	6

# OF VEHICLES THAT CAN BE CHARGED SIMULTANEOUSLY	6

<u>Construction Phases</u>

Phase 1: 2025-2033
Phase 2: 2034 Onward

Proposed Connected Load **(kW): 900**
Proposed Connected Load **(kVA): 1,125**

Legend

Existing	Proposed	
		Utility Transformer
		Switchgear
		Inductive Charger Power Cabinet
		Inductive Charging Pad
		Conduit for EV Charging
		Pull-box/Surface Mounted Box

Green Text = Implementation Phase 1
Orange Text = Implementation Phase 2

<u>NOTES:</u>

1. INDUCTIVE CHARGING PADS TO BE FED FROM SHARED POWER CABINETS WITH INTEGRATED LOAD MANAGEMENT SYSTEM. EACH PAD CAPABLE OF UP TO 300 KW OUTPUT WHEN OPERATING INDIVIDUALLY; LOAD AUTOMATICALLY DISTRIBUTED AMONG MULTIPLE PADS WHEN USED CONCURRENTLY BASED ON DEMAND AND ENERGY NEEDS.

REVISIONS

REV	DATE	BY	DESCRIPTION

RABA

DESIGNED: OXW
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PREPARED BY:
DKS
428 J Street, Suite 340
Sacramento, California 95814
Tel.: 916-368-2000

REDDING AREA BUS AUTHORITY
3333 S Market St, Redding, CA 96001

ELECTRIC VEHICLE CHARGING INFRASTRUCTURE
DOWNTOWN REDDING TRANSIT CENTER
1530 Yuba St, Redding, CA 96001
PHASE 2 - CONCEPTUAL PLAN

SHEET
4 of 5

APPENDIX H: COST ESTIMATES ASSUMPTIONS

The following provides an overview of the cost categories considered to develop the CAPEX estimates of the proposed charging infrastructure installation recommendations.

CAPITAL EXPENDITURE (CAPEX) ESTIMATES

CORE PROJECT COSTS

EV Chargers

This is the cost for the core charger unit before any product add-ons or auxiliary equipment, such as pedestals, cable management gear, credit card reader, Wi-Fi router, etc. These items may or may not be required depending on the specific location or use-case. If needed, they are accounted for in the Materials/Equipment category. The EV Chargers category may include:

This includes:

- Level 2 EV chargers:
  - Low-output (~6.7 kW), ChargePoint CT4000 or equivalent
  - Medium-output (~11.5 kW), ChargePoint CPF50 or equivalent
  - High-output (~19.2 kW), ChargePoint CP6000 or equivalent
- Medium-output DC chargers (50-100 kW ChargePoint/Blink/ABB or equivalent)
- DC fast chargers dispensers and rectifier units (150 to 350 kW ChargePoint/Blink/ABB or equivalent)
- Inductive Charging Equipment (InductEV or equivalent), including:
  - Inductive charging power cabinets
  - Inductive charging pads/coil assemblies
  - Pre-cast sockets, pullboxes, and foundations
  - High-power cable sets
- Gateway module/load Management Devices

Note: This excludes costs for extended warranties and branding/white labeling.

Materials/Equipment

This includes costs of purchasing and installing materials typically required for fleet EV charging projects (other than the EV chargers themselves) including the following items:

- Wiring
- Conduit Systems (underground and/or surface-mounted)
- Trenching and/or directional drilling
- Pull Boxes (installed in the ground and/or surface-mounted)

- Aerial wire spans
- Footings for installation of EV charger pedestals and electrical service panels
- Power cords and cable management for Level 2 charging stations
- Gateway module/load Management Devices
- Bollards
- Wheel stops
- Step-down transformers
- Electrical service panels including sub panels
- Circuit breakers
- Signage
- Striping for parking stalls

Site Restoration

Site restoration covers the costs of installing civil/landscaping improvements to restore the site following excavation and other construction activities including:

- Minor restoration for civil infrastructure such as roadway and/or sidewalk repaving
- Minor curb and gutter restoration
- Minor surface water (drainage infrastructure) restoration
- Minor landscaping restoration such as replanting

Permitting

Each local authority with jurisdiction mandates electrical permits for installation of EV chargers:

- Electrical permit fees charged by local jurisdictions, typically $5k per site plus $1k for labor and contingency.

Utility Fees

This consists of fees charged by the electrical utility (REU) to bring additional power to the fleet charging depot to power the EV chargers, including:

- Electrical upgrade design
- Transformer replacement/upgrades
- Establishing new or upgraded service connection

SUPPORTING/SOFT COSTS

Design & Engineering

An estimated 25% mark-up has been applied to the project costs excluding charger costs to account for fees of site-specific electrical, civil, and structural design, including system integration, utility coordination, and permitting materials (plan sets, load calculations, conduit schedules, one-line diagrams, specifications, cut sheets, etc.).

Pre-Construction Services

Costs incurred before actual construction begins. They may include site visits, procurement, environmental assessments, soil testing, and contract execution.

Construction Management

Fees associated with overseeing the construction process, typically paid to construction managers or general contractors to manage specialized sub-contractors (electrical, trenching, paving, etc.), safety compliance and overall project management.

Mobilization

Costs related to setting up the construction site before work begins. It includes transportation of equipment, setting up trailers, temporary utilities, fencing and security.

Commissioning

Testing of all systems to ensure compliance, safety, and functionality, including utility integration, software validation, EVSE power draw, vehicle testing, IT network and backend charger management system.

Administrative & Legal Costs

Includes legal fees, insurance premiums for project-specific bonds or coverages, and/or administrative overhead to support the project through commissioning.

Contingencies

A 25-35% mark-up, depending on site size and complexity, has been applied to the project costs for each cost category consistent with the agency's capital project budgeting.

LIST AND DESCRIPTIONS OF TERMS AND ACRONYMS

acronym	Term	Description (if applicable)
AC	Alternating current	Electric current that periodically reverses its direction and changes its magnitude continuously with time, in contrast to DC (direct current). AC is used across the vast majority of the electric grid.
ADA	Americans with Disabilities Act	A civil rights law passed in 1990 that prohibits discrimination against individuals with disabilities in various areas of public life, including employment, transportation, public accommodations, and communications.
BEB	Battery-electric bus	A fully-electric bus operating on a battery that can be recharged with a suitable charging station.
BESS	Battery energy storage system	A device or equipment that stores electrical energy from the grid or on-site DER generation sources and releases it when needed.
CMS	Charge management system/software	A system used by fleet managers or charging network operators to monitor and optimize EV charging operations, charging prioritization, and site power outputs.
CTSA	Consolidated Transportation Services Agency	A designated entity responsible for coordinating and improving social service transportation in a specific geographic area. Established in California in 1979 through Assembly Bill 120 ("Social Services Transportation Improvement Act").
DC	Direct current	Electric current that is uni-directional. As opposed to AC (alternating current).
DCFC	Direct current fast charging/charger	Charger which rectifies the AC voltage from the grid as part of the charging station, typical power output levels of 50 kW and above.
DER	Distributed energy resources	Energy generation and storage technologies, such as solar PV and BESS, that provide or increase

		electrical capacity at a site to augment or temporarily replace grid power.
DHCL	Dignity Health Connected Living	A private non-profit agency that has been running the ShastaConnect rural transit service in ShastaCounty.
DRTC	Downtown Redding Transit Center	RABA’s main transit center in downtown Redding, at 1530 Yuba St, Redding.
EB	Eastbound	Denotes the general direction of travel to be eastward for any given bus route.
EV	Electric vehicle	Used synonymous for fully electric vehicles in this document (also known as battery-electric vehicles, or BEVs).
EVSE	Electric vehicle supply equipment	All infrastructure and equipment components necessary to transfer energy (electricity) from a charging station to an EV. In a wider sense, EVSE includes software and communication protocols between the charging hardware and the EV.
FCEB	Fuel cell electric bus	A bus operating on hydrogen fuel cell technology. See FCEV.
FCEV	Fuel cell electric vehicle	A type of electric vehicle that uses a fuel cell to convert hydrogen into electricity, powering the vehicle's electric motor and producing only water vapor as a byproduct.
FTA	Federal Transit Administration	The federal agency responsible for improving public transportation by assisting state and local governments in planning, implementation, and financing public transportation projects.
GHG	Greenhouse gas	A gas that contributes to the greenhouse effect, warming the Earth. Examples: carbon dioxide (CO_2), methane (CH_4)
HD	Heavy-duty	A heavy-duty vehicle is one with a GVWR of more than 26,000 lbs. (FHWA Class 7-8).
kw	Kilowatt	A measure of power, 1 kW = 1,000 Watts

kwh	Kilowatt-hour	A unit of energy often used when referring to electrical energy, such as the one stored in an EV's battery
LCFS	Low Carbon Fuel Standard	A market-based state policy administered by the California Air Resources Board (CARB) designed to provide incentives for low-carbon fuels, such as electricity. Dispensing electricity to EVs using charging stations is one way of generating LCFS credits and selling these credits can provide a revenue source.
LCTOP	Low Carbon Transit Operations Program	A California state funding program established in 2014 as part of the Transit, Affordable Housing, and Sustainable Communities Program, providing formula-based funding to transit agencies for operating and capital projects that reduce GHG emissions and improve mobility, with a priority on serving disadvantaged communities
LD	Light-duty	A light-duty vehicle is one with a GVWR of up to 10,000 lbs. (FHWA Class 1-2).
MCS	Megawatt Charging System	A charging connector and associated charger-vehicle communication protocol currently under development to support high-speed charging of heavy-duty vehicles at power outputs of more than 1 MW (1 Megawatt, i.e. 1,000 kW) and up to 3.75 MW.
MD	Medium-duty	A medium-duty vehicle is one with a GVWR of more than 10,000 lbs. and up to 26,000 lbs. (FHWA Class 3-6).
NB	Northbound	Denotes the general direction of travel to be northward for any given bus route.
NRV	Non-revenue vehicle	Vehicles in a transit agency's fleet used for purposes other than transporting passengers, such as maintenance, supervisory, or construction activities.
NZEV	Near-zero emission vehicle	A vehicle that combines a conventional gasoline, diesel or natural gas-powered engine with a

		battery that can be recharged from the electrical grid. Some regulations consider PHEVs an NZEV, others consider PHEVS an ZEV.
OCPP	Open Charge Point Protocol	A standardized communications protocol between a charging station (i.e. the hardware) and the charging network provider's central charging management system (see CMS – i.e. the software).
	Opportunity charging	A charging approach that relies on charging and EV's or BEB's battery in short intervals throughout the day or period of use instead of charging it all at once outside of its use period (such as overnight). In the case of electrified transit systems, it is commonly used to extend the range of BEBs to enable continuous service with minimal downtime along longer routes or blocks.
PG&E	Pacific Gas & Electric	Investor-owned utility providing natural gas and electric service to residential and commercial customers in northern and Central California
PV	Photovoltaic	Production of electric power from light using semiconducting materials in solar cells/panels
RABA	Redding Area Bus Authority	A joint-powers agency providing public transit services in Redding, Shasta Lake, Anderson, and other parts of Shasta County, California.
REU	Redding Electric Utility	Local municipal utility providing electric service to residents and businesses in the City of Redding
SB	Southbound	Denotes the general direction of travel to be southward for any given bus route.
SGR	State of Good Repair	A California funding program established under the Road Repair and Accountability Act of 2017 (Senate Bill 1) intended to provide consistent financial support for maintaining, rehabilitating, and modernizing transit vehicles and infrastructure in the state
SJJPA	San Joaquin Joint Powers Authority	A public agency that manages the Amtrak San Joaquins rail service in California. It is responsible

		for planning, expanding, and improving the service, as well as representing the interests of the communities it serves.
SOC	State-of-charge	Battery state-of-charge, measured as a percentage of the battery's usable capacity
SRTA	Shasta Regional Transportation Agency	A Regional Transportation Planning Agency (RTPA) responsible for developing and implementing transportation plans and policies for the Shasta County region in Northern California. SRTA's main functions include long-range transportation planning, coordinating transportation funding, and overseeing public transit programs, including (until 2025) ShastaConnect.
V2B	Vehicle-to-building	Similar to V2G, but with the energy stored in an EV being made available for use by other electrical loads in a building or at a facility, such as waste compactors, the HVAC system, or interior lighting.
V2G	Vehicle-to-grid	A technology enabled by charger hardware and software as well as features onboard an EV that allows energy to be sent back to the power grid from the battery of an EV.
V2V	Vehicle-to-vehicle	Similar to V2G, but with the energy stored in one EV being sent directly or indirectly via a charger to another EV parked at the same fleet facility, as enabled by appropriate charging and electrical infrastructure.
WB	Westbound	Denotes the general direction of travel to be westward for any given bus route.
ZEB	Zero-emission vehicle	A vehicle that does not emit exhaust gas or other pollutants from the onboard source of power, such as an EV or a fuel cell electric vehicle.
ZEV	Zero-emission bus	A bus that does not emit exhaust gas or other pollutants from the onboard source of power, such as a BEB or an FCEB.


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530-226-3075