How the LOSSAN Corridor Can Do More for Southern Californians

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● INTRODUCTION

The LOSSAN-South Corridor connecting Los Angeles with San Diego is the second most significant rail passenger corridor in the United States. Patronage in the corridor is now many times higher than it was when the state started supporting Amtrak-operated *Pacific Surfliners*. However, ridership has plateaued in the last several years, as train congestion has lengthened running times and increased unreliability. The basic alignment of the railroad remains that of the late 19th century single track railroad, inhibiting running time improvements and restricting capacity. It takes almost 3 hours for *Surfliners* to cover the 128 miles from San Diego to Los Angeles, for an average speed of 44 miles per hour.

The Caltrans Division of Rail developed plans to significantly improve the speed and capacity of the corridor. It completed a program-level environmental review of projects along the entire LOSSAN-South Corridor that collectively would allow hourly regional express (also known as "intercity") trains to complete their runs from San Diego to Los Angeles in 1'50", including several intermediate stops, resulting in an average end-to-end speed of 70 mph. There would be increased local commuter service, as well.

The review divides the corridor into segments, and for each segment it identifies two or more alternative projects for improving the rail corridor in that segment. The Record of Decision that the Federal Railroad Administration signed in 2009 finds that rail improvement to the corridor is warranted without identifying which alternative projects to build in each segment. For those more specific decisions, Project Level EIRs will need to be conducted for each segment.

This article's analysis concludes that the Caltrans LOSSAN improvement program can make the LOSSAN-South corridor an effective alternative to the I-5 freeway, competing successfully with longer-distance auto travel between San Diego, Orange, and Los Angeles Counties. The proposed Miramar Tunnel, discussed below, would be a significant first step in bringing the corridor up to the level of the Northeast Corridor between Washington and Boston. (See Intercity Passenger Trains Are Not Commuter Trains)

● THE HISTORY OF THE EXISTING LINE

Today's 128-mile line between downtown San Diego and Los Angeles Union Station is the southern part of the overall LOSSAN Corridor. It runs through the heart of California's three most populous counties (Los Angeles, Orange, and San Diego), and it closely follows the congested I-5 for the line's entire distance. The other part of the LOSSAN Corridor extends northwesterly 104 miles from Los Angeles Union Station to Santa Barbara and another 118 miles beyond Santa Barbara to San Luis Obispo. The EIR/EIS for the Caltrans improvement program deals only with the southern part of the corridor, and that is our focus here. If a rebuilding of the more promising southern part of the corridor proves beneficial, the rebuilding could be extended.

Predecessors of the Atchison, Topeka & Santa Fe Railway built the southern part of the LOSSAN Corridor in the late 1880s. The line was surveyed and built with Victorian age technology in the 1880s when California contained few people. It was originally called the Santa Fe Surf Line, because it ran close to the ocean, coastal bays and lagoons from its southern-most point in National City (several miles south of downtown San Diego) to San Juan Capistrano, where it turned inland. At Fullerton the line joined

Santa Fe's transcontinental mainline, which it used for about 20 miles to Redondo Junction in Los Angeles. It then followed the Los Angeles River for the remaining 2.1 miles to an original terminal (La Grande Station) alongside the river channel at the First Street Bridge. It was extended another couple of miles to Los Angeles Union Station when that station opened in May 1939.

The rapid growth of Los Angeles and San Diego into large cities gave rise to vigorous passenger demand between them in the 1900s, but the public's embrace of autos beginning about 1915 cut into that demand. It was not until 1938 that Santa Fe management fought back, not with improvements to its lightly-built line, but with the introduction of a flashy diesel-powered light weight coach streamliner. Called the *San Diegan,* the streamliner made two round trips daily. In places, it cruised along at 90 mph, whooshing past autos on the adjacent U.S. 101 (now I-5).

Unfortunately, the highest speeds could only be achieved in a few locations, and the streamlined *San Diegan* averaged only 51 mph end to end. The need to negotiate slow passing sidings and numerous tight curves slowed the train down. So did stretches of the route running along beaches, where crowds crossed back and forth over the tracks.

To get the most out of the streamlined trainsets, the Santa Fe upgraded track and signaling before it inaugurated the *San Diegan* service. However, aside from about 25 miles of route between Redondo Jct. and Fullerton, it did not straighten the line's Victorian era alignment nor did it add a second track.[1]

Patronage did respond, however, peaking in 1947 at 1,026,389 annual passengers and remaining near that level for eight more years. In the early 1950s, the Santa Fe Railway bought additional attractive rolling stock for the route, including in 1952 a zippy, self-powered 2-car train (Budd RDCs) that made a non-stop schedule in 2'15" (57 mph average speed---fastest achieved to date). In 1955, patronage still stood above 900,000.

At the beginning of 1956, the RDC train suffered a tragic wreck. Packed with 161 passengers, the 2-car train attempted to negotiate the 15-mph Redondo Jct. curve at 70 mph and overturned with a loss of 30 passengers. The wreck demoralized management, already reeling from the region's relentless freeway expansion. Patronage declined, hitting 615,075 in 1959 and 530,042 in 1963. In 1965 the railroad discontinued all but three round trips per day. When Amtrak took over on 1 May 1971, it further reduced the schedule to two round trips daily plus an additional round trip three times per week. Patronage bottomed out in 1972 at 290,000.[2] Shortly thereafter, Amtrak reinstated three-trains-daily service, and patronage began to inch up.

● SUCCESSFUL EXPANSION OF SERVICE UNDER STATE DIRECTION

Section 403(b) of Amtrak's enabling legislation provided a mechanism for state or local jurisdictions to obtain additional passenger train service beyond Amtrak's core service. The interested jurisdiction would designate an agency to contract with Amtrak for a specified service, and reimburse Amtrak for one-half of the new service's deficit.

In 1974, California state legislation was enacted permitting the counties of Los Angeles, Orange, and San Diego to form a joint powers agency for the purpose of contracting with Amtrak to operate two additional trains between San Diego and Los Angeles. Because the counties could not agree on a service plan however, Caltrans took the lead role in negotiating a contract with Amtrak. Amtrak inaugurated a

[1] Based on an examination of timetables in the Tom Matoff collection.

[2] Sandra Kjerstad Bauer. Edmonton-Calgary Corridor Study, Report IV, "Passenger Rail Service in the San Diego – Los Angeles Corridor." Alberta Economic Development Transportation Services, April 1980 (revised Aug 1981), pp. 34-37.

fourth daily round trip subsidized by the state in September 1976. Other state-subsidized 403(b) frequencies were added in short order.[3]

Spurred by the 1973-74 energy crisis, annual patronage climbed to 394,000 in 1974. Spurred further by additional trains, annual patronage continued to climb, reaching 465,000 in 1976 and 832,000 two years later. The second energy crisis of 1979-80 pushed patronage up to 1,185,000 in 1979. Patronage remained at roughly that level through 1985 and then climbed again. By 2000 it stood at 1,563,318. Around this time, the San Diego – Los Angeles trains were rebranded as the *Surfliners*.

Table 1. LOSSAN Corridor Pacific Surfliner Annual Station Usage, 2019 (LOSSAN-south Stations Are Bolded)

Los Angeles Union Station	590,082	**LAX**
San Diego Station	328,730	**SAN**
Solono Beach	185,050	**SOL**
Old Town San Diego	183,123	**OLT**
Irvine	176,986	**IRV**
Fullerton	148,596	**FUL**
Santa Barbara	141,306	SBA
Oceanside	135,090	**OSD**
Anaheim	121,983	**ANA**
Santa Ana	72,709	**SNA**
Goleta	55,921	GTA
San Juan Capistrano	54,724	**SNC**
Ventura	42,613	VEC
Oxnard	41,876	OXN
San Luis Obispo	32,936	SLO
Chatsworth	31,597	CWT
Van Nuys	31,450	VNC
Burbank	29,764	BUR
Glendale	23,450	GDL
Simi Valley	21,859	SIM
Camarillo	19,669	CML
Carpenteria	16,265	CPN
Grover Beach	10,073	GVB
Moorpark	8,839	MPK
San Clemente Pier	7,807	**SNP**
Gudalupe	6,726	GUA
Surf/Lompoc	4,995	LPS
TOTAL	2,524,219	

Source: LOSSAN Rail Corridor Agency, Pacific Surfliner Station to Station Pairs (2019 Monthly Averages), February 2020.

After a series of studies commissioned by Caltrans, a joint powers agency grew out of the advisory panel made up of representatives of the three counties that had met informally. In 1989 the decision was made to create a new Joint Powers Authority, though it was not until 2012 that legislation was enacted creating the LOSSAN Rail Corridor Agency. The 2012 legislation transferred the responsibility for overseeing and designing the service from Caltrans to the new agency. Caltrans would continue to manage the contract with Amtrak. The legislation is complex. Among its many provisions are requirements for an annual business plan and the continuation of the feeder bus service for the *Surfliner* service. It permits competitive contracting for an operator for the *Surfliner* and does not preclude the expansion of *Surfliner* service.

In the early 1990s, public authorities bought about 300 miles of routes in Southern California from the Santa Fe and Southern Pacific railroads, using proceeds from Prop 116, a state-wide bond measure principally sponsored by TRAC. Included were about 100 miles of the Santa Fe route from San Diego to Fullerton, roughly 25 miles short of Los Angeles Union Station. The gap from Fullerton to Los Angeles now remains under the private control of the BNSF (then the Santa Fe). The huge purchase of private railroad right-of-way enabled an expansion of LOSSAN *Surfliner* service as well as the establishment of commuter trains throughout Southern California. *Pacific Surfliners* increased both in daily round trips as well as by extension northwesterly from Los Angeles to Santa Barbara and San Luis Obispo along the old Southern Pacific Coast Line.

Southern Pacific's Coast Route north of Los Angeles has historically shown less patronage-generating potential for interregional express trains than Santa Fe's Surf Line. This can be seen by reviewing the actual scheduled service patterns--Southern Pacific never operated fast, multi-daily streamliners in dedicated service between Santa Barbara and Los Angeles similar to the Santa Fe's *San Diegans*. It instead operated a luxury coach train and an overnight luxury sleeper train in each direction between Los Angeles and San Francisco. The overnight train stopped in Ventura and Santa Barbara, while the coach train stopped in just Santa Barbara.[4]

[3] This material is largely taken from Bauer, as well as, LOSSAN Rail Corridor Agency, April 2019, p. 8.

[4] There also was a slow, all-stops primarily mail train that ran between Los Angeles and San Francisco, and a daily, slow all-stops local that made a round trip between Los Angeles and Santa Barbara. This train was discontinued in the mid-1930s. Before 1941 there also was a second overnight sleeper train between Los Angeles and San Francisco. From the Matoff archive.

The relatively light use of stations north of Los Angeles demonstrates the weaker patronage potential in that segment compared to that south of Los Angeles (Table 1). Of the 590,000 LOSSAN North and South *Surfliner* passengers who began or terminated their trips at Los Angeles Union Station in 2019, only 78,000 were coming from or going to LOSSAN North stations. The other 511,000 passengers were coming from or going to stations on LOSSAN-South.

The difference is partly but not entirely explained by fewer *Surfliners* operating north of Los Angeles. By 2019 thirteen Surfliner round trips operated each day between San Diego and Los Angeles on LOSSAN-South. Five of these trains ran through 104 miles northwest beyond Los Angeles to Santa Barbara. Two of those five extended another 118 miles through lightly populated territory to San Luis Obispo.

Commuter trains also entered the mix. Rail commuters travel shorter distances, and the trains they use typically stop more frequently than interregional express trains. Their fares are lower, as well. [See our report Intercity Passenger Trains Are Not Commuter Trains] Their purpose is to take workers from suburban homes to their place of work.

The Southern California Regional Rail Authority, a joint powers agency composed of the transportation agencies of five Southern California counties, operates three commuter train lines over the LOSSAN Corridor under the marketing name of *Metrolink*. One begins in Oceanside in northern San Diego County and runs north to Los Angeles Union Station over LOSSAN-South. A second line has trains mostly starting at East Ventura and running southeasterly to Los Angeles Union Station over LOSSAN-North. A third connects San Bernardino and Riverside with Irvine and Oceanside. It uses the LOSSAN-South Corridor from near Orange to Oceanside. In addition, the San Diego North County Transit District runs commuter trains under the marketing name of *Coaster* from Oceanside south to downtown San Diego.

● MAKING LOSSAN-SOUTH A MODERN RAILROAD

Since the mid-1970s, improvements to the LOSSAN Corridor have emphasized the addition of more frequencies for both commuter trains and *Surfliners*, as well as the building of more stations. This resulted in more trains running at slower speeds, with more delays. Track rebuilding, including added sidings and signals, did not stem the slowing and deterioration of service. Despite the rebuilding, the railroad between San Diego and Los Angeles remains mostly a single-track affair following a curvy alignment laid out in the Victorian era. Increasing numbers of slow trains struggle to keep to schedule as they duck in and out of sidings to get by opposing trains. As transit operators continue to add more trains, the line becomes even slower and more subject to delays. *Surfliners* now average only 44 mph between San Diego and Los Angeles compared to the 1976 average of 49 mph--and that's only when they are on time!

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Segment	Passenger Boardings	Passenger Miles	Average Trip Length (miles)
Within North	403,759	33,352,429	82.6
Between North and South	404,671	66,218,149	163.6
Within South	1,737,612	145,001,616	83.4
TOTAL	2,546,042	244,572,194	96.1

Sources:
Pacific Surfliner Schedule Effective 20 July 2019 through 01 April 2020.
LOSSAN Rail Corridor Agency, Pacific Surfliner Station to Station Pairs
(2019 monthly averages), Feb. 2020

Table 3. Estimate of LOSSAN Demand Borne by Commuter Trains

Route	Daily PM/ route-mile	One-way route-miles	Daily PM	Average Trip Length (miles)
Coaster Oceanside-San Diego	1560	82	127,920	26.4
Metrolink Oceanside-LA	1697	174	295,278	29.2
Metrolink Santa Ana - Oceanside	1697	102	173,094	29.2

Source: National Transit Data Base, extracted with the Florida Transportation Information System on 14-15 July 2019

The *Pacific Surfliner* service is barely distinguishable from the Coaster and Metrolink commuter services. It actually is as slow or slower than commuter trains operating on the same tracks, even though

commuter trains make more stops. The *Surfliners* are more unreliable, as well, compared to commuter trains using the same tracks. The one huge difference is the average trip distance of *Surfliner* passengers (83.4 miles shown in Table 2) and commuter users (26 to 30 miles, shown in Table 3). Even though many trains have been added to the schedule, there has been little recent growth in regional express train usage in LOSSAN-South, despite increases in population, employment, and congestion on I-5. This indicates that while regional express train riders demand a very different type of service (much faster) than do commuters, they are not getting it. Experience with the Northeast Corridor suggests that the stagnation in *Surfliner* ridership is the result of travelers not being offered the faster service they demand and are willing to pay for.

Why are *Surfliner* passengers not getting the faster service they want? It is not for lack of demand. Demand patterns for commuter and regional express rail service in California and in the Northeast are more similar than is commonly realized. What sets the LOSSAN Corridor apart from the Northeast Corridor is the lack of differentiation between the average speeds of regional express and commuter trains. Commuter trains operate along most of the length of both the LOSSAN and Northeast corridors at similar speeds and fares.

What differs between the two corridors is the speed of regional express trains. The Northeast regional travel market is willing to pay high fares for fast service. Amtrak runs its Northeast regional express trains at average speeds of 55 to 78 miles per hour in contrast to the 40 to 45 mph average speeds of *Pacific Surfliners*. Northeast Corridor passengers strongly support the service, paying high fares and filling most seats. Passenger revenues are high enough to cover operating and maintenance expenses.

TRAC Board Member John Deter attributes the poor performance of the *Surfliner* service to parochial governance:

> I think one of the problems in getting LOSSAN to run *Surfliners* as a proper regional express service is its governance -- essentially it is a JPA representing county transportation agencies. Many of the same county agencies are part of SCRRA (MetroLink, which does the dispatching for *Surfliners* as well as for its own commuter trains), and they are probably biased toward commuter rail rather than regional express rail.
>
> Furthermore, SCRRA owns 100 route-miles from Moorpark to the Orange-San Diego county line, with BNSF owning the 25 miles from Los Angeles to Fullerton in the middle. North County Transit District owns the 50 miles or so in San Diego county. Not owning the tracks puts LOSSAN in a very weak bargaining position with MetroLink and NCTD in scheduling, capital improvements, etc.[5]

While bias in dispatching contributes to *Surfliners'* slow speeds and poor on-time performance, insufficient infrastructure in the LOSSAN Corridor is the heart of the problem. Amtrak can operate both quality commuter service and quality regional express service on the Northeast Corridor because it has the infrastructure to allow simultaneous operation of two classes of frequent trains, operating at different average speeds and catering to different markets. One class of traveler needs long station-spacing and high speeds and is willing to pay high fares to get those qualities; the other requires close station-spacing (and, as a result, lower speeds) and is not willing to pay high fares. In the era preceding

[5] E-mail, John Deeter to Greg Thompson, 06 June 2021.

the automobile, private Northeastern railroads, most notably the Pennsylvania Railroad, built infrastructure to allow such dual classes of service in response to demand as the Northeast urbanized. In contrast, private railroads in California built what we now call the LOSSAN Corridor during much the same time period, when the passenger demand was low. Southern California's great waves of population and economic growth came later, after the auto had become king. State and federal governments invested vast sums on a freeway-based transportation system to serve the demand for auto travel.

The 2007 Caltrans/FRA Program EIS/EIR addressed the need for rail infrastructure in the LOSSAN-South Corridor to accommodate two classes of demand. It divided the corridor into segments, and for each segment it identified a do-nothing alternative, and two or more projects for improving the corridor. Generally, the improvement alternatives consisted of implementing a project in each segment that speeded up service considerably while increasing capacity at significant cost, and one or more projects that took even more time out of the schedule at additional cost. The Program-Level EIR characterized the three alternatives and their costs. In 2009 Caltrans and the Federal Railroad Administration signed a Record of Decision, which found that either of the two levels of rail improvement should be undertaken by pursuing project-level EIRs in each segment, leading to decisions of which specific projects to implement.

Major projects included a tunnel through San Clemente to move the tracks away from the beach, another tunnel through Del Mar to remove the tracks from the crumbling bluffs, and another tunnel project to bypass the Miramar Grade, removing significant curvature and grades from the corridor. For each of these projects there are two or more alternatives, and project level EIRs need to be undertaken to determine courses of actions. Unfortunately, the California State Transportation Agency has effectively tabled the EIR in favor of pursuit of the High-Speed Rail project in the San Joaquin Valley and further freeway expansion.

Now it appears that the EIR is coming back to life. Controversy over widening of I-5 led to review of proposed improvements to the rail corridor in the vicinity of the Miramar Grade. Among the most important of the improvements studied is the Miramar Tunnel, which would tunnel under the mountain range immediately north of San Diego, bypassing the winding eight-mile Rose Canyon alignment of the original 19th century Santa Fe line.

The Cleveland National Forest Foundation, a San Diego-based conservation advocacy organization, filed a 2013 legal challenge to the I-5 widening, citing its unmitigated greenhouse gas and sprawl-inducing impacts. That resulted in a settlement agreement to jointly determine the feasibility of a Miramar tunnel to speed up passenger trains on the LOSSAN Corridor. The tunnel would speed up *Pacific Surfliners* and *Coaster* commuter trains while serving one of San Diego County's major growth nodes, University Town Center, thereby attracting auto users.

The goal is transformation of the San Diego-Los Angeles rail corridor into a modern rail traffic artery. What it lacks is the quality of infrastructure possessed by the Northeast Corridor to accommodate that demand. The Miramar Tunnel project can be the first step of that renewal. If such an upgrading is successful, it could serve as a prototype for other upgrades, including the Del Mar and San Clemente bypasses, the conversion of the Santa Clarita LOSSAN-North service from commuter to regional express, the Capitol Corridor, and others.[6]

[6] Bauer's report refers to the U.S. Department of Transportation, "High-Speed Ground Transportation Alternatives Study," 1973. It also references National Academy of Sciences, "High-Speed Ground Transportation Alternatives Study," 1975. The latter studied 17 corridors of less than 400 miles for potential higher speed rail development. See also U. S. Department of Transportation, Federal Railroad Administration. "High Speed Ground Transportation for America,"1997, which ranks the San Diego-Los Angeles corridor right behind the Northeast Corridor for passenger rail development potential.

●THE CALTRANS PROGRAM FOR THE LOSSAN-SOUTH CORRIDOR

The authors of the LOSSAN Corridor EIR present a realistic program for establishing a first-class, conventional-gauge regional express rail facility hosting both hourly regional express trains running at an average end-to-end speed of 70 mph and commuter trains running at average speeds of between 30 and 40 mph.

The programmatic EIR calls for:

- Cars and locomotives similar to those in use today
- Rebuilt infrastructure throughout
    - Single track replaced with double track, with stretches of 3 and 4 tracks
    - Line relocations using cut and cover subways under major roadways or tunnels through ridges
        - To remove tight curves
        - To remove most at-grade crossings with vehicles and pedestrians
        - To relocate tracks away from crumbling bluffs overlooking the ocean
        - To remove lengthy detours
    - To add the University Town Center station to connect with one of the region's most important financial, research, and commercial centers, including three major research hospitals and the University of California at San Diego. (The patronage-generating potential for this station should be similar to that of the Old Town San Diego station.
    - To facilitate operation of 16 daily Surfliner round trips on hourly headways while simultaneously accommodating 27 daily Coaster, 29 daily Metrolink commuter trains north of Irvine, 8 to 18 Metrolink trains between Oceanside and Irvine and several freight trains per day.
    - To allow *Surfliners* (stopping at some intermediate stations) to maintain average speeds throughout of around 70 mph.

The capital cost for accomplishing these performance standards would be $5.4 billion in 2007 dollars ($6.7 billion in 2019 dollars) for the more expensive, higher quality set of project alternatives. In 2009, a federal Record of Decision (ROD) adopting that alternative was signed. While the EIR/EIS may need to be updated, it will show even greater benefits due to increased traffic congestion.

The EIR estimates the annual operating and maintenance expense of the existing 13 *Surfliner* roundtrips (presumably for just LOSSAN-South) to be $71.7 million in 2019 dollars. The O and M (including line maintenance) for 16 roundtrips per day operating over the transformed LOSSAN-South corridor is estimated to be $127.6 million in 2019 dollars.

We suggest that the modernized railroad should eventually host half-hourly express trains (32 daily round trips), speeding from San Diego to Los Angeles in 1'48" at an average speed of 69 mph. It is likely that this average speed can be attained only with the elimination of some intermediate stops. As an illustration, in our demand estimation we relegate 3 existing *Surfliner* stops to commuter status. These are Anaheim, Santa Ana, and San Juan Capistrano. The average trip length of passengers using these redefined stops is 59 miles compared to 95 miles for passengers using the remaining *Surfliner* stops in LOSSAN-South. Passengers using the redefined stops would use commuter trains, which would operate at hourly or shorter headways. Table 5 below reflects these assumptions.

We also suggest that reconstruction of LOSSAN south include the evaluation of an alternative to Los Angeles Union Station. Not too long ago, there was consensus to improve the operational utility of regional express and commuter trains using Union Station by extending most or all of the stub-end tracks in the station into through-tracks. This would be accomplished by extending them south over the US 101 Freeway and then curving them east to rejoin the main passenger tracks along the west bank of the Los Angeles River. Since then, the project has been taken over by developers who want to create a retail mall below the tracks. The proposal now is to raise the entire track structure of Union Station by 15 feet at a cost of over a billion dollars of transportation improvement funds (not private equity), to create room for a retailing emporium. Such a raising of the tracks is not required for the mere extension of tracks over the Hollywood Freeway.

Instead there should be a feasibility study of returning the rail terminal to the location of Santa Fe's original station on the passenger mainline west of the Los Angeles River and beneath First Street. The design could include convenient transfer connections to light rail and the Red Line subway. Regional express and commuter trains could shave significant minutes from their running time by using this location instead of Union Station, while saving over a billion dollars in capital expense.

● A SCENARIO FOR IMPROVED SERVICE

Table 5 summarizes results of a possible scenario of Northeast Corridor-like *Surfliner* service on an improved alignment. Table 5 reflects a policy of having train users pay the same per passenger-mile fares as before the improvements: *Surfliner* fares remain at $0.35 per passenger-mile.[7]

Table 5 Post-Project Rail Passenger Traffic in LOSSAN South

Category	Annual Passengers Within LOSSAN-South	Annual Passenger Miles Within LOSSAN South	Average Trip Length (miles) Within LOSSAN-South	Daily Passenger-Miles in LOSSAN-South	Gross revenue earned within LOSSAN-South
Intercity					
Surfliner Passengers To Receive Improved Service	3,787,782	356,562,902	94	1,188,543	$124,797,016
Surfliner Passengers Between LOSSAN North and South	821,138	63,227,626	77	210,759	$22,129,669
Commuter					
LOSSAN-Surfliner Passengers Redefined as Commuters	547,656	32,250,624	59	107,502	$6,450,125
Coaster: San Diego-Oceanside	1,230,000	31,980,000	26	127,920	$6,396,000
Metrolink: Oceanside to Los Angeles	2,545,500	73,819,500	29	295,278	$14,763,900
Metrolink: Oceanside to Orange	1,492,190	43,273,500	29	173,094	$8,654,700
R2R passengers	375,000	14,250,000	38	57,000	$2,850,000
Total	10,799,265	615,364,152	57	2,160,096	$186,041,409
Travel Time Elasticity of -1.3; Policy with $0.35 per p.m. fares, 32 daily departures					

Five daily *Surfliner* round-trips operate in each direction from Goleta (the UC Santa Barbara stop west of central Santa Barbara) to San Diego. Between Goleta and Los Angeles, they operate as they do now over the existing unimproved corridor, with an average speed of 40 mph. At Los Angeles, however, the *Surfliners* enter the transformed LOSSAN-South trackage, where they average 69 mph, including stops, for the remaining 120 miles to San Diego. (The rebuilt route is 8 miles shorter.)

[7] The Pacific Surfliners grossed $86,319,000 in FY 2018, the most recent year that revenue figures are available. If the corridor total passenger-miles carried in FY 2018 were about the same as the 244,572,194 annual passenger-miles reported in Table 2 (page 8), then the average fare for passengers using the Surfliners was about $0.35 per passenger-mile.

In addition to passengers riding the half-hourly service (twice the service frequency called for in the EIR) in the LOSSAN-South segment, five of the fast through-trains also carry passengers between LOSSAN-North stations and various stations in LOSSAN-South. This scenario increases total corridor annual gross passenger revenue, from $95.4 million (shown in Table 4, page 9) which reflects "before" conditions, to $186 million after implementation (Table 5, above). The added commuter revenue in Table 5 is derived from the elimination of three *Surfliner* stops and the redefining as commuters of the *Surfliner* passengers who had previously used those stops.

Speeding up and increasing *Surfliners* frequency would add 812,000 additional daily passenger-miles to the 587,000 No-Project *Surfliner* passenger-miles. Adding the commuter patronage of 761,000 passenger-miles would total 2.2 million rail passenger-miles, or 7.9% of the combined freeway and rail traffic in the corridor (see Table 7 on page 14), a near doubling.

● RIDERSHIP ANALYSIS FOR THE CORRIDOR

Table 2 reports *Pacific Surfliner* annual patronage and passenger-miles for FY 2019, the last full year of data before the onset of the COVID-19 pandemic. The figures are broken down by segments of the total LOSSAN Corridor. These include passengers who ride between stations entirely within LOSSAN-North (e.g., Santa Barbara and Los Angeles), those who ride between stations entirely within

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LOSSAN-South (e.g., Irvine and Old Town San Diego), and those who ride between segments (e.g., Santa Barbara and San Diego).

On average, regional express *Surfliner* passengers traveling entirely inside of LOSSAN-South rode about 83 miles, yielding 145,001,616 annual passenger-miles (Table 2). Converting the annual passenger-miles to daily passenger-miles can be done with an annualization factor, reflecting somewhat lighter daily traffic on weekends. We use 300,[8] yielding an estimate of 483,389 weekday rail regional express passenger-miles.

The grand total of 2,546,042 annual boardings shown here in Table 2 is about 500,000 below the 2,946,300 *Pacific Surfliner* figure shown in the Business Plan for FY 2018. The difference is that the Business Plan figure includes passengers riding on R2R tickets, a program that heavily discounts tickets

[8] We use a figure of 260 when we convert commuter annual patronage to week day patronage, reflecting the much lighter weekend and holiday patronage of commuter trains compared to their week day patronage.

for commuters using *Surfliners* during times when commuter trains do not run.[9] Seventy-five percent of R2R passengers travel between just five station pairs: Los Angeles Union Station on the one hand, and Fullerton, Anaheim, Santa Ana, Irvine, and Oceanside on the other.

To the throughput of travelers entirely within LOSSAN-South, we add those passengers travelling between north and south. We assume that roughly half of the annual passenger-miles generated in this category are accrued in LOSSAN-South. That's one half of 66,218,149 annual passenger-miles (Table 2). Converting that to a daily figure with the 300 factor yields 103,866 daily passenger-miles.

Next is an estimation of the traffic carried by Coaster and Metrolink commuters. At the base of the estimation are data from the National Transit Data Base (NTDB data) for FY 2017. The NTDB contains summary statistics for all commuter train operators in the United States. In the case of LOSSAN-South, there are two operators. The San Diego North County Transit District operates only one route, that from Oceanside to San Diego, 41 miles on the LOSSAN-South corridor. The Southern California Regional Rail Authority, on the other hand operates several routes, including two on the LOSSAN-South corridor.

Table 3 contains total passenger-mile data for each of the two carriers. The Coaster operates 82 one-way route-miles, and each of those route-miles generates 1560 passenger-miles per day. Multiplying the two numbers together, we see that the Coaster carries 127,920 passenger-miles per day.

Table 3. Estimate of LOSSAN Demand Borne by Commuter Trains

Route	Daily PM/ route-mile	One-way route-miles	Daily PM	Average Trip Length (miles)
Coaster Oceanside-San Diego	1560	82	127,920	26.4
Metrolink Oceanside-LA	1697	174	295,278	29.2
Metrolink Santa Ana - Oceanside	1697	102	173,094	29.2

Source: National Transit Data Base, extracted with the Florida Transportation Information System on 14-15 July 2019

The Metrolink figures in Table 3 are averages over the entire Metrolink system. In 2017 that system generated 1697 passenger-miles for each one-way route mile that it operated. Metrolink's Oceanside-LA route has 174 route miles. If those 174 miles are reflective of the passenger-mile-generating potential of the system's average route mile, then the route attracted 295,278 passenger-miles per day in 2017.

One more category of passengers remains. This is the 500,000 R2R commuters who used *Surfliner* trains in 2019. As noted above, roughly seventy-five percent of these passengers traveled between Los Angeles on one hand and Fullerton, Anaheim, Santa Ana, Irvine, and Oceanside on the other in 2019. All of these station pairs are in LOSSAN-South. The weighted average distance of these passengers was 38 miles. Because they were commuters rather than regional express passengers, most of them would have traveled on week days.

To recapitulate, on the eve of the Covid-19 pandemic, the several rail services using LOSSAN-South carried about 1.24 million daily passenger-miles (Table 4). About 0.48 million of these were *Surfliner* passengers who both began and ended their trips in the southern part of the corridor. An additional 0.10 million of these were *Surfliner* passengers who traveled between the southern and northern parts of the Corridor. (The figure reflects only the passenger-miles incurred on the southern part of the corridor.) About .65 million passenger-miles accrued from commuters and R2R passengers riding in the southern part of the corridor.

[9] These are called R2R passengers. Their average trip length was about 38 miles per LOSSAN Rail Corridor Agency, 2019 Average Month Station to Station matrix for R2R passengers, Feb. 2020.

Table 4. Existing (2019) Rail Passenger Traffic in LOSSAN-South by Passenger Category

Category	Annual Passengers Within LOSSAN-South	Annual Passenger Miles Within LOSSAN South	Average Trip Length (miles) Within LOSSAN-South	Daily Passenger-Miles in LOSSAN-South	Gross revenue earned within LOSSAN-South
Intercity					
Surfliner Passengers Within LOSSAN-South	1,737,612	145,001,616	83	483,339	$50,750,565
Surfliner Passengers Between LOSSAN North and South	404,671	31,159,667	77	103,866	$10,905,883
Commuter					
Coaster: San Diego-Oceanside	1,230,000	31,980,000	26	127,920	$6,396,000
Metrolink: Oceanside to Los Angeles	2,545,500	73,819,500	29	295,278	$14,763,900
Metrolink: Oceanside to Orange	1,492,190	43,273,500	29	173,094	$8,654,700
R2R passengers	375,000	14,250,000	38	54,808	$2,740,400
Total	7,784,973	339,484,283	44	1,238,304	$94,211,448

● WHAT THIS TRANSFORMATION WOULD ACCOMPLISH

Reducing on-board rail travel time to become competitive with the auto would increase patronage. The Program EIR/EIS does not discuss this point except by providing the information in Table 6 below, which is abstracted from a study by Parsons-Brinkerhof.

Table 6. Intercity Trip Table Summary, LA-SD Market (Annual Trips)

Year	Auto	Intercity Rail	% Rail	Source
No-Project Alternative--1997	34,870,032	934,322	2.61%	Parsons Brinkerhof 2003
Rail Improvement Alternative--2020	42,023,218	5,770,000	12.07%	Parsons Brinkerhof 2003, Amtrak California

The study defines auto and rail trips as those traveling between major trip attractors within the rail corridor, but it does not identify the trip attractors nor does it identify how the number of trips by either auto or rail were collected. Unfortunately, the authors could not find the cited documents.

Because patronage forecasts or their summaries for the EIR/EIS could not be found, we estimated rail patronage changes with use of a constant elasticity model. The elasticity of demand with respect to a variable that affects demand (e.g., on-board travel time) is defined as the percentage change in demand resulting from a one percent change in the variable. Elasticities can be derived from ridership changes resulting from past rail service adjustments. Those calculated elasticities are then used to estimate patronage changes that would occur from future speed-ups in other corridors.[10]

For example, it is observed that 24,564 passengers traveled by *Surfliner* each month between Los Angeles and San Diego in 2019. That number reflects population and employment around each of the two stations, ease of access, travel time, fares, frequencies, the nature of competition, and many other variables. The onboard travel time between Los Angeles and San Diego is observed as 174 minutes. It is proposed to make changes that would reduce the onboard travel time to 103 minutes. An elasticity of -1.3 is used to estimate how the reduced travel time might affect demand. (The minus sign indicates that travel time and demand move in opposite directions.) The choice of -1.3 is based on the average of elasticities of rail demand with respect to on-board travel time observed from several past high-speed rail implementations, including Paris-Lyon phase 1 (-1.6), Madrid-Barcelona (-1.3), Madrid-Seville (-1.2), and Paris-Lyon phase 2 (-1.1).[11] The change in demand then can be estimated as 24,564 *

[10] For method, see R.Balcombe et al. *The Demand for Public Transport: A Practical Guide.* TRL Report TRL 593, 2004. Ch. 5, Demand Functions and Elasticities, pp. 39-44.

[11] Maria Borjesson, KTH "Forecasting Demand for High Speed Rail," CTS Working Paper 2012:12, Center for Transport Studies, SE-100, Stockholm, Sweden.

(103/174)^-1.3 That yields forecasted patronage of 52,866. This process is repeated for every pair of stations affected by the improvement to the line and summarized in Table 5.

Elasticity of patronage with respect to fares is assumed as -0.66. For decades transit planners have used fare elasticity near -0.33, but experience with high-speed rail indicates higher fare elasticities. The fare elasticity used here is -0.66.[12] For frequencies, we define the variable as the number of daily departures. The elasticity that we use in conjunction with that variable is 0.40. This value is based on urban transit demand studies that indicate that more daily departures increase patronage but not proportional to the increase in departures.

Annual rail boardings predicted by this model are forecast as 5,561,247 (sum of the first three lines in Table 5 on page 7). Interestingly, this figure comes remarkably close to the 5,770,000 annual boardings forecast by the P-B model shown above in Table 6. On the other hand, our model forecasts No-Project patronage several fold greater than theirs. This difference in initial conditions between the two models could arise from PB benchmarking the No-Project condition in the year 1997, when the corridor had less service and less highway congestion than the corridor did in 2019, our No-Project baseline year. Overall, we have confidence that our model comes close to predicting how the public would respond to the level of service that we outline.

COMPARISONS OF FUTURE RAIL AND AUTO VOLUMES

To what measure should the enhanced rail usage be compared? As noted above, the PB Model uses auto traffic between major activity centers within the corridor. Unfortunately, we were unable to find a definition of major activity centers in the corridor, nor did we discover the method of measuring auto and rail trips between such centers. We offer another possibility. This is to compare the volume of rail usage in the corridor, measured in passenger-miles, with the volume of passenger-miles using the nearby I-5/U.S. 101 corridor that closely follows the rail line from beginning to end.

The freeway is divided into post segments as close as 0.037 miles apart to 9.299 or more miles apart. In 2016 Caltrans measured the daily traffic volume for each segment. The volume times the distance of each segment yields VMT for the segment. Summing segment VMT over all segments in the corridor yields corridor highway VMT. Another Caltrans study from about 2015 documents the percentage of segment VMT made up of trucks (about 5% for our corridor), and environmental documents show that Caltrans uses a figure of about 1.2 when converting non-truck VMT to passenger-miles traveled. (PMT).

This method reveals that as of 2017 the LOSSAN freeway between Centre City San Diego and downtown Los Angeles accommodated about 30 million person-miles traveled on a typical weekday (or about 7,133 million person-miles annually). Table 4 (page 9) shows that the *Surfliner* and commuter rail services using the corridor accommodated about 1.24 million passenger-miles in 2019. Rail's share of the rail plus auto traffic was 4.5%. These figures are displayed in Table 7.

Table 5 (page 7) forecasts the *Surfliner* results of project implementation. (Our calculations of ridership increases included only *Surfliner* ridership.) Speeding up *Surfliners* and doubling their frequency would add 822,000 additional daily passenger-miles to the 587,000 No-Project *Surfliner* passenger-miles. Adding the commuter patronage of 761,000 passenger-miles would total 2.3 million

[12] *Ibid.*

rail passenger-miles, or 7.9% of the combined freeway and rail traffic in the corridor, a near double. These figures are also displayed in Table 7, below.

LOSSAN IMPROVEMENT AND INDUCED DEMAND ON THE FREEWAY

When a freeway becomes congested, such as the I-5 freeway following the LOSSAN corridor, it is natural to assume that widening the freeway will remove the congestion. That is because traffic using the freeway is thought to be a fixed amount that will flow freely once it is given more room, such as by adding a lane. In reality, it is observed that traffic expands to fill the additional space, a phenomenon known as induced demand. When traffic engineers build ever-larger facilities to relieve congestion, they induce demand by interfering with the equilibrium balance between the supply of highway capacity and the demand to use it.

An increase in highway capacity reduces (temporarily) travel time, the only cost directly borne by freeway users. When cost goes down, usage goes up. This is induced demand. The new lanes will entice users to come back to the freeway who in earlier times had given up on it because of congestion. They might switch back from a longer but less congested road, or from traveling at a time of less congestion, or from working at home, or from using trains, or from just not traveling at all.

The I-5/US 101 freeway that follows the LOSSAN Corridor between Centre City San Diego and Union Station Los Angeles carries about 7,133 million annual passenger-miles over this stretch, as shown in the previous section. Widening the freeway in that stretch by one lane in each direction would induce another 2140 million annual passenger-miles, a 30 % increase in freeway use.[13]

CONCLUSION

Induced demand takes on a critical role in transportation planning in the Age of Climate Change. The leading source of GHGs in California, auto use, keeps growing, even as the State is working throughout the economy to reduce GHG emissions. To achieve its climate goals, the State is not only encouraging the adoption of electric vehicles, it is adopting policies to slow and stop the growth of auto use. The implication of induced demand is that those policies will necessarily include increasing the cost of driving: stopping the expansion of freeway capacity and charging tolls for driving. That will require a

[13] The UC Davis Institute of Transportation Studies has developed an induced traffic calculator, for use with data from California's Metropolitan Statistical Areas. The estimate for this paper requires the use of the calculator for two adjoining MSA's: San Diego – Carlsbad and Los Angeles - Long Beach – Anaheim. The addition of a lane in each direction to the San-Diego – Los Angeles freeway would result in 114.6 added lane-miles to the San Diego – Carlsbad MSA and 127.2 added lane-miles to the Los Angeles – Long Beach – Anaheim MSA.

According to the calculator, the lane-mile additions would induce 1,095 million annual VMT in the former MSA and 783 million annual VMT for the latter MSA, for a total of 1,878 million induced annual VMT. Roughly five percent of the VMT in this corridor was composed of trucks in 2016 according to a Caltrans study, and Caltrans environmental documents show that it uses 1.2 as the average occupancy of passenger vehicles. These factors reveal that roughly 2,140 million annual passenger-miles would be induced by the two additional lanes.

The calculator is available at https://travelcalculator.ncst.ucdavis.edu/ and was accessed by Greg Thompson on 17 April 2021.

transformation in values in where new housing and jobs are built: Auto-dependent development--suburban sprawl--is incompatible with reducing GHGs. These new policies will require the simultaneous provision of alternative modes of travel, including the proposed improvements to the LOSSAN Corridor.

Table 7. Comparison of Rail and Freeway Usage

	Millions of Passenger-Miles Annually	% of Total
Rail Usage		
Existing Surfliner (2019)	176	
Total commuter patronage (2019)	163	
Total LOSSAN-South (2019)	339	4.5%
Patronage growth: proposed Improvements to LOSSAN-South	276	
Total rail usage in Corridor after improvements	615	7.9%
The above with 2-lane addition to I-5/US 101 in Corridor	615	6.2%
Freeway Usage		
2016 I-5/US 101 usage parallel to LOSSAN Corridor	7133	95.5%
Induced demand from 2-lane addition to I-5/US 101 in Corridor	2140	
Total	9273	93.8%
Total Corridor Usage		
Total Rail + Freeway patronage (2019)	7,472	
Total Rail + Freeway patronage with LOSSAN improvements	7,748	
The above with 2-lane addition to I-5/US 101 in Corridor	9,888	

It is immediately apparent from Table 7 that improvements to the rail corridor are not a replacement for additional freeway lanes. They may well be the best achievable option, though, given the challenges of climate change. The induced freeway traffic from the construction of additional freeway lanes would decrease the improved rail share from 7.9% to 6.2% (Table 7). If some of the induced freeway traffic were former rail users, the rail share of corridor traffic could drop well below 6.5%. Widening freeways will come to be seen as obsolete, because the resulting increase of freeway traffic and decline of rail traffic of that magnitude would cause a significant increase in greenhouse gas emissions.

Because regional express passengers desire to travel further than commuters, they demand faster trains to cut down on their travel time. If they don't get the service they want, they drive. Improvements to rail services in dense regional travel corridors, such as San Diego to Los Angeles, would offer longer-distance corridor travelers attractive alternatives to driving. It appears that demand will be high enough to pay for operating expenses.

The LOSSAN Corridor has the potential for carrying a significantly larger share of corridor traffic if it is improved to achieve auto-competitive speeds (70 mph average) for interregional *Surfliner* trains, along with carrying the slower commuter trains that make many stops. In addition to curtailing freeway expansion, a policy embracing dual levels of service on the same right-of-way would make the LOSSAN corridor similar to the busy Northeast Corridor. Now is the time to take the 2009 Caltrans plans for LOSSAN off the shelf and turn them into reality. Beyond those improvements, even more capacity could be achieved by adding more trains per day and building additional passing tracks where needed.

Editor's Note: Because LOSSAN regional express service may be able to pay for its own operations, TRAC believes this corridor is an excellent candidate for a Public-Private Partnership.