Chapter 5
RIDERSHIP, REVENUES AND OPERATING COSTS

INTRODUCTION

The development of operating plans facilitates the forecasts of ridership and, therefore, of revenues. This is because, for one thing, more frequent service can induce more riders, as riders come to see a rail service as increasingly convenient. The operating plans described in the preceding chapter also facilitate estimation of operating costs. This is because, for example, the plans specify the number of trainsets, which in turn dictate the total crews required.

This chapter provides ridership and revenue forecasts for the five Sonoma – Marin rail service options in the 2002 and 2012 planning years used for this study. It includes as well a description of the methodologies utilized to calculate ridership and revenues. The chapter also provides operating cost estimates for the planning years. Lastly, it includes a discussion of the proportion of operating cost covered by revenue for each service option. This ratio is also known as the farebox recovery ratio, a key measure in determining operating performance.

RIDERSHIP FORECAST

The approach followed in this project was a method that WSA employed successfully in the recent projects, including *Salt Lake City Light Rail Project* in 1999, *Nashville Light Rail Project* in 1999, and *Rochester Light Rail Project* in 1998. There are numerous methodologies to arrive at ridership estimates, some of which are very time consuming and expensive. However, given the budget and schedule that the SMART Commission faced for its assessment of the rail service, the methodology described below was an appropriate tool for the job, arriving at estimates based on existing and projected travel patterns, and on the experiences of operators of similar commuter rail services on the West Coast.

Methodology

The methodology is driven by the following key assumptions:

- Current congested conditions on the US 101 corridor during peak hours would persist indefinitely.
- Potential riders would be willing to drive up to 10 minutes from their homes to a station, or to take transit for the same distance.
- Upon arriving at their destination stations, riders would be willing to take either shuttle buses (provided by employers) or transit, or would walk to their workplaces.
- Riders would be willing to ride 10 minutes in a shuttle bus or transit, or walk about a half mile, from the stations to their workplaces.

- Peak ridership would account for 80 percent of total riders.
- Off-peak ridership would account for 20 percent of riders.
- San Francisco bound rail ridership (peak and off-peak) would comprise a 5 percent diversion of existing Golden Gate Transit (GGT) bus ridership.

Home-based Work Trips - The assumptions above allowed definition of specific target markets. Initial work focused on people going to work, as these would account for most of the riders. This was done by plotting three circles around each of the 11 proposed stations in the NWP rail corridor from Cloverdale to downtown San Rafael. The outer most circles had a five-mile radius. Ten minutes at an average driving speed of 30 miles per hour equals five miles. This, in general, would be the maximum distance that people would be willing to drive to a station. The middle circles had a radius of 2.5 miles. Ten minutes at an average shuttle bus speed of 15 miles an hour equals 2.5 miles[1]. This would be the maximum distance that people would be willing to ride a shuttle or transit from the station to the workplace. The inner circle represented 0.5 mile around each station, the distance people would be willing to walk to work.

These circles of varying radii appear in Figures 1 and 2. Figure 1 shows stations from Cloverdale to Santa Rosa. Figure 2 shows stations from Rohnert Park to San Rafael. These circles reflect the methodology's premise that people living within a 5-mile radius of any one station and commuting to a workplace within 2.5 mile shuttle ride or 0.5 mile walk of another station largely comprise the universe of potential rail service riders.

The next step involved Traffic Analysis Zone (TAZ) data generated by the Metropolitan Transportation Commission (MTC). TAZ data allows for the calculation of home-based work trips from one zone to another. The MTC provides projections for many years into the future, enabling calculation of future work trips. As the ridership forecast required calculation of potential riders going from one circle to another, the TAZ data showing home based work trips between zones was an appropriate data source. The remaining challenge was in fitting the TAZ data to the WSA circle-to-circle approach.

Fitting TAZ data to the circle approach required making certain judgments. If, for example, the clear majority of a population in a TAZ fell within the 5-mile radius circle around one station, *all* home-based work trips from that TAZ to workplaces in the 2.5-mile radius circles around other stations in the corridor were included in the analysis. Conversely, if the clear majority of a zone's population lay outside of the 5-mile radius, those home-based work trips were excluded from the analysis. Where stations were closely spaced – such as Marin County Civic Center and downtown San Rafael or Cotati and Rohnert Park, where the circles around each station actually share TAZs – other judgements were required in allocating TAZ work trips to one station versus another.

[1] The 15 mph average speed of a shuttle bus reflects a lower speed relative to a private automobile resulting from operation in urban conditions and frequent stops permitting riders to alight from buses.

Capture Rates - Having developed figures for the universe of potential riders, work then focused on determining the percentage of these potential riders who might actually be attracted to the rail service. This percentage is commonly called a *capture rate*.

Various commuter rail operators offered opinions based on their experience. These included the Los Angeles Metrolink, the East Bay's Altamont Commuter Express (ACE), and Vancouver's West Coast Express. These are operations with service levels that are similar to what is envisioned for the Sonoma - Marin Rail service at 18 to 32 trains per day. It was reasonable to conclude that their experience with regard to capture rates would be relevant for the SMART analysis. A ridership consultant who has done extensive capture rate analysis for Metrolink, and a senior researcher at MTC also offered opinions on what might be reasonable capture rates for a new commuter rail service. A synthesis of all comments revealed capture rates of between 3 and 10 percent depending on various factors, including total transit time savings, service levels, highway congestion, the proximity to stations of major employers, the cost of parking, and the availability of convenient transfers to shuttle or transit.

The capture rates that were applied to this corridor varied between 0.5 percent and 6 percent of the commuter market. The actual percentage of market share depends on four determinants. Primary among these was the trip distance. This is because, generally speaking, people are more tolerant of transfers from car to train and train to shuttle bus for longer trips than for shorter trips. Beyond trip distance alone, however, the capture rates were modified to reflect known factors in the corridor that likely would affect the mode choice. Specifically, capture rates for particular destinations were boosted above levels dictated solely by trip distance if the following three conditions or criteria were met:

- A high concentration of jobs/major employers within walking distance (approximately 0.5 miles) of a station;
- A high concentration of jobs/major employers for which shuttle services would be convenient (within approximately 2.5 miles); and
- Severe traffic congestion affecting travel times by car.

Four destinations in the corridor are characterized by these conditions. These are Santa Rosa, Cotati, Marin County Civic Center and San Rafael. Accordingly, capture rates for work trips to the destinations were boosted above the percentages dictated by distance alone.

In order to determine the proximity of jobs and major employers to stations, locations of both major employers and large office complexes with multiple employers between Santa Rosa and San Rafael were identified. For each of the four cities, high concentrations of jobs and major employers exist within 0.5 to 2.5 miles of stations. In Santa Rosa, San Rafael and Marin County Civic Center in particular, many jobs are within walking distance. While California State University Sonoma (Sonoma State) with 1,120 employees is somewhat beyond the 0.5-mile walking distance from Cotati station, it nevertheless is close enough for Cotati to fit the walking distance criterion.

Next was an analysis of how difficult the general areas around the stations are to reach by car now due to recurring congestion. To do so, peak-time Levels of Service (LOS) were reviewed. Levels of "E" or "F", indicating highly congested conditions surrounding the four destinations, were cited in the 1997 *Sonoma/Marin Modal Transportation and Land Use Study*[2]. While Petaluma and Novato each has poor peak hour LOS conditions, there are no high concentrations of major office complexes or major employers within walking distance of the stations. Accordingly, there was no need to modify the mileage-based capture rates for trips having these stations as destinations.

The base mileage-based capture rates and the modified rates for Santa Rosa, Cotati, Marin Civic Center and downtown San Rafael appear below in Table 5-1, Capture Rates.

Table 5-1
Capture Rates

Work Trip Miles	Mileage-Based Rate	Modified Rate[3]
0 - 4.9	0.5%	1.0%
5 - 9.9	1.0%	2.0%
10 - 14.9	3.0%	4.0%
15 - 19.9	4.0%	5.0%
20 - 29.9	5.0%	6.0%
30 +	6.0%	7.0%

San Francisco Trips - Rail-bus trips to San Francisco would require a transfer mid-route to Golden Gate Transit bus service, most likely at the San Rafael Transit Terminal. The number of these riders, however, likely would be small. There are two reasons for this. One, a transfer mid-route will likely militate against the attraction of rail-bus alternative versus express bus service. Two, a rail-bus alternative would represent only a small transit savings, if any, versus an express bus trip from Santa Rosa to downtown San Francisco[4]. Accordingly, a nominal market share of 5 percent of existing GGT riders between Sonoma County and San Francisco was assumed for the rail service. No rail share of Petaluma/Marin – San Francisco ridership was assumed, as a rail-bus option would provide no transit time savings relative to express bus service.

Ridership in 2002 and 2012

The various capture rates were then applied to the universe of targeted work trips. Eighty percent of these work trips would occur during peak commute hours, judging from Metrolink's statistics. Off-peak or mid-day trips would account for 20 percent of total trips. Total trips (80

[2] Performed for the Sonoma County Transportation Authority and the Marin Countywide Planning Agency by Calthorpe Associates. Please see page 3 of the Final Report.

[3] For trips home to work trips terminating in Santa Rosa, Cotati, Marin Civic Center and downtown Santa Rosa.

[4] A SMART rail – GGT express bus trip from Santa Rosa to the San Francisco financial district would result in a transit time savings of 6 minutes versus an all express bus trip. This calculation assumes scheduled conditions and a 5-minute interchange between rail and bus in downtown San Rafael. If the interchange is longer, the transit time savings would diminish.

percent peak period work trips and 20 percent off-peak trips) for the five service options appear in Table 5-2, Ridership Estimates for Service Options. San Francisco trips diverted from GGT were added to the Healdsburg to San Rafael and Cloverdale to San Rafael options only.
The 2012 forecast includes a factor accounting for the effect of more frequent headways, which will draw more riders to the system. It also will account for *externalities*, such as worsening congestion in the corridor, which will make a rail alternative increasingly appealing. The factor boosted ridership 30 percent above what it would be if based solely on the growth in home-to-work trips forecast by MTC. While arbitrary, this percentage increase appears appropriate. Certainly more frequent service draws riders. Further, should no mitigation for congested conditions on US 101 be found, trip times will worsen. A predictable consequence of both would be increasing ridership potential for the Sonoma - Marin Rail Service.

Table 5-2
Daily Ridership Estimates for Service Options

	Daily Passengers	
Options	2002	2012
Healdsburg – San Rafael	2,700	4,300
Cloverdale – San Rafael	2,900	4,700
Healdsburg – Petaluma	1,200	1,900
Cloverdale – Petaluma	1,400	2,300
Petaluma – San Rafael	900	1,400

The figures above are rounded to the nearest 100. As can be seen, the Cloverdale – San Rafael has the largest ridership potential. This is logical, as it would serve the *intra-county* riders (those traveling within one county) in both Sonoma and Marin, as well as serve *inter-county* riders (those traveling between counties). It would also have the longest trips, which would have the higher capture rates.

As a significant point of reference, ACE ridership (consisting mostly of commuters going relatively long distances to Silicon Valley) is 2,300 a day, with three inbound trips to San Jose and two outbound trips to Stockton. Metrolink's Ventura line from Oxnard to downtown Los Angeles currently carries 3,500 daily riders Mondays through Fridays, up from 1,600 when the service began in September 1992. The Coaster now handles 4,500 weekday riders from Oceanside to downtown San Diego, up from 1,900 per day at inception in March 1995.

REVENUES

Applying fares to the ridership between points results in revenue for the various service options. In order to understand how to structure the fares, fares charged by commuter and transit agencies were reviewed. The agencies included Metrolink, ACE, the Peninsula Caltrain service, the San Diego Coaster service, Golden Gate Transit and BART. This review revealed a few general characteristics of fares. One is that they tend to be mileage-based, with shorter distances having higher dollar-per-mile ratios than do longer distances. Secondly, total revenues are a *blend* weighted average of various types of fares. Most commuters buy monthly passes or multiple trip

tickets, both of which are sold at a discount off of cash fares. A blended per-mile fare schedule follows as Table 5-3, Proposed Fares per Mile. As an example, a trip between Santa Rosa and San Rafael, a distance of 37 miles, should cost on average $3.70. These fare levels are consistent with levels charged with GGT and Metrolink, assuming intermediate and longer distance trips, i.e., trips of 20 miles or more.

Table 5-3
Proposed Fares per Mile
1999 Dollars

Miles	$ per Mile
0 - 9.9	0.16
10 – 19.9	0.14
20 – 29.9	0.12
30 – 39.9	0.10
40 – 49.9	0.10
50 – 59.9	0.10
60 +	0.10

These mileage-based fares were applied to the work trip ridership estimates discussed earlier. In determining off-peak revenues, the fare levels were increased slightly as a further adjustment reflecting a higher proportion of cash paying riders (e.g., recreational trip riders) relative to other services. The results appear below as Table 5-4, Revenue Estimate for Service Options. The figures are rounded to the nearest $100.

Table 5-4
Daily Revenue Estimate for Service Options
1999 Dollars

Options	Daily Revenues	
	2002	2012
Healdsburg – San Rafael	5,900	9,500
Cloverdale – San Rafael	6,600	10,600
Healdsburg – Petaluma	2,000	3,200
Cloverdale – Petaluma	2,500	4,200
Petaluma – San Rafael	1,700	2,600

These numbers appear as annualized numbers in Table 5-5, Annual Revenue Estimate for Service Options, and are rounded to the nearest $100,000. This is to facilitate a comparison of revenues to the annual operating costs, also rounded to the nearest $100,000 and discussed in the following section.

Table 5-5
Annual Revenue Estimate for Service Options
Millions of 1999 Dollars

Options	Annual Revenues	
	2002	2012
Healdsburg – San Rafael	1.5	2.4
Cloverdale – San Rafael	1.7	2.7

Healdsburg – Petaluma	0.5	0.8
Cloverdale – Petaluma	0.6	1.1
Petaluma – San Rafael	0.4	0.7

OPERATING COSTS

Total operating costs are made up of various component costs including:

- Transportation costs, or the actual costs expected for running trains;
- Maintenance of equipment – the rolling stock or trainsets;
- Fuel;
- Maintenance of way – the track and structures along the rail route;
- Storage and shop facility maintenance – the cost of keeping the maintenance facility in operating order;
- Station service – keeping the stations in safe, clean and usable condition, as well as collecting revenue from ticket machines;
- Insurance and claims – a function of exposure, whereby options carrying more passengers over more route miles have higher premiums; and
- General and administrative expenses – salaries for managers and staff, plus costs allocated to the system (marketing, accounting, consulting, etc.) rather than to the functional areas cited above.

Driving each of these costs is a set of assumptions tailored to each operating service option. For example, regardless of the particular option, the rail service would be managed by a public transportation agency, with many of the day-to-day functions handled by a contracted operator or shared with the freight operator. These contracted or shared costs include transportation, maintenance of equipment, and maintenance of way. A major role of the agency will be to manage the contracts. Other duties include managing the finances of the system, as well as contracting for numerous other functions including marketing and accounting. Appearing below in Tables 5-6 and 5-7 are the operating costs for the options utilizing both diesel multiple unit (DMU) technology[5] and conventional locomotives with bi-level cars in 2002 and 2012. Because these two equipment types would bracket potential operating costs, no separate calculation for RDC Budd cars was performed.

The operating cost figures that follow include variable and fixed cost components. Variable costs are those costs that change with miles traveled or locomotives serviced. Fixed costs remain constant, regardless the miles traveled or locomotives serviced. Transportation and fuel are almost entirely variable costs, and therefore change from service option to service option in a given year. Facility maintenance and general and administrative expenses are mostly fixed costs, and do not vary per service option in a given year. Typically, railroads have a high percentage of variable operating costs.

[5] DMU 90-3s are assumed for the longer distance options, and DMU 90-2 are assumed for the shorter distance options. The 90-3s have greater seating capacity, but also have a higher fuel consumption.

In all operating cost calculations, the approach was to portray the likely behavior of the variable costs. An obvious example is fuel cost. Those service options having more train-miles[6] have higher fuel costs – the relationship between train-miles and fuel costs is essentially straight-line. A more subtle example is insurance. Insurance expense is a function of exposure to liability, and therefore is variable relative to passengers and train-miles. However, these costs would move more in a step-function manner rather than in straight-line manner.

Operating Costs by Service Option for 2002

Table 5-6
2002 Operating Cost Estimates for DMUs and Conventional Equipment
Millions of 1999 Dollars[7]

DMU Cost Category	Healdsburg To San Rafael	Cloverdale To San Rafael	Healdsburg to Petaluma	Cloverdale to Petaluma	Petaluma to San Rafael
Transportation	1.0	1.2	0.8	0.8	0.7
Maintenance of Equipment	1.2	1.2	0.7	0.8	0.5
Fuel	0.2	0.2	0.1	0.1	0.1
Maintenance of Way	1.1	1.2	0.6	0.6	0.5
Facility Maintenance	0.3	0.3	0.3	0.3	0.3
Station Services	0.6	0.6	0.4	0.5	0.4
Insurance	1.2	1.2	1.0	1.0	1.0
General and Administrative	1.4	1.4	1.3	1.3	1.2
Total	7.0	7.3	5.1	5.5	4.7

Conventional Cost Category	Healdsburg To San Rafael	Cloverdale To San Rafael	Healdsburg to Petaluma	Cloverdale to Petaluma	Petaluma to San Rafael
Transportation	1.0	1.2	0.8	0.8	0.7
Maintenance of Equipment	1.1	1.1	0.5	0.7	0.5
Fuel	0.8	0.9	0.5	0.6	0.3
Maintenance of Way	1.1	1.2	0.6	0.6	0.5
Facility Maintenance	0.3	0.3	0.3	0.3	0.3
Station Services	0.6	0.6	0.5	0.5	0.4
Insurance	1.2	1.2	1.0	1.0	1.0
General and Administrative	1.4	1.4	1.3	1.3	1.2
Total	7.5	7.9	5.5	5.9	4.9

Transportation: Cloverdale to San Rafael has the highest transportation costs of all service options, regardless of technology. This is largely because it has the most train-miles, requiring more total crewmen. On the other hand, while Cloverdale to Petaluma has more train-miles than Healdsburg to Cloverdale, transportation costs are identical. This is because the same number of crewmen, dispatchers, and supervisors would operate both options.

[6] A measure of the distance traveled by a trainset. A trainset moving one mile is equal to one train-mile.

[7] A cost calculation for Cloverdale – San Rafael appears in Appendix 2. This method was followed for all service options.

Maintenance of Equipment: It is anticipated that DMUs will be slightly more expensive to maintain than conventional equipment, resulting in a slightly higher total cost.

Fuel: DMU's will consume far less fuel per mile than conventional equipment, accounting for the differential.

Maintenance of Way: This cost is driven by train-miles. Accordingly, Cloverdale to San Rafael, having the most train-miles has the highest cost. Having the least train-miles, Petaluma to San Rafael has the least cost.

Facility Maintenance: This cost is a fixed cost, and accordingly it does not vary either by equipment type or service option.

Station Services: This is a variable cost is driven by ridership. Those options with more riders using stations have the higher costs. It does not vary by equipment type.

Insurance: This also is driven by ridership, and does not vary by equipment type.

General and Administrative: This cost is also a function of ridership. That is, the larger the ridership, the more administrative staff are needed for general management, accounting, marketing, etc. It does not function by equipment type.

Total Cost: Regardless of the rolling stock assumed, Cloverdale to San Rafael has more operating expenses than all other options on a total dollar basis. This result is a function of a high proportion of variable costs to total costs and traveling more train-miles. On the other hand, Petaluma to San Rafael is the least expensive option.

Operating Costs by Service Option for 2012

An identical analysis appears in Table 5-7 for 2012. In this while costs increase due to more train-miles, more riders accommodated, more locomotives repaired, etc., the proportionality among the service options remains the same. Cloverdale to San Rafael is still the most expensive on a total dollar basis, and Petaluma to San Rafael is still the least expensive.

Table 5-7
2012 Operating Cost Estimates for DMUs and Conventional Equipment
Millions of 1999 Dollars

DMU Cost Category	Healdsburg to San Rafael	Cloverdale To San Rafael	Healdsburg to Petaluma	Cloverdale to Petaluma	Petaluma to San Rafael
Transportation	1.4	1.4	1.1	1.1	0.8
Maintenance of Equipment	1.3	1.3	0.6	0.6	0.6
Fuel	0.2	0.2	0.1	0.1	0.1
Maintenance of Way	1.1	1.2	0.6	0.6	0.5
Facility Maintenance	0.3	0.3	0.3	0.3	0.3

Station Services	0.7	0.7	0.5	0.5	0.4
Insurance	1.3	1.3	1.1	1.1	1.0
General and Administrative	1.5	1.5	1.3	1.3	1.2
Total	7.8	7.9	5.6	5.7	5.0

Conventional Cost Category	Healdsburg to San Rafael	Cloverdale To San Rafael	Healdsburg to Petaluma	Cloverdale to Petaluma	Petaluma to San Rafael
Transportation	1.4	1.4	1.1	1.1	0.8
Maintenance of Equipment	1.3	1.3	0.6	0.6	0.6
Fuel	1.0	1.1	0.6	0.6	0.4
Maintenance of Way	1.1	1.2	0.6	0.6	0.5
Facility Maintenance	0.3	0.3	0.3	0.3	0.3
Station Services	0.7	0.7	0.5	0.5	0.4
Insurance	1.3	1.3	1.1	1.1	1.0
General and Administrative	1.5	1.5	1.3	1.3	1.2
Total	8.5	8.7	6.0	6.2	5.2

FAREBOX RECOVERY

The preceding sections represent the service options in terms of operating costs and revenues for 2002 and 2012. However, these figures should be analyzed on a common basis in order to more fully appreciate the differences. A common unit of analysis that provides for an apples-to-apples comparison of the service options is farebox recovery. This measures the proportion of operating costs that are covered by revenue. This ratio is discernable from the figures shown above.

The farebox recovery ratios for the five service options appear in Table 5-8, Farebox Recovery Ratios by Service Option for 2002 and 2012. This shows that, while Cloverdale to San Rafael is the most expensive on an absolute basis, it is also the option whose revenues cover more of its cost in both planning years. In other words, it is the most efficient option. It should also be noted that over time, efficiency improves. Comparisons of projected farebox recovery ratios for Sonoma – Marin rail service with those of existing commuter rail and transit operations appear in Chapter 6.

Table 5-8
Farebox Recovery Ratios by Service Option for 2002 and 2012
Millions of 1999 Dollars

2002	Healdsburg to San Rafael	Cloverdale to San Rafael	Healdsburg to Petaluma	Cloverdale to Petaluma	Petaluma to San Rafael
Revenue	1.5	1.7	0.5	0.6	0.4
Operating Cost (DMU)	7.0	7.3	5.1	5.5	4.7
Operating Cost (Conv.)	7.5	7.9	5.5	5.9	4.9
Farebox Ratio (DMU)	22%	23%	10%	12%	9%
Farebox Ratio (Conv.)	20%	21%	9%	11%	9%

2012	Healdsburg to San Rafael	Cloverdale to San Rafael	Healdsburg to Petaluma	Cloverdale to Petaluma	Petaluma to San Rafael
Revenue	2.4	2.7	0.8	1.1	0.7
Operating Cost (DMU)	7.8	7.9	5.6	5.7	5.0
Operating Cost (Conv.)	8.5	8.7	6.0	6.2	5.2
Farebox Ratio (DMU)	31%	34%	15%	19%	13%
Farebox Ratio (Conv.)	28%	31%	13%	17%	13%