Central Florida Commuter Rail Transit Project: Phase I Before-and-After Study (2019)

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Central Florida Commuter Rail Transit Project, Phase I; Orlando, FL

Phase I of the Central Florida Commuter Rail Transit Project introduced a 12-station, 32-mile commuter rail line into the Orlando, FL, metropolitan area. Commuter rail service on the project operates under the name SunRail. The project extends from its northern terminus in DeBary, south 26 miles to downtown Orlando, and then six miles further south to an interim southern terminus at Sand Lake Road. Phase I opened to service in July 2014 and is the subject of this Before-and-After Study. A Phase II project opened in December 2018, extending the line another 17 miles further south to Poinciana. The outcomes of the Phase II project will be documented in a separate Before-and-After Study.

The Phase I project is located entirely within a railroad right-of-way purchased by the Florida Department of Transportation (FDOT) from CSX Transportation (CSXT) in November 2011. Figure 1 is a map of the railroad corridor as well as the Phase I project and its station locations.

The project was developed and built by FDOT. SunRail service is currently operated by FDOT but will transition to the Central Florida Rail Commission by June 2021.

Planning for improved transit service in the corridor began in 2004, when FDOT, the Central Florida Regional Transportation Authority (doing business as LYNX), Volusia County Metropolitan Planning Organization (MPO), and METROPLAN ORLANDO (the Orlando MPO) conducted a Commuter Corridor Alternatives Analysis. The study resulted in a Locally Preferred Alternative (LPA) that was a 15-station, 54-mile commuter rail project to be built in the former CSX corridor. This LPA entered New Starts Preliminary Engineering (PE) in 2007.

The proposed project underwent three significant changes early in PE. First, the southern leg shortened by 17 miles, relocating its terminus to Sand Lake Road, in order to reduce the costs and risks of a starter line in the metro area. Second, the northern terminus in Debary was relocated four miles to the south to avoid neighborhood impacts associated with a new access road to the initially proposed station location. Third, a station was added at Maitland. Together, these early changes produced a substantially different proposed project, 32 miles long, with 12 stations, that was the subject of all further engineering, environmental, planning, and ridership forecasting efforts. Because the original LPA was abandoned early in PE, this Before-and-After Study treats the revised LPA as the starting-point definition of the project at entry into PE.

This revised LPA entered New Starts Final Design (FD) in 2008. The Federal Transit Administration (FTA) and FDOT entered into a Full Funding Grant Agreement (FFGA) in 2011 and the project opened to service in May 2014.

Physical scope

The project is entirely at-grade within the former CSXT railroad right-of-way. The physical scope of work focused on upgrading the existing railroad tracks, grade crossings and train control infrastructure to increase train capacity and improve safety; purchasing passenger trainsets; adding passenger stations; and building a Vehicle Storage and Maintenance Facility (VSMF) and an Operations Control Center (OCC). Track-capacity upgrades included construction of 17 miles of new second mainline track as well as upgrading six miles of siding track. Trackwork included the addition of 16 turnouts and 20 crossovers, and the removal of

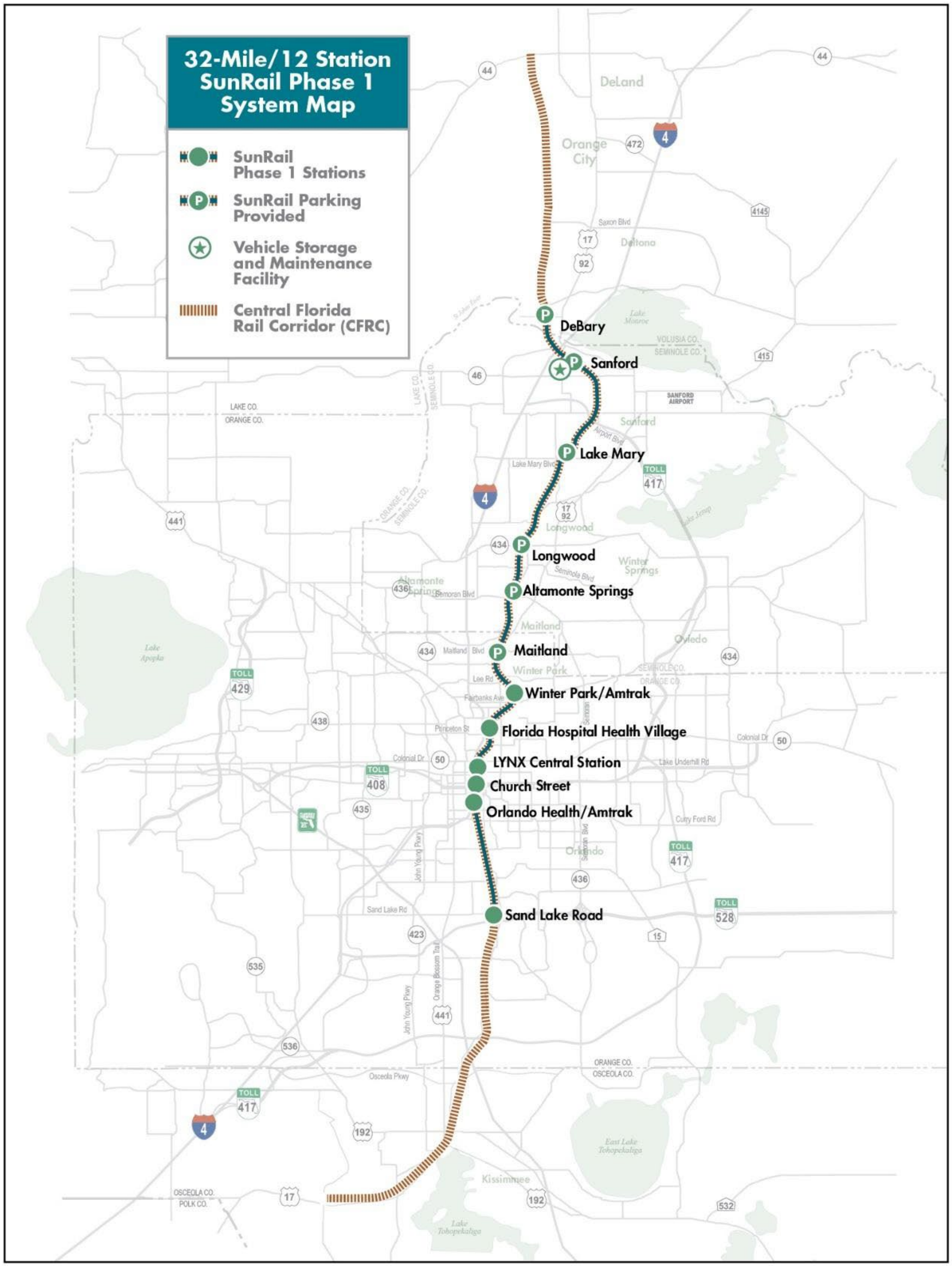

Figure 1. Map of the Central Florida Commuter Rail Transit Project, Phase I

14 previously existing turnouts to improve operations. Two miles of the project remain single-tracked due to right-of-way constraints.

All 12 stations are at-grade and accommodate trainsets with three passenger cars and a locomotive. The platforms have a height of 8” Above Top of Rail (ATR) with 22” ATR mini-high platforms to comply with requirements of the Americans with Disabilities Act (ADA). Each station has at-grade pedestrian crossings and standard platform amenities that include canopies, benches, decorative pavers, detectable warning strips at platform edge, handrails, water fountains, trash receptacles, bicycle parking, Ticket Vending Machines (TVM) and Ticket Validators, information kiosks, and closed-circuit television (CCTV) displays. The seven “origin” stations, located in primarily residential areas, also have park-ride (PNR) lots and drop-off (KNR) facilities. The seven PNR lots provide a total of 1,972 spaces. The five “destination” stations, located adjacent to major urban activity centers, do not have PNR or KNR facilities. All stations have direct connections to the local bus systems. Two of the destination stations are modified Amtrak stations that now serve both SunRail and Amtrak trains.

The VSMF one mile north of the Sanford station at the northern end of the line provides storage tracks and a Service and Inspection (S&I) facility. The site is also the location of the Operations Control Center, maintenance-of-way functions, and administrative offices. Under contract to SunRail, Amtrak provides heavy maintenance and car-wash services for the SunRail vehicle fleet at the Amtrak Sanford maintenance facility one mile south of the SunRail VSMF.

The project required acquisition of 71 parcels and the relocation of 19 businesses.

The project upgraded the Centralized Train Control (CTC) signal system, upgraded the existing highway-railway warning system at grade crossings receiving a new second track, added a new fiber optic backbone between the OCC and all stations, and installed 48 full-service and cashless ticket-vending machines – four at each station.

The project scope included acquisition of seven diesel locomotives, nine bi-level cab cars, and five bi-level passenger cars needed for reversible push-pull commuter rail operations using a mix of two- and three-car trainsets. Midday equipment storage is at the VSMF.

At PE-entry, because the original LPA anticipated the longer, 15-station, 54-mile LPA that was modified substantially early in PE, this study uses the shorter 32-mile segment to represent the PE-entry scope and serve as the basis for predicted-versus-actual comparisons of scope elements, capital costs, service impacts, operating and maintenance costs, and ridership. This approach avoids spurious comparisons based on an early project scope that was quickly abandoned.

The anticipated scope at PE-entry closely matched the actual outcome in terms of its general characteristics: its length, trackwork, number and nature of passenger stations, systems, and right-of-way acquisition needs. Differences occurred in six specific elements of the scope: 1) maintenance facilities were anticipated to be at the Amtrak Rand Yard, one mile south of their actual locations; 2) the initial assumption of diesel self-propelled passenger vehicles was later revised to diesel locomotives and passenger cars; 3) platform elevations were lowered from 42 inches to 22 inches above the rails to accommodate the freight service that continues to operate on the same tracks; 4) the number of locations assumed to need mitigation of contaminated soil and of impacts on wetland impacts turned out to be too pessimistic based on the findings of later detailed testing; 5) the planned reliance on a leased telephone-based communications system to save costs turned out to be unnecessary when FDOT found room in the project budget, plus additional funding outside of the FFGA, for a fiber-optic system, and 6) the specification of two ticket-vending machines per station was later revised to four per station.

By FD-entry, work during PE had resolved almost all the differences between the anticipated and actual as-built scopes, except for the location and function of the operations and maintenance facilities, the number of locations needing environmental mitigation, and the number of ticket vending machines. By the FFGA, further refinements during FD had resolved all remaining significant differences between the anticipated scope and the actual outcome.

Capital cost

The capital cost of the project was $357.2 million in year-of-expenditure (YOE) dollars spent on a schedule with a mid-point in June 2012. Principal cost elements were systems (23 percent), sitework and special conditions (20 percent), and the locomotive and passenger-car fleet (16 percent). Trackwork and the railroad guideway incurred only 12 percent of total costs, reflecting the reuse of most existing track and bridges. Professional services required only 11 percent of total costs, a low share that FDOT attributes to an early definition of project scope that remained largely unchanged, the use of standard FDOT procurement procedures, the adoption of CSXT railroad standards, the acquisition of currently available rolling stock, and the standardization of the station design. Average project costs were $11.2 million total per mile and $9.4 million per mile excluding the cost of vehicles.

Outside of the FFGA scope and budget, FDOT's purchase of the entire CSXT right-of-way cost $150 million in 2011.

FDOT predicted the capital costs of the project quite accurately throughout the planning and development of the project. At PE-entry, the predicted total cost of the project was $361.5 million in YOE dollars – higher than the actual project cost by 1.3 percent. Some differences existed within the total, however. The baseline capital cost prepared in constant 2007 dollars was $336.8 million, higher than the actual baseline project cost of $301.0 million translated back to 2007 dollars. This 12 percent overestimate was driven primarily by overestimates of the costs of right-of-way and the vehicles. The right-of-way estimate was high because of FDOT's generally conservative approach to evaluating real estate costs and because the booming real estate market in 2004-2007 had driven up market prices but actual property acquisition occurred in the devalued market in 2007-2009. Vehicle cost estimates were high because the self-propelled diesel units would have been more expensive than the locomotives and passenger cars eventually acquired for SunRail service. These overestimates were partially offset by the omission of costs to upgrade existing at-grade crossings where two CSXT tracks already existed and a conservatively high provision for signal-system costs whose pricing was revised downward as its specifications became clearer in later design work and procurement.

The net overestimate of the constant-dollar baseline cost at PE-entry was almost entirely offset by an under-estimate of inflation costs that was caused by an optimistic project schedule. The anticipated schedule at PE-entry in 2007 called for a mid-point of project expenditures in January 2009 leading to project opening in 2011. The actual schedule passed its mid-point of expenditures in June 2012 on the way to the May 2014 project opening, exposing project costs to three additional years of inflation not anticipated at PE-entry.

At both FD-entry and the FFGA, predicted costs exactly matched the actual costs of the project. The general pattern of small predicted-versus-actual differences that were evident within the accurate total-cost estimate at PE-entry persisted throughout – by progressively smaller margins. The constant-dollar baseline cost estimates were high by seven and four percent at FD-entry and the FFGA, compared to 12 percent at PE-entry. At FD-entry, the overestimate was still driven by overestimates of right-of-way costs and the vehicle fleet, offset by the continued absence of the costs of at-grade crossing improvements. By the time of the FFGA, further design work had eliminated all but the costs of grade-crossing improvements as significant predicted-versus-actual difference.

As at PE-entry, underestimates of inflation costs offset the overestimated baseline costs at both FD-entry and the FFGA but by decreasing margins as the planned construction schedule was lengthened and matched the actual schedule more closely.

FDOT attributes its accurate predictions of capital costs to strategies that established broad FDOT control of the project, a well-advanced status of project design at each of the milestones, well-established procedures to evaluate and price real-estate acquisitions, and generous contingency budgets. The early purchase of the CSXT right-of-way and the inclusion of a new train control center for central Florida were the principal steps towards broad control of the context. At the FFGA, the advanced status of the project meant that 75 percent of the project budget was either well known or already under contract (including contracts in place for design/build/maintain services, the purchase of locomotives and passenger cars, station construction, professional services and other soft costs, and 68 percent of right-of-way acquisition. Even with the advanced status of project commitments, FDOT included a total contingency allowance of 14 percent ($44 million) within the FFGA budget to provide sufficient flexibility to address unforeseen changes in remaining project scope and cost items.

Transit service

In 2017, the second full year of operation, SunRail provided service on the Phase I project on weekdays for 17 hours each day with trains running the full length of the 32-mile line between Debary and Sand Lake Road. Trains operated at 30-minute intervals in each direction during peak periods and 90- to 120-minute intervals in each direction midday and evenings. End-to-end running time was 63 minutes at an average speed of 30.5 miles per hour.

In the northern segment of the corridor, local bus routes connected at each station – generally configured to provide east-west access to the north-south rail line. Only two north-south bus routes remain in this segment of the corridor to provide local service for short trips in denser areas. Otherwise, north-south service over this 25-mile segment is provided by SunRail. Immediately north of downtown Orlando, the SunRail station at the LYNX Central Station connected rail service to the central transfer point for 35 LYNX bus routes serving all parts of in the LYNX bus system. South of downtown at the Sand Lake Road terminal station, two bus routes from the south stopped at the SunRail station on their way to downtown Orlando while two east-west routes provided feeder service to the station. Minor rerouting of existing bus routes throughout the corridor, plus the addition of a limited number of new feeder routes, established bus-rail connections at every station.

The service plans for the project at each milestone during project development accurately anticipated the key characteristics of service provided in 2017 – 30 minutes between trains in the peak periods and 120 minutes at other times during the 17 hours of weekday service. The plans differed from actual service levels in two details: they did not include four train-trips that were added (after the FFGA) in the shoulders of the peak periods to smooth the transitions between peak and off-peak spacing between trains; and the plan at FD-entry anticipated an end-to-end runtime that was five minutes faster than the actual 63 minutes, based on preliminary design of the signal system.

Operating and maintenance costs

Total SunRail operating and maintenance (O&M) costs were $34.1 million in FDOT's fiscal year 2017, incurred in four cost centers: vehicle operations (20 percent of the total), vehicle maintenance (26 percent), other maintenance (35 percent), and general administration (19 percent). Changes to local bus services to coordinate with SunRail resulted in a net increase in bus O&M costs of $1.35 million in the fiscal year.

The cost model used to predict SunRail costs was calibrated against the cost experiences of those peer systems and failed to recognize or capture the unique operating conditions and their costs associated with the SunRail project. Predicted O&M costs for SunRail (adjusted to equivalent 2017 dollars) significantly underestimated actual costs. Total predicted costs were $16.8 million at PE-entry (-51 percent), $17.2 million at FD-entry (-50 percent), and $19.1 million at the FFGA (-44 percent).

Predicted costs of vehicle-operations were consistently on-target, low by less than $0.25 million (-5 percent), a difference that reflected the addition of a few extra off-peak trains to the service plan subsequent to the FFGA.

Predicted costs for general administration were consistently low -- by approximately $2 million (-30 percent) at PE-entry and FD-entry, and by $1 million (-17 percent) at the FFGA. The predictions were low because they underestimated costs associated with the new SmartCard fare system and included no provisions for the General Engineering Consultant later added to the administrative staff – partially offset by an overestimate of liability insurance costs

Predicted costs for vehicle maintenance were consistently very low – by nearly $6 million (-65 percent) throughout project development. The predictions did not anticipate the 21 percent more-than-planned vehicle-miles of service that SunRail now provides (a few more trains and an added third car on some trains), the larger-than planned fleet size (50 percent more locomotives and passenger cars acquired in anticipation of Phase II service), or the larger number of contractors and locations providing vehicle-maintenance services.

Predicted costs for maintenance of way and systems were also consistently very low – by approximately $9 million (-75 percent) at PE-entry and FD-entry and by nearly $8 million (-65 percent) at the FFGA. The predictions significantly underestimated the costs of signal maintenance and the fare-collection system.

In general, the significant differences between the predicted and actual costs of both vehicle maintenance and facilities/systems maintenance appear to reflect significantly higher SunRail costs compared to 17 peer commuter rail systems in the United States.

Ridership

Actual ridership on the project averaged 3,250 trips per weekday in 2016, SunRail's second full year of operation. Four distinct travel markets were evident within SunRail ridership patterns: 1) a traditional commuter rail market averaging 1,620 trips (50 percent of all SunRail trips) between suburban residences and downtown; 2) a "reverse commute" market of 440 trips (14 percent) by residents of the urban core traveling to jobs and other activities in the suburbs; 3) a northern suburbs market of 670 trips (21 percent) made between locations in the northern suburbs; and 4) a crosstown market of 510 trips (15 percent) made between the northern and southern suburbs.

The traditional commuter rail market was the most work oriented, with 75 percent of its trips to/from work and the least likely to come from carless households (16 percent). Trips in this market rely heavily on autos (66 percent using park-and-ride, drop-offs, and pick-ups) to travel between home and SunRail while 17 percent walked and another 17 percent connected by bus. At the dense downtown end of the trip, 82 percent walked and 11 percent used a bus.

In contrast, trips in the small reverse-commute market were less work oriented (60 percent) and much more likely to come from carless households (47 percent). They relied primarily on walking (41 percent) and bus connections (46 percent) between home and SunRail. At the suburban ends of these SunRail trips, only 25 percent were able to walk to/from their destinations while 45 percent rode a bus and 30 percent were picked up or dropped off at the station.

SunRail riders traveling within in the northern suburbs market, unusual for commuter rail, were the least work-oriented (51 percent) but similar to their downtown-oriented neighbors in their car-ownership (only 23 percent carless) and access modes between home and SunRail (61 percent auto-based, 23 percent walk, and 15 percent bus). At their suburban destinations, they walked less than the suburban-bound reverse-commute market (66 percent compared to 82 percent for reverse commuters) and relied more on bus connections (18 percent) and pick-up/drop-offs (11 percent).

The crosstown market, traveling between the northern and southern suburbs, is also unusual for commuter rail. Sixty percent of this market comprises residents of the northern suburbs traveling to/from jobs and other activities south of downtown Orlando; the other 40 percent are based in residences to the south. Travelers in this market resemble the downtown-oriented traditional commuter market in their high levels of auto ownership, work-trip orientation, and reliance on cars to access SunRail. At their destinations, they resemble the northern-suburbs market with their reliance on bus connections and, even more so, the use of pick-up and drop-off connections.

Overall transit ridership in metropolitan Orlando increased from 82,000 to 92,000 trips per average weekday between 2010 and 2017, the interval during which SunRail was planned, built, and opened to service in May 2014. This gain reflects the introduction of SunRail (35 percent of the increase), two extensions of the downtown Orlando bus-rapid-transit circulator (20 percent), and a modest systemwide increase in local bus service (45 percent).

The relevant ridership forecast for the Phase I project was prepared during PE and supported FDOT design and environmental work, and FTA ratings of the project, through the subsequent FD-entry and FFGA milestones. The earlier ridership forecast available at PE-entry was for the initial project concept – the 52-mile commuter rail line – and is therefore not useful in the assessment of forecast accuracy.

The ridership forecast anticipated 4,300 weekday trips on the project in its opening year, an overestimate of 25 percent compared to actual ridership of 3,250 average weekday trips. Larger offsetting differences are evident in several subtotals. The forecast anticipated 4,275 weekday trips between home and work, nearly double the actual work-trip ridership of 2,200 on weekdays; and it anticipated essentially no non-work ridership – just 40 trips – compared to the actual 1,060 non-work trips on weekdays.

These differences highlight the general challenge inherent in efforts to prepare reliable ridership forecasts for initial fixed-guideway transit lines built in metro areas with previously all-bus transit systems. In the case of SunRail, the existing all-bus system primarily provided basic mobility for a primarily transit-dependent ridership base within the denser urban areas of Orlando. In contrast, SunRail provides long-distance service from areas with lower densities, higher car-ownership, and lower propensities to use transit. Ridership forecasting methods developed with data from an all-bus context can be hard-pressed to anticipate the fundamental changes in behavior invited by new fixed guideways – switches to transit by auto-oriented commutes, new park-and-ride and drop-off options, longer-distance travel, transfer connections between buses and trains, and – potentially – travel for purposes beyond routine commuting. Further, initial fixed guideways have no local peer facilities that can provide data and insights on the reasonableness of their ridership forecasts – a particularly daunting prospect for a proposed commuter-rail line in a metro area with a central business district that is unlike the much larger employment cores served by traditional commuter-rail systems.

Mindful of these difficulties, FDOT and FTA applied a judgment-based set of adjustments to the forecasts produced by the ridership-forecasting model. The adjustments identified trips that were predicted by the model to use SunRail in unlikely ways. Trips to work in downtown Orlando were judged to be most likely and were not subject to adjustment. In contrast, trips by members of households with two or more cars that were predicted to park at a suburban SunRail station, ride the train to another suburban station, and then transfer to a bus to reach a non-work activity more than two miles away were deemed much less likely and scaled downward. Adjustments to these and similarly less likely trips reduced the predicted number of trips on the project from the 5,400 produced by the model to the 4,300 adopted as the forecast for the project – closer to the actual 3,200-trip outcome.

Within this general context, some specific difficulties are evident in the SunRail forecasts. The large overestimate of work-trip ridership appears to be driven by a problem in the survey data used to develop and test the ridership model. For unknown reasons, the 2001 rider survey that provided the data to develop the model appears to substantially overstate the number of park-and-ride trips to transit particularly, and oddly, for commuters from households owning exactly one car. Records of park-and-ride usage from that time, plus subsequent rider surveys, indicate nothing like the large size of this market suggested by that survey. Unfortunately, the model extrapolated the misrepresented park-and-ride market from the survey data into the work-trip forecasts for SunRail. This overestimate was exacerbated by a separate overestimate of traffic congestion in the peak period that made travel times for cars and buses longer than they are and the new commuter-rail option incorrectly more competitive.

The near-absence of non-work trips in the SunRail forecast was caused by a very different problem. The ridership model makes the common simplifying assumption that all non-work trips are made in off-peak periods. It also assumes that transit riders arrive randomly at stops and stations to wait for their bus or train. SunRail's service plan for the opening year anticipated, and now provides, infrequent trains during off-peak hours. As a result, the ridership model represented them as having to endure extremely long wait times that made SunRail such an unattractive travel option that no travelers would ride it. No such problem occurred in the horizon-year forecasts when the SunRail service plan called for frequent train service throughout the day – and competitive waiting times. FDOT and FTA reviewers missed this problem because the focus at the time of SunRail planning and development was on the horizon year – the timeframe that FTA used exclusively to evaluate and rate the merits of proposed projects. Much less scrutiny was given to reviews of opening-year forecasts that effectively played no role in project evaluations.

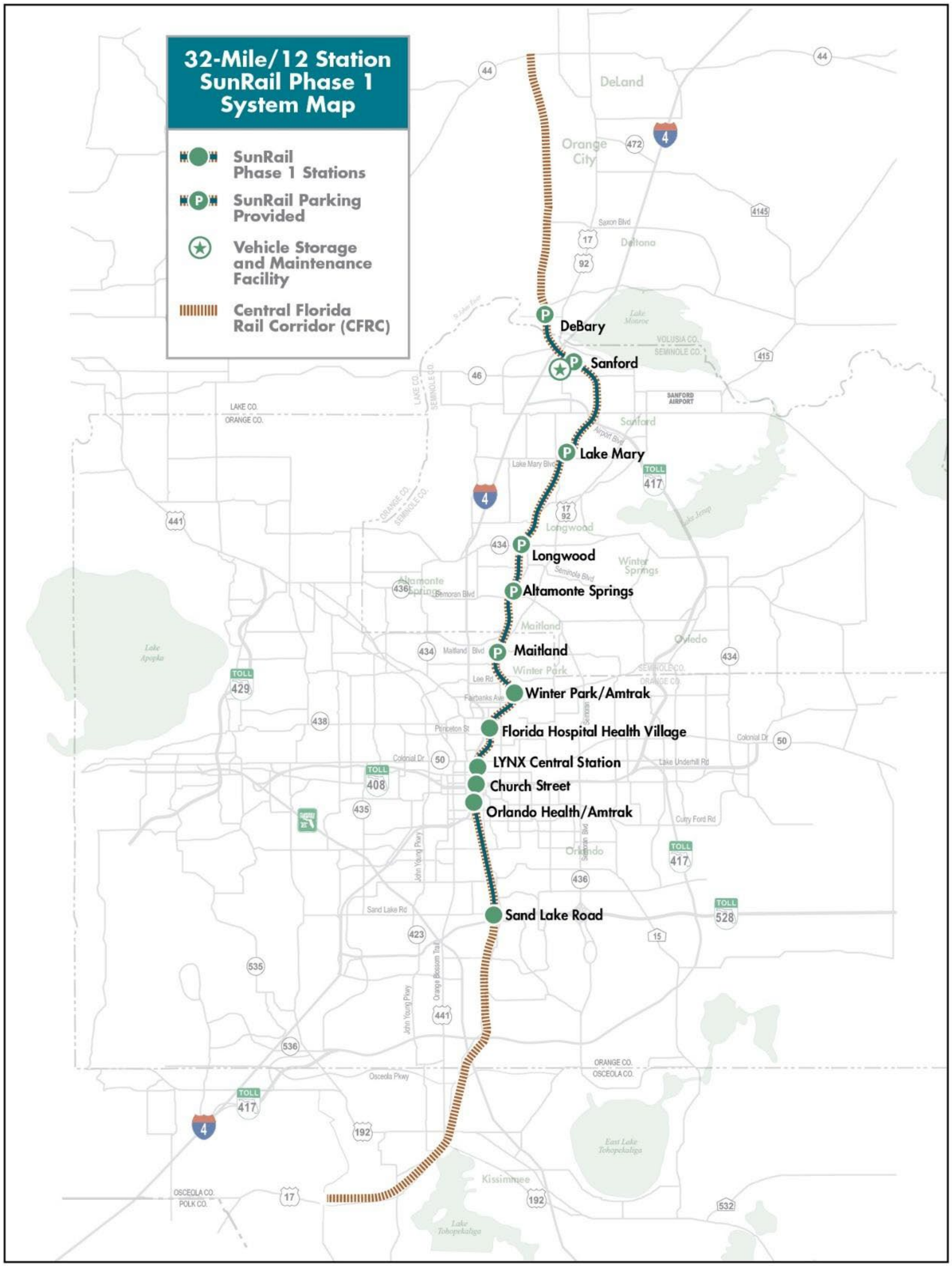

Figure 1. Map of the Central Florida Commuter Rail Project, Phase I