Santa Cruz Branch Rail Line
Rail Transit Feasibility Study
Final Report


Source: SCCRTC

Santa Cruz County Regional Transportation Commission

December 2015

Santa Cruz Branch Rail Line

Rail Transit Feasibility Study-Final Report

Table of Contents

EXECUTIVE SUMMARY I

Study Area ii

Purpose of Study iii

Why Consider Rail Transit on the Santa Cruz Branch Line? iv

Measuring Feasibility: Goals and Objectives v

Stations and Scenarios Analyzed v

Technical Analysis: Ridership and Costs ix

Funding Assessment xii

Other Evaluation Measures/Feasibility xiii

Service Parameters xiv

Implementation Steps xv

Public Involvement xvi

Study Scope Limitations xvi

1.0 INTRODUCTION 1

1.1 Purpose of Study 1

1.2 Regional Context 2

1.3 Project Area 10

1.4 History of Corridor and Rail Line Purchase 12

1.5 Bicycle and Pedestrian “Rail Trail” 17

1.6 Outreach and Public Involvement 21

1.7 Study Contents 25

2.0 RAIL SYSTEM OPTIONS 28

2.1 Rail Technology 29

2.2 Rail Car Layout 38

2.3 Comparable Systems 39

3.0 STUDY GOALS & OBJECTIVES 40

4.0 RAIL TRANSIT SERVICE ALTERNATIVES 42

4.1 Scenario Development 42

4.2 Service Scenarios 50

5.0 METHODS AND ASSUMPTIONS 57

5.1 General Assumptions 57

5.2 Operating Details 63

5.3 Ridership Forecasting Methodology 70

6.0 TECHNICAL ASSESSMENT OF SERVICE SCENARIOS 77

6.1 Capital Cost Estimates 77

6.2 Operations & Vehicle Maintenance Cost Estimates 100

6.3 Ridership Forecasts 107

6.4 Funding Assessment 117

7.0 EVALUATION OF RAIL TRANSIT 128

7.1 Evaluation Measures 128

7.2 Evaluation Results 133

7.3 Performance Comparison 138

7.4 Other Evaluation Criteria 141

8.0 PARAMATERS FOR RAIL TRANSIT SERVICE 143

8.1 Key Decision Factors 143

8.2 Suggested Parameters 145

9.0 IMPLEMENTATION STEPS 156

9.1 Regulatory Setting 157

9.2 Governance Options 160

9.3 Implementation Activities & Timeframe 161

9.4 Next Steps 167

Appendices

Appendix A – Public Outreach Summary

Appendix B – Metrolink Engineering Standards for CPUC GO 26-D Compliance

Appendix C – Stadler GTW Technical Information

Appendix D – Scenario String Charts (Weekdays 6-9 am) and Sample Trip Chart

Appendix E – Detailed Capital Cost Estimates

Appendix F – Funding Programs Considered

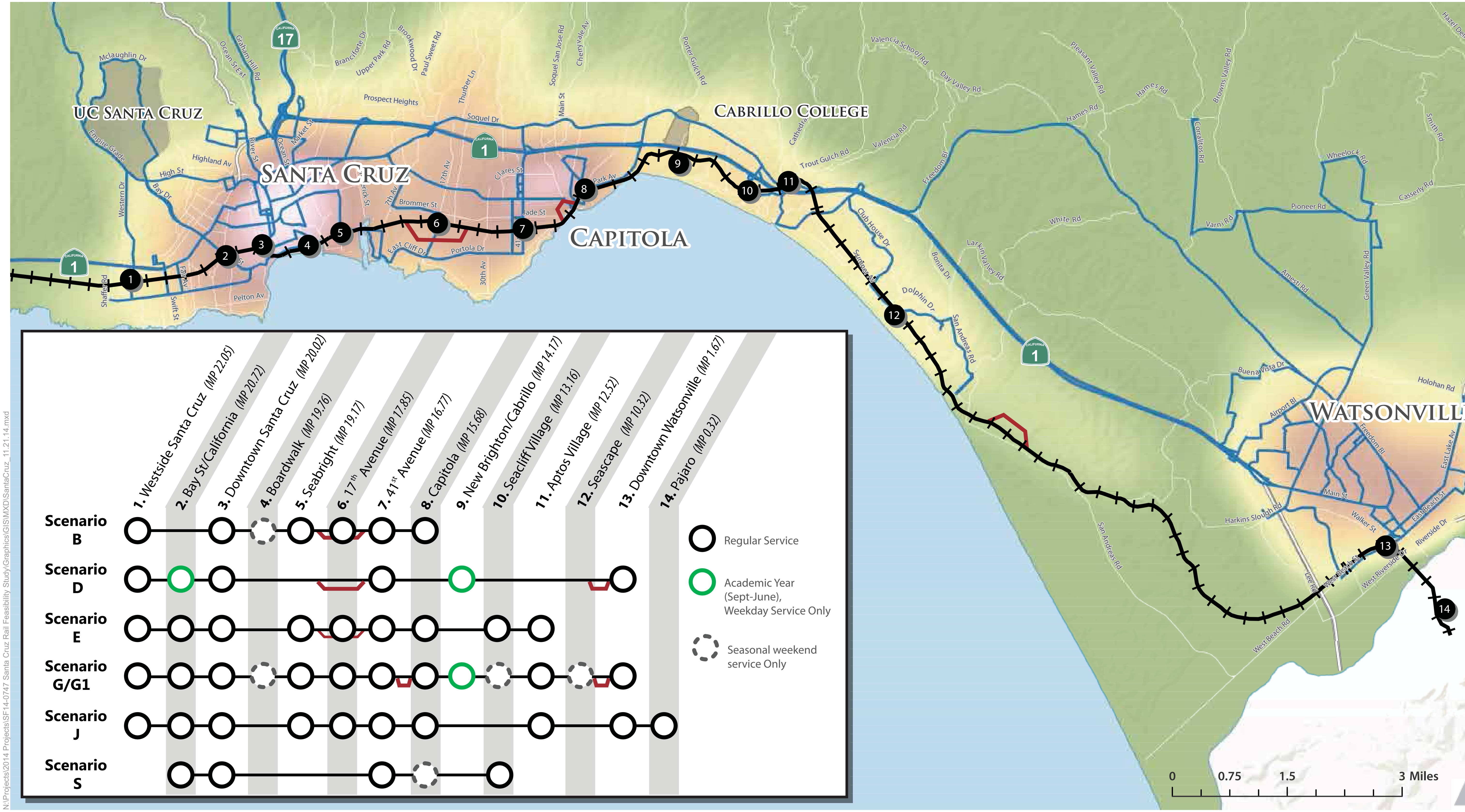
Appendix G – Goals and Evaluation Framework

Appendix H – Station Area Characteristics

Appendix I – Additional Information on Example Rail Systems in the U.S.

Appendix J – Smart Location Database Users Guide

Appendix K – Glossary of Terms



Potential Station | Santa Cruz Branch Line | Santa Cruz Metro Transit Routes | **Transit Likelihood:** High – Low | Passing Sidings *

SCCRTC RAIL STUDY

* *Varies by scenario.*

Figure ES-3
Santa Cruz Rail Feasibility Project Service Scenarios

November 2015

List of Tables

Table ES-1: Summary of Technical Analysis ... xi

Table 2-1: Rail Technology Overview ... 33

Table 2-2: Example Rail Systems in the U.S. ... 36

Table 4-1: Preliminary Station List ... 43

Table 4-2: Service Scenarios Initially Considered ... 47

Table 4-3: Screening Criteria for Service Scenarios ... 48

Table 4-4: Initial Screening of Service Scenarios Concepts ... 49

Table 4-5: Weekday Service Scenarios and Stations for Technical Assessment/Modeling ... 52

Table 5-1: Station Locations used in Simulation ... 60

Table 5-2: Scenario B Operating Details ... 64

Table 5-3: Scenario D Operating Details ... 65

Table 5-4: Scenario E Operating Details ... 65

Table 5-5: Scenario G Operating Details ... 67

Table 5-6: Scenario J Operating Details ... 68

Table 5-7: Scenario S Operating Details ... 69

Table 6-1: Capital Cost Estimate Summary ... 98

Table 6-2 Scenario S: Infrastructure Conceptual Cost Summary ... 99

Table 6-3: Scenario B (Santa Cruz – Capitola) O&M Costs ... 102

Table 6-4: Scenario D (Santa Cruz – Watsonville Peak Express) O&M Costs ... 103

Table 6-5: Scenario E (Santa Cruz – Aptos) O&M Costs ... 103

Table 6-6: Scenario G (Santa Cruz – Watsonville) O&M Costs ... 104

Table 6-7: Scenario G1 (Santa Cruz – Watsonville Locomotive) O&M Costs ... 104

Table 6-8: Scenario J (Santa Cruz – Pajaro Limited) O&M Costs ... 105

Table 6-9: Scenario S (Santa Cruz/Bay St – Seacliff) O&M Costs ... 105

Table 6-10: O&M Cost Summary ... 106

Table 6-11: Weekday Boardings, by Scenario ... 108

Table 6-12: Annual Boardings, by Scenario ... 109

Table 6-13: Peak Passenger Load ... 110

Table 6-14: Funding Sources Applicable to Capital Needs Only ... 118

Table 6-15: Funding Sources Applicable to Capital Needs and Ongoing O&M ... 119

Table 6-16: Potential Funding Sources Considered but Not Recommended 121
Table 6-17: Sample Farebox Recover Rate 124
Table 6-18: Sample Fares 125
Table 6-19: Rail System Costs and Fare Revenue over 20 years 126
Table 6-20: Annual System Ridership & Net Costs (1,000) 127
Table 7-1: Evaluation of Service Scenarios 134
Table 7-2: Scenario Performance Comparison 138
Table 7-3: Performance Comparison 139
Table 7-4: Ridership Comparisons 140
Table 9-1: Preliminary Implementation Timeline 166

List of Acronyms

CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CPUC	California Public Utilities Commission
CTPP	Census Transportation Planning Package
CWR	Continuously Welded Rail
DMU	Diesel Multiple Unit
EMU	Electric Multiple Unit
EPA	Environmental Protection Agency
FRA	Federal Railroad Administration
FRR	Farebox Recovery Rate
FTA	Federal Transit Administration
GTFS	General Transit Feed Specification
IP	Iowa Pacific Holdings
JPA	Joint Powers Authority
JTW	Journey-to-Work
LRT	Light Rail Transit
MBSST	Monterey Bay Sanctuary Scenic Trail
METRO	Santa Cruz Metropolitan Transit District
MPO	Metropolitan Planning Organization
MTIS	Major Transportation Investment Study
NCTD	North County Transit District
NTD	National Transit Database
O&M	Operations & Maintenance
P3	public-private partnership
PRT	Personal Rapid Transit
PTC	Positive Train Control
ROW	Right-of-Way
RTC	Santa Cruz County Regional Transportation Commission (also SCCRTC)
RTD	Regional Transit District
RTDM	Regional Travel Demand Model
RTP	Regional Transportation Plan
SC	Santa Cruz
SCCRTC	Santa Cruz County Regional Transportation Commission (also RTC)
SC&MBRR	Santa Cruz and Monterey Bay Railway (Iowa Pacific Holding)
SFMTA	San Francisco Municipal Transportation Authority
SMART	Sonoma-Marin Area Rail Transit
STOPS	Simplified Trips-on-Project Software
TAMC	Transportation Agency for Monterey County
TIGER	Transportation Investment Generating Economic Recovery
TOD	Transit Oriented Development
UCSC	University of California, Santa Cruz
UPRR	Union Pacific Railroad
VMT	Vehicle Miles Traveled
VTA	Santa Clara Valley Transportation Authority
WES	TriMet Westside Express Service

See Appendix K for Glossary of Terms

EXECUTIVE SUMMARY

Is rail transit service feasible in Santa Cruz County? What criteria should be used to define what is feasible? How can the community maximize use of the publicly-owned Santa Cruz Branch Rail Line? How much would it cost and how many people would ride rail transit? Could it help advance the community's mobility, environmental, economic, and other goals? Is there a "starter" rail transit service that could be implemented in the near term, and then augmented as demand and resources change? Could rail transit service be part of an integrated transportation network? How will rail transit service be coordinated with existing bus transit service, freight trains, planned regional and state rail service, and the planned Monterey Bay Sanctuary Scenic Trail Network – especially the 32 mile rail-with-trail project? These are some of the questions that spurred policy makers, agency staff, and community members to investigate if rail transit could serve some of Santa Cruz County's extensive transportation needs.

The Santa Cruz County Regional Transportation Commission (RTC) received a transit planning grant from the California Department of Transportation (Caltrans) to evaluate the feasibility of rail transit service[1] on the Santa Cruz Branch Rail Line. In May 2014, the RTC hired a team of consultants with extensive transit planning experience, led by Fehr & Peers, to conduct this study. The study includes a broad technical analysis of several public transportation service scenarios (developed based on input from the public), ridership projections, capital and operating cost estimates, review of vehicle technologies, and evaluation of funding options. Service scenarios were evaluated against multiple goals and objectives identified by the community, and compared to other rail transit systems in the nation. The report also discusses integration with other rail corridor uses, connectivity to other bus and rail services, and identifies feasible options for further analysis, environmental clearance, engineering, and construction. Based extensive input provided on the draft study, this final study includes additional information and clarification on many aspects of rail transit, as summarized in Appendix A.

[1] While there are many different types of passenger service that could operate on the Santa Cruz Branch Rail Line, this study focuses on public transportation options characterized by passenger service using the fixed guideway rail and either self-propelled or locomotive hauled passenger cars, operated on a regular basis by or under contract with a public transit agency or Joint Powers Authority for the purpose of transporting passengers within urbanized areas, or between urbanized areas and outlying areas.

STUDY AREA

The Santa Cruz Branch Rail Line is a continuous transportation corridor offering a variety of mobility options for residents, businesses, and visitors. In October 2012 the RTC completed acquisition of the rail line, which has been a transportation corridor since the mid-1870s, bringing it into public ownership. Funding for acquisition included state transit funds and passenger rail bond funds approved by the voters of both Santa Cruz County and the state of California. The rail corridor (Figure ES-1) spans approximately 32 miles of Santa Cruz County's coast from Davenport to Watsonville/Pajaro, runs parallel to the often congested Highway 1 corridor, and connects to regional and state rail lines. This underutilized transportation corridor is within one mile of more than 92 parks, 42 schools, and approximately half of the county's residents. Based on public input, travel patterns, and analysis of existing and forecasted future demographic conditions, this study focuses on the most populous and congested sections of Santa Cruz County – from the western edge of the city of Santa Cruz to downtown Watsonville - though service north to Davenport is not precluded from future analysis.

Figure ES-1: Santa Cruz Branch Rail Line

Source: SCCRTC, 2015

Although Santa Cruz County is not considered a major metropolitan area, the topography of the area concentrates development between the ocean and the mountains. The county's population density is one of the highest in California, with approximately 90,000 people living within one-half mile of the rail line. Areas along the rail line have population densities similar to Berkeley/Oakland and cities along the San Francisco Bay Peninsula. The number of people per square mile in the City of Santa Cruz and the Seacliff area are approximately 4,000; Live Oak ranges from 5,300 to 7,100 people/square mile, and the City of Watsonville has over 7,500 people/square mile.[2]

PURPOSE OF STUDY

The RTC was awarded a federal transit planning grant by Caltrans to conduct a rail transit study for the Santa Cruz Branch Rail Line. The objective of this study is to analyze potential public transit service scenarios using the rail fixed guideway, along with potential station locations that could serve Santa Cruz County. This analysis lays the groundwork for more detailed evaluation of operational characteristics and costs. Overall objectives of the study include:

- Analyze the feasibility of rail transit service on the Santa Cruz Branch Rail Line.
- Identify, evaluate and compare a range of near- and long-term rail transit service options.
- Understand how rail transit service can improve people's access to jobs, schools, recreation, goods/services, and other activities.
- Provide data regarding ridership potential, capital and operating/maintenance costs, revenue projections, and connectivity with other transportation modes.
- Identify governance and financing options.
- Meet or exceed sustainable communities, greenhouse gas emission reduction and natural environment protection goals. These include the California Global Warming Solutions Act of 2006 (AB 32) and Sustainable Communities and Climate Protection Act of 2008 (SB375) which aim to reduce greenhouse gas emissions, in part by reducing the number of miles people drive.
- Provide the community with general information regarding rail transit service options and service implementation, in consideration of forecasted ridership demand and funding.
- Identify possible locations for stations and passing sidings and assist local entities in ensuring coordination of land use, transit, trail, and freight plans along the corridor.
- Involve the community and the RTC board in the service evaluation and decision making process.

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[2] http://quickfacts.census.gov

WHY CONSIDER RAIL TRANSIT ON THE SANTA CRUZ BRANCH LINE?

When considering the current state of Santa Cruz County's strained infrastructure, as well as housing shortages and anticipated growth in population and jobs, we are faced with many questions. How will people get around? Where will they live? What kind of jobs will they find? What does this mean for quality of life? Will our highways support our growing transportation needs? Improvements in the housing supply and the transportation network are essential for a stronger local economy and quality of life.

> ***"I don't think we should plan for a [transportation] system that's 1956. We should plan for 2045."***
>
> **—Anthony Foxx, US Secretary of Transportation**

- **Provide mobility options.** Considering that local roads and highways are increasingly congested, that our population continues to grow, that state mandates require reductions in how much people drive, that many people in our community cannot drive, as well as our community values, it is important to provide transportation options which have the capacity to move people more efficiently and sustainably. Commuters, youth, seniors, low-income individuals, people with disabilities, businesses, and visitors have a diverse set of transportation needs. Adding new mobility options that expand travel choices can help address a multitude of these needs and provide an alternative to congested roadways.

- **More predictable travel times.** Congested roadways make it difficult to predict how long it will take to get places either by car or bus. Rail transit, operating on a fixed guideway, provides more reliable travel times. Transit riders are also able to relax, read, work, and avoid traffic.

- **Connecting Watsonville and Santa Cruz.** Rail transit could improve connections between the two largest and fastest growing cities in Santa Cruz County, expanding access to jobs, educational opportunities, and housing.

- **Connecting to California**. Rail transit would provide a new option for travel not only within Santa Cruz County, but would also connect at Pajaro Station with planned rail service to the San Francisco Bay Area, Monterey County, Sacramento, and south along the California Coast. Pajaro Station is about 20 miles from the planned High Speed Rail Station in Gilroy.

- **Rising demand for compact complete communities.** Public transportation investments can promote more walkable neighborhoods, with essential services and jobs nearby.[3] Compact development in turn provides a host of environmental and social benefits, helping to reduce vehicle miles traveled (VMT), fuel use, and greenhouse gas (GHG) emissions even from non-transit users. Compact development also makes the most of existing infrastructure (water, roads, utilities, schools, etc.) while minimizing sprawl into open spaces.

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[3] *Transit Cooperative Research Program (TCRP) Report 176: Quantifying Transit's Impact on GHG Emissions and Energy Use,* Transportation Research Board (TRB), 2015.

- **Funding landscape is changing**. The state's new Cap and Trade program includes significant funding for rail transit investments and is expected to grow over time. Recently the state has also made major policy changes to provide funding to maintain state highways but not to expand capacity on those highways.

Rail transit service could also contribute to or support many existing policies and goals of the RTC, local government, environmental groups and local business organizations. Coordination and collaboration with these entities would be essential to realize community goals. As part of a more diverse transit system, rail service would need to be integrated with existing fixed route bus service and the bicycle and pedestrian network. It is not realistic to represent rail transit service as the singular solution to many problems, yet it could provide a very strong supporting role in the future development of healthy sustainable communities in Santa Cruz County.

MEASURING FEASIBILITY: GOALS AND OBJECTIVES

At the start of this study, the RTC solicited input from the public on the goals, objectives and measures that should be used to evaluate the feasibility of rail service. Goals and objectives identified as priorities by the community are shown in Figure ES-2. These goals and objectives for rail transit in Santa Cruz County are consistent with regional, state and federal transportation planning goals and objectives related to access, mobility, maintenance, efficiency, economic vitality, safety, quality of life, and the environment.

STATIONS AND SCENARIOS ANALYZED

Based on existing and forecasted future travel patterns, as well as input from community members, technical stakeholders and rail peers, a series of station locations and service scenarios were analyzed for this study. The project team conducted a general, initial screening of ten service scenario concepts, with varying station locations, termini, and service hours. This included a qualitative assessment of ridership potential, capital costs, and connectivity to local, regional, state transit and intercity rail systems. Taking into consideration the initial screening, seven service scenarios (Figure ES-3), which represent a range of costs and near and longer term implementation potential, were selected for more detailed evaluation.

Figure ES-2: Study Goals and Objectives

Transportation Alternatives/Choices

GOAL 1: Provide a convenient, competitive and accessible travel option

More Options Provide additional and competitive travel options to address the current and future needs of the community (including employment, school, visitor, shopping, recreational, neighborhood and other daily trips)
Ridership Increase the number of people using transit
Faster Travel Times Reduce how long it takes to get places
Transit Connections Connect to the bus transit system (METRO)
Bike & Walk Connections Ensure connectivity to sidewalks, bike lanes and Monterey Bay Sanctuary Scenic Trail (or Rail-Trail)
Non-Drivers Expand options for seniors, children, people with disabilities, low-income, and those who cannot or do not drive
Visitors Expand options for visitors and tourists to reduce traffic congestion
Reliability Make it easier to predict how long it will take to get places (*reliability of transit travel times)*

Sustainability

GOAL 2: Enhance communities and the environment, support economic vitality

Reduce Traffic Reduce the number of cars on Highway 1 and local roads
Climate Reduce fuel consumption, greenhouse gas emissions, and air pollution
Other Car Impacts Reduce need for parking, road expansion and other land use effects of cars (preserve open space and reduce sprawl)
Serve Major Destinations Locate stations in areas with high concentrations of housing, jobs, services, visitors and activities
Economy Support access to jobs, shopping, tourist, and other economic activity centers/opportunities
Revitalization Stimulate sustainable development and revitalization of areas near stations
Minimize Impacts Minimize negative impacts of rail transit on neighborhoods, adjacent properties, and the environment (traffic, noise, parking, construction, etc)
Safety Provide safety measures to avoid conflicts between rail transit vehicles & cars, bicyclists or pedestrians
Consistency Ensure consistency with local, regional, state, and federal plans and policies

Cost Effectiveness

GOAL 3: Develop a rail system that is cost effective and financially feasible

Cost to Benefit (Cost Effectiveness) Develop a rail system that is cost effective
Cost per Rider Generate sufficient ridership to minimize per rider and system costs
Existing Resources Optimize use of existing infrastructure
Financially Feasible Develop a system that keeps operating and capital costs to a minimum
Funding Options Identify service options that are competitive for local, state, and federal funding sources
Efficiencies Maximize operational efficiencies, build partnerships with public and private agencies, groups, and interests

- Limited Service, Santa Cruz ←→ Capitola: Weekday and weekend service limited to primary stations[4] and a few key visitor destinations (Scenario B)
- Peak Express Service, Santa Cruz ←→ Watsonville: Service hours limited to peak weekday commute hours (Scenario D)
- Local Service, Santa Cruz ←→ Aptos: Weekday and weekend service to primary and secondary stations, including service near Cabrillo College (Scenario E)
- Expanded Local Service, Santa Cruz ←→ Watsonville: Weekday and weekend service to primary and secondary stations expanded to Watsonville (Scenario G)
- Santa Cruz ←→ Watsonville: Weekday and weekend service to primary and secondary stations utilizing FRA-compliant locomotives (Scenario G1)
- Regional Rail Connector, Santa Cruz ←→ Pajaro: Service connecting to future Capitol Corridor/Amtrak and Coast Daylight service at Pajaro to test potential for ridership demand with regional rail accessibility (Scenario J)
- Limited Starter Service, Santa Cruz/Bay St ←→ Seacliff Village: Very limited weekday and weekend service hours and station stops utilizing locomotives. (Scenario S)

While this represents a range of rail transit service options, the locations where service starts and ends (route/termini), the number and location of station stops, service days and times, vehicle types, passing sidings, station design and other factors could ultimately reflect a scalable hybrid of these scenarios and could change over time. For the purpose of estimating costs and travel times, light DMU vehicles[5] were analyzed for most scenarios. For Scenario G1, new locomotive-powered vehicles were analyzed. Scenario S included leased locomotive-powered vehicles, rather than purchasing new vehicles. If rail transit service is implemented, the range of transit vehicle types available would be analyzed during the procurement process.

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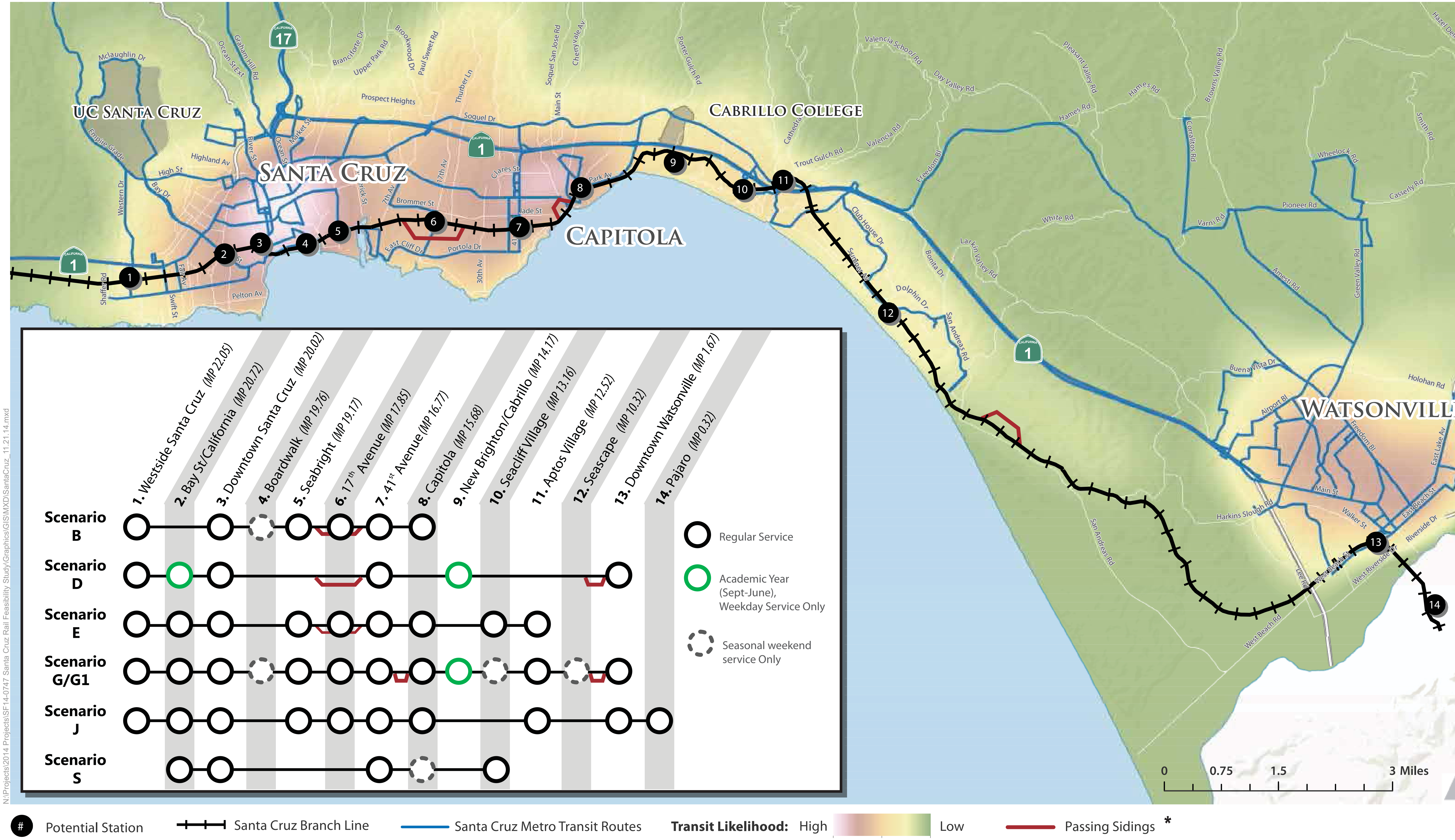
[4] Potential station locations anticipated to have higher ridership potential were identified as "primary stations". "Secondary stations" also have promising ridership potential, but not as high as primary stations. Other potential station locations were screened out for this analysis; however could ultimately be developed, in-step with growth in ridership potential (jobs, housing, infrastructure development or transit connections) or be utilized at special time periods (such as seasonal weekends or for special events).

[5] Light DMU: Diesel-electric Multiple Unit is a light, self-propelled tram-like rail unit consisting of 2 or more rail cars.



SCCRTC RAIL STUDY

* Varies by scenario.

Figure ES-3
Santa Cruz Rail Feasibility Project Service Scenarios

November 2015

TECHNICAL ANALYSIS: RIDERSHIP AND COSTS

Technical analysis of the scenarios described above included ridership forecasts, capital cost estimates, as well as operations and maintenance cost estimates.

Ridership: Fehr & Peers conducted a ridership modeling analysis to determine potential ridership demand at each station under each scenario. Based on existing travel and land use patterns, population and employment levels, as well as projected transit travel times, the ridership models found that in the base year[6] up to 1.65 million passengers per year (5,500 daily weekday boardings) would ride rail transit between Santa Cruz and Watsonville in Scenario G, which serves the greatest number of stations with the most frequency. This represents an increase in transit ridership, which currently is approximate 5.7 million on METRO's bus system.[7] In 2035, rail transit ridership could increase for this same service to over two million annual boardings. For the base year, the scenario with rail transit limited to morning and evening peak commute hours, serving significantly fewer stations had the lowest ridership estimate of 1,100 per day (287,500 annual boardings in Scenario D).

Capital Costs: In order to assess the capital needs of each scenario, consultants from RailPros conducted an assessment of existing infrastructure conditions and identified upfront and long-term cost estimates for the track, signal systems, crossings, stations, vehicles, and other components. In some instances, to minimize construction impacts once service is initiated and to reduce maintenance needs, full replacement and reconstruction of many rail elements is recommended and included in the cost estimates; though it is possible to initiate rail transit service before making all of the upgrades identified. The initial infrastructure construction costs (capital outlay) range from a low of $23 million (Scenario B: Capitola to/from Santa Cruz) to a high of approximately $48 million (Scenario G1: Watsonville to/from Santa Cruz using new locomotives). In addition to the base (or "raw") construction estimates, the study assumes an additional 30 percent for support costs (includes preliminary design and environmental review, preparing construction documents, permitting, construction management, etc.) and a 30 percent contingency. Not surprisingly, the capital cost is closely related to the amount of the rail line that is utilized for rail transit service, the number of stations, and the number of rail vehicles. The cost estimates are conceptual, based on recent unit costs on other rail projects in the California and the nation, as no engineering was performed for this feasibility-level study. Actual capital costs could range between 70 percent and 130 percent of these estimates, with more precise cost estimates only available following detailed surveying and engineering analysis.

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[6] "Base year" is from 2010 AMBAG Regional Travel Demand Model information.
[7] Santa Cruz METRO *June 2015 Monthly Ridership Summary* report.

Operations and Maintenance: LTK Engineering Services developed travel time forecasts, identified where new passing tracks (sidings) may be required to allow rail transit vehicles traveling in opposite directions to pass, and developed annual operating and maintenance cost estimates. This analysis found that with the capital upgrades identified, including new passing sidings, it would take either 36 or 41 minutes for rail transit vehicles to travel between Santa Cruz and Watsonville, depending on the number of station stops (6 or 10, respectively). Service between the Westside of Santa Cruz to Capitola Village would take 16 minutes. On average, rail vehicles would travel at 25-35 miles per hour (mph).

Annual Operating & Maintenance (O&M) costs were estimated for each of the operating scenarios under consideration. The annual O&M estimates are based on real cost data obtained from operating rail transit lines with similar service characteristics.

Cost data for ongoing annual costs for rail systems include:

- Rail vehicle operating costs – cost of operator salaries, dispatching, fuel, etc.
- Rail vehicle maintenance costs
- Ongoing rail right-of-way and station maintenance
- Administrative costs (including security, scheduling. marketing, and other administrative activities)

The rail service operating costs were derived by multiplying the number of annual hours that rail equipment would be in service for each scenario by the average hourly cost of providing service for six comparable rail transit systems. The rail vehicle maintenance costs were derived by multiplying the number of vehicles required for each scenario by an average maintenance cost per vehicle for comparable rail systems. Administrative costs represent an average of 38 percent of the combined total of annual rail operating and maintenance costs for peer systems. A 20 percent contingency was then added to the sum of these three cost sectors, resulting in the total O&M cost estimate for each scenario. The operating costs for scenarios utilizing locomotives pulling coaches (Scenarios G1 and S) are higher due to the additional vehicles, heavier weight and increased fuel consumption.

Table ES-1 provides a summary of the ridership, travel time, and cost estimates for each scenario analyzed. Preliminary capital and operating costs for Scenario S were provided by Iowa Pacific and then adjusted for consistency regarding contingency and support costs, Positive Train Control, and labor rates.

TABLE ES-1: SUMMARY OF TECHNICAL ANALYSIS

Metric	Scenario B SC - Capitola	Scenario D Peak: SC-Wats	Scenario E SC-Aptos	Scenario G SC-Wats	Senario G1 – FRA SC-Wats	Scenario J SC-Pajaro	Scenario S - FRA SC/Bay St -Seacliff
Track Miles	6.6	20.5	9.5	20.5	20.5	21.8	7.6
One-way Travel Time	16 min	36 min	23 min	41 min	41 min	43 min	25 min
Operating Hours and Frequency	All day, every 30 minutes	Peak hours Mon-Fri, every 30 minutes	All day, every 30 minutes	All day, every 30 minutes	All day, every 30 minutes	Match regional train schedules; 6 RT/day	Reduced hours; limited mid-day & weekends
Trips per weekday (both directions)	60	24	60	60	60	12	36
Number of vehicles (rail vehicle sets)	3	4	3	5	5	2	3 (leased)
Number of stations (weekday)	6	6	9	10	10	10	4 + 1 seasonal
Operating hours per year (revenue rail transit service hours)	9,800	4,313	9,800	13,591	13,591	5,024	5,513
Annual service miles (revenue miles)	145,000	136,000	204,000	400,000	400,000	56,000	91,500
Annual Boardings Low Estimate (Base Year)	846,000	287,500	1,413,000	1,509,000	1,509,000	528,000	420,000
Annual Boardings High Estimate (2035)	1,287,000	405,000	1,926,000	2,031,000	2,031,000	741,000	660,000
Daily weekday boardings Low Estimate (Base Year)	2,800	1,100	4,700	5,000	5,000	1,750	1,400
Daily weekday boardings High Estimate (2035)	4,300	1,600	6,400	6,800	6,800	2,500	2,200
Annual O&M cost *(operations, vehicle maintenance, general admin, & contingency)*	$7M	$3.8M	$7M	$9.9M	$14M	$3.7M	$5.4M

TABLE ES-1: SUMMARY OF TECHNICAL ANALYSIS

Metric	Scenario B SC - Capitola	Scenario D Peak: SC-Wats	Scenario E SC-Aptos	Scenario G SC-Wats	Senario G1 – FRA SC-Wats	Scenario J SC-Pajaro	Scenario S - FRA SC/Bay St -Seacliff
Annualized Recurring Maintenance of Way	$705k	$1.5M	$845k	$1.5M	$1.8M	$1.6M	$445k
Average Annual Cost	$7.6M	$5.3M	$7.75M	$11M	$16M	$5.3M	$6M
Infrastructure Cost *(tracks, stations)*	$23M	$40M	$28M	$41M	$48M	$41M	$19.7M
Vehicles	$25.5M	$34M	$25.5M	$42.5M	$61.5M	$17M	$0 (lease)
Total Capital Outlay *(infrastructure+vehicles +30% contingency & 30% support)*	**$77M**	**$119M**	**$85M**	**$133M**	**$176M**	**$93M**	**$31.5M** *(vehicle lease in O&M)*
Total Capital Outlay per Mile	*$12M*	*$6M*	*$9M*	*$6.5M*	*$8.5M*	*$4M*	*$4M*

Source: Fehr & Peers, LTK, RailPros, 2015, Scenario S – Iowa Pacific, adjusted for consistency
Notes: Costs shown in $2014 dollars. SC =Santa Cruz, Cap = Capitola, W = Watsonville, FRA = Federal Railroad Administration; Infrastructure (or "raw") costs include capital construction costs such as tracks, stations, and sidings.

FUNDING ASSESSMENT

A core component for demonstrating feasibility for any transit project is the ability to secure adequate funding for project implementation (planning, environmental review, design, procurement and construction) and for ongoing system operations and maintenance. Initiation of new rail transit service in Santa Cruz County would require a combination of federal and/or state capital funding, as well as new revenues for ongoing operations. This study includes an inventory of existing and potential new federal, state, regional, local, and private funding sources and identifies funding strategies, sources and mechanisms that are most reasonable to pursue. The study also evaluates a range of passenger fare levels that could optimize revenues without significantly impacting ridership levels.

For the purposes of this study it was assumed that funding sources used to fund the existing bus transit system would not be redirected to fund rail transit. The study found that a successful funding strategy for any scenario would need to include a new countywide sales tax with some portion dedicated to rail and some combination of the following sources – U.S. Department of Transportation TIGER grant program, Federal Transit Administration (FTA) §5309 Fixed Guideway Small Starts grant program, and/or California Cap and Trade program funds. Additional potential sources of revenue include regional shares of state and federal funds (such as the State Transportation Improvement Program), federal Economic Development Administration public works grants, FTA §20005(b) Transit Oriented Development (TOD) grants, developer fees, Smart Cities, Sustainable Communities, Healthy Neighborhoods and other land use or planning type grants; as well as public-private partnerships (P3).

Taking into consideration the universe of sources that may be available for capital and ongoing operations, higher cost scenarios could be more difficult to fund based on the current funding environment.

OTHER EVALUATION MEASURES/FEASIBILITY

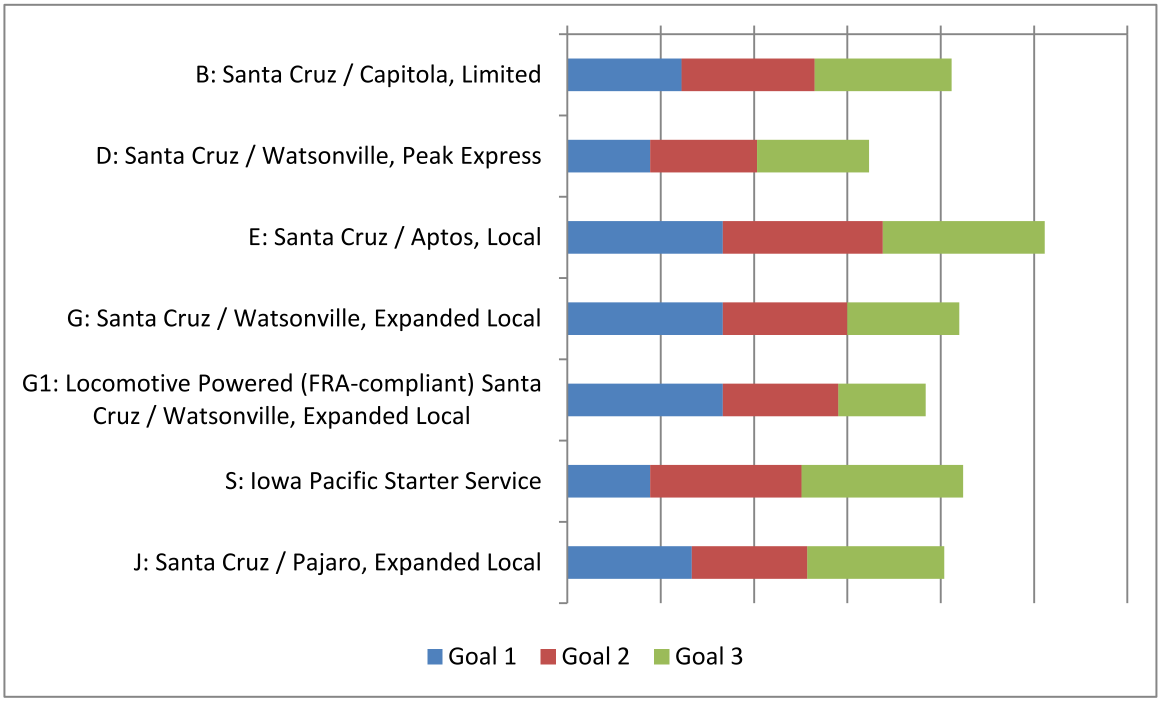
In addition to the base metrics of ridership and cost described above, an evaluation framework was developed to evaluate rail transit service along the Santa Cruz Branch Rail Line in the context of the goals and objectives identified by the community for this study. Each of the seven scenarios was comparatively evaluated against several quantifiable metrics. These evaluation measures included criteria to measure: transit operations and performance, connectivity and quality of access, livability and economic vitality, neighborhood and environmental impacts, impacts of construction on homes and businesses, capital and operating costs, and funding competiveness. Specifically, data for each of the following measures were considered:

- Travel time Competitiveness
- Boardings (ridership)
- Disadvantaged Communities/Equity
- Household Connectivity
- Bicycle/Pedestrian Connectivity
- Transit Connectivity
- Economic Development
- Job Access
- Traffic Impacts
- Environmental Benefits
- Noise & Vibration
- Parking Constraints
- Minimize Impacts to Homes/Local Businesses
- Capital Cost
- Operating and Maintenance (O&M) Costs
- Annualized Lifecycle Cost per Trip
- Funding Potential

Comparing the seven service scenarios based on the goals and evaluation measures (see Figure ES-4 and Section 7), Scenario E (local service between Santa Cruz and Aptos Village) scored the highest, followed by Scenario G (local service between Santa Cruz and Watsonville) and Scenario S (limited service from Santa Cruz to Seacliff). Scenario D (Watsonville/Santa Cruz Peak Express), which only operates during peak commute hours, has the lowest ridership and scored the lowest.

Figure ES-4: Evaluation of Scenarios

Advancement of project goals



GOAL 1 - Transportation Alternatives/Choices: Provide a convenient, competitive and accessible, travel option

GOAL 2 – Sustainability: Enhance communities & the environment, support economic vitality

GOAL 3 - Cost Effectiveness: Develop a rail system that is cost effective and financially feasible

Source: Fehr & Peers, 2015. Reflects equal weighting for each measure.

SERVICE PARAMETERS

This study evaluates the feasibility of implementing rail transit service along the Santa Cruz Branch Rail Line based on how well the range of potential service scenarios advance goals and objectives identified by the community. The technical analysis and evaluation of the service scenarios found that phased implementation of rail service within Santa Cruz County is feasible.

The service options are feasible from a constructability and operational standpoint and all options would improve accessibility and mobility along the underutilized rail corridor. Section 8 describes possible parameters and considerations for introducing rail transit service between Santa Cruz and Watsonville; the ultimate decision to pursue and implement rail transit service will be based on key decision factors.

Key decision factors include: available funding, ability to achieve community goals, and customer needs. Feasibility will rely heavily on securing a new sales tax with a portion of the funds dedicated for ongoing operation of rail transit service and which would provide an attractive match to federal and/or state grants for capital infrastructure. Additional information from the environmental analysis, market analysis, design engineering, and integrated system planning would also be used to make a final determination regarding what service alternative or hybrid to implement, if any.

IMPLEMENTATION STEPS

Before rail transit service could be initiated, several steps would need to be taken. Near-term (1-5 year) and mid-term (5-10 year) steps involved in transit project implementation include:

- Draft Environmental Studies and Conceptual Engineering –near-term.
- Preferred Alternative Selection and Preliminary Engineering –near-term.
- Final Design, Construction Documents, and Funding – near-term
- Right-of-Way (ROW) Acquisition for stations and sidings, if needed – near-term
- Construction Contractor Procurement – mid-term
- Construction – mid-term
- Vehicle Procurement – mid-term
- Opening – mid-term

Other considerations that would need to be addressed prior to implementation include:

- Integration/coordination with freight service
- Regulatory requirements – FRA and/or CPUC
- Governance structure for agency operating rail service
- Service operator
- Coordination with Santa Cruz METRO bus service

- Ridership forecasting using FTA Simplified Trips-on-Project Software (STOPs) methodology required for federal funding
- Funding strategies, competitiveness and procurement

PUBLIC INVOLVEMENT

Broad community participation helped shape this study, with extensive input gathered at several stages of study development. At the project outset in 2014, 2,000 members of the community provided input on study goals and objectives, evaluation measures, service scenarios, station locations, and operating hours. Through the Draft Study, the community considered the results of ridership, revenue and cost estimates and actively engaged in the discussion about the feasibility of future rail transit service.

Information about the study was provided at public meetings, workshops, and open houses, meetings with community organizations and public agencies, at community events (including farmers markets and First Friday), posted on a project-specific page on the RTC website (www.sccrtc.org), distributed through the RTC's eNews email group (http://www.sccrtc.org/about/esubscriptions/), and via dozens of media articles.

During the 70 day review period for the Draft Study in 2015, the RTC received over 400 written comments and over 2,600 people took a survey about the findings of the analysis. This final document provides clarification and additional information on topics raised by members of the public, Commissioners, RTC Committees, interest groups and partner agencies. Appendix A contains more information about public outreach and input, as well as a summary of comment topics and responses. It is important to note that this is a feasibility study, and answers to some questions would not be available until more detailed analysis is done through environmental, design engineering, or system planning stages.

The RTC received the final Rail Transit Feasibility Study at its December 3, 2015 meeting.

STUDY SCOPE LIMITATIONS

The scope of this study is limited to a preliminary analysis of rail transit options along the publicly-owned Santa Cruz Branch Rail Line. This is not a detailed service or implementation plan. If the RTC decides to move forward with implementing service, environmental review and engineering level design work would be initiated to provide more detailed analysis of potential environmental impacts, station locations, parking needs, and integration with the planned Monterey Bay Sanctuary Scenic Trail (MBSST or "rail trail"). Rail transit service hours, schedules, and frequency would be evaluated and coordinated with METRO buses and established with public input during service planning. Additionally, evaluation of multimodal transportation improvements along the heavily-traveled Santa Cruz to Aptos corridor is also in process as part of the Santa Cruz County Unified Corridors Plan. Starting with development of a multimodal county level travel demand model, the Unified Corridors Plan will analyze transportation investments on the parallel routes of Highway 1, Soquel Avenue/Drive and the Santa Cruz Branch Rail Line to identify the combination of investments that most effectively move people and provide transportation choices.

The RTC recognizes that there are also other options for the rail right-of-way that have been analyzed in the past or could be analyzed in the future. This includes other rail transit service – such as recreational rail service or intercity rail service to the San Francisco Bay Area or Monterey County; or expanded freight service. Some members of the community have also expressed interest in using the Santa Cruz Branch Rail Line for bus rapid transit (BRT) or personal rapid transit (PRT). Expanding rail transit service from downtown Santa Cruz to Harvey West business area near the Highway 1/Highway 9 intersection or up to Felton and other parts of San Lorenzo Valley has been suggested. Coordination with Big Trees/Roaring Camp to extend service from the downtown Santa Cruz wye toward Harvey West and the San Lorenzo Valley could take place in the future. Many members of the community have also requested that rail transit service be provided from Santa Cruz to San Jose over the Santa Cruz Mountains. This study does not preclude future analysis of these and other options, but they were outside of the scope of this study.

1.0 INTRODUCTION

Interest in expanding transportation options along the heavily traveled Santa Cruz – Watsonville corridor brought about purchase of the continuous 32-mile Santa Cruz Branch Rail Line by the Santa Cruz County Regional Transportation Commission (RTC) in 2012. With the purchase of the rail line, policy makers, collaborators, agency staff, and community members could investigate options to more effectively utilize the rail corridor to serve Santa Cruz County's diverse transportation needs. This feasibility study evaluates rail transit service scenarios designed to meet multiple objectives and identifies options to move forward for further analysis, environmental clearance, engineering, construction, and implementation as funding becomes available.

1.1 PURPOSE OF STUDY

The RTC was awarded a federal transit planning grant by the California Department of Transportation (Caltrans) to conduct a rail transit study for the Santa Cruz Branch Rail Line. The objective of this study is to analyze potential rail transit service scenarios, along with potential station locations that could serve Santa Cruz County. This preliminary assessment is intended to lay the groundwork for decisions about pursuing more detailed definitions of operational characteristics and costs. Overall objectives of this study include:

- Analyze the feasibility of rail transit service on the Santa Cruz Branch Rail Line
- Identify, evaluate and compare a range of near- and long-term rail transit service options
- Understand how commuter and/or intercity rail transit service might improve people's access to jobs, schools, recreation, goods/services, and other activities
- Provide data regarding ridership potential, capital and operating/maintenance costs, revenue projections, and connectivity with other transportation modes
- Provide governance and financing options
- Provide the community with practical recommendations regarding implementation of rail transit service, in accordance with forecasted ridership demand and funding
- Involve the community and the RTC board in the decision making process regarding next steps
- Provide information on possible station locations and passing sidings in order to assist local entities in coordination of land use, transit, trail, and freight plans along the corridor.

1.2 REGIONAL CONTEXT

As noted in the 2014 Regional Transportation Plan (RTP), there are a broad range of transportation challenges in Santa Cruz County. These include traffic congestion, access to jobs and services, safety, system preservation, greenhouse gas emissions, energy consumption, and funding, among others. Roadways between Santa Cruz and Watsonville are often at capacity, with buses also stuck in traffic during peak travel periods. The RTC's decision to purchase the Santa Cruz Branch Line in 2012 recognized that this continuous transportation corridor has the potential to address some key challenges and to:

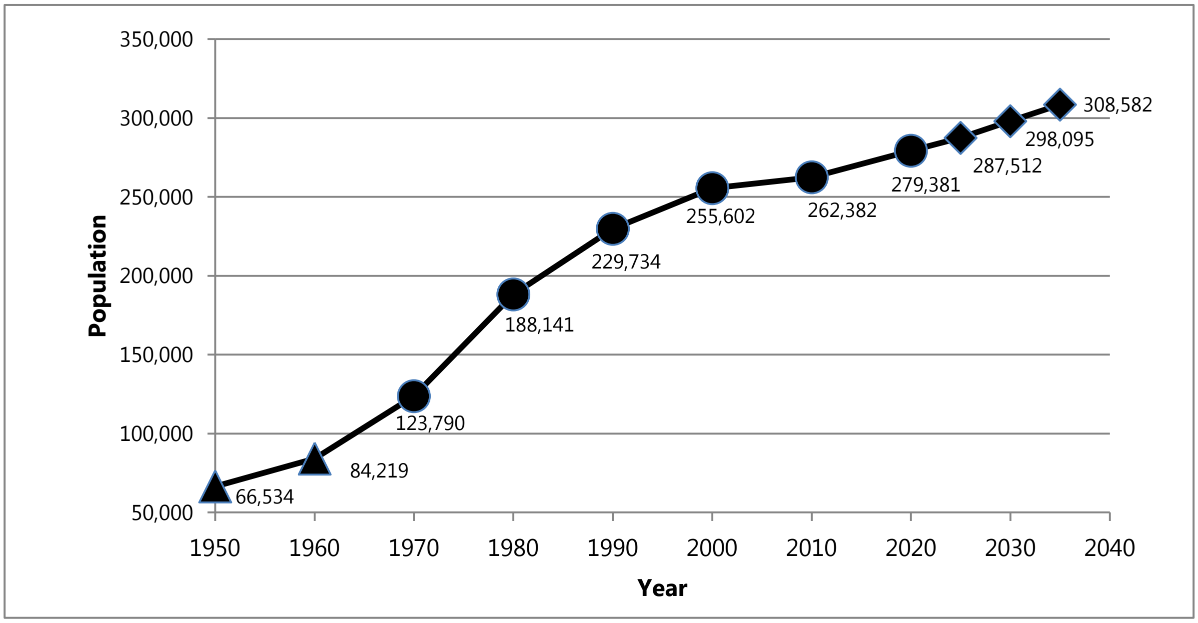
- Improve access to jobs and housing;
- Reduce travel times and provide more reliability;
- Reduce fuel consumption and greenhouse gas emissions;
- Expand travel options within Santa Cruz County and to other areas of the region and state; and
- Advance multiple other local, regional, state, and federal transportation goals.

The RTC used California and Santa Cruz County voter-approved Proposition 116 passenger rail bond funds and state transit funds to purchase the line. Prior to RTC's purchase of the rail line, Union Pacific Railroad only permitted use of the corridor for freight rail service.

1.2.1 WHY CONSIDER RAIL?

When asking the question, "Why consider adding rail transit to the transportation mix?" one might look at context and trends. First, consider existing roadway conditions, and that the majority of Santa Cruz County residents lives and works within a mile of the Santa Cruz Branch Rail Line. Approximately 90,000 people currently live within one-half mile of the rail line. Additionally, the Association of Monterey Bay Area Governments (AMBAG) estimates that Santa Cruz County is projected to experience a population gain of 46,200 residents by 2035 (Figure 1-1), requiring 15,720 additional housing units. Approximately 21,000 new jobs are projected. This is a modest growth rate by many standards, but when considering the current state of public infrastructure, housing shortages, and physical constraints, the impacts will be significant. How will people get around? Where will they live? What kind of jobs will they find? What does this mean for quality of life? Will our highways support a growing number of workers who commute both within and out of the county? Currently about 25 percent of the workforce in Santa Cruz County commutes north or south to jobs outside the county. Many people would like to see that percentage decrease. In order for that to occur, new jobs with livable wages will need to be created and sustained within the county. In order to attract and retain the talent and skill, as well as employers and companies essential for a stronger local economy, improvements in both the housing supply and the transportation network will be needed. The two are inextricably linked.

Figure 1-1: Historical and Projected Santa Cruz County Population



Sources: CA Department of Finance (▲), U.S. Census Bureau (●), AMBAG Projections (♦)

Adding rail transit would advance goals and policies in the 2014 Regional Transportation Plan (RTP) to improve access and increase safety in cost-effective and environmentally beneficial ways. The RTP policies were shaped by a sustainability framework that is based on the "triple bottom line" definition of sustainability: to maintain progress towards generating safe, equitable and cost-effective access to daily needs, while supporting economic vitality, protecting the environment, and meeting state requirements. The policies are outcome based, broad enough to adapt to changing conditions and not confined to a specific mode or project. The 2014 RTP was also the first time that land use coordination was included in the planning process for transportation. The following are just some of the reasons rail transit is consistent with adopted policies in the RTP as well as with recent policy and planning initiatives of local government and business organizations.

Need to provide options. Commuters, youth, seniors, low-income individuals, people with disabilities, businesses, and visitors have a diverse set of transportation needs. Adding new mobility options that expand travel choices can help address a multitude of these needs within the most heavily-populated parts of the county. The 32-mile rail right of way offers a continuous corridor to provide short and long distance travel needs. While some people may be able to ride a bike or walk to their destinations, many people depend on transit for short and longer distance trips. Transit can reduce social and economic inequalities by enhancing mobility for all.

More reliable travel times. Automobile and bus trip times have become increasingly unreliable as congestion affects not only highways, but also arterials and local streets. Unpredictable trip times, wasted fuel and loss of productivity are costs paid by residents, visitors, and businesses alike. Trips taken by rail provide an alternative to congested roads, could free up capacity on roadways, and afford transit users time to be productive, read, or use electronic devices. Because rail transit trips are not impacted by congestion, they provide a greater degree of travel time reliability. In terms of capacity, an average of about 2,000 automobiles per hour per highway lane can be accommodated before inducing congestion. Rail transit, in comparison, can serve up to 12,000 passengers per hour on single track, depending on rail vehicle length and frequencies. Thinking long term, the rail corridor provides an important public transit option to serve the needs of the community well into the future.

Improve connectivity. Rail transit service has the potential to improve connectivity between communities within the county, and also can connect with other rail service to adjoining counties, the Bay Area and Southern California. A station stop at the Pajaro/Watsonville junction (where the Santa Cruz Branch Line ends) is planned for both the extension of the *Capitol Corridor* train (Sacramento – Oakland - San Jose) into Monterey County and the proposed new *Coast Daylight* train service between Los Angeles and San Francisco (a project of the Coast Rail Coordinating Council). More details about these planned intercity state rail services are provided in the Regional Rail section below.

Scalable. Once investment is made to upgrade basic infrastructure -- such as track, structures, signals and stations -- capacity of rail transit vehicles can be increased by adding railcars or increasing frequency as demand grows.

Support economic vitality. The economy of Santa Cruz County is projected to add nearly 21,000 jobs by 2035. With current auto-based transportation infrastructure at capacity, other alternatives need to be explored to meet market demands of the coming decades. In particular, Santa Cruz County currently has a marked jobs-housing imbalance, with large numbers of workers commuting each day from more affordable housing in the Watsonville area to service sector or middle income jobs in Santa Cruz. Approximately 20% of employed residents commute to jobs in Silicon Valley.

Economic stakeholders, including the Santa Cruz Chamber of Commerce, have stated that a rail transit system in Santa Cruz County could provide an economic boost. For those commuting between Watsonville and Santa Cruz, rail service could provide a reliable and cost-effective alternative to commuting along congested Highway 1, allowing the money saved on personal fuel to be instead spent in the local economy. The Chamber also suggests that rail transit service for both customers and workers would increase the county's competitiveness as a potential location for tech and other companies, increasing job opportunities for Santa Cruz County residents.

Support efficient land use. Economic activity is attracted to rail transit lines because rail embodies a long-term investment that is not easily moved. Transit-oriented development, which is more compact than auto-based development, allows for the creation of walkable neighborhoods which improve quality of life while increasing desirable foot traffic in commercial areas. Such transit-oriented revitalization would allow for the creation of more affordable housing without the detrimental effects of sprawl into local open spaces and farmlands or the need for additional vehicle parking and capacity on roads as the population grows. Transit-oriented, mixed use neighborhoods, with shopping and dining within a walkable distance, allow those squeezed by the current housing crisis to have increased affordable housing options near to where they work or study.

Any new investments in compact affordable housing will also gravitate toward high quality transit corridors. Recent work by the County of Santa Cruz to bring sustainable principles into land use planning, to improve the permitting process, and to develop a strategic blueprint to build a stronger local economy can all be supported by focused investment in the rail transit corridor. Likewise, other local jurisdictions are evaluating zoning and policy changes to support more efficient development and encourage bicycling, walking and transit use.

Focusing new jobs and housing along the rail line is also consistent with Senate Bill 375 (SB375) and other state mandates to reduce greenhouse gas emission. At the heart of SB375 is the requirement to coordinate transportation investments with land use patterns in order to reduce the number of vehicle miles traveled. This includes investing in projects that provide more direct access to destinations and expand sustainable transportation options. The AMBAG Sustainable Communities Strategy (SCS) plan identifies strategies to minimize potential impacts of growth by focusing new housing, commercial, and employment-related developments within areas with frequent transit service – considered Transit Priority Projects (TPP), and mixed use projects that include residential, commercial, and other uses.

Rising demand for complete communities. Even for people who do not use transit, the availability of good quality transit service fosters communities where trip distances are shorter, and walking and cycling are more attractive options.[8] This supports the changing needs of aging baby boomers, as well as preferences of "millennials" and others who want to live in walkable neighborhoods with and a variety of essential services nearby. Data show that some millennials are choosing a mix of options like car sharing, ridesharing, cycling and transit over car ownership, and prefer to spend time relaxing or using mobile

[8] This is growing evidence that the land use benefits of transit are often greater than even the benefits generated by transit ridership. *Quantifying Transit's Impact on GHG Emissions and Energy Use—The Land Use Component*, TRB TCRP Report 176, 2015

devices instead of driving.[9] These preferences also support more active, healthier communities, and changes needed to achieve state and federal emissions reduction requirements.

Coastal Access. The Coastal Commission noted that reviving regular passenger service on the Santa Cruz Branch Line is directly supportive of the State's Coastal Act policies to maximize opportunities for public access, mitigate overcrowding or overuse of any single coastal area, provision for lower-cost visitor and recreation facilities, and protection of highly scenic coastal views.[10] Rail service would provide tourists and visitors with the option to move about and access beaches and other local features without using their cars. It has the potential to distribute recreational access to those beaches best able to accommodate it, so as to mitigate parking and roadway congestion issues, and to protect resources and neighborhoods from overuse in anyone area. Passenger rail service also has the potential to greatly enhance the recreational value of the Monterey Bay Sanctuary Scenic Trail (MBSST). For example, walkers and runners could ride rail transit in one direction and return on the path in the other direction. This would expand coastal public access opportunities for persons of all ages and abilities.

Reduce emissions. Rail infrastructure offers an important resource to reduce greenhouse gas emissions (GHG) from single occupant vehicles and position our community to be more competitive for transportation funding that is increasingly requiring GHG reduction strategies. The impacts of climate change become more significant every day. A prudent approach to plan for the future is to expand transit use, laying the foundation to transition away from fossil fuel dependence as rail vehicle technology advances or electrification becomes feasible. To delay may be more costly in the long-term.

Funding landscape is changing. State and federal plans and funding programs are increasingly focused on sustainability principles, especially as California seeks to create land use and transportation policies to accommodate a growing population and combat the greenhouse gas emission effects of cars while preserving crucial open space resources.[11] For instance, one new funding source for transportation at the state level is the Cap and Trade program. Contributions to rail are expected to grow over time, with the California State Transportation Agency, which sets policy direction for the Department of Transportation (Caltrans) increasingly supporting rail

> ***"We're going through a transformative time in transportation and in rail. Our shared objective is to see passenger rail in California become a viable robust service."***
>
> **—Brian Kelly**
> **Secretary, California State Transportation Agency**

[9] *Millennials and Mobility: Understanding the Millennial Mindset and New Opportunities for Transit Providers*, Transit Cooperative Research Program Web-Only Document 61, Transportation Research Board, July 2013

[10] California Coastal Commission comment letter on the Draft Rail Study, July 2015.

[11] For example Caltrans' 2040 California Transportation Plan, Smart Mobility Framework, Strategic Management Plan, District System Management Plan, Highway 1 Corridor System Management Plan, State Rail Plan, and Freight Mobility Plan.

investments. It is still too early to predict outcomes, but this does represent a shift in priorities at the state level. Furthermore, some state and federal programs provide funding specifically for rail or transit.

Integrated Transportation System. The introduction of a rail transit service in Santa Cruz County would contribute to or support many existing policies and goals of the community, the RTC, local government, environmental groups, and local business organizations, as well as state and federal agencies. Coordination and collaboration with these other entities would be essential to realize many goals and policies. As a key link in a more diverse transport system, rail service would need to be integrated with existing fixed route bus service. While it is not realistic to represent rail transit service as the one solution to many problems, it could provide a very strong supporting role in the future development of healthy sustainable communities in Santa Cruz County.

No transportation improvements are self-supporting. Transportation options for the public are part of the core services for the greater good that are not self-supporting, but rather "subsidized" from taxes and fees. The cost of transportation projects – whether it be for highways or rail – are not covered by user fees and are borne by the community based on their determination of what's best for healthy communities, a vibrant economy and preservation of the environment. In Santa Cruz County, the topography of the ocean and mountains concentrates much of the population to the narrow coastal shelf. Congestion on Highway 1 is exacerbated by these limitations. Conversely, the high population densities indicate conditions supportive of rail transit. When exploring expanded options to address travel needs in this corridor, it is practical to look at the relative benefits and costs of transportation options, both in the short and long term.

1.2.1.1 Characteristics of Success

Characteristics of the most successful rail transit systems in the United States include:

- **Connect to and improve on current transit options.** Rail can only be routed where railroad tracks are. That means many riders connect to another mode of transit on at least one end of their trip. For connections to major activity centers, this includes high quality, frequent service.
- **Rail transit service makes use of unused rail capacity in a corridor where highway capacity is scarce.** Using freight rail lines that aren't heavily used maximizes use of existing infrastructure.
- **It serves more than commuters.** A route that has ridership during the day, in late evening, and on weekends will get more use out of the same equipment and infrastructure**.**
- **Have a city at each end.** Serve employment centers in both directions and people traveling from one city to another.

- **Offer good connections to multiple employment centers.** Not everyone works in a central business district.
- **Serve long trips.** Rail transit vehicles provide comfort, with a smoother ride, wider seats, and the ability to get up during the trip.
- **Stations you can walk (or bike) to.** Transit is inherently pedestrian-oriented. Stations are located where people can walk or bike to them and thereby limit parking needs,

1.2.2 REGIONAL RAIL

As shown in Figure 1-2, Northern California has an expanding network of rail transit service. The Santa Cruz Branch Rail Line is a 32-mile spur off the main coastal rail line that stretches from San Diego to San Jose and beyond. The Santa Cruz Branch Rail Line extends between Davenport, a coastal community on the north end of Santa Cruz County, and the Pajaro/Watsonville Junction, a wye link just over the Santa Cruz County line in Monterey County. This Pajaro/Watsonville Junction provides the potential for the Santa Cruz Branch Rail Line to connect with a number of future regional and state passenger rail services. These include the Capitol Corridor extension from San Jose to Salinas, Coast Daylight from San Francisco to Los Angeles, California High Speed Rail in Gilroy, and the potential to provide rail service "around the bay" between Santa Cruz and the Monterey Peninsula or intercity service from Santa Cruz to the San Francisco Bay Area.

1.2.2.1 Capitol Corridor Extension

The Transportation Agency for Monterey County is leading efforts to extend the Capitol Corridor rail service to the Monterey Bay area. Service is currently between San Jose – Oakland - Sacramento - Auburn. The extended service would add two round trips to Salinas. The extension project has completed preliminary design and environmental review. The first phase of the project (Salinas only) is currently in final design and acquiring property. Capital costs for the first phase, estimated to be approximately $70 million, have been secured. The second phase of the project is the Pajaro/Watsonville multimodal station, envisioned to be a bus and rail transit hub. Grant funds are being sought for the Pajaro/Watsonville station, estimated to cost $23 million. This station would be the transfer station for future rail transit service on the Santa Cruz Branch Line and is envisioned to include 400 parking spaces.

1.2.2.2 Coast Daylight

A new state-sponsored intercity rail Amtrak service is proposed along the Coast Route with one train daily in each direction between Los Angeles and San Jose or San Francisco called the Coast Daylight. The Coast Daylight is proposed by the Coast Rail Coordinating Council, led by SLOCOG, as a new state supported intercity rail service, which would extend the Pacific Surfliner service from San Luis Obispo to either

Figure 1-2: Regional Rail Network

Source: SCCRTC, 2015

San Jose or San Francisco. This train will follow US 101 and the coastline, serving San Jose, Gilroy, Pajaro, Salinas, San Luis Obispo, Santa Barbara and Los Angeles. This new service will include a stop at the Pajaro/Watsonville Junction expanding local, regional and interregional travel options for Santa Cruz County residents and visitors. The new Coast Daylight rail transit service will complement the existing Amtrak Coast Starlight service which operates between southern California and the Pacific Northwest and includes stops in San Jose and Salinas.

1.2.2.3 California High Speed Rail

Efforts are underway to construct high speed train service from the San Francisco Bay Area to the Los Angeles basin, and will eventually extend to Sacramento and San Diego. In 2008 California voters approved Proposition 1A-Safe, Reliable High-Speed Train Bond Act, which provides some funding for the system, with over 60 percent of Santa Cruz County voting yes. In addition, the state is working with regional partners to implement a state-wide rail modernization plan that will invest billions of dollars in local and regional rail lines. The nearest station to Santa Cruz County will be in Gilroy, approximately 20 rail miles from the Pajaro station. The trip between San Francisco and Los Angeles is expected to be competitive with air travel and total less than 3 hours at speeds of over 200 miles per hour.

1.3 PROJECT AREA

The 32-mile Santa Cruz Branch Rail Line extends from the Watsonville/Pajaro Junction just over the county line in Monterey County to the town of Davenport, running parallel to the California coast line and Highway 1 in most sections. Adjacent land uses include residential, commercial, industrial, agricultural, and recreational and open space. Although Santa Cruz County has the second smallest land area of the state's 58 counties, it has the tenth[12] highest population density. The rail line links major activity centers as it traverses the heavily congested Santa Cruz-Watsonville travel corridor, providing access to the cities and towns of Santa Cruz, Live Oak, Capitola, Aptos, Seacliff, Rio Del Mar, La Selva, Watsonville, and Pajaro.

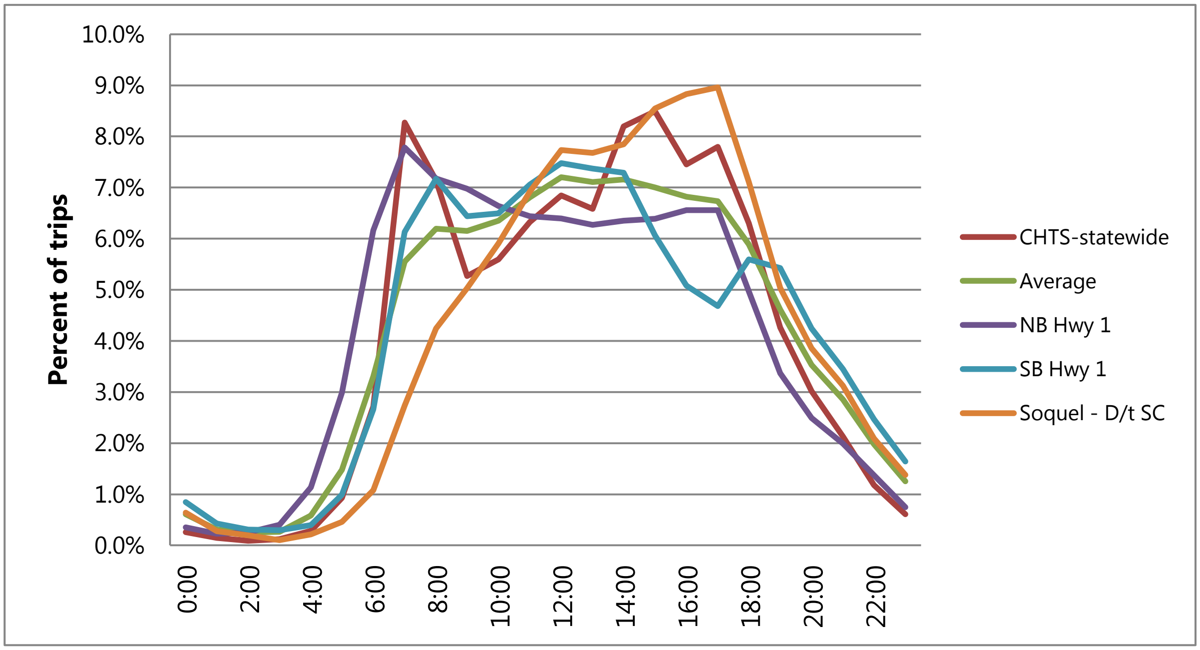
Given the county's physical barriers of mountains and the sea, it is not surprising that approximately half of Santa Cruz County's total population of 270,000 lives within one mile of the rail line. Approximately 90,000 people live within one-half mile of the rail line. The county's population density is about 600 people per square mile overall, with some areas much higher (City of Santa Cruz and the Seacliff area are over 4,000 people/ square mile; Live Oak almost 5,300 people/square mile, Twin Lakes area and City of Watsonville over 7,000 people/ square mile.[13] While growing at a slower pace than many areas of

[12] U.S. Census, 2010; GCT-PH1
[13] U.S. Census, Quick Facts, http://quickfacts.census.gov/qfd/states/06000.html

California, by 2035, the population of Santa Cruz County is expected to increase 18 percent to over 308,000, with most growth anticipated to be concentrated near the rail line. The majority of employed Santa Cruz County residents live and work in Santa Cruz County (approximately 77 percent). About 17 percent of commuters work "over the hill" in the San Francisco Bay Area and about 5 percent travel to work in Monterey or San Benito counties.[14]

Roadways parallel to the rail line, including Highway 1, Soquel Drive, and Capitola Road, are often heavily congested. State Route 1 is the only highway that traverses Santa Cruz County from its northern to its southern boundary. This key travel corridor currently experiences especially heavy congestion during weekday peak travel periods and on the weekends, though a significant amount of travel also occurs mid-day. Figure 1-3 provides a snapshot of when people are traveling on Highway 1 north and southbound, Soquel Avenue near downtown Santa Cruz, as well as statewide for all modes.[15]

Figure 1-3: Hourly Trip Distribution



Source: SCCRTC and Caltrans

Rail transit service expands travel options, providing an alternative to congested roadways, options for people that cannot or do not want to bike or walk to places, and people who cannot drive or afford a car. Overall, rail transit would increase travel choices by providing an additional travel option to the

[14] U.S. Census, American Community Survey 5-year summary Data (2006-2010)
[15] Caltrans, California Household Travel Survey, 2013

community with more reliable travel times than other modes, such as cars and buses, which are subject to mixed-traffic flows. The rail right-of-way can add capacity to move more people and goods, and could accommodate and promote non-auto dependent transportation.

1.4 HISTORY OF CORRIDOR AND RAIL LINE PURCHASE

Rail along the Santa Cruz County coast has a rich history dating back to the 1800s. As soon as the western end of the Transcontinental Railroad was completed in 1869 by Leland Stanford and his partners as the Central Pacific Railroad, plans began to link the Transcontinental Railroad with Northern and Southern California. The Southern Pacific Railroad constructed a standard gauge railroad line connecting the Transcontinental Railroad to Pajaro in 1871, continuing to Salinas and points south. Later that same year, the Santa Cruz County electorate approved railroad construction bonds to encourage railroads to build a line from Pajaro through Santa Cruz County and northward.

In December 1872, Southern Pacific surveyors began laying out the line between Watsonville and Santa Cruz, but decided not to build it due to the Financial Panic of 1873. Later in 1873, Santa Cruz County businessmen Claus Spreckels and F.A. Hihn became impatient and by December 1873, began construction of the Santa Cruz Railroad, starting in Santa Cruz and working toward Watsonville. The first revenue load was two carloads of potatoes delivered by a locomotive called the *Betsy Jane* on the Santa Cruz Railroad's Watsonville-Santa Cruz line completed in 1876.

1885 Chinese Rail Workers, Pajaro Valley Historical Association

Between 1876 and 1880, two new locomotives were delivered to provide service, the *Pacific* and the *Jupiter* (the latter is now displayed in a Smithsonian exhibit). However, service was hindered by competition from the Southern Pacific Railroad at Pajaro, and by a new over-the-mountain South Pacific Coast Railroad constructed in 1880 between Santa Cruz and the San Francisco Bay Area. The over-the-hill South Pacific Coast Railroad included 25 miles of rail and 6 tunnels.

1876 Steam Locomotive Jupiter, Smithsonian

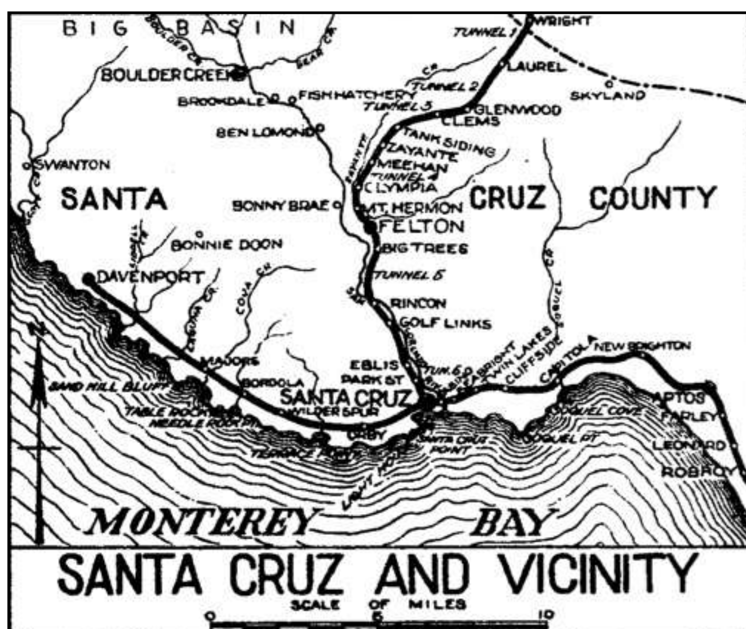
Santa Cruz Beach Boardwalk Archives

In 1881, the Santa Cruz Railroad trestle over the San Lorenzo River was brought down in a flood and, faced with increasing competition the Southern Pacific bought the Santa Cruz Railroad at auction, replaced the narrow gauge rail with standard gauge, and moved the narrow gauge locomotives to other areas (for example, the *Jupiter* was sent to Ecuador to transport bananas).

Continuing their empire-building, Southern Pacific bought the over-the mountain line (South Pacific Coast) in 1887, thereby controlling Santa Cruz County's two main railroad lines promoting tourism and industries. In 1903, President Theodore Roosevelt visited Santa Cruz County via train.

By 1927, Southern Pacific had begun the Suntan Special – an excursion train over the mountain from San Jose to the beach in Santa Cruz. By the late 1930s, the Suntan Special had become extremely popular, with a round trip costing $1.25. In 1940, a storm closed the over-the-mountain line and the Suntan Special was rerouted around-the-mountain through Pajaro/ Watsonville Junction to Santa Cruz.

Although initial plans were made for reopening the line over the hill, Southern Pacific Railroad filed an abandonment petition a few months later, due to an estimated $55,000 repair bill, a fully operational coast route, and due to the newly constructed state highway line which was officially opened to traffic and effectively paralleled the entire length of the mountain line. By the end of the summer of 1940, the rails were gone, bridges removed and the tunnel portals sealed with dynamite, bringing to an end nearly 60 years of railroad operations through the Santa Cruz Mountains to the Bay Area. Today, many visitors and commuters traveling on Highway 17 lament that the mountain route no longer exists. The cost of assembling the land to recreate



Southern Pacific 1922 Coast Division Map – Santa Cruz and Vicinity the rail line today would be prohibitive. Some observers have commented that a great opportunity was lost by not preserving the mountain rail line, and that consideration of how to best use the Santa Cruz Branch line should avoid repeating that scenario.

Following a 5 year hiatus during World War II (1941-1946), the around-the-mountain Suntan Special resumed service continued to September 1959 carrying about 900 passengers per trip during the summers.

Santa Cruz Beach Boardwalk Archives

In addition to the *Suntan Special*, Santa Cruz Big Trees and Pacific Railway, operated by Roaring Camp Railroads, has operated recreational rail service in Santa Cruz County for several decades. This includes a steam train at its site near Felton on the Roaring Camp & Big Trees Narrow Gauge RR since 1963, and since 1985 a passenger train between its Felton site and the Beach/Boardwalk area in the City of Santa Cruz through the San Lorenzo River Gorge. In 2014, over 160,000 passengers traveled on Roaring Camp trains, with over 23,000 riding the "Beach Train" seasonal service between Felton and the Beach/Boardwalk (April to September). These were not commuters, but rather almost exclusively recreational riders.

In 1990, California and Santa Cruz County voters approved Proposition 116 to expand passenger rail transportation, making funding available to buy the rail line. In the early 1990s, the RTC worked with then owner Southern Pacific to discuss the possibility of purchasing the rail line right-of-way or a portion thereof in order to institute passenger rail service. Before the appraisals and analysis were completed Southern Pacific was acquired by Union Pacific in 1996. In that same year, the RTC ran three demonstration trains on the corridor to showcase various kinds of modern rail vehicles and explore their suitability for Santa Cruz County: Return of the Suntan Special using a Caltrain locomotive, Coastal Cruzer using an IC3 Flexliner, and First Night Trolley using a DMU called the RegioSprinter. On one weekend in May 1996, over 1,250 passengers rode two trains from San Jose to the Santa Cruz Beach Boardwalk and back during the Return of the Suntan Special event. Over 1,000 fare-paying passengers rode either the Siemens RegioSprinter or the IC3 Flexliner. After determining that the new owner, Union Pacific, was not interested in allowing uses of the rail line other than freight as long as it owned it, the RTC began negotiations with the railroad in 2001 to acquire the line for a broader range of transportation uses, including passenger rail and a bicycle/pedestrian path.

In addition to the historical use of the Santa Cruz Branch Rail Line for passenger service, the line has also been used to ship freight since its inception. Freight trains on the rail line have hauled out from Santa Cruz County agricultural products, timber, lumber and cement. Freight trains have also brought into Santa Cruz County coal, lumber, and building materials. In 2009, the closure of a cement plant located in Davenport at the end of the rail line reduced freight tonnage on the rail line by over 90 percent. During its operation, which began in 1906, the cement plant accounted for most of the freight hauled on the Santa Cruz Branch Rail Line. Currently freight service is only operating in the Watsonville area and consists of lumber, feed stock for the production of biofuels, and agricultural products. The current rail line operator, Santa Cruz and Monterey Bay Railway, is working to expand freight service on the rail line.

In 2011, the California Transportation Commission approved acquisition of the Santa Cruz Branch Rail Line for public ownership and on October 12, 2012 the RTC successfully completed the acquisition deal with Union Pacific thereby transferring ownership of the Santa Cruz Branch line from the private sector to the people of Santa Cruz County.

1.4.1 PAST STUDIES ALONG THE SANTA CRUZ BRANCH LINE

Several studies have investigated the viability of passenger rail service along the Santa Cruz Branch Line and relevant information from those studies was considered in development of this study. These studies included examinations of rail transit and recreational rail service within Santa Cruz County, between the San Francisco Bay Area and Santa Cruz, and around the Monterey Bay. All of the previous studies concluded that next steps could not be pursued without acquisition of the rail corridor. The RTC pursued acquisition as a critical path component, and was successful in acquiring the line in 2012.

A 1983 *Feasibility of Rail Passenger Service: Watsonville/Santa Cruz* determined that a large ridership demand exists for passenger rail service between Watsonville and Santa Cruz, with joint freight/passenger operation during daytime hours. In August 1996, consultants Parsons Brinckerhoff completed the *Intercity Recreational Rail Study for the San Francisco Bay Area to Santa Cruz Corridor*. Demonstration trains were brought to Santa Cruz County in 1996 to test the *Suntan Special* service concept and the study concluded that intercity weekend rail service was feasible even with conservative ridership estimates.

In 1995 the SCCRTC, in partnership with the Santa Clara County Transit District, explored the feasibility of resurrecting rail transit between Santa Cruz County and Santa Clara County via the former South Pacific Rail Line through the Santa Cruz Mountains, which roughly parallels Highway 17. This feasibility study concluded that service was not feasible, due to expiration of property easements, condition of collapsed tunnels, and high costs. The lowest cost scenario was estimated to need $580.8– $829.5 million in capital investments (in 2015 dollars), compared to the upper bound capital costs estimate of the highest cost scenario in the current feasibility study at $228.3 million.

In 1998, consultants LS Transit Systems completed the *Around the Bay Rail Study*, which analyzed recreational rail service between Santa Cruz and Monterey, with connecting service to the San Francisco Bay Area and the Salinas Valley. In 1998 the *Major Transportation Investment Study (MTIS) for the Watsonville to Santa Cruz Corridor* was completed. MTIS evaluated significantly more intensive rail service than what is analyzed in this study (more than twice as much service as Scenario G, requiring more rail vehicles) and more expansive upgrades to the rail line, stations, and other components. Based on the MTIS, the Santa Cruz County Regional Transportation Commission selected a program of projects for the corridor which included acquisition of the Santa Cruz Branch Rail Line for future transportation purposes, including passenger and freight rail and a bicycle and pedestrian path (Coastal Rail Trail).

In spring 2003, an analysis by Alta Transportation Consulting, Inc. examined several alternative scenarios for recreational rail service along the Santa Cruz Branch Rail Line. With estimates of 10,000 to 25,000 annual riders, the study concluded that visitor-oriented passenger rail service offered between Capitola and Aptos could prove profitable and therefore attractive to private entrepreneurs experienced in visitor-oriented railroad operations. The Alta study anticipated the use of two-car, self-propelled rail vehicles operating at relatively slow speeds during the primary tourist season. Based on the results of the Alta study, a report on *Passenger Platforms and Related Improvements to the Santa Cruz Branch Line for Recreation Rail Service ("Village Cruzer")* was developed to provide cost estimates.

1.4.1.1 What has Changed since Prior Studies were Conducted?

Since the late 1990s, the possibility of rail transit service on the Santa Cruz Branch Rail Line has not been further analyzed and several factors regarding feasibility have changed. This study brings current information into the conversation of the feasibility of transit service on the rail line. As discussed earlier, some of the key changes since the last transit studies were conducted include the following:

- The community now owns the rail line.
- The Regional Transportation Commission (RTC) purchased the rail line with voter-approved funds intended for expansion of passenger rail service and to secure the funds, the RTC committed to initiate passenger rail service on the line
- The economy has improved, and this recovery was paralleled by increasing levels of congestion.
- There is community interest in expanding transportation options and transit service.
- Buses are often stuck in traffic.

- Emerging technologies, such as the smart phone, allow access to real time transportation information including transit.
- New California mandates (SB 375) to lower greenhouse gas emissions by reducing the number of vehicle miles traveled (VMT), and local goals to focus projected growth in areas that could be served by transit. These mandates are expected to become more stringent in the future.
- With roadways at or near capacity and parking constraints in many areas, local jurisdictions are working to minimize traffic impacts of existing and proposed new developments.
- New state and regional train service is now proposed to stop in Pajaro (just south of Watsonville), including the Capitol Corridor extension, Amtrak Coast Daylight, and connections to the planned California High Speed Rail (HSR).
- Changing demographics, including the aging Baby Boomer population looking to maintain mobility and access as they move into their retirement years.
- Population is projected to grow 20 percent by 2035.
- Car ownership rates are decreasing among younger generations.
- The community has many questions about what is possible for the rail line.

1.5 BICYCLE AND PEDESTRIAN "RAIL TRAIL"

Consistent with the RTC's goal to expand transportation use of the rail corridor, the RTC adopted a Master Plan for the Monterey Bay Sanctuary Scenic Trail Network (MBSST) in November 2013, which includes a bicycle and pedestrian trail within the rail right-of-way (or "rail trail"), as well as other connecting coastal trails and on-road facilities. As of December 2015, over 8 miles of trail within the rail right-of-way have been funded, with construction in some sections to begin as soon as 2016. This study identifies right-of-way needs for rail service in the context of the trail in order to assist with design of both, as well as a range of possible other uses for the rail corridor.

1.5.1.1 Scope of the Trail Project

The Monterey Bay Sanctuary Scenic Trail is a planned 50-mile network of bicycle and pedestrian paths along the coast of Santa Cruz County, from the San Mateo County line in the north to the Monterey County line at Pajaro. The primary MBSST trail will follow the existing 32-mile rail corridor, adjacent to the rail tracks. This trail is often referred to as the coastal rail trail.

Source: MBSST Master Plan, SCCRTC (2013)


Alaskan Way Trail, Seattle, WA; Rails to Trails

Similar to rails *with* trails facilities in other areas, the 32-mile MBSST coastal rail trail will coexist with existing and potential future rail service.

The MBSST Master Plan was developed through a multi-year comprehensive planning process involving extensive input from members of the public, local jurisdictions, and resource agencies. The Trail Master Plan defines the trail alignment and describes design features for this network of bicycle and pedestrian trails that will serve transportation and recreation uses. The Master Plan also identifies planning considerations associated with trail construction and proposes policies and options related to design, implementation, operation, maintenance and liability. Detailed design is being done as sections of the trail are funded and implemented.

An additional 18 miles of the MBSST Network consists of on-road facilities, other trails, and natural surface paths that connect to schools, shopping centers and coastal access areas. As envisioned by Congressman Sam Farr, the MBSST Network in Santa Cruz County will eventually connect to a Monterey County system of existing and planned trails so that walkers and bicyclists will be able to appreciate the coastal environment and access the Monterey Bay National Marine Sanctuary from the San Mateo/Santa Cruz border all the way to Pacific Grove in Monterey County.

1.5.1.2 Right-Of-Way Width

On average the Santa Cruz Branch Rail Line right-of-way is about 70 feet wide, providing sufficient width for the trail to co-exist with rail transit functions in almost all of the rail right-of-way. The absolute minimum width required for both a trail and single track rail in tangent (straight) sections of the right-of-way is 25 feet.[16] A sample cross section of the trail within the right-of-way is provided in Figure 1-4.

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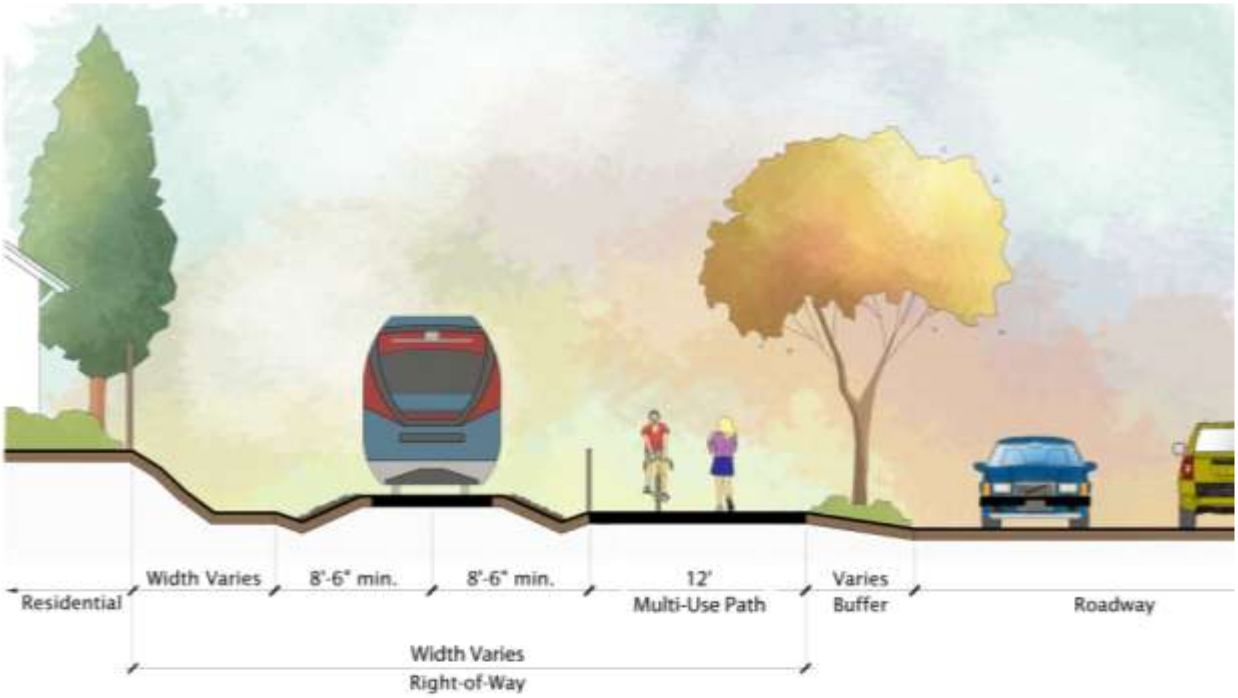
[16] Transportation design standards require multi-use bi-directional trails to be a minimum of 8 feet wide and require a minimum of 17 feet for train operations (8' 6" from the centerline of the tracks). 27-34 feet is needed for rail operations in double track sections, depending on track curvature and vehicle types. At stations, the minimum space needed for the station plus track is approximately 27'2".

Figure 1-4: Sample Cross-Section



Source: RRM

Since almost all of the right-of-way is significantly wider than 25 feet, additional space can be utilized for a wider trail and setbacks, passing sidings, and transit stations. Based on a planning-level analysis, 94% of the rail corridor is wide enough to add a 12-foot trail along the existing railroad tracks, with a 20 foot wide envelope for rail operations.[17] Only small portions of the rail right-of-way, together totaling less than 1/3 of a mile, are narrower than the 25 foot minimum. For those narrow sections, design solutions have been identified to accommodate the rail-with-trail. In a 1 mile section the rails would need to be shifted over in order to accommodate the trail adjacent to the rails, or right-of-way easements would be required. $250,000 per rail passing siding has been included in the rail cost estimates for potential right-of-way easements.

While some of the existing railroad bridges may be suitable for a cantilevered pathway, new separated bicycle/pedestrian bridges will need to be built adjacent to most railroad bridges for the trail project. The cost of new bicycle/pedestrian bridges is included in the MBSST cost estimates. One bridge over Soquel Creek in Capitola Village would need to be replaced in order to serve both the trail and rail operations.

[17] Field surveying to be done during design.

1.5.1.3 Dual Benefits

Constructing a trail along the rail line doubles the value a community derives from the rail corridor and provides citizens with an additional transportation choice. Access to stations is enhanced by separated rail-with-trail facilities. The potential for combined trips enables users to maximize where they can go, especially people who cannot walk or bike long distances. For instance, a 1-mile walking trip or a 3-mile bike trip can suddenly be expanded into a cross-county commute or fun outing. As often cited by Congressman Farr, the recreational and tourism draw of the Monterey Bay National Marine Sanctuary will be heightened by the rail and trail projects. Joint use of the rail corridor also expands options for general right-of-way maintenance, such as drainage, graffiti abatement, trash removal, safety, and security.

1.5.1.4 Bicycle and Pedestrian Safety

Sound design is critical to any world-class transportation project. Design elements that are part of the trail project will be of value to rail operations. Rail operations will be safeguarded through the use of fencing, grade separation or other buffers. Channelization of bicyclists and pedestrians to specific crossings will reduce trespassing and keep the tracks for the exclusive use of rail transit service except for designated, controlled areas. The Trail Master Plan demonstrates a variety of safety fencing that may be utilized depending on the specific environment and proposes crossing treatments. Amenities like benches, lighting, and water fountains are identified in order to draw users into an inviting community environment. Operational considerations like access for maintenance vehicles, emergency locators, conduit and other utilities will be considered during trail design.

1.5.1.5 Rail with Trail Projects are Growing

A recent report released by the national Rails-to-Trails Conservancy[18] surveyed 88 trail managers from 33 states of trails within or alongside active corridors. The report's findings are that rail-with-trail projects are safe, common and increasing in number. Between 1996 and 2013, the number of rail-with-trail projects increased from 37 to 167 (with the number of miles increasing from 299 to 1437). The report identified only 1 fatality during the past 20 years on one of these facilities and outlined various design features utilized to encourage high usage numbers and safe co-existence.

Rails-with-trails are operating successfully under a wide variety of conditions. Some are very close to rail tracks and others are farther away. Some use extensive separating fences or barriers, some use minimal

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[18] Rails to Trails Conservancy. "American's Rails-with-Trails: A Resource for Planners, Agencies and Advocates on Trails along Active Railroad Corridors". September 2013.

features. Some projects are next to high-speed, high-frequency rail services; others are on industrial branch lines or tourist railroads with slower rail vehicles operating only a few times per week. Designing to maximize safety and function is key to successful implementation and operation.

1.5.1.6 Public Support for Trail

As evidenced by the adoption of the Master Plan and extensive public involvement throughout its development, the Santa Cruz County community has shown support for the rail trail and broader MBSST projects. Additionally, funding and advocacy partnerships with the Land Trust of Santa Cruz County, Friends of the Rail and Trail, Ecology Action, Bike Santa Cruz County and others demonstrate the desirability of speedy implementation of the rail trail project.

Pinole, CA; Rails to Trails Conservancy

The Trail Master Plan was developed in coordination with local jurisdictions and key stakeholders, including the rail operator. The plan has been adopted by all coastal jurisdictions: the Cities of Santa Cruz, Capitola and Watsonville, as well as the County of Santa Cruz, which are taking the lead on the environmental review, design and construction of several sections of the trail. Detailed design of the trail is taking into consideration existing and possible future rail uses of the rail line.

1.6 OUTREACH AND PUBLIC INVOLVEMENT

Development of this rail transit study has included extensive outreach to and engagement with the public and stakeholders, including: rail and other transportation providers, local jurisdictions, seniors, interest groups, non-English speakers, people with disabilities and other transit-dependent populations. Input was solicited at key project milestones.

Santa Cruz County Regional Transportation Commission (RTC) was the lead agency for this study, prepared by a team of rail experts from Fehr & Peers, LTK, Rail Pros, and financial consultant Bob Schaevitz. In addition to providing oversight, the RTC undertook outreach and engagement activities related to the study. Over the course of the analysis, input was sought from the following five groups. A roster of these groups is included in Appendix A.

- General Public – In addition to general outreach to the public through public meetings and media outlets, project updates were regularly sent to individuals/groups that have signed up to receive information about rail projects through the RTC's "Rail eNews".
- Interest Groups – Representatives of environmental, business, neighborhood, visitor, disadvantaged community, and educational interests
- Technical Stakeholders – Including planning, public works and/or economic development representatives from local jurisdictions along the rail line (County and Cities of Santa Cruz, Capitola and Watsonville), the tri-county regional planning agency (Association for Monterey Bay Area Governments or AMBAG), and partner agencies such as the University of California, Santa Cruz (UCSC) and Cabrillo College; as well as representatives of business, tourism and transit riders.
- Study Team – Comprised of the Regional Transportation Commission, Santa Cruz Metropolitan Transit District, Iowa Pacific/Santa Cruz & Monterey Bay Railway and Caltrans in an oversight and advisory role.
- Rail Peers – Based on real world experience, technical components of the rail study were reviewed by agencies currently operating or planning rail transit service, including: the North County Transit District's Coaster/Sprinter (San Diego), Capitol Corridor, the San Francisco Bay Area's Caltrain (Peninsula Corridor Joint Powers Board), Santa Clara Valley Transportation Authority (VTA), Stockton/Modesto/San Jose's Altamont Corridor Express (ACE), Portland's TriMet, Golden Gate Railroad Museum, Roaring Camp Railroads (Big Trees & Pacific Railway), Transportation Agency for Monterey County (TAMC), San Luis Obispo Council of Governments, and Sonoma-Marin Area Rail Transit (SMART).

1.6.1.1 Outreach Materials

The RTC developed a webpage for this study on the agency website (www.sccrtc.org). Information on the webpage included background and history, the study overview and objectives, and project components as they were developed – such as scenarios and station locations, evaluation criteria and maps, results of public input received through questionnaires and workshops, a "What's New" section highlighting current project information, eNews sign up options, related rail resources, and the Draft Study.

A project fact sheet was also developed and updated regularly to provide general information about the purpose of the study and ways to participate. Fact sheets on the rail study were available at events, such as business fairs, communities meetings, farmers markets, as well as included in informational packets about RTC projects and programs.

Throughout the analysis, items relates to the study – such as outreach activities, graphics, maps and project updates – were posted on the RTC web newsfeed, Facebook, Twitter and Nextdoor.

1.6.1.2 Early Engagement Activities

Early on in the study, an online questionnaire was developed to obtain public input on:

- Rail transit service in Santa Cruz County in general
- Specifics of potential use by the public
- Stations and service scenarios
- Goals about transportation choices, sustainability and cost effectiveness
- Rail transit use preferences and considerations
- Demographics

Outreach for the questionnaire included the RTC's Rail eNews group, community groups, Facebook, media, paid advertisements and other outreach mechanisms. The questionnaire was posted online for a three week period in July/August 2014. In addition to the online version of the questionnaire, an abbreviated paper version in English and Spanish was distributed at local community gatherings such as farmers markets, transit centers and the flea market. Approximately 2,000 people participated in the first questionnaire.

In addition to the questionnaire, a community meeting with the consultants was held in Live Oak Senior Center on July 17, 2014. An overflow crowd of more than 100 people attended this summer workshop. The format included an overview of why the RTC is conducting the Rail Transit Study, information about potential rail service and vehicle types, and activity centers for attendees to provide input.

Highlights from the results of the summer 2014 questionnaire and workshop include:

- 65 percent of respondents indicated that they are "extremely interested" or "very interested" in taking a rail transit to destinations along the rail line
- 83 percent of respondents think rail transit will be "very good" or "somewhat good" for Santa Cruz County, as a whole, in the long term
- The most popular stations from north to south were: Westside Santa Cruz, Bay Street in Santa Cruz, Downtown Santa Cruz, Seabright, 17th Avenue/Live Oak, 41st Avenue/Pleasure Point, Capitola Village and Cabrillo
- The questionnaire results indicate rail transit service has the potential to take cars off the road in Santa Cruz: 77 percent of respondents indicated they currently drive alone to their primary destination, but 66 percent of respondents indicated they would walk to their neighborhood station when taking the rail transit.

- Interest is high in riding rail transit to connect with future rail service to the San Francisco Bay Area, Monterey and beyond, with 72 percent of respondents indicating they would be "extremely interested" or "very interested" in using such a connection.

To present materials in a visually engaging manner, a number of maps and other graphics were developed. Samples of graphic materials used at workshops, presentations to the RTC board, and on the project website include: transit likelihood maps (Section 4.0), goals and objectives (Section 3.0), station locations (Section 4.0), and summaries of the questionnaire results (Appendix A).

1.6.1.3 Regular Public Meetings

In addition to special outreach efforts focused on the rail study, the RTC board also received regular updates on the project and provided direction on several aspects of the study since May 2014. The agenda packets and minutes are posted on the sccrtc.org website, and many of these meetings are televised then available online through Community Television.

1.6.1.4 Outreach for the Draft Report

A broad range of public outreach activities were conducted to encourage community participation in the review of and discussion about the findings in the draft study. The draft plan was released for public review on May 21, 2015; the RTC established July 31 as the close of the comment period. On June 4, 2015, the consultant team presented the draft study at the RTC board's televised public meeting in Watsonville and hosted a well-attended evening public open house in mid-county. Presentations on the study were also made to local technical stakeholders and community groups, RTC Advisory Committees, the METRO board, and numerous community groups and service clubs throughout the comment period.

The Draft Study was posted on the RTC webpage and available at local libraries and the RTC offices. Information about the study was included in the RTC's web newsfeed, Facebook and Twitter pages, as well as through newsletters, news media, local businesses, and community groups. Email notices about the draft study and public meetings were sent directly to the RTC's "Rail eNews" email distribution list, which includes over 4200 people that have signed up to receive updates (http://www.sccrtc.org/about/esubscriptions/). Flyers and the Fact Sheet on the study were also updated and distributed at multiple venues. In addition to the draft study, the RTC's rail study webpage included the Executive Summary, links to an online survey and comment form to gather community feedback, maps, and responses to Frequently Asked Questions (FAQ).

A summary of public input and engagement activities is provided in Appendix A.

1.6.1.5 Public Input Received

There was wide-spread public participation and engagement, with thousands of people providing input on the draft study via an online survey, emails, comment forms, letters, and at numerous meetings. The RTC received over 430 written comments on the draft study and over 2,600 people took a survey about the findings of the analysis. A summary of comments received, survey results, and resultant edits to this study are included in Appendix A.

In the online survey regarding the Draft Study, 79% of respondents expressed support for public transit service in at least some sections of the rail corridor. The written comments received ranged from strong support for any type of rail service on the corridor, to support of certain types or frequency of rail service, to voicing concerns about potential impacts or certain aspects of scenarios analyzed, to strong opposition to any type of rail, to opposition of any activity on the rail line, and other comments in between. Those supportive of rail transit often focused on mobility, environmental, and economic benefits. Respondents also proposed specific parameters for a preferred service scenario (such as service area, station locations, vehicle types, cost, service hours, and frequency). Respondents also raised concerns about number of daily trains, cost, ridership estimates, horn noise, and trail integration.

While answers to many comments and questions submitted on the draft study were included in the draft study, this final document provides additional clarification and information on many topics raised by members of the public, Commissioners, RTC Committees, interest groups and partner agencies. However it is important to note that answers to some comments and detailed questions will not be explored until detailed analysis is done in later phases of study, including project-level environmental documentation, design engineering, operational service planning, or as part of a comparative unified corridors plan. The RTC received the final report on the Rail Transit Feasibility Study at its December 3, 2015 meeting and directed staff to pursue funding to conduct more detailed analysis.

1.7 STUDY CONTENTS

This study is organized into nine sections, summarized as follows:

- Section 1: Introduction - Purpose of the study and framework from which it was developed.
- Section 2: Comparable Systems and Technology Options – Description of rail comparable systems and rail technology options on systems in the U.S.
- Section 3: Study Goals and Objectives – Three core goals and corresponding objectives used to evaluate each scenario.

- Section 4: Rail Transit Service Alternatives - A description of the service scenarios and stations selected for analysis and the process involved in their selection.
- Section 5: Methods and Assumptions – Description of general assumptions, operating details, and ridership forecasting methodology used for this study.
- Section 6: Technical Assessment of Service Scenarios – Description of findings from the technical analysis of seven service scenarios, including:
  - Capital Cost Estimates
  - Operations & Maintenance Cost Estimates
  - Ridership Forecasts
  - Funding Assessment
- Section 7: Evaluation of Service Scenarios – Evaluation of how each scenario advances goals and objectives and identifies the highest performing scenarios with greatest potential for implementation.
- Section 8: Parameters for Rail Transit Service – Suggested service parameters to be considered for implementing rail transit service.
- Section 9: Implementation – Describes steps and timeline for implementation of rail transit service, including planning, design, environmental clearance activities, and regulatory and governance considerations.

1.7.1 STUDY SCOPE LIMITS

The scope of this study is limited to a preliminary analysis of rail transit options along the Santa Cruz Branch Rail Line. This is not a detailed service or implementation plan. If a decision is made to move forward with implementing service, environmental review and engineering level design work would be initiated to provide more detailed analysis of potential environmental impacts, station locations, parking needs, rail vehicle options, and integration with the planned Monterey Bay Sanctuary Scenic Trail (MBSST or "rail trail"). Operating schedules would be evaluated and coordinated with METRO buses. Additionally, evaluation of multimodal transportation improvements along the heavily-traveled Santa Cruz to Aptos corridor is in process as part of the Santa Cruz County Unified Corridors Plan. Starting with development of a multimodal county-level travel demand model, the Unified Corridors Plan will analyze transportation investments on the parallel routes of Highway 1, Soquel Avenue/Drive and the Santa Cruz Branch Rail Line to identify the combination of investments that most effectively move people and provide transportation choices.

The RTC recognizes that there are also other options for the rail right-of-way that have been analyzed in the past or could be analyzed in the future. This includes other passenger rail service – such as recreational rail service or intercity rail service to the San Francisco Bay Area or Monterey County; or expanded freight service. Some members of the community have also expressed interest in using the Santa Cruz Branch Rail Line for bus rapid transit (BRT), personal rapid transit (PRT), or putting in a cantilevered sky gondola to UCSC. Expanding rail transit service up to Felton and other parts of San Lorenzo Valley, and having rail service from Santa Cruz to San Jose over the Santa Cruz Mountains have also been mentioned frequently. This study does not preclude future analysis of these and other options, but they are outside of the scope of this study.

There are also some members of the community that have expressed interest in only building a multi-use bicycle/pedestrian trail within the rail right-of-way. Even if the community decides not to implement rail transit service in the near future, there are several reasons to retain the tracks. Beyond federal and state requirements associated with passenger and freight rail service, the RTC purchased the Santa Cruz Branch Rail Line in order to expand and preserve transportation options which have the capacity to efficiently move people and goods. Along with expanding bicycle and pedestrian facilities, the RTC is working to increase transit options and the rail corridor offers the opportunity to provide efficient, competitive transit in our community. In addition, use of the rail corridor line for goods movement could reduce truck traffic on local roads and highways. Especially as our population grows, given congestion on local roads and highways and the need to reduce greenhouse gas emissions, it is prudent to retain and expand, not eliminate, transportation options in this publicly owned right-of-way.

2.0 RAIL SYSTEM OPTIONS

Rail systems in the United States vary widely in terms of services provided, equipment used, and primary users. Passenger rail service is divided into two main categories: transit and excursion. Rail transit services are by and large patronized by passengers who—though they may enjoy the travel—ride rail as a means rather than an end. More than 75 of these types of transit services are recognized in the U.S., with services ranging from historic streetcar lines of less than 1 mile to modern streetcar and light rail systems to long distance commuter and intercity service. Depending on the type of service and equipment used, different local, state, and federal regulations apply.

Recreational excursion and tourist-type systems, by contrast, are not meant as transportation between two places as much as riding them is an activity unto itself. There are numerous excursion-type services around the U.S., including the Napa Wine Train and local examples like Roaring Camp Railroads and the Santa Cruz & Monterey Bay Railroad's "Train to Christmastown" which operate in Santa Cruz County. While some people may ride transit systems for recreation, that is not their primary function.

There are many different terms used to describe rail systems that carry passengers (as compared to freight rail). The sidebar provides examples of terms that are sometimes used to describe different passenger systems.[19] This study looks at a range of service types that are self-propelled or locomotive hauled and have relatively light passenger volumes, especially as compared to high volume heavy rail subway-type systems.

Passenger Rail Service Types

Public Transportation

- ***Rail Transit:*** *Local and regional passenger trains serving cities and suburban areas. It may be either self-propelled (like DMUs) or locomotive-hauled, typically having reduced fare, multiple-ride and commuter fares, and fewer stations than light or heavy rail. This is the type of service evaluated in this study.*
- ***Light Rail:*** *Also known as "streetcar," "trolleys" or "tramway". Vehicles are typically driven electrically with power being drawn from an overhead electric line and have "light volume" capacity compared to other systems. May use shared or exclusive rights-of-way, high or low platform loading and multi-car trains or single cars.*
- ***Intercity or Commuter Rail:*** *Passenger service typically characterized by longer distance, less frequent stops.*
- ***High Speed Rail:*** *Has exclusive right-of-way with speeds of over 124 miles per hour (200 km/h).*
- ***Heavy Rail:*** *Also known as "rapid rail," "subways," "elevated rail" or "metro". An electric railway with the capacity for "heavy volumes", exclusive rights-of-way, multi-car trains, high speed, high platform loading.*

Recreational Rail

- ***Excursion Service:*** *Primarily used by rail fans and families who enjoy train rides (often using historic rail equipment)*
- ***Tourist Rail:*** *Service linked to existing tourist areas and designed as one of numerous visitor attractions.*

[19] ATPA Glossary of Transit Terminology. Caltrans uses slightly different terms to distinguish between rail transit, intercity rail and excursion services in its rail plans, based on how different services are funded and administered in California.

2.1 RAIL TECHNOLOGY

The following provides an overview of rail transit vehicle technologies currently used in the U.S. that could potentially be implemented in Santa Cruz County. Systems are distinguished here as either "Railroad Transit" or "Rail Transit" in accordance with their regulatory status with the Federal Railroad Administration (FRA), specifically related to sharing the corridor with freight service or other heavy passenger rail and the requirement for a Positive Train Control (PTC) system. PTC is a computer-and-radio-based system that supplements the conventional signal system to automatically slow or stop rail vehicles prior to collisions. Non-FRA compliant rail cars can operate during different time windows (temporal separation) or on different portions of the track from freight with a physical barrier. This dichotomy is explored further in Section 5.1.1.

*While no specific vehicle or manufacturer is being recommended in this feasibility study, for the purposes of simulating five of the scenarios, a self propelled, articulated railcar (sometimes referred to as **Light DMU, Light Rail, or Tram**) was chosen as an example vehicle to test operating parameters and estimate costs. FRA-compliant locomotive vehicles were used for evaluating two of the scenarios.*

Photo: Denton A Train

Railroad Transit – FRA Compliant

- Locomotives + Trailer Cars
- Diesel Multiple Units (DMU)
- Electric Multiple Units (EMU)

Rail Transit – Non-FRA Compliant

- Self-propelled Light Rail (DLRT) or "Light" Diesel Multiple Units ("Light" DMU)
- Electric Multiple Units (EMU) (Light Rail)
- Electric Streetcar, trolley, tram

Examples of different rail technologies are provided in Figure 2-1. Table 2-1 provides additional information on different rail technologies. Figure 2-2 displays photos of the vehicles used or proposed vehicles for each example system. In an effort to maximize use of current infrastructure, such as the existing railroad tracks and bridges, and minimize costs, technologies that require new overhead electrical wires or otherwise are not readily available were not used for the seven scenarios.

Example systems

Operating characteristics of example U.S. rail transit systems, organized by rail technology type, are presented in Table 2-2. Section 2.2 provides additional information on systems in areas that are most comparable to Santa Cruz County. Additional information on these systems and others in the U.S. is listed in Appendix I.

Other and Emerging Technology

While this study focuses on existing rail vehicle technologies that are readily available in the United States, there are several innovative technologies currently being developed that could be feasible in the future. These include everything from improved traction, braking and real time route-planning, to development of low and zero-emission vehicle power. Work that railroad and freight industries are doing with the California Air Resources Board[20] will support reductions in rail vehicle emissions across all rail sectors. Already, the current generation of light DMUs has significantly lower emissions than 30 years ago and diesel technology in general has improved significantly. Compared to heavy DMUs, light DMUs emit lower amounts of common pollutants per gallon of fuel burned, including: CO, ROG, and PM10.[21] Hybrid, compressed natural gas (CNG), and other technologies are also increasingly available.

Battery advancements for electric vehicles could eventually eliminate the need for expensive overhead wires. Battery powered electric systems currently can only operate very short distances, though induction or wireless charging is being investigated by many manufacturers, as well as regenerative brakes that transfer electrical energy from braking rail vehicles into local power grids.

Road-Rail busses are vehicles which have both steel wheels for rail and rubber wheels for roads, enabling them to move between the two treatments. While many prototypes have been attempted over many decades, few have been successful. Road-Rail bus systems currently in use internationally use track that is vastly different from the existing tracks on the Branch Rail Line and would require expensive modification.

Railbus (Santa Cruz de la Sierra, Bolivia)

[20] *Sustainable Freight: Pathways to Zero and Near-Zero Emissions,* California Air Resources Board, 2015.

[21] Sonoma-Marin Area Rail Transit Draft Supplemental EIR, Section C.4.2 Air Quality, November 2008. Available at: http://www.sctainfo.org/pdf/smart/dseir/c4_alt_train_vehicles.pdf

An older technology developed in the 1930s is a railbus. A railbus is a lightweight passenger rail vehicle usually comprised of a bus, or modified bus body that runs on four wheels with a fixed base. However none are currently in operation in the U.S. They have commonly been used in other countries, including Germany, Italy, France, the United Kingdom, Bolivia, Argentina, Australia, India, Indonesia, Japan and Sri Lanka.

Because railbuses and road-rail buses have not been implemented in the US, it is unclear how implementation and investment would occur. Much of the funding that a local rail transit project could hope to secure requires the use of technologies that have been proven successful in the U.S. and such is not the case with both a Road-Rail bus concept and railbus.

British Rail Railbus

The same funding concern holds for Personal Rapid Transit (PRT). In addition, the California Public Utilities Commission has stated that its rail regulations apply to PRT, including identical headway requirements. This regulation would render PRT unable to provide adequate ridership levels. While high speed magnetic levitation (maglev) vehicles are unlikely to be used locally any time soon, the future will undoubtedly include ever expanding rail transit vehicle options and advancements that could be considered.

Section 8.0 includes additional information on emerging technologies. One option for the Santa Cruz Branch Rail Line would be to start with readily available technology that also meets FTA Buy American requirements, FRA weight requirements, and is proven to meet safety and reliability standards, and then transition to lower or zero emission vehicles over time.

Figure 2-1: Rail Technology Summary

TABLE 2-1: RAIL TECHNOLOGY OVERVIEW

Rail Technology	Investment Level		Advantages of technology	Disadvantages of Technology	Positive Train Control (PTC) Required?
	Approx. Unit Cost (per Vehicle Set)	Approx. per-mile cost[22]			
Rail Transit (Freight may not be allowed, or may only be allowed under temporal separation[23])					
Light Diesel Multiple Units/ Light Rail (DMU/DLRT)	$7M-10M (articulated unit)	$5M-25M	• No electrical infrastructure • Improved system reliability since each unit is powered • Several US builders	• Slower acceleration (Light DMUs have slower acceleration than EMUs, but are faster than locomotives + train cars) • More engines to maintain • Specialized parts and maintenance facility	No, block signals only
Electric Light Rail – Electric Multiple Units (EMUs)	$4M-6M (articulated unit)	$40M-125M *(varies depending on existing infrastructure and right-of-way)*	• High acceleration • Improved system reliability since each unit is powered • Can be powered by clean electricity	• Requires electrified infrastructure, with associated visual impacts • More capital intensive • Usually not extendable • Specialized parts and maintenance facility	No, block signals only on main line; traffic signals in mixed traffic
Streetcar/Tram/ Trolley	$3-5M (articulated unit)	$30M-60M (includes electrification)	• High acceleration • Can be powered by clean electricity	• Requires electrified infrastructure • Most systems are less than 3 miles. The longest in the U.S. is only 7.5 miles. • Usually not extendable • Without dedicated lanes, can be slow/unreliable[24]	No, generally uses traffic signals

[22] Wide construction cost range because each rail project is unique, with different requirements related to right-of-way acquisition, track reconstruction, upgrades, and other issues.
[23] In addition to freight, other heavy rail vehicles, such as those used by Big Trees/Roaring Camp, would also require temporal separation.

TABLE 2-1: RAIL TECHNOLOGY OVERVIEW

Rail Technology	Investment Level		Advantages of technology	Disadvantages of Technology	Positive Train Control (PTC) Required?
	Approx. Unit Cost (per Vehicle Set)	Approx. per-mile cost[22]			
FRA Compliant Railroad Vehicles (Potential for co-mingled freight service)					
Electric Multiple Units (EMU)	$28-35M (6-car set)	$10M-100M (electrification of existing track)[25]; plus $5-25M for other infrastructure	• High acceleration • Lower emissions[26] • Add rail cars to meet demand • Adding rail cars does not degrade performance	• Requires electrified infrastructure • Used equipment generally not available	Yes
DMU (Diesel Multiple Units)	$8M-10M (Married Pair)	$5M-25M	• No electrical infrastructure • Improved system reliability since each unit is powered • Can add rail cars to meet demand • Adding rail cars does not degrade performance	• Slower acceleration Higher AQ emissions • More engines to maintain • Used equipment generally not available	Yes
Locomotives + Trailer cars	$3M used; $12M-16M new (Locomotive + 2 trailers & cab car)	$5M-25M	• No electrical infrastructure • Add cars to meet demand • Several U.S. builders • Rebuilt equipment and parts available at lower cost	• Slowest acceleration • Adding rail cars degrades performance (speed, acceleration) • Highest Air Quality (AQ) emissions[27]	Yes

Source: LTK, 2015

[24] While "streetcar" technology can run in a dedicated right-of-way, if the system has its own dedicated area it is typically classified as "light rail"

[25] EMU electrification requires either a 3rd rail or overhead catenary. Notably, hybrid systems (like a diesel-electric hybrid locomotive or diesel-electric multiple unit) have increased per-train cost and do not have significantly lower per-mile costs, as some electrical infrastructure is still needed.

[26] If available, EMUs can be powered by clean electricity; otherwise emissions are created where the electricity is generated.

[27] Actual air quality emissions could differ depending on energy source. Biodiesel, liquefied natural gas, and electricity from clean sources reduce air emissions.

Figure 2-2: Example Rail Vehicle Technology Systems

Light DMU/Light Rail - Sprinter
(NCTD, San Diego, CA)


Light DMU – MetroRail
(Austin, TX)


Transit LRT – Sac LRT
(SACRT, Sacramento, CA)


Railroad DMU - WES
(TriMet, Portland, OR)


Railroad DMU- SMART
(Sonoma-Marin Transit District, CA)


Portland Streetcar
(TriMet, Portland, OR)


Locomotive - South Coast Rail (MBTA, MA)


Railroad Diesel-Electric Locomotive -
Cal (Peninsula Corridor Joint Powers, CA)


Railroad EMU - Caltrain Electrified (proposed)

TABLE 2-2: EXAMPLE RAIL SYSTEMS IN THE U.S.

Main Details				Platform-Vehicle Interface		Operational Details				Capacity (per car)		
Example	**Length** *(appox miles)*	**Regulatory Agencies**	**Does Freight Use Line?**	**Platform Height**	**Boarding Type**	**Service Span**	**Typical Headways (min)**	**Grade Crossing**	**Fare Media**	**Seats**	**Standees**	**Bikes**
Light Diesel Multiple Units												
Sprinter (NCTD)	22	CPUC (Waiver from FRA), FTA	Yes; Temporal Separation	23"	Level Boarding (via platform extensions)	4 a.m. - 9 p.m.	30	Yes	Compass Card, Paper passes	136	90	0-4
DCTA (Denton County)	21	FRA, FTA	Yes; Temporal Separation	24"	Level Boarding	4:30 a.m.- 11 p.m.	20-40 (peak), 60-80 (off-peak)	Yes	Paper passes, mobile ticketing	104	96	4
EMUs (Light Rail)												
Sacramento LRT	23 (Gold Line)	CPUC, FTA	None; (Accommodated on other LRT systems w/ temporal separation)	8"	3 steps up (high-blocks for disabled passenger level boarding)	5 a.m.- midnight	15	Yes	Paper passes	64	177	4
Locomotive + Trailer Cars												
Caltrain (Current)	77	Mainly FRA, some CPUC	Yes; Freight restricted by temporal separation to specific time windows	8"	1-3 Steps to car floor (mini-highs for disabled passenger level boarding)	5 am- midnight	~12 (peak), 60 (off-peak)	Yes	Clipper Card, Paper passes	350-400	~200	0-40

Main Details				Platform-Vehicle Interface		Operational Details				Capacity (per car)		
Example	**Length** *(appox miles)*	**Regulatory Agencies**	**Does Freight Use Line?**	**Platform Height**	**Boarding Type**	**Service Span**	**Typical Headways (min)**	**Grade Crossing**	**Fare Media**	**Seats**	**Standees**	**Bikes**
Diesel Multiple Units (FRA Compliant "Heavy" DMU)												
SMART (Sonoma-Marin)	43 (1st phase)	Mainly FRA, some CPUC	Yes; Freight restricted to specific "windows", freight runs on gauntlet tracks at stations	48"	Level Boarding	5 -10 a.m., 12 -9 p.m.	30	Yes	Clipper Card	80	~80	0-10
WES (Portland) *EMU*	15	Mainly FRA, some OPUC	Yes; Freight restricted to non-peak hours; DMUs run on gauntlets (allow freight trains to bypass the high-level station platform)	48"	Level Boarding	6 -10 a.m., 4 -8 p.m. Mon-Fri	30	Yes	Paper passes	150	~140	0-6
Electric Multiple Units (EMU)												
Caltrain Electrification (2019)	50	Mainly FRA, some CPUC	Yes; Temporal Separation (night time only) pending waiver	8"	1-3 Steps to car floor (level boarding future phase)	5 a.m.-midnight	10 (peak) 30 (off-peak)	Yes	Clipper Card, Paper passes	550-600	~200	0-40
Streetcar												
Portland Streetcar Inc. (partner w/TriMet)	4 (North/ South Line)	OPUC, FTA	No	8"	Single small step onto car (with level boarding for disabled passengers)	6 a.m.-11:30 p.m.	15 (20 nights & on Sunday)	Yes (in mixed traffic; some in dedicated lanes)	Paper passes	30	125	0

Source: LTK, 2015. Comparative information on additional rail systems provided in Appendix I.

2.2 RAIL CAR LAYOUT

Bicyclists boarding bike car on Caltrain.
Source: Fehr & Peers, 2015

Rail Car Uses and Layout

Regardless of the type of vehicle technology, rail cars can be designed to accommodate a variety of uses. The actual design (including the number of seats, on-board restrooms, amount of space for bicycles, surfboards, luggage or other items), inclusion of Wi-Fi, the allowance of pets, etc. is very flexible and would be considered at a later stage. Level boarding is preferable for users and operations.

Bicycles On-board

Providing storage space on-board rail vehicles is an attractive amenity to many transit passengers because it provides them with a means of transportation connecting to transit both before they board and after they alight transit. Many systems are implementing bicycles on-board programs and retrofitting or purchasing passenger cars with space for bicycle storage. The configuration of bike cars can vary. For example, Caltrain's Gallery train set can accommodate 40 bicycles in each bike car. Caltrain's Bombardier train set can accommodate 24 bicycles in each bike car.[28] Below are samples of a few possible configurations.

Caltrain bike car; Source: Fehr & Peers, 2015.

Bikes on-board concept for BART,
Source: East Bay Express, 2013

[28] Bicycle FAQs. San Mateo County Transit District, 2015. Available at: http://www.caltrain.com/riderinfo/Bicycles/Bicycle_FAQs.html

2.3 COMPARABLE SYSTEMS

Comparable Systems

Given the wide range of rail service types, this study considered rail transit case studies throughout the U.S. Looking at a variety of rail systems provides insight into operational, cost, and other characteristics associated with rail transit. Several communities with similar characteristics of Santa Cruz County have implemented rail systems and/or rails with trails. Sprinter (San Diego), TriMet WES (Portland), and SMART (Sonoma/Marin) represent comparable systems in terms of areas that serve a similar demographic. Additional systems with similar characteristics to those being considered in this study are included in Appendix I.

Rails with Trails

In its effort to maximize use of the Santa Cruz Branch Rail Line, the RTC developed the Monterey Bay Sanctuary Scenic Trail Network (MBSST) Master Plan, which identifies the Santa Cruz Branch Rail Line right-of-way as the spine for a network of multi-use trails. As of 2013, there were over 160 rails-with-trails in 41 states, with another 60 rail-with-trail projects in various stages of development across the country.[29] Examples of rail systems with an adjacent pedestrian and bicycle trail include: the Santa Fe Rail Trail (Santa Fe, New Mexico), Folsom Parkway Rail-Trail (Sacramento, California), and the Porter Rockwell Trail (Salt Lake City, Utah). The SMART rails-with-trails system, located in Marin and Sonoma counties, shares many similarities in functionality, design, and length to what is being conceptualized for Santa Cruz County. See Appendix I for comparable rails-with-trails systems in the U.S.

San Clemente multiuse rail-with-trail

[29] *America's Rails-with-Trails*, Rails to Trails Conservancy, 2013.

3.0 STUDY GOALS & OBJECTIVES

Based on input received from members of the public, community leaders, technical stakeholders, rail experts, and the RTC Board, a series of goals and objectives were developed for this Study. The evaluation framework presented later in this report matches project goals and objectives with evaluation criteria that allows for a comparison of the service scenarios in order to provide decision makers and the community with practical recommendations about implementation of rail transit service. More detail on the evaluation criteria that comprise the evaluation framework is presented in Section 7.

The goals and objectives for rail transit service in Santa Cruz County are presented on the next page (Figure 3-1). Goal 1 is focused on transit access and convenience. Goal 2 is focused on community and economic vitality. Goal 3 is focused on financial feasibility.

The goals and objectives are also consistent with regional, state, and federal goals related to access, mobility, transportation system preservation, efficiency, economic vitality, safety, quality of life, the environment, and integration and connectivity of the multimodal transportation system. These include goals, objectives and sustainability principles identified in the RTC's long range Regional Transportation Plan (RTP), AMBAG's Metropolitan Transportation Plan (MTP)/Sustainable Communities Strategy (SCS), Caltrans' California Transportation Plan, Smart Mobility Framework, Strategic Management Plan, District System Management Plan, Highway 1 Corridor System Management Plan, and State Rail Plan.

Figure 3-1: Study Goals and Objectives

Transportation Alternatives/Choices

GOAL 1: Provide a convenient, competitive and accessible travel option

More Options Provide additional and competitive travel options to address the current and future needs of the community (including employment, school, visitor, shopping, recreational, neighborhood and other daily trips)
Ridership Increase the number of people using transit
Faster Travel Times Reduce how long it takes to get places
Transit Connections Connect to the existing (METRO) bus transit system
Bike & Walk Connections Ensure connectivity to sidewalks, bike lanes and Monterey Bay Sanctuary Scenic Trail (or Rail-Trail)
Non-Drivers Expand options for seniors, children, people with disabilities, low-income, and those who cannot or do not drive
Visitors Expand options for visitors and tourists to reduce traffic congestion
Reliability Make it easier to predict how long it will take to get places *(Improve reliability of transit travel times)*

Sustainability

GOAL 2: Enhance communities & the environment, support economic vitality

Reduce Traffic Reduce the number of cars on Highway 1 and local roads
Climate Reduce fuel consumption, greenhouse gas emissions, and air pollution
Other Car Impacts Reduce need for parking, road expansion and other land use effects of cars (preserve open space and reduce sprawl)
Serve Major Destinations Locate stations in areas with high concentrations of housing, jobs, services, visitors and activities
Economy Support access to jobs, shopping, tourist, and other economic activity centers/opportunities
Revitalization Stimulate sustainable development and revitalization of areas near stations
Minimize Impacts Minimize negative impacts of trains on neighborhoods, adjacent property owners, and the environment (including traffic, noise, parking, construction, etc.)
Safety Provide safety measures to avoid conflicts between trains & cars, bicyclists or pedestrians
Consistency Ensure consistency with local, regional, state, and federal plans and policies

Cost Effectiveness

GOAL 3: Develop a rail system that is cost effective and financially feasible

Cost to Benefit (Cost Effectiveness) Develop a rail system that is cost effective
Cost per Rider Generate sufficient ridership to minimize per rider and system costs
Existing Resources Optimize use of existing infrastructure
Financially Feasible Develop a system that keeps operating and capital costs to a minimum
Funding Options Identify service options that are competitive for local, state, and federal funding sources
Efficiencies Maximize operational efficiencies, build partnerships with public and private agencies, groups, and interests

4.0 RAIL TRANSIT SERVICE ALTERNATIVES

A multitude of rail transit service options exist along the Santa Cruz Branch Rail Line. These include where rail transit vehicles might travel between (routes/termini), location and number of stations, service hours, frequency (headways), and service span (such as weekend only or weekday peak periods). The number of miles of track that are used, rail vehicle speeds, location and number of passing sidings, vehicle types, and the presence of freight rail vehicles are among some of the other factors that could influence schedules, potential ridership, cost, and overall feasibility. While service hours and schedules, the location of stations and sidings, and other factors would undergo additional analysis and could change periodically if service is implemented, this section summarizes the service scenarios and associated stations that were recommended for further study.

4.1 SCENARIO DEVELOPMENT

Development and screening of the initial set of ten scenarios and associated stations was conducted to identify five scenarios recommended for further detailed analysis. Scenario development began in summer 2014, as a collaborative process between RTC Staff, the Project Team, the Technical Advisory Committee, the Rail Peers Group, and community members. This section walks though the development process step-by-step, starting with the initial, longer set of potential station locations and ending with the five scenarios recommended for further study.

4.1.1 STATION TIERS

Before the actual scenarios were developed, a comprehensive list of potential station locations was developed and shared with RTC Staff, the RTC board, and community members. The initial assessment of station locations is presented in Table 4-1 and displayed in Figure 4-1 and Figure 4-2. These two figures overlay the potential station location with a transit likelihood index. This index was calculated for all potential stations included in the service scenarios. This score incorporated station specific built environment variables including population and employment density, mix of uses, demographics (zero car households), and design (walkability). More detail on the transit likelihood index is discussed in Section 5.3. Appendix H summarizes characteristics for each of the station areas considered, including primary users of each location, constraints, and other factors. The station locations were sourced from past studies and input from RTC Staff, the Project Team, the Technical Advisory Committee, the Rail Peers, and community members.

TABLE 4-1: PRELIMINARY STATION LIST

Station Name *(# in Figure 4-1 Map)*	**Mile Post**	**Approximate Location**	**Notes/Alternative Location**
Davenport *(1)*	31	Highway 1/ROW	
Westside Santa Cruz *(2)*	22	Natural Bridges/ROW	Shaffer Rd; Natural Bridges Dr; Swift; Almar Ave.
Bay St./California *(3)*	20.7	Bay St./California Ave.	Potentially primary during UCSC school term only
Santa Cruz Downtown/ Wharf *(4)*	20	Pacific Ave/Beach St	Depot Park (Pacific Ave/Center St). Possible Hwy 17 Bus connection
Santa Cruz Boardwalk *(5)*	19.6	Leibrandt Ave./ROW	Potentially weekend-only
Seabright *(6)*	19.1	Seabright Ave./ROW	
Harbor/7th Avenue *(7)*	18.5	7th Ave./ROW	
17th Avenue *(8)*	17.8	17th Ave./ROW	
41st Avenue (Pleasure Pt & Capitola) *(9)*	16.8	41st Ave./ROW	
Jewell Box (Jade St Park/Cliff Dr.) *(10)*	16.4	Nova Dr. / 47th Avenue	Cliff Dr. / 49th Avenue
Capitola Village *(11)*	15.7	Monterey Ave./Park Ave.	
New Brighton/Cabrillo *(12)*	14.2	New Brighton Rd./Cabrillo College Dr.	Park Ave. / Coronado St.
Seacliff Village/Cabrillo *(13)*	13.2	State Park Dr.	Alternate ST stop for Cabrillo
Aptos Village *(14)*	12.5	Soquel Dr/Aptos Crk Rd	Trout Gulch Rd. /ROW
Seascape *(15)*	10.3	Seascape Blvd./Sumner	Rio del Mar Blvd.
La Selva/Manresa St. Beach *(16)*	8.6	San Andreas Rd./ROW	
Ohlone *(17)*	2.8	Ohlone Parkway	Potential park-and-ride
Downtown Watsonville *(18)*	1.7	W. Beach St./Walker St.	
Pajaro *(19)*	0.3	Salinas Rd./Railroad Ave.	Connection to other regional rail systems

Source: Fehr & Peers, 2015. Bolded stations were included in technical analysis.

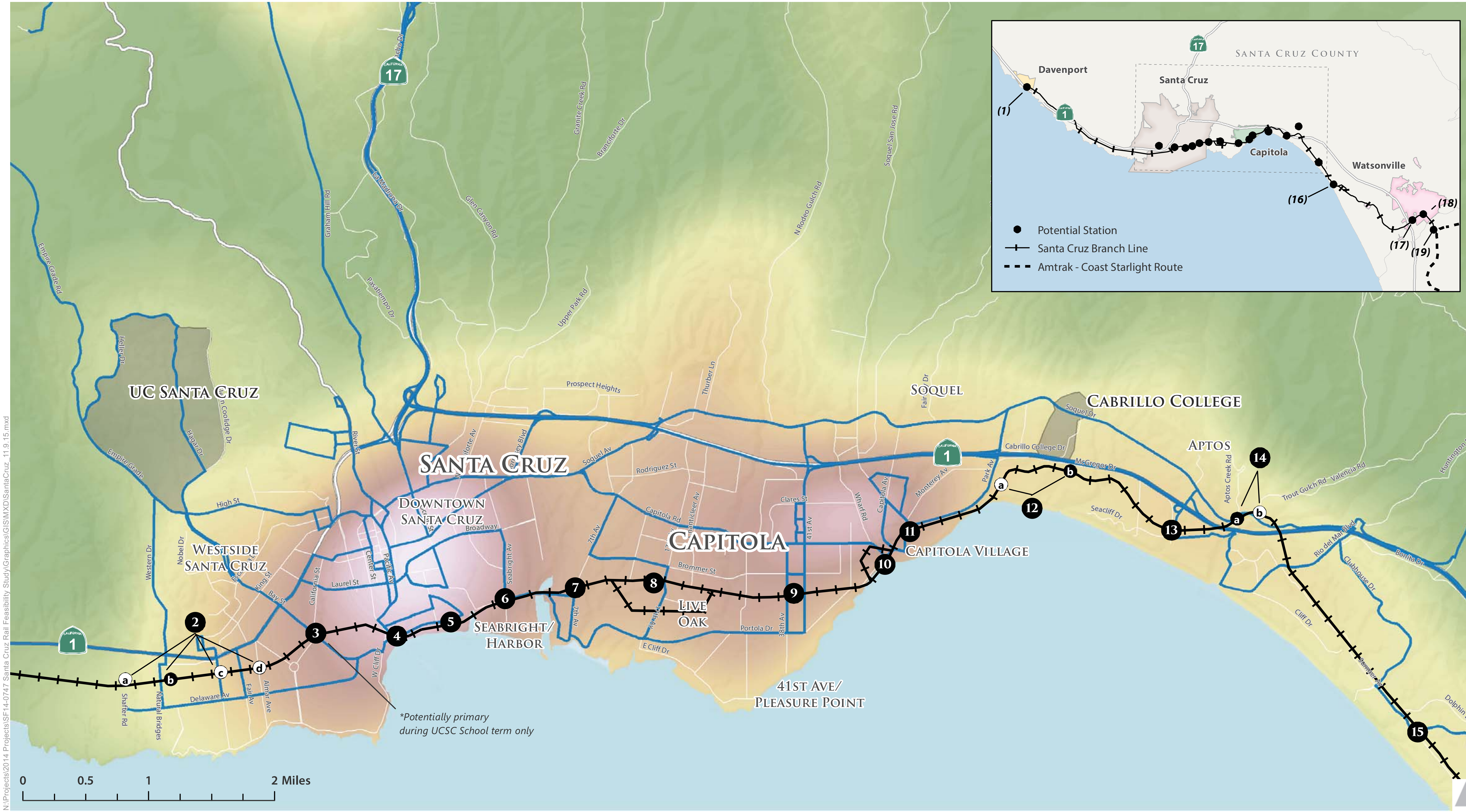
The initial list of potential station locations were categorized by service type, based on associated potential stations and service days/hours:

- **Express:** Limited stops at stations spaced further apart to reduce travel time
- **Local:** More closely-spaced stops across a mix of primary and secondary stations

The RTC-owned Santa Cruz Branch Rail Line includes the wye area near Depot Park, north to the intersection of Chestnut Street and Maple Street in downtown Santa Cruz. The primary downtown station identified above is approximately located at Pacific Ave and Beach St., 0.512 miles from the downtown METRO bus station. The alternate possible location at the old Santa Cruz station in Depot Park is located 0.445 miles from the downtown Metro station. Including an additional alternate possible location at Chestnut and Maple Streets would reduce this distance to 0.268 miles. However, at this location the Right-of-Way is located in the center of Chestnut Street, which would create a range of complications for both the rail project and existing local traffic. Additionally, to bring the rail transit route around the wye to create closer access to downtown, rail vehicles would necessarily be push-pull, which would narrow the scope of this high-level feasibility project. For rail vehicles traveling to/from Bay Street and other locations west of Depot Park, this turn-around time would also lead to longer travel times, changes in the current scheduling model, and possible additional siding requirements. As such, a station closer to the Santa Cruz Wharf was the location evaluated in this study.

The Bay Street/California station is classified both as a primary and secondary station due to the seasonality of potential riders. The main ridership base of this station is expected to be students, faculty, and staff of the University of California, Santa Cruz (UCSC), who would transfer to bus or shuttle traveling up Bay Street to the main campus. UCSC is on the quarter system, with the main academic year spanning from late September to mid-June annually. As such, frequent service at this station would be most productive between September and June of each year. During summer months, service to this station would be consistent with that of a secondary station. The Westside Santa Cruz station could also be considered a major transfer point for buses traveling to UCSC via Western Drive; however buses traveling past the Westside station are currently less frequent than those traveling up Bay Street.

Similarly, Cabrillo Community College would to be served through either a station near New Brighton State Beach or in Seacliff Village near State Park Drive. Service would be reduced when classes are not in session. The distance from the Seacliff Station to Cabrillo Community College on existing roadway and pedestrian facilities is about 1.5 miles. Coordination of schedules with bus or shuttle service would be recommended. For the New Brighton location, a bicycle/pedestrian overcrossing at Highway 1 would provide more direct non-motorized access to Cabrillo Community College.



Station

Santa Cruz Branch Line

Santa Cruz Metro Transit Routes

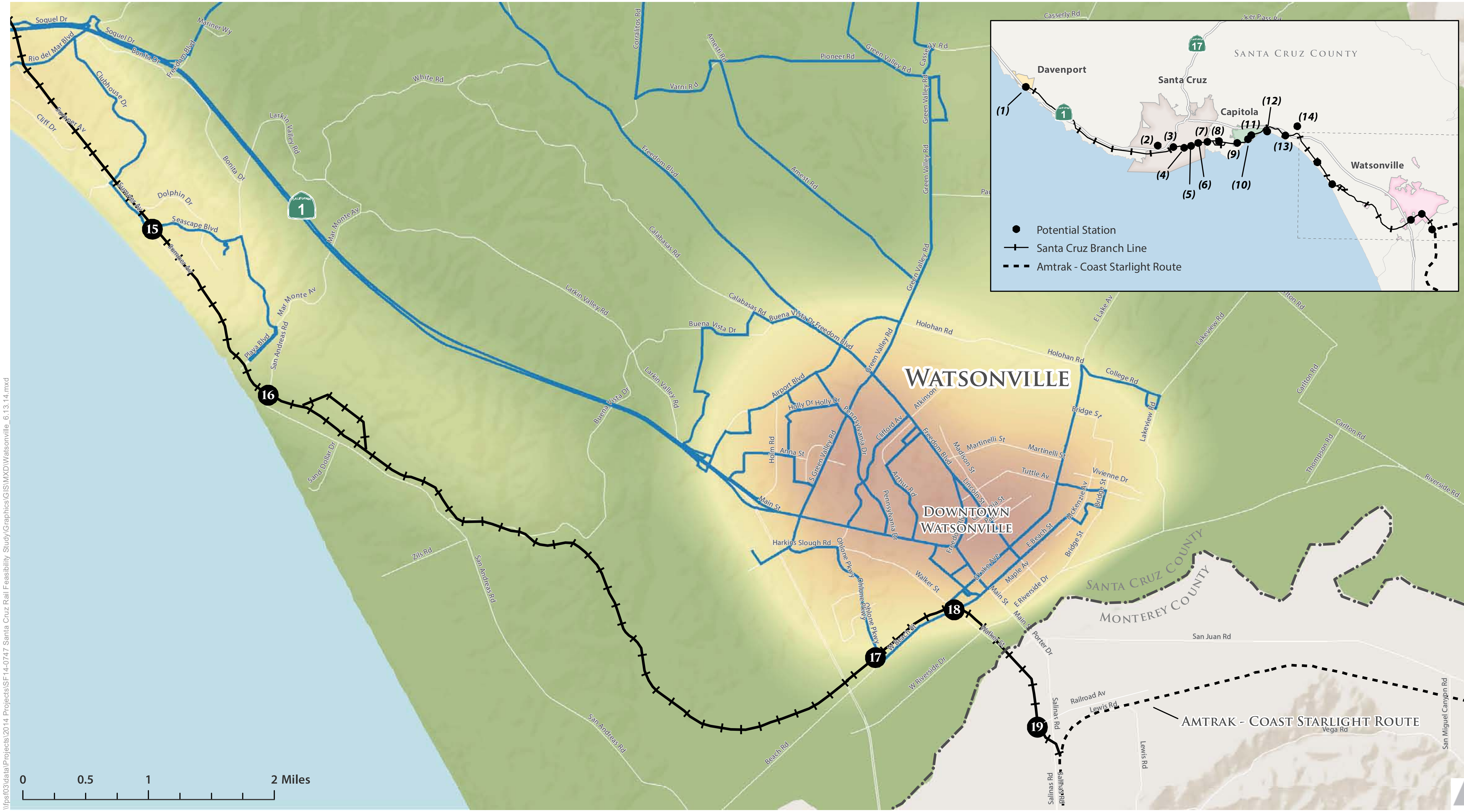
Transit Likelihood: High — Low

Transit Likelihood is a variable that captures population per acre, jobs per acre, land use diversity, street intersection density, and number of zero car housholds per census block group.

Figure 4-1

Transit Likelihood and Preliminary Stations Map - Santa Cruz

November, 2015



Station | Santa Cruz Branch Line | Santa Cruz Metro Transit Routes | **Transit Likelihood:** High – Low

Figure 4-2

Transit Likelihood and Preliminary Stations Map - Watsonville

* *Transit Likelihood is a variable that captures population per acre, jobs per acre, land use diversity, street intersection density, and number of zero car housholds per census block group.*

November, 2015

4.1.2 INITIAL SERVICE SCENARIOS

The ten potential service scenarios initially considered are summarized in Table 4-2. This initial list of scenarios was developed based on existing and forecasted future travel patterns, input from technical stakeholders and the Rail Peers groups, then shared with community members via the RTC's website, emails, community groups, a public workshop held in July 2014 as well as via an online questionnaire. Over 2,000 people provided input on initial scenarios. At the public workshop, members of the community expressed the most interest in the Santa Cruz to Pajaro route with weekday and weekend service. Santa Cruz to Seascape and Davenport to Pajaro were the least popular scenarios, based upon community feedback from the public meeting and the online questionnaire administered concurrently in July 2014.

TABLE 4-2: SERVICE SCENARIOS INITIALLY CONSIDERED

ID	Scenario	Service Type	Service Spans	# of Stations
A	Santa Cruz ←→ Watsonville	Express	Weekday	5-6
B	Santa Cruz ←→ Capitola	Limited Express	Weekend and Weekday	6-8
C	Santa Cruz ←→ Aptos	Limited Express	Weekday Peak and Seasonal Weekends	6-8
D	Santa Cruz ←→ Watsonville (Limited)	Limited Express	Weekday Peak	4-8
E	Santa Cruz ←→ Aptos(Local)	Expanded Local	Weekday and Weekends	6-8
F	Santa Cruz ←→ Seascape	Expanded Local	Weekday and Seasonal Weekends	8-10
G	Santa Cruz ←→ Watsonville	Expanded Local	Weekday and Weekends	10+
H	Santa Cruz ←→ Watsonville (Peak)	Expanded Local	Weekday Peak and Seasonal Weekends	10+
I	Davenport ←→ Pajaro (Full ROW)	Future Conditional: Includes stations to be added in-step with future demographic and economic growth	Weekday Peak	11+
J	Santa Cruz ←→ San Jose (via Pajaro)	Future Conditional	Weekday Peak	11+

Source: Fehr & Peers, 2015

4.1.3 INITIAL SCREENING OF SERVICE SCENARIO CONCEPTS

Taking into consideration public and stakeholder input received during the summer of 2014, the project team conducted an initial, general screening of the scenarios. The screening criteria for the service scenarios are detailed in Table 4-3. Each screening criteria is scored on a high to low scale, indicating how closely a scenario meets a criteria. Table 4-4 displays the results of the initial screening process. The redundancy criterion is scored on a slightly different scale. See Section 7.0 for more information on the evaluation criteria.

TABLE 4-3: SCREENING CRITERIA FOR SERVICE SCENARIOS

Screening Criteria	Qualitative Assessment
Ridership Potential	• Does the scenario serve stations with high ridership potential? • Would new users be attracted to the scenario in terms of location of stations and travel time? • Would the scenario be expected to achieve high, medium, or low ridership per route mile?
Capital Cost	• Is the capital cost to build and operate the system a low, medium, or high investment in relation to other scenarios? • Is the capital cost commensurate to the ridership potential of the scenario?
Transit Connectivity	• Does the scenario improve connectivity to local, regional, and or state transit systems (bus and rail)?
Route Redundancy	• Is the scenario duplicative of another in terms of stations served and span of origin/destination stations?

Source: Fehr & Peers, 2015

TABLE 4-4: INITIAL SCREENING OF SERVICE SCENARIOS CONCEPTS

ID	Scenario	Ridership Potential	Capital Cost	Transit Connectivity	Route Redundancy	Recommended for detailed analysis?
A	Santa Cruz ←→ Watsonville (Express)	Medium	Medium	Medium	Redundant to D, G, H	No
B	**Santa Cruz ←→ Capitola (Limited)**	**Medium**	**Low**	**Medium**	**Somewhat redundant to C, E, F**	**Yes**
C	Santa Cruz ←→ Aptos (Limited)	Medium	Medium	Medium	Somewhat redundant to B, E, F	No
D	**Santa Cruz ←→ Watsonville (Peak Limited)**	**Medium**	**High**	**High**	**Redundant to A, E, G, and H**	**Yes**
E	**Santa Cruz ←→ Aptos (Local)**	**High**	**Medium**	**Medium**	**Somewhat redundant to B, C, F**	**Yes**
F	Santa Cruz ←→ Seascape (Local)	Medium	High	Medium	Somewhat redundant to B, C, E	No
G	**Santa Cruz ←→ Watsonville (Local)**	**High**	**High**	**High**	**Redundant to A, D, H**	**Yes**
H	Santa Cruz ←→ Watsonville (Peak Local)	Medium	High	High	Redundant to A, D, G	No
I	Davenport ←→ Pajaro (Full ROW)	Low	High	Medium	Redundant to J	No
J	**Santa Cruz ←→ San Jose (via Pajaro)**	**High**	**High**[1]	**High**	**Redundant to I**	**Yes, but refine to Santa Cruz ←→ Pajaro**

Fehr & Peers, 2015
[1]Potentially even higher capital costs than other scenarios since additional rolling stock would be needed for this route.

4.2 SERVICE SCENARIOS

Five scenarios were recommended to the SCCRTC Board in September 2014 for detailed analysis. They represent a range of possible service scenarios from low to high cost and near-term to long-term implementation potential.

The following scenarios were modeled assuming use of light Diesel Multiple Unit (DMU) vehicles, except where specified below.

- Limited Service: Santa Cruz ←→ Capitola - Limited service to primary stations and key visitor destinations (modeled as weekday only) (Scenario B)
- Peak Express Service: Santa Cruz ←→ Watsonville - Service during peak weekday commute hours (Scenario D)
- Local Service: Santa Cruz ←→ Aptos - Weekday and weekend service to primary and secondary stations (Scenario E)
- Expanded Local Service: Santa Cruz ←→ Watsonville - Weekday and weekend service to primary and secondary stations (Scenario G)
- Regional Rail Connector: Santa Cruz ←→ Pajaro - Service connecting to future Capitol Corridor/Amtrak and Coast Daylight service at Pajaro to test potential for ridership demand with regional rail accessibility (Scenario J)

Following an initial review of technical information by the Project Team and Rail Peers, two additional scenarios were added that represent an FRA-compliant version of Scenario G and potentially lower cost "starter" concept:

- FRA-compliant Locomotive Powered: Santa Cruz ←→ Watsonville - Weekday and weekend service to primary and secondary stations (long-term). Requires Positive Train Control (PTC) (Scenario G1)
- Limited Starter Service Alternative: Santa Cruz (Bay St/UCSC) ←-> Seacliff (Cabrillo) - Reduced weekday and weekend service hours and station stops, using leased FRA-compliant locomotive powered rail vehicles (Scenario S)

Lastly, as the Project Team moved into the technical analysis stage of the Study, the scenarios selected were further refined to fit the parameters of the available modeling tools, methods, and data. Table 4-5 provides detail on the seven scenarios as analyzed and modeled for the capital cost estimates, operations and maintenance cost estimates, ridership forecasts, and funding assessment.

Ridership and operating model runs (LTK's TrainOps® software) were performed for the weekday scenarios only, consistent with the existing AMBAG model capabilities. Like most regional models, the AMBAG model is focused on weekday commute trips and does not capture weekend trips, which are largely comprised of non-commute trips or leisure travel. As a result, weekend ridership was estimated using a factoring method based on weekend Metro bus ridership.

For the operations analysis, weekend service was not separately simulated, as it is assumed that weekend service patterns could be accommodated within the operating envelope provided for weekday service. Weekend service is qualitatively analyzed in Section 6.0.

TABLE 4-5: WEEKDAY SERVICE SCENARIOS AND STATIONS FOR TECHNICAL ASSESSMENT/MODELING

ID	Scenario	Weekday Operating Period	Service Description	# of Stops	Station Stops	Station Location
B	Santa Cruz ←→ Capitola (Limited)	Full service hours (6:00 a.m. to 9:00 p.m.)	Limited Express: Limited stops at a mix of primary and select secondary stations (skip-stop)	6	Westside Santa Cruz	Natural Bridges/Right-of-way (ROW)
					Downtown Santa Cruz	Pacific Ave/Beach St
					Boardwalk (seasonal weekends) – qualitative analysis only	*Leibrandt Ave./ROW*
					Seabright	Seabright Ave./ROW
					17th Ave.	17th Ave./ROW
					41st Ave.	41st Ave./ROW
					Capitola Village	Monterey Ave./Park Ave.
D	Santa Cruz ←→ Watsonville (Peak Express)	AM peak (6:00 - 9:00 am) PM peak (4:00 to 7:00 p.m.)	Limited Express: Limited stops at a mix of primary and select secondary stations (skip-stop)	6	Westside Santa Cruz	Natural Bridges/ROW
					Bay Street/California *(academic year only)*	Bay St./California Ave.
					Downtown Santa Cruz	Pacific Ave/Beach St
					41st Ave.	41st Ave./ROW
					New Brighton/Cabrillo *(academic year only)*	New Brighton Rd./ROW
					Downtown Watsonville	W. Beach St./Walker St.

TABLE 4-5: WEEKDAY SERVICE SCENARIOS AND STATIONS FOR TECHNICAL ASSESSMENT/MODELING

ID	Scenario	Weekday Operating Period	Service Description	# of Stops	Station Stops	Station Location
E	Santa Cruz ←→ Aptos (Local)	Full service hours (6:00 a.m. to 9:00 p.m.)	Expanded Local: More closely-spaced stops at all primary and a mix of secondary stations	9	Westside Santa Cruz	Natural Bridges/ROW
					Bay Street/California	Bay St./California Ave.
					Downtown Santa Cruz	Pacific Ave/Beach St
					Seabright	Seabright Ave./ROW
					17th Ave.	17th Ave./ROW
					41st Ave.	41st Ave./ROW
					Capitola Village	Monterey Ave./Park Ave.
					Seacliff Village/Cabrillo	State Park Dr./ROW
					Aptos Village	Soquel Dr. / Aptos Creek Rd.
G	Santa Cruz ←→ Watsonville (Expanded Local)	Full service hours (6:00 a.m. to 9:00 p.m.)	Expanded Local: More closely-spaced stops at all primary and a mix of secondary stations	10	Westside Santa Cruz	Natural Bridges/ROW
					Bay Street/California	Bay St./California Ave.
					Downtown Santa Cruz	Pacific Ave/Beach St
					Boardwalk (seasonal weekends) – qualitative analysis only	*Leibrandt Ave./ROW*
					Seabright	Seabright Ave./ROW
					17th Ave.	17th Ave./ROW
					41st Ave.	41st Ave./ROW
					Capitola Village	Monterey Ave./Park Ave.

TABLE 4-5: WEEKDAY SERVICE SCENARIOS AND STATIONS FOR TECHNICAL ASSESSMENT/MODELING

ID	Scenario	Weekday Operating Period	Service Description	# of Stops	Station Stops	Station Location
					New Brighton/Cabrillo - academic year only; Seacliff Village – seasonal weekends	New Brighton Rd./ROW
					Aptos Village	Soquel Dr. / Aptos Creek Rd.
					Seascape *(seasonal weekends) – qualitative analysis only*	Seascape Blvd/ROW
					Downtown Watsonville	W. Beach St./Walker St.
G1	Santa Cruz ←→ Watsonville (Expanded Local, Locomotive Powered)	Full service hours (6:00 a.m. to 9:00 p.m.)	Expanded Local: More closely-spaced stops at all primary and a mix of secondary stations	10	Westside Santa Cruz (UCSC)	Natural Bridges/ROW
					Bay Street/California (UCSC)	Bay St./California Ave.
					Downtown Santa Cruz	Pacific Ave/Beach St
					Boardwalk (seasonal weekends) – qualitative analysis only	*Leibrandt Ave./ROW*
					Seabright	Seabright Ave./ROW
					17th Ave.	17th Ave./ROW
					41st Ave.	41st Ave./ROW
					Capitola Village	Monterey Ave./Park Ave.
					New Brighton/Cabrillo –(academic year only)	New Brighton Rd./ROW
					Aptos Village	Soquel Dr. / Aptos Creek Rd.

TABLE 4-5: WEEKDAY SERVICE SCENARIOS AND STATIONS FOR TECHNICAL ASSESSMENT/MODELING

ID	Scenario	Weekday Operating Period	Service Description	# of Stops	Station Stops	Station Location
					Seascape *(seasonal weekends) – qualitative analysis only*	Seascape Blvd/ROW
					Downtown Watsonville	W. Beach St./Walker St.
J	Santa Cruz ←→ Pajaro (Regional Connector)	Limited 7 days /week (approx. 6 round trips per day from 6:00 a.m. to 9:00 p.m.)	Service connecting to planned Capitol Corridor and Coast Daylight trains, based on planned schedules for those services	10	Westside Santa Cruz	Natural Bridges/ROW
					Bay Street/California	Bay St./California Ave.
					Downtown Santa Cruz	Pacific Ave/Beach St
					Boardwalk (seasonal weekends) – qualitative analysis only	*Leibrandt Ave./ROW*
					Seabright	Seabright Ave./ROW
					17th Ave.	17th Ave./ROW
					41st Ave.	41st Ave./ROW
					Capitola Village	Monterey Ave./Park Ave.
					Aptos Village	Soquel Dr. / Aptos Creek Rd.
					Downtown Watsonville	W. Beach St./Walker St.
					Pajaro	Salinas Rd./Railroad Ave.

TABLE 4-5: WEEKDAY SERVICE SCENARIOS AND STATIONS FOR TECHNICAL ASSESSMENT/MODELING

ID	Scenario	Weekday Operating Period	Service Description	# of Stops	Station Stops	Station Location
S	Santa Cruz (Bay St) ←→ Seacliff (Starter Service, leased vehicles)	6:30 a.m. to 8:00 p.m.	Limited Service to primary stations with varied headways	5	Bay Street/California	Bay St./California Ave.
					Downtown Santa Cruz	Pacific Ave/Beach St
					41st Ave.	41st Ave./ROW
					Capitola Village *seasonal only*	Monterey Ave./Park Ave.
					Seacliff Village/Cabrillo	State Park Dr./ROW

Notes: Fehr & Peers, 2015
1. Model runs were performed for the weekday scenarios only. Weekend full service hours are defined as 10:00 a.m. to 8:00 p.m. and were analyzed qualitatively in Section 6.0. For example, weekend service ridership was estimated using the same proportion of weekday rider experienced by the local bus transit (50%).
2. Weekday full service hours are defined as 6:00 a.m. to 9:00 p.m.
3. Stations assumed to provide year-round service, with the following exceptions. Under Scenario D at the Bay Street/California Avenue (service September through June only to align with academic year) and under Scenario G at the New Brighton/Cabrillo Station (September through June only).
4. The New Brighton/Cabrillo station under Scenario G assumes a future bicycle and pedestrian overcrossing at Highway 1 near the station.
5. While not part of this service analysis, stations could be added or modified when/if actual service is implemented based on demand, such as expansion to Davenport (Future Conditional).

5.0 METHODS AND ASSUMPTIONS

This section summarizes the operating assumptions used for the technical assessment of seven scenarios. General assumptions about vehicle technology, station locations, and track are presented followed by more detailed operating characteristics of each scenario. These assumptions are consistent across all four technical assessment areas:

- Capital Cost Estimates
- Operations and Maintenance Cost Estimates
- Ridership Forecasts
- Funding Assessment

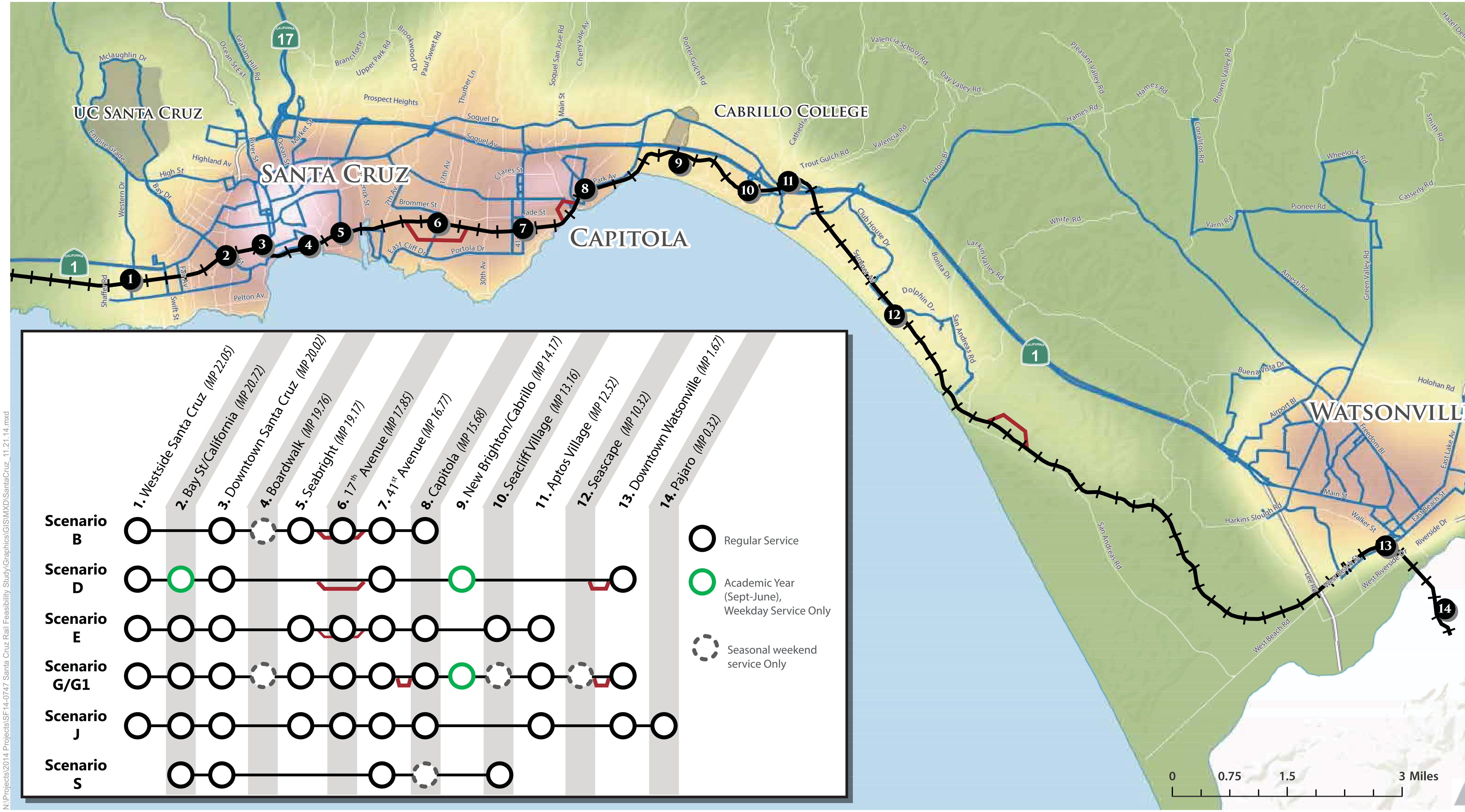
The scenarios, as modeled in the four technical assessment areas, are summarized in Table 4-5 and visually depicted in Figure 5-1.

5.1 GENERAL ASSUMPTIONS

This section presents general assumptions about the service scenarios, including vehicle technology, station locations, and track (including turnouts and curves). Additional information is provided in Section 6.0.

5.1.1.1 Vehicle and Stations

No specific vehicle or manufacturer is being recommended for this feasibility study, but for the purposes of simulating five of these scenarios, the Stadler GTW (articulated railcar) was chosen as an example vehicle to test operating parameters of the Santa Cruz line. Appendix C includes a general technical description of this vehicle, but the important details are that a single car is 135 feet long; although cars can be coupled together to form longer vehicle sets and the internal layout can be designed to accommodate a varying number of mobility devices (ex. wheelchairs), bicycles and other equipment. These types of “light” Diesel Multiple Unit (DMU) rail transit vehicles cannot be on the tracks at the same time as freight and/or passenger rolling stock (such as locomotive with cars or heavy DMUs) compliant with national regulations enforced by the Federal Railroad Administration (FRA). Two of the scenarios analyzed evaluate the capital and operation costs of using vehicles that can be comingled with freight and/or heavy passenger rail vehicles and modifications to operations that could be required. Specifically, Scenario G1 analyzes use of a locomotive and two passenger cars, as compared to Scenario G which assumes light DMU vehicles. Scenario S also analyzes use of FRA-compliant locomotives.



Potential Station | Santa Cruz Branch Line | Santa Cruz Metro Transit Routes | **Transit Likelihood:** High — Low | Passing Sidings*

SCCRTC RAIL STUDY

* *Varies by scenario.*

Figure 5-1

Rail Transit Service Scenarios

November 2015

5.1.1.2 Stations

As described earlier, a series of potential station locations were identified based on travel patterns and public input. The exact location of stations would be subject to design-level analysis in the future. For the purpose of the capital cost analysis, platforms were assumed to be 150 feet long with station track 250 feet long (must be longer than the station platform). 280 foot long platforms would essentially "future-proof" the system by providing enough space for a rail vehicle set of two coupled GTW railcars to berth with ten feet of tolerance. For a two coupled GTW railcar scenario, this distance could be shortened (to roughly 210 feet) to account for just the platform length over the end doors of a two-car rail vehicle set, plus ten feet of operational tolerance—with the front and rear ends of the rail vehicles hanging over past the platform. As an initial cost saving, the station length could be cut down further to just 85 feet, allowing for just a single railcar with five feet of tolerance; in this case, a footprint could be left for a future platform extension as ridership warrants and funding permits. The controlling assumption in this instance would be that the growth necessary to require two rail cars is either unlikely in the short- to medium-term or would be accompanied by a more significant capital program (potentially including further double tracking to increase frequency) that would handle platform lengthening once the system is up and running and proving its viability.

To facilitate level boarding within ADA tolerances, for the purpose of the cost and operation analysis, station platforms were assumed to be sited on tangent (straight) track. Stations were also assumed to be sited such that rail transit vehicles would completely clear grade crossings when stopped at platforms, and thus would not block roadways (Table 5-1). The exact location of stations, including the decision to locate stations on one side of the tracks or the other was not made at this time, and is an issue to be settled at the preliminary engineering stage in coordination with local jurisdictions.


Example of level boarding at CapMetro in Austin, Texas

While the goal was to provide at least 100' of tangent track extending from both ends of the station, this may not possible in a few locations.

- **Downtown Watsonville**: Where the track exits Walker Street and enters the right-of-way there is a curved segment of track. It may be possible to build a platform between Beach and Walker Streets on the west side of the intersection on new tangent track. (This is the location of the historic Watsonville Depot) However, this is a narrow 40' section of Right-of-Way (ROW) and so also adequately accommodating any freight in this area would be difficult, especially in scenarios that call for a two-track terminal in Watsonville.

- **Aptos**: The area around Aptos Creek Road is very constrained. Immediately east the tracks are on a long curve, and moving the station west away from the road would encroach on the viaduct over Soquel Drive.
- **Downtown Santa Cruz**: The area south of the wye, near the wharf is also very constrained and there may be less than 100' of tangent track between the end of the platform and the curve as the rail line enters Beach Street, which is an acceptable deviation from the 100' standard to keep the station near the intersection of Beach Street and Pacific Avenue. Notably Depot Park is an alternate location.

TABLE 5-1: STATION LOCATIONS USED IN SIMULATION

Station *(station #)*	**Intersection (ROW Crossing)**	**East Stationing**	**West Stationing**	**Details**
Pajaro *(14)*	Salinas Rd./Railroad Ave.	13+14	15+94	West side of Salinas Rd. parallel to Railroad Ave.
Downtown Watsonville *(13)*	Beach St./Walker St.	83+32	86+12	West of intersection
Aptos Village *(11)*	Soquel Dr./Aptos Creek Rd.	660+50	663+30	West of Aptos Creek Rd. due to track curve on east side
Seacliff Village/ Cabrillo *(10)*	State Park Dr.	684+08	686+88	East side of State Park Dr.
New Brighton/ Cabrillo *(9)*	New Brighton Rd.	747+06	749+86	West side of New Brighton Rd.
Capitola Village *(8)*	Monterey Ave/Park Ave.	818+82	821+62	East side of Monterey Ave.
41st Ave *(7)*	41st Ave.	878+25	881+05	West side of 41st Ave.
17th Ave *(6)*	17th Ave.	936+35	939+15	East side of 17th Ave.
Seabright *(5)*	Seabright Ave.	1001+26	1004+06	East side of Seabright Ave.
Downtown Santa Cruz *(3)*	Pacific Ave/Beach St.	1055+63	1058+43	West of intersection
Bay St/California *(2)*	Bay St/California Ave.	1091+87	1094+67	Clear of curve #68
Westside Santa Cruz *(1)*	Natural Bridges Rd.	1161+63	1164+43	East side of Natural Bridges Rd.

LTK, 2015
Note: Stationing is measured in feet from a given point (for example: in the first row, near the Pajaro junction) and the '+' is a convention for ease of interpretation. For instance, the stationing for a point 1 mile (5280 feet) from the zero-point would be 52+80.

In the simulations, all station stops were assumed to include a dwell time (door open time for boarding and alighting) of 30 seconds. For a rail system of this intensity, this is the industry standard and is expected to be a reasonable amount of time necessary to both board and alight passengers throughout the corridor, including those in mobility devices or bicycles. Notably, the average dwell time on the Caltrain and Capitol Corridor systems, which do not have level boarding, is also 30 seconds, though actual dwell times can vary.

Parking, bicycle, and pedestrian access, and amenities at stations would be specified and designed during future phases of project analysis. Stations would be designed to provide access from the planned MBSST bicycle/pedestrian trail. Typical station amenities include: station platforms, passenger waiting areas with weather shelter, real-time train arrival information signs, passenger drop-off area (sometimes referred to as "kiss-and-ride"), boarding areas for people with disabilities, trash receptacles, ticket vending machines, bicycle parking, pedestrian-scaled lighting, and wayfinding signage. Identification of specific station amenities will be determined, studied, and selected at a later date. Station location and amenities are discussed in more detail in Section 8.2.3.2.

5.1.1.3 Track

The track profile for this study was developed by RailPros. The curve calculations were used in LTK's TrainOps® simulations, with a further assumption of a maximum 4 inches of super elevation on the outer rail. A Union Pacific track chart provided grades along the right-of-way.

All turnouts were assumed to be #20 type[30], allowing for a maximum of 50 mph. It would be unlikely that a rail transit vehicle would be going this fast when it reaches a point of switch. As a capital cost saving item the switch could be changed to a #15 (allowing for traversal at 35 mph). It is assumed this is a design decision that can be made during the engineering phase of the project. The cost difference on a per-siding basis for only upgrading the tracks to #15 rather than #20 is approximately $60,000 to $80,000.

5.1.1.4 Freight

Simulation efforts and cost estimates for five of the seven scenarios assume rail transit service is not comingled with freight service on the corridor. If both passenger and freight service are operated on the line, it is likely that two waivers would be necessary. First, a waiver (likely based on temporal separation) would need to be granted by the FRA, allowing for non-FRA compliant operation. FRA has granted the waiver for temporal separation to many agencies. Secondly, a California Public Utilities Commission

[30] A turnout, or switch, is in this situation an electrically-powered mechanical device which allows trains to be routed from the main track to the siding (or vice versa). The rating of a turnout (ex. #10, #15, #20) correlates with the maximum allowable speed of a train moving across the switch.

(CPUC) waiver would be required to allow for tighter track spacing in two-track areas (an important consideration in areas where the ROW is very narrow), and, if at all possible, to allow for infrequent and periodic movement of freight cars past station platforms that do not meet the clearance requirements of CPUC General Order 26-D. If this is obtained, it would remove any requirements for gauntlet tracks or platform bridges, with savings in both construction and maintenance costs. The difference in estimated construction and maintenance costs for comingled service versus separated rail services are reflected in Scenarios and G1 and G, respectively.

5.1.1.5 Other Simulation Assumptions

Weekend service was not separately simulated, as it is assumed that weekend service patterns could be accommodated within the operating envelope provided for weekday service. See scenario descriptions below for a qualitative discussion of how weekend service would differ from weekdays.

In order to provide operators with sufficient time to reverse the rail vehicles at terminals (end points), an effort was made to keep rail vehicles from starting their next run without at least 10 minutes of time at the terminal. In practice, turns on a single DMU railcar can be as short as five minutes, but in some cases this can require use of an additional "fallback" operator (an additional operator who waits through a headway at a terminal to be ready to take the rail vehicle out immediately upon arrival, relieving the original operator who waits for the next vehicle). While hiring additional staff does impose a cost on the system, the alternative to quick reversal of rail vehicles at terminals would involve an additional rail vehicle (and an associated operator), as well as double-tracking one or both terminals.

Finally, once maximum operations are accounted for, a 20 percent spare ratio for vehicles (measured as spare vehicles divided by revenue fleet) was applied. For small systems like this, that generally means adding a single vehicle to the fleet for maintenance and "protection" of the scheduled service reliability.

All simulations were performed using the consultant team LTK's TrainOps® software. Track alignment data from RailPros and vehicle parameters from Stadler were imported into the system, and various operating scenarios were then populated. Where necessary, passing tracks were sited to allow for bi-directional 30 minute headways and minimize delay. All simulations assume a simple fixed block signaling system and a 6 percent efficiency allowance to account for a modest level of operator variability.

5.1.1.6 Sidings

As noted earlier, headways were set at 30 minutes and the operation simulations determined where the optimal siding locations would be located based on the scenarios analyzed. However the three siding locations identified in this preliminary analysis are representative and may not be the ones carried through to final design. If headways or start times are staggered and recovery time at each end changes, siding locations could change also. That level of analysis would be conducted during implementation phases.

5.2 OPERATING DETAILS

This section presents more detailed information on operating profiles assumed for each scenario. All scenarios of the operating plan, with the exception of the Scenario S, assume average speeds of 25 mph to 30 mph. To achieve these average speeds with multiple station stops (as well as several sharp curves, which require slower speeds), the maximum allowable speed of the rail vehicles between stations is generally on the order of 45 mph to 55 mph, depending on the civil limit for that for that section of track. Although the civil limit allows for these higher speeds, under the scenarios analyzed, rail vehicles travel at 25 to 35 mph on average.[31] The actual speed of the rail vehicle in any section of track is often significantly lower, as the rail vehicle accelerates and decelerates near stations. Appendix D includes a sample trip chart with sample acceleration and deceleration rates between rail stations. Achieving the higher allowable speeds requires maintaining the track to at least 'Class 3' standards, as outlined in the Code of Federal Regulations, Title 49, Part 213 (49 CFR 213). Class 3 track allows for rail vehicles to travel at speeds up to 60 mph. However, by operating under General Order 143-B of the CPUC, speeds will be restricted to a maximum of 55 mph. The sample scenarios were developed to be different enough to ascertain variations and a hybrid scenario that mixes and matches components could be pursued.

5.2.1.1 Scenario B – Westside Santa Cruz to Capitola (Limited)

The shortest of the five scenarios, Scenario B covers just 6.6 miles, making six stops in total: Westside Santa Cruz, Downtown Santa Cruz, Seabright, 17th Avenue, 41st Avenue, and Capitola Village. Weekday service was assumed to run with a consistent 30 minute bi-directional headway from 6 a.m. to 9 p.m., while weekend service would only run from 10 a.m. to 8 p.m. During spring/summer weekends, a Boardwalk stop at Leibrandt Avenue would be added.

One passing siding was necessary between Leona Creek and Rodeo Creek Gulch. This passing track is 0.87 miles long, and would include double tracking 17th Avenue Station. To maintain legibility within the

[31] The civil limit is essentially a "speed limit" for a section of track, and is based on track geometry and the quality to which the physical track is maintained. During later engineering phases these values could change depending on the detailed design. "Class 3" track allows for trains to travel at speeds up to 60 mph. However, by operating under General Order 143-B of the CPUC, speeds are restricted to a maximum of 55 mph.

system, all eastbound rail vehicles are assumed to take the siding track, resulting in right-hand running service through the station.

Since the 17th Avenue siding is in the middle of the line, vehicles do not run on identical schedules in both directions. Eastbound trips leave Westside Santa Cruz at the top and half hour (0:00 and 0:30), while Westbound trips leave Capitola at 0:04 and 0:34 past the hour. With roughly 16 minute one-way trips, the resulting asymmetric turn times are summarized in Table 5-2. A fleet of three vehicles is necessary to provide this service: two in revenue on any given day, with a third trip to allow for a maintenance rotation. A string chart showing service between 6 a.m. and 9 a.m. is in Appendix D.

TABLE 5-2: SCENARIO B OPERATING DETAILS

Route Length (mi)	Intermediate Stops (Weekday)	One-way Trip time (East/West)	Eastern Terminal Turn Time	Western Terminal Turn Time	Fleet Size
6.6	5	15:19 / 15:58	18:41	10:02	3

Source: LTK, 2015

On weekends, the additional Boardwalk Station is unlikely to adversely affect operations. It will likely shorten the turn time at Westside Santa Cruz, but not so much as to impair consistent service. The Westside Santa Cruz Station does not need to be double tracked in this scenario. As with all changes to roadway configurations and signal timing, more detailed analysis and study would be necessary at a later stage to determine the exact roadway and signal modifications needed for traffic to move smoothly and safely.

5.2.1.2 Scenario D – Santa Cruz to Watsonville (Peak Express)

Scenario D would cover the 20.5 miles between Westside Santa Cruz and Downtown Watsonville, making four intermediate stops: Bay Street/California, Downtown Santa Cruz, 41st Avenue, and New Brighton/Cabrillo. The Bay Street/California and New Brighton/Cabrillo stations would only be served during the academic year for UCSC and Cabrillo Community College (September through June). Year-round service would run weekdays only during the peak periods: 6:00 a.m. – 9:00 a.m. and 4:00 p.m. – 7:00 p.m.

In order to consistently provide service in this scenario, two passing tracks are necessary. The first, around 17th Avenue, is identical to that of Scenario B described above. The second would be near Seascape, from Via Medici to San Andreas Road. At 1.32 miles long, it would not require double tracking any stations. Similar to Scenario B, however, all eastbound rail vehicles would again take the siding to allow for right-hand running service. This passing siding could conceivably be extended east toward Spring Valley Road, but the simulation indicated that rail vehicles could pass each other on the shorter two-track section without incurring any delay, so while extending the siding would allow for more resilient service, it is not strictly necessary. Additionally, the Westside Santa Cruz Station must be double tracked.

The stopping pattern during the academic year was simulated. Travel and turn times are summarized in Table 5-3. A total of four vehicle sets are necessary to provide this service: three in revenue service on any given day, with a fourth vehicle set to allow for a maintenance rotation.

A string chart showing service between 6:00 a.m. and 9:00 a.m. is in Appendix D.

TABLE 5-3: SCENARIO D OPERATING DETAILS

Route Length (mi)	Intermediate Stops (Weekday)	One-way Trip time (East/West)	Eastern Terminal Turn Time	Western Terminal Turn Time	Fleet Size
20.5	9	36:10 / 36:26	5:34	11:50	4

Source: LTK, 2015

Service would not be degraded outside of the academic year when Bay St/California (UCSC) and New Brighton (Cabrillo) are not served. To make sure passing locations are still efficient, rail vehicles may have to dwell at 17th slightly longer, or the westbound schedule could be adjusted slightly, which would also allow for longer turn times in Watsonville.

5.2.1.3 Scenario E – Santa Cruz to Aptos (Local)

This scenario is the shorter of the two local services simulated. Running 9.5 miles from Westside Santa Cruz to Aptos Village, rail transit vehicles would make seven intermediate stops: Bay Street/California, Downtown Santa Cruz, Seabright, 17th Avenue, 41st Avenue, Capitola Village, and Seacliff Village. Like Scenario B, service is assumed to operate with consistent bi-directional 30 minute headways, spanning from 6:00 a.m. to 9:00 p.m. weekdays and weekends from 10:00 a.m. to 8:00 p.m.

TABLE 5-4: SCENARIO E OPERATING DETAILS

Route Length (mi)	Intermediate Stops (Weekday)	One-way Trip time (East/West)	Eastern Terminal Turn Time	Western Terminal Turn Time	Fleet Size
9.5	7	23:30 / 23:09	5:30	7:51	3

Source: LTK, 2015

Travel times are about 23 minutes, allowing for turns in the five to eight minute range (Table 5-4). While this is quite quick, lengthening the turns would require adding a vehicle to the fleet and double-tracking the Westside Santa Cruz Station. A total of three rail vehicle sets are necessary to provide this service: two in revenue service on any given day, with a third vehicle set to allow for a maintenance rotation.

A string chart showing service between 6 a.m. and 9 a.m. is in Appendix D.

5.2.1.4 Scenario G – Santa Cruz to Watsonville (Expanded Local)

Scenario G is the longer of the two local services simulated, running 20.5 miles from Westside Santa Cruz to Downtown Watsonville. Its weekday service would be identical to that of Scenario E, but rail vehicles would stop at New Brighton/Cabrillo instead of Seacliff/Cabrillo, and service would terminate at Downtown Watsonville instead of Aptos Village, for a total of 10 stops. The New Brighton/Cabrillo stop would be in service during the academic year only, from September to June. On weekends under this scenario, New Brighton/Cabrillo would not be served, but Boardwalk (at Leibrandt), Seacliff/Cabrillo, and Seascape would have seasonal (such as Memorial Day through Labor Day) service.

1. An initial simulation run was attempted using Scenario D's passing sidings at 17th and Seascape. By adding stops at Capitola and Aptos, the time between sidings became too large to support 30-minute bi-directional headways.
2. A second concept was tested, replacing the 17th Avenue siding with one between the Capitola and New Brighton Stations. The time between the end of the Westside Santa Cruz double track terminal and the Capitola siding was too large (because of stops at Seabright, 17th, and Capitola compared to Scenario D), and so this approach was abandoned.
3. Attempts to move or lengthen the Seascape siding westward proved futile. Due to the presence of several single-track viaducts (over various creeks and CA-1) no potential two-track sections were long enough to provide an efficient passing location.
4. Another option would be to replace the 17th Avenue siding with one at 41st Avenue, running all the way from Rodeo Creek Gulch to Soquel Creek. However, most of this right-of-way is only 30-35 feet, narrower than the preferred 45 feet, and too narrow for a two-track station. However, the Stadler GTW is only nine feet and eight inches wide (9'8''), and so a two track section with three feet between rail vehicles and a three foot buffer on both sides could fit. Thus, a short (roughly half-mile) two-track section from 41st Avenue (beginning east of the crossing) to Soquel Creek was used for this scenario.

This option is not ideal for several reasons. This siding location is based on transit schedules using 30 minute headways and the existing right-of-way might not be able to accommodate double tracking plus the envisioned trail. Additionally because of the short length of the 41st Avenue siding, westbound rail vehicles incur about 20 seconds of running delay, as they must slow down until the eastbound rail vehicle has entered the siding. If service between Santa Cruz and Watsonville is pursued, other schedule/headway options, additional right-of-way, or design changes would need to be evaluated to accommodate the trail.

This service pattern requires four vehicles in revenue service at a time. Three are generally in motion while the fourth would layover either in Watsonville or at Westside Santa Cruz. This requires either Watsonville or Westside Santa Cruz to be double tracked, as there are brief moments when two rail transit vehicles must occupy a terminal. For the purposes of the simulation, Westside Santa Cruz was chosen, since the right-of-way is wider and is surrounded by a longer segment of tangent track.

The resulting service pattern is summarized in Table 5-5, and a string chart showing service between 6:00 a.m. and 9:00 a.m. is in Appendix D.

TABLE 5-5: SCENARIO G OPERATING DETAILS

Route Length (mi)	Intermediate Stops (Weekday)	One-way Trip time (East/West)	Eastern Terminal Turn Time	Western Terminal Turn Time	Fleet Size
20.5	9	40:45 / 40:45	7:15	31:15	5

Source: LTK, 2015

During seasonal weekends when there are a total of 11 intermediate stops, it is possible that service will be somewhat degraded. Since the passing sidings in this scenario do not include a two-track station, it is more likely that rail vehicles will experience either running delay or will have to stop and wait for the approach of the meeting rail vehicle. Since there will be no additional running time between the Seascape siding and the Watsonville terminal, turns at Watsonville should remain consistent. Turns at Westside Santa Cruz may decrease slightly, but should stay above the minimum tolerable threshold of a five minute turn. On weekdays during the few non-academic months, run times should actually improve as rail transit vehicles will operate faster between the 41st Avenue and Seascape sidings.

5.2.1.5 Scenario G-1 – Locomotive Powered (FRA-Compliant)

The operating details for Scenario G1 are almost identical to Scenario G, save for the following: Scenario G-1 would be operated on locomotive-powered, FRA-compliant vehicles.

Passing sidings would be the same as Scenario G and there is no material change in schedule for the locomotive-hauled service. Under this scenario, there would be a bit of running delay (because a rail vehicle on a passing track slows a little to make sure the oncoming rail vehicle clears the interlocking before proceeding), but 30 minute bi-directional headways are still feasible. The study assumes level boarding for Scenario G-1 (which increases capital costs compared to Scenario G as doors on locomotive hauled cars are higher up on the vehicle body than on a DMU); if level boarding is not provided dwell times would be longer, also impacting overall travel times and operating details.

5.2.1.6 Scenario J – Santa Cruz to Pajaro (Expanded Local)

Scenario J is the longest of the five scenarios considered and would provide a low frequency service. Rail service would operate 21.8 miles from Westside Santa Cruz to Pajaro, stopping at Bay Street/California, Downtown Santa Cruz, Seabright, 17th Avenue, 41st Avenue, Capitola Village, Aptos Village, and Downtown Watsonville in the interim. A seasonal Boardwalk stop (at Leibrandt Avenue) would be used during spring/summer weekends as well. Service would run roughly every two hours, seven days a week. During the week, rail vehicles would depart from Westside Santa Cruz on the even hours (such as 6:00 am, 8:00 am, 10:00 am, etc.) and depart from Pajaro for a return trip on the odd hours (7:00am, 9:00 am, etc.). This would allow for eight daily round trips, with the final rail vehicle arriving at Westside Santa Cruz at about 9:45 p.m. Since weekend service would not start until 10 am, there is only time for five round trips, with the last trip of the day arriving at Westside Santa Cruz around 7:45 p.m.

TABLE 5-6: SCENARIO J OPERATING DETAILS

Route Length (mi)	Intermediate Stops (Weekday)	One-way Trip time (East/West)	Eastern Terminal Turn Time	Western Terminal Turn Time	Fleet Size
21.8	8	42:56 / 42:35	17:04	17:25	2

Source: LTK, 2015

This service pattern requires just a single revenue rail transit vehicle set (though a second would be required to allow for a maintenance rotation) and no passing tracks. As shown in Table 5-6, terminal layovers would be about 17 minutes, although they could be adjusted (so long as a second revenue vehicle set and passing tracks were not necessary) to meet future Capitol Corridor or Coast Daylight service at the Pajaro Station. The addition of the Boardwalk stop during the summer would not significantly change operations—travel times would become slightly longer, reducing turn times at the terminals. Otherwise, service would remain unchanged. A string chart showing full weekday service can be found in Appendix D.

5.2.1.7 Scenario S – Limited Starter Service – Santa Cruz/Bay St to Seacliff (Cabrillo)

This scenario shares characteristics of Scenarios D and E, but utilizes FRA-compliant locomotive vehicles. Running 7.6 miles from Bay Street/California Avenue in Santa Cruz to Seacliff Village/State Park Drive, rail vehicles would make two intermediate stops year-round: Downtown Santa Cruz and 41st Avenue, as well as Capitola Village seasonally from June through Labor Day and for special events. It is anticipated that additional stations could be added incrementally, but this reflects service to the highest use stations. Weekday service hours and frequency would be bi-directional with 38 minute headways from 6:30 a.m. to 9 a.m. and from 3:30 p.m. to 6:30 p.m., with hourly bi-directional service mid-day from 9:00 a.m.-3:30 p.m. and from 6:30 p.m. to 8 p.m. Weekend service would be limited to bi-directional 60 minute headways over twelve hours (for example from 8:00 a.m. to 8:00 p.m.).

TABLE 5-7: SCENARIO S OPERATING DETAILS

Route Length (mi)	Intermediate Stops (Weekday)	One-way Trip time	Eastern Terminal Turn Time	Western Terminal Turn Time	Fleet Size
7.6	2	28 min.	10 min	22 min	3

Source: Iowa Pacific, 2015

Travel times estimated by Iowa Pacific were about 25 minutes, allowing for weekday turns in the 10 minute range in Seacliff and 22 minutes at Bay Street. This scenario assumes that double-tracking the termini stations is not needed. A total of three rail vehicle sets are necessary to provide this service: two in revenue service on any given day, with a third rail vehicle set to allow for a maintenance rotation. Siding location is near 17th Avenue.

5.2.1.8 Storage and Maintenance Facility

Maintenance facilities are best located near terminals. This minimizes the need for deadheading rail vehicles (running vehicles without passengers) to the beginning of their run or back to the shop at the end of the day. Although major maintenance of vehicles (such as mid-life overhauls) could happen remotely, outside of Santa Cruz County, at shared facilities, more frequent work, including washing, mandated inspections, re-fueling, and other mechanical maintenance must happen at the local maintenance facility.

Based on a preliminary assessment of land use and real estate values, locating a general maintenance facility in Watsonville along the ROW is likely the most effective choice if service is provided to that city. Similar to stations, the maintenance facility should be built with future two-car consist scenarios in mind. To that end, indoor shop tracks and outdoor storage tracks should all be about 300 feet long. See Section 9.3 on future implementation activities, including analysis recommendations that would inform the future decisions regarding maintenance facility siting.

Regardless of the size of the facility, the location must be given special consideration in scenarios B and E. These scenarios end at Capitola and Aptos respectively, roughly ten miles from Watsonville. Using a facility in Watsonville in these scenarios would require deadheading rail vehicle sets almost as far as the revenue route itself, which would create a significant operational cost, both in terms of crew time and fuel burned. Therefore, in these scenarios it is probably best to locate the maintenance facility near the Westside Santa Cruz terminal. Current land use in this area includes light industrial and is not that dense, making this a potentially good fit.

Although several of the scenarios require smaller fleets, another bit of 'future-proofing' would be to size the facility for a future 10-car fleet, with five engines. This necessitates a two track shop with four outdoor storage tracks, which could be placed on a three acre site. If placed beyond the end of the revenue line, a single throat opening up to a larger yard would be acceptable. If the facility is placed parallel to revenue track, two points of access to the main track would be preferable. In so doing, rail transit vehicles will never need to stop and reverse along the main track, potentially conflicting with in-service rail vehicles.

If a site of that size is unavailable or the system is unlikely to expand, smaller facilities may be feasible for a few of the scenarios. For Scenario J, a very simple 2-track maintenance shop could suffice, with one track inside a shop and another storage track outside. Scenarios B and E also have smaller fleet requirements, potentially allowing for a single shop track with two outdoor storage tracks.

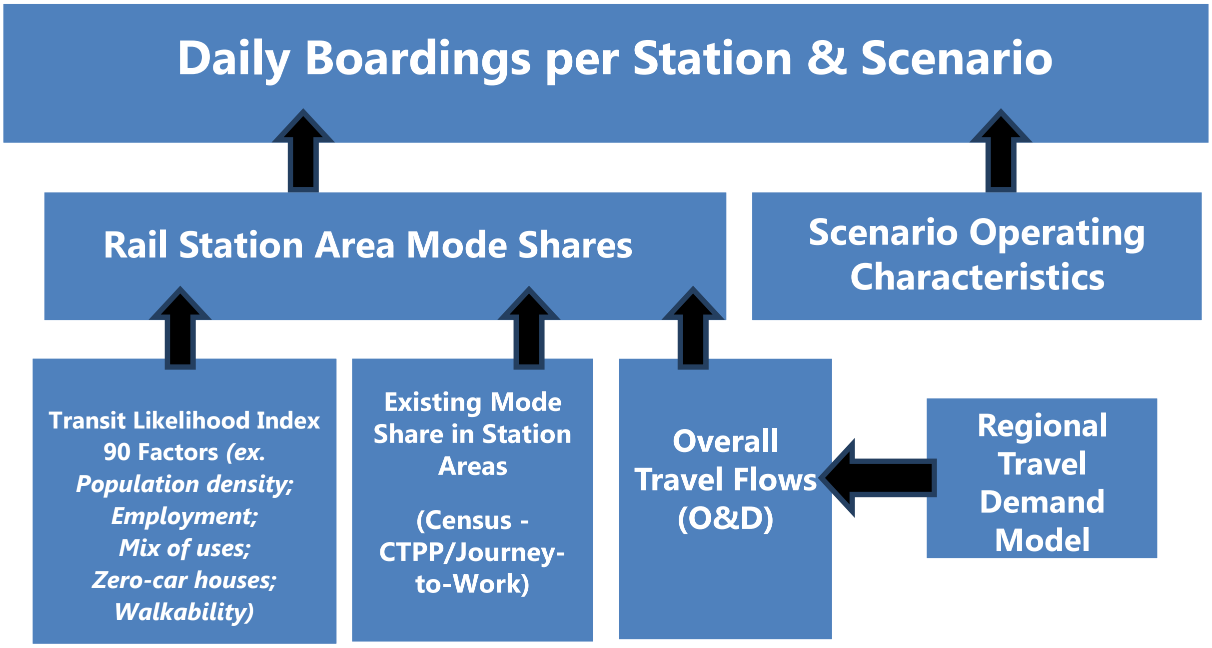
It would be appropriate to investigate in the future if cost sharing for maintenance facilities with the short-line freight or recreational service operators in Santa Cruz County is possible.

5.3 RIDERSHIP FORECASTING METHODOLOGY

The seven service scenarios analyzed in this study (described in Table 4-5) address a range of service markets, schedules, frequency, and potential vehicle technologies. Ridership forecasts were prepared using origin-destination (O&D) travel flow data from the Association of Monterey Bay Area Governments (AMBAG) regional travel demand model (RTDM), demographic and other built environment data from the Environmental Protection Agency (EPA) Smart Location Database, and transit mode share data from the Census Transportation Planning Package (CTPP) tabulations from the American Community Survey (ACS, conducted by US Census Bureau) (Figure 5-2).

Fehr & Peers has extensive experience in developing Direct Ridership Models (DRMs) for rail systems across the country, including several within California such as Altamont Commuter Express (ACE), Caltrain and BART. However, these models were not found to be directly applicable to the Santa Cruz County Rail project since the models did not include key input variables important to this study such as student population and visitor travel. Therefore an integrated approach was developed for this project in order to incorporate the benefits of both direct ridership forecasting and the regional model, which does include student and visitor travel markets.

Figure 5-2: Ridership Forecasting Development Process



Source: Fehr & Peers, 2015

The number of person trips estimated to travel along the study corridor, disaggregated into rail station to station trip interfaces, was extracted from the AMBAG Regional Travel Demand Model (RTDM). The person trip estimates represent the total travel along the study corridor by all modes. The AMBAG *2014 Regional Growth Forecast* projects population growth in Santa Cruz County of 46,000 persons (18% increase from 2010 to 2035) and employment growth of 21,000 employees (19% increase from 2010 to 2035) over that time period. From 1990 to 2010, population growth in the City of Watsonville (20,100) and the City of Santa Cruz (10,200) represented most of the overall county population growth of 32,600 persons.

Origin-destination travel flows for both Baseline Conditions and 2035 Conditions were extracted from the AMBAG RTDM in order to provide an estimate of base travel flows along the corridor for each scenario. Benefits of using the RTDM are that it provides origin-destination travel flow information; it incorporates key populations likely to use rail in Santa Cruz County, including students and tourists; and it uses future land use projections in order to forecast changes to travel flows across the region in the future. In addition, the origin-destination travel flows provided by the AMBAG model cover a full 24-hour period. The model outputs the AM peak period (6 to 9 a.m.), midday (9 to 4 p.m.) and PM peak period (7 to 6 p.m.). These travel flows were adjusted for each scenario to account for the time period in which the rail is in operation; however there is not an exact way to break down the trips hourly.

To estimate the share of total person trips that would be made by rail for each of the study scenarios, the demographic and built environmental characteristics of each proposed Santa Cruz rail station area was identified and compared to stations on other existing passenger rail lines in Northern California. The approach relied on an analogous station-matching process to determine rail mode share for future Santa Cruz stations based on existing stations on other rail lines with similar station characteristics in California.

A transit likelihood score was calculated for each station in each of the service scenarios analyzed. The results of this analysis are visually depicted in Figure 4-1 and Figure 4-2 maps. This score incorporated station specific built environment variables including population and employment density, mix of uses, demographics (such as zero car households), and design (such as walkability). The transit likelihood score for Baseline Conditions was calculated using data from the EPA's Smart Location Database, a nationwide geographic data resource for measuring location efficiency.[32] The database includes more than 90 variables, which are available for Santa Cruz County at the Census Block Group level (Appendix J). Population, employment and demographic changes forecast in the AMBAG RTDM were used to forecast 2035 transit likelihood scores for each station. A transit likelihood score was also calculated for existing ACE and Amtrak stations[33] with similar built environments to the Santa Cruz County rail transit station areas. Direct ridership forecasting techniques were used to determine the relationship between the transit likelihood score of a station and the transit mode share of the station using Census Transportation Planning Package (CTPP) transit mode shares for the existing stations. CTPP is a set of special tabulations about workplace-based and residence-based trips and traveler characteristics using large sample surveys conducted by the Census Bureau, specifically the American Community Survey (ASC).[34] There are several surveys conducted by the Census Bureau that ask questions related to commuting including means of transportation, time of departure, mean travel time to work, vehicles available, and distance traveled. These surveys are commonly referred to as journey-to-work data and are the source of mode share estimates in the CTPP from the areas surrounding the potential stations on the Census Block Group level[35].

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[32] EPA Smart Locations Database, 2014 (http://www2.epa.gov/smartgrowth/smart-location-mapping#SLD)
Notably fares, parking availability, recreational riders, and some additional factors could also factor ridership levels, but could not be calculated through the model.

[33] The following Amtrak Capitol Corridor Stations were used: Berkeley, Centerville, Emeryville, Fairfield/Suisun City, Hayward, Martinez, Oakland Jack London Square, Richmond, San Jose, Oakland Coliseum. The following Altamont Commuter Express Stations were used: Great America, Livermore, Pleasanton, San Jose, Santa Clara, Vasco

[34] The CTTP does not capture weekend travel. If weekend, non-commute, trips could be estimated from an accurate, validated data source and added to the ridership estimates for this project, overall system ridership would increase. However, no accurate, validated source for such data currently exists.

[35] More information on CTTP can be found http://www.fhwa.dot.gov/planning/census_issues/ctpp/

These relationships were then applied to the Santa Cruz County rail transit stations in order to forecast the rail mode share for each station and scenario. Lastly, the rail mode shares were applied to the travel flows produced by the RTDM in order to forecast rail trips per station.

In order to forecast peak period ridership for Scenario D, which includes service only during weekday peak periods (Monday through Friday), peak period trip tables from the AMBAG RTDM were used. The RTDM defines the AM Peak Period as 6:00 – 9:00 a.m. and defines the PM Peak Period as 4:00 – 7:00 p.m.

UC Santa Cruz and Cabrillo College are special uses that would be expected to generate rail riders. Since none of the rail scenarios would directly serve either campus, forecasts of the number of university employees and students that would travel by rail was determined using a similar analogous station-matching process that is described in Section 5.1.3.2.

Community members have asked who would be riding the rail lines. The highest ridership stations are the Bay Street/California (where UCSC employees and students are forecast to transfer to a METRO or UCSC shuttle bus to campus), Downtown Santa Cruz, 41st Street, Capitola Village, and the station where Cabrillo College employees and students would access the rail line (New Brighton or Seacliff Village depending on the scenario). The questionnaire conducted in the summer of 2014 indicated that the primary trip purposes for respondents interested in riding rail transit in Santa Cruz County are commute and leisure (Appendix A). Onboard surveys from the Capitol Corridor rail line (which links Sacramento to the Bay Area) indicates the primary travel purpose is work related. Most riders use the Capitol Corridor to commute to work or to travel for business (66%), but 16% of all riders are traveling to visit family or friends and 8% are traveling to leisure or recreational destinations.

Community members have also asked what would increase ridership, whether buses would generate more riders than rail, whether a more detailed model of the relationship between the proposed rail and existing bus service could be provided, and whether cars would be removed from Highway 1 as a result of new rail service. The most significant factors that would result in higher ridership levels are new transit-oriented-development within one-half mile of stations, good modal access to all stations, adequate park-and-ride facilities, and high quality of rail service (such as longer hours and more frequent service). Many national research studies have indicated that persons are more likely to ride rail transit than bus transit, due to factors such as more consistent travel times. A more detailed model that reflects a detailed integration of a new rail line with existing or modified bus routes could be developed in subsequent project development stages. This effort would need to be preceded by the selection of a preferred rail alignment and station locations, development of conceptual station plans, and consultation with Metro staff to determine what changes to the existing bus route system would occur with a new rail service. This more detailed modeling effort would be able to answer questions about potential travel benefits, such as reductions in vehicle miles traveled (VMT) and auto trips on Highway 1.

5.3.1.1 Ridership Ranges

Since the CTPP is based on commute data and commute trips tend to have higher transit mode shares than non-commute trips, these mode shares were used for the “high” ridership estimates. These mode shares were then adjusted down to account for the fact that in most rail systems non-commuters are less likely to take transit. These adjusted mode shares were used for the “low estimates”. Both the high and low mode shares were applied to the overall origin-destination travel flows from the AMBAG model for each scenario for both Baseline Conditions and 2035 Conditions in order to estimate the total number of trips by rail. These are general estimates developed to compare the relative benefits of each study scenario, which is a key reason for presenting a high/low range for each scenario alternative.

5.3.1.2 Other Ridership Factors

The following section describes ridership forecasts that were made to account for special generators (such as colleges) and to estimate ridership from transfers to potential future regional rail service (such as new Capital Corridor or Coast Daylight service to Pajaro) with Scenario J. More detailed modeling would result in more refined ridership estimates, which could also include refined estimates for park-and-ride use or bus or shuttle transfers, commuters traveling from Monterey County to jobs in Santa Cruz County, Watsonville origins and destinations more than one-half mile from the rail line, and recreational users. See Section 9.4.3 for more information.

5.3.1.2.1 Weekend Ridership

Like most regional travel demand models, the tri-county AMBAG model is focused on weekday commute trips and does not capture weekend trips, which are largely comprised of non-commute trips or leisure travel. As a result, ridership modeling captures weekday trips only. For the purpose of this study, based on a comparison of Santa Cruz Metropolitan Transit District (METRO) and San Diego-area Sprinter weekday to weekend ridership levels, weekend ridership was assumed to be 50 percent of weekday ridership.

5.3.1.2.2 UC Santa Cruz Forecasts

In order to account for trips going to or coming from the University of California at Santa Cruz (UCSC) main campus but taking a shuttle, bus or bike to access a station, travel flows from the AMBAG RTDM for trips between UCSC and stations along the corridor for each scenario were also extracted from the AMBAG model. These UCSC trips were then applied to the station closest to the campus (could be either downtown, Bay or Westside). For Scenario B, this was the Downtown Santa Cruz Station, but for scenarios D, E, G and J this was the Bay Street / California Avenue. The same mode share analysis described above was used to determine the portion of these trips that would be made by rail. While some students, facility, and staff may access the main campus via shuttles or buses from the Westside Santa Cruz Station; for simplification purposes the Westside location ridership estimates only reflect service to UCSC administrative and research facilities located in that area.

5.3.1.2.3 Cabrillo College Forecasts

The New Brighton Drive Station initially scored low on the transit likelihood index. However, Cabrillo College is located near the station and student surveys found that approximately 11 percent of students currently take transit. Based on Cabrillo student's current patterns, the transit likelihood score was adjusted to account for the higher transit likelihood of the station due to its proximity to the college. This adjustment increased the rail mode share estimate and therefore the rail ridership forecasts for the station. The same process was conducted for the Seacliff Village station in Scenario E. This scenario is not served by New Brighton, making Seacliff Village the closest station to Cabrillo College. For both of these potential stations, closing the last mile with transit and shuttle services and bicycle and pedestrian facilities is important to help students get from the station to the Cabrillo Campus, much of which is on elevated land with a steep grade. For the New Brighton location, a bicycle/pedestrian overcrossing at Highway 1 would provide more direct non-motorized access to Cabrillo Community College. The challenge of ensuring that a public transit user can connect to and from different transit services to their destination is often referred to as the "first and last mile problem."[36]

5.3.1.2.4 Forecasts for Scenario J

The Pajaro Station is included in Scenario J as a connection to regional rail, with two planned rail connections: 1) the Capital Corridor Extension to Salinas; and 2) the Coast Daylight. The scenario has only six roundtrips per day, rather than 30 for other scenarios. This is an 80 percent reduction in frequency. Therefore, while under the other scenarios rail transit would arrive every 30 minutes, in Scenario J rail service would arrive on average only about once every two-and-a-half hours. Research has shown that reductions in frequency of service reduce ridership potential, and ridership reductions are more drastic (elasticities are higher) with longer headways.[37] Rail service frequency elasticities on ridership have been estimated to vary from 0.4 to 0.8, meaning that as service frequency is reduced by 10 percent, ridership can decrease by 4 to 8 percent. We used an elasticity value of 0.8 to estimate the reduced ridership potential due to the reduced frequency in Scenario J. This higher elasticity value was used due to the significant reduction in number of daily trips compared to scenarios B, E, and G

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[36] Mineta Transportation Institute, Using Bicycles for the First and Last Mile of a Commute, 2009 <http://transweb.sjsu.edu/MTIportal/research/publications/documents/BikeCommute.pdf>

[37] Traveler Response to Transportation System Changes Interim Handbook, TCRP Project B-12, March 2000

Detailed ridership forecasts have not yet been developed for the Capital Corridor Extension to Salinas or the Coast Daylight system. However, updated studies are currently in progress. For Capital Corridor, a daily ridership rate was estimated based on recent annual system-wide ridership[38] forecast. From this rate, 30 percent was assigned to the Pajaro Station.[39] For Coast Daylight, daily system-wide ridership was divided by the number of stations to achieve a base station-level ridership estimate.[40]

Based on these preliminary estimates drawn from system-wide ridership forecasts, a value of 100 daily boardings was added to the Pajaro Station forecasts under Baseline Conditions, which would be generated from riders transferring from the Capital Corridor or Coast Daylight systems. Likewise, 100 daily boardings were added to the other stations along the corridor, accounting for riders which would alight at Pajaro and transfer to Capital Corridor or Coast Daylight. These 100 boardings were distributed across the remaining stations according to the boarding distribution among those stations. A total of 200 daily boardings, attributed to regional rail transfers, were added to the Scenario J forecasts. These estimates include daily round trips and one-way trips (with the corresponding inbound or outbound trip made on a different date). For modeling purposes, it was assumed that the daily boardings would match the daily alightings at the Pajaro Station. The same process was applied for 2035 Conditions using a value of 150 daily boardings and 150 daily alightings at Pajaro Station.

5.3.1.3 Ridership Terms

Ridership is measured as total weekday passenger boardings, defined as the number of passengers who board rail vehicles at any given station in either direction within the extent of a service scenario. Daily boardings generally match or are similar to daily alightings. Alightings are when a passenger exits off of rail transit at his/her destination station or location. This is because most transit riders make two trips per day: an initial trip and a return trip. For the initial trip, the passenger boards at the origin station and alights at the destination station. For the return trip the passenger boards at the destination station and alights at the origin station. Therefore, the daily boardings value includes both the boarding at the origin station from the initial trip and the boarding at the destination station for the return trip. Although the transportation analysis only cites daily boardings, the analysis covers both origin and destination station trip ends.

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[38] *Capital Corridor Extension To Salinas*, Transportation Agency for Monterey County (2014) <http://www.tamcmonterey.org/programs/rail/pdf/railextensionflyer-KickStart.pdf>

[39] *Commuter Rail Extension to Monterey County Ridership Validation Report,* Transportation Agency for Monterey County (2009), p. 25 < http://www.tamcmonterey.org/programs/rail/salinas_rail.html>

[40] *Coast Corridor Service Development Plan,* Caltrans (2013) < http://californiastaterailplan.dot.ca.gov/docs/Final_2013_Coast_Daylight_SDP.pdf>

6.0 TECHNICAL ASSESSMENT OF SERVICE SCENARIOS

Following the selection of service scenarios to be studied, the Project Team moved forward with analyzing each scenario. The analysis focused on system costs, ridership, and funding eligibility or competitiveness. Although the technical approach for each analysis category varied, the overall goal across all categories was to gather and estimate the most accurate performance metrics for each scenario using available data sources. The data presented in this section are intended to provide a fuller picture of how each scenario would operate. The results of the technical analysis also serves as inputs for the evaluation of scenarios, presented in Section 7.0.

This section includes the full technical assessment of the service scenarios selected for further study, presented in the following order.

- Capital Cost Estimates
- Operations and Maintenance Cost Estimates
- Ridership Forecasts
- Funding Assessment

6.1 CAPITAL COST ESTIMATES

In order to assess the capital needs of each scenario, an assessment of the existing conditions and determination of upgrade and maintenance requirements for the track and signal systems for the Santa Cruz County Rail line between Pajaro, Milepost 0.0, and West Santa Cruz, Milepost 22.1 was performed. RailPros conducted a field inspection of the line[41], reviewed previous documentation made available by RTC, and developed cost estimates based on this information and the service scenarios carried forward for analysis.[42] For five scenarios, this analysis was based on capital needs for a light Diesel Multiple Unit (DMU) operation on the line. Capital needs if FRA-compliant vehicles were used, which are compatible with comingled freight train use of the line, were also analyzed for Scenario G1 and by Iowa Pacific for Scenario S.

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[41] RailPros' Field Inspector was Dale Hansen, who was responsible for track maintenance on the TriMet (Portland) DMU operation, Portland & Western shortline, and previously on the Caltrain line.

[42] 2012 Bridge Inspection Report, SCCRTC. Track Maintenance / Cost Evaluation for the Santa Cruz Branch, HDR, 2009. Valuation Maps, SCCRTC. Track Charts, SSCRTC, Valuation Maps, SCCRTC.

6.1.1 COST ASSUMPTIONS

It has been assumed that all work would be performed by contractors at prevailing wage. Costs are conceptual and are based on the project team's recent experience with rail line rehabilitation and maintenance bid costs; no engineering was performed. The estimates are meant to provide a general estimate in order to assist with discussions about next steps. Costs will be more precise once design engineering is conducted, though even at that point in time, many variables may still exist when estimating costs. It is common for the cost of materials to fluctuate from one construction season to the next; condition of the line could change due to interim maintenance and upgrades that may be done by the short line operator; or degrade over time due to weather and general wear and tear. Estimated capital cost breakdowns by element of work is contained in Appendix E, and includes a 30 percent contingency, given these uncertainties. It is assumed that most improvements would be contained within the existing right-of-way, though an allowance has been made for potential additional property acquisition at stations or sidings in order to provide ample space for a trail. The exact geometry of the trail at these locations is not known at this time and would be performed during the preliminary engineering phase of the projects.

To the extent possible, costs have been estimated based on high-quality second hand material (such as rail). However, safety-critical signal system apparatus, grade crossing equipment, and ties are assumed to be new. While there may be upfront cost savings from using some second hand components, other used components are not a better value. For example, railroads have found that there is little or no savings available from installing second hand ties (which can vary widely in their condition depending upon their previous service) on a life-cycle basis, which require replacement sooner than a new tie would. Moreover, replacing worn components after operations commence is substantially more expensive, as work crews have to compete with rail operations for access to the track.

Good quality second hand material that meets Buy America requirements is usually available. Given the light service, it would likely last for the 20-year analysis period (assuming freight traffic remains at current levels). The price of second hand material fluctuates with the price of new material, since steel is a fungible commodity. A more detailed cost-benefit analysis of second-hand materials would be appropriate during design engineering.

To minimize construction impacts once service is initiated, reduce maintenance needs, and in anticipation of forthcoming state and federal regulations, full replacement and reconstruction of some elements is recommended and included in the cost estimates. However, to reduce upfront costs, it may be possible to initiate rail transit service before making all of the changes described below, with the expectation that future upgrades may be made at a later time.

6.1.2 EXISTING CONDITIONS

The review of the existing conditions was performed October 13 through October 15, 2014. A hi-rail vehicle was not available, so the field investigation consisted of a walking inspection in the vicinity of each grade crossing. Approximately one-third to one-half of the track between Pajaro and West Santa Cruz was inspected during this time. In addition to planning for upgrades, photographs were taken to document specific conditions. In addition to the October 2014 field inspection, information from inspections, design work, and hi-rail tours conducted by JL Patterson, HDR, and others from 2009 to 2013 were also utilized. Since there has been little traffic on the line since those prior evaluations, conditions have remained generally the same.

6.1.2.1 Existing Rail

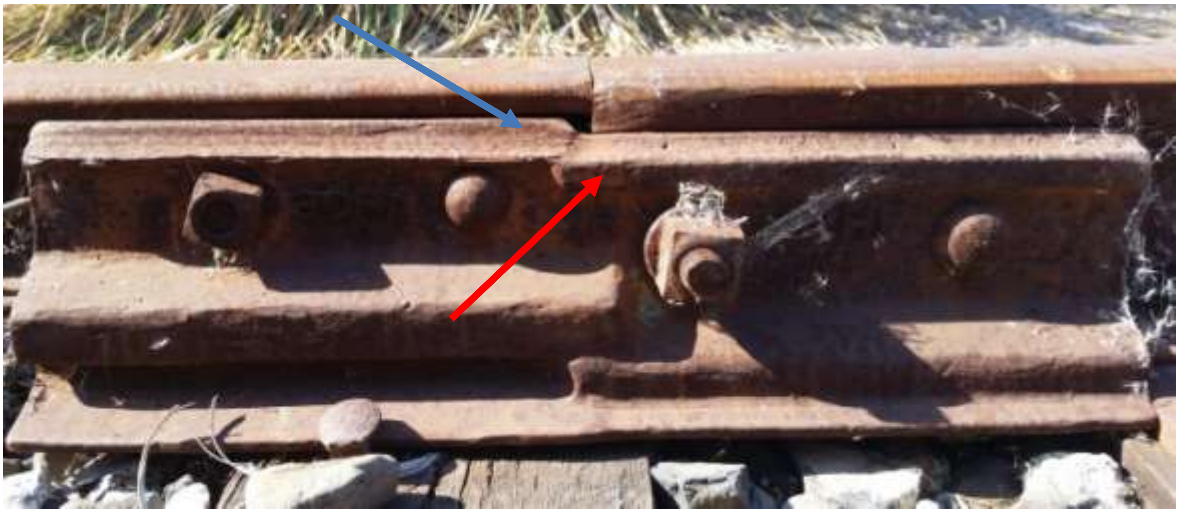
The existing track consists mostly (roughly 60 to 70 percent of the rail between Pajaro and Santa Cruz) of 90 pound (#) per yard jointed rail, rolled in the 1914 to 1915 era. The remainder of the rail is a mixture of sizes, ranging from 110# to 136# rail. There is evidence of some of the 90# rail sections being surface bent (meaning it has developed vertical bends).

Most of the heavier rail sections were brought to the line "used" (also called "relay" rail) having been removed from other areas of Southern Pacific's main line tracks when the rail was worn to the point that it was no longer suitable for main line service. Some portions of this "relay" rail have horizontal curve wear on the gage side (face) of the rail. New rail would have a vertical face on either side of the head of the rail; in some instances the original vertical surface on the relay rail is worn back at an angle.

Some of the rail is vertically worn on the jointed sections of track; in places there are signs of wheels hitting the angle bars, the components of the track which join rails together (Figure 6-1). This condition is acceptable in an "excepted track status," which is limited to freight rail vehicles with a maximum speed of 10 mph. This condition exists sporadically along the rail line. While an inspection by regulatory agencies, such as the Federal Railroad Administration (FRA) or California Public Utilities Commission (CPUC), would allow the current rail to remain in service in the current operational context (track classified as "excepted" with only infrequent freight rail vehicles operating at low speeds), these same agencies would likely apply a more stringent requirement if the operational context changed to include rail transit vehicles operating at the 25 mph to 50 mph speeds necessary to maintain the schedules identified in the Ridership and Operational sections of this study.

To fully assess the rail condition and provide a quantitative basis for decision-making and scoping the necessary upgrades prior to commencing rail transit service, it is recommended that the rail be inspected for internal defects and that the rail cross-section be measured. Several contractors can provide this service, using specialized hi-rail vehicles equipped with appropriate sensors to detect metallurgical flaws and excessive wear. This could guide a prioritization and phasing plan. Note that, to operate at the speeds assumed in the Operating Plan, this same testing would be required on an annual basis and is included in the annual maintenance cost estimate presented in Section 6.2.

Figure 6-1: Joint Bar



Showing evidence of wheel flanges contacting the top of the bar (red arrow) and wear at the mating surface between the bar and the rail (blue arrow).

6.1.2.2 Proposed Rail Improvements

For cost estimate purposes, the replacement of all rail on portions of the line to be used for passenger service was included. Depending upon the service scenario examined, this ranged from 6.6 miles in Scenario B (service from Capitola to Westside Santa Cruz) to 22.1 track miles of rail replacement for Scenario J, which contemplates service from Pajaro to Westside Santa Cruz. Testing the internal characteristics of the rail may reveal that some of it is adequate for service at 40 mph to 50 mph and does not need to be replaced. If the operating plan proposed in Section 5.2 were implemented (predicated on speeds in excess of 30 mph for rail transit service), annual internal inspections of the rail would be a requirement under FRA regulations.

To reduce maintenance costs, it was assumed that the new rail is Continuously Welded Rail (CWR), which consists of a series of shorter pieces of rail welded together into long strings, thus eliminating high-maintenance joints. This rail results in less maintenance and less wear on the track structure. Conversely, the existing rail is known as "jointed rail", which has a bolted connection (joint) every 39'. Over time, the bolts on such joints become loose and require frequent tightening and maintenance. It is possible that portions of the rail replacement could be performed incrementally and with high-quality relay (second-hand or "used") CWR rail which has had very little wear. Such rail is periodically available on the second-hand market, is sustainable, and can often be obtained at a discounted price compared to new rail.

There are several other considerations favoring rail replacement, including the reduction in noise from passing rail vehicles (CWR eliminates the "clickety-clack" sound at each joint), improved ride quality for passengers, and the improvement in the track cross-level, which reduces wear on vehicle suspensions. The last point is an important one, since at least one manufacturer of DMU vehicles recommends much smoother track than could be provided by the existing jointed rail.

Rail replacement would cost approximately $100 per track foot using good-quality second-hand rail, including tie plates (which spread the load from the rail over the tie) and spikes. It may be possible to reduce this cost somewhat if both rail and ties (see section on ties, below) were replaced under the same contract, which would allow the contractor to achieve economies of scale. The price of rail is constantly fluctuating, in concert with the location and quantity of available second hand rail, the price for steel, and the price for scrap metal and thus this cost is expected to change over time.

6.1.2.2.1 Existing Ties

Existing ties are wood, spaced at approximately 24" (or slightly farther) apart. Over time, wood ties decay and lose their ability to support the rails and secure the rails in place. In the early 2000s, due to the poor condition of the existing ties, Union Pacific (UP) replaced approximately one third of the ties. It is not known what tie replacement programs preceded the UP's program, but it is estimated that the next-most-recent replacement program would have been in the 1990's. Based on an average estimated 30-year tie life and work done in recent years, it is estimated that approximately 1/3 of the ties have approximately 20 years of useful remaining lifespan. The lifespan is shorter at curves due to the higher stresses on the track structure. The remainder of the ties will need to be replaced sooner, with some ties needing to be replaced within the next 10 years. The existing tie condition is generally satisfactory for the current operation at Class 1 speeds. However the existing tie condition is not suitable for the higher forces generated by rail vehicle speeds and increased passenger traffic evaluated in this study.

6.1.2.2.2 Proposed Tie Replacement

In order to improve the ability to maintain the track to a higher class and to provide a roadbed that complies with FRA regulations now and into the future, the proposed tie replacement program would include replacing approximately one-third of the existing wood ties for any scenario. For Scenario B, extending between Capitola and Westside Santa Cruz (the shortest of the scenarios considered), this would be approximately 5,700 ties. For Scenario J, extending between Pajaro and Westside Santa Cruz (the longest of the scenarios considered), this would be approximately 19,200 ties. These replacement programs range in cost from approximately $1 million to $3 million, respectively. Replacing approximately one-third of the ties in the operating section would provide compliance with applicable regulations for Class 3 track which allows for speeds up to 60 mph, and relatively high speeds around the curves, would replace substantial portions of the ties in sections of the track where drainage is blocked and mud or sand covers the rails, and would provide additional support at locations where existing rail joints are removed and replaced with CWR. At these locations, the existing ties can be weak or have inadequate support resulting from the pounding of wheels at the joints, and the subgrade soils below the track maybe inadequate to support forces from higher use and speeds.

The cost of replacing ties as part of a tie replacement program, where thousands of ties are replaced by the same contractor, would be approximately $165-$190 per tie depending upon quantity replaced, the spacing of ties, and the type of timber used (for example, softwood ties cost less than hardwood ties but have a shorter lifespan in curves). The unit cost used for the estimate is $165/tie and assumes a large quantity in order to achieve economies of scale.

Tie replacement represents a relatively small component of the overall capital cost. However, if a major tie replacement program were deferred until after rail transit service commenced, the unit cost would be substantially higher and passenger service disrupted, since rail transit service would "compete" with tie replacement crews for access to the track. This would substantially reduce the tie replacement crew's productivity, Moreover, if ties were replaced after service commenced, the tie replacement program would have to be immediately followed by a surfacing program to smooth the track behind the tie crew, otherwise speed reductions would be necessary in the work areas,

6.1.2.2.3 Existing Switches (Turnouts)

Turnouts are used to allow rail vehicles to pass. Many of the existing turnouts are 90# rail with "knife" points, a moving component of the switch which directs wheels from one track to another, which present an exposed vertical surface to wheels. While this configuration worked in the past, it has since been replaced with a more modern design known as an undercut switch point, which decreases maintenance requirements and likelihood of derailment. See Appendix E for detail on the number of turnouts affected, by scenario. Many of the existing turnouts also have self-guarded frogs, a component which allow wheels to cross from one rail to another, a design which is only suitable for operation at low (below 15 mph) speeds.

6.1.2.2.4 Proposed Turnout Replacement

Since many of the exiting turnouts are also in areas of poor drainage, work would be necessary at these locations under any circumstances. Because of their moving parts, turnouts require a significant amount of maintenance. It is recommended that all existing turnouts on spur tracks in the area where rail transit operations are considered be replaced with new turnouts. This would reduce maintenance costs, improve ride quality, and allow higher speed operation. Moreover, turnout components for 90# rail are no longer made and thus replacement parts are difficult to find. When 90# replacement parts are available, they are always second-hand and often worn. Each turnout is estimated to cost $90,000, which is a composite cost for replacement of several frogs, but new turnouts at sidings (which are assumed to be sized to allow 25 mph operation). The total turnout replacement cost for shorter scenarios is approximately $600,000 in total, increasing to over $800,000 for the Santa Cruz-Watsonville scenario. A few 115# turnouts with self-guarded frogs are in relatively good condition and may be able to have only the frogs replaced. The unit cost of turnouts has been adjusted to account for these partial replacements.

6.1.2.2.5 Drainage

Drainage on much of the line is good, but sections near Watsonville, near grade crossings, and in cuts have significant amounts of mud in the ballast rock under the ties; some of this results from activities from adjacent land owners; other drainage problems have resulted from inadequate maintenance of drainage ditches which have become silted-in or are not sized appropriately for the flows. The mud reduces the ability of the ballast to support the track and results in poor ride quality, faster decay of the wood ties, and eventually the deterioration of the track geometry to the point that rail vehicle speeds must be reduced. In addition, mud increases the electrical conductivity of the ballast, which reduces the ability of the electronic controls for grade crossing signals which rely on electrical voltages in the rails to detect oncoming rail vehicles.

Note that as development has occurred adjacent to the tracks, local hydrology patterns have changed. Resolving these issues may require an analysis of the title of the rail right-of-way and conditions imposed upon it by the original land owners, the pre-developed hydrology, the regulations in effect at the time the adjacent development occurred, and a determination if the adjacent land owners have, in fact, made drainage worse. This could be an important consideration when planning new development in the right-of-way.

It is estimated that 90 days of ballast cleaning efforts, using a combination of backhoes and rail-mounted vacuum trucks, could re-establish basic ditches and removed mud from the worst sections of track between Pajaro and Santa Cruz. The estimated cost of this work for longest Scenario J is $370,000, and the cost is proportionately less for scenarios involving shorter segments.

6.1.2.2.6 Track at Grade Crossings

Most existing grade crossings have asphalt or rubber surfaces (estimated at 75 percent of the total). Since these cannot be inspected or renewed without completely removing them, and since the track under these surfaces would be replaced as part of a larger rehabilitation program, the cost estimates in this study assume that all these grade crossings would be reconstructed.

Scenario J contemplates rail transit operations on the track in Walker Street in Watsonville. This track and the asphalt overlay have started to deteriorate due to both truck and rail freight traffic. Although this track could likely be operated for several additional years, once rail transit service commences, it would be difficult to repair this track while maintaining frequent rail transit service. It is recommended that this track be upgraded with concrete crossing surfaces at the high-traffic street intersections, and grinding of the existing asphalt between the intersections. The pavement between these intersections could be ground smooth with an asphalt mill, although that would reduce the thickness of the pavement section.

The track in Beach Street in Santa Cruz is in generally good condition. Some replacement of the track in front of the Boardwalk is recommended, though this could occur by removing short sections of asphalt, replacing the ties, especially near rail joints, and repaving with asphalt overlay.

A unit cost of $900 per track foot has been assumed to account for complete replacement of the track at each public crossing, minor repair of drainage problems in the crossing and in adjacent track, and installation of new or second-hand concrete crossing panels. The lifespan of a grade crossing varies dramatically with drainage and the levels of rail and roadway traffic. If constructed with new materials and properly drained, grade crossings can last 20-25 years.

6.1.2.2.7 Structures

Several prior reports have identified the condition of the structures along the line. Using the Consumer Price Index, the annual maintenance cost information in these reports has been updated to account for inflation. This resulted in cost increases of approximately 40% compared to costs from the structures maintenance planning effort conducted in 2005 and 2006, the last time annual structure maintenance costs were estimated for the line.[43] The costs for capital upgrades were based on the capital costs in the 2012 JL Patterson report.

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[43] See the "General Structures Assessment Report-2005" and "Detailed Structures Assessment Report-2006" by Biggs Cardosa Associates and HNTB, respectively, available at http://www.sccrtc.org/projects/rail/rail-line-purchase/rail-line-due-diligence/

6.1.2.2.8 Rehabilitation Costs

For this feasibility study, bridge inspections from 2012 were utilized. Structure rehabilitation costs (capital costs) are based on those in Table 5.1 of the 2012 report by JL Patterson,[44] with only costs for the structures between Pajaro and West Santa Cruz (MP 22) included, since this study does not evaluate rail transit service beyond MP 22. It is not known how many of the existing bridges between MP 4 and MP 8 (which are close to curves in the track) could accommodate track alignment changes necessary at the curves in order to achieve speeds at Class II (max 30 MPH for passengers, 25 MPH for freight) or higher. At this time, no costs have been included for potential reconstruction of these bridges.[45] The JL Patterson report evaluated structure costs based on Class II speeds on the bridges. It is also possible that the condition of some structures has deteriorated further, as timber members weaken with age; though bid proposals provided to the RTC in 2013 for several structures were lower than estimates included in the 2012 JL Patterson report.

6.1.2.3 Other Rehabilitation Considerations

Approximately 20,000 tons of new ballast (drainage rock) is recommended for track surfacing, necessary to allow higher speeds, and for remediation of areas of poor drainage.

Approximately 1,000 feet of complete track replacement has been assumed to resolve fouled ballast in locations such as the cut near the Monterey Avenue crossing.

Clearing of vegetation is recommended in order to:

- Improve sight lines for rail vehicle operators
- Provide required sight distances for roadway vehicles at crossings
- Prevent tree leaves and branches from fouling the ballast
- Prevent tree leaves from creating slippery rail conditions (a well-documented and operationally problematic phenomena on several rail transit systems)

These costs are estimated to be approximately $100,000 in order to have a professional arborist crew clear vegetation impacting rail transit operations between Santa Cruz and Pajaro. The vegetation clearing cost

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[44] See The "Santa Cruz Branch Rail Line Alignment and Bridge Evaluation & Repair / Rehabilitation or Replacement Recommendation Report" by JL Patterson and Associates, Inc, 2012, available at: http://www.sccrtc.org/projects/rail/rail-line-purchase/rail-line-due-diligence/alignment-and-bridge-evaluation-repairrehabilitation-or-replacement-recommendation-report/

[45] The Federal Railroad Administration holds track owners responsible for developing and maintaining a Bridge Management Program and performing periodic inspection and rating of most rail structures.

could vary widely depending upon the number of trees involved and the access to each location. A tree survey by an arborist could refine this cost.

Notably, the actual amount of upgrades needed to initiate rail transit service, will depend on the condition of components at the time. For instance some at-grade crossings are already planned to be reconstructed as part of road projects and some track rehabilitation is being done by the short-line operator. However, similar to the roadway network, heavy storms, wear-and-tear, and other factors will impact the condition of the line over the years.

6.1.3 NEW CONSTRUCTION

New construction, such as new infrastructure and rehabilitation of existing infrastructure, includes the following categories of work discussed below.

6.1.3.1 New Sidings

Up to three new sidings have been estimated for the Watsonville-Santa Cruz scenarios to allow rail transit vehicles to meet and pass each other, with fewer sidings for the shorter scenarios. Though the number and location of sidings could change based on transit schedules, termini and other factors, the number of sidings in this study is based on frequencies and schedules discussed in Section 4.2 and Section 5.

The desired minimum clearance for a single track configuration is 30 feet, except for areas with station platforms or sidings where additional clearance is needed. The 30 foot single track width provides adequate space for drainage, safety zones (the area for people to stand outside the envelope of a passing train and not get hit), and maintenance activities such as removing and replacing ties. Clear zones of less than 30 feet should be used in limited situations. Clear zones of less than 22 feet would make it difficult to perform routine maintenance such as tie replacement. Where a rail clearance of less than 25 feet is provided for a single track configuration, the storm drainage for the entire right-of-way should be included within the trail envelope either using a surface or subsurface drainage system. Minimum widths required for double track sections range from 27.5 feet to 34 feet (12.5’ or 15’ between track centerlines), depending on curvature and if CPUC or FRA requirements apply.

Siding lengths range from zero for Scenario J (where there is only one rail vehicle set on the line at a time) to nearly two miles for Scenario D (where multiple rail vehicles would pass each other for each trip). It has been assumed that each siding would be equipped with spring or remote-activated power switches at each end to allow rail vehicle operators to enter the siding without having to stop their vehicles, alight, throw the switch, and re-board the vehicle before proceeding. The style of remote activation would be from a radio message generated from on-board the vehicle. These turnouts would be in addition to the existing spur tracks serving industries. Each siding would be equipped with a signal that would, at minimum, indicate the position of the turnout. See the Operating Assumptions in Section 5.2 for additional information about siding locations analyzed in this study.

6.1.3.2 New Stations

Depending on the scenario, up to ten new stations have been included in the cost estimates. The capital cost estimate assumes each station would be relatively modest and consist of a short (approximately 150'), high level (raised), concrete platform compliant with the Americans with Disabilities Act (ADA) and "Level Boarding" requirements, a small shelter, simple lighting, and bike lockers. The cost estimate of each station, based on recent information for stations on the SMART system in Sonoma and Marin counties, is $300,000. The cost for stations could range from $300,000 for basic stations to $500,000 for a station with more amenities and features. The short platforms would need to be lengthened in a later stage if demand warranted operation of vehicle sets with more passenger cars. Station track is assumed to be longer than the platform, at approximately 250 feet in length. A single track configuration with a station would require at least 28 feet of right of way (10 feet for a static envelope + 30" + width of platform).[46]

A "gauntlet track" at each station, which would allow freight rail vehicles to bypass the station platform, would be required because raised platforms that allow for level boarding are too close to the track to allow wider freight cars to pass. This configuration has been used on the SMART system, while separate siding tracks for stations have been used in Southern California, Utah, and other locations. The estimated cost for each gauntlet track, which must be slightly longer than the station platform to ensure the track at the platform has tangent approaches, including complete track replacement in front of the platform is $250,000, plus an additional $270,000 for signalization and remote control of the switches for the gauntlet tracks. The signalization would consist of a remote-control switch operated from the rail vehicle itself, a switch point indication signal, and an advance signal to warn rail vehicles of the upcoming switch.

As a lower cost option, it is possible that drop-down access ramps could be provided at each station, though these have only been used on one other property (NCTD's Sprinter service). If freight service will be infrequent, these could be an option for cost reduction, though if a drop-down ramp were damaged or failed in operation, the station could effectively be out of service.[47]

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[46] This ROW example calculation assumes a Stadler GTW DMU with a 9'8" static envelope, an estimated 10' dynamic envelope, and 14'8" platform widths. Gauntlet tracks are assumed have a centerline shifted half the gauge from the main track, or 2'4.25". This study assumes platforms, ticketing machines and access to adjacent streets can be provided within existing rail and street right-of-way. Park-and-ride facility needs to be determined in future phase.

[47] See the USDOT document: "US Department of Transportation's Disability Law Guidance – Full-Length, Level Boarding Platforms in New Commuter and Intercity Rail Stations" (available at: www.fra.dot.gov/Elib/Document/1397) and the FRA's document "ADA & Level Boarding – Consolidated Questions and Answers" (available at: https://www.fra.dot.gov/eLib/Details/L03698).

Gantlet track (additional set of rails) adjacent to high level platform (under construction) at the SMART project.

It has been assumed that seasonal stations could be much simpler (for example, it is possible that the Santa Cruz Boardwalk station could be "grandfathered" and not require high-level boarding, or that rail vehicles could stop at a grade crossing to board and alight passengers). However, this assumption needs to be revisited as more definition is developed on the regulatory requirements and type of equipment employed; if the equipment only allows for high-level boarding, then these stations would be the same as other stations, since they would require high-level platforms and a way for freight rail vehicles to pass-by the high-level platform. Conceivably, rail transit equipment capable of both high-level and low-level boarding could be acquired, though this may increase the equipment cost. No specific additional costs have been included for the seasonal stations at this time.

6.1.3.3 New Railroad Crossings and Crossing Warning Devices

Of the 40 existing public grade crossings between Pajaro and Westside Santa Cruz, 17 have relatively modern grade crossing signal equipment. For Scenario J, extending the full distance between Pajaro and Santa Cruz, the remaining crossings (23) are recommended to be upgraded with active warning devices, with a minimum of bells, flashers and crossing gates. For scenarios that involve shorter distances and less track, only the crossings within the track subject to rail transit operations would be upgraded.

A traffic study, geometric analysis of the space available for warning devices at each crossing location, rail operating analysis, and site investigation would determine the type of grade crossing equipment at each location, whether the crossing would require an interconnected traffic signal, and whether the electronic circuitry to operate any given crossing would need to be interconnected with the adjacent crossings. The study (known as a "Field Diagnostic Study") is required under California Public Utilities Commission (CPUC) rules, and must include representatives from the railroad, track owner, and roadway authority; the ultimate scope of improvements to both the signal system and roadway geometrics depends upon the outcome of the diagnostic study. A unit cost of $350,000 has been assumed for each new crossing signal system.

It has been assumed that the 28 listed private grade crossings would not be upgraded with active warning devices under any of the scenarios considered. Instead, the passive “Stop” signs would remain. This assumption could be revisited, depending upon traffic and sight distance considerations at some of these locations. Note however, that upgrading some private crossings by the implementing agency could potentially set a precedent to upgrade all of them. Also note that as more crossings are equipped with active warning devices, the signal circuitry required to link crossings together becomes substantially more complex.

6.1.3.4 Quiet Zones

Federal regulations require rail vehicles to sound their warning horns as they approach crossings. A Quiet Zone is a section of railroad line at least one-half mile in length that contains one or more grade crossings where horns are not routinely sounded at the crossings. The ability to avoid sounding the horn at a Quiet Zone is made possible if sufficient improvements have been made to the signal system and roadway such that rail vehicles are not required to sound their warning horns.[48] This typically involves some upgrade to the grade crossing equipment, which presumably would occur at the same time as the overall grade crossing warning device upgrade program, as well as roadway upgrades (revised channelization, medians, signing, and often ADA upgrades to sidewalks). Quiet Zones have often been used to mitigate noise issues identified during environmental studies. At this time, no Quiet Zones have been included in the cost estimates, but could be explored during design and environmental review.

In general, the agency implementing a Quiet Zone bears the cost of the additional infrastructure. Based on information provided by the FRA, because the absence of routine horn sounding increases the risk of a crossing collision, a public authority that desires to establish a Quiet Zone usually will be required to mitigate this additional risk. Public authorities seeking to establish quiet zones should be prepared to finance the installation of the supplementary or alternative safety measures. In addition, establishment of Quiet Zones may have legal and liability considerations.

The final cost of the Quiet Zone would be highly dependent upon environmental commitments, the outcome of the Field Diagnostic Study, roadway geometry, rail vehicle operating speed, and number of

[48] The federal regulations which require train horns to be sounded, and which govern the establishment of quiet zones can be found on the Federal Railroad Administration’s website at: http://www.fra.dot.gov/Page/P0104

crossings involved. Note that the cost for a Quiet Zone can be substantially higher if revised roadway or pedestrian geometry is required. A further review of Quiet Zones will occur in the next phase of analysis.

6.1.3.5 New Railroad Signal System

Capital costs assume a signal at each end of each siding track and one signal in approach of each siding. The cost for a modest operations control office (for monitoring and control of the railroad), incorporated into the maintenance facility, have been included as part of the railroad signal cost. This system is simpler and thus less expensive than the types of systems being installed along many transit railroads. Under any circumstance, if the operation falls under FRA jurisdiction, implementation of a new signal system would require FRA's approval.

A key assumption for the cost estimate for five scenarios is that light DMU rail transit operations would be fully temporally separated from the freight operation and thus the regulations requiring Positive Train Control (PTC) would not apply. PTC is a computer- and radio-based system that supplements the conventional signal system to automatically slow or stop rail vehicles prior to collisions.

The PTC regulation is complex, and the implementing agency may be able to find exemptions from the regulation. However, it is likely that PTC would be required if the railroad is operated under FRA regulation and rail vehicle speeds were 20 mph or faster (which would be necessary to maintain any of the five operating scenarios since each has an average speed in excess of 25 mph).[49] Cost estimates for PTC are included for Scenarios G1 and S, as shown in Appendix E. The FRA would need to be consulted for their final interpretation. However, there is precedent for this assumption: the Sprinter DMU system between Oceanside, CA and Escondido, CA, operates without a PTC system. The justification is that the Sprinter DMU operation (which operates mornings through the evenings) is not part of the general system of rail transportation and there is no opportunity for the few freight rail vehicles (which operate only a few times each week late at night) to comingle with rail passenger vehicles.

This is a critical assumption, because a PTC system is expensive to construct and maintain, and could add significant cost to the signal system. This strategy is known as "temporal separation" and has been accepted by the FRA. It is likely that the Santa Cruz Branch Line could adopt a similar operational pattern to the Sprinter line (a few freight rail vehicles which could be time-separated from the DMUs), and thereby take advantage of the temporal separation provisions.

[49] Note that 49 CFR Part 236.1005(b)(6) states "New rail passenger service. No new intercity or commuter rail passenger service shall commence after December 31, 2015, until a PTC system certified under this subpart has been installed and made operative."

For Scenarios G1 and S, which are predicated upon locomotive-pulled rail vehicles that are comingled with freight, a PTC system would be required.[50] Since no engineering has been performed, the system has been assumed to be Wabtec's "I-ETMS" PTC system. Costs for installation of such a system can vary widely (up to $3 million per mile; higher costs are associated with shorter route lengths and costs typically decreases on a per route mile length due to economies of scale) and are dependent upon a number of contextual factors, including the quality of radio, cellular, and GPS reception along the line, and whether a secondary path ("backup") communication system is desired. For the Scenario G1 cost estimate, no backup system has been assumed.

6.1.3.6 Structures

While there is no allowance for complete reconstruction of structures, there has been an allowance made for 1,000 to 7,000 square feet (depending upon scenario) of new retaining wall. Such walls could be used to create sufficient level ground for passing sidings, or to improve drainage. Capital costs for upgrades to existing structures have been based on the costs outlined in the 2012 report by JL Patterson and Associates.

6.1.3.7 Maintenance Facility

Capital costs for the vehicle maintenance facility have been included, based on the number of vehicles employed for each scenario. It has been assumed that a basic facility would cost approximately $1,000,000. This cost would allow for minor property acquisition, a small office, utilities, site lighting, basic tools and equipment, provision for fueling equipment and a fuel spill containment system, storm water treatment system, a method to inspect underneath vehicles, a paved parking area for staff, and an enclosed shop facility in order to keep maintenance crews from tracking mud into the vehicles. Note that the location for a maintenance facility can influence operating costs, since rail transit vehicles needing to make long trips from the rail transit service area to a maintenance facility can add substantially to the overall operating cost with additional mileage on vehicles, fuel burn, and crew times. The final cost of the facility will be influenced by the actual location, whether land acquisition would be required, and if the facility is shared with freight and/or recreational rail operations. The facility could be expanded in future phases as service expands. A larger maintenance facility with more features and amenities would be more costly.

[50] PTC is required when Class I freight carriers share tracks with FRA-regulated passenger rail service in order to prevent train-to-train collisions. See the Public Law 110-432 - Rail Safety and Improvement Act of 2008 for more information www.fra.dot.gov/eLib/Details/L03588.

It may be possible to reduce maintenance facility costs by utilizing a drop pit and minimal facilities given Santa Cruz's mild climate. In some systems, heavy maintenance is outsourced to other rail operators or third parties.

6.1.3.8 Right-of-way

On average, the publicly-owned Santa Cruz Branch Rail Line is 70 feet wide, with some sections over 150 feet and only a few spot locations less than 25 feet (totaling less than 1/3 of a mile). While many sections of the existing right-of-way (ROW) are wide enough to accommodate sidings and stations, as well as the planned bicycle/pedestrian trail, the capital cost estimates include an allowance for right-of-way acquisition at the stations ($150,000) and passing sidings ($250,000). Though this allowance may not be needed at each location, on average, it accounts for the possible need for at least some right-of-way acquisition. As the operating plan, environmental documentation, station, maintenance facility and siding locations are refined, the right-of-way allowance would be updated to reflect property values in these specific areas.

The $1 million cost for the maintenance facility assumes no right-of-way would be required. Depending upon the location of the facility, the cost could be higher. See Section 5.2.1.8 for more information on the Maintenance Facility.

6.1.3.9 Environmental Mitigation

At this time, no costs have been itemized for environmental mitigation (such as wetlands or species mitigations). Mitigation costs are undetermined at this phase of study as they are entirely based on specific environmental measures that would be identified during a future phase or phases of environmental study. However, the cost estimates have been adjusted to include a 30 percent contingency, plus 30 percent for support (or soft) costs above and beyond construction capital. It has been assumed that the operating plan and resultant station and siding locations are sufficiently flexible that their final locations can be determined in order to avoid or significantly minimize impacts to environmentally sensitive areas. Since DMU-type and modern locomotive equipment tends to be much quieter than full-sized railroad equipment, no costs have been included for noise and vibration mitigation (such as sound walls). A noise and vibration study would need to be conducted prior to implementation to determine if sound walls would be necessary.

Depending upon a refined scope of work, the implementing agency would determine what type of environmental document (if any) is required prior to implementation of service. It is possible that, if all work were contained entirely within the right-of-way, the project could be eligible for a categorical exclusion at the federal level and no state level document would be needed.

6.1.3.10 Vehicles

As noted earlier, while the exact vehicle type and design would be determined at later stage of implementation, for the purpose of cost estimating and operational simulations Light Diesel Multiple Unit (DMU) vehicles have been used for most scenarios (see Appendix C). The number of vehicles for each scenario is based upon the operating requirements, such as headway and overall route length, with a minimum of three DMUs for the Capitola to Santa Cruz scenario, and a maximum of five DMUs for the expanded Watsonville to Santa Cruz scenario. Each new vehicle has been estimated to cost $8.5 million. Note that vehicle costs can vary substantially depending upon passenger capacity, manufacturer, options selected, and procurement strategy. Seating, bicycle storage areas, and spaces for mobility devices can be determined during the vehicle procurement process.

An alternate scenario with conventional locomotive-pulled rail vehicles, Scenario G1, has also been assessed. Equipment costs for this scenario were based on recent equipment purchase costs from other agencies for MP36 locomotives and bi-level passenger cars. Like Scenario G, four rail vehicle sets were assumed to be required, with one spare locomotive and 2 spare cars.

6.1.3.11 Contingency and Administrative Costs

As previously discussed, the capital cost estimates include a 30 percent contingency and 30 percent allowance for “soft” costs, such as environmental review, design, permitting, construction management, and administration. Note that, together, these allowances costs increase the overall capital cost estimates by 60 percent.

6.1.4 MAINTENANCE OF WAY COSTS

Costs for track, signal, and station maintenance are estimated for a twenty-year operating horizon starting after completion of the capital program. Costs occurring infrequently, or in “out” years (such as programmed tie renewal) are considered “capital” maintenance and have been converted to an annualized cost by dividing the cost of the item by the number of years between each occurrence. Note that vehicle maintenance is discussed in Section 6.2.1.1.

6.1.4.1 Track Inspection and Maintenance

Track inspection would need to occur at least twice per week, based on current regulations from the FRA. For Scenarios D, G, and J, which are each over 20 miles long, a single person and hi-rail vehicle could accomplish each bi-weekly track inspection in one day. A full day would be required to traverse the entire railroad (22 miles in length) at an average inspection speed of three to four miles per hour, including the return drive and making minor repairs along the way. This would need to occur at night, when rail transit service is not operating. An additional one day per week would be necessary for detailed turnout inspections and documentation.

A three-person crew has been assumed to provide minor maintenance two days per week. This would include maintenance items identified by the track inspector, such as adjustment of turnouts, as well as minor repairs to drainage, culvert clearing, fencing, signage, minor brush clearing, repair of trespasser damage, maintaining required trainman's walkways, and any heavy repairs at stations requiring construction expertise. This crew could also perform minor tie renewal at critical locations and complete minor emergency repairs. Additional costs have been allowed for rental of equipment, such as a backhoe for ditching or culvert replacement, an air compressor, etc. Minor tie replacement by this three-person crew would be a very slow process, since they would have to work between the relatively frequent rail vehicles.

An allowance has been made for up to 3 days per year of minor track surfacing to fix horizontal and vertical alignment problems as they develop over time. This work would typically need to be performed on short notice; because surface problems result in poor ride quality and can also necessitate reduced travel speeds until they are repaired. A contractor would need to mobilize a tamper to affect such repairs. The actual amount of this work would be highly dependent upon the scope of the initial rehabilitation work.

6.1.4.2 Vegetation Management

An annual vegetation management program would be required to ensure that the ballast does not become fouled with organic material. This would include an abatement program within 12 to 25 feet of track centerline, as well as selected tree trimming and brush clearing to maintain sightlines for rail vehicle operators and at grade crossings.

6.1.4.3 Signal Maintenance

Each grade crossing with active warning devices must be inspected monthly, and each control point and power switch must be inspected quarterly. In addition there are annual, biennial, and ten-year inspections required for various signal system components. The required inspections would require approximately 600-800 hours per year. An additional four hours of time per year per crossing has been allowed for "emergency" calls to respond to problems, such as broken crossing gates and signal system malfunctions. The complexity of the signal system and number of interconnections with traffic signals and between grade crossings can influence the amount maintenance required. This would have to be determined in final design.

For Scenario G1, additional maintenance costs have been included for the PTC system, including annual maintenance contracts with the vendor and licensing fees.

6.1.4.4 Station Maintenance

Minor maintenance at stations is assumed to involve one person performing litter removal, inspection, and minor maintenance (such as graffiti and trash removal) at each station every other day. More major maintenance, such as repairs to passenger waiting shelters, would be performed by the two-person maintenance crew or by a contract vendor.

6.1.4.5 Structures Maintenance

Annual costs for the maintenance of structures are based on prior inspection reports of the Santa Cruz Branch Rail Line, including those conducted in 2005 and 2006, and the most recent 2012 report. Because some of these reports are several years old and a formal maintenance program has not yet been established because there are minimal rail transit operations on most of the branch, the condition of the various structures (particularly weather-related decay and trespasser-related conditions) may have changed. In general, structure maintenance costs would include: minor replacement of timber or steel members, replacement of fasteners, tightening of fasteners, repair of headwalls damaged due to erosion or trespassing, repair of handrails, and minor track repair on structures or at the approaches to structures. The cost for structures maintenance has been assumed to include only those structures in the operating area for each scenario (for example, the structures maintenance cost for Scenario E, between Santa Cruz and Aptos does not include maintenance for the structures between Aptos and Pajaro).

The cost indicated for each structure is representative of the average maintenance cost over time. For example, a given structure may require little or no maintenance in any single year. However, over a period of several years, maintenance will likely be required. The maintenance cost would also be influenced by the extent of the repairs performed during the initial rehabilitation effort.

6.1.4.6 Capitalized Track Maintenance

Capitalized maintenance includes a major tie replacement program after approximately 10 years of operation, when approximately one-third of the ties would be replaced, based on an assumed 30-year tie life. This cost has been expressed as an annualized cost, with the total number of ties replaced divided by the frequency of the program (10 years). The costs are based on recent experience with contract tie replacement on rail properties in Southern California.

It is assumed that the railroad would need to be completely surfaced once every 10 years to maintain ride quality and compliance with FRA regulatory requirements. Under relatively light rail transit service and with few trucks at most crossings, grade crossing surfaces should last on the order of 20 to 25 years. Thus, relatively little grade crossing repair would have to be performed. On an annualized basis, an average of approximately one grade crossing per year would need to be rehabilitated. However, it is assumed that most grade crossings would be reconstructed during the initial rehabilitation. As a result, there would be little or no grade crossing maintenance in the first 15 years of operation (since most grade crossings are new), after which time multiple grade crossings would need to be rebuilt each year as the crossings deteriorate over time.

Together, these capitalized maintenance costs, expressed as annual costs, represent a major portion of the annual maintenance cost.

6.1.4.7 Railroad Flagging

No separate costs have been allowed for railroad flagging, which is similar to highway flagging in that it protects third parties (such as utility companies working in the right-of-way as they perform maintenance on their systems) from the hazards of moving rail vehicles. It has been assumed that the rehabilitation/maintenance contractors would provide their own flagging. However, if the line is in regular operation throughout the day, federal regulations require that any outside parties wishing to do work within the right-of-way have railroad flag protection, similar to the flagging that occurs in highway work zones. Examples of this work include maintenance to any utilities in or crossing the corridor, or roadway or construction work adjacent to the track. Typically, these costs would be carried by outside parties, although the specific agreements with each utility may influence the cost sharing arrangement.

6.1.4.8 Soft Costs

No costs have been included to administer the maintenance contract, flagging, third party work, or coordination with the operations staff. However, a 10 percent contingency has been included in the maintenance budget.

6.1.5 INFRASTRUCTURE CAPITAL AND MAINTENANCE COST SUMMARY

Consistent with industry practice, costs have been expressed in two broad categories, initial capital expenses (outlay) and ongoing maintenance costs. The former category includes the initial capital outlay to bring the line to a condition adequate to support regular rail transit service. The maintenance costs include recurring costs necessary for maintenance of the infrastructure, with periodic maintenance expenses annualized. A detailed breakdown of capital and maintenance of way cost estimates are provided in Appendix E. A summary of the respective cost estimates for each scenario is included in Table 6-1.

The initial Infrastructure Construction Cost (capital) ranges from a low of $23 million (Scenario B) to a high of approximately $48 million (Scenario G1), excluding soft costs and contingencies. Not surprisingly, the capital cost is related to the length of line that must be rehabilitated for rail transit service.

Total Capital Costs also include vehicles, as well as a 30 percent allowance for soft costs (such as preparation of construction documents and agency administration) and a 30 percent contingency have been included as separate line items. These comprehensive capital cost estimates range from $77 million (Scenario B) to $176 million (Scenario G1). The allowances for contingency and soft costs should be revisited as the project scope and design is refined.

Because this is a conceptual estimate, a range of costs, illustrating costs ranging from 30 percent above the Total Capital Cost to 30 percent below is also shown. This cost range reflects the fact that requirements for environmental documentation, environmental commitments, and engineering have not been established. Many conceptual studies such as this one include similar cost ranges.

Annual infrastructure maintenance costs (exclusive of vehicle maintenance), range from a low of $571,000 per year (Scenario B) to a high of $1.3 million per year (Scenario G1). Like the capital costs, the maintenance costs are related to the length of the line and the amount of infrastructure maintained. They are also influenced by the amount of capital work performed during the initial rehabilitation phase; some maintenance costs could be reduced if additional rehabilitation were performed early on. Capitalized maintenance costs are also included on an annualized basis.

6.1.6 STARTER SERVICE – SCENARIO S CAPITAL COST ESTIMATES

To understand the minimum capital investment needed to initiate rail transit service, preliminary cost estimates for an incremental startup of service between Seacliff and Bay Street in Santa Cruz were developed by Iowa Pacific. Those estimates were then refined for consistency with the other scenarios regarding contingency and support costs, as well as certain line items. The Scenario S cost estimates are summarized in Table 6-2. This estimate assumes that service could be initiated with leased vehicles and minimal upgrades to the rail line, with additional rail line improvements made incrementally in the future.

TABLE 6-1: CAPITAL COST ESTIMATE SUMMARY

Santa Cruz Branch Line: Infrastructure Conceptual Cost Summary Table	Capitola (Monterey Ave) to Westside Santa Cruz MP 15.5-22.1	Watsonville to Westside Santa Cruz MP 1.6-22.1	Aptos to Westside Santa Cruz MP 12.5-22.1	Watsonville to Westside Santa Cruz MP 1.6-22.1 - DMU (expanded service)	Watsonville to Westside Santa Cruz MP 1.6-22.1 - Locomotive Hauled (expanded service)	Pajaro to Westside Santa Cruz MP 0.0-22.1
Scenario =>	**B**	**D**	**E**	**G**	**G1**	**J**
Estimated Infrastructure Construction (only) Cost	**$22.7 million**	**$40.4 million**	**$27.8 million**	**$40.7 million**	**$48.2 million**	**$40.9 million**
Vehicle Cost Estimate	$25.5 million	$34.0 million	$25.5 million	$42.5 million	$61.5 million	$17.0 million
Total Estimated Capital Cost (including Vehicles + 30% Soft Costs, and 30% Contingency)	$77.1 million	$119.1 million	$85.3 million	$133.2 million	$175.6 million	$92.7 million
Cost Range - Upper (130% of Total Estimated Capital Cost)	$100.2 million	$154.8 million	$110.9 million	$173.2 million	$228.3 million	$120.5 million
Cost Range - Lower (70% of Total Estimated Capital Cost)	$53.9 million	$83.4 million	$59.7 million	$93.2 million	$122.9 million	$64.9 million
Total Track Miles	6.6	20.5	9.6	20.5	20.5	22.1
"Raw" Construction Cost per Mile *(including track rehab, limited structure rehab, and new stations+signals, but excluding vehicles, contingency and soft costs)*	$3.4 million	$1.97 million	$2.9 million	$1.9 million	$3.2 million	$1.85 million
Total Estimated Capital Cost per Mile *(including vehicles, support & contingency costs)*	$11.7 million	$5.8 million	$8.9 million	$6.5 million	$8.6 million	$4.2 million
Annual Infrastructure Maintenance Cost (*excluding* Annualized Capitalized Maintenance), same each year for Years 1-20.	$517,000	$950,000	$587,000	$986,000	$1,261,000	$1,023,000
Additional Capitalized Maintenance Cost, Expressed as an Annualized Cost	$189,000	$498,000	$255,000	$498,000	$498,000	$540,000

Source: RailPros, 2015

TABLE 6-2 SCENARIO S: INFRASTRUCTURE CONCEPTUAL COST SUMMARY

SEACLIFF TO SANTA CRUZ (BAY ST) - MP 13.1 TO 20.7

Scenario =>	S
Estimated Infrastructure Construction (only) Cost *(not including PTC, contingency, or soft costs)*	**$12.2 million**
Positive Train Control *(estimates range from $1.1M total to $3M per mile)*	$7.5 million
Total Estimated Capital Outlay Cost *(including PTC, 30% Soft Costs, and 30% Contingency. No upfront vehicle cost - leases included in O&M)*	**$31.5 million**
Total Track Miles	7.56
"Raw" Construction Cost per Mile	$2.6 million
Total Estimated Capital Cost per Mile *(including 30% contingency and 30% support costs; does not include vehicles)*	$4.2 million
Annual Infrastructure Maintenance Cost	$589,000
Annual Vehicle Cost (lease and maintenance)	$911,000
Additional Capitalized Maintenance Cost, Expressed as an Annualized Cost	$443,400

Source: Iowa Pacific and RTC, 2015

Unit costs for Scenario S (Table 6-2) were similar to those used for the six scenarios analyzed by RailPros and LTK for this study (Table 6-1), however the following capital and operating cost assumptions differed for Scenario S:

- Vehicles: Lease (rather than purchase) conventional, FRA-compliant locomotives and coaches.
- Structures: Costs based on rehabilitation bid documents prepared by JL Patterson (2013), rather than 2012 JL Patterson initial estimates
- Grade Crossing Surface Replacement and Signal Upgrades: Assumes fewer grade crossing track/surface replacements and grade crossing signal upgrades at Seabright Avenue only, with upgrades to other crossings to be done over time. Prior to implementation additional analysis and CPUC evaluation may require additional crossing upgrades at outlay.
- Positive Train Control (PTC): Initial estimate assumed only $1.1 million for PTC and only $100,000 for ongoing PTC system maintenance. Actual costs could vary widely and be as high as $3 million per mile. $7.5 million used for consistency with Scenario G1.
- Spring switch costs assumed for each end of track only.
- Stations: Assumes a five foot bridge plate and ADA ramps to be used at platforms rather than gauntlet tracks. If platform is not raised, a bridge plate with handrails may be required. Notably, because this is a new service, FRA, FTA, or the State Architect could require gauntlet track.

Notably, the lower cost for some capital and ongoing maintenance costs could be due to the fact that some expenses could be shared between the freight and recreational rail services.

6.2 OPERATIONS & VEHICLE MAINTENANCE COST ESTIMATES

This section outlines the service assumptions and associated ongoing Operations and Vehicle Maintenance (O&M) cost estimates for the six scenarios that underwent detailed analysis by LTK. Estimates for Scenario S, prepared by Iowa Pacific, are shown under 6.2.3.

6.2.1 OPERATION & MAINTENANCE ASSUMPTIONS

All operations and maintenance (O&M) costs are in 2014 dollars. Six peer systems that use DMU technology and provide a similar service to what has been simulated here were used to produce an expected average unit cost. These systems were the Sprinter (NCTD, Oceanside, CA), RiverLine (NJTransit), West Side Express (Tri-Met, Portland), CapMetro (Austin), the A-Train (Denton County, TX), and SMART (Sonoma-Marin). In the case of SMART (since it is not yet in operation), projected O&M costs were used. Data on the other five systems comes from the 2012 National Transit Database (NTD), and have been escalated by two years at three percent.

While the cost per revenue hour for DMU vehicle sets varies nationwide, this study uses an average of the six peer agencies listed above. The resulting unit cost for an operational vehicle revenue hour of DMU-type service is **$376**. This number includes fuel, operators' salaries, dispatching, and other expenses. While there is modest variation among the peer systems, granular data on the individual components of the estimate are not available, so further refinements to the estimate for this analysis are not practicable. Daily Revenue Train hours are the sum total of the in-service time of the revenue fleet on a given day, rounded up to the nearest hour. This includes both running time and turn time at a terminal. Except during extended periods of no service (such as the midday period in Scenario D), this assumes that turns will be short enough that rather than shut down and plug into shore power[51], rail transit vehicles will continue to run their own engines.

For Scenario G1, the TrainOps simulation found that with the sidings as laid out for DMU-type rail vehicles in Scenario G, there is no material change to the schedule for a locomotive hauled service. There would be a little bit of running delay (as a rail vehicle on a passing track slows a little to make sure the oncoming

[51] Shore power—plugging in to an electrical line present at a terminal— allows a train to remain "on" with lighting, communications, and HVAC systems running without running its main engine(s). This is generally only employed where turn times are measured in hours, as the shutdown-startup process takes time and depending on the length of the shutdown may involve FRA-mandated equipment tests.

rail vehicle clears the interlocking before proceeding), but 30 minute bi-directional headways are still feasible. For the purposes of an operating cost estimate, the cost per vehicle revenue hour is the determining factor, as the annual revenue hours would not differ between DMUs and a locomotive operation. Ten peer systems[52] were compared to develop a unit operating cost for Railroad Locomotive Revenue vehicle hours at **$278** per revenue hour. Since the rail vehicle set in this scenario will include two passenger cars, the unit cost for revenue hours is doubled to **$556**. While labor costs are expected to be comparable using either DMU or conventional equipment, part of this higher cost is due to increase fuel cost associated with the heavier weight of conventional equipment.

Annual revenue train hours and miles were generally based on 250 weekdays plus 115 Saturdays, Sundays and Holidays. Scenario D is an exception to this—the service would only run during seasonal weekends (Memorial Day through Labor Day), so 39 Saturdays, Sundays, and Holidays were assumed. Although weekends were not simulated, since the expectation is that rail transit vehicles would idle during layovers (even if layovers became shorter or longer due to schedule differences on the weekends or out of season), the total operating time would be a function of the span of service, not one-way trip times.[53]

6.2.1.1 Vehicle Maintenance

A vehicle maintenance unit cost of **$173,000** (for DMU operations) and **$89,000** (for Scenario G1 Railroad Locomotive operations) per year was also based on NTD data. This estimate does not include replacement, which is a capital cost (see Section 6.1). Vehicles generally have a 30-year useful life—but it should be noted that under current regulations, "replacement funds" can be available from the FTA to help pay for new vehicles. Maintenance of Way (such as track and signals) is covered in the capital cost estimate. General administration (including marketing, security, etc.) is assumed to count for another 38 percent of the combined operations plus vehicle maintenance cost, based on prevailing industry trends. Finally, given the variability of cost for different systems a contingency cost of 20 percent was added to all figures.

6.2.1.2 Siding Locations

Sidings were located such that no right-of-way acquisition would be necessary purely for operational reasons. Potential acquisitions resulting from the need to provide space for the MBSST Rail Trail or to share the corridor with freight are included in the capital cost estimate. Environmental impacts, parking availability, and station access are also not analyzed here; these items would be a part of a complete

[52] Altamont Corridor Express (Bay Area), Coaster (NCTD), Caltrain (Bay Area), Metrolink (Los Angeles), NorthStar (Minnesota), RailRunner (New Mexico), Music City Star (Tennessee), Front Runner (Salt Lake City), Virginia Railway Express (Northern Virginia), Sounder (Seattle).

[53] Per the National Transit Database, revenue hours "are comprised of running time and layover/recovery time."

environmental analysis or the preliminary engineering stage. See Section 9.4.4 for more detail on next steps related to parking.

6.2.2 OPERATION & MAINTENANCE COST ESTIMATES

Table 6-3 through Table 6-9 detail the Operation and Maintenance (O&M) cost estimates for each scenario. Estimates for Scenarios B-J are based on a unit cost that was generated by evaluating national peers. As a result, the annual costs are in line with national trends given a system of the size analyzed in this study. Similar to capital cost estimates, preliminary cost estimates for an incremental startup of service between Seacliff and Bay Street in Santa Cruz were developed by Iowa Pacific which were then refined to adjust labor allowances to match common overhead rates. The unit cost per operational vehicle revenue hour for Scenario S locomotive service is approximately $424 (conductor, crew, supervision, fuel, and insurance), with labor costs adjusted to match industry standards. Including the annual vehicle lease cost it increases to $589 in Scenario S.

TABLE 6-3: SCENARIO B (SANTA CRUZ – CAPITOLA) O&M COSTS

Item	Units	Unit Cost	No. of Units	Annual Cost ($thousands)
Operations	Revenue hours/year	$376	9800	$3,687
Vehicle Maintenance (MOE)	Vehicles	$173,000	3	$519
			Subtotal	$4,205
General Administration	38%			$1,588
			Subtotal	$5,794
Contingency	20%			$1,159
			Total Estimated Annual O&M Cost	**$6,952**
			Revenue Miles (Weekday)	445
			Revenue Miles (Weekend)	296
			Annual Revenue Miles	145,270
			O&M Cost per Revenue Mile ($)	**$52.72**

Source: LTK, 2015

TABLE 6-4: SCENARIO D (SANTA CRUZ – WATSONVILLE PEAK EXPRESS) O&M COSTS

Item	Units	Unit Cost	No. of Units	Annual Cost ($thousands)
Operations	Revenue hours/year	$376	4313	$1,622
Vehicle Maintenance (MOE)	Vehicles	$173,000	4	$692
			Subtotal	$2,314
General Administration	38%			$874
			Subtotal	$3,188
Contingency	20%			$638
			Total Estimated Annual O&M Cost	**$3,825**
			Revenue Miles (Weekday)	544
			Revenue Miles (Weekend)	0
			Annual Revenue Miles	135,948
			O&M Cost per Revenue Mile ($)	**$38.79**

Source: LTK, 2015

TABLE 6-5: SCENARIO E (SANTA CRUZ – APTOS) O&M COSTS

Item	Units	Unit Cost	No. of Units	Annual Cost ($thousands)
Operations	Revenue hours/year	$376	9800	$3,687
Vehicle Maintenance (MOE)	Vehicles	$173,000	3	$519
			Subtotal	$4,205
General Administration	38%			$1,588
			Subtotal	$5,794
Contingency	20%			$1,159
			Total Estimated Annual O&M Cost	**$6,952**
			Revenue Miles (Weekday)	625
			Revenue Miles (Weekend)	416
			Annual Revenue Miles	204,040
			O&M Cost per Revenue Mile ($)	**$38.20**

Source: LTK, 2015

TABLE 6-6: SCENARIO G (SANTA CRUZ – WATSONVILLE) O&M COSTS

Item	Units	Unit Cost	No. of Units	Annual Cost ($thousands)
Operations	Revenue hours/year	$376	13591	$5,113
Vehicle Maintenance (MOE)	Vehicles	$173,000	5	$865
			Subtotal	$5,977
General Administration	38%			$2,258
			Subtotal	$8,235
Contingency	20%			$1,647
			Total Estimated Annual O&M Cost	**$9,882**
			Revenue Miles (Weekday)	1,237
			Revenue Miles (Weekend)	787
			Annual Revenue Miles	399,976
			O&M Cost per Revenue Mile ($)	**$28.43**

Source: LTK, 2015

TABLE 6-7: SCENARIO G1 (SANTA CRUZ – WATSONVILLE LOCOMOTIVE) O&M COSTS

Item	Units	Unit Cost	No. of Units	Annual Cost ($thousands)
Operations	Revenue hours/year	$556	13591	$7,561
Vehicle Maintenance (MOE)	Vehicles	$89,000	10	$895
			Subtotal	$8,456
General Administration	38%			$3,194
			Subtotal	$11,649
Contingency	20%			$2,330
			Total Estimated Annual O&M Cost	**$13,979**
			Revenue Miles (Weekday)	1,238
			Revenue Miles (Weekend)	788
			Annual Revenue Miles	399,938
			O&M Cost per Revenue Mile ($)	**$39.95**

Source: LTK, 2015

TABLE 6-8: SCENARIO J (SANTA CRUZ – PAJARO LIMITED) O&M COSTS

Item	Units	Unit Cost	No. of Units	Annual Cost ($thousands)
Operations	Revenue hours/year	$376	5024	$1,890
Vehicle Maintenance (MOE)	Vehicles	$173,000	2	$346
			Subtotal	$2,236
General Administration	38%			$844
			Subtotal	$3,080
Contingency	20%			$616
			Total Estimated Annual O&M Cost	**$3,696**
			Revenue Miles (Weekday)	174
			Revenue Miles (Weekend)	109
			Annual Revenue Miles	56,147
			O&M Cost per Revenue Mile ($)	**$93.67**

Source: LTK, 2015

TABLE 6-9: SCENARIO S (SANTA CRUZ/BAY ST – SEACLIFF) O&M COSTS

Item	Units	Unit Cost	No. of Units	Annual Cost ($thousands)
Operations (excluding vehicles)	Revenue hours/year	$424	5513	$2,337
Vehicle Maintenance & Lease	Vehicles (locomotive + coach)	$182,000	5	-$911
Track Maintenance and PTC	Per year			$589
			Subtotal	$3,837
General Administration				$647
			Subtotal	$4,485
Contingency	20%			$897
			Total Estimated Annual O&M Cost	**$5,382**
			Revenue Miles (Weekday)	270
			Revenue Miles (Weekend)	195
			Annual Revenue Miles	91,500
			O&M Cost per Revenue Mile ($)	**$59**

Source: Iowa Pacific 2015; with labor and contingency amounts adjusted for consistency.

6.2.3 SCENARIO S O&M COSTS

Similar to capital cost estimates, preliminary cost estimates for an incremental startup of service between Seacliff and Bay Street in Santa Cruz were developed by Iowa Pacific and were then refined to adjust labor allowances to match common overhead rates. The unit cost per operational vehicle revenue hour for Scenario S locomotive service is approximately **$424** (conductor, crew, supervision, fuel, and insurance), with labor costs adjusted to match industry standards. Including the annual vehicle lease cost it increases to **$589.**

6.2.4 SUMMARY COSTS

Table 6-10 summarizes the various scenarios and their associated Operations and Maintenance costs. These costs correlate most strongly with revenue hours of service, as labor costs (paid in hourly wages) are typically the largest cost driver of rail operations. This is seen most plainly by comparing the difference between scenarios B and E, which is an incremental cost associated with extending service from Capitola to Aptos, and the difference between scenarios D and G, where costs more than double as service hours are extended and more stations are served, even though the end-to-end route is the same length.

TABLE 6-10: O&M COST SUMMARY

Scenario	Description	Length (miles)	Weekday Stops	Annual Revenue Miles	Annual O&M Cost ($millions)
B	Santa Cruz – Capitola (Limited)	6.6	6	145,500	**$7.0**
D	Santa Cruz – Watsonville (Peak Express)	20.5	6*	136,600	**$3.8**
E	Santa Cruz – Aptos (Local)	9.5	9	204,000	**$7.0**
G	Santa Cruz – Watsonville (Expanded Local)	20.5	10**	400,000	**$9.9**
G1	Santa Cruz – Watsonville (Expanded Local – *Locomotive powered)*	20.5	10**	400,000	**$14.0**
J	Santa Cruz – Pajaro (Expanded Local)	21.8	10	56,000	**$3.7**
S	Santa Cruz/Bay St – Seacliff/Cabrillo (Limited Local - *Locomotive powered)*	7.6	5	91,500	**$5.4**

*Bay St/California (UCSC) and New Brighton/Cabrillo stop during academic year (Sept.-June) only
** New Brighton/Cabrillo stop during academic year (Sept.-June) only
Scenario S: Revenue hours are limited mid-day, with only 18 weekday trips and 13 weekend trips in each direction

6.3 RIDERSHIP FORECASTS

This section details the ridership forecasts for weekday Santa Cruz County Rail service scenarios under both Baseline and 2035 Conditions. The purpose of this analysis is to prepare ridership estimates to support the evaluation of service options. These initial ridership forecasts were developed for comparing alternatives, and are one of several performance measures (including capital costs, operating and maintenance costs, funding options, and other evaluation criteria described in Section 7.0) the RTC Board will review in order to determine next steps, which may include selection of alternatives to evaluate in subsequent environmental and preliminary engineering studies. In this analysis, Baseline Conditions represent opening year and primarily use data from 2010. These include 2010 land use and travel flow data from the Association of Monterey Bay Area Governments (AMBAG) Regional Travel Demand Model (RTDM), Smart Location Database variables (which are primarily based on 2010 Census data), and Census Transportation Planning Products (CTPP) data from 2010. 2035 Conditions are based on 2035 land use projections and travel flows included in the AMBAG RTDM.

CTTP mode shares were then adjusted down to account for the fact that in most rail systems non-commuters are less likely to take transit. These adjusted mode shares were used for "low estimates". Both the high and low mode shares were applied to the overall origin-destination travel flows for each scenario for both Baseline Conditions and 2035 Conditions in order to estimate the total number of trips by rail. These are general estimates developed to compare the relative benefits of each study scenario, which is a key reason for presenting a high/low range for each scenario alternative.

Ridership projections were *not* adjusted to estimate potential summer and weekend visitor use, and do *not* reflect what could happen if more people decide to use transit more frequently (mode shift) or there are major shifts in land use. See Section 5.3 for more information on the methodology used for the ridership forecasts.

6.3.1 RIDERSHIP FORECASTS (2035)

Daily boardings per scenario under Baseline and 2035 Conditions are summarized in Table 6-11 Scenario G has the highest ridership potential. This scenario has ten stations and full service hours. The second highest scenario is Scenario E which has nine stations and full service hours. The scenario with the third highest ridership is Scenario B which has six stations and full service hours. The fourth highest scenario is Scenario J which has ten stations but limited service. Ridership potential is lower in this scenario due to its limited service: six daily trips per direction rather than 30 in the other scenarios. However, since Pajaro would be a transfer station from regional rail, transfer riders are accounted for in the forecast. Finally, the scenario with the lowest ridership potential is Scenario D, which has six stations and only runs during peak hours. The peak period operation of this scenario would reduce its ridership potential compared to the other all day scenarios.

TABLE 6-11: WEEKDAY BOARDINGS, BY SCENARIO

ID	Scenario	Weekday Operating Period[1]	Trips per Day per Direction	Number of Stations	Baseline Conditions Daily Boardings Estimates		2035 Conditions Daily Boardings Estimates	
					Low	High	Low	High
B	Santa Cruz ←→ Capitola (Limited)	Full service hours (6:00 a.m. to 9:00 p.m.)	30	6	2,800	3,400	3,700	4,300
D	Santa Cruz ←→ Watsonville (Peak Express)	AM Peak (6:00 a.m. to 9:00 a.m. P.M. Peak (4:00 p.m. to 7:00 p.m.)	12	6	1,100	1,350	1,300	1,600
E	Santa Cruz ←→ Aptos (Local)	Full service hours (6:00 a.m. to 9:00 p.m.)	30	9	4,700	5,150	5,900	6,400
G	Santa Cruz ←→ Watsonville (Expanded Local)	Full service hours (6:00 a.m. to 9:00 p.m.)	30	10	5,000	5,500	6,150	6,800
G1	Santa Cruz ←→ Watsonville (Expanded Local with locomotive)	Full service hours (6:00 a.m. to 9:00 p.m.)	30	10	5,000	5,500	6,150	6,800
J	Santa Cruz ←→ Pajaro (Expanded Local)	Limited service (6 round trips per day from 6:00 a.m. to 9:00 p.m.	6	10	1,750	1,950	2,250	2,500
S	Santa Cruz/Bay St ←→ Seacliff	Full service hours (approx. 6:00 a.m. to 9:00 p.m.)	19	5	1,400	1,600	2,000	2,200

Source: Fehr & Peers, 2015

[1] Daily Ridership is presented as weekday passenger boardings, defined as the number of passengers who board a rail vehicle at any given station in either direction within the extent of a service scenario. As explained in the Section 5, the AMBAG model, like most regional models, cannot estimate weekend ridership. As a result, ridership modeling captures weekday trips only. However, for the purposes of this study, based on Santa Cruz Metropolitan Transit District (METRO) weekend ridership levels, weekend ridership can be assumed to be 50 percent of weekday ridership. Weekend ridership is not reflected in Table 6-11.

Annual boardings per scenario under Baseline and 2035 Conditions were also estimated and are summarized in Table 6-12. This analysis assumes that rail transit services are in operation 250 weekdays and 100 weekend days per year. For the purposes of this analysis, weekend daily boardings are assumed to be 50 percent of weekday daily boardings.

TABLE 6-12: ANNUAL BOARDINGS, BY SCENARIO

ID	Scenario	Weekday Operating Period[1]	Weekday Trips per Day per Direction	Number of Stations	Baseline Conditions Annual Boardings Estimates[2]		2035 Conditions Annual Boardings Estimates[2]	
					Low	High	Low	High
B	Santa Cruz ←→ Capitola (Limited)	Full service hours (6:00 a.m. to 9:00 p.m.)	30	6	846,000	1,005,000	1,113,000	1,287,000
D[3]	Santa Cruz ←→ Watsonville (Peak Express)	AM Peak (6:00 a.m. to 9:00 a.m. P.M. Peak (4:00 p.m. to 7:00 p.m.)	12	6	287,500	342,500	337,500	405,000
E	Santa Cruz ←→ Aptos (Local)	Full service hours (6:00 a.m. to 9:00 p.m.)	30	9	1,413,000	1,539,000	1,764,000	1,926,000
G	Santa Cruz ←→ Watsonville (Expanded Local)	Full service hours (6:00 a.m. to 9:00 p.m.)	30	10	1,509,000	1,650,000	1,845,000	2,031,000
G1	Santa Cruz ←→ Watsonville (Expanded Local – w/locomotive)	Full service hours (6:00 a.m. to 9:00 p.m.)	30	10	1,509,000	1,650,000	1,845,000	2,031,000
J	Santa Cruz ←→ Pajaro (Expanded Local)	Limited service (6 round trips per day from 6:00 a.m. to 9:00 p.m.	6	10	528,000	585,000	672,000	741,000
S	Santa Cruz/Bay St ←→ Seacliff	Full service hours (approx. 6:00 a.m. to 9:00 p.m.)	19	5	420,000	480,000	600,000	660,000

Source: Fehr & Peers, 2015.
Notes:
1. Daily weekday passenger boardings were calculated, defined as the number of passengers who board a rail transit vehicle at any given station in either direction within the extent of a service scenario. As explained in the Section 5, the AMBAG model, like most regional models, cannot estimate weekend ridership. As a result, ridership modeling captures weekday trips only. However, for the purposes of this study, based on Santa Cruz Metropolitan Transit District (METRO) weekend ridership levels, weekend ridership can be assumed to be 50 percent of weekday ridership.
2. Annual ridership estimates are based on 250 weekday service days annually and 100 weekend service days annually (weekend daily ridership assumed to be 50 percent of weekday daily ridership estimates)
3. Scenario D does not include weekend service.

All scenarios provide weekend service except Scenario D. The order of ridership levels per scenario from highest to lowest is the same as for the daily analysis, with Scenario G having the highest annual ridership and Scenario D having the lowest annual ridership. More detailed modeling would result in more refined ridership estimates, which could address questions about ridership estimates for specific stations, including the Watsonville station. See Section 9.4.3 for more information.

6.3.2 STATION USE

The following twelve figures show the weekday ridership range by scenario for each station under Baseline and 2035 Conditions. These estimates are based on existing and forecast future multimodal travel and growth patterns. The location of housing and key destinations (jobs, major activity centers) is a major factor. In Figure 6-2 through Figure 6-13, daily weekday ridership is presented as passenger boardings, defined as the number of passengers who board a rail transit vehicle at a given station. Numbers may not match totals due to rounding. The High and Low ridership ranges reflect the high and low mode shares applied to the overall origin-destination travel flows for each scenario for both Baseline Conditions and 2035 Conditions in order to estimate the total number of trips by rail as described in Section 5.1.3.1.

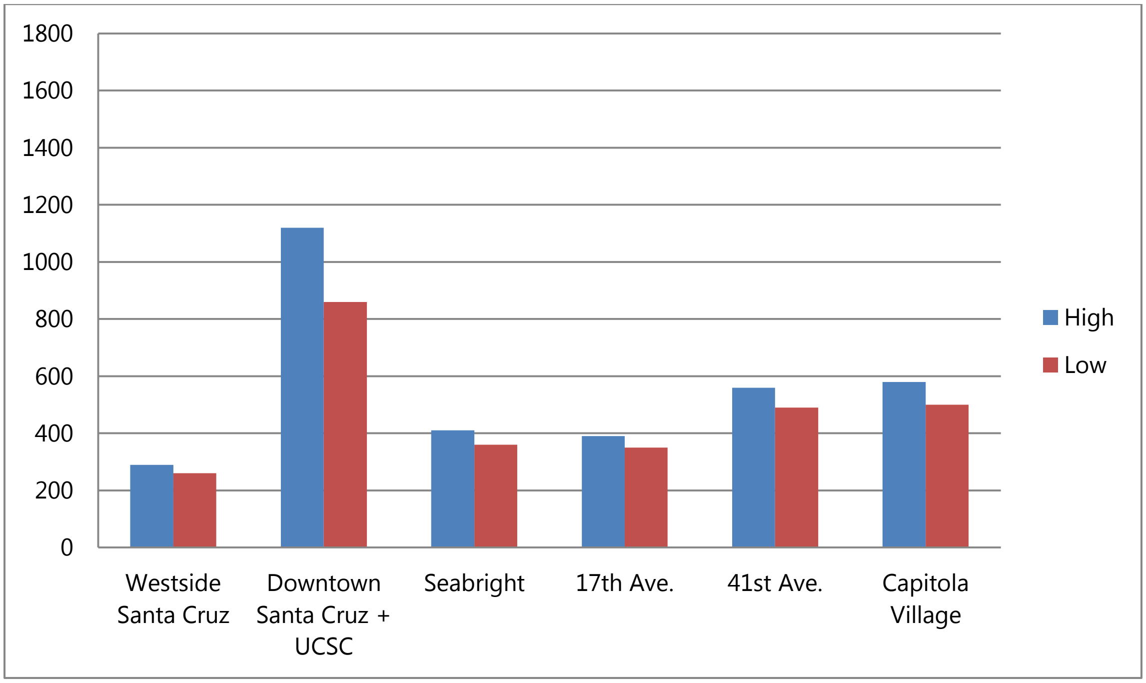
Passengers were assigned to individual rail vehicles based on direction of travel and rail vehicles per hour. Passenger boarding and alighting stops were also considered. Based on this analysis, the peak passenger load (maximum number of people on a single vehicle set) was calculated per scenario and is summarized in Table 6-13. The peak passenger load ranges from 44 in Scenarios D and J to 64 in Scenario G.

TABLE 6-13: PEAK PASSENGER LOAD

Scenario	Scenario	Peak Load
B	Santa Cruz ←→ Capitola (Limited)	55
D	Santa Cruz ←→ Watsonville (Peak Express)	44
E	Santa Cruz ←→ Aptos (Local)	62
G	Santa Cruz ←→ Watsonville (Expanded Local)	64
J	Santa Cruz ←→ Pajaro (Expanded Local)	44

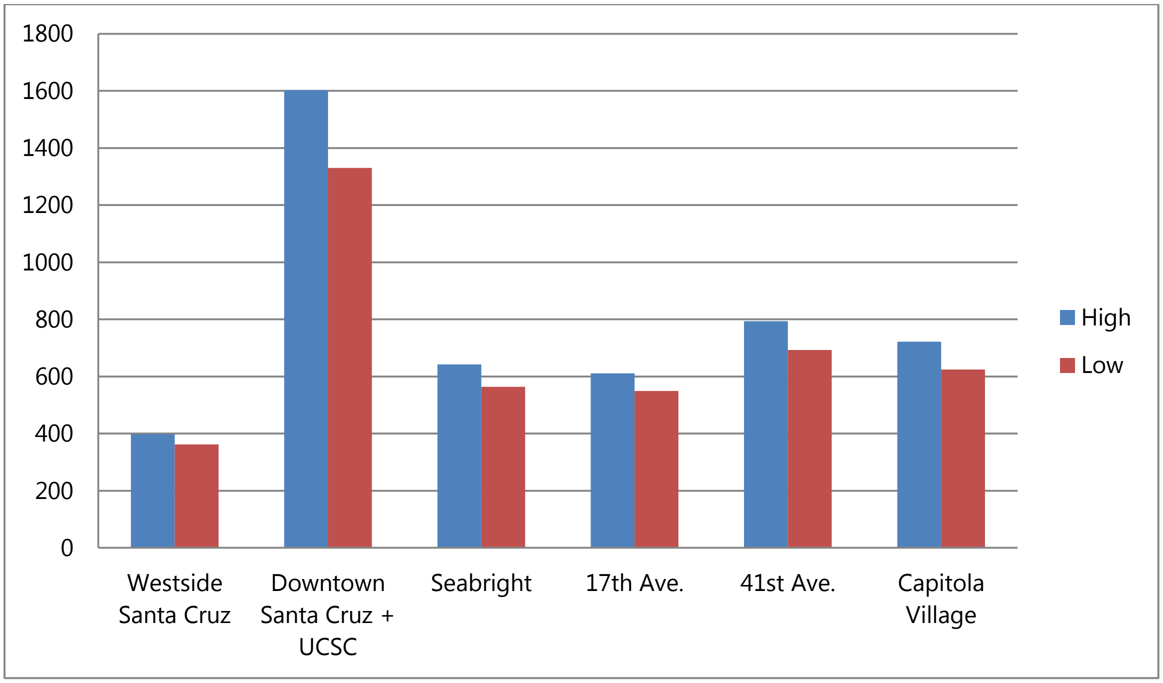
Source: Fehr & Peers, 2015

Figure 6-2: Scenario B Santa Cruz to Capitola Limited, Baseline Conditions, Daily Boardings



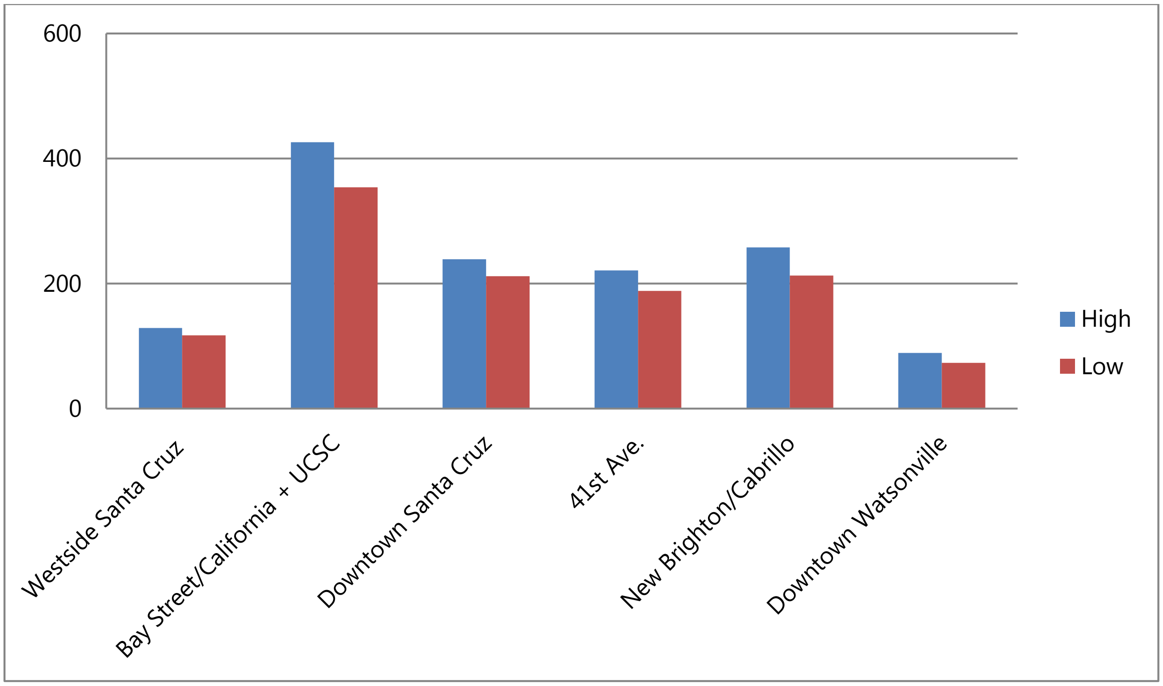
Source: Fehr & Peers, 2015

Figure 6-3: Scenario B Santa Cruz to Capitola Limited, 2035 Conditions, Daily Boardings



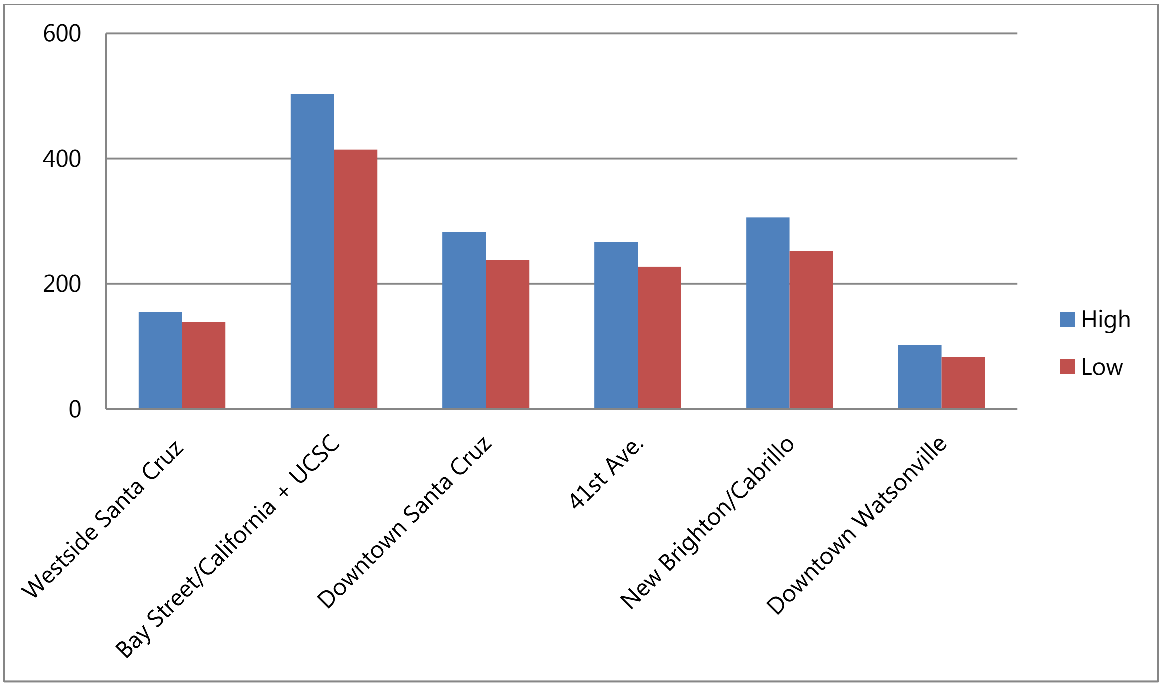
Source: Fehr & Peers, 2015

Figure 6-4: Scenario D Santa Cruz to Watsonville Peak Express, Baseline Conditions, Daily Boardings



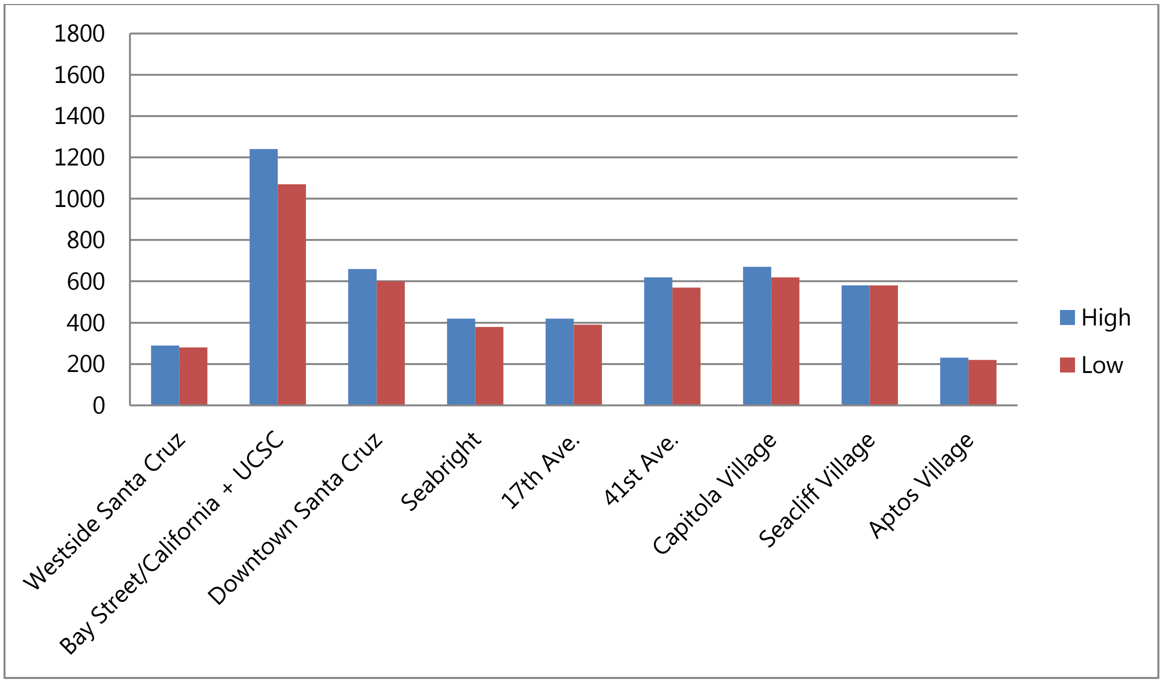
Source: Fehr & Peers, 2015

Figure 6-5: Scenario D Santa Cruz to Watsonville Peak Express, 2035 Conditions, Daily Boardings



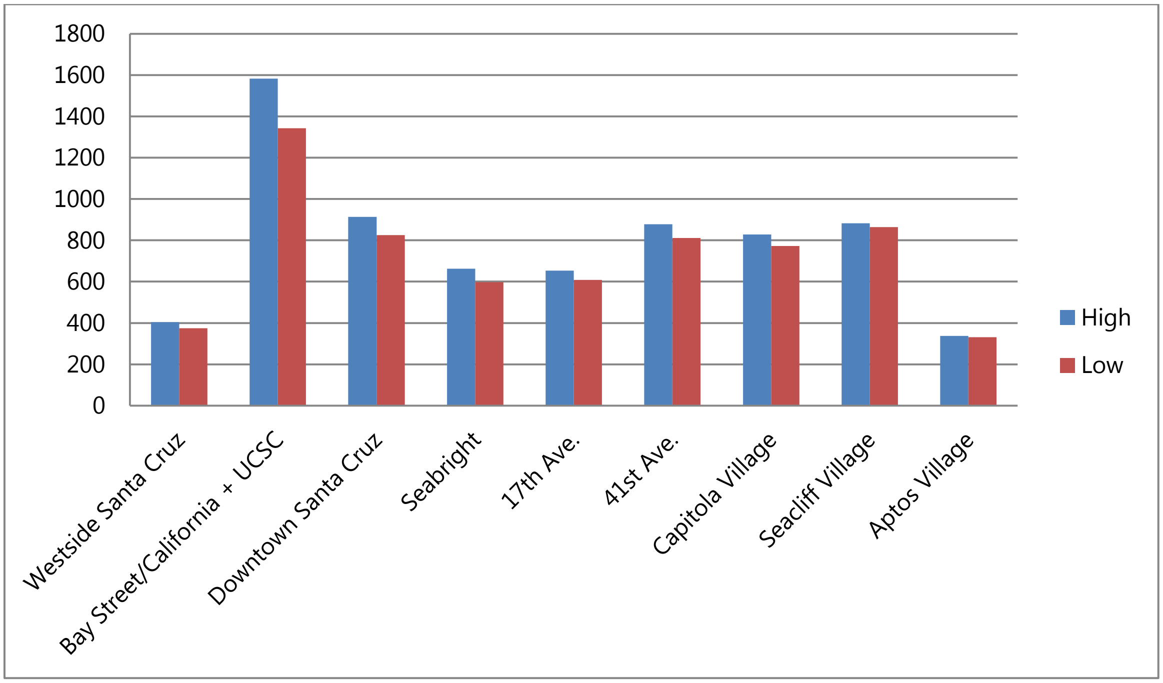
Source: Fehr & Peers, 2015

Figure 6-6: Scenario E Santa Cruz to Aptos Local, Baseline Conditions, Daily Boardings



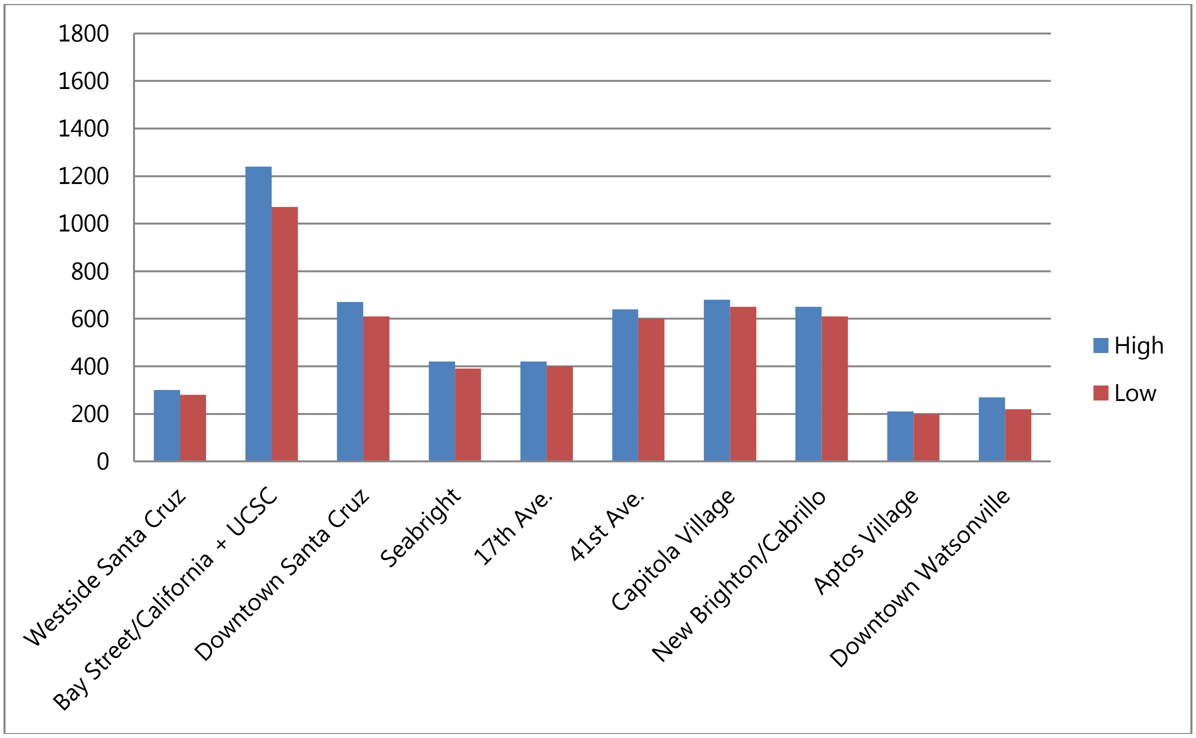
Source: Fehr & Peers, 2015

Figure 6-7: Scenario E Santa Cruz to Aptos Local, 2035 Conditions, Daily Boardings



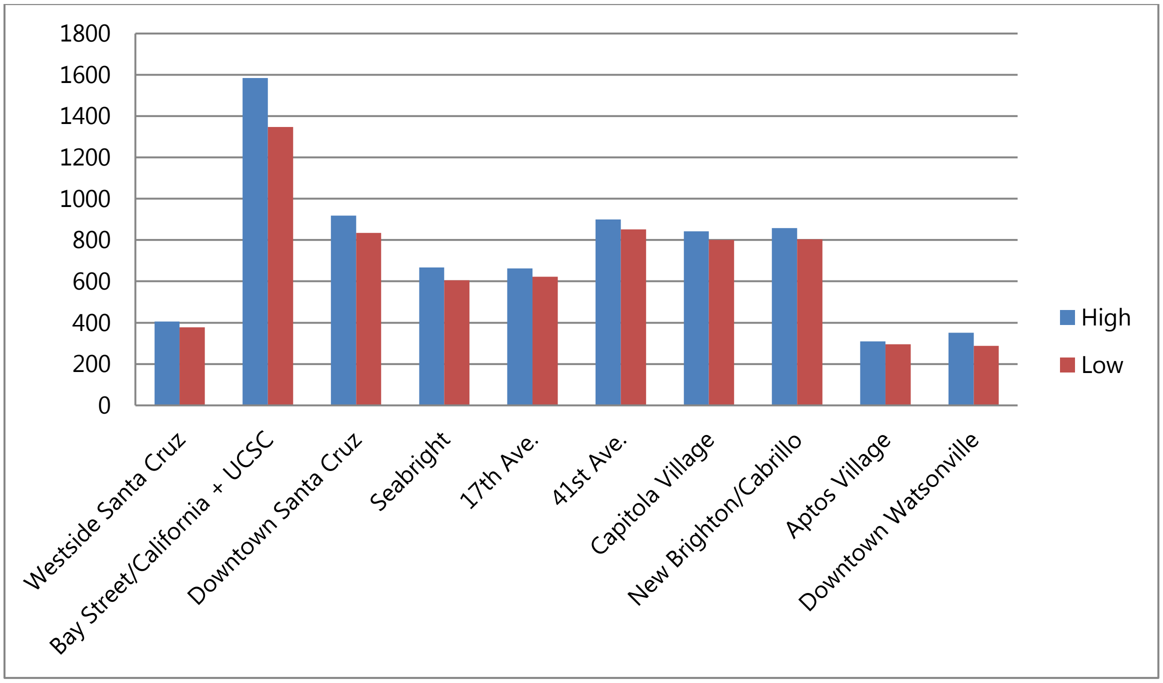
Source: Fehr & Peers, 2015

Figure 6-8: Scenario G and G1 Santa Cruz to Watsonville Expanded Local, Baseline Conditions, Daily Boardings



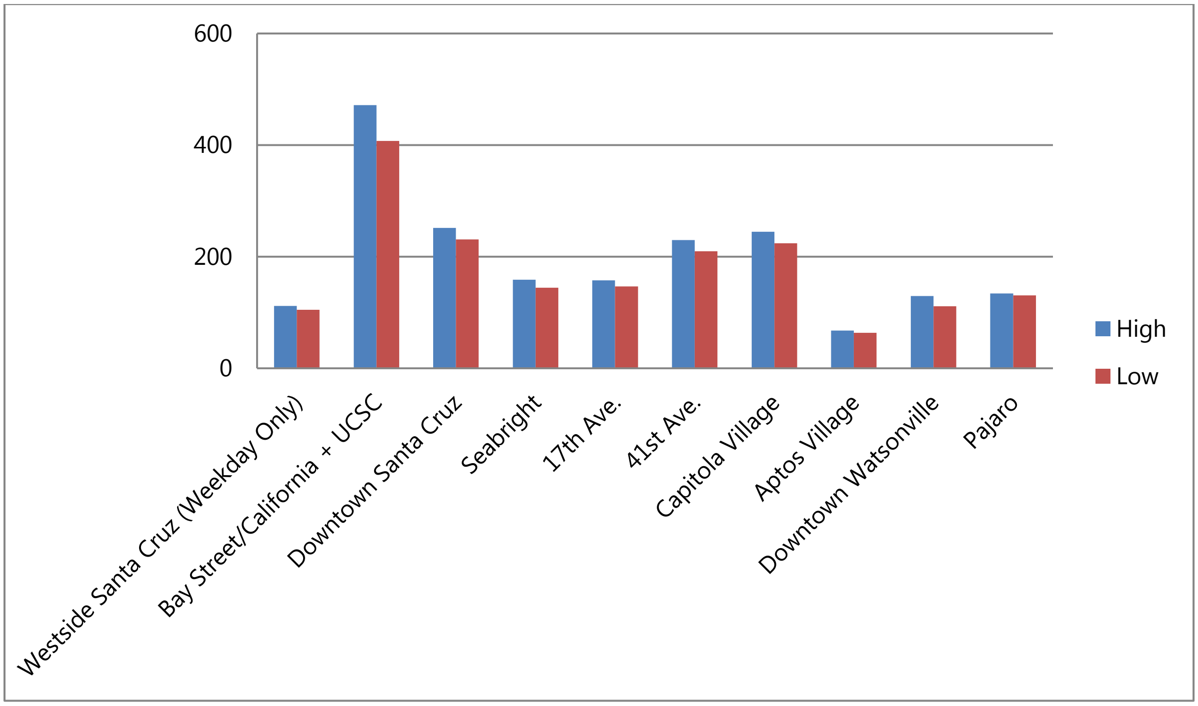
Source: Fehr & Peers, 2015

Figure 6-9: Scenario G and G1 Santa Cruz to Watsonville Expanded Local, 2035 Conditions, Daily Boardings



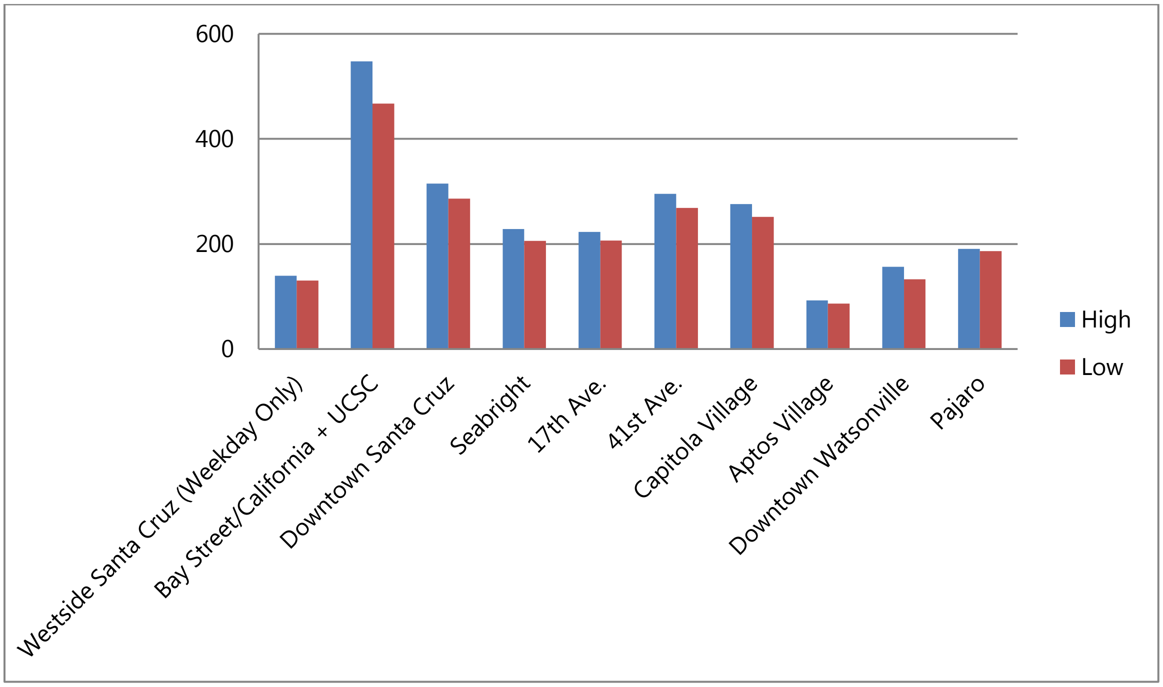
Source: Fehr & Peers, 2015

Figure 6-10: Scenario J Santa Cruz to Pajaro Expanded Local, Baseline Conditions, Daily Boardings



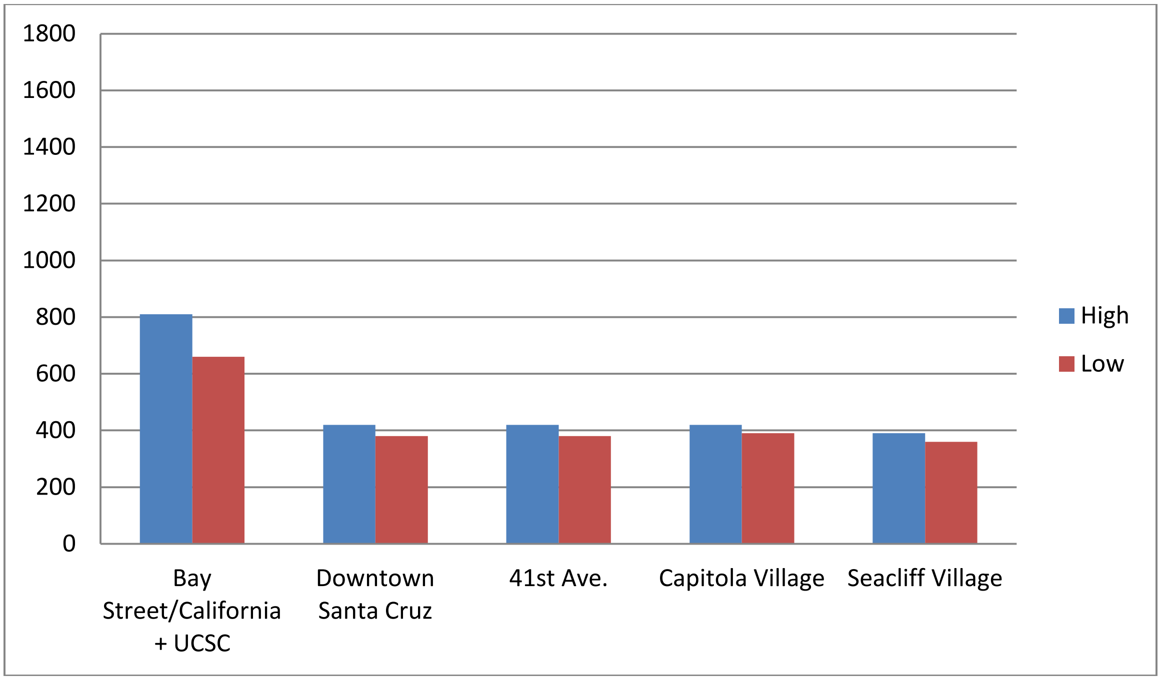
Source: Fehr & Peers, 2015

Figure 6-11: Scenario J Santa Cruz to Pajaro Expanded Local, 2035 Conditions, Daily Boardings



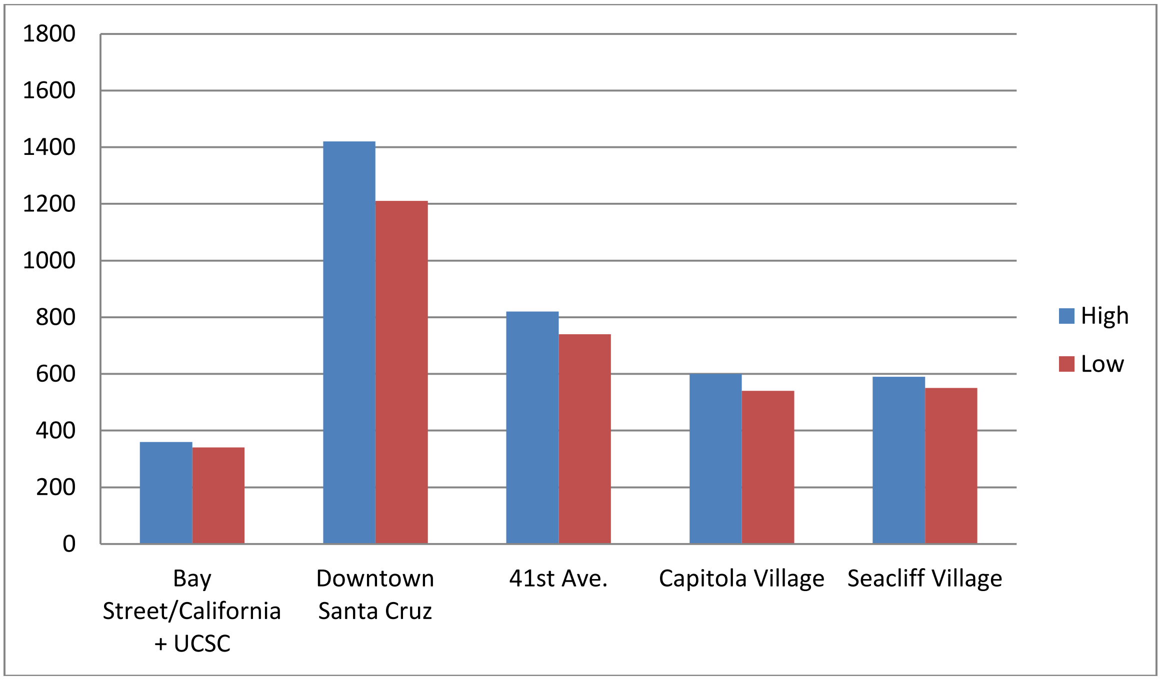
Source: Fehr & Peers, 2015

Figure 6-12: Scenario S Santa Cruz/Bay St to Seacliff/Cabrillo, Baseline Conditions, Daily Boardings



Source: Fehr & Peers, 2015

Figure 6-13: Scenario S Santa Cruz/Bay St to Seacliff/Cabrillo, 2035 Conditions, Daily Boardings



Source: Fehr & Peers, 2015

6.4 FUNDING ASSESSMENT

This section provides background information, analysis, and recommendations to facilitate decision-making regarding development of one or more strategies for funding capital improvements and ongoing operations and maintenance of rail transit service on the Santa Cruz Branch Line.

6.4.1 POTENTIALLY AVAILABLE FUNDING SOURCES

More than 50 funding sources were considered for this analysis and are listed in Appendix F. For convenience, they are classified into four groups, as follows:

- Existing Federal Grant and Loan Programs
- Existing State Grant and Loan Programs
- Existing Local and Regional Sources
- Available and Potential New Mechanisms

Following an initial screening, sources were removed from further consideration that are not active grant programs, are not currently available for rail transit, are currently fully committed to other projects or programs, are very difficult to secure or are otherwise not reasonable to consider. Over 30 potential funding sources remain potentially available for rail transit.

6.4.1.1 Definition and Characteristics of Candidate Funding Sources

Key characteristics of revenue sources that could be candidates for funding rail transit capital and ongoing operations and maintenance (O&M) are provided in Table 6-14 and Table 6-15. A base assumption used for this study was that funding sources used to fund the existing bus transit system would not be redirected to fund rail transit. The "potential revenue yield" assumes that only a small portion of revenue sources also used by local jurisdiction's to fund other transportation projects might be available for rail transit. Also provided in both tables are "Priority Scores" for each source, consisting of a qualitative assessment of overall utility of the funding source to the Project based on the following considerations:

- Availability
- Revenue yield
- Competition for funds
- Implementation difficulty

In three cases where the source is not active or is only being considered prospectively, the term "Watch" is used instead of a score.

TABLE 6-14: FUNDING SOURCES APPLICABLE TO CAPITAL NEEDS ONLY

SOURCE	Potential Revenue Yield	Minimum Match	Priority Score[1]
Federal Grants			
Congressional Earmarks (Suspended)	$10 million	20%	Watch
EDA Public Works Grants	$2 million	50%	3
FHWA Regional Surface Transp. Program (RSTP)	$0.3 million/Year	20%	3
FTA §5303/5304/5305 Planning Assistance	$0.1 million/Year	None	2
FTA §20005(b) Transit Oriented Development (TOD)	$1 million	20%	3
FTA §5309 Fixed Guideway New/Small Starts	$50 million	20%-65%	**5**
FTA Transit Invest. for Greenhouse Gas & Energy Reduction (TIGGER) (ARRA)	$5 million	None	1
USDOT Transportation Investment Generating Economic Recovery Program (TIGER) (ARRA)	$10 million	20%-70%	**5**
Federal Loans[2]			
FHWA Transp. Infrastructure Financing and Innov. Act (TIFIA)	$10 million	50%	4
FRA Railroad Rehab. and Improvement Financing (RRIF)	$5 million	None	3
State Grants			
Active Transportation Program (ATP)	$0.3 million/Year	11.47%	2
Cap and Trade Program (SB 862)	See Footnote 3	TBD	4
Santa Cruz County RTIP (STIP Element)	$0.3 million/Year	Various	3
State Loans[2]			
California Transportation Fin. Authority	Inactive	Unknown	Watch
Local			
City/County Developer Fees ($1,000/permit)	$0.6 million/Year	None	3

Source: Robert Schaevitz, 2015

1. Qualitative score based on: availability, revenue yield, competition for funds, availability of match, and implementation difficulty. 5 = Best, 1 = Worst.
2. Funding source(s) for repayment are required.
3. Three elements in the Cap and Trade Program appear to have potential applicability to the Project: Affordable Housing/Sustainable Communities ($200M), Transit Capital ($100M), and Low Carbon/Transit Operations-LCTOP ($50M). Amounts are statewide in 2015 based on $1 billion in total revenue annually.

TABLE 6-15: FUNDING SOURCES APPLICABLE TO CAPITAL NEEDS AND ONGOING O&M

SOURCE[2]	Source Type	Potential Annual Revenue Yield	Priority Score[1]
State			
VMT-Based Road User Charges (Potential)	*Subvention*	*Unknown*	*Watch*
Cap and Trade - LCTOP	*Subvention*	*$80,000 +*	*4*
Local (Active Now)			
Rail Corridor Lease Revenue	*Direct Rev*	*$50,000*	*2*
Legally Authorized (Available)			
UC Santa Cruz Transit User Fee (new)	*Operating Rev*	*$50,000*	*3*
Special Assessment Districts (SAD)	*Assessment*	*$5 million*	*3*
Santa Cruz Co. Transportation Sales Tax	*Tax*	*$4 million*	***5***
City/County General Funds (Taxes, Fees, Etc.)	*Multiple*	*$1 million*	*3*
Community Facilities District (CFD)	*Assessment*	*$5 million*	*3*
Rail System Advertising & Concession Revenue	*Direct Rev*	*$200,000*	*3*
Rail System Parking and Miscellaneous Revenue	*Direct Rev*	*$750,000*	*3*
Rail System Fare Revenue	*Direct Rev*	*See Tables*	***5***
P3 - Short-line Operator	*Contribution*	*Unknown*	*2*
P3 - Tourism-Based Businesses	*Contribution*	*Unknown*	*2*
P3 - Station Area Development, Services, etc.	*Contribution*	*Unknown*	*2*
Tax Increment Financing (TIF) (SB 628, AB 229)	*Tax*	*$6 million*	*3*
Transient Occupancy Tax (TOT)	*Tax*	*$80,000*	*2*
Vehicle Registration Fees (SB 83)	*Fee*	*$500,000*	*3*

Source: Robert Schaevitz, 2015
1. Qualitative score based on: availability, revenue yield, competition for funds, and implementation difficulty. 5 = Best, 1 = Worst.
2. No matching funds are required for any of these sources.

6.4.1.2 Identification of Feasible and Infeasible Sources and Mechanisms

The following data were assembled for each funding source listed in Appendix F:

- Source Type
- Source Level
- Existing Legal Authority (Fed/ State)
- Current Status
- Current Funding Available
- Applicability By Function
- SC Rail Project Eligible
- Authorization Requirements
- Revenue Yield (Millions)
- Matching Funds Required (Yes/No)
- Minimum Matching Percentage
- Suitable for Debt Service
- Available if Metro is Owner/Operator (Yes/No)
- Available if New JPA is Owner/Operator (Yes/No)
- Available if Concessionaire is Owner/Operator (Yes/No)
- Included in 2014 SCCRTC Regional Transportation Plan (Yes/No)

6.4.1.3 Other Candidate Local Revenue Sources

The following candidate local revenue sources, identified in the *Local and Regional Funding Mechanisms for Public Transportation* (TCRP 2009) and/or *Alternative Funding and Financing Mechanisms for Passenger and Freight Rail Projects* (NCRRP Project 07-01), were reviewed but not included in the analysis because they are considered very difficult to implement.

- Property tax increase
- Realty transfer tax and mortgage recording fees
- Corporate franchise taxes
- Business license fees
- Utility fees/taxes
- Tolls
- Heavy goods vehicle charges

Numerous other candidate local funding measures from these documents were evaluated and are shown in Appendix F.

6.4.2 FUNDING SOURCES CONSIDERED BUT NOT RECOMMENDED

From this information, criteria were used to identify those sources having no potential or very limited potential to play a role in funding the proposed Santa Cruz County Rail Service at this point in time. The criteria were:

1. Currently Committed to Existing Local Transit and Roads
2. Not Available for Rail Transit[54]
3. Likelihood of Success Very Low

Sources not recommended for further consideration are listed in Table 6-16 along with the basis for each decision.

TABLE 6-16: POTENTIAL FUNDING SOURCES CONSIDERED BUT NOT RECOMMENDED

SOURCE	Source Level	Status	Decision Basis*
FRA Intercity Passenger Rail	Federal	Existing	2
FTA §5307 Urbanized Area Formula Program	Federal	Existing	1
FTA §5310 Seniors and Individuals with Disabilities	Federal	Existing	2
FTA §5311 Rural Area Formula	Federal	Existing	1, 2
FTA §5311(f) Rural Intercity Bus	Federal	Existing	1, 2
FTA §5337 State of Good Repair Program	Federal	Existing	1, 2
FTA §5339 Bus and Bus Facilities Formula	Federal	Existing	2
FTA 5336 Urban Small Transit Intensive Cities (STIC)	Federal	Existing	1
FTA §5340 Urban/Rural Growing and High Density States	Federal	Existing	4
Motor Fuel Tax (Local Subvention) (HUTA)	State	Existing	1
Motor Vehicle Emissions Reduction Grant Program (AB 2766)	Region	Existing	2
Proposition 1A Bonds - High-Speed Rail	State	Existing	3

[54] Federal and state transit and rail funding programs are restricted by type of service: urban/transit, commuter, and intercity. FTA (federal) funding, in particular, cannot be used for intercity service. The FTA defines "commuter rail" as (1) "…short-haul rail passenger service operating in metropolitan and suburban areas, whether within or across the geographical boundaries of a state, usually characterized by reduced fare, multiple ride, and commutation tickets and by morning and evening peak period operations," and also (2) "…urban passenger train service consisting of local short distance travel operating between a central city and adjacent suburbs. Service must be operated on a regular basis by or under contract with a transit operator for the purpose of transporting passengers within urbanized areas (UZAs), or between urbanized areas and outlying areas."

TABLE 6-16: POTENTIAL FUNDING SOURCES CONSIDERED BUT NOT RECOMMENDED

SOURCE	Source Level	Status	Decision Basis*
State Transit Assistance (STA)	State	Existing	1
Transportation Development Act (TDA) / LTF	State	Existing	1
County Local Option Fuel Tax (New)	Local	Potential	3
Employer/Employee (Head) Tax (New)	Local	Potential	3
Metro Transit Non-Fare Revenue	Local	Existing	1
Metro Transit Passenger Fares	Local	Existing	1
Metro Transit Sales Tax	Local	Existing	1

Source: Robert Schaevitz, 2015
1. Currently Committed to Existing Local Transit and Roads
2. Not Available for Rail Transit
3. Likelihood of Success Very Low

6.4.3 ESTIMATED RAIL SYSTEM COSTS AND FARE REVENUE

6.4.3.1 Definition of Potential Funding Strategy Elements

The elements of a successful funding strategy, such as collection of funding sources and underlying assumptions, were identified and evaluated for both capital investment needs and ongoing O&M needs for the following service scenarios:

- Scenario B: Santa Cruz <-> Capitola (Limited)
- Scenario D: Santa Cruz <-> Watsonville (Peak Express)
- Scenario E: Santa Cruz <-> Aptos (Local)
- Scenario G/G1: Santa Cruz <-> Watsonville (Expanded Local)
- Scenario J: Santa Cruz <-> Pajaro (Expanded Local)

Several factors were considered in the process of assembling and evaluating funding strategy elements, namely:

1. Estimated rail system costs and fare revenue.
2. Applicability of each funding source to project activities: planning, capital, or operations and maintenance.

3. Potential revenue yield from each funding source.
4. Requirements for matching funds (federal and state grant programs only).
5. Relative utility of each funding source based on availability, revenue yield, competition for funds, and implementation difficulty.
6. Institutional options[55] and their impact on funding availability.

Conclusions and suggestions are provided at the end of this section.

6.4.3.2 Cashflow Simulations

Cost and ridership estimates for this study were assembled in order to prepare a financial cashflow simulation for each scenario. Each simulation included year by year estimates for:

- Ridership
- Capital Investment (Construction and Acquisition) Costs
- Recurring Operations and Maintenance Costs
- Fare Revenue

A prototypical project schedule was developed to facilitate the simulations:

- Construction 2018 – 2020 (1-3 years depending on scenario)
- Revenue Service 2026 – 2045 (20 years)

Fare revenue was estimated in two ways based on a survey of similar rail operations:

1. Using a target farebox recovery rate, or ratio (percent of O&M cost covered by fare revenue); and
2. Using an achievable target "market" fare.

An initial (startup) farebox recovery rate target of 15 percent was selected for this analysis. The vast majority of rail systems in the United States experience farebox recovery rates (FRR) of between 20 percent and 40 percent when mature.[56] Further a sample of FRRs was obtained for the rail and bus[57] operators shown in Table 6-17.

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[55] "Institutional options" refers to alternative arrangements for organizing, supplying, and managing the delivery of rail service, including identification of participants, establishment of a legally-supported and managerially sound organizational structure, and assignment of roles and responsibilities.
[56] Source: Federal Transit Administration, National Transit Database (NTD).
[57] For purposes of this analysis, the Golden Gate Transit District was used as a proxy for the not-yet opened Sonoma-Marin Area Rail Transit (SMART) system. Current, fare schedule development for the SMART system is proceeding with the GGTD zone fare structure as a model. Current FRR for the SCMTD (METRO) is also provided for comparison purposes.

TABLE 6-17: SAMPLE FAREBOX RECOVER RATE

System	Farebox Recovery Rate
Caltrain	56%
Capital Metro MetroRail (Austin, TX)	20%
Denton County A-Train (Dallas, TX)	6%
Metrolink (Los Angeles Region)	55%
NCTD Sprinter (San Diego)	20%
PATCO (Philadelphia-NJ)	57%
Tri-Met WES Comm. Rail (Portland)	7%
Golden Gate Transit District (GGTD)	30%
SCMTD (Highway 17 Express Commuter Bus)	38%
SCMTD (Fixed Route Bus)	23%

Source: National Transit Database and Operator Reports FY14 and FY15 METRO report

The variation in recovery rates is due to many factors, including but not limited to: system size, system age, local labor costs, local transit mode share, and ridership. Farebox recovery is often low in the early years of operation, particularly for new, limited rail transit service such as that contemplated in this study. Based on these findings, for the purpose of estimating potential fare revenues, a farebox recovery level of 15 percent was used.[58] Ultimately, farebox recovery goals could be established to require that rider fares cover a higher percentage of the transit systems operating cost, while taking into consideration impacts of higher fares on ridership.

In a similar fashion, current fares charged by a similar set of rail operators were obtained and are displayed in Table 6-18.

[58] An Excel-based financial model prepared in support of this report is designed to allow varying FRRs by scenario. Subsequent analysis can make use of this capability. Note that none of the O&M funding sources identified have explicit FRR minimums established as a condition of funding. In the vast majority of cases, however, support for a project will diminish over time if an initially low FRR does not improve to at least 20% or more.

TABLE 6-18: SAMPLE FARES

System	Length (miles)	One-Way Fares	Fare Structure
Caltrain	77	$3.25 - $13.25	Zone System
Capital Metro MetroRail (Austin, TX)	32	$2.75	Flat Rate
Denton County A-Train (Dallas, TX)	21	$3.00	Flat Rate (2-Hr)
Golden Gate Transit District (GGTD)*	NA	$4.50 - $11.75	Zone System
NCTD Sprinter (San Diego)	22	$2.00	Flat Rate
NJ Transit River Line (Camden-Trenton)	34	$1.50	Flat Rate
Tri-Met WES Comm. Rail (Portland, OR)	15	$2.50	Flat Rate (2-Hr)
SCMTD (Highway 17 Express Commuter Bus)*	35	$7.00	Flat Rate

Source: Operator Documents
*While not current rail operators, GGTD as proxy for SMART and METRO buses are included in this table for comparative purposes.

A base fare per trip of $2.50 was set for the five service scenarios[59] based on considerations including the type of service anticipated, the relative cost of living in Santa Cruz, and a desire to maximize use of the service to the extent consistent with financial responsibility and industry norms. This compares with METRO's current flat fare of $2.00. Using this $2.50 base fare, farebox recovery ranged from a low of 9 percent for Scenario D (Santa Cruz to Watsonville Peak Express) to a high of 22 percent for Scenario E (Santa Cruz to Aptos Local).

6.4.4 SUMMARY AND OUTLOOK

The results of the calculations of costs and fare revenue for a twenty year period are summarized for the five service scenarios in Table 6-19 (in constant 2014 dollars).

The analysis of the service alternatives resulted in estimated up front capital costs as follows:

- Scenario B $77 million
- Scenario D $119 million
- Scenario E $85 million
- Scenario G $133 million
- Scenario G1 $176 million
- Scenario J $93 million

Based on the revenue estimates, it appears unlikely that costs in excess of $100 million can be met with funding sources available or potentially available at this time.

[59] As with the FRR, the Excel-based financial model is designed to allow target base fares to vary by scenario. Subsequent analysis by SCCRTC can make use of this capability.

TABLE 6-19: RAIL SYSTEM COSTS AND FARE REVENUE OVER 20 YEARS

(Constant 2014 dollars – in Millions)

Service Scenario	B	D	E	G	G1	J
Ridership						
Cumulative 20 Years (2021-2040) [1]	19.2	7.0	29.6	31.3	31.3	11.4
Farebox Recovery Goal	15%	15%	15%	15%	15%	15%
Target Fare (2014 Dollars)	$2.50	$2.50	$2.50	$2.50	$2.50	$2.50
Capital Cost (Outlay) Prior to Start of Service						
Total	$77.1	$119.1	$85.3	$133.2	$175.6	$92.7
Highest One-Year Outlay	$54.0	$59.6	$51.2	$66.6	$87.8	$46.4
Cumulative O&M Costs and Fare Revenue (over 20 years)						
Recurring (O&M) Costs	$171.0	$118.1	$172.8	$251.9	$347.9	$120.9
Fare Revenue (Farebox Recovery Goal)	$25.7	$17.7	$25.9	$37.8	$52.2	$18.1
Fare Revenue (Target Fare)	$48.0	$17.6	$74.1	$78.2	$78.2	$28.5
O&M Costs Less Fare Revenue (Farebox Recovery Goal)	$145.4	$100.5	$146.9	$214.2	$295.7	$102.7
O&M Costs Less Fare Revenue (Target Fare)	$123.1	$100.6	$98.7	$173.8	$269.7	$92.4
Cumulative Total Costs						
Total Cost (Capital and Recurring)	$248.1	$237.2	$258.1	$385.1	$523.5	$213.6
Total Cost Less Fare Revenue (Recovery Goal)	$222.5	$219.6	$232.2	$347.4	$471.3	$195.4
Total Cost Less Fare Revenue (Target Fare)	$200.2	$219.7	$184.0	$307.0	$445.3	$185.1
Annual O&M Cost Less Fare Revenue (Farebox Recovery Goal)						
2021 (Year 1)	$6.5	$4.5	$6.6	$9.7	$13.4	$4.5
2030 (Year 10)	$7.3	$5.0	$7.3	$10.7	$14.8	$5.1
2040 (Year 20)	$7.8	$5.3	$7.8	$11.4	$15.7	$5.5
Annual O&M Cost Less Fare Revenue (Target Fare)						
2021 (Year 1)	$5.3	$ 4.5	$4.1	$7.4	$11.8	$3.8
2030 (Year 10)	$6.1	$ 5.0	$4.9	$8.7	$13.5	$4.6
2040 (Year 20)	$6.6	$ 5.3	$5.2	$9.2	$14.3	$4.9

Source: Robert Schaevitz, 2015
Notes: Figures expressed in millions; cumulative ridership based on average of high and low daily ridership, annualized using 250 weekdays/year and 50% of weekday ridership for 115 weekends/holidays over 20 years.

Annual system operations and maintenance costs, *net of fare revenue*, were estimated as shown in Table 6-20 for baseline ridership and 2014 costs. Annual operating subsidies in excess of $10 million annually may be difficult to achieve in the current funding environment.

TABLE 6-20: ANNUAL SYSTEM RIDERSHIP & NET COSTS (1,000)

Scenario	Annual Cost	Annual Ridership	Farebox Revenue (15% recovery goal)	Farebox Revenue ($2.50 target fare)	Net Cost (15% recovery goal)	Net Cost ($2.50 fare)
Scenario B	$7,660	930	$1,150	$2,325	$6,510	$5,335
Scenario D	$5,270	320	$790	$800	$4,480	$4,470
Scenario E	$7,800	1,480	$1,170	$3,700	$6,630	$4,100
Scenario G	$11,400	1,580	$1,710	$3,950	$9,690	$7,420
Scenario G1	$15,700	1,580	$2,355	$3,950	$13,345	$11,750
Scenario J	$5,260	560	$790	$1,400	$4,470	$3,860
Scenario S	$5,830	450	$875	$1,125	$4,955	$4,705

Source: Fehr & Peers, LTK, RailPros, and IP, 2015.
Notes: Annual Cost includes O&M plus annualized recurring maintenance of way cost.
Actual fare levels not yet determined.

7.0 EVALUATION OF RAIL TRANSIT

7.1 EVALUATION MEASURES

An evaluation framework was developed to evaluate rail transit service along the Santa Cruz Branch Rail Line in the context of the project's goals and objectives. The measures used to assess the rail transit scenarios are described in the Introduction, Preferred Alternative, and Implementation sections of this document.

As noted by the American Public Transportation Association, benefits of public transportation include:

- Public transportation provides personal mobility for people regardless of income and abilities.
- Public transportation provides an affordable, and for many, necessary, alternative to driving.
- Access to public transportation gives people transportation options to get to work, go to school, visit friends, or go to a doctor's office.
- Public transportation reduces the number of cars on roadways.
- Public transportation provides economic opportunities and supports community revitalization.
- Public transportation reduces gasoline consumption.
- Public transportation provides an alternative to driving in traffic.
- Provides personal mobility to all, improving access to job and educational opportunities.

Beyond assessment of benefits and costs/impacts of rail transit service in general, the evaluation measures and metrics described below were used to conduct a comparative assessment of the seven service scenarios analyzed as part of this study. The evaluation measures were used to measure each scenario's effectiveness, identify fatal flaws, and differentiate service scenarios in terms of benefits and costs. Feedback from RTC staff, the RTC Board, technical stakeholders, and AMBAG helped refine the range of potential evaluation measures into the set used in this feasibility study. The development of these criteria was based on an initial review of typical and context-sensitive performance metrics, the unique character (land use, transportation, existing and long-range needs) of the County, data availability, the project type (rail corridor), the overall scope of the project, and experience with similar feasibility studies.

The evaluation measures used to compare the performance, benefits and costs for seven service scenarios are described below, organized by the goal and evaluation measure associated with each. The primary evaluation measures used for the evaluation framework include:

Benefits	1) Transit Operations and Performance
	2) Connectivity and Quality of Access
	3) Livability and Economic Vitality
	4) Sustainable Communities
Impacts/Costs	5) Neighborhood & Environmental Impacts
	6) Construction Impacts
	7) Capital and Operating Costs
	8) Funding Competiveness

Based on these general measures, specific evaluation measures were developed along with the definition of each evaluation measure, organized by goal, as described below. For each evaluation measure and specific criteria discussed above, each scenario was scored on a scale of low to high, on a comparative range with a score ranging from 1 to 3:

- Highest performance/most desirable outcome for criterion received a score of 3.
- Moderate performance/moderately desirable outcome received a score of 2.
- Lowest performance/least desirable outcome received a score of 1.

Goal 1: *Provide a convenient, competitive and accessible, travel option*

- **Transit Operations and Performance Evaluation Measures:**
  - ***Travel time Competitiveness with Automobile*:** This measure compares transit travel time to automobile travel times, by scenario. Auto travel times were sourced from AMBAG model 2035 Congested Travel Time Matrix, which is derived from AM time period (6:00 -9:00 AM), but used for both AM and PM Peak periods (one-way only). Transit travel times are from the Operations Analysis detailed in Section 5.2. One-way transit trip times were averaged. Each scenario was given a high, medium, or low score. A low score indicates a scenario is not competitive with auto travel. A medium score indicates a scenario is mostly competitive with car travel. A high score indicates travel by rail transit is almost equal to the same route by car.
  - ***Boardings (Ridership):*** Average between high and low estimates for 2035 daily boardings (Table 6-10). Scenarios are ranked on a spectrum of highest to lowest boardings estimated for that scenario (see Section 6.3 for more detail). A high score indicates higher ridership as compared to other scenarios. Medium is for ridership that is about at the median of all scenarios. Low is attributed to lower-end ridership, as compared to other scenarios.

- ***Disadvantaged Communities/Equity Analysis:*** Expressed as zero car households and low-income households within one-half mile of station, by scenario.[60] Fare levels assumed in the cost analysis do not vary between scenarios. A high score indicates a high percentage of zero-car and low-income households are located in station catchment areas and would be served. A low score represents the opposite – a low percentage of such households in the station catchment area.

- **Connectivity/Quality of Access Evaluation Measures:**
  - ***Household Connectivity:*** Expressed as households located within one-half mile of stations in each scenario.[61] A high score indicates connectivity to more densely populated areas. A low score indicates connectivity to less dense areas.
  - ***Bicycle and Pedestrian Connectivity:*** Non-motorized Access expressed as bicycle facility (Class I, II, or III) connecting to station and sidewalk connectivity within one-half mile surrounding station. A high score represents strong connectivity to existing bicycle facilities and complete sidewalks. A low score represents fewer connections to bicycle facilities and more sidewalk gaps surrounding station areas.
  - ***Transit Connectivity:*** Measured by number of local and regional transit routes near stations in each scenario.[62] Existing transit routes derived from METRO service maps.[63] Regional transit connectivity includes access to the Highway 17 Express Bus, as well as implementation of the Capital Corridor Extension to Salinas, with a stop in Pajaro, and the Amtrak Coast Daylight. A high score indicates connectivity to a higher volume of existing and future transit connections; a low score represents poor connectivity.

Goal 2: *Enhance communities, the environment, and support economic vitality*

- **Livability and Economic Vitality Evaluation Measures:**
  - ***Economic development:*** Expressed as a station's proximity to future land use developments and transit expansions. Land use focus areas associated with the Sustainable Santa Cruz County Plan and University of California at Sustainable Santa Cruz County Plan documents.[64] A high score indicates proximity to more economic development areas as compared to other

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[60] EPA Smart Locations Database (2010), http://www2.epa.gov/smart-growth/smart-location-mapping
[61] 2010 Census data from AMBAG model
[62] One-half mile is considered a reasonable walking distance to transit stations. Cervero, Robert. *The Half Mile Circle: Does It Best Represent Transit Station Catchments?* UC Berkley Center for Future Urban Transport, 2011. <http://www.its.berkeley.edu/publications/UCB/2011/VWP/UCB-ITS-VWP-2011-5.pdf>. While some additional bus and shuttle services exist (such as Greyhound, MST, Capitola beach shuttle, private employer shuttles, etc.), this evaluation does not include connectivity to those additional services.
[63] SC Metro website <https://www.scmtd.com/en/>
[64] Sustainable Santa Cruz County Plan documents available here: http://sustainablesantacruzcounty.org/documents/project-documents/

scenarios. Additional information on potential economic benefits included in the Section 1: Introduction.

- ***Job access:*** Expressed as total employees working at sites located within one-half mile of stations, by scenario. Data source is the AMBAG 2035 model. A high score indicates strong connectivity to job-rich areas; a low score indicates limited access to job-rich areas.

- **Potential Neighborhood & Environmental Impacts Evaluation Measures[65]:**
  - ***Traffic Impacts:*** Expressed as probability of traffic impacts on parallel roadways, at-grade crossings, stations, etc. as a factor of route length and weekday service hours, by scenario. For this measure, a high score indicates fewer at-grade crossings, thus fewer incidences of impacts. This variable does not assume a specific time factor that integrated gate downtime events at at-grade crossings, as gate downtimes can vary due to many factors. In general, shorter or less frequent routes encounter fewer at-grade crossings than longer routes due to the rail vehicle encountering fewer crossings overall. A traffic study done during preliminary engineering and environmental review and rail operations plan would provide more detailed information on estimated gate downtimes for each intersection. Sample gate downtimes from Caltrain can be found in Section 8.2.5.4.
  - ***Environmental Benefits:*** Expressed as mode shift factor[66] applied to daily auto trips (AMBAG station-to-station travel flows 2035 model output). The mode shift factor is determined using a methodology developed by the American Public Transportation Association (APTA). Mode shift factor is a measurement that captures various savings that result when a person who formerly drove in a private automobile shifts to transit. These savings can be characterized by VMT reductions, fuel savings, and greenhouse gas emissions savings, among other outputs. This evaluation measure seeks to capture the environmental benefits of shifts away from private automobile to rail transit, using the APTA methodology.
  - ***Noise and Vibration Impacts:*** Qualitative noise impacts based on route length, frequency of service, and type of equipment assumed for each scenario (see Section .5.0). A high score indicates fewer noise occurrences, medium indicates moderate, whereas low score indicates more noise occurrences. More detailed noise and vibration analysis would be part of later phases of study. See Section 9.4 for more detail on implementation and next steps.
  - ***Parking Constraints:*** A preliminary, qualitative evaluation of constrained land uses or usable space surrounding each station that could be potentially used to provide parking. A high score indicates low probability of parking constraint issues and a low score indicates a higher probability of parking constraint issues. This is *not* a measurement of parking demand at stations. This evaluation could be conducted during a later project development phase.

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[65] All environmental assessments are preliminary, qualitative, high-level and do not satisfy any CEQA/NEPA requirements that would possibly be studied in the future.

[66] Mode shift factor determined using APTA's Default by agency type option for Santa Cruz Metro (NTD, 2013), per the methodology outlined in *Recommended Practice for Quantifying Greenhouse Gas Emissions from Transit, APTA, 2009 (p.38)*.

- ***Construction Impacts:*** Qualitative construction impacts based on the route length and number of passing tracks. A high score represents minimal potential impacts/disruptions (such as construction noise and traffic impacts) to homes/local business. A low score indicates higher incidence of potential impacts/disruptions.

Goal 3: *Develop a rail system that is cost effective and financially feasible*

- **Capital and Operating costs Evaluation Measures:** [67]
    - ***Capital Cost****:* Expressed as capital cost estimates by scenario (including design, construction, construction management, right-of-way, vehicles, support facilities as described in Section 6.1). For this measure and O&M costs (below), a high score indicates lower cost, as this is the more desirable option due to cost-effectiveness. A low score indicates higher costs, as this is less desirable/cost-effective.
    - ***Operating and maintenance (O&M) costs****:* Expressed as O&M cost estimates (data sourced from results presented in Section 6.2).
- **Service efficiency and Cost effectiveness Evaluation Measures:**
    - ***Farebox Recovery Ratio****:* Farebox recovery ratio is defined as the proportion of operating expenses expected to be met by fares paid by passengers (see Section 6.4)./
    - ***Annualized Lifecycle Cost per Trip:*** Annualized capital cost and O&M cost compared to projected annual trips (annualized capital cost over useful life + annual O&M ÷ annual trips). For this measure, a high score indicates lower cost per trip as most desirable.
- **Funding Competiveness Evaluation Measures:**
    - ***Funding Potential:*** Captures ability to compete for local, state, federal funding sources (see Section 6.4). Funding availability (quantity, applicability, competitiveness) is largely independent of alignment. Capital cost under $100M and O&M cost under $10M are considerably more feasible and thus received medium to high scores. Capital costs exceeding $100M coupled with high O&M costs received a low score. Longer alignments may have more potential for Public-Private Partnerships (P3) and other innovative funding options.

In addition to the criteria used to distinguish between scenarios, travel time and speeds of rail transit vehicles, ridership, and cost per passenger are described in Section 6.3. Evaluation metrics which did not distinguish between alternatives such as: safety (avoiding model conflicts), ability to meet local, state, and federal goals, improved travel time reliability as compared to automobile and bus, connectivity with the Monterey Bay Sanctuary Scenic Trail Network (MBSST), and the ability to increase overall transportation

[67] Capital and O&M cost evaluation measures are based on cost only. Overall effectiveness compares cost to overall benefits, including cost per rider, cost per mile, cost per hour of transit service, and other factors.

network throughput were considered as part of the overall evaluation of rail service. Evaluation criteria considered but not included in this study due to redundancy with other criteria, data limitations, model capabilities, and/or inability to quantify within the study's scope/budget are listed in Appendix G.

7.2 EVALUATION RESULTS

Results of the evaluation of service scenarios are presented in Table 7-1. For each evaluation measure and the specific criteria discussed above, each scenario was scored on a scale of low to high, on a comparative range with a score ranging from 1 to 3. Each scenario also received sub-scores for each goal. These sub-scores were subsequently summed to produce a composite or total score, also shown in Table 7-1.

7.2.1 SCORES FOR SCENARIOS

Based on the results presented in **Table 7-1**, the service scenarios performed as follows from highest composite score to lowest composite score. Note that two scenarios tied for the second ranking.

1) E: Santa Cruz ←→ Aptos, Local

2) G: Santa Cruz ←→ Watsonville, Expanded Local

2) S: Santa Cruz/Bay St ←→ Seacliff, Limited Local Service

3) B: Santa Cruz ←→ Capitola, Limited

4) J: Santa Cruz ←→ Pajaro, Expanded Local

5) G1: Locomotive Powered (FRA-compliant) Santa Cruz ←→ Watsonville, Expanded Local

6) D: Santa Cruz ←→ Watsonville, Peak Express

Key results from the analysis are described below, by scenario. Notably, the scores in Table 7-1 are based on the limited set of measures for which data were available, with each measure given equal value. However, the community has indicated that some measures are more important than others, including several qualitative measures which are not considered in this section, this was taken into consideration in the parameters for future rail service section of this document (see Section 8.0).

TABLE 7-1: EVALUATION OF SERVICE SCENARIOS

Evaluation Measures	B: Santa Cruz / Capitola, Limited	D: Santa Cruz / Watsonville, Peak Express	E: Santa Cruz / Aptos, Local	G: Santa Cruz / Watsonville, Expanded Local	G1: Locomotive Powered Santa Cruz / Watsonville Expanded Local	S: Locomotive Limited Starter Service	J: Santa Cruz / Pajaro, Expanded Local
Travel time Competitiveness	3	2	3	1	1	1	1
Boardings (ridership)	2	1	3	3	3	1	1
Disadvantaged Communities/Equity	1	1	2	3	3	1	3
Household Connectivity	1	1	2	3	3	2	2
Bicycle/Pedestrian Connectivity	3	2	3	2	2	2	2
Transit Connectivity	1	1	2	3	3	1	3
Goal 1 sub-score	***11***	***8***	***15***	***15***	***15***	***8***	***12***
Economic Development	1	1	3	3	3	1	3
Job Access	1	1	2	3	3	3	3
Traffic Impacts	3	2	3	1	1	3	1
Environmental Benefits	1	1	3	3	3	1	2
Noise & Vibration	3	3	3	2	1	3	1
Parking Constraints	3	3	2	1	1	3	2
Minimize impacts to homes/local businesses	3	1	2	1	1	3	1

TABLE 7-1: EVALUATION OF SERVICE SCENARIOS

Evaluation Measures	B: Santa Cruz / Capitola, Limited	D: Santa Cruz / Watsonville, Peak Express	E: Santa Cruz / Aptos, Local	G: Santa Cruz / Watsonville, Expanded Local	G1: Locomotive Powered Santa Cruz / Watsonville Expanded Local	S: Locomotive Limited Starter Service	J: Santa Cruz / Pajaro, Expanded Local
Goal 2 sub-score	***15***	***12***	***18***	***14***	***13***	***17***	***13***
Capital cost	3	2	3	2	1	3	3
Operating and maintenance (O&M) costs	2	3	2	2	1	3	3
Farebox	1	1	3	2	2	1	1
Annualized Lifecycle Cost per Trip	2	1	3	2	2	3	2
Funding Potential	3	2	2	1	1	3	2
Goal 3 sub-score	**11**	**9**	**13**	**9**	**7**	**13**	**11**
COMPOSITE SCORE	**37**	**29**	**46**	**38**	**35**	**38**	**36**

Source: Fehr & Peers, Rail Pros, LTK, Bob Schaevitz, 2015
Notes: Total score does not necessarily equate to ranking for each scenario, as the total is based on this limited set of measures for which data were available and each measure was given equal value. However the community has indicated that some measures are more important than others, including several qualitative measures, which is taken into consideration in the “preferred alternative” section of this document.
Scoring scale: 3 = highest performance/most desirable outcome for criterion in question; 2 = moderate performance/moderately desirable outcome; 1= lowest performance/least desirable outcome.

7.2.1.1 E: Santa Cruz / Aptos, Local

Scenario E received the highest score among all scenarios. It scores highest for Goal 2, as it would bring the highest community, environmental, and economic benefits of all scenarios since it serves several stations in heavily populated sections of the county with relatively frequent service. The potential traffic and noise and vibration impacts would be minimal through use of light Diesel Multiple Unit (DMU) rail vehicles. The environmental benefits in terms of the potential to reduce Greenhouse Gas Emissions (GHG) are strong. Travel time is competitive with automobiles and it would attract significant ridership. Transit connectivity is fairly strong and non-motorized access is very strong. From a cost perspective, this is a cost effective scenario in terms of capital costs and annualized lifecycle costs. Operating and Maintenance (O&M) costs would be reasonable and the farebox recovery would be strong. Funding competitiveness is moderate (medium score) with better prospects for capital funding, with costs under $100 M and better prospects for O&M funding.

7.2.1.2 G: Santa Cruz ←→ Watsonville, Expanded Local

Scenario G scores highest for Goal 1 measures. It has strong transit operations and performance, in terms of being competitive with automobile travel times, attractive high ridership, and providing access to low-income and zero-car households. Scenario G also scores almost as well in Goal 2, with similar results to Scenario D. For noise impacts, Scenario G received a medium score because it operates with light DMUs, which are quieter than locomotives, but the route is fairly long (with a higher number of potential receptors affected along the route) and the service is relatively frequent (with more potential occurrences of impacts). However, because of the length of the route it would potentially cause traffic impacts and construction disruptions to more areas in comparison to other scenarios. This scenario scores poorest in Goal 3 – cost effectiveness and financial feasibility. Because capital costs and annual O&M costs are higher this scenario has greater challenges for funding competitiveness.

7.2.1.3 S: Santa Cruz (Bay St) / Seacliff (Cabrillo), Limited Local

Scenario S is similar to Scenario E, but serves fewer stations (five). Because of its limited geographic reach, limited stops, and fewer roundtrips per day, it did not score as high under some evaluation measures. This scenario scores very well for Goal 2. Like Scenario E, it would it would bring high community, environmental, and economic benefits, however this scenario may have higher noise and vibration impacts due to the use of a locomotive. Scenario S did not score high for Goal 1, primarily due to the limited number of stations served. It is not as competitive with automobile travel times as the other scenarios. Ridership estimates are lower for this scenario, as compared to others. Due to the limited station stops, it is also not as connected to as many bicycle and pedestrian routes as stations that stop at more stations along the corridor. From a cost perspective, this is the most cost effective scenario in terms of up front capital costs. Expanding this limited service to Watsonville could be very costly given federal requirements for positive train control.

7.2.1.4 B: Santa Cruz / Capitola, Limited

Scenario B has a short route length compared to other scenarios, with approximately 6.6 miles of track. This scenario is time competitive with automobile travel and would attract a moderate level of ridership. It has strong non-motorized access for bicycles and pedestrians. It scored best in terms of Goal 2, which includes measures that captures livability and commercial vitality, neighborhood and environmental impacts, and construction impacts. The noise and vibration effects and construction would not disrupt the community as much as other scenarios that span a longer distance. The potential for traffic impacts is also low. From a capital cost perspective, this scenario is affordable and scored well. The farebox recovery rate is low, however. Due to the low capital costs, this scenario has strong prospects for being competitive and good prospects for O&M funding (under $6M per year to operate).

7.2.1.5 Scenario J: Santa Cruz / Pajaro, Expanded Local

Scenario J ranks fourth. It scores best, with a composite score of 13, for Goal 2. It would offer good economic development prospects in terms of being in close proximity to proximity to future land use developments and transit expansions, including land use focus areas associated with the Sustainable Santa Cruz County Plan. Scenario J scores moderately in Goal 1. Travel times are not competitive with automobiles and boardings are low. However, it would have strong transit connectivity and reach a large proportion of low-income and zero car-households along the alignment.

7.2.1.6 Scenario G1: Locomotive Powered (FRA-compliant) Santa Cruz / Watsonville, Expanded Local

Scenario G1 scored similar to Scenario G for Goal 1, given that they share similarities in alignment and stations served. It scores moderately well for Goal 2 measures, as it would potentially cause more traffic impacts and construction disruptions in comparison to other scenarios due to its length, and may have higher noise and vibration impacts due to the use of a locomotive. This scenario scores low for funding and cost effectiveness due to its high capital and O&M costs.

7.2.1.7 Scenario D: Santa Cruz / Watsonville, Peak Express

Scenario D had the lowest score. Given it serves the fewest station areas, fewer roundtrips per day, and limited service hours it did not score as high under most evaluation measures for Goals 1 and 2. This scenario scores low for funding and cost effectiveness due to its low fare revenue compared to ridership.

7.3 PERFORMANCE COMPARISON

Table 7-2: Performance Comparison summarizes preliminary ridership, operations and maintenance (O&M) cost, and resulting productivity estimates for the seven Santa Cruz County Rail service scenarios considered as part of this feasibility study. For this analysis, the service scenarios were analyzed for opening year "Baseline" conditions. O&M costs include operating expenses (fuel, operator's salaries, maintenance, and other expenses), annual vehicle maintenance unit cost, and maintenance of way (non-vehicle track maintenance per route mile), administration, and contingency. The estimated cost per boarding ranges from approximately $5 to $14.[68]

TABLE 7-2: SCENARIO PERFORMANCE COMPARISON

Metric	Scenario B	Scenario D	Scenario E	Scenario G	Scenario G1	Scenario J	Scenario S
Annual O&M Cost	$7.0M	$3.8M	$7M	$9.9M	$14.0M	$3.7M	$5.4M
Weekday Ridership Low	2,800	1,100	4,700	5,000	5,000	1,750	1,400
Annual Ridership Low Estimate[1]	846,000	278,500	141,3000	1,509,000	1,509,000	528,000	420,000
Cost per boarding (Low Ridership)	**$8**	**$14**	**$5**	**$7**	**$9**	**$7**	**$13**
Weekday Ridership High	3,400	1,350	5,150	5,500	5,500	1,950	1,600
Annual Ridership High Estimate[1]	1,005,000	342,500	1,539,000	1,650,000	1,650,000	585,000	480,000
Cost per boarding (High Ridership)	**$7**	**$11**	**$5**	**$6**	**$8**	**$6**	**$11**

[1]Annual ridership is for baseline (2010) and is based on 250 weekdays x weekday ridership + 115 weekend days x 0.5 x weekday ridership. Weekend ridership is estimated at 50% of weekday based on SC Metro April 2013 ridership analysis showing Saturday as 55% of weekday ridership and Sunday as 45% of weekday ridership.

[68] Note that cost per boarding does not include fare revenue and is considered gross cost per boarding, not subsidy per boarding, which is consistent with the National Transit Database (NTD) cost per boarding data shown in the following section.

7.3.1.1 Comparable Systems

Table 7-3 presents performance and productivity data for comparable rail systems. Data were obtained from the 2012 National Transit Database (NTD). The estimated cost per boarding for the various Santa Cruz County Rail service scenarios are in line with comparable rail systems.

TABLE 7-3: PERFORMANCE COMPARISON

System	Annual O&M $	Annual Revenue Hours	Annual Fare Rev. $	Farebox Rec. %	Cost per VRH $	Cost per Boarding $	Annual Ridership
Rail Transit – DMU							
Tri-Met WES (Portland)	6.5M	7,500	$450K	7%	860	16	418K
Capital Metro (Austin)	11.4M	10,200	$2.3M	20%	1,115	22	530K
Denton County A-Train (Dallas)	9.8M	20,400	$565K	6%	480	25	387K
NCTD Sprinter (San Diego)	13.8M	30,300	$2.7M	20%	455	6	2.5M
NJ Transit River Line	31.2M	49,300	$2.4M	8%	635	11	2.8M
Railroad							
Altamont Commuter Express (ACE)	12.2M	20,200	$4.2M	34%	605	16	1.2M
Caltrain	98M	184,000	$55M	56%	530	8	13M
Music City Star (Nashville)	4.0M	6,800	$790K	20%	580	14	280K

Sources: Fehr & Peers, 2015; NTD and Operators.

Table 7-4 shows comparative ridership statistics for similar systems in the California, including Sprinter (NCTD) Oceanside to Escondido, Alameda Corridor Express (ACE), and Capital Corridor (Roseville to San Jose).

TABLE 7-4: RIDERSHIP COMPARISONS

Rail Line	Service Status	Annual Ridership (millions)	Route Length (miles)	Number of Stations	Number of Weekday Trains
Santa Cruz Rail Transit Study					
Scenario B – Westside Santa Cruz to Capitola	Currently being studied	0.85[1] (forecast)	6.6	6	60
Scenario E – Westside Santa Cruz to Aptos Village		1.4[1] (forecast)	9.5	9	60
Scenario G - Westside Santa Cruz to Watsonville		1.5[1] (forecast)	20.5	10	60
Comparable Systems					
Sprinter (NCTD) Oceanside to Escondido	Started 2008	2.5[2]	22	15	68
Altamont Corridor Express (ACE) (Stockton to San Jose)	Started 1998	1.2[3]	85	10	8
Capitol Corridor (Roseville to San Jose)	Started 1991	1.75[4]	170	17	30/17
Sonoma-Marin Area Rail Transit (SMART) (Santa Rosa to San Rafael)	Service projected to start late 2016	1.3[5] (forecast)	43 (Phase 1)	10 (Phase 1)	30

Notes:
1-Fehr&Peers, Annual Boardings - Low Estimate (Base Year)
2-Sprinter Source: http://www.gonctd.com/sprinter
3-ACE Source: https://www.acerail.com/
4-Capitol Corridor Source: http://www.capitolcorridor.org/about_ccjpa/business_plan.php. Current daily weekday rail vehicles for Capitol Corridor – 30 from Sacramento to Oakland, 17 from Sacramento to San Jose
5-SMART Source: http://main.sonomamarintrain.org/

7.4 OTHER EVALUATION CRITERIA

This section reflects some of the additional issues and criteria that were not evaluated as part of this study, but often are considered during subsequent implementation stages for rail projects. These factors may be considered as part of the RTC's Unified Corridor Plan, environmental review of rail transit, or in specific grant programs.

Federal and State Funding Programs

Federal and state funding priorities and criteria for grant programs are constantly changing. The two most significant programs that may apply to this rail project are the FTA Small Starts Program and California's Cap and Trade Program. The FTA Small Starts Program is for projects with a total capital cost of $250 million or less and a grant request of $75 million or less. The evaluation criteria for Small Starts Program funding include Mobility (ridership), Economic Development (transit supportive plans and policies), Environmental Benefits (reduction in vehicle miles traveled), Cost Effectiveness (cost per rider), Land Use, and Congestion Relief.

California's Cap-and-trade program is a market based regulation that is designed to reduce greenhouse gases (GHGs) from multiple sources. Revenues are used for a number of GHG reduction programs including transportation programs such as the Transit and Intercity Rail Capital Program (CalSTA), the Low Carbon Transit operations Program (Caltrans to local agencies), Affordable Housing and Sustainable Communities (SGC and member agencies), and Low Carbon Transportation (ARB). The Transit and Intercity Rail Capital program is a competitive grant program for rail and bus transit operators to integrate state and local rail and other transit systems, and those that provide connectivity to the high-speed rail system.

Environmental Consideration

Community members have requested additional information about potential benefits and negative impacts of rail transit, including emissions, visual, noise, and other environmental considerations. While some of these items were preliminarily analyzed and presented in Section 7, detailed analysis would occur through environmental review of rail transit. Additional information on Draft Environmental Studies and Conceptual Engineering is provided in Section 9.3 of this study.

Economic Analysis

A more expansive economic analysis of potential rail line uses has been suggested by several individuals and organizations and could be considered in the future. For instance the Coastal Commission recommends that the economic analysis be augmented to consider the additional public access benefit (and revenue) that would result from recreational (tourist) use of rail along the coast. Such an effort should evaluate the added value and revenue generation for the county overall, not just the net cost of the rail operation itself. These criteria could include potential for support of the County's tourist economy, by attracting riders to highly scenic ocean views and/or the opportunity to ride in historic or otherwise interesting rolling stock; potential for improving conjunctive use with the MBSST by facilitating and extending access for bicyclists, walkers and wheelchairs; and potential for distributing recreational access to those beaches best able to accommodate it, so as to mitigate parking and roadway congestion issues and to protect resources and neighborhoods from overuse in any one area. Other economic analyses might include the reduced wear and tear on local roads and reduced auto-oriented infrastructure.

Property Values

Members of the community also expressed concerns about the impact that rail could have on property values. There have been many studies, both professional and academic, on the subject of rail transit's impacts upon property values close to the system.[69] Research suggests that in some instances rail transit could increase property values in Census tracts that contain rail transit stations. Examples include Portland, Oregon (10.6% higher compared to similar properties more than 500 meters from rail), Dade County Florida (5%), Philadelphia (7.8%), and Southern New Jersey (10%).

However, little literature exists on the property value correlations of properties that are immediately next to or otherwise near the tracks, but not near a transit station. Some examples suggest an interaction of a lower valuation due to externalities such as noise or vibration that is counteracted by a higher valuation due to living in a community with high quality transit options, resulting in a much more modest increase in property values than those with walkable access to transit stations (Portland, OR).

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[69] Smith and Gihring, *Financing Transit Systems Through Value Capture: An Annotated Bibliography*, 2015.
K. O'Sullivan, University at Albany-SUNY. *Land Value Capture for Mass Transit Finance: Strengthening the Land Use – Transportation Connection*, 2014.
Al-Mosaind, Musaad, *Light-Rail Transit Stations and Property Values: A Hedonic Price Approach*
Parsons Brinckerhoff, *The Effect of Rail Transit on Property Values: A Summary of Studies*. 2001
Robert Cervero, *Transit-Based Housing in the San Francisco Bay Area: Market Profiles and Rent Premiums*, Transportation Quarterly, 1996.

8.0 PARAMATERS FOR RAIL TRANSIT SERVICE

This study provides a capital, operations, ridership, and funding assessment of seven sample rail transit service scenarios for Santa Cruz County – based on the initial set of service concepts presented to and vetted by the RTC, technical and community stakeholders and the public at large. The preceding Section presented an "alternatives evaluation" using qualitative and quantitative metrics in order to differentiate the degree to which each of those service scenarios meet the goals and objectives listed in Section 3. Ultimately, a hybrid service scenario or phased implementation of a combination of scenarios could be implemented and meet the project's goals and objectives while providing options between higher and lower capital outlay investments. This section suggests parameters for future rail transit service based on the technical evaluation presented in this study and community input.

8.1 KEY DECISION FACTORS

All rail transit service options analyzed in this study are feasible from a constructability and operational standpoint. Rail transit service would improve accessibility and mobility along the rail corridor. However, available funding, ability to achieve community goals, customer needs, and scalability are key factors to be considered by RTC when making a determination of which type of service to pursue for implementation. This section addresses those key considerations, recommends parameters for rail transit service based on the analysis and community input, and discusses scalable/phased service options. Section 9 outlines implementation considerations, timeline (schedule), and provides a summary of recommended next steps for implementation of Santa Cruz County rail transit service.

Funding

Funding is the most significant factor for RTC in determining which, if any scenario is viable. Since local, state and federal funding for transit service is limited, scenarios with lower capital costs and operating expenses would be easier to implement. Given the assumption that transit funds currently used by METRO for bus service would not be redirected to rail transit, funding to construct and operate local rail transit service would need to include dedicated funding from a new sales tax and at least one of the following sources: California Cap and Trade, FTA §5309 Fixed Guideway Small Starts Grant Program[70] or U.S. Department of Transportation TIGER Grant Program. Private-public partnerships and cost sharing could also be an option for some capital and ongoing operating expenses.

[70] The Small Starts Program has a maximum grant size of $75 million. Rail transit on the Santa Cruz Branch Rail Line may not qualify for a regular "New Starts" grant in excess of that amount.

Community Goals

Community goals, such as environmental benefits/impacts, noise and vibration impacts, economic benefits, the ability to conveniently accommodate disabled persons, as well as tradeoffs and priorities among different goals would also be considered in selecting a preferred service scenario.

Customer Needs

How transit customers would perceive and utilize the system should also be considered when deciding what option to pursue for implementation. Characteristics of some service options will be more attractive to customers and result in higher ridership, but typically come with higher capital and operating expenditures. A preferred service option will consider how important different characteristics and parameters are to customers. These may include station locations, vehicle types, travel speeds, smoothness of ride, and level boarding.

Scalability

While some capital investments would be needed for the introduction of any rail service, some infrastructure components could be phased in. This includes the number of vehicles and number of stations, station design, and some bridge improvements. The drawback to a phased implementation approach for infrastructure would be a lack of economies of scale, additional administrative and management costs, and the work would have to be done on an operating rail line. Scaling operations, such as service span, headways, and days of operation, would have less impact to a rail line currently in operation and would cost less in terms of initial O&M costs with a lower service level; however that would also affect the attractiveness of the service and result in lower ridership to start. Regardless of which approach (higher or lower investment) is pursued, a minimum operable segment (MOS) should be clearly defined during draft environmental studies and conceptual engineering.

Long Term Considerations

Due to physical characteristics of Santa Cruz County (mountains and ocean), as well as community desires to preserve open space, it is anticipated that any future growth in Santa Cruz County will continue to be focused between Santa Cruz and Watsonville. Rail transit investments tend to focus future growth in areas immediately adjacent to the rail line and, properly planned, can reduce sprawl pressures.

8.2 SUGGESTED PARAMETERS

Taking into consideration key decision factors and community input provided on this study, the following describes a possible approach to implementing rail transit service between Santa Cruz and Watsonville. This reflects a hybrid of service scenarios D, E, and G evaluated for this study.

8.2.1 Service Area

Scenario G is the full service option described in the study, with 10 stations and rail vehicles every 30 minutes, from Westside Santa Cruz to Watsonville. While providing the most convenient, competitive and accessible travel option, resulting in the highest ridership, the $133 million capital cost and $9.9 million annual operating cost of this scenario could make it challenging to implement. The following describes an approach to delivering the project in phases.

8.2.1.1 Initial Service

Options for initiating lower cost transit service could involve construction of fewer infrastructure improvements and reduced service hours and train frequency. Initial capital elements could include the following:

- Rail upgrades and sidings from Santa Cruz to Watsonville that would allow for up to 30 minute service frequency
- Five stations: Downtown Santa Cruz (Depot Park), 17th Avenue, Capitola Village, Cabrillo (Seacliff Village), and Watsonville
- Four vehicles: three in service, and one in reserve/maintenance

Operations:

- Peak Hours: 30 minute headways during weekday peak periods (such as 7:00 to 9:00 a.m. and 4:00 to 7:00 p.m.) for the segment between Santa Cruz and Watsonville stations.
- Midday and evenings: Service would only be provided through the urban core stations between the Santa Cruz and Seacliff, and be less frequent than 30 minutes. Less frequent midday and evening service could be provided to Watsonville as ridership warrants.
- Weekends: None or hourly summer service between Santa Cruz Depot and Capitola Village.

It is anticipated that the annual operating and maintenance cost for the above service levels would be in the $5-8 million range, based on bracketing the above service option between those evaluated for Scenarios D, E and G.

The exact locations of sidings, where a second track is provided to allow rail vehicles traveling in opposite directions to pass, would be determined as final decisions on the frequency of service, station locations, speed of rail vehicles, and other service characteristics are determined. Based on the analysis conducted in this study, the initial service associated with Scenario D requires two sidings, one at 17th Avenue and one just north of Watsonville. Providing expanded service levels may require construction of a third siding, as described in Scenario G.

8.2.1.2 Subsequent Phases: Add Service and Infill Stations

RTC and its agency partners could add infill stations as funding for stations and vehicle procurement becomes available. They may include, but not be limited to the West Side Santa Cruz, Bay/California, the Boardwalk, Seabright, 17th Avenue, Capitola Village, and Aptos Village stations. Infill station infrastructure costs can range from $300,000 to $500,000 or more per station, plus ROW acquisition costs. To provide service to these added stations, an additional rail vehicle would also need to be acquired.

The annual operating & maintenance cost, if all infill stations were constructed and full day service (6:00 a.m. to 9:00 p.m.) was provided at 30 minute headways to Watsonville, would be about $9.9 million (Scenario G).

While the phased approach does allow for the funding to be secured in an incremental fashion (such as moving from Scenarios D to G, as described above), it should be noted that the overall capital cost will likely be higher than proceeding with full implementation of Scenario G. This is due to the potential need for a third siding with a phased approach (only 2 are needed if proceeding directly with the full service Scenario G) and the fact that individual station, siding, and vehicle costs are likely to be higher if done separately than as part of a larger package.

8.2.1.3 Extension from Watsonville to Pajaro

Providing future service to Pajaro to connect to trains headed to the Bay Area and others parts of California (Scenario J) six times per day could require the acquisition of another rail vehicle in order to maintain 30 minute service between Santa Cruz and Watsonville. An additional crew may be needed, given the turnaround required, which would add to the annual operating and maintenance cost described above.

8.2.2 SERVICE CHARACTERISTICS

The highest ridership levels occur on the segment between the Westside Santa Cruz and Aptos Village stations. Ultimate service on this segment of the corridor should be provided during full service hours on weekdays (such as 6:00 a.m. to 9:00 pm), with rail vehicles operating at 30 minute headways. Phasing of service on this segment could include 60 minute headways during the midday and evening hours.

Ridership levels on the segment from the Aptos Village to Watsonville stations are predicted to be lower given the lower densities on the approximately 11-mile segment. Initial service to Watsonville could include 30 minute headways during the peak periods and limited service during mid-day and evening hours. As ridership demand warrants, more frequent service would be provided during full service hours on weekdays.

8.2.3 STATIONS

8.2.3.1 High Ridership Stations

The stations with higher levels of forecast ridership are the Bay Street/California (where UCSC employees and students are forecast to transfer to a shuttle bus or bicycle to campus), Downtown Santa Cruz, 41st Avenue, Capitola Village, and New Brighton or Seacliff Village (where Cabrillo College employees and students would access the rail line). Moderate ridership levels are projected at the Westside Santa Cruz, Seabright, 17th Avenue, Aptos Village, and Downtown Watsonville stations.

Community members have asked what would increase ridership at planned stations. The most significant factors that would result in higher ridership levels are compact transit-oriented destinations (employment, shopping, etc) and walkable neighborhoods (residential) within one-half mile of stations, good modal access (such as pedestrian, bicycle, shuttle bus, and drop-off infrastructure and/or service enhancements), adequate park-and-ride facilities on a system-wide level and high quality of rail service (such as longer hours and/or more frequent service). Rideshare incentive programs and individual decisions to use transit could also result in increased ridership numbers.

8.2.3.2 Station Location and Design

The development of station concept plans is a key element of the preliminary engineering and environmental assessment process that occurs after a feasibility study is completed. Planning and design of stations and park-and-ride facilities is a multi-step process that involves extensive community engagement. The first step involves assessing needs, identifying potential sites, evaluating those sites, and selecting a preferred site. The second step is the conceptual design stage where details are determined, such as internal circulation, bus interface, parking layout (if included) and access by all modes. The final step involves preparing detailed design plans where ADA provisions, safety and security considerations, and amenities (such as restrooms, wifi, benches, concessions or retail) are addressed.

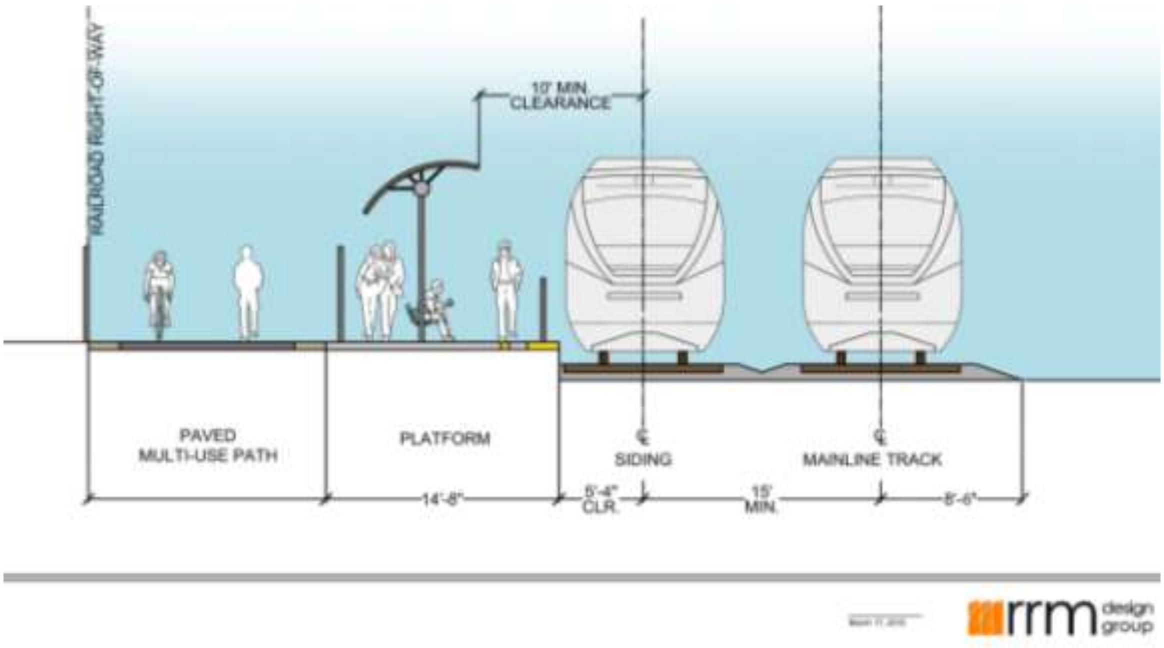
Park-and-ride facilities are important elements of most rail transit operations, particularly for stations oriented primarily to serve residential users. Parking can vary substantially at rail stations, ranging from no dedicated parking at some stations to park-and-ride facilities at some terminus stations. Park-and-ride lots can be shared or exclusive facilities designed, constructed, and operated as part of the overall rail system. Parking fees could be collected at rail transit park-and-ride facilities. The ridership analysis did not make assumptions about mode of access, including parking. An analysis of park-and-ride locations, sizes, and any parking fees would be done at a later phase in coordination with cities and the County of Santa Cruz (see Section 9.4.4).

The factors that are typically considered when selecting park-and-ride facilities include: land use compatibility, availability, accessibility, visibility, physical feasibility, environmental compatibility, and development costs. The size of a park-and-ride facility depends on factors such as: estimated parking demand, bus service frequencies, street system capacity, availability of reasonably priced land, and environmental constraints. Estimated parking demand is a function of the station type (for example, terminus stations typically draw from a larger catchment area than other stations along the line), the overall service population (combination of population and employment in an area), density of uses adjacent to the station, proximity of special generators, and walkability.

At stations where little or no parking is provided, and there are concerns about the potential for overflow parking in residential, commercial, or employment districts, parking management strategies such as short-term parking limits and parking permits are applied. Any station design and parking policies should include consultation and coordination with local jurisdictions.

Station design would also consider integration with the Monterey Bay Sanctuary Scenic Trail Network (MBSST) Rail Trail. There are several examples of where bicycle/pedestrian trails, similar to the planned MBSST provide access to rail stations. For conceptual purposes, Figure 8-1 provides an example of one possible layout for an area with a separated trail (width could vary), station, and a passing siding. Most sections of the rail line would not require double tracking, and actual station, track and trail layout would vary based on location.

Figure 8-1: Sample Double Tracked Station Cross Section



Source: RRM (2015). Provided for conceptual purposes only.
Actual layout would be developed during the design phase of project implementation.

8.2.3.3 Station Access

The development of station access plans is a key element of the preliminary engineering and environmental assessment process that occurs after a feasibility study is completed. Provisions for all access modes including bus, bicycle, walking, park-and-ride, kiss-and-ride (drop-off by car or taxi), carpools (such as those established through Cruz511.org), other ride services (for example companies like Lyft or Uber), as well as carshare and bikeshare should be considered and included where appropriate and feasible.

Station provisions for modes where a driver drops off passengers include either curbside loading areas on adjacent streets or similar loading areas in off-street lots where provided. Bus access provisions include on-street or off-street bus stops with platforms, shelters, lightings, and other amenities. Bicycle access provisions include the addition of off-street paths and on-street lanes that provide connections to the station as well as bike parking at or near the station platform. Most rail transit systems also have provisions for bikes within the rail vehicles (see Section 2.2). Pedestrian facilities should be provided that connect the station platform to adjacent sidewalks, bus stops, and loading areas.

Rail providers also may adopt station access policies. For example, Caltrain's access guiding principles are as follows[71]:

- Increase access capacity to support ridership growth
- Prioritize sustainable access
- More effectively manage land and capital assets
- Prioritize cost-effective access modes
- Enhance customer satisfaction
- Solidify partnerships to implement improvements

Founded on the guiding principles, Caltrain's system-wide access mode of transportation priority is (in order of priority) walk, transit, bike, and automobile. As discussed in Section 9, coordination with Santa Cruz METRO buses will be a critical component of any implementation plan.

8.2.4 VEHICLE TECHNOLOGY

The "Light" DMU technology described in Section 2 of this study is currently the most readily available for providing frequent rail transit service in Santa Cruz County.

Community members expressed a desire for smaller, lighter rail vehicles that generate low or zero emissions. This study assesses Light DMU vehicles as the primary vehicle technology for a number of reasons; the most significant is that it is currently the most cost-effective system to serve a longer 20+ mile corridor with low to moderate population densities. The majority of passenger locomotives or self-propelled diesel multiple unit vehicles that are used for rail lines are powered by diesel fuel. New diesel rail transit vehicles being produced by manufacturers have reduced emissions.

The Sonoma-Marin Area Rail Transit (SMART) commuter rail vehicles, scheduled to begin service in late 2016, will use Heavy DMUs. Southern California's Metrolink will accomplish lower emissions through the use of the latest diesel fuels and technology. The United States and California are actively mandating a transformation in diesel emissions. New rules now require the use of ultra-low sulfur diesel (ULSD) fuel, which contains 15 parts sulfur per million, a huge reduction from the 500 parts per million previously allowed. Ultra-low sulfur diesel makes it possible to add advanced emission control technology to diesel engines, a technology that doesn't work with high-sulfur diesel. Rules requiring new DMUs to use these advanced emission control systems took effect in 2011. SMART is meeting these requirements by using

[71] *Caltrain Comprehensive Access Program Policy Statement*. Peninsula Corridor Joint Powers Board, 2010. Available at: http://www.caltrain.com/Assets/_Public+Affairs/pdf/Comprehensive+Access+Policy.pdf

high-efficiency catalytic after treatments, such as catalyzed diesel particle filters, selective catalytic reduction systems, and NOx absorbers.

In 2009, lower emission locomotives were introduced on the Capitol Corridor intercity rail line that connects the Bay Area and Sacramento. The upgraded engine technology allowed the locomotives to advance from Tier 0 to Tier 2 EPA emission standards, resulting in a 50 percent reduction in operating emissions.

Metrolink, the commuter rail authority that serves about 41,000 daily riders from six Southern California counties, is spending about $200 million to replace all of its diesel-hauled locomotives with some of the most sophisticated low-emission engines available. They will become the first passenger line in the nation to operate the state-of-the-art engines. The Tier 4 locomotives are expected to reduce particulate matter and nitrogen oxide emissions by more than 85% compared to their current Tier 0 locomotive engines. Metrolink is set to take delivery of its first locomotive in December and the rest next year.

New technologies are currently being developed that may be available for future use in this corridor. As an example, Metrolink is working with the South Coast Air Quality Management District to explore development of a liquefied natural gas (LNG) locomotive and some manufacturers are starting to develop hybrid vehicles.

The vehicle procurement process, particularly if it involves purchasing new vehicles, typically starts three to five years before construction of a line is complete and is ready to be operational. The first step in the process is to develop a rail vehicle technology report that assesses current vehicle options, identifies procurement options, and provides a recommended vehicle type, vehicle parameters, procurement approach and schedule. This process allows for consideration of vehicles that meet community goals for service operations and other factors such as emission characteristics. Determination of a vehicle type is made as part of the preferred alternative selection in the environmental analysis phase of project development.

While rail transit lines can be electrified the costs can be prohibitive, especially for smaller systems. The cost for constructing electric light rail and modern streetcar lines ranges from $50 to 100 million per mile and up. Given traditional funding sources, neither of these technologies is cost-effective for the Santa Cruz line at this time.

8.2.4.1 Vehicle Layout

Given the high level of community interest, opportunities to enhance access to and from stations, and the active cycling environment in Santa Cruz County, specifications for rail transit vehicles should include accommodations for transporting bicycles. Railcars would also include designated areas for people in mobility devices and with limited mobility. Vehicles could also include space for large baggage, such as surfboards, and onboard restrooms. The specifics of vehicle layout would be decided at future stages and vehicle design and floor plan could undergo public review prior to vehicle procurement/purchase.

8.2.5 GRADE CROSSING TECHNOLOGY

This section describes grade crossing technologies commonly used by rail transit systems in the US.

8.2.5.1 Active Warning Devices

The intersection of railroad tracks and public streets without physical separation (known as a "grade" crossing) can pose a risk of a collision between rail vehicles using the tracks and cars or pedestrians using the street. The Federal Railroad Administration (FRA) and California Public Utilities Commission (CPUC) regulate the safety of these crossings to ensure that conflicts do not occur, including crossing design, signage, and active warning devices, such as rail vehicle horns and electronic bells.

Current standards for active warning devices include the following:

- **Electronic Bells:** The American Railway Engineering and Maintenance-of-Way Association (AREMA) Standards requires that electronic bells on rail vehicles be utilized at intersections at levels between 61 and 91 decibels, as heard from 50 feet away.
- **Horns:** For FRA-regulated service, the FRA "Final Rule" (49 CFR Part 222) requires all rail vehicles to sound their horns at a grade crossing. The current practice is for horns to sound at least 15 seconds in advance of all public grade crossings, but no more than 20 seconds or one-fourth of a mile before the rail vehicle reaches the crossing, at a minimum of 96 decibels and a maximum of 110 decibels when measures at 100 feet in front of the locomotive or rail engine car.
- **Wayside horns:** An alternative treatment, also present an opportunity to reduce noise associated with grade crossings. Wayside horns are located at the grade crossing itself and are directed toward the street, reducing noise at locations beyond the crossing.

In order to reduce noise associated with grade crossings, the FRA "Final Rule" provides a mechanism for local jurisdictions to create "Quiet Zones" based on specific risk-reduction criteria. Where Quiet Zones are implemented, rail vehicles are exempt from the requirement to sound their horn at grade crossings, but are not exempt from sounding electronic bells.

8.2.5.2 Quiet Zones

A Quiet Zone is a portion of track where rail vehicles do not routinely sound their horns at grade crossings. Electronic bells, which are not as loud as horns, are still required to sound. Operators may still sound their horns in the event of an emergency or safety risk.

In order to develop a quiet zone, the absence of a horn is usually counterbalanced with safety improvements to reduce risk of collision. Standard crossing gates include two gates designed to limit the mixed-flow traffic lanes at either side of the tracks. In rare cases, drivers, bicyclists, or pedestrians may travel around the lowered gates, posing a safety risk. To deter these activities, Quiet Zone Supplemental Safety Measures (SSMs) may include:

- Four-Quadrant Gates: A pair of additional gates can be installed in the opposite lane on both sides of the tracks, limiting the ability of drivers to travel around the gates.
- Curb Medians or Channelization Devices: Medians, in the form of curbs or channelization devices, may be installed to prevent drivers from traveling around the gates. Medians must be installed at least 60 feet from the crossing.

The FRA also establishes Alternative Safety Measures (ASMs) for use instead of Supplemental Safety Measures (SSM) under special circumstances in which the above treatments are not feasible. ASMs are subject to approval by the FRA. For both SSMs and ASMs, pedestrian crossing improvements are required, which may include additional warning signs, barriers, or gates.

Four-Quadrant Gates. Source: SMART

Channelization Device. Source: SMART

Pedestrian Gates. Source: OCTA

Curb Medians. Source: SMART

The minimum length for Quiet Zones is one-half mile; there is no maximum length. Quiet Zones can include one or multiple crossings, and may be active for 24-hour periods, or can be limited to shorter periods of time such as overnight. Quiet zones are generally implemented over broad areas to reduce complexity.

While improvements needed for Quiet Zones could be installed at railroad crossings, the rail agency cannot actually designate them. Only local public agencies with control over streets and roads (such as cities or the County of Santa Cruz) may establish Quiet Zones. For example, the SMART system in Sonoma/Marin is currently being constructed to be "Quiet Zone Ready" with the required rail components, and the local jurisdictions along the way will complete the Quiet Zone components based on their community's priorities. Cities and the county would need to adhere to the following administrative steps required to implement quiet zones.

The steps to implement Quiet Zones are as follows:

1. Diagnostic review of crossings
2. Notice of Intent to CPUC/FRA
3. Implementation of SSMs or ASMs
4. Notice of Establishment to CPUC/FRA

The CPUC requires that a diagnostic review be conducted for every crossing within a potential Quiet Zone to determine necessary safety improvements. A diagnostic review is intended to assist the local agency in devising appropriate Quiet Zone treatments, and may include engineers, the CPUC, RTC, Iowa Pacific Railroad, Caltrans, and the FRA.

The application begins when a jurisdiction files a Notice of Intent to establish a Quiet Zone with the CPUC, along with RTC and Iowa Pacific Railroad. The Notice would describe the length of the Quiet Zone, which crossings will be included, and proposed SSMs or ASMs.

Once the CPUC (in coordination with the FRA) approves the proposed Quiet Zone, the local applicant may install the improvement measures. After installation, the applicant may issue a Notice of Establishment, which codifies the Quiet Zone's operations. The Quiet Zone may commence operation 21 days after the Notice of Establishment.

8.2.5.3 Wayside Horns

As noted above, wayside horns are another tool available to reduce the noise associated with rail horns. Wayside horns are positioned at crossings directed toward drivers, pedestrians, and bicyclists. Wayside horns are subject to the same volume standards as horns (96-110 decibels); however, the noise footprint is reduced because the sound is directed toward the roadway.

Wayside Horn. Source: City of Fort Collins

Wayside horns may substitute for train horns upon approval by the FRA. The use of wayside horns is not the same as establishing a quiet zone, although they may be used within quiet zones.

8.2.5.4 At-Grade Crossings and Gate Downtimes

Gate downtime events occur at at-grade intersections where the rail ROW must cross mixed-traffic. For safety and traffic operations reasons, gates are placed on both sides of the track at all at-grade crossing locations. When a rail vehicle is crossing at a location, the gates are down. A gate down time event occurs when these gates come down at a crossing due to a rail vehicle either passing or crossing. The gates are in place to help ensure all modes can cross safety at the crossing and avoid collisions between mixed-flow automobiles, bicyclists, and pedestrians and rail vehicles.

Gate downtime events at at-grade crossings can vary due to many factors, particularly those factors related to the speed of the rail vehicle (such as adjacent track alignment/geometry and station configurations/location). In general, shorter routes encounter fewer at-grade crossings than longer routes due to the rail vehicle encountering fewer crossings overall. Caltrain is a system that currently uses diesel locomotives pulling heavy rail cars and operates on a ROW that consists of at-grade and grade separated intersections between Gilroy and San Francisco. Typical gate downtimes for Caltrain at at-grade crossings are as follows[72]:

- Gate downtimes vary from about 40 seconds to about 85 seconds in the AM peak hour
- Gate downtimes vary from about 35 seconds to about 95 seconds in the PM peak hour

[72] Peninsula Corridor Electrification Project Final EIR, Appendix D, Peninsula Corridor Joint Powers Board, 2015. http://www.caltrain.com/Assets/Caltrain+Modernization+Program/FEIR/App+D+Part+2

9.0 IMPLEMENTATION STEPS

This study provides a preliminary analysis of rail transit service along the Santa Cruz Branch Rail Line, based on goals and objectives identified by the community in the summer of 2014. This section presents the conceptual implementation considerations, timeline (schedule), and a summary of steps involved in implementing rail transit service. In addition to the general implementation strategy outlined below, the Regional Transportation Commission (RTC) should continue to collaborate with the Santa Cruz Metropolitan Transit District, stakeholders, and the community at large to further define rail service.

SMART Platform Rendering (Conceptual)

Prior to deciding the exact type of rail transit service to implement, if any, more detailed answers are needed to several implementation questions. These implementation considerations include: regulatory requirements, freight integration, governance structure for operations, project development activities, and potential funding strategies. The implementation timeline provides generalized timeframes for implementation activities. At this stage, the feasibility level, the study does not delve into durations for all detailed activities that would need to occur – rather umbrella activities have been represented with indicative timeframes. For instance, a broad "construction" activity stage represents all construction-related activities that could include preliminary site surveys, track reconstruction, station construction (including platforms, ticketing machines, bike and vehicle parking), as well as testing and commissioning.[73] Finally, additional project development steps that are more focused in nature are described; including ensuring regulatory requirements are met, bus/rail coordination, preparing ridership forecasts that meet FTA requirements, and where funding efforts should be focused.

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[73] Testing and commissioning is the process by which equipment and facilities (which are complete or near completion) are tested to verify if it functions according to its design objectives or specifications.

9.1 REGULATORY SETTING

Based on the operating assumptions of frequent headways there are two possible regulatory proposals for operating both non-Federal Railroad Administration (FRA) compliant rail vehicles and FRA compliant Railroad equipment and freight on the Santa Cruz Branch Rail Line, both with precedents in California.

The suggested approach is to operate exclusive passenger service during peak travel times as a "transit system," while freight operations would not be conducted in the same sections of the rail line or would be conducted outside of passenger service hours (at night, early morning or in mid-day time windows if only peak hour service is implemented), in order to avoid intermixing passenger and freight operations. This is known as temporal separation. Under this arrangement, the passenger operation would not be subject to many of the regulations the FRA has developed to govern railroad operations and maintenance. Such operations have historically employed passenger equipment that is not suitable for operation on other railroad networks (and the equipment may not need to meet FRA criteria). Such an operation would likely be considered a "transit system," subject to the regulations of the California Public Utilities Commission (CPUC). It is important to note that the FRA has the authority to regulate all rail systems but has specifically chosen not to regulate transit systems. While the passenger operation would be subject to the CPUC, freight operations would continue to be subject to regulation by the FRA. An example of a system operating under such a regulatory regime is the Sprinter system, operating between Oceanside and Escondido in Southern California.

WES at Beaverton Station in Oregon

The other regulatory option would involve an operation fully under the jurisdiction of the FRA that would allow freight and passenger vehicles to "comingle", operating on the rail line at the same time. This would require equipment that is subject to all FRA regulations and would also require compliance with other FRA requirements. Examples of these requirements include level boarding at passenger stations, operations and rules compliance. Another particularly important regulatory requirement for operating FRA-compliant vehicles is Positive Train Control; this is discussed further in the Section 9.1.1 below. The FRA's requirements (except the level boarding requirement described later) can be found in 49 CFR Parts 200-299.

The choice of type of system and the possible regulatory approaches may also influence the type of environmental documentation. For example, if the passenger operation were initiated without federal funds and outside the FRA's regulatory regime, and thus outside the rubric of interstate commerce, then it may be unable to avail itself of federal NEPA requirements. In this scenario it may only be subject to the California Environmental Quality Act (CEQA).

9.1.1 INTEGRATION/COORDINATION WITH FREIGHT AND OTHER SERVICES

Tigard gauntlet tracks

As discussed in Section 5.1, no specific vehicle or manufacturer is being recommended for this feasibility study, but for the purposes of simulating five of these scenarios, the Stadler GTW (articulated DMU railcar) was chosen as an example vehicle to test operating parameters of the Santa Cruz line. Appendix C includes a general technical description of these light DMUs. These rail transit vehicles cannot be on the tracks at the same time as freight and/or passenger rolling stock (such as locomotive with trailer cars or heavy DMUs) compliant with national regulations enforced by the Federal Railroad Administration (FRA). Two of the scenarios analyzed evaluate the capital and operation costs of using vehicles that can be comingled with freight and/or heavy passenger rail vehicles and modifications to operations that could be required. Specifically Scenario G1 analyzes use of a locomotive and two passenger cars, as compared to Scenario G light DMU.

If freight service or heavy passenger rail vehicles (such as those used on Big Trees Railway by Roaring Camp) are operated during the same time period as rail transit service, or is "comingled" with the rail transit service, or if the rail transit service is operated with FRA-compliant railroad technology (as distinguished from rail transit technology), then the corridor would come under federal railroad regulations and require the installation of more advanced signaling and Positive Train Control[74]

[74] PTC is a safety system designed to monitor train movement and prevent train collisions and over speeds, especially in areas with temporary speed restrictions or where rail workers are present. Under the US Rail Safety Improvement Act (RSIA), all Class I railroads and any operators (including transit agencies) that connect to the mainline American freight network are mandated to install a PTC system by 2018.

For a low-intensity alignment with moderate ridership levels to justify costs it would be desirable, if possible, to avoid the capital investment required with more elaborate rail vehicle control systems. By physically separating sections of track (using a derail, for example), freight service could continue to be run at one end of the track while rail transit service is operated at the other end. (For instance, the division could come between Capitola and Watsonville, with rail transit service on the west end and freight on the east end.). Alternately PTC can be avoided by "temporal" separation (freight service provided at times where there is no scheduled rail transit service). In addition to FRA train control regulations, the presence of freight rail vehicles on the line will require specific clearance at stations and along the line. Railroad clearances are governed by the states. If freight rail vehicles operate at all in the corridor, the California Public Utilities Commission under its General Order 26-D requires minimum setbacks from the center of track to the edge of a typical freight car, the clearance requirement depending on the height of the platform. Appendix B prepared by SCRRA (Metrolink) in Southern California, is an illustration of how this General Order is applied to different facilities. Effectively, if freight service is present at any time, GO 26-D precludes any platform higher than 8" above top of rail without special measures to separate platform edges from the sides of freight cars – these typically being either gauntlet tracks (as on the SMART system in Sonoma and Marin Counties) or bridge plates (as on the SPRINTER system in North San Diego County). While higher platforms are not required for some existing rail systems using conventional equipment, such as rail vehicles used by Caltrain and Amtrak, the Americans with Disabilities Act (ADA) requires level passenger boarding for new rail systems, and is a requirement of the FRA for platforms adjacent to tracks where there is no freight service. Comingled freight and rail transit service operations can result in higher maintenance costs than rail transit options.

Capital Metro

Based on current Santa Cruz Branch Line operations, there is infrequent freight service being operated north of downtown Watsonville. If Iowa Pacific, the Branch Line's freight operator, expands freight markets north in the future, technologies to accommodate the theoretical availability of freight service north of Downtown Watsonville comingled with rail transit service option should be considered. If freight is desired, decisions will need to be made about hours of operation/temporal separation, the cost and affordability of rail transit service, and economic, environmental and other objectives for the movement of people and goods in Santa Cruz County.

Options that, for example, would allow operation of non-FRA compliant "light" DMUs include those used by the NCTD for their Sprinter system (Siemens Desiro), the Austin Capital Metro (Stadler GTW), or Denton County A-Train (Stadler GTW). Operating under CPUC Light Rail Order 143B, rail transit vehicles can run at speeds up to 55 mph using simple block signal systems, with no PTC or Centralized Traffic Control system required—another potential source of capital cost reduction. The Sacramento and Santa Clara VTA light rail systems are operated safely and successfully on this basis, despite featuring bi-directional operation on segments of single track.

9.2 GOVERNANCE OPTIONS

Transit governance for a rail line of the type Santa Cruz is investigating for feasibility typically falls into one of six broad categories.

1. Regional lines which cross several jurisdictions can have a special Regional Transit District/Authority (RTD) created solely to operate the rail transit system. This is how BART and SMART are governed. The creation of a district like this allows voter-approved taxes to be dedicated to the transit service.
2. A new or already-existing RTD can oversee the rail transit system as well as other transportation modes (such as buses, paratransit, even traffic and taxi service). This is the model used by San Francisco (SFMTA/Muni), Tri-Met (Portland, including the WES commuter service) and others.
3. A Joint Powers Authority (JPA) could be formed by the various governments in the area. This is similar to a rail-only RTD, however it does not have a dedicated funding stream and instead relies on its constituent members to allocate funds to it as part of their budgets. This is how Caltrain and others are structured.
4. A state Department of Transportation could be the operating agency. This style of governance is typically seen in smaller (typically east coast) states, where a single metropolitan area so dominates the state that the success of its transit service is seen as a state imperative. In California, Caltrans currently only operates interregional rail service and would not consider operating a primarily local rail transit service of the type evaluated in this study.
5. The local state-sanctioned transportation commission (in this case RTC) or federally-sanctioned Metropolitan Planning Organizations (MPO; in this case AMBAG) can be placed in charge of the rail line. Although typically these organizations are only responsible for high-level planning and coordinating funding among a region's communities, some also take direct responsibility for public transit services.
6. Finally, rail transit service need not be a wholly public enterprise. Private, unsubsidized transit or a public-private partnership (P3 or PPP) are potential options as well. While these types of arrangements have been used for bus transit systems in several areas, fewer rail transit examples

exist. P3s like the Hudson–Bergen Light Rail (HBLR) is owned by New Jersey Transit and operated by the private 21st Century Rail Corporation. AirTrain JFK is an 8.1-mile system operated by Bombardier Transportation under contract to the Port Authority of New York and New Jersey.

Ultimately, the success of any governance structure for rail transit in Santa Cruz County will depend on two factors:

- How well local control and regional goals can be balanced; and,
- The stability and equity of the funding source.

The web of local, regional, state, and federal funding options is not part of this governance analysis, except to note that current dedicated tax receipts can only be counted on if an RTD option is selected, not a JPA, MPO, or P3 structure. Furthermore, the issue of direct operation versus a contract operator/maintainer is a complex one whose calculus changes depending on the governance structure of the agency, and so should be examined in detail at a later date. More than one organizational model would have the flexibility to consider whether or not to contract service to an external entity. Instead, this recommendation focuses narrowly on which of the six structures outlined above would likely provide Santa Cruz County with the most effective rail transit service.

The highly specialized requirements of rail service (whether of FRA compliant or CPUC regulated rail), and scarcity of resources for construction and operating support, suggest a tightly organized, highly focused rail agency may be a desirable solution. However, the many decisions and long-term service oversight required to effectively knit the rail and bus services into one comprehensive service, however provided, suggest the desirability of a single oversight entity, an umbrella agency, with planning and financial responsibilities, to administer the collaboration of the two transit elements. RTC or METRO, with an expanded mission and powers as well as a focused group of staff with rail transit service design and operating expertise, would appear to be a logical entity to assume the role of the "lead agency" or "project sponsor".

9.3 IMPLEMENTATION ACTIVITIES & TIMEFRAME

Implementation activities range from preliminary engineering, environmental analysis, and approval, to procurement, construction, and finally operation. It is assumed that the implementation timeline begins once the lead agency's Board approval is given to conduct preliminary engineering and environmental analysis activities. The timeframes depicted in Table 9-1 are illustrative and can vary significantly depending on public processes, the political and community atmosphere, as well as unforeseen delays in approvals, particularly during the engineering/design, environmental and construction stages.

Key activities for implementing service are as follows:

- **Engage regulatory agencies to determine regulatory regime** – Discussions with FRA would focus on vehicle technology and whether to implement a system operating under temporal separation, which would exempt the passenger operation from certain FRA requirements, platform requirements, and other project development considerations.
- **Develop Design Criteria** – Establish design criteria for a maintainable rail right-of-way in conjunction with trail design, with a focus on the most constrained locations. Develop design criteria for third party installations, such as utilities (such as a water, sewer, conduit, or electric crossing or installation parallel to the track). This would provide consistent guidance to such third parties and prevent them from installing or maintaining their systems in a manner that compromises SCCRTC's ability to use the ROW. The same is true of grade crossings and modifications to crossings that local agencies may propose.
- **Develop Bridge Ratings & Test Rail Conditions** – As needed, develop bridge ratings to meet FRA requirements and/or obtain a waiver for portions of the rail line that are out of service. Test existing rail to provide a quantitative basis for understanding rail replacement requirements.
- **Draft Environmental Studies and 15% Conceptual Engineering** – Draft environmental studies and conceptual engineering could take 36 months (3 years). Activities under this task include 15% design for rail ROW and stations, fleet planning and initial specifications, operating plan development, and operating and capital cost development. For this three year duration, the majority of time will be spent developing the draft environmental studies, including public outreach and the collection and response to public comments. A preferred alternative will be identified and vetted. It is anticipated that funding efforts be ongoing throughout this process.
- **Preferred Alternative and Preliminary Engineering** – In this stage, the preferred alternative will be confirmed following outreach and finalization of the environmental studies. Preliminary engineering for the preferred alternative will follow, which represents the 35% design stage to refine conceptual engineering and to improve the project scope, cost estimates, traffic management plan, and select vehicle technology. Preliminary engineering will also identify whether ROW acquisition is required and, if so, the extent and location of these proposed acquisitions. This activity typically take up to 18 months.
- **Develop Fare Policy** – Development of a comprehensive fare policy would occur in parallel with the preparation of final design documents. This task includes the identification of fare policy and structure as well as fare payment technology. An agency's fare policy establishes the principles and goals that are the foundation for fare pricing decisions. Fare policies may be established through a formal policy statement or on an ad hoc basis as a result of a specific problem or community concern. Examples of long-term fare policy goals are to maximize ridership, social equity, and/or revenue. Short-term objectives could include meeting a certain farebox recovery ratio, ridership, or revenue target. These policies help guide the development of a fare structure. Alternative purchase methods that could be considered include individual trip payment, multiple-ride tickets, and unlimited-ride passes. Fares may also be differentiated by rider characteristics

(such as demographic and socioeconomic aspects such as age or financial capacity, affiliation, or mobility impairment) or trip characteristics (trip distance, time period, etc.). Another consideration in the fare structure is the degree to which the rail service is integrated in the operations and fare structure of the Metro system and the bus/rail fare differential. Fare payment technology strategies to consider include electronic payment through various media, including Smart Cards, as well as payment infrastructure options (on-board vs. station ticket vending machines).

- **Smart Card Fare Media:** Many transportation systems in the U.S. and the world are moving toward a unified electronic media fare card model instead of selling individual, disposable paper tickets for each system in a region. Electronic media is defined as portable media that contains the ability to store and retrieve data in a non-volatile manner by a method of electronic reading, writing, or both. There are four key types of electronic media: integrated circuit cards (Smart Media), magnetic cards, capacitive cards, and optical cards[75]. The purpose of these cards is to improve fare collection systems. Currently, METRO and MST offer smart cards. METRO offers CRUZ Cash cards to transit patrons. These plastic cars are about the size of a credit card, are reloadable, and can be used on both systems. MST offers reloadable GoCards. North of Santa Cruz County, a number of other regional Bay Area transit systems offer reloadable Clipper Cards to transit patrons. Clipper Cards can be used on the following transit systems: AC Transit, BART, Caltrain, City Coach, FAST, Golden Gate Transit & Ferry, Marin Transit, Muni, SamTrans, San Francisco Bay Ferry, SolTrans, the VINE, and VTA. The TAP card is a regional smart card that can be used on transit systems in Southern California. The potential creation and implementation of interoperable smart cards for rail transit in Santa Cruz County should be explored in later studies.[76]
- **The fare policy and structure study may include the following steps:**
    - Identify Fare Policy Goals
    - Develop Evaluation Framework
    - Conduct Research on Rail Fare Structures Elsewhere
    - Conduct Market Analysis of Fare Methods
    - Develop a Revenue and Ridership Model
    - Evaluate Alternatives and Recommend a Fare Structure
    - Implement Fare Structure
    - Monitor and Evaluate Fare Structure Effects

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[75] "Trends in Electronic Fare Media Technology." APTA, 2004.
[76] "TCRP Report 115: Smartcard Interoperability Issues for the Transit Industry." Transportation Research Board, 2006.

- **Final Design, Construction Documents, and Funding** –Once preliminary engineering is finalized, final design as well as production of construction documents will occur. This task includes preparing the full engineering package, including the project management plan, quality control/quality assurance for construction, utility relocation, and obtaining permits, etc. Funding activities will include identifying sources, applying for funding, and procuring or obtaining agreement for funding. This stage will take about 24 months.
- **ROW Acquisition** – If needed, additional right-of-way (ROW) acquisition will start about halfway through the final design, construction documents, and funding task, once the majority of funding has been arranged and the locations for potential ROW acquisition are finalized. ROW acquisition will include valuating property and seeking to purchase this ROW. ROW acquisition is estimated to take up to 18 months, although this could be highly variable depending on the extent of acquisition required.
- **Contractor Procurement** - Once final design, construction documents and ROW acquisition are complete, the project will move into contractor procurement, which will take about 6 months (includes notice to bid, bidding evaluation, and approval).
- **Construction** - Once the contractor is selected, construction, testing and commissioning activities will take place for the next 48 months. This will include construction of the new stations, the rail corridor trackage, and signal systems. This activity also includes crossing upgrades and station parking, if applicable. It is noted that the construction timeframe is based on a conservative estimate of resource deployment to minimize costs – a quicker construction timeframe could be achieved however, with deployment of multiple work crews simultaneously which would raise costs.
- **Vehicle Procurement** – If the Lead Agency decides to use new vehicles, vehicle procurement for new rail vehicles should begin 36-48 months prior to initiation of rail transit service. This activity includes making decisions on vehicle technology and design, including number of seats, space for bicycles, etc., then preparing a vehicle Request for Proposal (RFP) (separate from the contractor procurement), notice to bid, evaluation of bids, and selection of a preferred vendor. From the selection of a car builder to the delivery of a pilot rail transit vehicle which meets Lead Agency requirements can be expected to take 18-24 months. It is assumed that the vehicles procured by Lead Agency would be similar to current models already being produced (such as a Stadler DMU) and do not require a new design (or assembly line) that would take longer to develop, build, and deliver. Commissioning and testing of the vehicles requires another 6-12 months depending on the size of the order and the availability of a sufficiently long segment of track for testing—though some level of testing will also be required once construction activities are complete. Leasing used vehicles, as is proposed under Scenario S, would significantly reduce vehicle procurement time.
- **Opening** – Overall, the timeframe from initial Board approval for conceptual studies to the first day of service will be about **10-11 years**.

Potential factors to consider that may delay or lengthen the implementation process include:

- **Local Coordination** - Coordination with local jurisdictions and coming to an agreement on the final design may result in longer than anticipated implementation timelines. Coordination may revolve around station design, ensuring trail compatibility, etc.
- **Funding** – Procurement of full funding could take longer than expected as well. This includes the time to secure local funding as well as any federal, state, and/or regional grants.
- **Environmental Approvals** – Depending on the level of changes to cross streets and right-of-way, the environmental approval process (along with right-of-way acquisition) have the greatest chance of impacting and thus delaying implementation of Santa Cruz County rail transit service.
- **Right-of-Way Acquisition** – The larger the amount of land required in sensitive areas, the higher the likelihood for implementation delays due to potential litigation (from residents, businesses, etc.).

9.3.1 DESIGN-BID-BUILD VS DESIGN-BUILD

This concept implementation timeframe assumes a design-bid-build (D-B-B) process of project delivery. Design-build (D-B) is a method of delivering infrastructure projects that differs from the traditional style of D-B-B in which the design team works directly with the contractor under a single contract. D-B can provide time savings, cost savings, and improved quality over D-B-B contracting but this project delivery approach is not without potential drawbacks. These include reduced competition favoring large national engineering and construction firms, deviation from traditional quality assurance/quality control roles through the combination of engineering and construction, and potential to increase project costs if low-bid selection criteria are not used.

The decision to pursue a D-B-B or D-B project delivery approach is best made after the preliminary engineering and environmental document is prepared, as it is advisable to avoid committing to a specific delivery method until more is known about the project. Once some preliminary engineering is complete and the type of environmental document is determined, thereby establishing the overall scope of the project and the likely range of environmental commitments, the decision for D-B-B or D-B can be finalized. A key factor in whether D-B is "faster," "cheaper," or "more successful" compared to D-B-B is whether the owner is willing to surrender sufficient control of the final scope of the project to let the D-B contractor work in the most efficient manner. It also requires an owner to be able to make decisions quickly in order to respond to questions from the D-B contractor. Moreover, when there are many outside stakeholders (cities, utilities, regulatory agencies, community members, etc.), D-B may not be a preferred course of action. It is difficult or impossible for a contractor to price the effect of these outside parties, or the demands they may place on the project once the contractor starts work.

TABLE 9-1: PRELIMINARY IMPLEMENTATION TIMELINE

		Time post-board Approval																																															
		Year 0				Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Year 9				Year 10				Year 11			
Item		Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Board Approval																																																	
Draft Environmental Studies & Conceptual Engineering																																																	
Preferred Alternative and Preliminary Engineering																																																	
Final Design, Construction Documents, Funding																																																	
ROW Acquisition																																																	
Contractor Procurement																																																	
Construction																																																	
Vehicle Procurement																																																	
Vehicle Commissioning & Testing																																																	
Opening																																																	

9.4 NEXT STEPS

During environmental and design phases, additional consideration should be given to the following activities in order to ensure the Lead Agency meets all regulatory agency requirements, actively coordinates and ensures connectivity with bus transit, prepares ridership forecasts that are FTA compliant for grant applications, and focuses funding efforts in specific areas.

9.4.1 REGULATORY AGENCY REQUIREMENTS

As the details of the Lead Agency's preferred service alternative are developed, it is recommended to open a dialog with the regulatory agencies (FRA and CPUC) to ensure that their requirements are clearly understood and, if waivers from some regulatory requirements are pursued, that the conditions for obtaining such waivers are identified and understood early on. Early engagement with these agencies – the same agencies that will enforce compliance with the regulatory standards – would be a low-cost first step to ensure a consistent understanding of the standards to which the rail transit system will be held.

Generally, since agencies must strive to provide accessibility in the most integrated manner possible, it is assumed that level boarding would likely be required and the cost estimates for all but Scenario S reflects this assumption. The Lead Agency may want to open discussion with the FRA and/or CPUC on this subject and consult counsel for an interpretation of the statutory and regulatory framework for level boarding. If the Lead Agency pursues a service that would be subject to FRA regulation, the Lead Agency may be required to submit a plan to the FRA (or Federal Transit Administration) which details compliance with the performance standard set forth in 49 CFR Part 37 and receive approval of that plan prior to commencing construction.[77]

In the event the Lead Agency pursues an approach that would not be regulated by the FRA, then accessibility would likely need to be provided under the California Code of Regulations Title 24. Note that an approach that avoided federal regulation may also imply that the start-up of the service would be governed by CEQA. The California Office of the State Architect can provide additional information on accessibility guidelines and interpretations of Title 24.

[77] The Code of Federal Regulations, Title 49, Part 37 outlines the requirements for accessibility at transportation facilities. See particularly 49 CFR Part 37.35 through Part 37.107. These regulations address both configuration of stations and acquisition of both new and used equipment. The Federal Railroad Administration's General Counsel has also issued a guidance memo on level boarding, which can be found at the following URL: https://www.fra.dot.gov/eLib/Details/L03698 .

9.4.2 COORDINATION WITH SANTA CRUZ METRO AND OTHER OPERATORS

Making a fixed transit corridor such as a rail spine thrive may depend upon effective, seamless integration with the local bus network, other shuttle services, and inter-regional connections. This study has not developed a bus/rail integration plan, but the chances for eventual success of rail transit service would be significantly enhanced by ensuring unity of transit network design philosophy between its rail and bus elements. This, in turn, becomes more likely if there is unified policy oversight of both the bus and rail services.

Ultimately, the rail system should be integrated with Santa Cruz Metro bus service. Most station locations are located along existing bus routes. Scheduling for rail transit and buses should be coordinated as well, which will maximize ridership and accessibility by minimizing wait times and providing direct transfers. A bus/rail integration plan would identify bus route reconfigurations, headway compatibility, and any new route needs. In addition to the METRO bus service and paratransit systems, there are several additional bus and shuttle systems that could provide access between rail stations and destinations. These include the UCSC TAPS bus and shuttle system, the Santa Cruz Trolley (seasonal), Capitola beach shuttle (seasonal), Monterey-Salinas Transit (MST), as well as shuttles and buses provided by some employers and senior housing facilities.

Additionally, development of a rail station at Pajaro Junction for Capitol Corridor and Coast Daylight service, as well as connections to High Speed Rail in Gilroy, and possible future rail transit service around the Monterey Bay, should also be coordinated. In Monterey County, the Transportation Agency for Monterey County (TAMC) has been working cooperatively with the Capitol Corridor Joint Powers Authority to extend the Capital Corridor rail service to Salinas. The service is planned to begin with two daily round trips from Salinas to San Jose and beyond to Sacramento, and will be increased to up to six round trips as demand warrants. The extension will include three new station stops in Monterey County: Pajaro/Watsonville, Castroville, and Salinas. The rail extension, in addition to connecting Salinas with San Jose and the jobs base of Silicon Valley, will connect to other Bay Area cities via connections to Caltrain, Altamont Corridor Express, Amtrak and planned High-Speed Rail service at stations in Gilroy and San Jose. The first phase of the Capitola Corridor extension project is fully funded; environmental review and preliminary engineering are completed; and the project is now in the final design and property acquisition phase.

If rail service on the Santa Cruz Branch Rail Line is not initially implemented all the way to Pajaro, these connections could be provided through the use of “feeder” buses, similar to the Highway 17 Express Bus, which provides connections between Santa Cruz and the train station in downtown San Jose. Longer term plans for rail transit service on the Santa Cruz Branch Rail Line should consider connections to the intercity rail network through bus or direct rail connections, enhancing the financial feasibility of the project, and furthering the state-wide integrated rail system.

The Harvey West neighborhood contains several potential rail transit destinations, including retail, schools, light industry, and other businesses, currently served by Metro route 4. The rail Right-of-Way through this area is owned by Roaring Camp Railroads and its Big Trees and Pacific Railway, not the SCCRTC. The current study focuses on the Branch Rail Line owned by the RTC, though coordination with Roaring Camp to extend service to Harvey West or the San Lorenzo Valley could take place in the future.

9.4.3 RIDERSHIP FORECASTING

Should the Lead Agency Board decide to pursue federal funds through the Federal Transit Administration (FTA) New Starts or Small Starts Programs for the preferred alternative, a more intensive ridership forecasting effort will be required to support a grant application. The FTA allows project sponsors to use either the currently adopted regional model or FTA's national ridership forecasting tool (STOPS) to prepare formal ridership forecasts for the preferred alternative. Either of these ridership forecasting tools provides a consistent approach for comparison to other proposed systems for competitive federal funding applications. The RTC and County of Santa Cruz are currently developing a new local model that will be sensitive to multimodal travel. This model has potential to be applied to a more detailed ridership analysis in future phases of work. Since the release of STOPS by the FTA, many transit agencies are preparing ridership forecasts using both the regional model and STOPS, largely because FTA has requested use of the latter. The STOPS ridership forecasting tool is discussed below.

9.4.3.1 Simplified Trips-on-Project Software (STOPS)

STOPS is a method developed by the FTA to quantify the measures used by FTA to evaluate and rate transit projects.[78] In order to receive most federal transportation funding sources, these data are required:

Model inputs required for STOPS are summarized below:

- Trip-making characteristics in the corridor as represented by Census Transportation Planning Package (CTPP) Journey-to-Work (JTW) data sets.
- Information on the density of the street grid conveyed by Census Block definitions.
- Data from the Regional Model:

[78] More information can be found on the STOPS website: http://www.fta.dot.gov/grants/15682.html

  - TAZ-level population and employment data for base year and all future year scenarios (including existing)
  - Auto Travel Time Skims for all future year scenarios (including existing)
- General Transit Feed Specification (GTFS) data for all transit agencies that operate in the project corridor.
- Daily boardings for each existing stop/station in the project corridor.

STOPS model limitations are summarized below:

- **Does not address special travel markets** (including college students and tourists, which are a major factor in Santa Cruz County); only estimates routine travel by permanent residents.
- **Accurately forecasts work-based trips, less accurately predicts other types of trips**. STOPS is based on worker-flow data from the Census Transportation Planning Projects (CTPP), which do not cover any other type of trip. STOPS estimates non-home based trips by summing the home-based transit attractions (work and non-work).
- Starts with CTPP data then adjusts over 13 years to represent the current year, which introduces uncertainties.

STOPS uses ridership data from existing rail systems in the study area in order to develop factors to adjust ridership estimates for a new fixed guideway project. If no rail service exists in the corridor, STOPS allows a "cloning" step that copies CTPP data from a TAZ that best resemble the project corridor in the future and uses in the ridership forecasting process for the corridor without existing fixed-guideway service.

9.4.4 STATION PARKING

The ridership analysis did not make assumptions about mode of access, including parking. An analysis of park-and-ride locations and sizes would be done at a later phase. One of the next steps in the study process will be development of a parking policy for the rail line. It will have consequence in terms of patronage and cost-effectiveness, as well as traffic impacts, supporting bus service access, and pedestrian circulation near stations. The station location analysis for this study included a general evaluation of constrained land uses or usable space surrounding each station that could be used to provide parking (see Section 7.1). Use of a regional travel demand model with a transit mode-of-access component will allow the project team to forecast person trips arriving at each station via walk, bus transit, or auto (park-and-ride or kiss-and-ride). On-demand transportation providers, such as Uber and Lyft, are growing in popularity to close the first-mile/last-mile gap from transit stations, in addition to carshare and bikeshare providers. Depending on the model's sophistication, parking demand can be estimated either in a constrained or unconstrained manner. Typically, these forecasts will be used to support the environmental review process and will provide a good starting point for discussing the key issues surrounding the decision to provide station parking, how much, and in what form. In addition to determining whether RTC-owned and operated parking facilities are feasible and make sense financially, other considerations should be given to the impact of spillover and mitigation in residential neighborhoods. Creation of residential permit parking (RPP) Programs or Parking Benefits Districts should be considered if neighborhood parking could be impacted. The potential to develop a shared parking Program with operators of off-street parking facilities to accommodate Santa Cruz rail parking demand, allowing riders to use excess capacity in these facilities, should also be considered. An analysis of park-and-ride locations, sizes, and any parking fees should be completed in coordination with cities and the County of Santa Cruz.

9.4.5 FUNDING

It is important to note that funding feasibility for new rail service is largely driven by five factors: cost, ridership, region size (population), competition for funds, and local match for federal and state funds. The only factors directly controllable by the sponsor are competition and local match. The SCCRTC or its successor sponsor should focus efforts in three areas:

1. Build local consensus and partnerships to minimize local competition for funds and maximize locally-generated revenue (local match) including public private partnerships and developer fees.
2. Lobby regional and state agencies charged with distributing state and local funds to keep the project visible and build support for the view that the Project should be a priority and allowed to secure its fair share of funding.
3. Reach out to partner agencies and project sponsors within and outside of California to build a more in-depth understanding of options, strategies, and techniques that can be applied to securing federal and state funding.

If a transportation sales tax measure is pursued, this study will provide essential information to consider inclusion of environmental analysis or rail transit service in the ballot initiative's expenditure plan. If the Lead Agency decides to apply for federal New Starts/ Small Starts funding through the Federal Transit Administration, this study will provide important information to support the application. To successfully compete for FTA funds, the Lead Agency will need to demonstrate a dedicated local funding source as well as address preliminary engineering plans and cost estimates, NEPA and CEQA clearance, project governance, and prepare more detailed ridership forecasts that meet FTA criteria.

9.4.6 ADDITIONAL CONSIDERATIONS

Within the local context, the next implementation steps to consider include:

- Integrate recommendations into city/county land use planning efforts, future Regional Transportation Plans and Metropolitan Transportation Plans, including the Sustainable Communities Strategy. Work with local jurisdictions to consider transit-oriented development along the rail line that would support job growth, housing affordability, and maximize transit and trail use. This may include infill housing development, encouraging denser redevelopment near stations, providing density bonuses near station areas, developing high quality transit corridors near stations, and transforming station areas into fully multimodal nodes.
- Work with local jurisdictions and property owners to preserve right-of-way for future stations/parking, potential siding locations, and trail facilities.
- Forward study results to Caltrans for inclusion in future State Rail Plans.
- Continue to empower and engage the community in future stages of project implementation.