OASIS Rail Conceptual Alternative Solutions
HAM/CLE – OASIS Rail Corridor
PID No. 86463

Prepared For:

Ohio Department of Transportation
District 8
505 S. State Route 741
Lebanon, Ohio 45036

***Prepared By*:**

9987 Carver Road, Suite 200
Cincinnati, Ohio 45242
513-984-7500

February 8, 2016

TABLE OF CONTENTS

Appendices

Exhibits

Tables

1 EXECUTIVE SUMMARY AND RECOMMENDATIONS

The OASIS Rail Transit corridor, an important component of the multi-modal Eastern Corridor Program, runs for approximately 17.2 miles between the Riverfront Transit Center (RTC) in downtown Cincinnati and eastern communities in Hamilton and Clermont counties, to an eastern terminus in the City of Milford near IR 275. The OASIS rail transit service will broaden the range of travel options and expand the overall transportation network within the region.

In this phase of project planning, a significant amount of analysis and assessment has refined the project in a number of important areas. These are reflected in this Conceptual Alternative Solutions Report, and include:

- Preliminary engineering analysis to identify feasible alternatives in each of the four OASIS segments, and where multiple alternatives may exist, to recommend those alternatives that best meet the Purpose and Need and Record of Decision for the project, and/or offer advantages over other options.
- Detailed descriptions of the basic rail service proposed for the corridor, as well as descriptions of add-on services that could be offered, and the availability of funding for associated capital, operations, and maintenance costs.
- A restatement of the Diesel-Multiple Unit (DMU) as the recommended rail technology.[1]
- Estimates of annual operating and maintenance costs.
- Assessment of the existing and needed capital infrastructure, both to identify deficiencies over the corridor, as well as the recommended infrastructure elements required to provide the OASIS rail service.
- Estimates of capital costs for all project categories in a consistent, FTA-approved format (Standard Cost Categories) that can be used should the Project Partners seek federal funding.
- Identification of potential bus feeder services and connectivity with local bicycle facilities, both to strengthen network connections, and as part of the multi-modal intent of the Eastern Corridor program.
- Ridership forecasts for the basic service and the add-on services, as well as the methodology used in developing these forecasts.
- A preliminary analysis of the OASIS Rail Transit corridor's financial feasibility.
- An identification of potential environmental impacts for more-detailed assessment in the next phase.
- Feedback from the series of public involvement meetings held in the summer of 2012, and their implications for the rail service, which was helpful in providing services and information to respond to stakeholders as the planning and design effort moves forward.
- High-Level Rail Traffic Controller Modeling (RTCM) to identify operating requirements for initial and future infrastructure to support rail operations.

[1] DMU vehicles were the recommended rail technology during the development of the Tier I environmental document, and have been subsequently reconfirmed as the most appropriate rail technology.

Based on the work completed in this phase, the following recommendations are made regarding the preferred alignment in each of the project segments identified in Exhibit 1-1.

Segment 1

Sawyer Point Park Alignment Alternative 4 was preferred by the Cincinnati Park Board and will be studied in further detail moving forward. This alternative placed the track as close to the south side of Pete Rose Way and Riverside Drive as possible while maintaining the current roadway section as is. The south sidewalk was moved to the south side of tracks to maintain free access to the Sawyer Point Park parking area to the south. The track was also positioned to fit between Pete Rose Way and the I-471 bridge pier to the south of Pete Rose Way. Signalized at-grade crossings are required at the Eggleston Avenue entrance to the park and across Pete Rose Way at Butler Street. It is acknowledged that further coordination with the Park Board will be required as this alignment is refined.

In addition, Alignments 1A and 1B entering the RTC were further evaluated and, in agreement with the Partners, Alignment 1B will be further developed. Alternative 1B includes adequate space and right of way to accommodate a second future track alignment for potential operations expansion. The grade crossing at Pete Rose Way and Broadway will require further study to address coordination with vehicular traffic movements and pedestrians from the nearby venues.

Segment 2

Two alignment alternatives in Segment 2 have been studied: Alternative 2A that utilizes the Southwest Ohio Regional Transit Authority (SORTA) owned track to the north; Alternative 2B that utilizes the Genesee and Wyoming, Inc. (GWI)[2] track alignment to the south. At this stage, one track is needed to accommodate passenger rail service from Milford to the RTC from a capacity standpoint, with a second track needed at each of the proposed station locations, as well as a potential need for intermediate siding locations at locations identified as points where train meets could take place as service is implemented and train frequencies are increased. Alternative 2A is recommended for further development with capital cost implications between both alternatives being relatively minor; the construction and operation of Alternative 2A will have minimal impacts on GWI's existing and future freight rail operations.

Segment 3

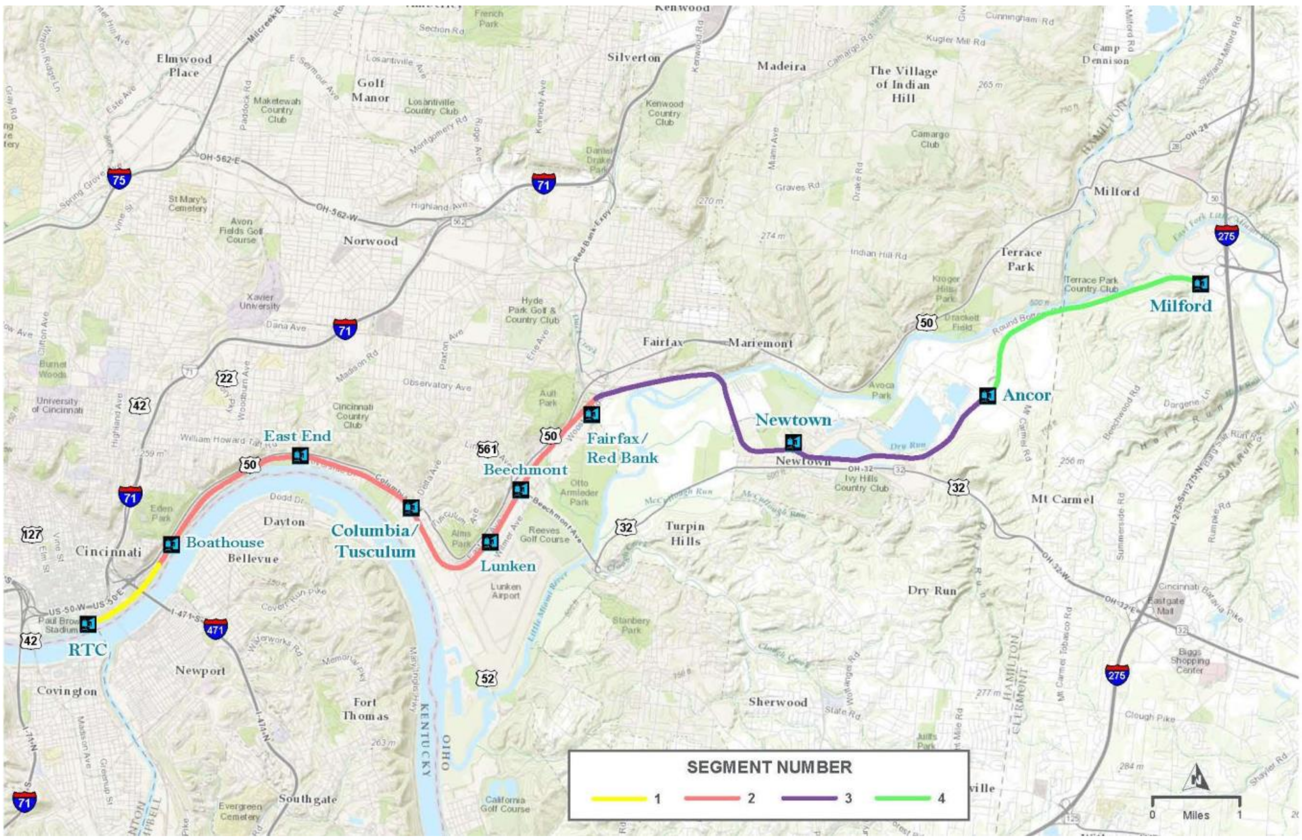
Two alignment alternatives have been studied: Alternative 3A that utilizes the existing Norfolk Southern Railroad (NS) single track; Alternative 3B that utilizes a new, parallel offset track within existing NS right of way requiring new bridges and extensive retaining walls. Alignment 3A is recommended for further development in the next phase of work. Operating agreement discussions/negotiations should be initiated with NS as soon as possible to determine if an agreement is possible, and what system and operating requirements would be required. Capital costs for Alternative 3A are approximately $22 million (32%) less than Alternative 3B which requires a separate parallel track.

[2] The Genesee & Wyoming Railroad is an operator of short-line railroads throughout the United States, Belgium and Australia. On the OASIS rail corridor, GWI is the owner of the Indiana & Ohio Railroad (IORY). In 2012, GWI purchased Rail America, largely expanding its rail network.

Segment 4

Two alignment alternatives have been studied: Alternative 4A that utilizes the existing Norfolk Southern Railroad (NS) single track and Alternative 4B that utilizes a new, parallel offset track within existing NS right of way requiring new bridges and extensive retaining walls. Alignment 4A is recommended for further development in the next phase of work. Capital costs for Alternative 4A are approximately $8 million (14%) less than Alternative 4B which requires a separate parallel track. The vehicle maintenance facility is recommended to be constructed with Segment 4 at a location to be determined in future project development since it will minimize non-revenue operations of vehicles due to proximity to Milford.

Exhibit 1-1: Segment Map



The project team also recommends the following items as they apply to the other Oasis passenger rail elements and operations:

Rail Service. Alternative rail operating plan scenarios were also evaluated, including Basic Service and Enhanced Service. The Basic Service is recommended as the initial operating plan for the Oasis Corridor. This includes weekday peak period and mid-day service, along with all requisite capital cost elements (track, signaling and crossing improvements, and maintenance facility). Based on the Station Area Planning process and ridership forecasts, rail service would serve the Columbia-Tusculum, Fairfax (Red Bank), Newtown and Ancor stations, along with terminal stations at the RTC and in Milford. A special event station is also recommended at the Boathouse. Alternate station locations could be considered including moving Fairfax to the Clare Yard, and combining Newtown and Ancor at a central location, referred to as "Newcor" in this report.

Technology. The Diesel Multiple Unit (DMU) is reconfirmed as the selected rail technology. Given the characteristics of the corridor and the proposed services, this technology can provide for the current and future service needs at a reasonable cost. The DMU technology preference is the "alternatively compliant" vehicle such as the Stadler GTW 2/6 operating in the Dallas area (Denton County). Characteristics of this vehicle include: lighter weight through the use of advanced materials, excellent performance capabilities and low-floors for easier boarding and alighting with reduced platform costs (while simultaneously allowing for joint rail operations in those segments where freight trains might operate.) This class of DMU vehicles, designed to meet Federal Railroad Administration (FRA) standards for passenger crash- worthiness could offer flexibility by being able to operate with freight trains on other OASIS corridor segments without the need for an FRA waiver[3]. They are appropriate as well given the operational characteristics of the OASIS rail line, which include proximity to existing homes in many areas, noise and air quality issues/concerns, and the ability to negotiate the vertical and horizontal alignment profiles within the corridor. An FRA compliant vehicle such as the Sonoma County Nippon Sharyo vehicle may also be considered.

Rail Maintenance Facility. It is recommended that a permanent site near Ancor, approximately four acres, be selected and reserved for the service's Rail Maintenance Facility (RMF). This location is consistent with the land use vision for the Ancor area, and it would provide for both the OASIS rail service, as well as for future growth should the Wasson rail corridor be developed. The proposed maintenance facility could provide storage and maintenance capacity for both lines, reducing associated capital costs and maximizing use of the facility.

[3] Pending the approval of new proposed rules by the federal Office of Management and Budget and the FRA. Refer to Steve Sweeney, "'Crashworthiness' in context", *Trains*, September 2013, 20.

2 INTRODUCTION

2.1 Introduction/Background

As recommended in previous studies, the OASIS Rail Transit corridor runs for approximately 17.2 miles between the Riverfront Transit Center (RTC) in downtown Cincinnati, and eastern communities in Hamilton and Clermont counties, with an eastern terminus in the City of Milford near IR 275. (A potential branch line from Newtown to Eastgate is also being investigated separately from this project.) The OASIS Rail Transit line can provide a rail-based transit option to broaden the transportation network within the region. It is an important multi-modal component of the Eastern Corridor Program.

The Eastern Corridor Program was initiated to address mobility and connectivity issues between the City of Cincinnati core and the eastern suburbs. The original Ohio Kentucky Indiana Regional Council of Governments (OKI) led Major Investment Study (MIS) was completed in 2000, and identified an area covering approximately 165 square miles, extending from the Cincinnati Central Business District and riverfront redevelopment (The Banks), east to the I-275 Outer-Belt in Clermont County. The MIS resulted in a recommended multi-modal strategy for addressing current and future deficiencies in the area.

In 2002, the Eastern Corridor Land Use Vision Plan (ECLUVP) was completed. This effort evaluated economic development, green space preservation and quality of life issues related to future land use within the Eastern Corridor. The ECLUVP was developed based on extensive input from the communities impacted and resulted in a comprehensive future land use plan complimenting the multimodal transportation vision.

A tiered environmental document approach was undertaken next to address federal requirements. The Tier 1 Final Environmental Impact Statement (FEIS) was completed and a Record of Decision (ROD) issued by the Federal Highway Administration in June 2006. In relation to the Rail Transit component of the Eastern Corridor, the ROD included the following purpose and need elements:

Rail Transit network investments in the Eastern Corridor are needed to:

- *Increase accessibility by reaching areas not currently being served by transit;*
- *Connect people with jobs;*
- *Provide better service to the transit-dependent (or transportation-disadvantaged);*
- *Improve overall transportation by coordinating and linking with other travel modes;*
- *Provide important future capacity and connectivity beyond reasonable limits of the highway system;*
- *Connect people with major recreational destinations and the regional attractions for non-car travel;*
- *Provide a visible, high profile link to the Cincinnati Central Business District from outlying areas;*
- *Improve regional connectivity;*
- *Link to and support the Eastern Corridor land use vision plan;*
- *Support and facilitate bus, highway and TSM improvements; and*

- *Implement regional long range transportation plans specific to rail investments.*

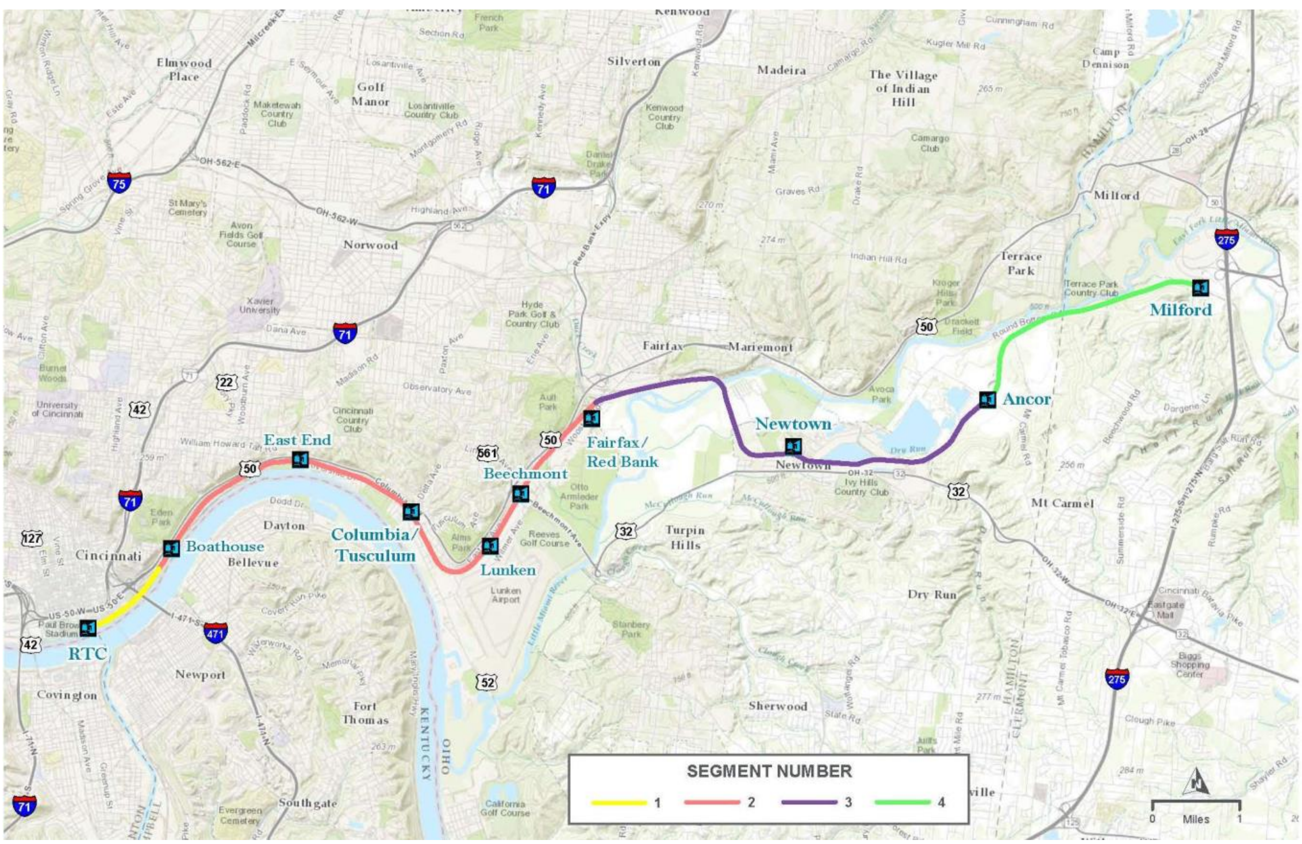
The purpose of the rail transit capacity investments in the Eastern Corridor is to implement, in logical segments, effective rail transit service in the Eastern Corridor. This component will provide a new, high-visibility, regional scale transportation alternative to driving, will increase mobility for non-drivers, will provide a high-capacity transit mode to support the expanded bus network, will establish stations at effective locations with links to bus, bike, pedestrian and roadway systems, will connect downtown Cincinnati with outlying areas of population and employment, will support neighborhood development and revitalization consistent with the land use vision plan, and reduce demand for new highway capacity while providing a way to meet the future travel demand.

This report completes the preliminary analysis of the Oasis Rail Transit project, providing the Eastern Corridor Partners with information to determine whether to advance the project. Preliminary Engineering and Draft and Final Environmental Impact Statements will be completed for the project if it advances through Federal Transit Administration (FTA) Project Development.

2.2 The OASIS Rail Transit Corridor

The OASIS Rail Transit corridor is divided into four segments as shown on Exhibit 2-1. This section provides detailed information on each, as well as alternatives and options that might exist.

Exhibit 2-1: Segment Map



2.3 Segments

2.3.1 Segment 1

Segment 1 of the OASIS passenger rail project begins at the Boathouse and terminates within the RTC. The challenge in this segment is establishing a rail alignment since none currently exist. In addition to the alternatives alignment work completed by URS in 2009, the HDR consultant team also investigated a number of additional alignment options for this segment (refer to *OASIS Rail Corridor – Sawyer Point Alignments Study* in Appendix A) given the environmental conditions and sensitivity of the park district.

Five rail alignment alternatives were evaluated, each utilizing a single track route that required a minimum of 18 feet of width to maintain the recommended vehicle clearances (as opposed to the wider double track configuration originally evaluated in the 2009 URS study). Four of these alignments encroach upon Sawyer Point Park and required extensive coordination with the Cincinnati Parks Department. Under City Ordinance No. 102-1995, the City of Cincinnati and SORTA agreed to preserve the NW Riverfront Running Track for future passenger rail service, either on the current alignment or "substituted property".

The National Environmental Policy Act (NEPA) process requires that at least one alternative be considered as an avoidance option. Accordingly, one alignment was investigated by placing the trackway completely on Riverside Drive and Pete Rose Way, across the frontage of Sawyer Point Park. This alignment, namely Alternative 3, is discussed in further detail below and, due to various impacts, was eliminated as a viable option for further consideration.

A graphic of the five alignments is provided in Appendix A. A written description of each alternative is given below:

Sawyer Point Park Alternative 1

This alternative is primarily located on elevated structure, permitting park access, parking and Pete Rose Way to pass underneath. Starting near the Boathouse to the east, the routing runs westward up a sloped embankment along the former NW Running Track route until it begins on structure approximately 15 feet above grade southeast of the Flying Pig entry. The track continues on structure diagonally across the west half of the parking lot across the Pete Rose Way/Butler Street intersection, and then goes back to grade on a sloped embankment on the north side of Pete Rose Way.

Comments: The alignment on structure minimizes impacts on parking and park patron access. However, it does have a visual impact on the park, with an estimated beam depth of 6 feet, blocks continued use of the former NW Running Track for service and event vehicle access, and would cut through the solar collection array planned for the west parking lot.

Sawyer Point Park Alternative 2a

This alternative is at grade and runs along the north half of the Sawyer Point Park parking lot just south of the existing I-471 bridge piers and across an at-grade crossing with signals at the Eggleston Avenue park entrance. The alignment continues west to an extended, diagonal at-grade crossing of Pete Rose Way at the Butler Street intersection. The sidewalk along the south side of Pete Rose Way is maintained and pedestrian fencing will be required on both sides of the trackway.

Comments: The alignment has an impact on parking capacity of the lot with a reduction of approximately 175 spaces. Also, pedestrian access to the parking lot from the south Pete Rose Way sidewalk is restricted by the trackway. The parking entry/payment system will need to be modified to avoid trapping cars in the payment queue in the rail crossing when the gates are activated.

Sawyer Point Park Alternative 2b

This alternative is located at essentially the same horizontal alignment as Alternative 2a, except the track is on an above-grade structure from approximately 400 feet east of the Eggleston entrance, and continues on structure until past Butler Street on the north side of Pete Rose Way. The east approach to the bridge will require the tracks be on-grade transitioning to a retaining wall supported embankment until a clearance of 12 feet is attained below the bridge for vehicular access 400 feet east of the Eggleston entrance.

Comments: The alignment has an impact on parking capacity of the lot with a reduction of approximately 140 spaces, primarily in the east end of the lot where the bridge approach ramp is located. Pedestrian and vehicular access is maintained from Pete Rose Way without a rail grade crossing at the Eggleston Road entrance or on Pete Rose Way at Butler Street. The high skew of the bridge requires that a pier be place in the center of Pete Rose Way to keep bridge spans feasible. The bridge would block view of Flying Pig gateway from Eggleston Road entrance and Pete Rose Way.

Sawyer Point Park Alternative 3

This is an avoidance alternative that misses the Sawyer Point Park property completely by placing the trackway on the north side of Riverside Drive and Pete Rose Way, without widening the roadway into the park property. Due to the buildings and I-471 bridge piers on the north side, the roadway cannot be widened to the north. Therefore, the existing roadway can only accommodate the track, and one traffic lane in each direction, eliminating turn lanes at Eggleston Avenue and Butler Street. Signalized rail grade crossings will need to be installed to get across Riverside Drive west of the Boathouse, and cross Adams Crossing and Eggleston Avenue. To accommodate the required rail grades, Riverside Drive will need to be lowered in front to Adams Landing, necessitating a retaining wall to be constructed in front of the building.

Comments: As part of this study, a traffic impact analysis was performed using VISSIM traffic modeling software to measure the effects of reducing Pete Rose Way to one lane each direction, and the elimination of turn lanes at intersections. The model predicts a Level of Service (LOS) for the intersections along the roadway with a graduated scale of ‘A’ (free of congestion) to ‘F’ (congested to point of failure).

The model indicated that during AM Peak Hour Traffic, the intersection at Mehring Way would operate at a LOS of ‘F’ and the Eggleston Avenue intersection would operate at a LOS of ‘E’. Traffic counts taken during an afternoon Cincinnati Reds game were also added to the model to verify traffic impacts during special events. As a result, 11 intersections were found to fail (LOS F) with Alternative 3 in place. Extensive stormwater and sanitary sewer modifications would also be required in the roadway. Train noise/vibration remediation may be required for Adams Landing and other adjacent buildings.

Sawyer Point Park Alternative 4

This alternative placed the track as close to the south side of Pete Rose Way as possible, while maintaining the current roadway section as is. The south sidewalk would be moved to the south side of tracks to maintain free access to the Sawyer Point Park parking area to the south. The track would also be positioned to fit between Pete Rose Way and the I-471 bridge pier to the south of Pete Rose Way. Signalized at-grade crossings are required at the Eggleston Avenue entrance to the park and across Pete Rose Way at Butler Street.

Comments: The proposed alignment would eliminate approximately 115 parking spaces in the Sawyer Point Park lot. It maintains a continuous pedestrian access between parking lot and north sidewalk and requires the least amount of right of way acquisition when compared to other alternatives encroaching on Sawyer Point Park.

Multiple meetings with the Cincinnati Parks Department and City of Cincinnati Department of Transportation and Engineering (DOTE) staff occurred to discuss the development of alternatives. These meetings were held to enable stakeholders to review, understand, and collaboratively develop the alignment alternatives, as well as consider and discuss impacts.

At the final meeting held September 12, 2012, the five refined alternative alignments described herein were presented to City of Cincinnati Parks and DOTE staff, along with Eastern Corridor Partner representatives. The group agreed that Alignment Alternative 4 should be carried forward and recommended for conditional approval by the Cincinnati Park Board. A report was prepared, namely the *OASIS Rail Corridor – Sawyer Point Park Alignments Study*, *October 10, 2012* (provided for reference in Appendix A), that summarizes and compares the alignments, and provides a basis for the recommended Alignment Alternative 4. The primary reasons for the selection of he preferred alignment were:

1. Provides minimum visual obstruction to the park from Pete Rose Way and Eggleston Avenue.
2. Maintains continuous pedestrian access between the parking lot and east/west sidewalk.
3. Minimizes parking and right of way impacts.
4. Avoids impacts to park green spaces.
5. Avoids impacts to proposed solar energy panel array.
6. Provides better grade crossing geometrics at Eggleston park entrance.

In further development of the Segment 1 alternative, it was determined that two alignments approaching the RTC entrance should be studied in greater detail. Both of these alignments avoid the proposed pedestrian structure located at the base of the Pete Rose Way Pedestrian Bridge's stair tower (both existing and proposed) and minimize impacts on the Broadway Street parking lot (also locally known as the "Dumbo Lot"). These alignment alternatives are located in the approach to the entrance of the RTC and differ only in how they cross Broadway Street. Specifically:

- *Alignment 1A* – Crosses Broadway Street close to the north curb line of Pete Rose Way, which will allow a railroad grade crossing that can be consolidated with the roadway intersection signals and crosswalks. The alignment is approximately 25 feet south of Alternative 1B, which provides additional parking lot area for the lot to the north.

- *Alignment 1B* – Utilizes the alignment used in the previous 2009 alignment study. It crosses Broadway Street approximately 30 feet north of Pete Rose Way and requires an extended grade crossing and traffic signal to prevent vehicles from standing on the tracks while waiting for the southbound green signal at Pete Rose Way.

Following a presentation of the above Segment 1 Alternatives 1A and 1B to the Eastern Corridor Partners, the Partners and City of Cincinnati Transportation Planning staff subsequently directed that the Alternative 1A be utilized for further plan development. Alternative 1A provides a grade crossing at Broadway Ave. and Pete Rose Way that functions better with respect to the traffic signals, and the vehicular and pedestrian movements in and around the crossing and the existing intersection. The Partners also directed that the Alternative 1A also incorporate a second future track parallel alignment to facilitate future expansion, and ensure that adequate right of way be procured with Segment 1 to accommodate the potential future expansion.

2.3.2 Segment 2

Segment 2 is defined as the alignment running from the Boathouse to near the US 50/Red Bank Road intersection, near the Village of Fairfax. There are currently two tracks contained within the SORTA owned right of way (ROW)[4]. The southerly track located closest to the Ohio River, is currently being used by the Indiana & Ohio Railway (IORY, a unit of GWI) to service Sawyer Place Company at 1801 Riverside Drive, Queen City Terminals at 3806 Kellogg Avenue, and the Undercliff Yard west of Lunken Airport. The GWI track is bolted joint rail on timber crossties, and has an operational speed limit of 10 MPH (FRA Class 1 Track). The SORTA owned adjacent line located immediately to the west and north of the GWI line is currently out of operations and in deteriorated condition. Two conceptual rail alignment alternatives are considered in this report. Alternative 2A utilizes the out-of-service SORTA owned track, which could operate independently of the adjacent GWI freight track, except for areas at the proposed station locations and intermediate areas needed to ensure operations reliability and performance through double tracking. Alternative 2B utilizes the existing GWI trackway from the Boathouse to north of Airport Road, where it moves over to the out-of-service SORTA track before entering the Undercliff Yard. Both alternatives cross over the GWI trackway near the east end of Segment 2 at the wye near Red Bank Road. A parallel station track, approximately 1000 feet long, will be provided at the Columbia-Tusculum station on either alternative. A center platform station is utilized in the preliminary alignment alternatives that will facilitate reverse commute operations while a vehicle is at the station. Center platforms have been utilized at all stations on the project, with the exception of the special event Boathouse station in Segment 1.

Existing railroad bridges in Segment 2 are in varying degrees of deterioration and all will require significant rehabilitation or replacement to adequately serve a long-term rail transit service. Additionally, the bridges over Riverside Drive, Collins Avenue, and Delta Avenue are functionally obsolete with respect to their roadway alignments and vertical and horizontal clearances. If the bridges are to be replaced, consideration of improved roadway alignments will need to be addressed in the project development.

[4] SORTA, as owner of the rail corridor, has primary maintenance responsibility for the tracks, structures, etc. within its ROW.

While these alternatives look at each track within the ROW individually, it is likely as OASIS service is initiated and expands over time to include greater frequencies and the potential addition of new corridors as part of the long-planned regional rail network that much of the corridor ROW will be required to provide sufficient rail capacity to accommodate rail movements. That final determination will be refined in Phase 2 as the RTCM is continued to identify the necessary ROW and track capacity required to accommodate future service and infrastructure needs.

In examination of the operation of passenger rail service as defined by this project, in essence service from Milford to the RTC, at this point in the study process we anticipate that one track in this segment will suffice from a capacity standpoint, with double track needed at the stations and at intermediate locations. Additional double trackage will need to be reserved for future expansion of rail operations and to provide for service reliability. Additionally, as new corridors of the Oasis rail line (such as Eastgate) or new corridors not currently under planning consideration but part of a larger regional rail network (refer to SORTA's 2002 MetroMoves plan) are brought on-line, insuring that there is available ROW to accommodate any realistic service scenarios will become essential. These new operational lines might enter the OASIS corridor at different locations, including at or near Fairfax and between Newtown and Ancor.

Given this initial premise, each of the rail lines in Segment 2 were considered independent in the development of a preferred passenger rail alignment, and each has advantages and disadvantages in terms of their use and ability to be developed for a startup service on the OASIS rail corridor.

Table 1: Segment 2 Track Alignment Considerations

Measure	Opportunities and Challenges
Operations	Preliminary results indicate that the north track and GWI operating track can each handle the opening day operations of the OASIS service from Milford to the Riverfront Transit Center. Capacity analysis and the identification of storage/passing tracks and center platform stations have been determined and included in Appendix F.
Cost	The costs associated with upgrading the GWI operating track will be slightly less than the cost associated with the refurbishment of the SORTA owned track. The north track is currently out of operations and may require more substantial upgrade, including bed and ballast upgrade.
Technology	From an operational standpoint, the preferred technology, namely the DMU, could successfully operate on either track. Based on the approval of new FRA performance standards, the proposed European-designed, low-floor DMU vehicles (such as the Stadler GTW 2/6 or 2/8, for example) would not require temporal separation of passenger and freight service.
Shared Use	Use of the GWI operated line for passenger rail would potentially eliminate the initial need to utilize the entire north line, although expanded segments will be needed to provide service reliability, assure operational capacity and to accommodate future expansion of the regional rail network. Reserving sufficient capacity on the SORTA owned line for passenger rail operations will likely constrain opportunities to use this corridor for other transportation modes in those areas identified through the RTCM as needed for rail service. In a letter to SORTA dated November 13, 2008, FTA reiterated its position that the federally purchased rail corridor "must be utilized as it was originally intended and must be utilized for a future bus or rail transit project".

2.3.3 Segments 3 and 4

The only existing track in Segments 3 and 4 of OASIS is in the corridor owned by Norfolk Southern Railway (NS). The existing track is constructed of continuously welded rail on timber crossties. Dispatching of trains in these segments is done by NS staff, using a manual block system like that in Segment 2. There is no track signaling system in these segments. Unlike in Segment 2, the maximum track speed is 25 mph (FRA Class 2 Track).

There are ten bridge structures in Segments 3 and 4, with six of these classified as in "fair condition" and the other four classified as in "poor condition" which will require significant rehabilitation or portions replaced for utilization in passenger rail service.

The Segment 3 and 4 alignment analysis focused on the existing NS freight railroad right of way in Segments 3 and 4. By staying within the existing railroad right of way, the project will avoid potential environmental impacts in construction. Minimal environmental impacts are especially critical in the areas between Red/Bank Road and Newtown due to floodway, national scenic river, cultural resources and 4f designated areas adjacent to the existing railroad right of way in this area. The alignment would include track, bridge and roadway grade crossing upgrades, and an approximately 1,000-foot long parallel station track for the Fairfax and Newtown stations.

Consideration of an alternate and/or additional rail alignment between the Newtown/Ancor area and the Eastgate area is of interest to Clermont County, and will be studied in the next phase of work.

Segments 3 and 4 of OASIS include two alternatives in each:

- *Alternative 3A* - Passenger rail operations from the east end of Segment 2 near the intersection of Red Bank Road and Old Wooster Pike to the beginning of Segment 4 near Broadwell Road in Ancor. Alternative 3A utilizes the existing single track NS freight railroad line, including the existing bridge structures.
- *Alternative 3B* - Passenger rail operations from the east end of Segment 2 near the intersection of Red Bank Road and Old Wooster Pike to the beginning of Segment 4 near Broadwell Road in Ancor. Alternative 3B utilizes a new running track parallel to the existing NS freight track with a 15 foot offset. The proposed 15 ft. offset is the preferred AREMA minimum and is used in Segment 3B to facilitate keeping the new track within the existing NS right of way.
- *Alternative 4A* - Passenger rail operations from the Ancor site to the Milford terminus near IR 275 using the existing NS freight railroad line.
- *Alternative 4B* - Passenger rail operation from Ancor site to the Milford terminus near IR 275 along a new parallel alignment with the existing NS line, with a minimum 25 foot offset. The 25 foot offset is used in Segment 4B because NS right of way is wider in this segment, and the environmental issues associated with Segment 3 are less of a concern.

Table 2: Segment 3 & 4 Track Alignment Considerations

Measure	Opportunities and Challenges
Operations	Using the existing NS tracks, or adding a second track within NS right of way, would require an operating agreement with NS to allow trackage rights, and would add undetermined compensatory costs. Future expansion of operations along the NS line would require further negotiations with NS and may be limiting based on freight rail service needs. A separate and parallel track may need to be constructed and would be owned by the OASIS, which would require an operator agreement.
Cost	Utilizing the existing NS track may be more cost effective than building a separate parallel track (refer to the estimates contained in Appendix E). This cost differential will be dependent on negotiations with NS and their required needs, as well as associated capital upgrades needed to operate passenger rail service and NS.
Technology	Based on the approval of new FRA performance standards, the proposed DMU vehicles, would not require the need for temporal separation of passenger and freight service.
Shared Use	There are no plans to accommodate other transportation modes along this section of railroad.

2.3.4 Summary of Recommendations Moving Forward

A summary of alternatives to be further studied in are provided below. In all Segments, identifying and securing sufficient track to provide reliable passenger rail operations and maintenance activities will be a primary consideration.

Segment 1
Alignment Alternative 4 was preferred by the Cincinnati Park Board and will be studied in further detail moving forward. This alternative placed the track as close to the south side of Pete Rose Way as possible while maintaining the current roadway section as is. The south sidewalk was moved to the south side of tracks to maintain free access to the Sawyer Point Park parking area to the south. The track was also positioned to fit between Pete Rose Way and the I-471 bridge pier to the south of Pete Rose Way. Signalized at-grade crossings are required at the Eggleston Avenue entrance to the park and across Pete Rose Way at Butler Street. It is acknowledged that further coordination and collaboration with the Park Board will be required as this alignment is refined.

Alignment Alternative 1A entering the RTC, with the proposed rail right of way wide enough to accommodate a future second track, is recommended to be further developed with respect to the grade crossing at Pete Rose Way and Broadway and how it works with vehicular traffic movements and pedestrian access.

Segment 2
Alignment Alternative 2A utilizing the north SORTA owned trackway for initial passenger rail service is recommended for further development. The estimated cost differences for either alternative are relatively minor, and utilization of the north track alignment will minimize impacts on GWI's freight operations during construction and while in passenger service.

Segment 3
Alignment 3A utilizing the existing NS track infrastructure and right of way is recommended for further development. Operating agreement discussions/negotiations should be initiated with NS as soon as possible to determine if an agreement is possible, and what system and operating requirements would be required. Capital costs for Alternative 3A are approximately $22 million (32%) less than Alternative 3B which requires a separate parallel track.

Segment 4

Alignment 4A utilizing the existing NS track infrastructure and right of way is recommended for further development. Operating agreement discussions/negotiations will with NS will also be required for this segment. Capital costs for Alternative 4A are approximately $8 million (14%) less than Alternative 4B which requires a separate parallel track. An analysis of an extension to the Eastgate area will also be examined under a separate, but coordinated study.

2.4 Purpose and Layout of this Document

This report presents the operating characteristics and associated conceptual costs for a variety of different OASIS Rail Corridor service alternatives along a rail alignment stretching from downtown Cincinnati and the RTC to the City of Milford. The purpose of this report is to provide the project Partners, stakeholders, and the public important information and options for their consideration in advancing the planning and engineering for the Eastern Corridor program, and in making decisions on the timing, station locations, span of service, and other rail project components. Information contained in subsequent sections of this document includes the following:

- Description of the operating characteristics of basic service oriented to commute trips;
- Discussion of DMU vehicle options that may be available for the corridor;
- Details for the conceptual capital cost estimate organized by the Federal Transit Administration (FTA)'s Standard Cost Categories (SCC);
- Description of the operating characteristics of additional services that could target non- commute trips and the forecast ridership associated with each additional service type;
- Summary of cost estimates for various "add-on" service alternative scenarios;
- Description of supporting bus feeder networks and bicycle network connections; and
- Recommendations and next steps.

This report is structured to provide planning-level information consistent with Federal Transit Administration (FTA) with requirements for project evaluation within the Federal New Starts and Small Starts programs The pursuit of federal funding to further advance the Oasis project will trigger actions requiring more detailed study and procedures as the project moves through the environmental process and project development.

Some capital cost elements contained in this report are subjective and are used to provide planning-level estimates for unknown factors, and others may be completely undetermined at this point in the study process. Key unknowns at this point in the planning process are the precise track conditions and the state of repair for bridge structures on the rail corridor, including culverts and drainage facilities, ROW costs, utility relocation costs, insurance costs, and negotiated shared use agreement costs. As these are better determined during preliminary engineering, these costs would be refined at that time.

3 PROPOSED BASIC RAIL SERVICE

3.1 System Characteristics

The OASIS Rail Corridor is a 17.2-mile commuter rail corridor connecting communities in eastern Hamilton and western Clermont counties, including neighborhoods in the City of Cincinnati, Anderson Township, Village of Newtown, and City of Milford. The proposed basic service would provide a weekday, peak-period service for commuters traveling within the corridor. Three mid-day round trips will supplement the peak hour service. Seven initial stations would be served along the corridor (six of which will be used for daily service). Rail alignment alternatives were discussed in the previous section.

Commuter rail typically operates between a city center and the suburbs and commuter towns that draw large numbers of people who travel to and from the city during the weekdays. The basic OASIS corridor service is intended to operate during the morning and afternoon peak periods to accommodate the commute travel needs of people who live in these eastern communities and work in downtown Cincinnati. The proposed basic service would provide frequent, 30-minute service during weekday peak-periods for commuters traveling within the corridor. Three mid-day round trips will supplement the peak hour service. The basic service would also include some limited reverse commute service from downtown Cincinnati toward Milford and midday service between both terminal stations.

Beginning earlier in the OASIS planning process, ten potential station locations (in addition to the RTC station) were identified and considered for inclusion either with the initial service or to be considered for future implementation. As the Phase 1 work has been performed, several land use, access, and other issues have been identified and analyzed. The results of that process suggest that reducing the number of stations from the original eleven could shorten the travel time and reduce the capital expenditures required for establishment of the rail service. Offering a travel time that is competitive and reliable compared to a trip in a personal automobile provides the best opportunity for a new rail service to be successful, and increases ridership.

As part of Phase 1, a Station Area Planning (SAP) assessment was undertaken for all potential station areas (the SAP has been prepared as a separate document). This preliminary exercise was designed to identify those stations which offered the highest potential considering a range of evaluation criteria, including ridership, access/walkability, physical constraints, and development opportunity to create Transit-Oriented Development, supportive residential and commercial/retail in proximity to a station. Consideration of an alternate and/or additional rail alignment between the Newtown/Ancor area and the Eastgate area is of interest to both Clermont County and Hamilton County, and will be considered in the next phase of work. This work would include development of Station Area Planning to the same level of development for any proposed station(s) in that alignment as for the stations already included in Segments 1-4.

Exhibit 3-1 provides an assessment of the ten OASIS rail station locations east of RTC, describing their total net land available, the amount of land that the assessment deemed vacant or potentially “susceptible to change.” The ratings are shown as Low (Yellow), Medium (Blue) and High (Green), indicating the potential development opportunities within each station planning area.

Exhibit 3-1: Station Assessment by Area Vacant/Susceptible to Change (STC)

Station	TOTAL NET 1/2 Mile (~ 502 acres)*	Vacant 1/4 mile (acres)	Vacant 1/2 mile (acres)	Vacant TOTAL	STC 1/4 mile (acres)	STC 1/2 mile (acres)	STC TOTAL	Vacant/STC TOTAL	Percentage Vacant/STC	Rating
Boathouse	147	3.9	13.9	17.8	0.8	2.28	3.08	**20.88**	**14.2**	**Low**
East End	296	5.7	19.9	25.6	0.2	0.3	0.5	**26.1**	**8.8**	**Low**
Columbia Tusculum	294	18.9	40.3	59.2	6.2	7.9	14.1	**73.3**	**24.9**	**Medium**
Lunken Airport	250	4.9	11.8	11.8	1.8	2	3.8	**15.6**	**6.2**	**Low**
Beechmont	362	6.2	27.1	33.3	1.1	1.2	2.3	**35.6**	**9.8**	**Low**
Fairfax (Red Bank)	270	7.3	27	34.3	22	128.7	150.7	**185**	**68.5**	**High**
Newtown (Existing Track)	463	4.6	49.1	53.7	4.3	49.2	53.5	**107.2**	**23.2**	**Medium**
Newtown (B)	486	6.5	48.1	54.6	0	41.4	41.4	**96**	**19.8**	**Medium**
Ancor	396	16.5	121.4	137.9	14.6	61.1	75.7	**213.6**	**53.9**	**High**
Milford	422	38.2	59.8	98	39.4	141.6	181	**279**	**66.1**	**High**

* Total Net is derived from excluding Floodway, Barriers, and Steep Slopes. It is based on the analysis diagrams and does not exclude existing Right-of-way.

Exhibit 3-2 summarizes the results of station area assessments using a variety of evaluation criteria to determine the overall potential. Criteria used included whether that station location:

- Supported the OASIS land use vision
- Was consistent with federal livability principles
- Was consistent with local plans or zoning
- Met station spacing criteria
- Offered development potential within ¼ and ½ mile radius
- Provided good access to stations
- Offered Intermodal potential (through connections to pedestrian/bicycle facilities and/or bus feeder network)
- Satisfied physical requirements
- Provided local transit ridership base

Exhibit 3-2: Station Area Evaluation Criteria Ratings

Station	Oasis Corridor Vision	Livability Principles[8]	Planning / Zoning	Approximate Station Spacing (miles)[2]	Development Potential within 1/2 mile buffer (acres)[3]	Bus /Bike Access to Station[4]	Multimodal Potential[5]	2030 Ridership Forecast[6]	Constraints on Access to Station	Composite Results: Recommended Initial Stations
RTC	Yes	High	Yes	0.0	High	High	High	1,720	None	X
Boathouse[7]	Yes	Med	No	1.0	Low 21/147 (14%)	Low	Low		Distance, pattern, topo, roadways	X
East End	Yes	Low	Yes	2.0	Low 26/296 (9%)	Low	Low		Distance, pattern, topo, roadways	
Columbia-Tusculum	Yes	Med	Yes	1.4	Medium 73/294 (25%)	Medium	Medium	220	Distance, topo, roadways	X
Lunken Airport[7]	Yes	Low	Yes	1.5	Low 16/250 (6%)	Low	Low		Distance, topo, roadways	
Beechmont	Yes	Med	Yes	0.7	Low 36/362 (10%)	Low	Low		Distance, pattern, topo, roadways	
Fairfax (Red Bank)	Yes	Med	Yes	1.5	Low 185/270 (69%)	Low	Low	410	Distance, pattern, topo, roadways	X
Newtown	Yes	High	Yes	2.0	Medium 237/486 (49%)	High	High	360	None	X

Station	Oasis Corridor Vision	Livability Principles[8]	Planning / Zoning	Approximate Station Spacing (miles)[2]	Development Potential within 1/2 mile buffer (acres)[3]	Bus /Bike Access to Station[4]	Multimodal Potential[5]	2030 Ridership Forecast[6]	Constraints on Access to Station	Composite Results: Recommended Initial Stations
Ancor	Yes	Low	No[1]	2.7	Low 21/147 (14%)	High	Low	290	None	✓
Milford	Yes	High	Yes	3.3	Low 21/147 (14%)	High	High	440	Distance, pattern, topo, roadways	✓

Notes :

1. Under threshold due to number of industrial parcels.
2. Desired station spacing is 2-5 miles.
3. Percent is calculated by dividing the potential developable area by the total net area. Based on low (6-20%), medium (21-50%) and high (50%+).
4. Access to station i s based on bus and bike master plans.
5. 'Intermodal Potential' i s based on other transit connections in the vicinity of the station.
6. Projections show daily boardings, both inbound and outbound under "Six Station" Scenario described in the Conceptual Alternative Solutions report (V12, November 2013)
7. Boathouse and Lunken Airport can be special-use stations.
8. Low = Meets up to 2 Liveability Principles. Medium = Up to 4 principles. High = Up to 6 principles.

The results of this evaluation analysis were presented at the three public outreach meetings held within the corridor on August 31 through September 2, 2012. Stations suggested to be retained for future reconsideration (in the event of land use changes or increased travel demand, and subject to the availability of resources to construct and operate them) include East End, Lunken Airport, and Beechmont. The initial seven OASIS corridor stations would be located at (from west to east):

- Riverfront Transit Center (RTC) in downtown Cincinnati;
- Boathouse (special events only);
- Columbia-Tusculum;
- Fairfax (Red Bank);
- Newtown;
- Ancor; and
- Milford.

Subsequent to this initial station analysis, an alternative Fairfax station location has been identified to the east within the NS Clare Yard, which would require relocation of the yard and construction of a new roadway connection within the NS rail right of way. Also, an alternate station location was identified combining the Newtown and Ancor stations midway in between along relocated State Route 32. Either of these options may be further developed if the Oasis project advances.

Table 3 below shows the preliminary operating speeds and travel times for the basic OASIS service, based on the train simulation model. These speeds and travel times will be further refined as the project advances.

Table 3: Preliminary Operating Speed and Travel Time

From	To	Distance (Miles)	Maximum Operating Speed (MPH)	Train Travel Time (Min)	Total Travel Time with Station Stop (Min)	Average Speed (MPH)
Milford	Ancor	3.3	50	4.9	4.9	40.4
Ancor	Newtown	2.6	50	4.4	5.4	35.4
Newtown	Fairfax (Red Bank)	3.3	50	6.3	7.3	31.4
Fairfax (Red Bank)	Columbia-Tusculum	3.1	37	6.1	7.1	30.5
Columbia-Tusculum	RTC	4.9	37	9.3	10.3	31.6
Total		17.2		31.0	35.0	33.3

Source: HDR Engineering

Based on the train simulation model data, approximately 35 minutes are needed to travel by rail the 17.2 mile distance between Milford and downtown Cincinnati, including the in-rail vehicle travel time and the dwell time to allow passengers to comfortably board and disembark at stations along the way (this time may be revised due to further refinement of the rail alignment). By comparison, the observed travel time reported from Google Earth to make this trip by car is a minimum of 50 minutes during the peak period.

To enable a "clockface" schedule with easy-to-understand departure times, approximately 10 minutes is allowed for layover at each end, which allows the train sufficient time to prepare to operate in the opposite direction, allow for operator breaks and, if needed, catch up to the schedule. Therefore, while a passenger traveling between the terminal points of the corridor would spend 35 minutes end-to-end, the total round-trip time for a train including terminal layovers would be about 90 minutes. These times will continue to be refined as the planning process is advanced.

3.2 Ridership Forecasts

The ridership forecast was updated using the FTA Simplified Trips-on-Project Software (STOPS) model and OKI population and employment forecasts. This model was developed by the Federal Transit Administration (FTA) for application to projects pursuing FTA New Starts funding. The use of a common model allows the FTA to evaluate projects on a "level playing field". In addition, this model is easier to use than traditional travel forecasting models.

A weekday forecast was prepared for the opening year in 2020, using the 2010 OKI population and employment estimates. Table 4 below summarizes the forecasted ridership for the OASIS Rail Corridor for the opening year of 2020.

Table 4: OASIS Line Ridership Summary for Basic Service (FTA STOPS Model)

	2020	
	Daily Boarding	Annual Boarding
Peak ridership from Travel Model	3,200	832,000
Off-peak ridership from Travel Model	2,100	546,000
Total Ridership	5,300	1,378,000

3.3 Operations Plan

Basic Service	
Length of System	17.2 miles
Number of Stations	6
Days of Operation	Monday-Friday
Headway	30 minutes
One-way travel time	35 minutes
Span of Service	6:00am-7:05 pm

The operating plan described below depicts a general service level for use in projecting ridership, identifying vehicle requirements and estimating operating costs. An actual operating plan may vary from this scenario with respect to the frequency or the span of service, but is likely to offer a similar overall level of service.

The basic service is targeted largely to commuters working in downtown Cincinnati. Peak service would operate for about 2.5 hours in the morning and afternoon. Six westbound trips would be provided from Milford to downtown Cincinnati between 6:00 am and 8:00 am, while six eastbound trips would be provided in the afternoon from downtown Cincinnati to Milford between 4:30 pm and 6:30 pm. Commuter service would be provided every 30 minutes during those time periods on weekdays. During the morning and afternoon peak periods, one additional trip would be provided to enable a 15 minute frequency at the “peak of the peak”.

Operating a peak period schedule with 30-minute headways provides an attractive travel alternative to personal vehicles, and enough time to “recycle” two trains during the commute period; that is, sending a train back to Milford so that it can make a second inbound trip to the Riverfront Transit Center (RTC), reducing rail vehicle requirements and maximizing their utilization. Rather than sending an empty train back for a second run, this train can be used to provide a reverse commute trip for those who live in Cincinnati and work in the eastern communities or Milford. Reverse commute trips would leave the RTC for Milford at 6:45 am and 7:15 am, and would return to Cincinnati from Milford at 5:15 pm and 5:45 pm. The schedules reflect a 35 minute travel time and a 10 minute layover for return trips. The travel time was derived from the train simulation model, considering train performance characteristics, station dwell times, grades, curves, and unique track conditions influencing top speeds.

Midday service would also be provided on weekdays between 9:00 am and 2:35 pm to serve non-work passengers. Some of those trips are likely to begin at the end of the morning peak, or end at the beginning of the afternoon. The basic operating schedule used for planning purposes is shown in Table 5.

Table 5: Basic Service Operating Plan

Trainset	Westbound - Toward Cincinnati		Trainset	Eastbound - Toward Milford	
	Depart from Milford	Arrive at Riverfront Transit Center (RTC)		Depart from Riverfront Transit Center (RTC)	Arrive at Milford
Morning Service			**Morning Service**		
1	6:00 AM	6:35 AM	1	6:45 AM	7:20 AM
2	6:30 AM	7:05 AM	2	7:15 AM	7:50 AM
3	7:00 AM	7:35 AM			
4	7:15 AM	7:50 AM			
1	7:30 AM	8:05 AM			
2	8:00 AM	8:35 AM			
Midday Service			**Midday Service**		
1	10:00 AM	10:35 AM	1	9:00 AM	9:35 AM
2	12:00 PM	12:35PM	2	11:00 AM	11:35 AM
3	2:00 PM	2:35 PM	3	1:00 PM	1:35 PM
Afternoon/Evening Service			**Afternoon/Evening Service**		
1	5:15 PM	5:50 PM	1	4:30 PM	5:05 PM
2	5:45 PM	6:20 PM	2	5:00 PM	5:35 PM
			3	5:15 PM	5:50 PM
			4	5:30 PM	6:05 PM
			1	6:00 PM	6:35 PM
			2	6:30 PM	7:05 PM

Source: HDR Engineering

3.4 Vehicles

The Tier 1 EIS recommended the use of self-propelled passenger coaches called Diesel Multiple Units (DMUs) as the preferred rail transit technology within the OASIS Rail Corridor. In 2010, HDR developed the *OASIS Rail Transit Technology Alternatives* document, which provided an overview of the available rail transit technologies and how they relate to these factors.

While there are a number of other technologies available, they were previously considered and subsequently rejected. These options included:

- Diesel-Powered Locomotives pulling single or bi-level passenger coaches
- Electrically-powered light rail vehicles called Electric Multiple Units (EMU/LRT)
- Electrically-powered streetcar-type vehicles
- Diesel-Powered Passenger Cars (Diesel Multiple Units)

The DMU was selected as the most-appropriate technology based on a number of factors, including s:

1. Flexible operational capabilities
2. Relative Capital, Operating, and Maintenance Costs
3. Potential Ability for Shared Track Usage with Freight
4. Community/Customer Acceptance

Operational Capabilities

The primary factor in selecting one technology over another is its ability to meet the operational needs of the OASIS rail service. Factors related to operational capabilities include the type, schedule, and service offered, station spacing, and the performance of the equipment in providing an effective travel time between stations, including the starting/stopping characteristics of the vehicles. The lighter-weight DMU vehicles under consideration offer rapid acceleration, redundant power supply, and regenerative braking to improve fuel economy, minimize noise impacts, and allow for rapid deceleration in an emergency.

Service Type, Schedule and Frequency

The basic service proposed for OASIS is a weekday, peak-period passenger service to provide a commute alternative for traveling between Milford and Cincinnati (and intermediate stops). The service will operate Monday through Friday, with most trips in the AM traveling toward Cincinnati and most trips in the afternoon traveling toward Milford (with limited “reverse commute” trips offered during both peaks). Frequent 30-minute service will be operated in the peak period, peak direction (i.e., to RTC in the morning, to Milford in the afternoon). A limited number of trips will be offered, with service during the peak every 30 minutes, and with limited hour off-peak frequency in the mid-day.

Any rail technology would be able to meet this criterion. A traditional locomotive-pulled commuter rail service offers frequencies of between 30 minutes and one hour in the peak period, and limited off-peak service. Electrified light rail transit (LRT) service typically offers much higher frequencies, with trains every 10-20 minutes in the peak, and 30-45 minutes in the off-peak period. Streetcar services usually offer 5-10 minute frequencies during the peak periods, and typically 20-30 minutes in off-peak periods. DMUs offer the ability to appropriately serve the OASIS rail service, and their performance is suitable for the proposed schedule and frequency of trains.

With the recent developments and attractions at the Banks, and multitude of festivals and sporting events located near the RTC, the Partners will also be considering further service enhancements, including the implementation of evening, special and weekend service.

---

[5] Pending the approval of new proposed rules by the federal Office of Management and Budget and the FRA. Refer to Steve Sweeney, “’Crashworthiness’ in context”, *Trains*, September 2013, 20.

Corridor Length and Station Spacing

The OASIS rail corridor is approximately 17.2 miles long. This is the first differentiator between DMUs and other rail technology options. Seventeen miles is traditionally too long for the average streetcar line, which typically operates between 23 and 7 miles – with many routes shorter yet, and too short for most commuter rail routes using traditional "push-pull" locomotives and coach cars. An average commuter rail route is between 20 and 50 miles long. An EMU/LRT vehicle, powered by an overhead catenary system, could also easily provide for the length of the OASIS corridor, but the costs and visual impacts of the power system are not justified by the forecasted ridership and service schedule.

Station spacing on the OASIS system is also a differentiator between available rail technologies. With six stations (excluding Boathouse, a limited-use Special Event station) over 17.2 miles, the average station spacing is that works out to be an average distance between stations of almost 2.4 miles. This spacing falls between typical commuter rail systems and LRT systems, which offer more of an urban service. Streetcar stop spacing is even tighter, consistent with its use in downtown areas as a pedestrian accelerator. Passenger cars hauled by locomotives are best suited to routes with long distances between stations, so that their slower acceleration and braking capacities are offset by the long travel distances between stations. The DMU vehicles under consideration would offer the performance capability to travel more quickly and effectively than locomotives between OASIS rail stations.

Travel Time

Providing a travel time that is competitive to that of an automobile is another consideration. DMUs have sufficient internally-produced power to be able to accelerate and brake quickly, making them a very-responsive technology option and one which can provide for attractive travel times between stations. Streetcars are not designed for speed, given their typical use in urbanized areas, frequently operating in mixed flow with other traffic. EMUs can also provide a similar travel time, albeit with the need to provide for overhead power.

Relative Capital and Operating Costs

From both a capital and operating cost perspective, DMU vehicles fall into a middle-ground between locomotive-powered coaches and EMU/LRTs. The cost of any rail technology requiring the installation of an overhead catenary-based power system are typically would be higher than the cost for diesel-powered options which would not require an off-vehicle power source. Acquisition costs for DMU vehicles are higher than for EMU/LRT vehicles on a per unit basis, but these costs are balanced against the higher investment required for track electrification. The DMUs under consideration offer flexibility in quickly adding additional coaches to create longer trainsets with more passenger capacity.

Opportunities for Shared Track Use

DMU and Locomotive-powered rail vehicles are ideally suited for shared use on tracks over which freight service operates because they don't require overhead power. Freight railroads often use double-stacked rail cars, and any operational concerns about damaging the overhead power system can be an impediment to initiating a service. In the case of the OASIS Corridor, where a substantial portion of the planned line is owned by NS, this is another important consideration. Two categories of DMU vehicles (FRA Compliant and "alternatively compliant") provide the opportunity to operate on shared track with freight trains.

Community/Customer Acceptance

The various rail technologies have differing visual, noise, and vibration characteristics that have different impact on adjacent land uses along the route. The electric powered options generally have the least noise and vibration impacts, followed by DMU's. Locomotives pulling passenger cars tend to have the greatest noise and vibration impacts, and the most significant visual impact.

FRA-Compliant Vehicle
US Railcars or Nippon Sharyo

Alternately-Compliant Vehicle
Stadler

FRA Compliant Vehicle vs. Alternately Compliant Vehicle Options

While two different options exist within the realm of DMU rail vehicles: FRA-Compliant and Alternately-Compliant, the Eastern Corridor Partners and public have indicated a preference for the lighter-weight "Alternately Compliant" models. Representative images of the two vehicle types are shown at left (none of the manufacturers shown is meant to be an endorsement of a particular vehicle, but rather representative examples of the different vehicle classes). FRA Compliant vehicles are by nature heavier vehicles and are designed to conventional standards for joint operation with other heavy rail equipment (such as intercity passenger and freight trains). This type of rail vehicle has been approved for shared track operations with freight traffic by the FRA without restrictions, such as temporal separation (times during which freight trains would not operate) and track lockouts (to prevent access to tracks when lighter passenger rail vehicles were in service) which were required in those situations where lighter, non-compliant rail technologies were used. They generally feature high-floors, which can necessitate taller, more-expensive platforms at stations, and have a slightly larger profile which increases their visual impact.

The Alternately-Compliant vehicle represents the next generation of rail vehicles in America. Starting in 2009, the Denton County (Texas) Transportation Authority (DCTA), began working with the FRA, the American Public Transit Association (APTA), freight railroads and rail manufacturers to get approval to operate lighter European-designed rail vehicles like that shown above, ultimately receiving an FRA waiver in 2011. This process involved testing and safety enhancements to protect the operator and passengers. This waiver allows for operation with freight trains (there are multiple railroads in the DCTA's service area), and allowed for regional flexibility there in Texas.

In June 2013, the FRA's Rail Safety Advisory Committee (RSAC) voted unanimously to recommend implementation of new crashworthiness performance standards for next generation rail vehicles (including the European-designed DMU rail vehicles used in Denton County, Texas and in Austin, Texas). The rules will also provide flexibility for such DMUs to operate with existing freight and passenger systems without the need for a waiver such as was required for DCTA in 2011. These rules would recognize the technological advances that have been made to increase passenger safety through the use of energy absorbing techniques and high tech materials that facilitate the use of a smaller, low platform vehicle. These new rules have not been approved by the FRA at this time, however, necessitating the continued approval of use of this vehicle on a case by case basis. In addition to FRA approval, the alternatively compliant vehicles must also be approved by the freight railroad with which they would share tracks.

In selecting the DMU technology, the Partners considered a range of issues take into consideration in selecting any future technology, including: costs to purchase, operate, and maintain the vehicle fleet, its potential for interoperability and expansion as ridership increases and new corridors are added to the regional rail network, and community/customer acceptance. The DMU vehicles address these needs well.

Regardless of the vehicle type selected, there will be a need to enter into agreements with NS and potentially other freight railroads in order to gain operating rights and either shared use of their existing tracks or the ability to construct additional trackage and stations to support passenger rail service. While the Alternatively-Compliant (Stadler) vehicle is preferred by the Partners and the public, an FRA-Compliant alternative (Nippon Sharyo) was developed to provide an option for shared track operation with the freight railroads.

For the purposes of this document, a "railcar" refers to a single vehicle and a "train" refers to one or more railcars joined together operating as one unit. The number of railcars needed to accommodate the basic commute-oriented service is based on the ridership projections and the operating plan presented in Sections 3.2 and 3.3, respectively.

The *Transit Capacity and Quality of Service Manual (TCQSM) 2nd Edition* by the Transportation Research Board notes that in general, commuter rail loading standards aim to provide all passengers a seat. This policy is due to the typically longer ride on commuter rail than light rail. As noted earlier, the travel time associated with the Oasis Line falls between a typical commuter rail service and light rail. A small standing load would result in standees for 1-2 stations, which would be about 10-15 minutes of travel time on the Oasis Line.

Ridership forecasts indicate that 3,100 passengers will ride the service in the peak period, or about equating to approximately 1,550 passengers in the AM peak period and 1,550 passengers in the PM peak period. Since a railcar seats 155 passengers, eleven railcars would provide seats to all passengers during the peak period, if passenger arrivals were evenly distributed.

However, passengers commuting to and from work will not likely arrive at the rail stations evenly during the hours of operation, however. To account for the uneven passenger loading, 60% of the peak period ridership was assumed to arrive during the peak hour, and 60% of the peak hour ridership was assumed to arrive during the peak 30 minutes of the peak hour. This results in a peak 30 minute ridership of about 560 passengers, which is almost twice the seated capacity of a Stadler two-car DMU train. This surge in demand can be accommodated by running a 4- car train in the middle of the peak, or inserting an additional train, which creates a 15 minute frequency at that time. The longer train would require extended platforms at all the stations, for just two trips per day. Instead, the operating plan reflects the insertion of an additional peak hour train to address the short-term capacity requirement, without impacting the station platform length.

The Nippon Sharyo FRA compliant vehicles are about half the length of the Stadler vehicles, providing some additional flexibility in the operating plan to accommodate peak loads. As with the Stadler operating plan, the Nippon Sharyo adds an "extra" train during the peak of the peak. The train lengths can be varied, however, running 3 car trains for most of the peak period, and inserting the 4 car trains at the maximum load period. This operating scenario would result in similar levels of standees as the Stadler option, but with fewer empty seats at other times. The operating plans for the Stadler and Nippon Sharyo scenarios are shown below in figures 3-3, and 3-4 respectively.

The peak period railcars would be used to serve off-peak passengers during the midday. In 2020, the anticipated ridership for the off-peak is about 2,300 passengers. Two Stadler trains consisting of two railcars could each make a round-trip to meet this travel need.

Since the operating plan allows for two trains to "recycle" during the commute period, eight railcars would be needed to provide the service outlined in the operations plan. FTA requires 20 percent of the active vehicles to be available as spare to be used in the event of equipment failure or accidents. Thus, a fleet size of ten railcars, including active and spare vehicles, is needed to offer the basic service consisting of morning and afternoon commute, reverse commute and midday services. This operating plan would result in a limited number of standees during the peak period.

Exhibit 3-3 shows how the eight car operating fleet could accommodate the basic service operating plan. The various trains that would be in operation are represented by different colors, and the boxes represent the number of individual railcars that are needed as part of each trainset. Exhibit 3-4 shows a Nippon Sharyo alternative following the same schedule, but more vehicles in each train due to the shorter car length and lower vehicle capacity.

Exhibit 3-3: Stadler Alternatively Compliant Fleet Operations for Basic Service

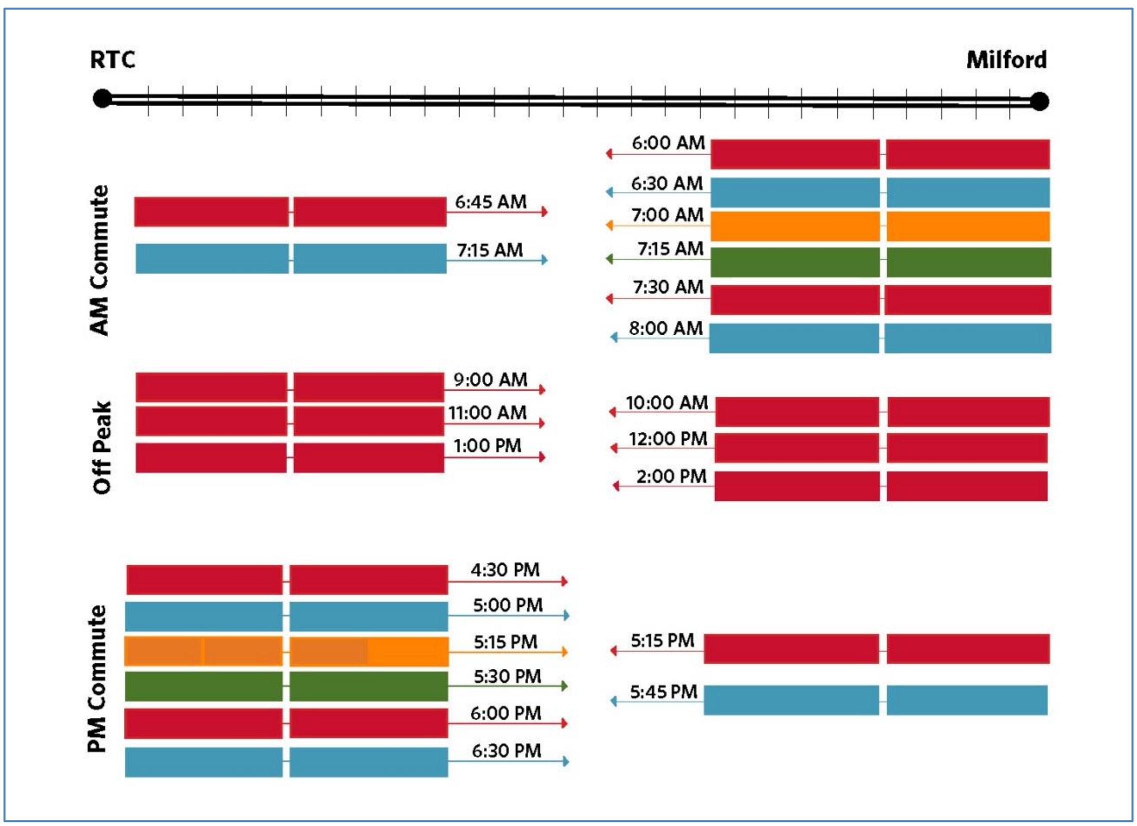
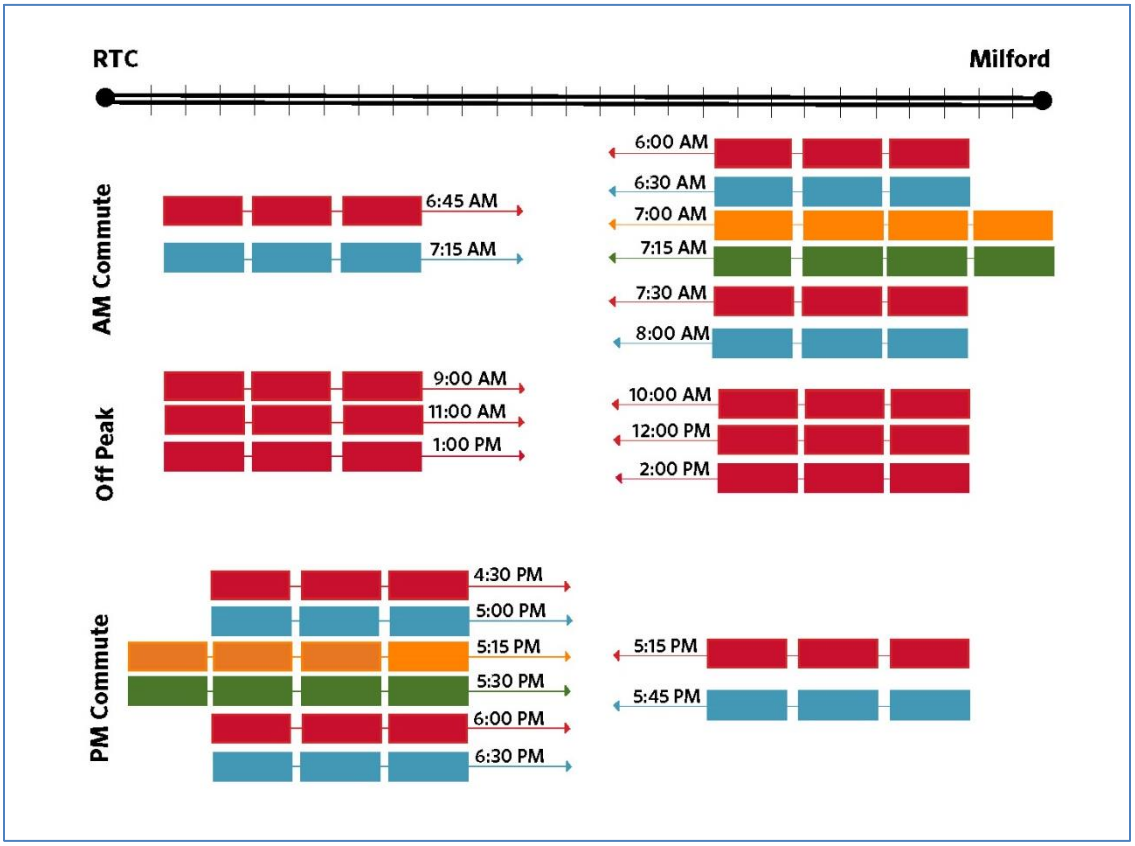


Exhibit 3-4: Nippon Sharyo FRA Compliant Fleet Operations for Basic Service



3.5 Annual Operating and Maintenance Costs

The Oasis operating and Maintenance (O&M) cost model was developed using information from the 2012 National Transit Database. The model included data from commuter rail operations in Nashville, Portland, Minneapolis, San Jose, and San Diego. Commuter rail administration, vehicle operations, vehicle maintenance and non-vehicle maintenance costs were allocated to three variables: annual revenue train-hours, annual revenue car-miles, and directional track-miles. Unit costs were then calculated for each variable and overhead/administrative costs. It includes three variables to reflect operating labor driven by train hours, and maintenance cost related to car operation and track length. These sum of these variable costs are multiplied by 1.534 to account for administrative and other overhead costs. This factor was also derived from the NTD data. Finally, the entire cost is factored by 1.04 to account for inflation from 2012 to 2015. This coefficient was derived from the Bureau of Labor Statistics Consumer Price Index.

Operating Cost Model ($2015)

*Annual Operating and Maintenance Cost =(Annual Train Revenue Hours X $980) + (Annual Car Revenue Miles X $4.43) + (Directional Track Miles X $17,700))*1.534*1.04 (inflation)*

This model allows consideration of changes in service hours, train length, and miles of single and double track, each of which may change during project development.

The operating cost model was applied to the two operating scenarios identified in Section 3.4, the Stadler alternatively compliant option and the Nippon Sharyo FRA compliant option. The train hours and track miles are constant between the two alternatives. The Nippon Sharyo has significantly higher car miles since the vehicles are smaller and have lower capacity, requiring more cars to provide adequate capacity. The higher cost associated with the Nippon Sharyo option is expected because there are more vehicles to maintain. The amount of the increase is worthy of further analysis if the project advances. The cost difference between the two options should be considered as a likely maximum that may be reduced using a more sophisticated modelling approach. As the project is developed in greater detail, the O&M cost estimates would be analyzed in greater detail along with other aspects of the project.

Table 6: Application of Cost Models to Service Plans ($2015)

Alternative	Service Summary	Train Length (cars)	Annual Operating Cost
Stadler Alternatively Compliant	Peak Period: 6 peak direction, 2 reverse Off Peak: 3 round trips	2 2	$8,900,000
Nippon Sharyo FRA Compliant	Peak Period: 6 peak direction, 2 reverse Off Peak: 3 round trips	3,4 3	$9,700,000

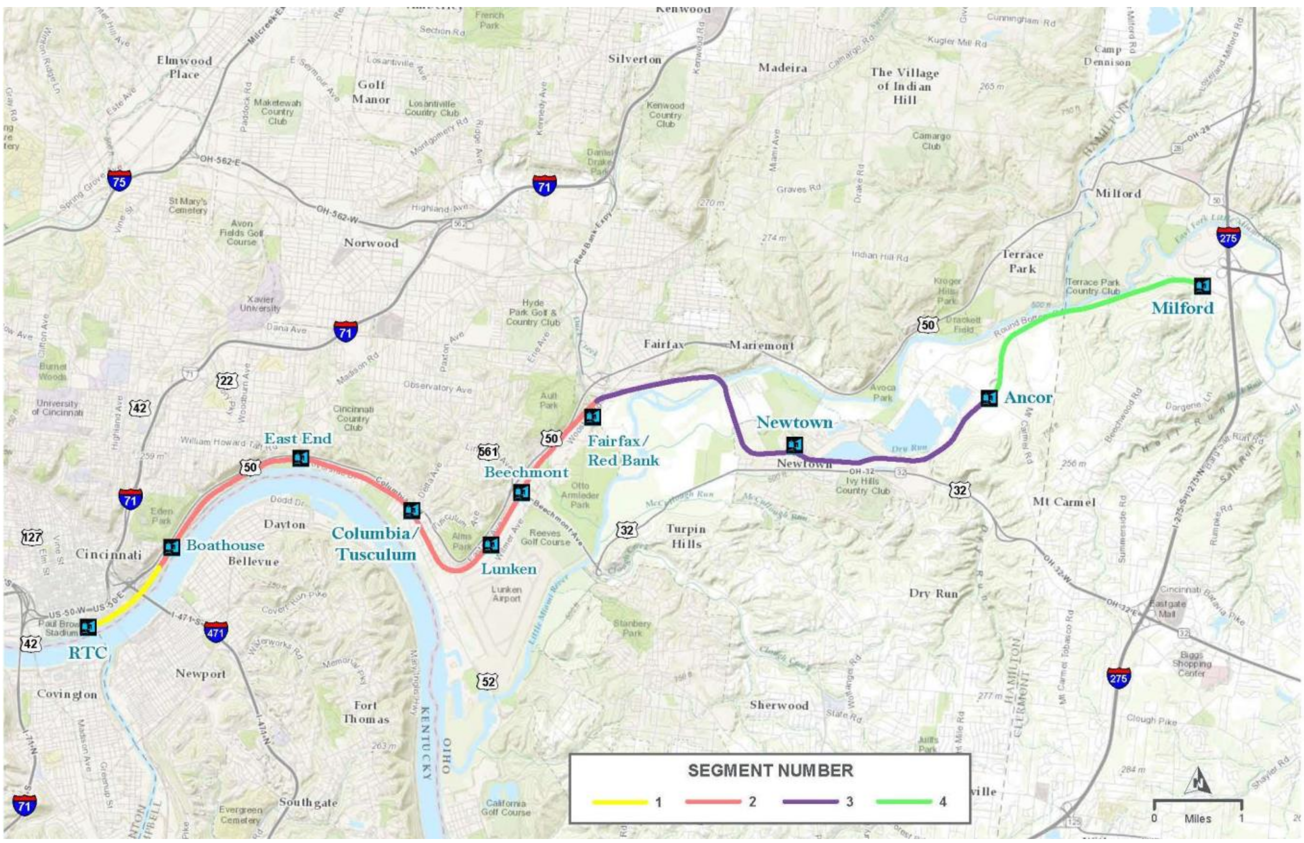
4 INFRASTRUCTURE

4.1 Existing Infrastructure Conditions

The existing OASIS rail corridor infrastructure helps to paint a picture of the elements needed to upgrade the corridor to accommodate the proposed OASIS passenger rail service, the first component of a potential regional rail network. Notwithstanding that future potential, the following subsections provide a summary of the existing infrastructure within the OASIS corridor. The OASIS rail corridor can be divided into four segments as described below:

- OASIS Segment 1 is depicted as a yellow line;
- OASIS Segment 2 is depicted as a red line;
- OASIS Segment 3 is depicted as a purple line; and
- OASIS Segment 4 is depicted as a green line.

Exhibit 4-1: OASIS Rail Corridor Alignment



4.1.1 OASIS Segment 1

OASIS Segment 1 is approximately one mile in length and would extend from the RTC to the Boathouse on a new alignment. Key considerations include the ability of the RTC to accommodate rail transit and alternative alignment options.

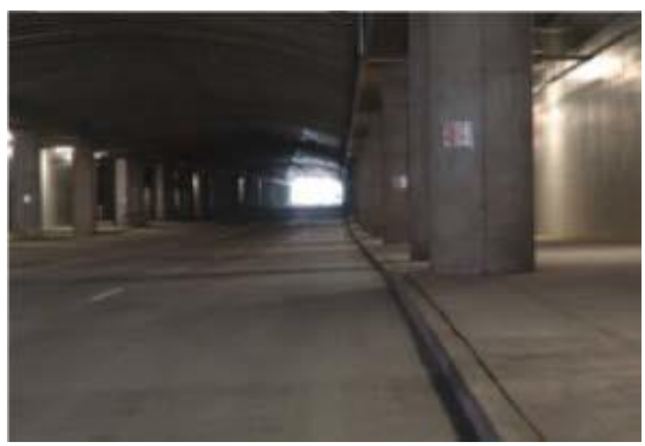
4.2 Riverfront Transit Center

4.2.1 General

The Riverfront Transit Center Station (RTC) will be the downtown terminal rail transit station for the OASIS Rail Corridor Project. The rail station improvements work will be an alteration to the existing SORTA operated transitway located under Second Street on the northern edge of the Banks Development.

The *Riverfront Transit Center Design Information Analysis* (Parsons Brinckerhoff, August 2010) analyzed the current design constraints of the RTC. The report states the following:

- The facility is more than 3,000 feet in length; with "saw tooth" shaped bus parking bays positioned for angular bus parking, and was designed to accommodate charter bus traffic and event staging activities.
- Regularly scheduled bus transit service to the RTC was not envisioned in the original design considerations and is not included in any current transit planning efforts.
- Currently provides two-way vehicular circulation with at-grade vehicle access from Central Avenue and Broadway.
- SORTA holds an easement for fixed guideway transit along Second Street (above the RTC).
- The ventilation system for the RTC was designed to handle diesel exhaust for typical diesel buses. Operation of certain transit vehicles may require modifications to the existing exhaust system.
- The majority of vertical alignment within the RTC is relatively flat with grades less than 1.0 percent, but at the west end of the RTC grades are roughly 5.0 percent and at the east end of the RTC grades exceed 2.5 percent.
- Vertical clearance ranges between 19.5 feet and 26.2 feet which may limit access. Height requirements for some transit vehicles may require the floor to be lowered.



- Offset distance to the roadway support columns is roughly 52.5 feet and will be a design constraint for the potential locations for track facilities.

An *Alternatives Summary Report* (URS Corporation, July 2009) identified and evaluated three potential alignment alternatives to connect the RTC to the Boathouse. All three alternatives accessed the RTC from the east.

The RTC must be brought to a state of good repair prior to the opening of the train station. There is evidence of water leaks from the ceiling, these leaks must be patched and the ductwork, lights and ceiling panels that are water damaged should be repaired or replaced. There are also visible cracks in the floor and walls that will need to be repaired and finishes replaced. The cause of these leaks should be determined and mitigated so that they do not reoccur after the new station is in place.

The decorative tile finish on the walls of the North side of the RTC and in the stair and elevator lobbies should be preserved during construction. Areas where the floor, walls and ceiling must be replaced should match the adjacent finishes. The new station platform will be cast in place concrete; decorative finishes should be designed to compliment the existing mosaic wall tiles. All materials used shall be durable and in keeping with the design aesthetic of the existing bus facility in the RTC.

As part of the evaluation of the RTC for commuter rail use, two platform location alternatives were investigated to determine if they meet the requirements of Chapter 5 of *NFPA 130, Standard for Fixed Guideway Transit and Passenger Rail Systems, 2010 Edition*. The first alternative centers the platforms on Vine Street, the second has the platforms located further east between Vine and Walnut Streets. A discussion of alternatives is provided in the latter portion of this section.

4.2.2 Operations and Joint Use

The RTC is currently not used by SORTA/Metro for passenger boarding and alighting, however, Metro Plus vehicles currently layover in the facility. In addition, SORTA allows charter bus and event support vehicle storage in the facility during games and events at the two ball parks and US Bank Arena. The Transit Authority of Northern Kentucky (TANK) uses the RTC for event service.

Some loading and unloading of passengers is performed during events, but it is primarily used for parking during the events. Additionally, a loading dock for the Banks development is located on the south side of the RTC below Walnut Street, and provisions have been made for a future loading dock below Race Street on the south side.

SORTA is reviewing the feasibility of extending one or more routes, including the new MetroPlus service from Government Square to the RTC.

From a rail perspective, in addition to passenger transfer operations during the morning, midday and afternoon service periods, the RTC will provide sheltered, secure storage for up to four two-unit train sets during the day until needed again in the afternoon. This will eliminate the need to run the empty vehicles back and forth from the RTC to the maintenance facility proposed near Ancor between commutes. Light cleaning of the vehicles could also be performed at the RTC between commutes. Therefore, the RTC will be occupied by the trains from approximately 6:30 am to 6:30 pm (weekdays). During this time, the RTC could be less available for use by other vehicles and/or transit services. However, evening and possibly limited weekend use for events may still be possible. Mid-day access to the loading docks may also be possible with flagmen to protect the train operation.

4.2.3 Code Compliance

The project is subject to the code provisions of the Cincinnati Building Code which references the *2011 Ohio Building Code*, Chapters 4101:1-1 to 4101:1-35 of the *Ohio Administrative Code* (OBC), including March 2012 Updates. OBC Section 34 provides the code requirements for alteration work to existing buildings and includes provisions for means of egress. Although, the OBC does not recognize NFPA 130 as a code, as a project requirement the station design must satisfy the requirements of Chapter 5:

Stations, Section 5.5: Means of Egress. The City of Cincinnati, as the authority having jurisdiction over the RTC, likely recognizes the NFPA, including Section 130.

4.2.4 Vehicle Characteristics

The proposed RTC will consist of two side platforms running west to east. The platforms are sized to accommodate a two-car train consisting of a DMU vehicle such as the Stadler DMU GTW 2/8 low-floor vehicles (used as a representative example). A standard train length is 368 feet, and would consist of a two cars. The distance between the outer edges of the doors from front to rear of the vehicle is approximately 318’-2”. Each railcar has a maximum capacity of 301 passengers which correlates to a maximum train capacity of 602 passengers. The seated load for the individual vehicles is 155 (310 per train).

4.2.5 Platform Characteristics

The platforms and station will be fully code compliant and ADA Accessible. Low floor vehicles have a floor height of approximately 21 inches above top of rail. The platform height will be set such that there is no more than ½-inch vertical difference between the top of the platform and the door sill of the train. Additionally, the platform edge will be located such that the horizontal gap between the door sill and platform sacrificial edge is not greater than 2 inches. A 24-inch wide tactile warning strip will be installed at the edge of the platforms. A guardrail will be required at all edges of the platform that are not required to be open for access to train cars. The platform surface will be broom finished cast in place concrete, with integral tactile warning tiles installed at the boarding edge. Platforms will be 13 feet wide and a length of 340 feet will be provided allowing for approximately 11 feet of clear space from the last vehicle door edge to the platform end. The platforms will have a ±60-foot wide central staircase and two 7-foot-wide end-of-platform ramps down to the existing transitway level.

4.2.6 Amenities

The transit station should be provided with benches and trash receptacles on the platform. Provisions should be made for recycling either separated at the source (multiple receptacles required) or separated at a remote sorting facility (single trash receptacle.) In addition to the benches and trash receptacles, the station will require ticket vending machines (TVM). These should be located where they are convenient, yet out of the flow of traffic and where a queuing area can be provided also out of the way of pedestrian traffic. Location and arrangement of TVMs and ticket validators will be dependent on the fare collection system selected. Public telephones and public toilets may be provided at the discretion of the operating agency. The current facility has no infrastructure in place for public toilets. Emergency telephones are required by code and should be provided at the platform. Blue light emergency units are already in place in the elevator lobbies, condition of these shall be verified prior to opening of the station. Existing lighting should be sufficient for the platform, however it should be repaired as needed to be fully operational. Additional lighting may be required in specific areas such as ticket vending, passenger information areas, and maps. Existing emergency lighting will need to be confirmed as operational and sufficient to meet applicable codes.

4.2.7 Signage

Existing signage at the RTC is intended for use by bus passengers. This must be changed to reflect the new train service. Bus bay signage should be removed and replaced with platform identification signage. Passenger information, including schedules, system maps, neighborhood maps, and way finding signage should be added in the station. The street level electronic signs should be programmed to list train arrival and departure information. Signage should be added at street level to direct customers to the train station. Electronic arrival/departure information is an option that could be added at the platform level if desired by the operating agency; it is not required by code. All signage shall be ADA compliant and where required, visual and audible messaging shall be included.

4.2.8 Electrical/Communications

The existing electrical capacity of the RTC must be evaluated to determine if it will be sufficient to supply all new electrical items at the station. The existing PA system should be re-used at the new station and should be surveyed and repaired/replaced as necessary. Adequacy of the existing Electrical Distribution room and Communications Room needs to be verified in order to determine if any additional service or repairs are required. The fire alarm system needs to be evaluated and upgraded as necessary to accommodate the addition of the two passenger platforms and train storage area.

Mechanical

The existing RTC is not heated or air conditioned. Neither heating nor air conditioning will be added to the reconfigured station. An existing exhaust system draws air from the base of the columns up to the ceiling level and out of the facility.

The existing supply air ventilation system consists of four large axial supply fans each rated for a maximum of 120,000 cubic feet per minute (CFM) of airflow at high speed. The fans are controlled by a variable frequency drive which allows the fans to speed up or slow down based on the incoming hydrocarbon and nitrogen oxide detectors readings within the station. The ventilation system was designed for 8.5 air changes per hour within the station based on the station being utilized as a bus depot. Eight vane axial exhaust fans draw air from within the station at the ceiling level. The exhaust fans are rated for 66,700 cfm and are single speed.

With the RTC's potential use as a rail transit facility, a calculation for the containment emission rates must be conducted to determine that emissions from the new trains will be properly diluted to maintain an acceptable tenable environment when utilizing the existing fan system. The Subway Environment Simulation (SES) program or Computational Fluid Dynamics (CFD) software should be used to simulate the longitudinal airflow in the tunnel. The new DMU 2/6 and 2/8 trains have two diesel electric drive systems each with a rating of 520kW, or approximately 700 horsepower (HP) each. This is a total of 1,400 HP per two car train. With the new double platform configuration, there is opportunity for two DMU trains to be at the station at the same time, equivalent to 2,800 HP engine power. A typical city bus has an engine size of approximately 300 HP; therefore, a single train in the station is equivalent to five buses parked at the station, and two trains parked in the station is equivalent to 10 buses. It is assumed all other parked trains not in operation have their engines turned off. Historical data indicates that the exhaust system runs at a lower speed for a majority of the time and only when all bus bays are filled and buses are idling for extended periods of time does the exhaust system go to full speed.

Therefore, it is likely that the existing exhaust system can handle the increased train load, although it may run at a higher speed for a larger percentage of the year. This will be verified in the next stage of the project using the computer simulation previously discussed. A supplemental smaller under platform exhaust system may be needed to remove excess train heat at its primary source, which is the underside of the train near the brakes and near the air conditioning condensers.

The station will need to be brought up to current National Fire Protection Association (NFPA) standards for both emergency smoke control and fire protection. *NFPA 130: Standard for Fixed Guideway Transit and Passenger Rail Systems, 2010 edition*, lists the requirements for the emergency smoke control system and the fire protection requirements. A smoke control system will need to be installed due to the enclosed trainway length being greater than 1,000 feet. A CFD model will be produced to determine whether the existing exhaust fan system can be used as a means for smoke exhaust within the station during a train fire event when using the heat release rate and fire smoke release rate of the new DMU rail cars. If the CFD model indicates that the existing system is not sufficient in expelling the heat and smoke release from a DMU rail car fire, then a new emergency ventilation system will need to be installed. If it is determined that the existing system can be used, then it is likely that several upgrades would need to occur, these include:

a. Ventilation system fans that are designated for use in fire emergencies shall be capable of satisfying the emergency ventilation requirements to move tunnel air in either direction as required providing the needed ventilation response. Motors capable of reversing may need to be installed.
b. Fans must come up to full operating speed in no more than 60 seconds for variable speed motors. This will need to be verified by field testing.
c. Emergency ventilation fans, their motors, and all related components exposed to exhaust flow shall be designed to operate in an ambient temperature of 482°F for a minimum of 1 hour. New fan internals, such as the motor, shroud, axial impellers, etc. may need to be replaced to meet the temperature ratings.

There is an existing automatic dry type sprinkler system in the RTC. This will remain in place and be tested to ensure its functionality. NFPA 130 requires that all enclosed train stations be provided with a public address system and emergency voice alarm reporting devices such as emergency telephone boxes or manual fire alarm boxes. These will need to be upgraded and installed within the station.

Additionally, per NFPA 130, a Class I dry standpipe is required to be installed. The system should run the entire length of the tunnel. The pipe will be a minimum diameter of 4 inches and be mounted to the wall with adequate expansion joints to permit thermal growth due to ambient temperature changes. Fire department hose valve stations will need to be installed at approximate intervals of 250 feet along the entire length of the standpipe. The system should be cross connected and fed from two independent street mains.

4.2.9 Operations/Ridership Data

From an operations perspective, service loading standards are based on a "commuter rail" standard per the TCQSM. In the basic service, peak period peak direction trains will depart from Milford from 6:00 AM to 8:00 AM and from the RTC from 4:30 PM to 6:30 PM. The forecasted ridership anticipates 1,550 passengers each in the AM peak and 1,500 passengers in the PM peak periods.

Monday through Friday, six trains would run from Milford west toward RTC (downtown Cincinnati) during the AM peak, with two trains which would operate east from RTC to Milford, providing a reverse commute. Middays there would be three round-trip between RTC and Milford beginning after 9:00 a.m. During the PM peak, the opposite of the morning service would be provided: Six trains between RTC and Milford, with two trains from Milford to RTC. See Exhibits 4-2, 4-3, and 4-4 for the proposed OASIS service schedule and a diagram illustrating the direction of service during different time periods, respectively using the Stadler and Nippon vehicles. An alternate plan using FRA compliant vehicles is shown in Exhibit 4-4, assuming the same operating schedule. The FRA compliant option requires more vehicles per train because they are smaller and provide less capacity per vehicle; however, they offer more opportunity to respond to varying demand by time of day. The alternatively compliant vehicle is the baseline assumption.

Exhibit 4-2: OASIS Rail Basic Service Operating Plan

Trainset	Westbound - Toward Cincinnati		Trainset	Eastbound - Toward Milford	
	Depart from Milford	Arrive at Riverfront Transit Center (RTC)		Depart from Riverfront Transit Center (RTC)	Arrive at Milford
Morning Service			**Morning Service**		
1	6:00 AM	6:35 AM	1	6:45 AM	7:20 AM
2	6:30 AM	7:05 AM	2	7:15 AM	7:50 AM
3	7:00 AM	7:35 AM			
4	7:15 AM	7:50 AM			
1	7:30 AM	8:05 AM			
2	8:00 AM	8:35 AM			
Midday Service			**Midday Service**		
1	10:00 AM	10:35 AM	1	9:00 AM	9:35 AM
2	12:00 PM	12:35PM	2	11:00 AM	11:35 AM
3	2:00 PM	2:35 PM	3	1:00 PM	1:35 PM
Afternoon/Evening Service			**Afternoon/Evening Service**		
1	5:15 PM	5:50 PM	1	4:30 PM	5:05 PM
2	5:45 PM	6:20 PM	2	5:00 PM	5:35 PM
			3	5:15 PM	5:50 PM
			4	5:30 PM	6:05 PM
			1	6:00 PM	6:35 PM
			2	6:30 PM	7:05 PM

Source: HDR Engineering

Exhibit 4-3: OASIS Rail Fleet Operations Stadler Alternatively Compliant Vehicle

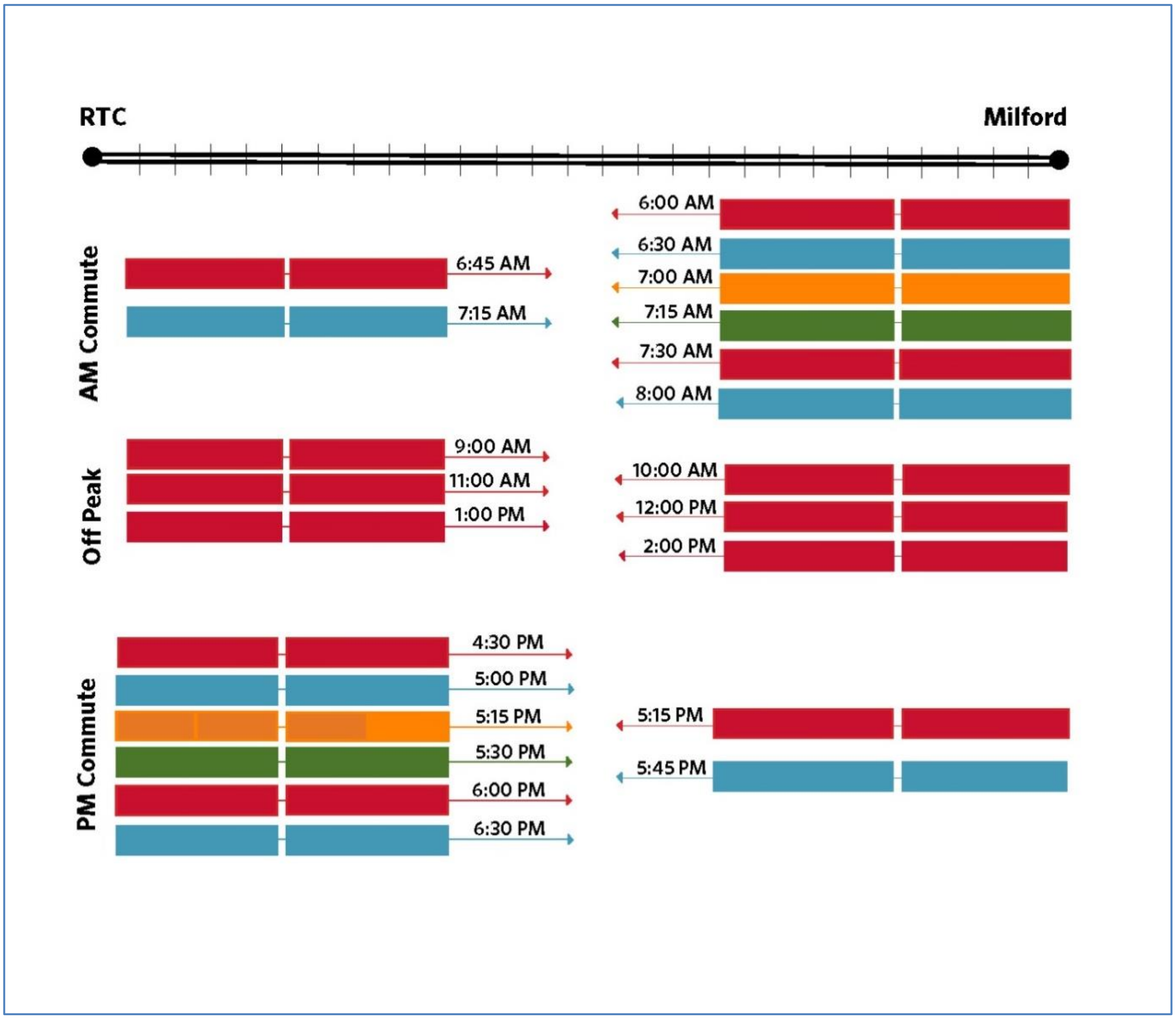
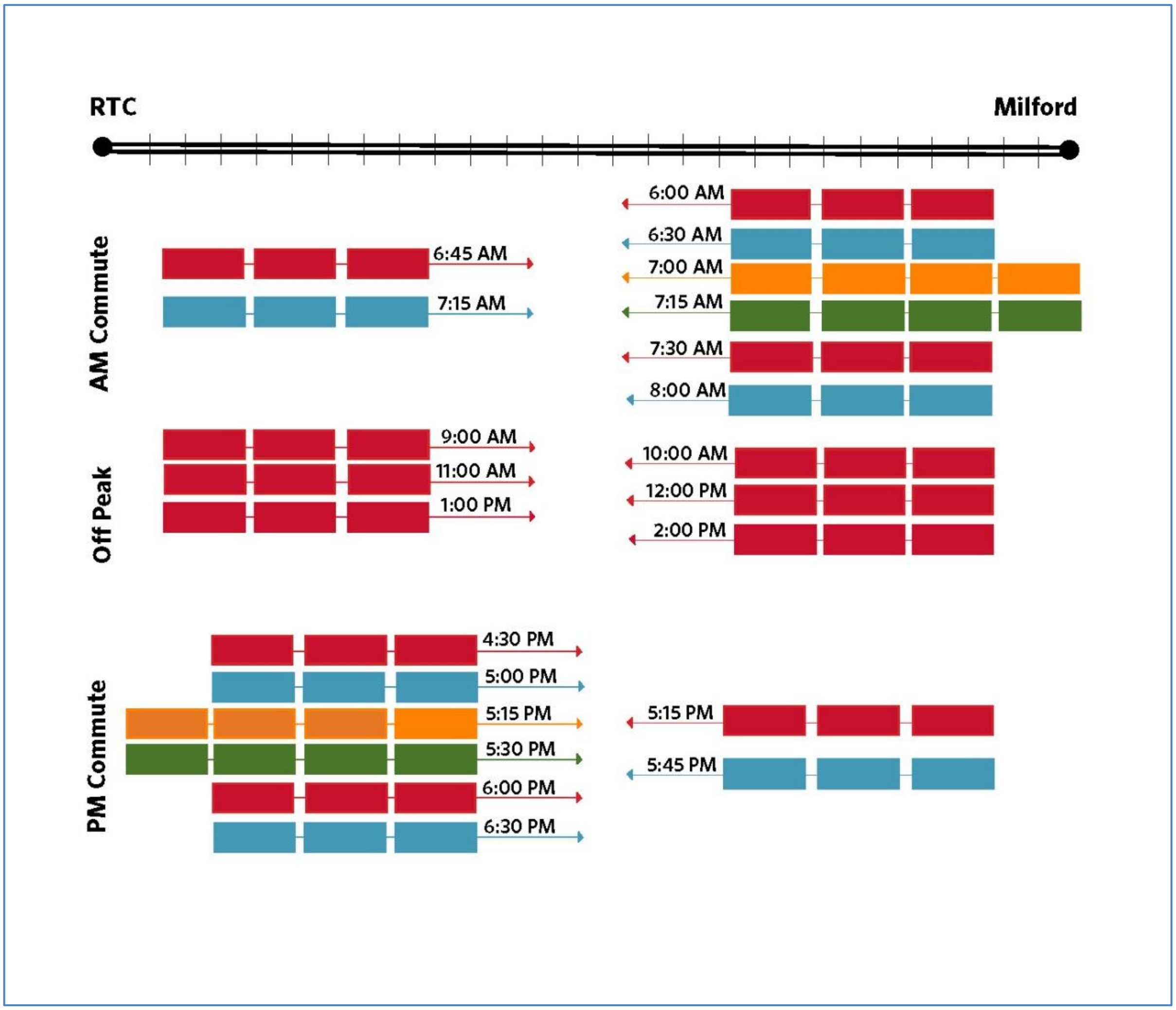


Exhibit 4-4: OASIS Rail Fleet Operations Nippon Sharyo FRA Compliant Vehicle



4.3 RTC Platform Design Alternatives

Two platform location alternatives were evaluated to meet the means of egress, programmatic and functional requirements of the RTC station.

- Platform located on Vine Street
- Platform located between Vine and Walnut Streets

4.3.1 Alternative 1 - Platform Located on Vine Street (See Exhibit 4-7 for Platform Layout)

Mainline Platform Design

With the platforms centered on Vine Street, mainline platform passengers will have access to two northwest stairs (Existing Stairs #2 and #3) and two northeast stairs (Existing Stairs #4 and #5) during an emergency. All exits would require alteration to be reconstructed as vertical exit enclosures. Per the building code, fire barriers and horizontal assemblies will be provided with a minimum fire-resistance rating of 1-hour rating. Existing Stairs #3 and #4 will accommodate areas of refuge sized to accommodate one wheelchair space of 30 X 48 inches for every 200 occupants, equating to four (4) spaces (two spaces in each area). The exit enclosures will lead directly to the exterior of the building via the existing stairs up to the exit discharge to the public way at the north side of Second Street.

Passing Platform Design

With the passing platform design option, passengers will have access to two southwest stairs (existing stair to The Banks Parking Garage), and two southeast stairs (existing stairs to the Municipal Parking Garage) during an emergency. Alterations would be required to provide area(s) of refuge to accommodate a minimum of four (4) wheelchair spaces. The exit enclosures will lead directly to the exterior of the building via the existing stairs up to the exit discharge to the public way at the south side of Second Street.

Tail Track Design

This alternative would allow for the construction of a set of tail tracks to accommodate one consist on each track to the west of the platforms. A west crossover would allow trains to access opposite platforms. A total of four trains could be stored at the station considering the tail track storage area and the platforms.

4.3.2 Alternative 2 - Platform Located Between Vine and Walnut Streets (See Exhibit 4-8 for Platform Layout)

Mainline Platform Design

With the platforms located between Vine and Walnut Streets, mainline platform passengers will have access to one northwest stair (existing stair #3) and two northeast stairs (existing stairs #4 and #5) during an emergency. Existing stairs #4 and would require alteration to be reconstructed as vertical exit enclosures. Per the building code, fire barriers and horizontal assemblies will be provided with a minimum fire-resistance rating of 1-hour rating. See the calculations in Exhibit 4-4.

Existing stair #3 would require an exit passageway to be constructed on the south side of the flood gates to extend east to towards the mainline platform. This exit passageway would connect to an exit enclosure with an interior exit stair up to grade. The exit passageway is required to meet the NFPA 130 requirement that the maximum travel distance on the platform to a point at which a means of egress route leaves the platform shall not exceed 325 feet.

Passing Platform Design

Existing stairs #3 and #4 will accommodate areas of refuge sized to accommodate one wheelchair space of 30 X 48 inches for every 200 occupants, equating to four (4) spaces (two spaces in each area). The exit enclosures will lead directly to the exterior of the building via the existing stairs up to the exit discharge to the public way at the north side of Second Street. See the calculations in Exhibit 4-6.

Exhibit 4-5: Mainline Platform Capacity and Travel Time Check

Mainline Platform Capacity Check - Alternative 1					
Exit Element	Rate of Travel	Width of Exit Element (in)	Exit Capacity (ppm)		
Existing Stair #2	1.41	93	131		
Existing Stair #3	1.41	97	137		
Existing Stair #4	1.41	97	137		
Existing Stair #5	1.41	97	137		
Total Mainline Platform			**542**		
Time to Process Passing Platform with Max Occupancy (Train Crush Load/Mainline Exit Capacity)			1.11	minute	
Walking Time Check					
Longest Travel Distance			323	feet	@ 124 fpm
Travel Time			2.60	minute	

Mainline Platform Capacity Check - Alternative 2					
Exit Element	Rate of Travel	Width of Exit Element (in)	Exit Capacity (ppm)		
Existing Stair #2	1.41	93	131		
Existing Stair #3	1.41	97	137		
Existing Stair #4	1.41	97	137		
Existing Stair #5	1.41	97	137		
Total Mainline Platform Capacity			**542**		
Time to Process Passing Platform with Max Occupancy (Train Crush Load/Mainline Exit Capacity)			1.11	minutes	
Walking Time Check					
Longest Travel Distance			323	feet	@ 124 fpm
Travel Time			2.60	minutes	

Exhibit 4-6: Passing Platform Capacity and Travel Time Check

Passing Platform Capacity Check - Alternative 1							
Exit Element	Rate of Travel (pi m)	Width of Exit Element (in)	Exit Capacity (ppm)				
Existing Doors to Existing Stair #4B	2.08	72	149.76				
Existing Doors to Existing Stair #4C	2.08	72	149.76				
Existing Doors to Existing Stair #4B	2.08	72	149.76				
Existing Doors to Existing Stair #4C	2.08	72	149.76				
Total Passing Platform Capacity			**599**				
Time to Process Passing Platform Max Occupancy (Train Crush Load/Passing Platform Exit Capacity)			1.01	minutes			
Walking Time Check							
Longest Travel Distance			268	feet	@	124	fpm
Travel Time			2.16	minutes			
Passing Platform Capacity Check - Alternative 2							
Exit Element	Rate of Travel (pi m)	Width of Exit Element (in)	Exit Capacity (ppm)				
Existing Doors to Existing Stair #4B	2.08	72	149.76				
Existing Doors to Existing Stair #4C	2.08	72	149.76				
Existing Doors to Existing Stair #4B	2.08	72	149.76				
Existing Doors to Existing Stair #4C	2.08	72	149.76				
Total Passing Platform Capacity			**599**				
Time to Process Passing Platform Max Occupancy Train Crush Load /Passing Platform Exit Capacity)			1.01	minutes			
Passing Platform Walking Time Check - Alternate B (Platform Between Vine and Walnut Streets)							
Longest Travel Distance			194	feet	@	124	fpm
Travel Time			1.56	minutes			

Passing platform passengers will have access to one southwest stair (existing stair to The Banks Parking Garage, and two southeast stairs (existing stairs to the Municipal Parking Garage) during an emergency. Alterations would be required to provide area(s) of refuge to accommodate a minimum of four (4) wheelchair spaces. The exit enclosures will lead directly to the exterior of the building via the existing stairs up to the exit discharge to the public way at the south side of Second Street.

Tail Track Design

Alternative 2 would allow for the construction of a single tail track to accommodate two trains on the track to the west of the Mainline Platform with a west crossover to allow track access to the passing platform. A total of four trains could be stored at the station considering the tail track storage area and the platforms.

4.3.3 Conclusions/Recommendation

In both RTC alternatives, the mainline platform and passing platform evacuation times are dominated by the walking travel time to reach an exit component. The maximum travel time along the longest travel path on the mainline platform side yields a walking time of 2.60 minutes which meets the 4-minute criteria (see calculations in Exhibits 4-7 and 4-8 for associated travel times). Both north and south exits afford adequate exit capacity to meet the 4-minute criteria with ample time to ascend via the existing stair towers to each respective point of safety at street level to meet the 6-minute station evacuation criteria. Additionally, both alternatives provide adequate train storage area via the use of tail tracks to the west of the RTC.

Although travel times and travel distances are satisfied in both alternatives, Alternative 2 requires the construction of an exit passageway to the west to meet the NFPA 130 maximum travel distance criteria. It is feasible to meet travel distances without constructing the exit passageway to the west; however, this would involve enabling passengers to cross the tracks at pedestrian crossings to access opposing platform exits.

This passenger movement in case of emergencies is not preferred and would require protective safety devices (e.g., gates or z-crossings) at the crossings to restrict unanticipated movements during normal operation. The implementations of these devices were not evaluated in this study. Therefore, It is for the reasons above that it is recommended that Alternative 2 be dropped from consideration, and Alternative 1A be used for further design development.

The exit capacity will support evacuation of 1,056056 passengers total standing on the platform (entraining load) and in the incident train (train load) when evacuation starts. This is almost equivalent to the entire boarding activity projected for the peak hour in 2040, indicating that the RTC should be able to satisfy emergency evacuation requirements. A more detailed analysis will be conducted in subsequent project phases as the ridership forecasts are refined further developed and a specific rail car capacity is adopted.

4.3.4 OASIS Segment 2

OASIS Segment 2 is approximately seven miles in length and extends from the Boathouse to U.S. 50 in the Village of Fairfax following the existing rail right-of-way owned by SORTA (purchased from Conrail in 1994 with federal participation). The existing right-of-way varies in width from about 40 to 100 feet, but is assumed adequate for at least two tracks throughout. The physical infrastructure such as the track, bridges, signals, etc. is owned by SORTA, which is responsible for its maintenance. IORY provides freight service in accordance with an agreement with SORTA. An underutilized trackbed is located on the north side of the SORTA right of way, running parallel to the active IORY track.

Rail freight service between downtown Cincinnati and Red Bank Road is currently limited to only two customers plus Undercliff Yard operations near Lunken Airport. There are on average two trains per week that serve these customers on an as-needed basis.

There are two other minor rail services that use the existing OASIS line in Segments 1 and 2. The Cincinnati Railway Company operates a weekly dinner train service between Oakley and the Boathouse area, as well as special event services several times a year, including Mother's Day and Father's Day. Also, the Ringling Brothers Barnum and Bailey Circus has arrived by train for its shows at the US Bank Arena.

The maximum current operating speed on the line is 10 mph and the line is currently described as an industrial spur track. IORY has indicated that service will increase in the future to 12 trains per week or two trains six days per week. Train operations are currently governed by a Manual Block System; whereby, the I&O train dispatcher grants a train operating rights within prescribed limits. There are no signals on the line.

The track is constructed of jointed rail on timber crossties. The size of the rail on this line is considered representative of what was used for mainline trackage though the 1980s. Generally the overall condition of the track would be classified as fair to poor, and is classed as FRA exempt.

OASIS Segment 2 has eight bridge structures. Structures assessed to be in poor condition include the Lancaster Pedestrian Tunnel and the bridges over Collins and Delta Avenue. The bridge over Duck Creek is in fair condition, while the bridges over Riverside and Stanley Avenue and the Wenner and Congress Pedestrian Tunnels are in satisfactory condition.

4.3.5 OASIS Segment 3 and 4

OASIS Segments 3 and 4, four and five miles in length respectively, extend from the Village of Fairfax to the City of Milford. The existing rail in these segments are owned and operated by NS and are part of a 105-mile light density line that runs from the City of Cincinnati to Peebles, Ohio (active portion of the track). NS has preserved the line east of Peebles for possible future use. The right-of-way width varies from 60 to 150 feet in width and is assumed adequate for at least two tracks throughout.

Rail freight operations are currently limited to a few industries located in Village of Newtown and the Bulkmatic facility located just west of the wye connection with OASIS Segment 2 near U.S. 50 crossing at the Village of Fairfax. Train speeds are currently limited to a maximum of 25 mph (FRA Class 2). There is a potential for expansion of freight rail service in this corridor according to NS and local jurisdictions responsible for economic development.

The track is constructed of 132 lb. Continuous Welded Rail (CWR) on timber crossties. Generally the overall condition of the track would be classified as fair to good.

OASIS Segments 3 and 4 have a total of ten bridge structures – four are classified as being in "poor" condition, and six are in "fair" condition. All structures were given a visual inspection and a condition assessment prepared. All need some maintenance regardless of the assessed condition. Structures in poor condition include a 10' x 6-5" box culvert, a 6' culvert arch pipe with extension, NS Bridge No. 2072, and a 4' x 4' box culvert. Structures in fair condition include NS Bridge No. 2080 over the Little Miami River, NS Bridge No. 2079 over clear Creek, NS Bridge No. 2078 over Dry Creek, NS Bridge No. 2077 over Dry Run Road, NS Bridge No. 2073 over Mount Carmel Road, and a double 9' x 9' concrete box culvert.

Consideration of an alternate and/or additional rail alignment between the Newtown/Ancor area and the Eastgate area is of interest to both Hamilton County and Clermont County, and will be considered in the next phase of work. This would be all new track in a new ROW, possibly running parallel to roadway improvements.

Exhibit 4-7: Alternative 1 – Platform Layout

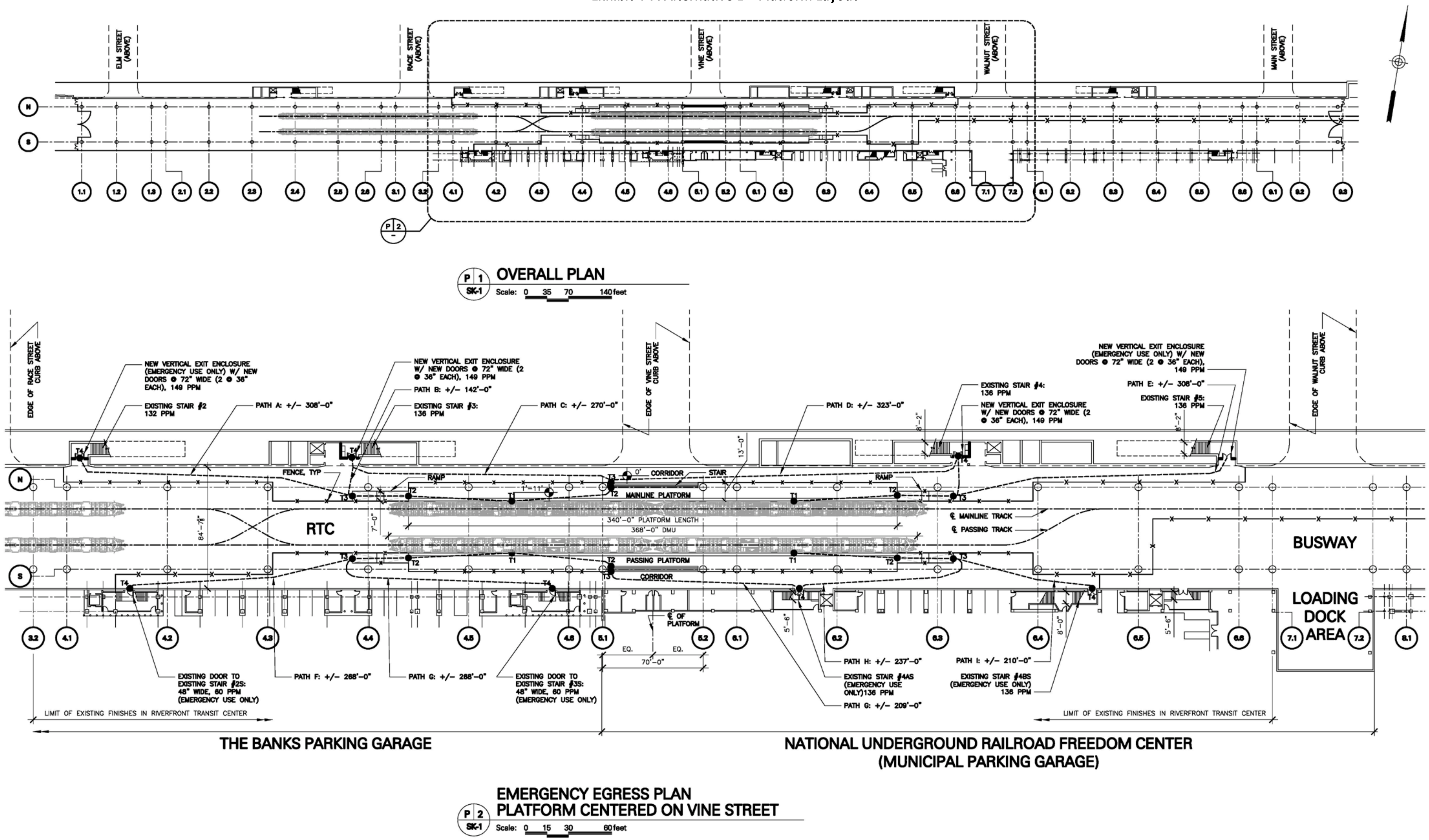
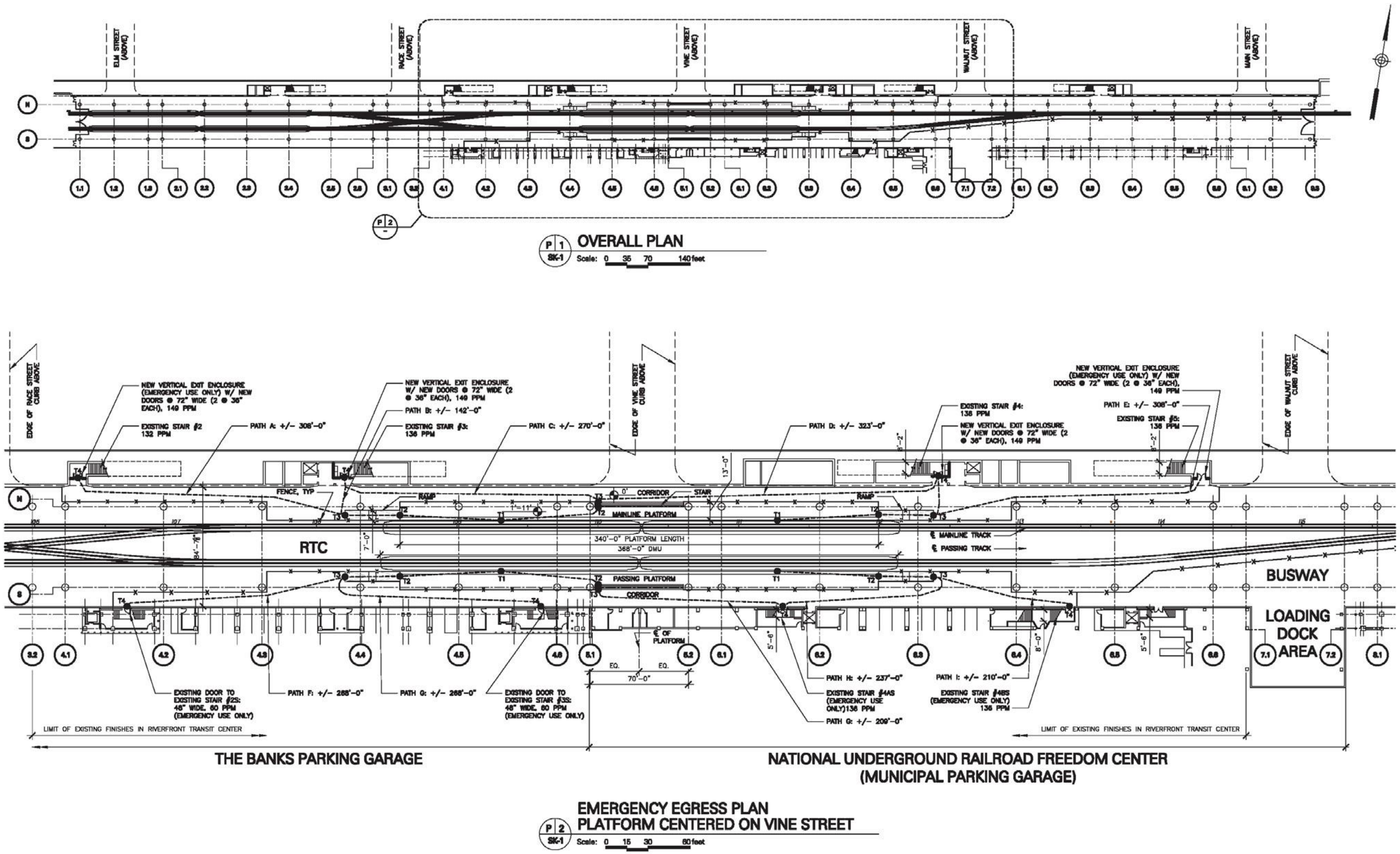


Exhibit 4-8: Alternative 2 – Platform Layout



4.4 Infrastructure Required to Provide Rail Service

As discussed in the previous section, a large portion of the infrastructure needed to make a passenger rail connection between Milford and downtown Cincinnati currently exists within the corridor. However, in certain areas, significant upgrades are needed to bring existing rail up to the standards required for passenger rail and/or new construction is needed where no rail currently exists. Also, a parallel alignment in Segment 4 will need to be further studied if an agreement with NS cannot be reached to share the freight railroad line. In addition to the rail vehicles, the following infrastructure elements would be needed to provide the basic regional rail service:

- Track;
- Stations;
- Support facilities;
- Site work;
- Systems; and
- Signals.

4.4.1 Track

The following track would be needed to facilitate basic OASIS rail service and support future development of the regional rail network:

- **OASIS Segment 1**: Construct one mile of new mainline track and any associated passing track and/or sidings required for service reliability and operational capacity that might be identified through RTC modeling;
- **OASIS Segment 2**: Replace seven miles of track that is located within SORTA right-of-way to bring to commuter rail standards and construct second track, crossovers, and passing sidings as necessary to ensure rail ROW and reserve rail capacity sufficient to meet potential future operational and maintenance requirements; and
- **OASIS Segments 3 and 4**: Upgrade nine miles of NS-owned ROW (to at least FRA Class 4) and construct passing sidings as necessary, or build separate track in NS ROW if an agreement with NS cannot be accomplished to use their existing track. The parallel track alternative shall require new, independent bridges and have a minimum offset of 15 feet in Segment 3, and 25 feet in Segment 4.
- **All Segments** – Double track will be provided as possible at stations (center platforms) to minimize train delay. As discussed, this will not be practical at the RTC in order to allow for the movement of buses and service vehicles. A center platform will also be provided at Milford station, consistent with its status as a terminal station.

The operating plan assumes that trainsets will be "recycled" during the morning and afternoon commute periods; that is, an inbound train will return to Milford after the first trip so that it can be used for a second inbound trip. Westbound and eastbound trains will be using the single track at the same time, except in those locations where a need for passing tracks and/or double track is required. Therefore, passing sidings will be needed to accommodate two-way operations. Passing sidings are a short segment of track parallel to a mainline connected to it at both ends by switches. Based on the conceptual operating plan, it is projected that inbound and outbound trains would meet in at least three locations, and it is generally likely that as train frequencies increase, there will be additional meeting points. This plan currently accounts for three passing sidings and six switches, with the passing sidings generally located in the vicinity of Columbia-Tusculum, Fairfax (Red Bank) and Ancor. It is preferable to have passing sidings located at stations, so that passenger loading and unloading can occur while the train operating in the opposite direction passes, though locations where additional track capacity is needed for rail operations may be required. The locations and number of passing sidings greatly impacts the operations schedule, and more detailed planning (through the use of RTCM) will be needed to determine the exact locations where trains are expected to meet. Modeling of rail operations to identify and validate passing meets and points of potential delay will take place in the next phase of OASIS planning.

Bridge structures within the corridor would need to be upgraded to facilitate the commuter rail operations. Inspections would be conducted in coordination with SORTA and IORY (and with appropriate consultation). Upgrades are projected to be needed at the four bridges in OASIS Segment 2 and ten bridges within OASIS Segment 3 along the existing NS railroad that are currently in fair or poor condition. This plan considers operation on the existing rail corridor within this Segment. More detailed investigation of each bridge will be needed to determine the nature and extent of the required repairs.

4.4.2 Stations

Initial Station Area Planning (SAP) was conducted during Phase 1 work. This process looked at the ten locations originally proposed for consideration as OASIS rail station stops. These included:

1. Riverfront Transit Center
2. Boathouse
3. East End
4. Columbia-Tusculum
5. Lunken Airport
6. Beechmont
7. Fairfax (Red Bank)
8. Newtown
9. Ancor, and
10. Milford.

The process also included the creation of a corridor vision, consistent with and supportive of the OASIS corridor's Purpose and Need and earlier ROD. This vision is that the rail service and stations are to not only provide a new transportation option to reduce automobile highway demand but also to knit the stations within their respective communities, to the benefit of both the rail service and neighborhood development. Three different station types were developed – Regional, District, and Community – with their size and amenities matched with to the number of passengers and connections that would exist in different places along the corridor. Representative examples of these three station types can be found in Appendix C.

Two additional station options were subsequently developed, relocating Fairfax further to the east within the Clare Yard Site, and combining Ancor and Newtown at a central location.

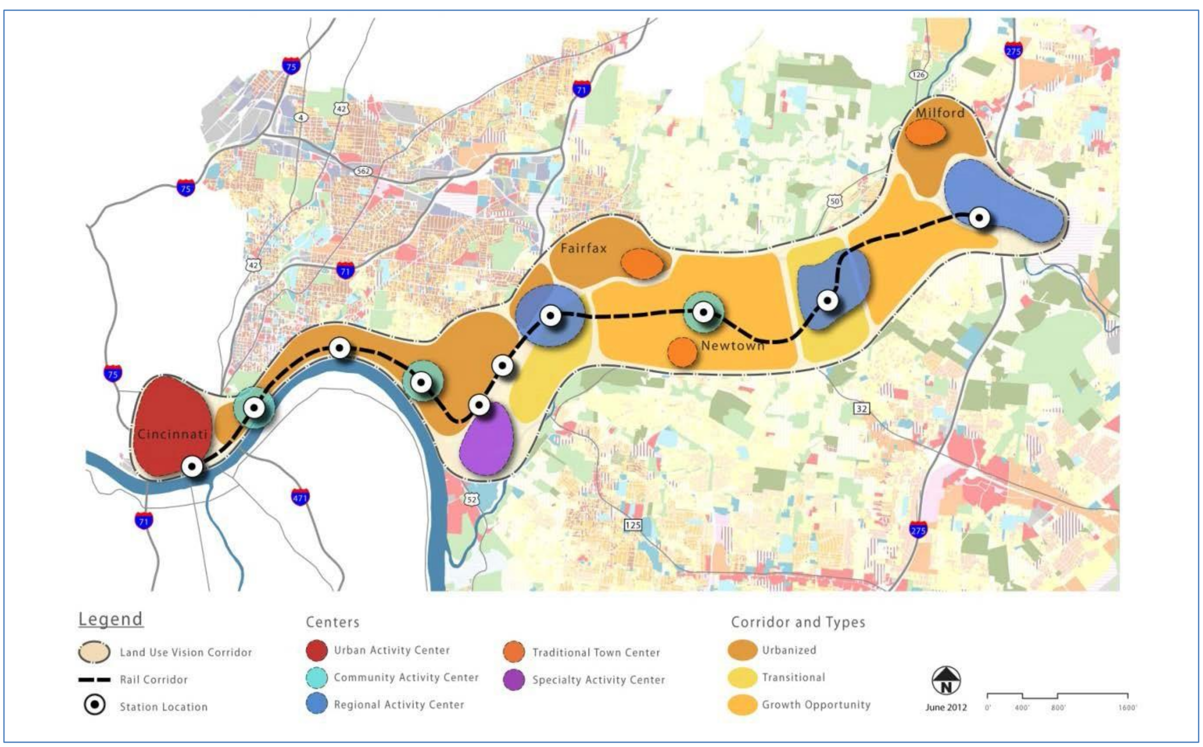
An area around each station location was evaluated to identify issues and opportunities, which included:

- Defining a ¼ and ½ mile capture radii – These two distances are accepted standards for station planning, and represent five and ten minute walks to the stations from existing and proposed transit-supportive land uses.
- Identifying vacant and "susceptible-to-change" properties – These two standards provide a focus on the potential development capacity around each station. The analysis allows the rating of stations based on their potential. A spreadsheet was prepared for each station.
- Analyzing development factors – helping to understand where and how growth could be accommodated and any physical limitations to station area development and/or access to stations

This initial level of station area planning identified as vacant or susceptible to change land that may have included steep slopes and/or land within a floodplain, knowing that these constraints would be analyzed and addressed more discretely as part of specific Station Area Planning workshops and TOD planning in the next phases of OASIS project development. Likewise, any discussion of real estate development market issues is to be part of future planning phases.

As a result of this process, which is fully-described in a standalone document (*Draft Station Area Analysis, HAM/CLE OASIS Rail Corridor, August 2013*), a number of station locations are not recommended for initial service (East End, Lunken Airport, and Beechmont), or are suggested as Special Event stations (Boathouse).

Exhibit 4-9: OASIS Corridor Station Vision



To accommodate the basic service (and potential special event and weekend service), stations would be built at Columbia-Tusculum, Fairfax (Red Bank), Newtown, and Ancor, along with terminal stations at the RTC and in Milford. As described earlier, the RTC facility would be retrofitted to accommodate a station in downtown Cincinnati. Amenities for all stations, at a minimum, would include lighting, shelters, trash receptacles, and posted information about the service to help educate first-time riders, restrooms, and ticketing machines. Parking lots would be located at stations where the automobile is anticipated to be the primary access mode, and would be sized to accommodate estimated ridership demand.

Platforms at stations would be constructed with a minimum length of approximately 340 feet, the length of two DMU rail vehicles similar to those envisioned to provide service. This length could also accommodate 4-car FRA compliant trains that may also be considered in the future. All proposed operating scenarios for both “basic” and “add-on” service envision trainsets consisting of no more than two railcars in both the opening year and 2040 scenarios (this could be a matched pair of DMU vehicles with an additional passenger coach to provide expanded seating and standing capacity).

Modern DMU vehicles have doors on both sides, providing flexibility to have right side or left-side boarding. Center platforms are anticipated for the majority of OASIS Rail Corridor stations (all stations with the exception of the terminal stations at RTC and at Milford).). Side platforms are proposed at the RTC to accommodate rail operations in the facility and still provide vehicle access. Providing two tracks in the RTC would allow for railcar storage during the day. The width of the RTC is 52.5 feet, which should accommodate both side platforms with a minimum width of 15 feet. Alternative arrangements for bus parking in the RTC once rail operations have commenced would need to be made, and will be studied as part of the next phase of OASIS rail development.

The cost of stations will depend on the ultimate number of intermediate stations, as well as the level of amenities and land costs (not included in this estimate) at each station. More extensive station amenities and larger parking areas will add to the attractiveness of the system, but will also increase project costs. These costs will be more-easily determined following the Station Area Planning Workshops to be held within each station community as part of the next phase of planning.

4.4.3 Support Facilities

The main support facility for the project will be the vehicle maintenance facility. The proposed facility is anticipated to be a heavy maintenance and storage facility for up to ten active and spare DMU vehicles operating on the OASIS Rail Corridor project (and the facility could be easily sized upward to accommodate the future maintenance and storage of DMU units operating on other, additional rail corridors, such as the Wasson or Eastgate Line). This proposed DMU vehicle capacity is based on a preliminary assessment of operating requirements. The facility would be designed to provide vehicle storage and maintenance services, including vehicle inspection, exterior washing, interior cleaning, component change-out, painting, body repair, heavy maintenance, wheel truing, and spare parts storage. In addition, a rail operations control center would be located at the facility, as well as office space for administrative and operations personnel. The potential for this facility being a joint rail/bus maintenance facility (as SORTA does not have an Eastside garage/yard) should be considered.

It is assumed that such a vehicle maintenance facility would be constructed at a location somewhere along the alignment. It would be preferable to construct the facility near the eastern end-of-line, such as Ancor or Milford, to reduce the number of deadhead miles; that is, the number of miles traveled by the vehicles to and from the storage facility with without passengers onboard, as well as the opportunity to jointly serve future expansion of the regional rail network. More detailed planning is needed to determine the exact location of the vehicle maintenance facility. Should service be established on Segments 1-2 ahead of the full corridor to Milford, a "temporary" maintenance facility would be sited at an appropriate location to minimize non-revenue runs and ease of operations.

The cost of this facility will be driven in large part by the property acquisition costs (to be determined) and the size and nature of the facility. An architecturally-significant building would be more costly than a basic building that has functionality as the primary consideration, but this would be discussed as part of the station area planning workshops.

4.4.4 Site Work

Site work includes elements such as utility relocation, right of way, environmental mitigation, and erosion control; items that have not yet been analyzed for this project. For purposes of this estimate, costs in this category are defined based on a percentage of the costs for guideway and track construction, stations, and support facilities. The cost for these components could vary greatly, depending on the details of the final project design and the site conditions that are encountered.

4.4.5 Systems

Various system elements are included in this category, including train control and signaling, traffic signaling, and grade crossing protection, communications, and safety and security. The existing alignment operates without a train signaling system, and it is assumed that a completely new system will be required to operate safe and reliable regional rail services. Railway signals are electrical devices installed adjacent to the rail line to convey information about the state of the line ahead. The signal might inform the operator of the speed at which the train may safely proceed or it may instruct the operator to stop because another train is approaching. A signal system is needed to ensure safe operations, given the speeds at which the rail vehicles would operate and the volume of trains operated. Positive train control will be an important consideration as the rail service is further defined.

Improvements at all at-grade crossings would be developed to allow Quiet Zone applications throughout the corridor. At-grade crossings infrastructure improvements would consist of installing various grade crossing protection devices including four-quadrant gates, raised medians and wayside horns. There are 18 at-grade crossings between Milford and the Boathouse in Cincinnati.

5 ESTIMATED CAPITAL COSTS

5.1 Standard Cost Categories

All major transit investments pursuing federal funding through Federal Transit Administration (FTA) grant programs must organize their project costs according to the agency's Standard Cost Categories (SCC) structure. This structure ensures that capital cost estimates can be fairly compared from one project to another.

The SCC classification includes the following categories:

- Category 10: Guideway and Track Elements;
- Category 20: Stations, Stops, Terminals and Intermodal;
- Category 30: Support Facilities: Yards, Shops, and Administrative Buildings;
- Category 40: Sitework and Special Conditions;
- Category 50: Systems;
- Category 60: Right-of-Way, Land, and Existing Improvements;
- Category 70: Vehicles;
- Category 80: Professional Services;
- Category 90: Unallocated Contingency; and
- Category 100: Finance Charges.

Additional descriptions of the types of costs included in each category are provided below. The definitions are typical examples of types of costs that may be incurred on major rail transit projects; however, not all of the design elements noted in the descriptions are necessary for the options considered for the proposed OASIS Rail Corridor project.

5.1.1 SCC Category 10 – Guideway and Track Element

Guideway and track elements consist of portions of the running way transit system constructed within the transit right-of-way. Category 10 includes a guideway within a dedicated/exclusive right-of-way; required cut and fill; underground tunnels and aerial structures; embedded track; direct fixation track; ballasted track; necessary removal of asphalt, earth excavation, backfill, drilling, mining, finished grading, and retaining walls; and other work needed for guideway or track construction. The unit of measure is typically in track feet unless otherwise noted. Trackage at the maintenance facility is included separately within the Support Facilities category (SCC Category 30).

Track unit costs vary among the segment alternatives from $180 to $280 per track foot. Unit costs for track across the range were applied in consideration of upgrading existing track that is in good repair (such as existing NS track in Segments 3 and 4) at $180 per foot, to new track on a new alignment (as in the west half of Segment 1) at $280 per foot.

To keep initial costs down to develop a commuter rail "starter" system, the cost estimates for each segment assume the existing bridges along the alignment will be rehabilitated, as opposed to being replaced.

5.1.2 SCC Category 20 – Station, Stops, Terminals, and Intermodal

Category 20 consists of any costs associated with the stations either above or below ground including: grading, excavation, ventilation structures and equipment, station power and lighting, platforms, canopies, finishes, equipment, ticket vending machines, landscaping, mechanical and electrical components, access control, security, artwork, station furnishings (benches, trash receptacles, etc.) and signage. At this level of detail, a “typical” station design was identified and the same unit cost was applied to all station locations; site-specific station elements would be considered as part of future Preliminary Engineering activities.

5.1.3 SCC Category 30 – Support Facilities, Yard, Shops, and Administrative Buildings

Category 30 is comprised of vehicle storage and maintenance buildings; track for storage of vehicles; office support areas; major shop equipment and bus maintenance facilities; costs associated with clearing and grubbing, rough grading, excavation, construction of building structures, drainage facilities, roadways, asphalt pathways, lighting, mechanical and electrical components, landscaping, access control, safety and security, fueling stations; and other items necessary for construction and operation of a storage and maintenance facility.

5.1.4 SCC Category 40 – Sitework and Special Conditions

Included within Category 40 are all of the materials and labor required for construction of the track/ transitway; environmental mitigation and hazardous material/soil contamination removal; required wetland, historical/archeological and park mitigation; sidewalks, public art and bike facilities; fencing; site lighting and signage; as well as any costs associated with mobilization, traffic mitigation and temporary construction. Examples of sitework includes the costs for clearing, grubbing, earthwork, utility relocations (private and public), hazardous material mitigation, wetland mitigation, construction of retaining walls, roadways, curb and gutter, drainage facilities, landscaping, and the installation of erosion control measures and maintenance of traffic devices not otherwise included in the other categories.

The percentages used to determine estimated costs of utility locations, drainage and environmental mitigation were varied for each segment in consideration of where new trackway is being installed (higher percentage), or where the project is simply improving the existing track in place (lower percentage).

5.1.5 SCC Category 50 – Systems

Category 50 includes costs associated with communications, train control, train signals, traffic signals, crossing protection, and other associated systems elements. The estimate assumes that Positive Train Control (PTC) will need to be installed for the whole system since they are mandated to be in place beyond 2018.

5.1.6 SCC Category 60 – Right-of-Way, Land, and Existing Improvements

Category 60 includes the costs for parcel impacts, including purchase, easements, relocations, real estate fees, and professional services associated with parcels needed for the transit and highway improvements. Professional services can include administration, real estate and relocation consultants, legal counsel, court expenses, insurance, etc. Right-of-way costs for this estimate were based upon representative examples of rail right-of-way acquisition in other cities, converted to a general cost per mile. This approach did not distinguish between actual property acquisition and potential shared trackage rights in the Oasis corridor. It provides an "order of magnitude" approximation for further refinement as the project develops.

5.1.7 SCC Category 70 – Vehicles

Category 70 includes the cost of DMU vehicles using diesel propulsion. The base cost estimate includes a cost for an Alternatively Compliant Vehicle (Stadler GTW 2/8) and a separate cost estimate for an FRA Compliant Vehicle (Nippon Sharyo SMART unit). It should be noted that the FRA Compliant alternative estimate includes increased costs for taller station platforms (50" high instead of 21").

5.1.8 SCC Category 80 – Professional Services

Under professional services Category 80, FTA identifies eight sub-categories. These categories represent expenditures related to project engineering; project and construction management; insurance; legal matters (such as permit review fees and surveys); testing and inspections; and technology-related training of personnel.

The costs allowed for each professional service subcategory were estimated using a percentage of construction costs based on historical averages for projects of this type. The right-of-way and vehicle procurement costs are not factored in when calculating professional services. Costs were calculated individually for each professional service sub-category, and not cumulatively. The eight professional services sub-categories include:

- Preliminary Engineering;
- Final Design;
- Project Management for Design and Construction;
- Construction Administration and Management;
- Professional Liability and other Non-Construction Insurance;
- Legal, Permits, Review Fees by other agencies, cities, etc.;
- Surveys, Testing, Investigation, and Inspection; and
- Start up.

5.1.9 SCC Category 90 – Unallocated Contingency

Category 90 provides a standard unallocated contingency to account for any items or issues potentially not considered. The Unallocated Contingency percentage is applied to the sum of each of the above cost categories, exclusive of the contingency applied to each individual cost category.

5.1.10 SCC Category 100 – Finance Charges

Category 100 includes finance charges expected to be paid by the project sponsor/grantee prior to either the completion of the project or the fulfillment of the federal funding commitment, whichever occurs later in time. Finance charges incurred after the later of these two dates would not be included in the total project cost.

5.2 Capital Cost Estimates

The capital cost summary in Table 7 below reflects the three alternatives summarized below:

Consolidated Alternative A: This estimate is for the recommended alternative segment alignments 1, 2A, 3A and 4A and utilizes an Alternatively Compliant Vehicle (Stadler) with low station platforms. **Present Day Total Cost = $289,800,000; and 2020 Year of Expenditure (YOE) Cost = $340,000,000.**

Consolidated Alternative A & FRA Vehicle: This estimate is essentially the same as above, except it includes and FRA Compliant Vehicle (Nippon Sharyo) and taller station platforms. **Present Day Total Cost = $278,500,000; and 2020 YOE Cost = $327,000,000.**

Consolidated Alternative B: This estimate includes alternative segment alignments 1, 2B, 3B and 4B where the vehicle would operate on the IORY freight track in Segment 2, and on a new track alignment parallel to existing NS freight tracks, but operationally separate. **Present Day Total Cost = $325,600,000; and 2020 YOE Cost = $382,000,000.**

The Year of Expenditure costs use ODOT's inflation forecasts, applied to a representative project build-out schedule.

Table 7: Capital Cost by Category

Consolidated Costs	**Alternative A**	**Alternative A & FRA Vehicle**	**Alternative B**
Cost Category	**Cost Estimate**	**Cost Estimate**	**Cost Estimate**
Guideway and Track Elements	$49,800,000	$49,800,000	$71,600,000
Stations	$23,900,000	$28,900,000	$23,900,000
Maintenance Facility	$20,200,000	$20,200,000	$20,200,000
Sitework and Special Conditions	$8,900,000	$8,900,000	$15,300,000
Systems	$20,300,000	$20,300,000	$20,300,000
Right of Way / RR Agreements	$34,800,000	$34,800,000	$34,800,000
Vehicles	$77,000,000	$61,700,000	$77,000,000
Professional Services	$36,200,000	$36,200,000	$41,000,000
Unallocated Contingency	$17,200,000	$16,200,000	$19,500,000
Finance Charges	$1,500,000	$1,500,000	$2,000,000
TOTAL (Present Day, 2015)	**$289,800,000**	**$278,500,000**	**$325,600,000**
TOTAL (Year of Expenditure)	**$340,000,000**	**$327,000,000**	**$382,000,000**

Costs for various project elements have been estimated using a recent cost estimates from other similar projects. For most track-related items, cost estimates were obtained from the most recent estimates for Charlotte's (North Carolina) planned North Corridor project, which is a 25-mile single track rail corridor connecting Uptown Charlotte and communities to its north along an existing Norfolk Southern (NS) alignment. Much like the OASIS corridor, the Charlotte North Corridor uses an existing lightly-used freight rail corridor and will upgrade the infrastructure to commuter rail standards. General unit costs were applied to the anticipated quantities to determine a high level cost estimate for OASIS Rail Corridor project. Refer to Appendix E for detailed estimates for each individual segment and their respective alternatives. These cost estimates do not include any costs that might arise through negotiations with NS as part of trackage rights agreements. As the project advances and costs for each element are refined, the contingency amounts will be modified to reflect these refined cost estimates.

The main components developed during at this conceptual level include:

- Major corridor items (including track);
- Major structural items (including stations and bridges); and
- Major systems elements (including track signalization elements).

As the project progresses further, conceptual engineering drawings depicting the various design options will be needed to help refine the more detailed cost estimates shown in Appendix E.

6 ADD-ON SERVICES

The basic service operates for a relatively limited portion of the week by serving morning, midday, and afternoon peaks during the weekdays. To increase the amount of service provided to the corridor, several supplemental service alternative options were evaluated, including:

- Evening;
- Weekend; and
- Special Event services.

Information regarding the conceptual operations plans and potential ridership for these "add-on" rail services is provided below for the Stadler option. The Nippon Sharyo costs would generally be comparable. The longer trains which increased the peak period costs are not necessary during these "add-on" conditions, except for high volume special events.

6.1 Evening Service

6.1.1 Operations Plan

Evening service could provide four eastbound and four westbound trips on weekdays following the conclusion of the commute-based afternoon service. The afternoon commute service could seamlessly transition into evening service after the last train leaves Cincinnati at 6:30pm. The frequency of service would increase to one hour for most trips, with one half hour trip in order to optimize service and reduce operating costs. The 8:30 and 9:30 trips from downtown could be delayed half an hour to create a constant hourly headway, although the operating costs would likely increase.

Evening Service	
Days of Operation	Monday - Friday
Headway	1 hour
One-way travel time	35 minutes
Span of Service	6:15pm-10:05pm

A sample operations schedule for evening service is shown in Table 8.

Table 8: Evening Service Sample Schedule

Trainset	Depart from RTC	Arrive at Milford	Depart from Milford	Arrive at RTC
4	-	-	6:15 PM	6:50 PM
1			7:15 PM	7:50 PM
4	7:00 PM	7:35 PM	7:45 PM	8:20 PM
1	8:00 PM	8:35 PM	8:45 PM	9:20 PM
4	8:30 PM	9:35 PM	-	-
1	9:30 PM	10:05 PM	-	-

Service would be provided to all stations served by the regular commute service. The intent of the evening service is primarily to serve recreational and entertainment trips.

The same railcars that will provide the basic service can be used to provide evening service. Roughly 200 passengers are anticipated to use the evening service daily. Based on the operations plan, eight one-way trips (Cincinnati to Milford or Milford to Cincinnati) would be offered during the evening.

6.1.2 Operations Costs

The largest expenses in operating a service like this are labor and fuel; however expenses related to vehicle wear and tear would still be incurred. The order of magnitude cost to operate the evening service every year is roughly $2.9 million, as shown in the table below.

Table 9: Annual Operating Cost for Evening Service

	Trips per Day	Operating Estimate
Evening Trips	8	$2,900,000
TOTAL		$2,900,000

6.1.3 Ridership Forecast

The FTA STOPS model is not directly applicable for use for "add-on" rail service options. The forecasts for each of the-add on services were developed using comparisons with experience in other cities, and/or application of headway elasticity factors. Table 10 presents a general ridership forecast for the OASIS Rail Corridor for evening service in opening year.

Table 10: Ridership Forecast for Evening Service

	2020	
	Daily Boardings	Annual Boardings
Evening Service	200	52,000

6.2 Weekend Service

6.2.1 Operations Plan

A weekend service could be operated from Milford on Saturdays and Sundays between 10:30 am and 10:20 pm, with 90 minute departures. The weekend service is primarily intended to serve recreational and entertainment trips. Service would still be provided to all stations served by the basic service. A sample operations schedule for weekend service is shown in Table 11.

Weekend Service	
Days of Operation	Saturday/Sunday
Headway	90 minutes
One-way travel time	35 minutes
Span of Service	10:30 am-10:20pm

The weekend service could be a viable option considering the continued success of the Banks development in downtown Cincinnati and the documented number of visitors and residential units. In addition, the casino is also another attraction which could increase ridership (a shuttle would be required to transport visitors from the RTC to the casino).

Table 11: Weekend Service Sample Schedule

Trainset	Depart from Milford	Arrive at RTC	Depart from RTC	Arrive at Milford
1	10:30 AM	11:05 AM	11:15 PM	11:50 PM
1	12:00 PM	12:35 PM	12:45 PM	1:20 PM
1	1:30 PM	2:05 PM	2:15 PM	2:50 PM
1	3:00 PM	3:35 PM	3:45 PM	4:20 PM
1	4:30 PM	5:05 PM	5:15 PM	5:50 PM
1	6:00 PM	6:35 PM	6:45 PM	7:20 PM
1	7:30 PM	8:05 PM	8:15 PM	8:50 PM
1	9:00 PM	9:35 PM	9:45 PM	10:20 PM

The same rail vehicles that will provide the basic weekday commute service can be used to provide weekend service. Roughly 830 passengers per weekend are anticipated to use the service.. Based on the operations plan, sixteen one-way trips (Cincinnati to Milford or Milford to Cincinnati) would occur during a day.

6.2.2 *Operations Costs*

The largest expenses in operating a rail service like OASIS are fuel and labor. The order of magnitude cost to operate the weekend service every year is roughly $ 2.4 million, as shown in the table below.

Table 12: Annual Operating Cost for Weekend Service

		Trips Per Day		Operating Estimate
Saturday Trips		16		$1,200,000
Sunday Trips		16		$1,200,000
TOTAL				**$2,400,000**

6.2.3 *Ridership Forecast for Weekend Service*

Additional ridership forecasting was performed for the add-on weekend service. Weekend ridership varies dramatically on other commuter rail system, ranging from about 28% to 75% of average weekday ridership. A conservative weekend ridership for Oasis would range from the low end of 28% to the average of 51% of weekday trips experienced by existing commuter rail lines.

Table 13: Ridership for Weekend Service

	2020	
	Weekend	Annual
Weekend ridership (Saturday + Sunday)	1,150-2,100	59,800-109,200

6.3 Special Event Service

6.3.1 Operations Plan

Special Event Service	
Headway	30 minutes
One-way travel time	35 minutes
Span of Service	3.5 hours

Special event service could supplement the weekend service by providing improved frequency and additional capacity. The proposed weekend service, presented in Section 6.2.1, would operate on selected Saturdays and Sundays between 10:30 am and 10:20 pm with 90 minute headways. To provide more service, the frequency of service would increase to 30-minute headways. Service would span a total of three and a half hours (2 hours prior to the event and 1.5 hours following the event). Service would still be provided to all regularly-served stations, as well as to special event station at the Boathouse (for events occurring in the immediate area).

Special event service could provide for recreational trips by passengers attending one or more of the following local events:

- **Baseball:** The Cincinnati Reds play games at the Great American Ballpark on weekends beginning at 1:00 pm, 4:00 pm, 7:00 pm or 8:00 pm with the average length of a game is 2 hours 50 minutes. This plan is based on an average of seventeen home games on Saturday and sixteen home games on Sunday between March and September.
- **Football**: The Cincinnati Bengals play games are played at Paul Brown Stadium begin Sundays at 1:00 pm or 8:20 pm when televised. This plan is based on an average of ten home games annually consisting of preseason and regular season games.
- **Festivals:** Local festivals are held at various times throughout the year, typically on Saturdays or Sundays (such as Riverfest) between 12:00 pm and 11:00 pm. The plan is based on service provided for five annual events.

For planning purposes, 48 days throughout a year were considered special event days. Consideration was only given to special events that occurred on a Saturday or Sunday.

Ridership for an average independent event is still an unknown (annual ridership has been estimated and included in Table 15) and the number of railcars needed to operate special event service would fluctuate depending on the event. For planning purposes, four trainsets each with two railcars are assumed to provide the service on special events days. Service could be provided by trainsets that would also serve the basic service. The time period when service is operated would depend on the start time of the event. A sample for a 1:00 pm game is shown in the table below. The number 1 trainset is already in weekend service, and its operating cost is already included in weekend service. Additional weekend service provided by this trainset outside of the special event service is not shown this schedule, which focuses upon the special service time period.

Table 14: Special Event Service Sample Schedule

Trainset	Depart from Milford	Arrive at RTC	Depart from RTC	Arrive at Milford
1*	10:30 AM	11:05 AM	11:15 AM	11:50 AM
2	11:00 AM	11:35 AM	11:45 AM	12:20 AM
3	11:30 AM	12:05 PM	12:15 PM	12:50 PM
1*	12:00 PM	12:35 PM	12:45 PM	1:20 PM
2	12:30 PM	1:05 PM	-	-
2	-	-	4:15 PM	4:50 PM
3	4:00 PM	4:35 PM	4:45 PM	5:20 PM
1*	4:30 PM	5:05 PM	5:15 PM	5:50 PM
2	5:00 PM	5:35 PM	5:45 PM	6:20 PM
3	5:30 PM	6:05 PM	6:15 PM	6:50 PM

6.3.2 Operations Costs

Special event service trips would operate 12 trips in addition to the weekend trips already in service. The order of magnitude cost to operate the special event service every year is roughly $800,000, as shown in the table below.

Table 15: Annual Operating Cost for Special Event Service

	Trips per Day	Operating Estimate
Special Event Service	12	$832,000
TOTAL		**$832,000**

6.3.3 Ridership Forecast for Special Event Service

Additional ridership forecasting was performed for the add-on special event service. The projections were based on operating a service for weekend games and events at Great American Ball Park, U.S. Bank Arena, and Paul Brown Stadium. Table 16 presents the ridership forecast for the OASIS Rail Corridor for special event service in opening year of 2020.. The range is based upon the proportion of special event travel carried by the Main Street LRT in Houston.

Table 16: Ridership for Special Event Service

	2020 Boardings
Special Events Service	49,000-98,000

6.3.4 Capital Costs

The special event service is the only "add-on" service that would require additional infrastructure beyond what was described for basic service. The Boathouse near downtown Cincinnati would be considered a special events station. The conceptual cost provision for an additional station would be about $750,000 and is comprised of the following categories:

Table 17: Capital Cost Estimate for "Add-On" Special Event Service

	Cost Estimate
Boathouse Station	$600,000
Fare collection	$137,000
TOTAL	**$737,000**

A station at the Boathouse was not originally included in the basic service between downtown Cincinnati and Milford. The designation of more stations improves access to the system, but slows travel time, reflecting the balance between providing access and having a rail travel time that is competitive with that of travel by automobile. However, Boathouse station is planned as one of the initial stations to allow for evening, weekend, and/or special event service to that area of the corridor.

6.4 OASIS Bus Feeder Network and Bicycle Connections

To help provide connectivity and extend the reach of the OASIS Rail Corridor service, a range of multi-modal connections would be provided, including a network of bus feeder services. Additionally, connections between OASIS Stations and regional bicycle/pedestrian facilities would expand the range of walking and bicycling options available for recreational cyclists and those commuting by bike. This section provides an overview of both.

6.5 Bus Feeder Network

In examining the potential need for bus feeder services to connect with the OASIS Rail Corridor, the following subtasks were undertaken[8]:

- Review of a 2004 Bus Feeder Plan
- Summary of Existing SORTA Bus Services
- Development of New Bus Feeder Services
- Potential Partnership Issues
- Needed Supportive Station Infrastructure

[8] Since the development of this initial report in late 2012. Any changes to Metro services since then are not reflected in this report.

6.5.1 Review of 2004 Bus Feeder Plan

A bus feeder plan developed as part of the expanded bus alternative in the 2004 Eastern Corridor Tier 1 FEIS included new community circulator and feeder routes to provide connections between OASIS Rail stations and surrounding communities. The bus feeder routes (bus feeder to rail transit) were one of three main components of the expanded bus alternative that also included primary service routes and transit hubs.

The 2004 Eastern Corridor plan recommendations were developed based on SORTA's MetroMoves regional transit plan (June 2002). Hub development and related actions, including local circulator bus and related community issues, were recommended to be part of the core Tier 2 analysis framework as recommended at the end of Tier 1 work. The 2004 Eastern Corridor plan identified six feeder routes and seven circulator routes for the OASIS Rail line. The feeder route components were:

1. Plainville & US 50 to East End Station;
2. I-275 to Seymour;
3. Eastgate to Newtown;
4. Seymour Reading to Beechmont;
5. East End to the University of Cincinnati; and
6. Red Bank to the University of Cincinnati.

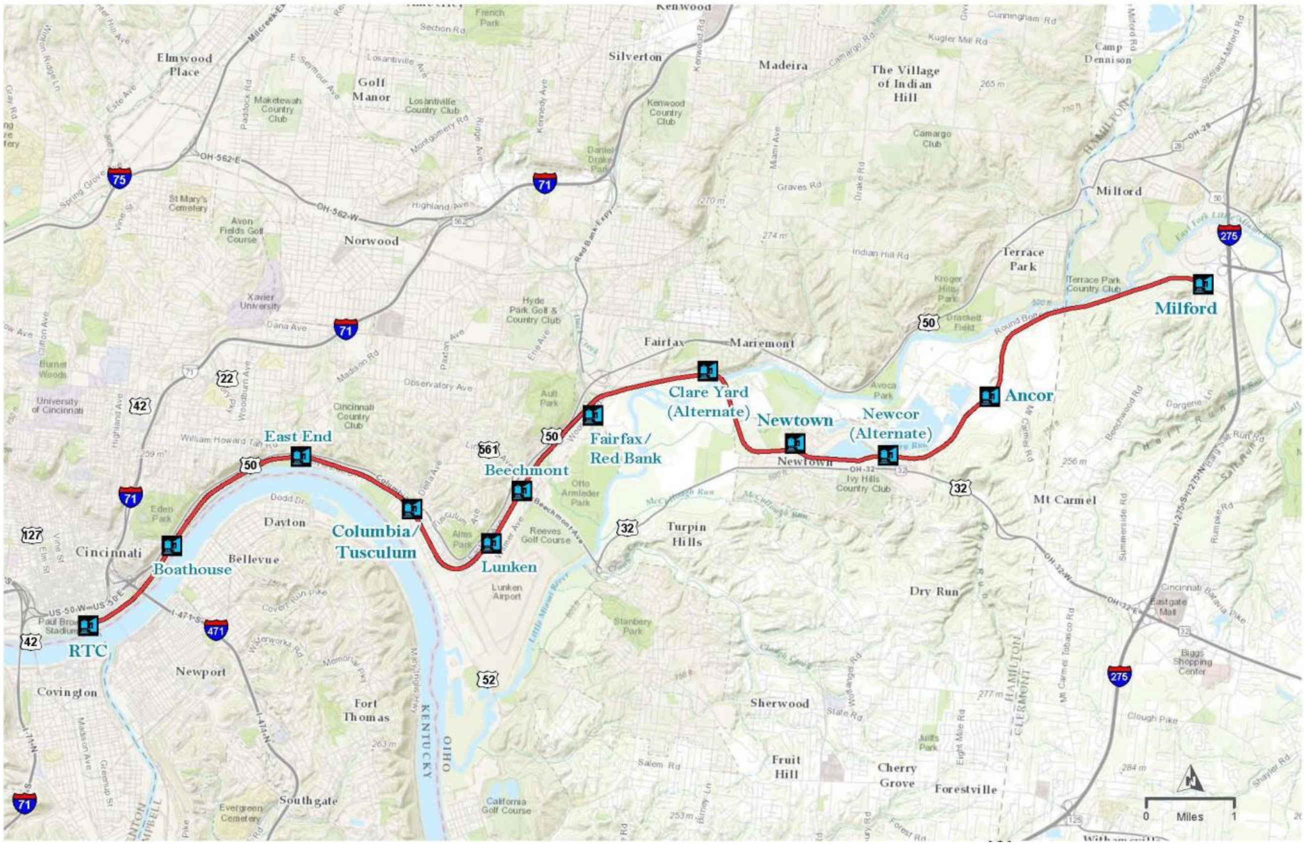
An evaluation of the 2004 feeder routes also looked at the proposed routes recommended to connect with the proposed stations. This 2012 assessment reviewed where the stations for the OASIS rail line are currently under consideration and notes current bus services available in the area.

As recommended in the previously completed Eastern Corridor MIS, ten OASIS rail stations were planned for as part of the ultimate system buildout. Although this document recommends eliminating some of these stations as the initial buildout of the system, each has been evaluated in this section of the report in case of further development or expansion. These stations included:

1. Riverfront Transit Center (RTC)
2. Boathouse
3. East End
4. Columbia-Tusculum
5. Lunken Airport
6. Beechmont
7. Fairfax (Red Bank)
8. Newtown
9. Ancor
10. Milford

See Exhibit 6-1 for a graphic showing the location of these stations.

Exhibit 6-1: 2012 Proposed OASIS Rail Station Locations



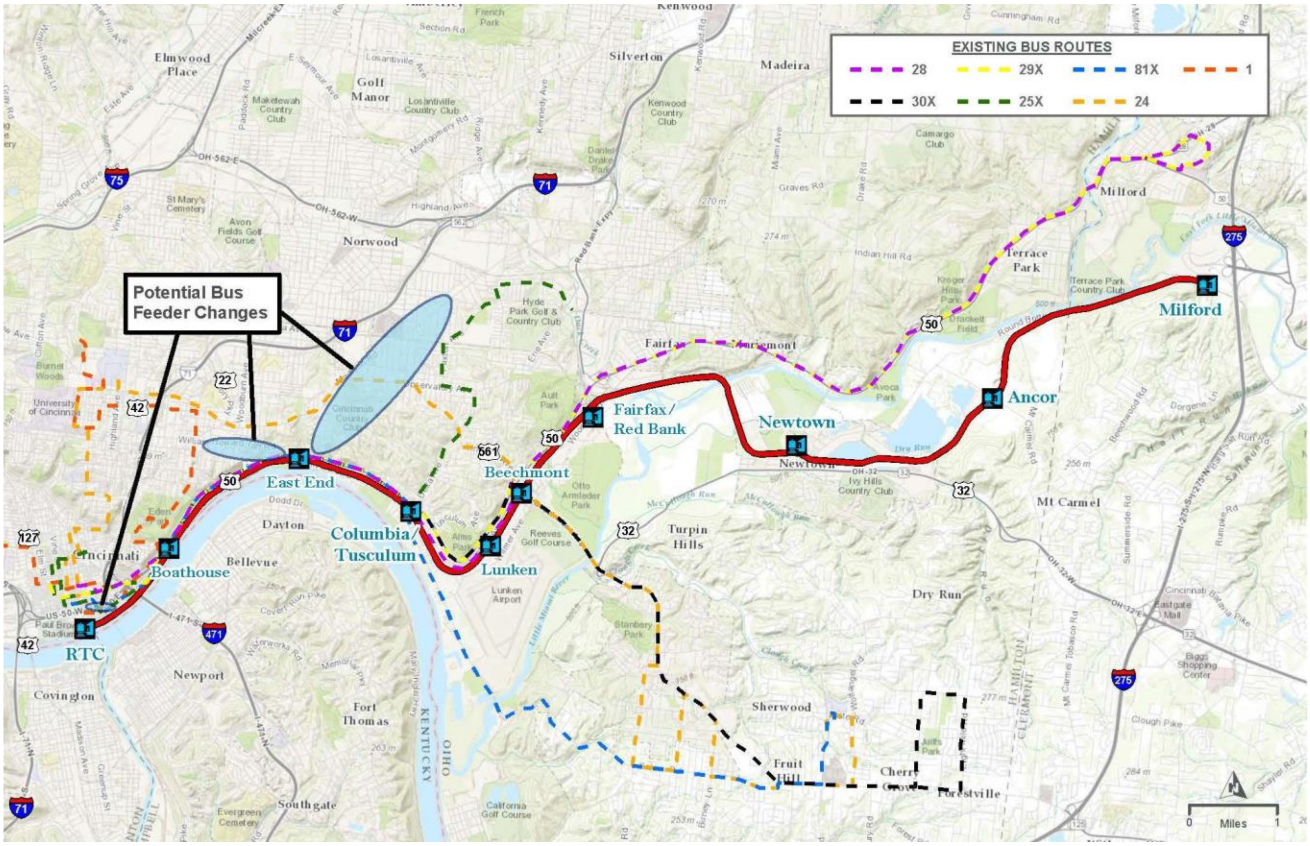
Since the 2004 expanded bus alternative was developed, SORTA service has been cut back throughout the entire SORTA system, including in the area of OASIS rail transit alignment alternatives.
Bus feeder services identified in the 2004 plan are still appropriate for serving the OASIS passenger rail line currently being considered, including:

- US 50 to East End Station
- Eastgate to Newtown
- East End to University of Cincinnati
- Red Bank to University of Cincinnati

Services proposed in 2004 that may need changes based on updated development and/or demographics include:

- Service between the RTC (OASIS Station #1) and Government Square would address new development along the riverfront at The Banks. The feeder would be the Cincinnati Streetcar ; otherwise, a bus route would be needed as a circulator.
- I-275 to Seymour could be revised to a different location.
- Based on demographics and development, a feeder between the East End and Oakley or Walnut Hills should be considered.

Exhibit 6-2: 2012 Changes from 2004 Bus Feeder Service Plan

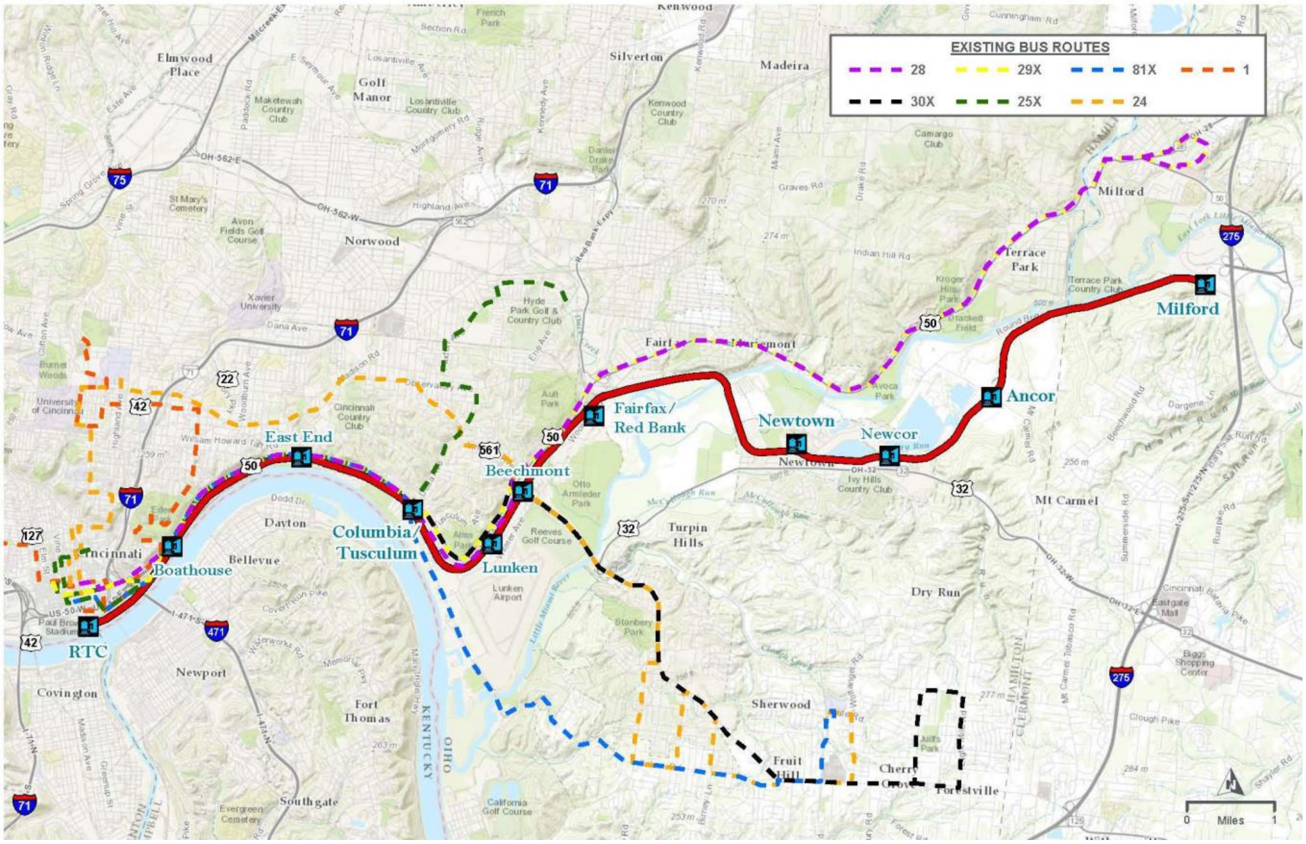


6.5.2 *Identify Existing Transit Services*

There are existing SORTA bus routes that partially run along roadways near the OASIS corridor within the study area. These routes and the associated roadways along which that they partially run are (see Exhibit 6-5 for locations of existing bus routes)

- Routes 28 (East End-Milford), 29x (Milford Express): Columbia Parkway/Wooster Pike
- Routes 25x (Mt. Lookout Express), 30x (Beechmont Express) Via Columbia Parkway
- Route 81x (Mt. Washington Express) Eastern Avenue
- Route 1 (Museum Center-Mt. Adams-Zoo) Downtown
- Route 24 (Anderson-UC) crosses the rail line at Beechmont Avenue

Exhibit 6-3: Existing Bus Service



Notes:

None of the existing routes were found to serve either OASIS Station #5 (Lunken Airport) or OASIS Station #9 (Ancor). Station #5 provides access to Lunken Airport and should be considered for a feeder route, if or when that station is developed. Station #9 is less likely to warrant bus service due to the type of land uses surrounding it and current roadway access. Future service may be considered at Station #9 to accommodate workers should employment rise in this area, as anticipated in employment projections to 2030.

Two additional routes that do not run along the roadways in the vicinity of the OASIS rail line, but are close enough to consider for modifications, are Route 31 and Route 11/69. Route 11 could be modified or have a circulator to serve OASIS Station #3. An identification of Route 69 is not shown on Metro website schedule but rather as Route 11. Route 11 adds a local destination of Madisonville that other routes accessing the OASIS rail line do not serve. Should Route 11 not be used as a circulator to Station #3, then Route 31 should be considered.

Finally, determination of the ultimate changes to existing bus routes will be dependent on the services operated by SORTA at the time the OASIS rail service is operational.

The following are suggested potential modifications to existing SORTA routes that could provide connectivity to OASIS Stations as the regional rail service is established:

- Route 1 Downtown - Museum Center/Mt Adams/Zoo
  - Local destinations include: the Downtown/Central Business District; the Banks; and stadiums and arenas
  - Provides stop to serve OASIS Station #1 (Riverfront Transit Center)
- Route 81x Mt Washington Express
  - Local destinations include: Columbia-Tusculum neighborhood; Anderson Towne Center; Lunken Airport; areas along the riverside
  - Modify route to terminate at OASIS Station #4 (Lunken Airport)
  - Route 30x Beechmont Express
  - Local destinations include: Anderson Towne Centre, Anderson Township, Columbia-Tusculum neighborhood; Beechmont Avenue
  - Could serve OASIS Stations #4 (Columbia-Tusculum) and #6 (Beechmont)
- Route 25x Mt. Lookout Express
  - Local destinations include: Mt Lookout, Hyde Park and Oakley neighborhoods; Mt.
  - Lookout Square and Hyde Park plaza
  - Could serve OASIS Station #4 (Columbia-Tusculum)
- Route 29x Milford Express (Renamed from 28x)
  - Local destinations include: Mariemont Village; Milford Shopping Center; Little Miami Trail; Milford; and Terrace Park
  - Could modify to serve OASIS Stations #4 (Columbia-Tusculum), #8 (Newtown), and #10 (Milford)
- Route 28 East End/Milford
  - Most comprehensive route that can serve the most stations but it basically parallels the proposed OASIS rail line alignment.
  - Local destinations include: Riverside/Boathouse; Mt. Lookout, Columbia-Tusculum, Mariemont, and Terrace Park neighborhoods; Newtown; Milford; Red Bank Road corridor; Milford Shopping Center; Little Miami Trail
  - Could serve OASIS Stations #2 (Boathouse), #3 (East End), #4 (Columbia-Tusculum), #6
  - (Beechmont), #7 (Fairfax), #8 (Newtown), and #10 (Milford)
  - Modifying this route should only be done at locations where transfers to other routes can occur since it essentially mimics the OASIS Rail Line.
- Route 24 Anderson/UC
  - Local destinations include: University of Cincinnati; Hyde Park Plaza; Beechmont; Anderson Township; Surrounding park area of US 50 and Little Miami River
  - Could serve OASIS Station #6 (Beechmont)

6.5.3 Develop New Conceptual Bus Feeder Services

The SORTA transit system and the funding available for service expansion have undergone significant changes since 2002, when the MetroMoves regional transit plan was completed. A new 2023 Transit Plan was recently completed that offers a more-current and feasible plan to improve the region's transit system. This plan focuses on:

- Restoring the undesirable 2009 service reductions
- Transforming the system into a multi-hub transit network
- Building additional transit capacity, including BRT services in key transportation corridors

While the services discussed in this section may be operationally feasible and important to the future OASIS rail service, coordination with SORTA staff and a comprehensive analysis of this portion of SORTA's service area and the development of appropriate bus improvements will be necessary. Naturally, the most-important factor in determining the feasibility of new feeder services will be the availability of funding to operate them.

Therefore, the conceptual services suggested here should be considered as just that – conceptual – and presented for planning and discussion purposes. Further refinement of service and how to connect between OASIS rail stations and residential/employment areas also will be conducted in a later phase of the project.

Assessment

As identified in Section 6.5.2, most of the ten OASIS Rail station locations are currently served by SORTA or the CTC. However, the types of service vary. They consist of peak period commuter express service connecting outlying neighborhoods and communities with downtown Cincinnati, or local service that operates throughout the day. Most of the existing routes are not designed to serve as feeder routes from adjacent neighborhoods and activity centers and the stations. Depending on the facilities and services provided, OASIS passengers generally have an array of options to access stations:

- Drive and park (park and ride)
- Drive and get dropped off/picked up
- Walk
- Bicycle
- Paratransit (i.e., SORTA's Access service)
- Bus

Feeder bus routes can serve multiple purposes, including:

- Connecting residents in surrounding areas to the OASIS rail line.
- Connecting OASIS rail line passengers to employment and other activity centers in areas surrounding stations.
- Travel between points served by the route apart from the OASIS rail stations.

Each station and its surrounding area was reviewed to determine the following:

- Are existing services designed to function as feeder services?
- Can existing services be modified to function as feeder services?
- What new feeder services could be provided?

Station 1 – Riverfront Transit Center (RTC)

The RTC station will serve downtown Cincinnati. In addition to the addition of a bus stop at the RTC, as identified in Task 2, the Cincinnati Streetcar line will also serve as a feeder/distributor to the OASIS rail line. Given the availability of these two services and the density of the SORTA and Transit Authority of Northern Kentucky (TANK) bus route networks, a new feeder service at this station may be redundant.

Station 2 – Boathouse

The Boathouse station is located in a physically constrained area, as it sits alongside the Mount Adams hillside, with no direct street connections to Mount Adams due to the presence of Columbia Parkway, a limited access facility which parallels the OASIS rail line in this area. The Adams Landing and Twain's Point condominium and apartment buildings are within walking distance of the station location. SORTA Route 28 runs along Riverside Drive, directly serving the station. A new feeder route at this station would be redundant at this time.

Station 3 – East End

The East End station area serves a small neighborhood that sits below Columbia Parkway and the OASIS rail line. A possible feeder route from this area previously identified in the 2004 plan would connect the East End station with Uptown and the University of Cincinnati, via William Howard Taft Road. However, Columbia Parkway effectively cuts off the neighborhood from other Cincinnati areas to the north. Although there is an existing bus stop to the north of the station, it is not positioned to serve as a bus stop for a feeder route. There is no pullout, nor room for a pullout due to the steep embankment. Buses could turn from William Howard Taft Road eastbound to Columbia Parkway eastbound and use the stop, but departing buses cannot turn around to reach William Howard Taft westbound.

Another approach would be via Gladstone Avenue, which runs directly alongside the OASIS corridor, and Collins Avenue, which connects Gladstone Avenue with William Howard Taft Road. Gladstone Avenue would require upgrading to accommodate the size and weight of buses, and a turnaround would be needed. The possibility of the latter feature may be problematic due to the steep grade of the land in the station area. The steep grade of Gladstone Avenue and the lack of a traffic signal at the intersection of Gladstone and William Howard Taft are also issues of concern.

Because of these conditions and uncertainty, a feeder route between the East End station and the University of Cincinnati would not viable at this time.

Although the station is located within the boundaries of the East End neighborhood, the station area is relatively remote from the most developed portion of the neighborhood, which is located further east, in the vicinity of Stanley and Kellogg avenues. Therefore, consideration should be given to revising the station designation in the future to reduce confusion. "East End-Torrence" is one possibility.

Station 4 – Columbia-Tusculum

This station area is currently served by two SORTA express routes that operate during weekday peak periods only: Route 25X Mt. Lookout and Route 81X Mt. Washington. The schedule of both routes currently consists of two morning and two afternoon and evening trips per weekday.

Route 25X serves portions of the Oakley, Hyde Park, Mt. Lookout and Columbia-Tusculum neighborhoods. North of the station location, it operates as an “open door” service, accessible from all stops. Between the Delta Avenue-Columbia Parkway intersection and downtown, it operates in “closed door” express mode via Columbia Parkway. Bus travel time between the intersection of Delta Avenue and Columbia Parkway, which is a block north of the station area, is currently 12 minutes.

Route 81X serves portions of the Columbia-Tusculum, East End, and Mt. Washington neighborhoods. East of the station location it operates in “open door” mode. Between the station location and downtown, it operates in “closed door” express mode via Riverside Drive. Bus travel time between the intersection of Stanley and Kellogg Avenues, about three blocks from the station location, and downtown Cincinnati is currently 15 minutes.

Truncating both routes at the Columbia-Tusculum station is feasible, but taking into account the bus travel time between the station and RTC, factoring in two intermediate stations along the way and pedestrian or transit connections between the RTC and Government Square area, ridership levels may be adversely affected.

However, there is the potential to add a feeder route that connects the station with the close-by Mt. Lookout and Hyde Park neighborhoods.

It should be noted that the station location is technically within the East End neighborhood, not Columbia-Tusculum, as the boundary between the two neighborhoods is Columbia Parkway, a block to the north of the station. Therefore, consideration should be given to revising the station designation to reduce confusion. “East End-Columbia-Tusculum” is one possibility.

Station 5 – Lunken Airport

The Lunken Airport Station is located within walking distance of most of the tenants of the industrial zone located between the tracks and Wilmer Avenue, and the residential area strung along Eastern Avenue between the tracks and Columbia Parkway. SORTA Route 28 currently provides local service along Eastern Avenue. Columbia Parkway and the adjacent hillside to the northwest, along with Lunken Airport to the east, form a physical barrier between this station area and other residential and employment areas. Consequently, a feeder route is not necessary.

Station 6 – Beechmont

SORTA Routes 24 and 28 provide local service along Beechmont Avenue and Eastern Avenue, respectively. The Linwood neighborhood is relatively small and isolated. These factors are not conducive to a feeder route and one is not recommended to serve the Beechmont Station when developed.

Station 7 – Fairfax

The Fairfax station is located, in part, to capture ridership from the Villages of Fairfax and Mariemont, and could also be a critical station linking the OASIS rail corridor to future potential services that might operate from Sharonville, or through development of the Wasson Line to Xavier University. To the north of Mariemont is the Cincinnati neighborhood of Madisonville. The proposed station location is relatively isolated relative to existing residential and employment areas due to the location of the rail right-of-way and surrounding geographic constraints. Additional locations may be examined if the project advances.

Although geographically small, the villages of Fairfax and Mariemont have a relatively high population density. The Madisonville neighborhood of Cincinnati is also densely populated and features transit-oriented development characteristics. A feeder route is recommended to connect the Fairfax station with the villages of Fairfax and Mariemont along with the Madisonville neighborhood.

Station 8 – Newtown

The Newtown station location was part of the initial scope of work within the Eastern Corridor Segment II/III effort. Due to changes in the roadway project, this station location has not been fully examined at this time. A preliminary assessment has identified a potential location along the NS rail right-of-way west of Church Street. Additional station location analysis would be appropriate if the project advances.

SORTA, in conjunction with Clermont County, currently operates Route 82X, an express route connecting the Union Township park & ride facility in the Eastgate area and downtown Cincinnati via I-275 and I-471. It currently consists of five morning weekday peak period and five afternoon/evening weekday peak period trips, along with two reverse commute trips in the morning. A feeder route that connects the Union Township park & ride with the Newtown station could supersede Route 85X.

Station 9 - Ancor

The Ancor station location serves the adjacent industrial park but is otherwise relatively isolated and removed from residential or other employment areas, with little potential for a feeder route. Future development will drive the need to consider potential feeder routes in the future as the area grows. An alternate location combining the Ancor and Newtown stations midway between may also be considered, possibly coordinated with roadway network improvements.

Station 10 – Milford

The Milford station is located in the southern portion of Milford near IR 275. Although its immediate vicinity is relatively sparsely populated, it is conveniently situated near the interchange of I-275 and U.S. 50. Several residential subdivisions are located to the east and northeast but would be difficult to serve due to the preponderance of winding streets and cul-de-sacs. Park & ride access is more appropriate for residents of these areas. However, the Milford Parkway commercial area is located just to the north of the station area, and downtown Milford is located to the northwest. SORTA's Route 28 serves areas about a mile to the north; however, the length of this route makes it difficult to re-time its schedule so that it meets the schedule of OASIS trains. Therefore, a feeder route serving the commercial area and residential core is suggested. As the passenger rail operations are firmly established, it may be appropriate to consider feeder service to areas in Clermont County already heavily populated and growing.

6.5.4 Feeder Bus Route Descriptions

Route maps of the four recommended feeder routes are shown in Exhibits 5-6 through 5-9 following this section. Parameters are summarized in Table 20, which also follows.

At this stage of the development of the OASIS Rail project, various assumptions must be made to determine a precise route, schedule, and type of equipment needed. These assumptions are described below.

Precise station locations have not yet been established. Therefore, the feeder route descriptions start where the potential OASIS corridor crosses the major roadway in the target area for purposes of route design. It is the intent of this document to identify the potential and opportunities for feeder bus routes and refine those services and operations as the project proceeds through the design process.

Once the OASIS rail service schedule is finalized, feeder bus schedules to provide close integration and minimal transfer delays will be developed. Related documents reference 15 or 30 minute service during weekday peak periods and 60 minute or less frequent service during the midday off-peak period. For the purposes of this analysis, 30 minute service is used as a working assumption based on 5:00 am-9:00 pm and 3:00 pm-7:00 pm, for a total of eight hours of service.

Note: Where the round trip running time of a feeder route is 30 minutes but the OASIS rail line headway during the midday is 60 minutes, it is not possible to operate feeder service without the bus sitting in layover 50 percent of the time. Again, these conceptual feeder bus service comments are meant to identify potential issues, and any feeder service schedules will be further refined as planning for the rail service is advanced.

The travel speed in local route conditions used to estimate round trip running time is around 13 mph (faster on express-type roadways). It includes layover and is based on information provided by SORTA.

Ridership estimates will be determined based on the input of the bus feeder route parameters. In the meantime, the size of equipment is an estimate.

Station 4 – Columbia-Tusculum: Mt. Lookout-Hyde Park Feeder Route

- Alignment: From the station, north on Delta Avenue, north on Linwood Avenue, west on Erie Avenue, east on Wasson Avenue, south on Paxton Avenue, west on Erie Avenue, south on Linwood Avenue, and south on Delta Avenue to the station.
- Local destinations served: Mt. Lookout Square, Hyde Park Square, Hyde Park Plaza shopping center.
- Round trip mileage: 5.7 miles.
- Estimated round trip running time including layover: 30 minutes.
- Schedule: 12 round trips (6 am peak trips, 6 pm peak trips). The schedule will allow the feeder to meet each OASIS Rail peak direction trip.
- Vehicle requirement: 1
- Type of bus: A small bus may be the appropriately sized equipment.

Station 7 – Fairfax: Fairfax-Mariemont-Madisonville Feeder Route

- Alignment: From the station, east on Wooster Road, east on Wooster Pike, north on Madisonville Road, west on Murray Avenue, north on Plainville Road, west on Madison Road, north on Kenwood Road, and east to the SORTA Kenwood layover facility. The return trip would proceed west out of the Kenwood layover, south on Kenwood Road, east on Madison Road, south on Plainville Road, east on Murray Avenue, south on Madisonville Road, west on Wooster Pike, and west on Wooster Road to the station.
- Local destinations served: Fairfax industrial area (Dragon Way), Mariemont business district, Madisonville business district.
- Round trip mileage: 6.0 miles.
- Estimated round trip running time including layover: 30 minutes.
- Schedule: 12 round trips (6 am peak trips, 6 pm peak trips). The schedule will allow the feeder to meet each OASIS Rail peak direction trip.
- Vehicle requirement: 1
- Type of bus: A small bus may be the most appropriately sized equipment.

Station 8 – Newtown: Newtown-Eastgate Feeder Route

- Alignment: From the station, north on Church Street, east on new S.R. 32, south on Eastgate Boulevard, east on Aicholtz Road, and north to the Union Township Park & Ride facility. The return trip would proceed south out of the Union Township Park & Ride, west on Aicholtz Road, north on Eastgate Boulevard, west on S.R. 32, and south on Church Street to the station.
- Local destinations served: Eastgate commercial area Union Township Park & Ride.
- Round trip mileage: 12.4 miles.
- Estimated round trip running time including layover: 40 minutes.
- Schedule: 12 round trips (6 am peak trips, 6 pm peak trips). The schedule will allow the feeder to meet each other OASIS Rail peak direction trip. If necessary, the frequency can be widened to reduce the vehicle requirement. The round trip running time does not result in optimal efficiency, but a 15 minute one way running time between Eastgate and Newtown appears unrealistic.
- Vehicle requirement: 1 (2 if service levels are doubled)
- Standard: A standard-size bus may be the most appropriately sized equipment.
- Midday variation: This feeder could also operate during the midday, with one operating every 60 minutes, coordinated with the OASIS rail 60 minute midday schedule at the Newtown station. The eastern end of the alignment has sufficient operating time to be routed to the Eastgate Mall and Eastgate Boulevard commercial strip, in addition to the Park & Ride facility.

Station 10 – Milford: Milford Feeder Route

- Alignment: From the station, north on Beechwood Road, west on Chamber Drive, north on Milford Parkway, west on U.S. 50 (Lila Avenue), south on Cemetery Road, west on Garfield Avenue, north on Main Street, east on Main Street, east on Lila Avenue, south on Milford Parkway, west on Chamber Drive, and south on Beechwood Road to the station.
- Local destinations served: Milford Parkway commercial area, Milford Parkway industrial park,
- U.S. 50 commercial strip, downtown Milford.
- Round trip mileage: 6.0 miles.
- Estimated round trip running time including layover: 30 minutes.
- Schedule: 12 round trips (6 am peak trips, 6 pm peak trips). The schedule will allow the feeder to meet each OASIS rail peak direction trip.
- Vehicle requirement: 1
- Type of bus: small bus may be the most appropriately sized equipment.

Exhibit 6-4: Columbia-Tusculum-Mt. Lookout-Hyde Park Feeder Route

Exhibit 6-5: Fairfax-Mariemont-Madisonville Feeder Route

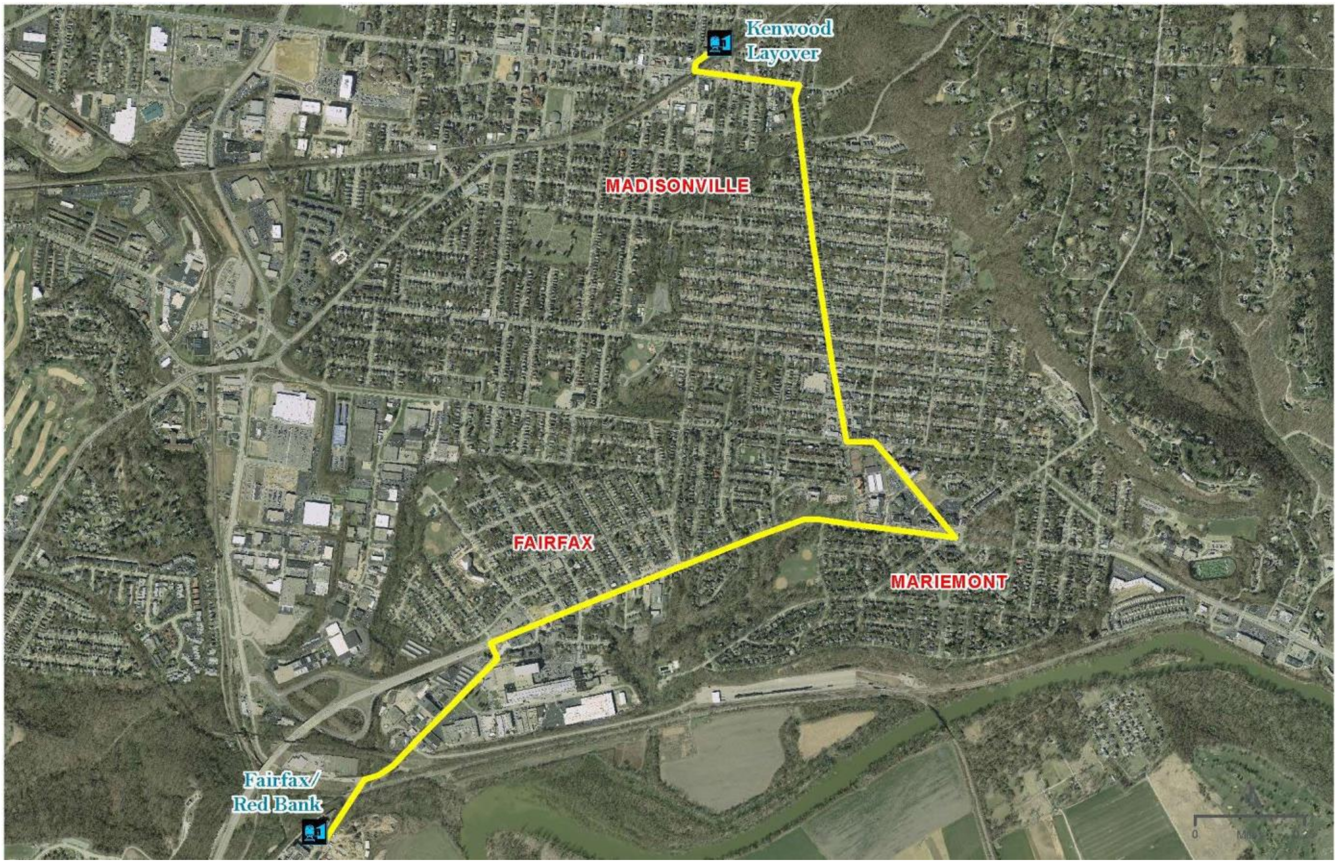


Exhibit 6-6: Newtown-Eastgate Feeder Route

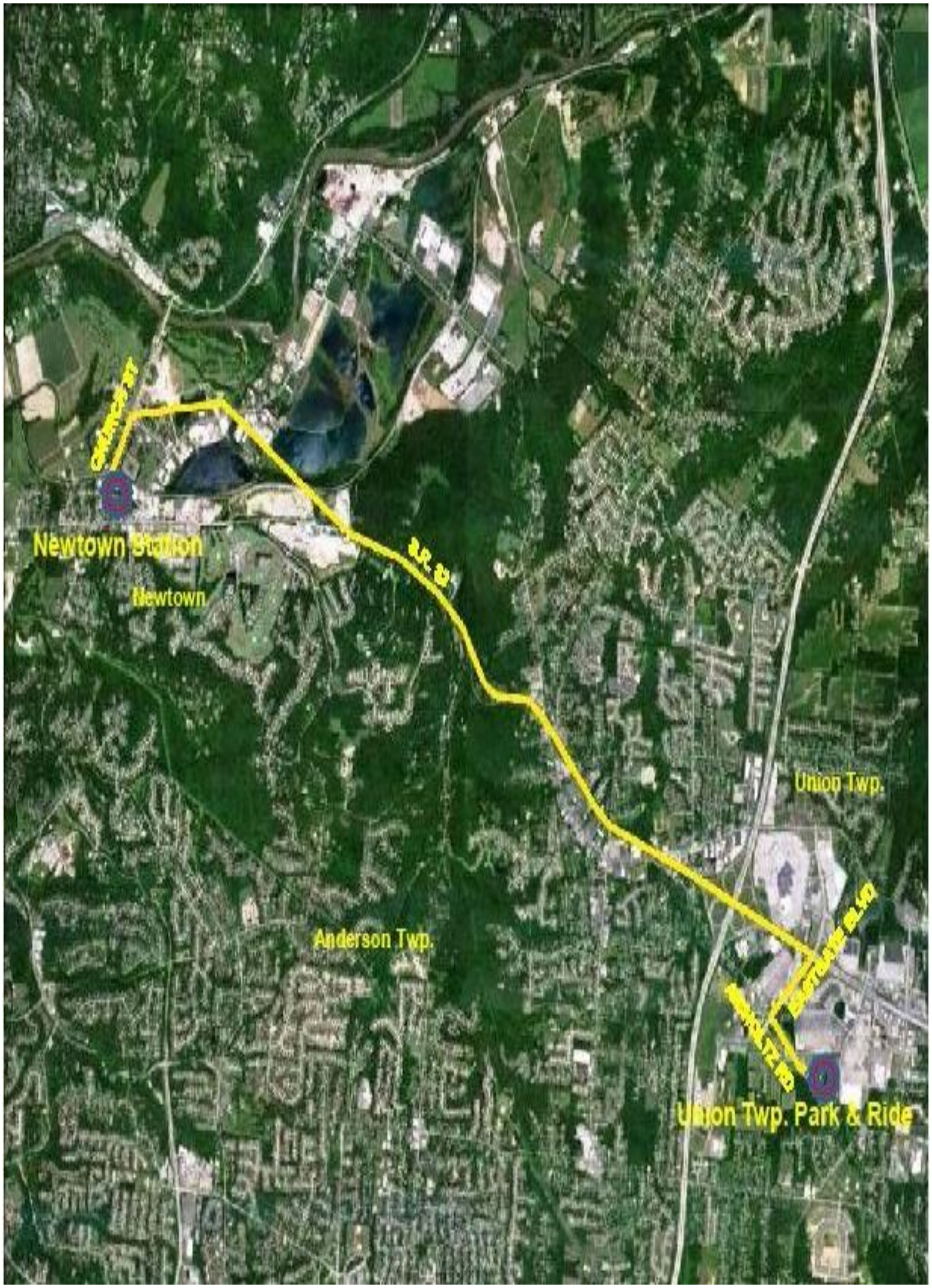


Exhibit 6-7: Milford Feeder Route

Table 18: Feeder Bus Route Parameters

Feeder Route	Round Trip Mileage	Round Trip Running Time	Peak Period Service Frequency	Number of Trips	Number of Buses
Columbia-Tusculum-Mt. Lookout-Hyde Park	5.7 mi.	30 min.	30 min.	16 (8 am, 8 pm)	1
Fairfax-Mariemont-Madisonville	6.0 mi.	30 min.	30 min.	16 (8 am 8 pm)	1
Newtown-Eastgate	12.4 mi.	40 min.	30 min.	16 (8 am 8 pm)	2
Milford	6.0 mi.	30 min.	30 min.	16 (8 am 8 pm)	1
Total	**30.1 mi.**	--	--	**64 (32 am 32 pm)**	**5**

Partnership and Operational Issues

The provision of feeder routes that serve various OASIS rail stations will present opportunities to partner with local communities or social services. These would likely involve retail business organizations, as they represent most of the significant local destinations outside of residential areas. There are only a handful of small industrial park-type employment areas in feeder route areas, and there are no major employers.

Opportunities that could be explored include:

- Support from the Mt. Lookout Square and Hyde Park Square business associations for midday service to/from the Columbia-Tusculum station.
- Support from Fairfax and Mariemont business associations for midday service to/from the Fairfax station.
- Support from Eastgate Mall and Eastgate area business associations for midday service to/from the Newtown station.
- Support from Milford business associations for midday service from the Milford station.

It should be noted that examples of this type of partnership are uncommon. The business districts served are relatively modest and may not have the wherewithal to sustain the costs of midday service.

Other partnership issues include:

- It is feasible to partner with outside organizations, such as social service agencies to provide midday service. Social service agencies could potentially provide their own service to the stations, and as a result to provide the best service possible for their clientele.

- However, social service agencies are traditionally reluctant to open their doors to the general public, and the general public is not always favorably disposed to riding on such services.
- SORTA could be the operator of the feeders that serve Hamilton County exclusively: Columbia-Tusculum-Mt. Lookout-Hyde Park and Fairfax-Mariemont-Madisonville. The routes could be contracted to a private or third party entity to operate, but they would still be done so under the auspices and funding of SORTA.
- Clermont County should be responsible for the funding—and potentially the operation—of the Newtown-Eastgate and Milford routes. The Milford route falls wholly within Clermont County. Although the Newtown-Eastgate route operates primarily within Hamilton County, the ridership would be generated within Clermont County. Clermont County would also have the options of contracting the service to SORTA or a third party operator.
- SORTA operates Access, a complementary paratransit service for persons with disabilities who, due to physical or cognitive reasons, are unable to use fixed route service. As stipulated in federal requirements designed to implement the Americans with Disabilities Act (ADA), this coverage must be located within a 3/4 mile of fixed local routes during the time periods in which those routes operate. This would expand SORTA's Access coverage and operating costs, and is an important issue that would need to be resolved prior to the establishment of any feeder service.

Task 6.5.5. – Required Supportive Station Infrastructure Needs

Assessment

Station 1 – Riverfront Transit Center (RTC)

The RTC currently has sufficient room to provide for some future bus connections within the facility. At street level, a Cincinnati Streetcar stop is currently being developed. A shelter will be developed on Second Street to accommodate passengers. A bicycle rental station is being developed. No additional improvements necessary for OASIS rail and connecting buses are required.

Station 2 – Boathouse

No bus stops are recommended for this station. A bus pullout on both sides of Riverside Drive would be necessary to safely accommodate on-street bus stops at the station location. Because of the heavy use of the existing parking lot, and its ensuing sporadic congestion, it is not recommended that buses enter the Boathouse lot to serve the station. The addition of on-street stops is not critical at this OASIS rail station, however, and would require a signalized pedestrian crossing to the north side of Riverside Drive. Without a signal, passengers would have to cross at an unprotected location.

Station 3 – East End

No bus stops are recommended at this station.

Station 4 – Columbia-Tusculum

As the terminus of a recommended feeder route, the station should consist of a minimum of two bus stops or sawtooth bays, to accommodate the feeder and any other possible future route or shuttle service. A passenger shelter should be desirable. Wayfinding signage should be added to direct other passengers to existing bus stops on Columbia Parkway near Delta Avenue.

Station 5 – Lunken Airport

Although a feeder route is not recommended for this station, the station design should include provision for at least one bus stop or sawtooth bay to accommodate service that could be added in the future. Given its proximity to the regional bicycle/recreation path, bicycle storage lockers would be an appropriate addition.

Station 6 – Beechmont

Although a feeder route is not recommended for this station, the station design should include provision for at least two bus stop or sawtooth bays to accommodate existing Route 24 and other service that could be added in the future.

Station 7 – Fairfax

As the terminus of a recommended feeder route, the station should consist of a minimum of three bus stops or sawtooth bays to accommodate the feeder, potential diversion of Routes 28 and 29X, and any other possible future route or shuttle service. A passenger shelter would be desirable. There is already a traffic signal at the intersection of Wooster Road and Wooster Pike, allowing for safe and efficient feeder route access.

Station 8 – Newtown

As the terminus of a recommended feeder route, the station should consist of a minimum of two bus stops or sawtooth bays, to accommodate the feeder and any other possible future route or shuttle service. A passenger shelter would be desirable. Given its proximity to the regional bicycle/recreation path, bicycle storage lockers would be an appropriate addition.

Station 9 – Ancor

Although a feeder route is not recommended for this station, the station design should include provision for at least one bus stop or sawtooth bay to accommodate service that could be added in the future.

Station 10 - Milford

As the terminus of a recommended feeder route, the station should consist of a minimum of three bus stops or sawtooth bays, to accommodate the feeder, a possible extension of Routes 28 and 29X, and any other possible future route or shuttle service. A passenger shelter would be desirable. As a terminus station, the inclusion of bicycle storage lockers would be an appropriate addition.

Table 19: Recommended Bus-Related Infrastructure Needs

Station	New Bus Stops/Bays	New Passenger Shelter	Traffic Signal Improvements	New Bicycle Facilities
RTC	1	No	No	Existing nearby
Boathouse	0	No	No	No
East End	0	No	No	No
Columbia-Tusculum	2	1	No	No
Lunken Airport	1	No	No	Yes
Beechmont	2	No	No	No
Fairfax	3	1	No	No
Newtown	2	1	No	Yes
Ancor	1	No	No	No
Milford	3	1	No	No
Total	**15**	**4**	**0**	**2**

6.6 Bikeway Facilities

There are multiple bikeways and trails that would provide connections to the proposed rail service. Potential connections between regional and local bicycle trails and the OASIS rail corridor are described below by Segment. Exhibit 6-10 shows the rail corridor by segment, and the location and routes of existing bicycle facilities. Exhibit 6-11 provides an overview of planned and future bicycle facilities by rail corridor segment.

OASIS Segment 1

Several preferred bicycle routes in downtown Cincinnati would connect to the RTC station, as well as the Riverfront Trail. Connection to the Boathouse station would also be through the Riverfront Trail. The former L&N Bridge, now known as the Purple People Bridge and a signed bicycle route on Eggleston Avenue also could provide connections to Segment 1 stations. Connections to the cities of Newport, KY and Covington, KY are provided via the Taylor Southgate Bridge (preferred bike route) and the John Roebling Suspension Bridge (a route to use with caution). Additional extensions to tie into the OASIS station locations in Segment 1 are not anticipated.

OASIS Segment 2

Segment 2 has several existing and planned bicycle routes that would connect to OASIS station locations. Existing and planned shared streets, bike lanes, and shared use bikeway paths along the Riverside Drive corridor connect to the East End, Columbia-Tusculum, and Lunken Airport station locations. On-street facilities would also provide connections from adjacent neighborhoods to the East End and Columbia-Tusculum stations.

There have also been discussions concerning a temporary bike path along this segment, within the SORTA owned right of way. Those discussions continue between the bikeway advocates, SORTA, the short line operator (GWI) and the Eastern Corridor Partners regarding this potential shared use of the right-of-way

Exhibit 6-8: Existing Bicycle Facilities Along OASIS Rail Corridor

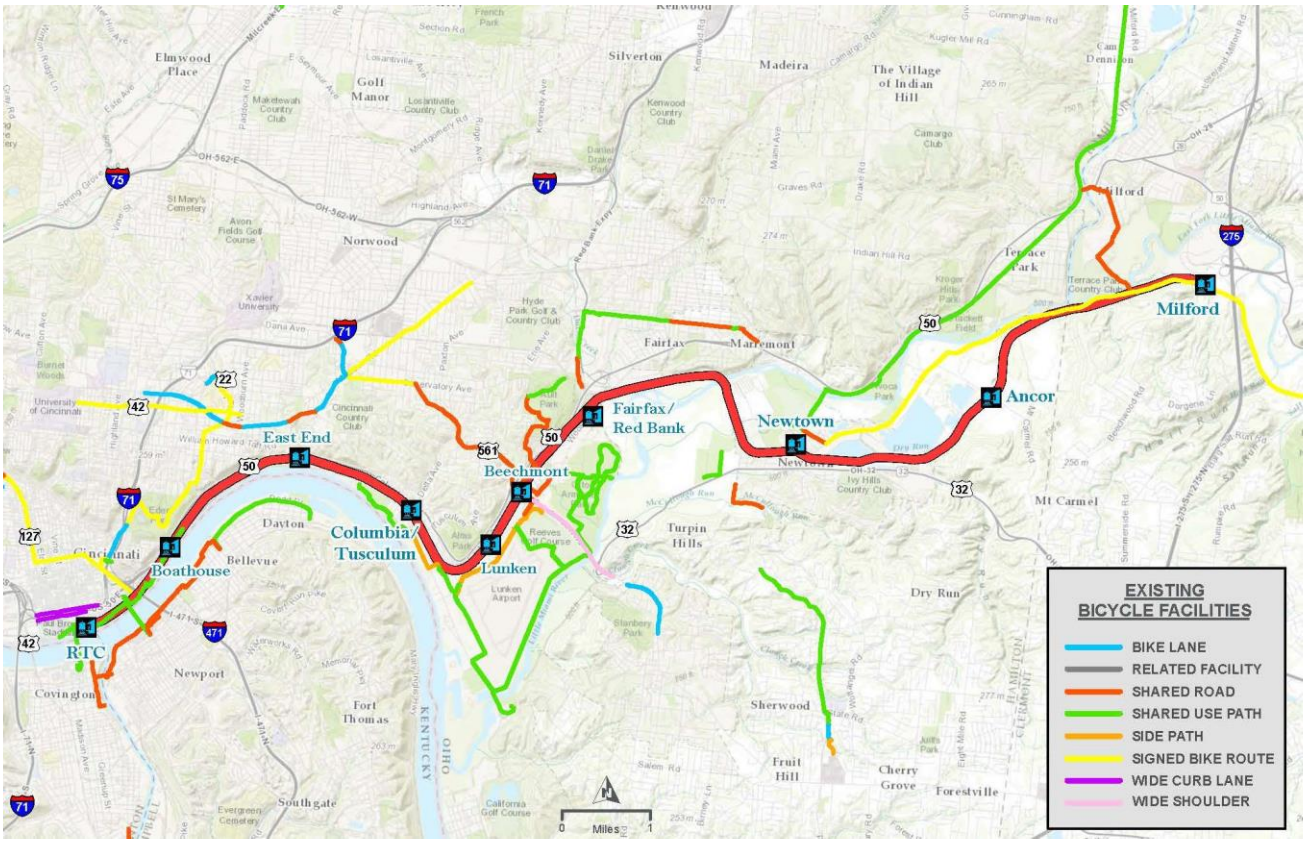
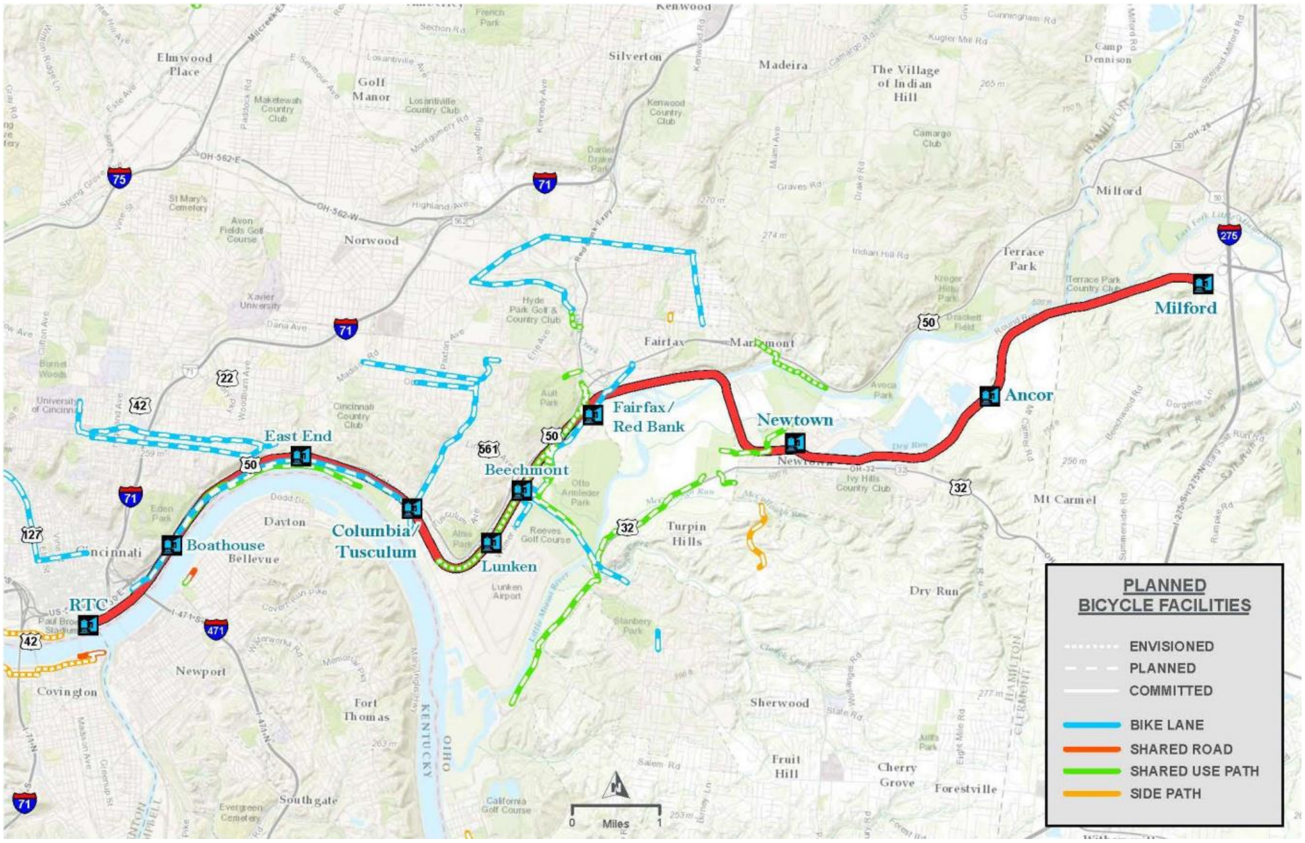


Exhibit 6-9: Planned Bicycle Facilities along OASIS Rail Corridor



Sources: OASIS Rail Corridor Existing and Future Conditions Report; OKI 2008 Regional Bicycle Plan

The Ohio River Trail is a proposed shared-use path, extending approximately 16 miles from Lunken Airport to the Village of New Richmond in Clermont County, with a large portion constructed alongside US 52 (Kellogg Avenue). This trail would provide connections to each of the stations within Segment 2. The planned bikeway along US 50/Wooster Pike (following existing roadway and rail) provide a connection to the Beechmont station. In addition, improvements to bicycle facilities with Otto Armeleder Park and at Lunken Airport would also provide access to proposed Beechmont and Lunken Airport station locations.

In addition, the Ohio Erie Trail (Murray Avenue, Red Bank Road) connects to the Beechmont station.

The following signed bike routes and dedicated bike lanes would need extensions to connect to Segment 2 stations:

- Eden Park Ave (Gilbert Avenue to Victory Parkway) would need an extension to the Boathouse station
- Victory Pkwy (Eden Park Avenue to Taft Road) would need an extension to the East End station
- Madison Rd (Victory Parkway to Brotherton Road) would need an extension to the East End station

- Observatory Ave (Madison Avenue to SR 561/Linwood Avenue) would need an extension to either the East End or Columbia-Tusculum stations
- Gilbert Ave (Court Street to Elsinore Place) would need an extension to the Boathouse station.

OASIS Segment 3

Within Segment 3, the Little Miami Trail would connect directly to the Newtown station location. Existing and planned extensions of the bikeway along US 50/Wooster Pike would provide a connection to the Fairfax (Red Bank) station. Bicycle facilities along the relocated SR 32 would provide connections to both the Fairfax (Red Bank) and Newtown stations.

In Segment 3 there are also planned bikeways along portions of Round Bottom Road, Newtown Road, Wasson Road, Murrey Avenue and Batavia Road. Extensions from each of these planned routes, except for Newtown Road, would be needed to provide connections to Segment 3 stations.

Erie Ave (Saybrook Avenue to Rosslyn Drive) would need an extension to connect with the Fairfax (Red Bank) station. Additional extensions of bicycle paths and routes to stations in Segment 3 are not anticipated.

OASIS Segment 4

No shared use paths or other bicycle trails are located within Segment 4. A few preferred routes and routes to use with caution do connect to both the Ancor and Milford station locations. Extensions from Round Bottom Road and Broadwell Road could provide connectivity with the Ancor station from Newtown. A potential extension of a bike route on Mount Carmel Road would provide a connection to State Route 32. However, a route on Mount Carmel Road would need to proceed with caution, due to the terrain.

For the Milford station, a potential connection would be from the commercial development along Milford Parkway. An extension from the Milford station of a bicycle path south along Beechwood Road would provide a connection to nearby residential development.

7 RIDERSHIP MODELING APPROACH AND ASSUMPTIONS METHODS AND RESULTS

7.1 Introduction

This section presents a general description of the analysis methods used in forecasting the daily ridership for the proposed OASIS Commuter Rail service. Travel demand was initially forecast for the year 2030 by applying the OKI/MVRPC travel demand model to a population and employment forecast developed specifically for the Eastern Corridor. The forecasts reported in this document were developed using the current FTA "STOPS" travel demand model developed for the Federal Transit Administration (FTA). This model was applied using the OKI population and employment forecasts.

7.2 Description of the FTA STOPS Travel Demand Model

The STOPS (Simplified Trips-on-Project Software) model is a stand-alone ridership forecasting software package developed by the Federal Transit Administration (FTA). The software applies a set of travel models to predict detailed travel patterns on fixed guideway systems. STOPS was specifically developed to support FTA New Starts and Small Starts projects. The model is sensitive to mode type, project service characteristics, route lengths, alignments, and demographic and employment projections.

STOPS utilizes a modified four-step (trip generation, trip distribution, mode choice and trip assignment) model structure to quantify total transit ridership by trip type, mode of access and auto ownership. It also computes the change in automobile vehicle miles travelled (VMT) that is attributable to the proposed transit project. The component sub-models in STOPS have been calibrated with local adjustments and compared to rider-survey datasets from locations within six metropolitan areas. STOPS was validated against stop-specific counts of trips in nine other metropolitan areas, resulting in a total 24 total fixed-guideway systems, as presented in Table 20.

The STOPS model requires the following inputs:

- US Census Transportation Planning Products (CTPP) Journey to Work trip flow data for the study area;
- Current transit system schedules and ridership (provided by the Southwest Regional Transportation Authority [SORTA]);
- Local demographic and land use data and highway travel times from the regional travel demand models (provided by OKI Regional Council of Governments); and
- Project specific information, such as station locations and vertical profiles, and operating plans (developed by the Oasis Commuter Rail Project Team).

Table 20: Fixed-Guideway Systems in STOPS Calibration and Validation

Metropolitan Area	Commuter Rail	Heavy Rail	Light Rail	Streetcar	BRT	Total
Calibration						
Atlanta		1				**1**
Charlotte			1			**1**
Denver			1			**1**
Phoenix			1			**1**
San Diego	1		2			**3**
Salt Lake City	1		1		1	**3**
Subtotal	**2**	**1**	**6**	**0**	**1**	**10**
Validation						
Kansas City					1	**1**
Houston			1			**1**
Minneapolis	1		1			**2**
Nashville	1					**1**
Norfolk			1			**1**
Portland	1		1	1		**3**
San Jose			1			**1**
Seattle	1		1	1		**3**
St. Louis			1			**1**
Subtotal	**4**	**0**	**7**	**2**	**1**	**14**
Total	**6**	**1**	**13**	**2**	**2**	**24**

Source: FTA

This simplified forecasting model allows regions that do not have sophisticated models with a transit component to analyze fixed-guideway transit options. It is considerably easier to use than the standard model due to the reduced number of inputs required. Application of this model will facilitate comparison of projects across the country by FTA as it evaluates Small and New Starts funding applications.

7.3 Application of the FTA STOPS Travel Demand Model

The application of STOPS model to the Oasis Commuter Rail study was conducted in three steps as described below.

Step 1: Identify and Compile Model Inputs

The first step in the application of the STOPS model was to identify and compile all the required inputs for the base year (2010) model.

This included the 2010 employment and demographic data and the peak period highway travel times and distances from the OKI regional travel demand model. STOPS also requires year 2000 Journey to Work trip flow data which were downloaded from the FTA's website. The base year unlinked transit trips for the local transit system were obtained from the National Transit

Database website and fed into STOPS for self calibration. The transit level of service data was also obtained directly from SORTA in the form of GTFS (General Transit Feed System) files. After performing thorough quality control checks of the inputs, the STOPS model was executed for the base year and the resulting ridership results were analyzed to make sure they compared well with observed data.

Step 2: Run Opening Year No-Build Alternative

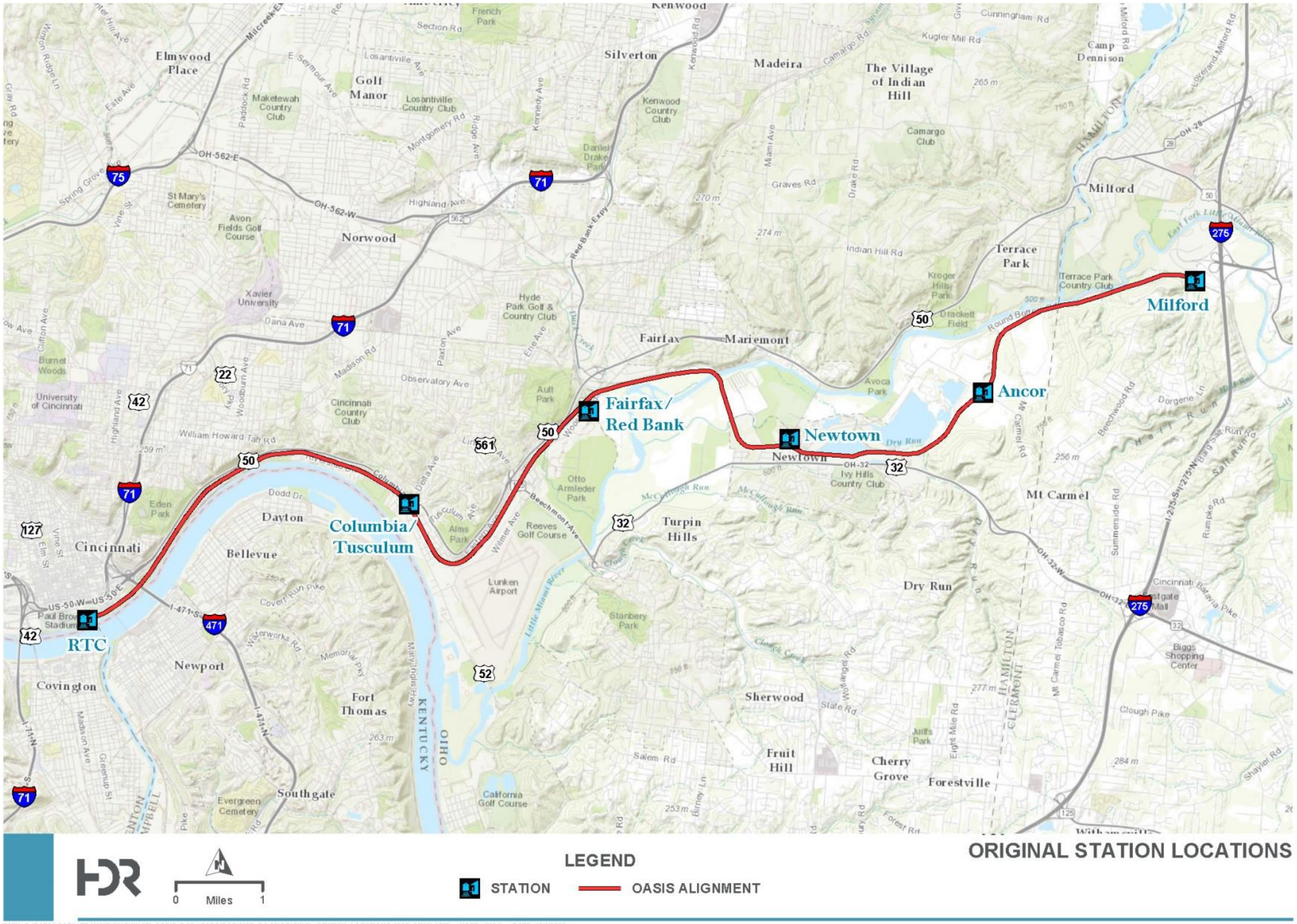
In the second step, the STOPS model was applied using the base year (2010) demographic and land use inputs and "No-Build" transit network assumptions. The demographic and employment data obtained from OKI in November 2015 indicate there would be negligible growth in the study area between 2010 and 2020 and also between 2020 and 2040. Therefore, the opening year ridership forecasts for this project were developed using the 2010 demographic and land use data provided by OKI. The ridership results obtained from this step represents the opening year (2010) No-Build conditions and serves as a benchmark against which the ridership results of the Build alternative (with commuter rail in place) were compared and evaluated.

Step 3: Run Build Alternative for the Opening Year

In the third step, the operating plan for each of the three commuter rail alternatives (described later in this memorandum) was coded in the opening year network (2010) of the STOPS model. This process involved developing GTFS inputs detailing the frequency of the each proposed commuter rail service and its operating characteristics such as speed, station locations, access and intermodal connectivity. The average operating speeds between station pairs are consistent with the estimates produced by the RTC simulation model. The general alignment and locations of stations for the proposed commuter rail service are shown in Exhibit 7.1 for the base case alternative**.** Based on some preliminary ridership analysis conducted in 2012 and 2013, three previous stations (East End, Lunken Airport and Beachmont) were found to have very low ridership and therefore were eliminated from the current analysis. For each alternative, a model run was conducted for the Build scenario using the opening year inputs.

The operating assumptions for each alternative are shown in Table 21 and the travel time assumptions used in the model are shown in Table 22. The travel times included in Table 22 include a 1 minute dwell time at each station. This is a conservative assumption that allows a small buffer in the schedule.

Exhibit 7-1: Station Locations and Rail Alignment for the Base Case Alternative



From the output results of the STOPS model, the commuter rail ridership by trip purpose (work and non-work) and auto ownership category (transit dependent population) was summarized. The STOPS model also produces daily station boardings and alightings.

Table 21: Commuter Rail Alternatives and Service Assumptions

Alternative	Scenario	Station Changes	Number of Inbound trains			Number of outbound trains		
			AM	MD	PM	AM	MD	PM
1	Basic Service	None	6	3	2	2	3	6
2	Alt 1	Combine Newtown and Ancor (NewCor)	6	3	2	2	3	6
3	Alt 2	Move Fairfax to Clare Yard	6	3	2	2	3	6

Source: HDR Engineering

Table 22: Commuter Rail Travel Time Assumptions

	Travel Time Between Stations		
Station	**BASE**	**ALT 1**	**ALT 2**
Milford	-	-	-
Ancor	0:04:52	-	0:04:52
Newtown/Ancor (NewCor)	-	0:06:21	
Newtown	0:05:23	-	0:05:23
Fairfax/Red Bank	0:07:21	0:08:59	-
Clare Yard	-	-	0:04:52
Columbia Tusculum	0:07:04	0:07:04	0:09:33
Downtown (RTC)	0:10:20	0:10:20	0:10:20
Total	**0:35:00**	**0:32:44**	**0:35:00**

Source: HDR Engineering

ALTERNATIVES MODELED

Base Case Alternative:

The Base Case alternative would provide six inbound trains during the AM peak period, 3 round trips during midday and two during PM peak period. The outbound service during the PM peak period would be reverse of the AM service. There would be five stations (not including the downtown station, RTC) as shown in Exhibit 7.1 above.

Alternative 1

In Alternative 1, the Newtown station and Ancor Station would be combined into a new station, located approximately mid way between Newton and Ancor. In this document, the new station is referred to as NewCor station. The station locations are shown in Exhibit 7.2. The level of train service in this alternative would be identical to the Base Case.

Alternative 2

In Alternative 2, The Fairfax/Redbank station would be relocated to a new location, about a mile east. The relocated station is located at the east end of the NS Clare Yard. The station locations are shown in Exhibit 7.3.The level of train service in this alternative would be identical to the Base Case.

Exhibit 7-2: Station Locations and Rail Alignment in Alternative 1

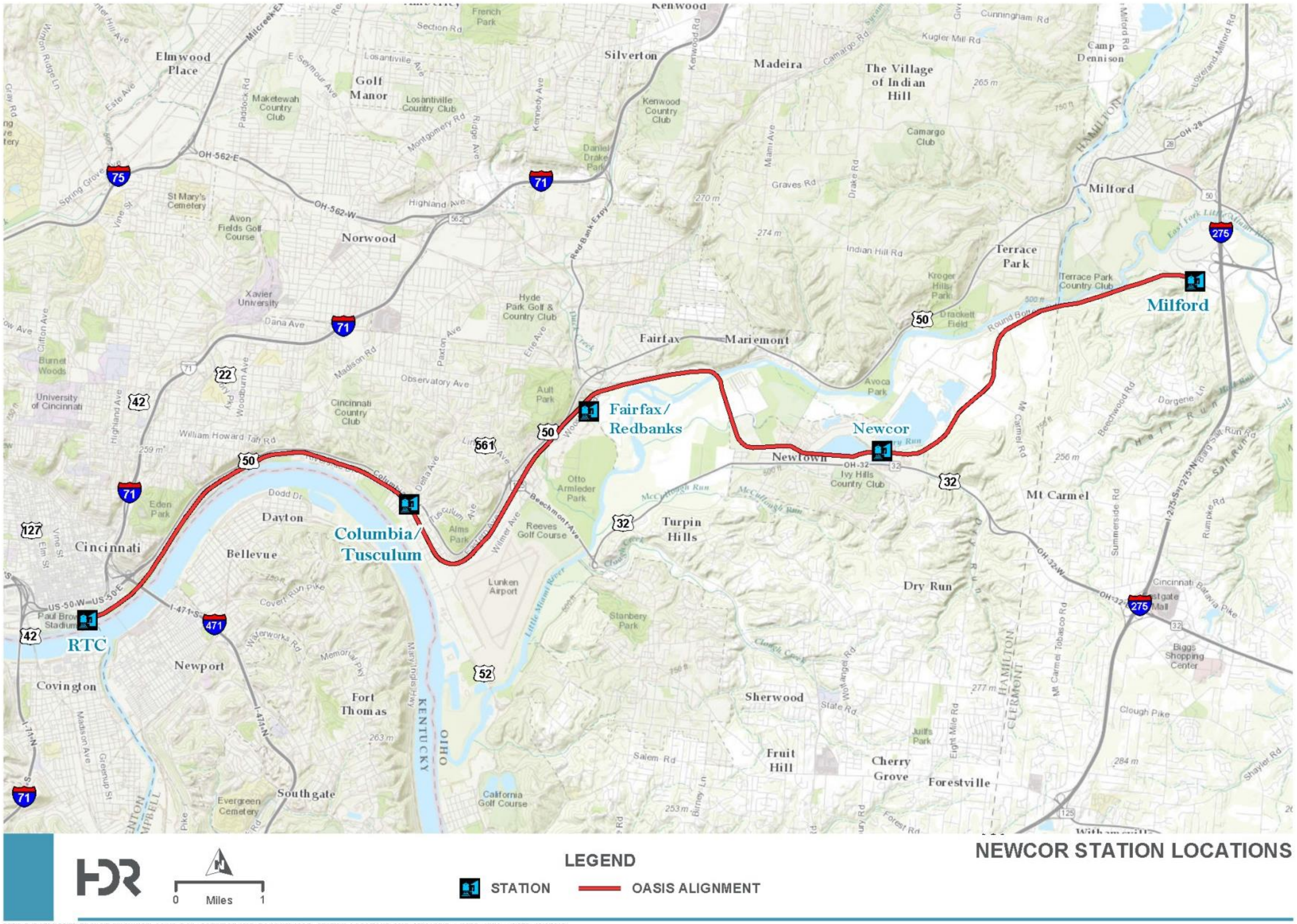
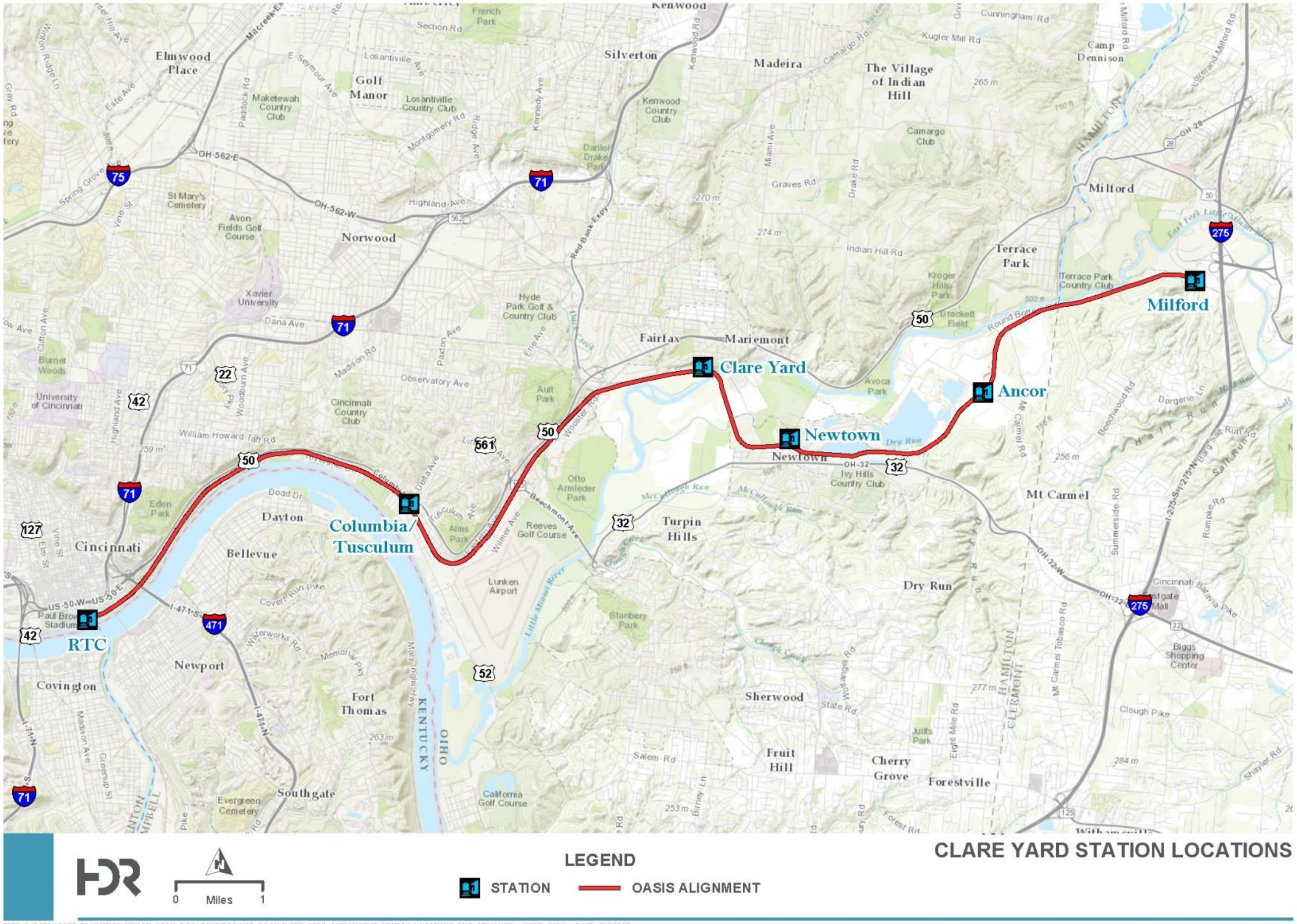


Exhibit 7-3: Station Locations and Rail Alignment in Alternative 2



PATH: E:\DATA1\COTA_TRANSIT\CINCINNATI_OASIS_RAIL_CORRIDOR\MAP_DOCS\CLARE_YARD_ALTERNATIVE_STATION_LOCATIONS_MAP_85X11.MXD - USER: JHILL - DATE: 12/1/2015

7.4 Changes to STOPS Model and Inputs

In July 2014, HDR developed ridership forecasts for this rail line using Version 1.02 of the STOPS model. Since then, FTA's contractor has implemented a number of changes to the STOPS model. These changes became necessary after FTA's contractor reviewed the ridership results of several STOPS applications to Commuter Rail projects (including Oasis forecasts) and noted some anomalies in the non-work related trips. For the Oasis commuter rail project, FTA's contractor recommended a number of modifications to the input data in order to achieve a more reasonable calibration. Some key modifications in the inputs include the following.

- Indiana and Kentucky TAZ zone systems were removed from the STOPS setup. Given the fact that the study corridor is across the River from TANK services (Transit Authority of Northern Kentucky) and not likely to be used by many Kentuckians, it was decided the census trips from that area need not be included in the model.
- The modeled area was adjusted so that all CTPP JTW records are processed for trips within Hamilton County and for trips from Clermont or Butler Counties to Hamilton County. All other trips (most importantly intra-Clermont County trips) were excluded from the analysis.
- The calibration target was reset from 87,300 to 54,600 to account for the changes in the modeled area as well as the change in calibration year, i.e. from 2005 to 2010.

This forecast used the most up- to-date version of the STOPS model at the time, Version 1.51.

7.5 Model Results

The results of the STOPS model indicate under the basic service assumptions, the proposed commuter rail alternative would carry about 5,300 riders a day in the opening year (see Table 23). The commuter rail is projected to attract a large number of new trips, about 4,000 in the opening year in the Base Case. These trips are those diverted from the automobile mode. As a result of this diversion, there would be a reduction in the automobile vehicle miles traveled (VMT). As shown in Table 24, it is estimated that the under the basic service alternative, the commuter rail will contribute to a reduction of about 41,400 auto VMT in the opening year.

The travel markets served by the proposed rail do not vary much across alternatives. As seen in Table 23, for Base Case, about 62 percent of the ridership would be comprised of home based work trips, 32 percent home based other trips and 8 percent non-home based trips. For Alternatives 1 and 2, the percentages are almost the same as in Base case.

STOPS results indicate that, the transit dependent ridership in this corridor would be relatively small, about 400 riders in Base Case and Alternative 1 and about 175 in Alternative 2. The transit dependent population, according to STOPS, is defined as those with no cars in their households.

As seen in the Table 23, the highest inbound boardings in all three alternatives would occur at Milford station and they are in the range of 975 to 1,025 per day. For the remaining stations, the inbound boardings range from 250 to 650. As seen in the table, approximately 42 to 44 percent of the daily boardings occur at RTC station indicating most trips boarding at the outer stations are destined to CBD.

For Alternatives 1 and 2, the projected daily ridership is about 5,000 trips a day. More than 75% of the rail ridership is projected to come from the automobile mode. As a result, there would be substantial reduction in highway VMT. For these two alternatives, the VMT reduction is estimated to be about 41,750 and 43,850 respectively. Shown in Table 24 are the trips by mode of access. As seen, about 44 percent of the trips are projected to access the stations by Park and Ride and Kiss and Ride modes and 6 percent would transfer from buses. The remaining 50 percent of the boardings would be by walk access and they would primarily occur at downtown end.

Table 23: Ridership Results

DAILY BOARDINGS			
	BASE CASE	ALTERNATIVE 1	ALTERNATIVE 2
Milford	1,000	975	1,025
Ancor	250	N/A	325
NewCor (Combined Stn)	N/A	575	N/A
Newtown	450	N/A	400
Clare Yard	N/A	N/A	450
Fairfax Red Bank	600	500	N/A
Columbia Tusculum	600	650	600
RTC	2,300	2,300	2,200
Total Station Boardings	**5,300**	**5,000**	**5,000**
NEW TRIPS AND VMT REDUCTION			
New Transit Trips	4,000	3,800	3,850
VMT Reduction	**41,374**	**39,440**	**41,412**
RIDERSHIP BY TRIP PURPOSE			
Home based work	**3,200 (60%)**	**3,100 (62%)**	**3,100 (62%)**
Home based Other	**1,700 (32%)**	**1,550 (31%)**	**1,550 (31%)**
Non Home Based	**400 (8%)**	**350 (7%)**	**350 (7%)**
TRANSIT DEPENDENT RIDERS			
Transit dependent riders	**400**	**400**	**175**

Table 24: Trips by Mode of Access

	Base Case	Alternative 1	Alternative 2
Trips by mode of access	Walk 50.0 % Kiss N Ride 11.0 % Park N Ride 33.0 % Transfer 6.0 %	Walk 51.0 % Kiss N Ride 10.5 % Park N Ride 32.0 % Transfer 6.5 %	Walk 51.0 % Kiss N Ride 10.5 % Park N Ride 32.0 % Transfer 6.5 %

Source: HDR Engineering

7.6 Additional Ridership Forecasting

The Oasis project will continue to evolve as the project is further developed. The performance characteristics may change with respect the impacts of station locations, track geometrics, vehicle performance improvements, and service policies. Any of these changes will impact system ridership, and should be incorporated into future ridership forecasts. In addition, the STOPS model itself will continue to evolve as it is applied to more projects. The current forecasts provide a good benchmark for system performance. Additional forecasts should be developed as appropriate in the future in response to system refinement, in the same manner that updates would be conducted in other areas such as the capital cost estimates and financial plans.

8 OASIS FINANCIAL FEASIBILITY

The financial feasibility component of the OASIS rail line study considers a broad array of funding approaches including value capture mechanisms, public-private partnership opportunities, and state and federal loan and grant programs. These sources can help finance both the upfront capital costs and ongoing long term operation and maintenance expenses associated with the OASIS rail line connecting Milford to downtown Cincinnati This analysis is documented in detail in the Technical Memorandum: Oasis Funding Analysis and Strategy, December, 2015. Key elements of the report are summarized in this chapter. This chapter of the report summarizes the funding approaches used for recent commuter rail projects, and identifies the additional local funding needs necessary to support implementation and operation of the Oasis project.

8.1 Examples of Commuter Rail Financial Strategies

Funding approaches used for nine recent commuter rail lines implemented across the country are summarized below in Table 26. As shown in the table, the majority of the new commuter rail lines utilized a variety of federal, state and local funding sources.

Federal funding: Five of the commuter rail lines were successful in obtaining Federal Transit Administration (FTA) New Starts funds under the Section 5309 Capital Investment Grant Program. The Capital Investment Grant program is the primary federal discretionary program for supporting locally planned, implemented, and operated transit "guideway" capital investments, including commuter rail projects. Projects applying for New Starts funds must undergo evaluation by the FTA throughout the project development process. Projects are evaluated according to a variety of criteria including mobility improvements, environmental benefits, cost-effectiveness, operating efficiencies, transit supportive land use, and local financial capacity.

As shown in the table, the share of New Starts funding for the five projects ranged from 25 percent to 80 percent. However, it should be noted that in today's current federal funding climate, the Front Runner North Project (Utah Transit Authority (UTA)) would likely no longer receive 80 percent funding from the New Starts program. Based on recent feedback from the FTA, project sponsors are encouraged to limit New Starts funding requests to a maximum 50 percent share of total capital costs.

In addition to the FTA New Starts program, two projects took advantage of Federal Highway Administration (FHWA) programs that are eligible to fund transit projects. As described in more detail in Section 4, the two programs, Congestion Mitigation and Air Quality Improvement (CMAQ) program and Surface Transportation Program (STP), could potentially provide funding to support specific elements of the Oasis Rail Transit Project.

State funding: Reflecting the regional importance of commuter rail service, four projects received funding support from their respective state governments. The State of New Mexico provided the largest share of total funding (93 percent), while Florida and Minnesota were primary funding partners as part of New Starts Grants application providing 25 percent and 31 percent of total funding respectively.

Local funding: The largest local funding sources were dedicated sales taxes and direct contributions from the general funds of local jurisdictions (counties and cities) served by a commuter rail line. Two lines were able to obtain a small amount of regional funding from their respective Metropolitan Planning Organizations (MPO). Two other lines were able to take advantage of unique circumstances. For the Front

Runner North Line (UTA), the agency was able to leverage the value of previously purchased railroad right-of-way as local match for the FTA New Starts grant. UTA was able to use the right-of-way value as local match because the agency did not use federal funds to purchase the property. In Denton County (TX), funding for the A-Train included local dedicated sales tax revenue and an allocation of $190 million to the transit agency from the payment the MPO received upon entering into a concessionaire's agreement for a long-term lease of a regional toll road facility to the private sector.

Table 25: Funding Strategies – Recently Implemented Commuter Rail Systems ($, in millions)

	Sun Rail (FL)	North Star (MN)	Front Runner North (UT)	Front Runner South (UT)	Music City Star (TN)	A-Train (TX)	MetroRail (TX)	Rail Runner (NM)	Sounder (WA)
Federal									
New Starts	$179	$157	$489		$24				$100
FHWA Funds		$5			$8				
State	$89	$99			$4			$125	
Local									
Local Jurisdictions	$89	$51			$3			$10	
Dedicated Sales Tax			$82	$368		$48	$105		$301
MPO Programmed Funds		$6			$2				
Right-of-Way Value			$40						
Toll Road Concessionaire Payment						$190			
Total	$357	$317	$612	$368	$41	$238	$105	$135	$401

8.2 Local Financing Needs

The Oasis Funding Analysis Technical Memorandum considers two Scenarios:

- Alternative A1 assumes the use of a Stadler alternatively compliant vehicle that operates on the north track within the SORTA right-of-way between the Boathouse and Fairfax/Redbank in segment 2, and shares track within the Norfolk Southern right-of-way between Fairfax/Red Bank and Milford (segments 3 and 4).
- Alternative A2 assumes the use of a Nippon Sharyo FRA compliant vehicle that operates on the north track within the SORTA right-of-way between the Boathouse and Fairfax/Redbank in segment 2 and shares track within the Norfolk Southern right-of-way between Fairfax/Red Bank and Milford.

These are not all of the potential options, but provide a starting point for consideration of funding options. The operating funding assumptions developed in the technical memorandum are identified in Table 26 below. The costs are reported in inflated dollars for the first full year of operation.

Table 26: Conceptual Operating Funding Gaps ($2021 dollars)

	Alternative A1	Alternative A2 with FRA Vehicle
O & M Funding		
Federal:		
Formula grants (up to $1/trip times CPI to 2021)	$ 1,600,000	$ 1,480,000
SORTA:	**$ -**	**$ -**
Station Area Assessment Districts:	$ 500,000	$ 500,000
Advertising/ Other private:	$ 250,000	$ 250,000
Fares:	$ 3,190,000	$ 2,860,000
TOTAL O & M COST OFFSETS	$ 5,500,000	$ 5,100,000
TOTAL O & M COSTS	$ (10,300,000)	$ (11,200,000)
NET OPERATING DEFICIT AFTER OFFSETS	**$ (4,800,000)**	**$ (6,100,000)**

CPI inflation at 2.5%/yr (16% from 2016-2021)
* Maximum likely amounts shown for all categories except SORTA where no commitments are shown.

Alternative 2 generates less formula grant and farebox revenue because its ridership forecast is about 7% lower than Alternative 1. Alternative 2 has a higher operating cost because it uses shorter vehicles, requiring a larger fleet.

Two potential capital funding scenarios are presented in Table 27. The first column under each alternative assumes that the project would receive a small TIGER grant, and no FTA New Starts funding. The second column reflects a 50% New Starts Grant, and no TIGER funding for capital. The combinations range from a local need of $100 million to $256 million, in year of expenditure (inflated) dollars. Alternative 2 has lower capital needs because of the reduction in vehicle costs. While it requires more vehicles, the cost per vehicle is considerably lower than the Stadler vehicle.

Table 27: Conceptual Capital Funding Gaps ($2021 dollars)

	Alternative A1		Alternative A2 & FRA Vehicle	
	TIGER but no New Starts	With New Starts	TIGER but no New Starts	With New Starts
CAPITAL COST (A)	**$340**	**$340**	**$327**	**$327**
Federal:	**$42**	**$192**	**$42**	**$185**
Planning/AA/Env'tl Grants	$2	$2	$2	$2
TIGER	$20	$0	$20	$0
New Starts	$0	$170	$0	$163
Other	$20	$20	$20	$20
State:	**$37**	**$37**	**$37**	**$37**
TRAC	$15	$15	$15	$15
TID Grants	$2	$2	$2	$2
All Other State/ODOT	$20	$20	$20	$20
Station Area/Private Sector:	**$5**	**$5**	**$5**	**$5**
Local:	**$0**	**$0**	**$0**	**$0**
TOTAL Identified Sources (B)	**$84**	**$234**	**$84**	**$227**
FUNDING GAP (A-B)	**$256**	**$106**	**$243**	**$100**

The capital funding gap would likely be financed using bonds. Potential bonding requirements are summarized below by alternative.

- Alternative A1:
  - TIGER but No New Starts: Debt issued: $256 million; annual debt service payment $23.6 million
  - With New Starts: Debt issued: $106 million; annual debt service payment $9.8 million
- Alternative A2:
  - TIGER but No New Starts: Debt issued: $243 million; annual debt service payment $22.4 million

8.3 Potential Supplemental Funding Sources

As shown in the prior tables, a significant funding gap exists in the OASIS Rail Transit Project on both the capital and operating sides, even after taking all presently identified available sources of funding into effect. This is because no significant and sustainable long-term local funding source has yet been identified to support the project. Commuter rail projects implemented across the country are typically underpinned by a major long term source of local or regional transit oriented funding that underwrites the major portion of annual operating deficits (after allowing for fares and Federal operating subsidies) and helps provide a significant share of local match towards Federal capital funds.

Numerous options, either singularly or in combination, can be considered to provide the source of this local sustained funding commitment that will inevitably have to be made before the Oasis Project can proceed. By far, the most commonly used source of local funding around the country is a dedicated sales tax specifically to be allocated to funding and maintaining transportation and transit projects. While a general commitment has been made by the Partners that a broad based tax is not being considered at this time to fund The Eastern Corridor Program improvements, including the Oasis Rail Transit Project, the following is provided ensure a common understanding of the issues associated with these sources.

Dedicated taxes are typically voted upon by the citizens of the affected jurisdiction(s), usually after a fully developed public information program has been developed and implemented, explaining the projects to be undertaken, and the benefits to be obtained from completing the entire program of projects. Some regions combine transit, road, bicycle, pedestrian (and even open space) projects in a packaged referendum to provide a broad range of benefits to all citizens. Sales taxes are used because the benefits are so widely distributed – for example, almost all citizens benefit from congestion relief, reduced air pollution and improved accessibility, regardless of which particular transportation mode they use.

Sales taxes are typically used because they offer a relatively predictable and long term sustainable source of revenue (which is beneficial for supporting up front capital costs through bond financing as well as ongoing operations costs). As well, they shift some of the cost recovery to out-of-town visitors who also benefit from the transportation improvements.

Some other alternatives or supplements to use of a transportation sales tax exist uniquely in the Ohio and Cincinnati area context. The two Transportation Improvement Districts (HCTID and CCTID) which cover the OASIS and Eastern Corridor project improvements have the power to levy broad property based assessments to finance transportation improvements without requiring a local vote. The City of Cincinnati uses the earnings tax (as have other jurisdictions in Ohio), as a method of funding SORTA (Metro) transit operations. A relatively small increase from the current rate (.3 percent) could mathematically make a major contribution to an OASIS funding package. For example, in the calculations described as part of the conceptual financial strategies in Section 4.3, a 10 to 12 percent increase in this rate (from .3 percent to .33 percent or.336 percent) could completely fill the expected gap in operating and maintenance cost funding in 2021. Similarly, other possible sources of funding might be a local area tax on motor vehicle registrations or tolls on local area bridges.

Use of any of these tools alone, or in conjunction with sales tax, to generate new revenue could provide major sources of local funding for OASIS, either as a stand-alone project or as part of a larger program of multi-modal transportation improvements. The critical issue becomes one of defining a process, and its timing, to identify which of these tools might have the highest degree of support and viability in the region in the context of the area population's current attitudes towards the need for and support of transportation and other forms of public infrastructure

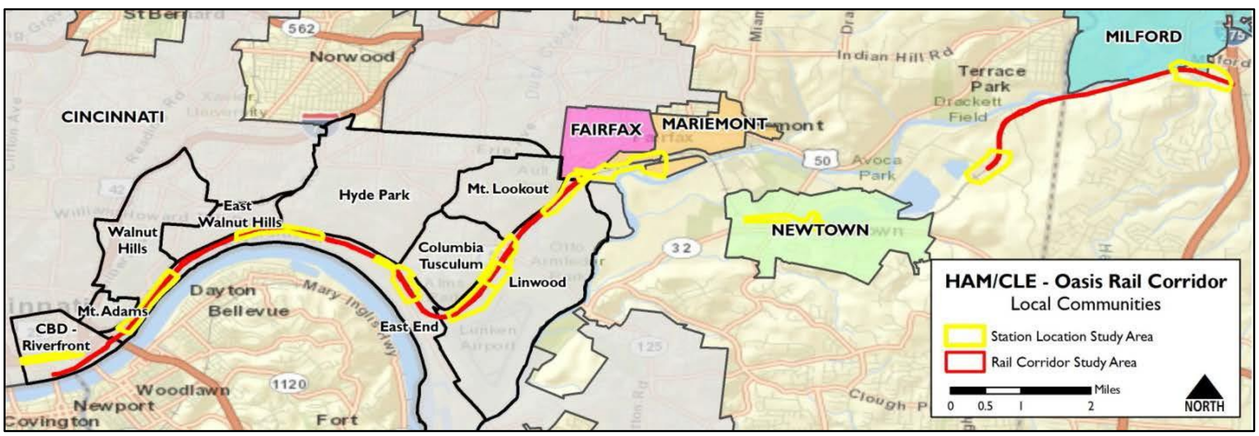
9 ENVIRONMENTAL IMPACTS

This environmental analysis was originally scoped for segments 1, 2, and 4 for the Oasis project. As the roadway portion of the Eastern Corridor program was modified, segment 3 was not analyzed as planned as part of that project. An initial environmental screening was conducted for segment 3, and is documented separately in Environmental Status Summary HAM/CLE- Oasis Rail Corridor PID 86463, October 30, 2015. This chapter covers Oasis segments 1, 2, and 4.

9.1 Community Setting and Characteristics

The study area for the OASIS rail corridor includes the communities of Cincinnati, Fairfax, Mariemont, Newtown, and Milford, as well as unincorporated parts of Hamilton and Clermont Counties. Within the City of Cincinnati, the project area includes various neighborhoods, including: the CBD-Riverfront, East End, Mt. Adams, Walnut Hills, East Walnut Hills, Hyde Park, Columbia-Tusculum, Mt. Lookout, and Linwood (listed roughly from west to east), as seen in Exhibit 9-1. A brief narrative of each city and neighborhood is listed below.

Exhibit 9-1: Local Communities



Fairfax: Fairfax is a village located just east of the City of Cincinnati, between the Cincinnati and the Village of Mariemont. Fairfax has an area of 0.8 square miles and had a population in 2011 of 1,697.

Mariemont: Mariemont is a village located just east of the City of Cincinnati and the Village of Fairfax along the Little Miami River. Mariemont is 0.9 square miles in area and had a population of 3,402 in 2011. Mariemont is listed on the National Register of Historic Places and was designated a National Historic Landmark in 2007.

Milford: Milford is an eastern suburb of Cincinnati located along the Little Miami River. Located in both Hamilton and Clermont Counties, the City of Milford is 3.8 square miles and had a population in 2011 of 6,722.

Newtown: Newtown is a village located east of the City of Cincinnati, just south of the Little Miami River. Newtown has an area of 2.4 square miles and in 2011 had a population of 2,671.

CBD-Riverfront (Downtown): Cincinnati's Central Business District-Riverfront neighborhood is a 0.8-square-mile area on the south end of the city along the Ohio River. In 2010, the neighborhood had a population of 4,850 residents. It is home to the cooperate headquarters of The Kroger Co., Fifth Third Bank, and Procter & Gamble, as well as the sports arenas of Paul Brown Stadium, Great American Ballpark, and US Bank Arena. I-71 bisects the neighborhood along its southern end.

Columbia-Tusculum: Columbia-Tusculum is roughly a 0.9-square-mile neighborhood with a population of 1,304 in 2010. Founded in 1788, it is the oldest neighborhood in Cincinnati; it is also home to the Columbia-Tusculum Historic District. The Columbia-Tusculum neighborhood is bordered by the neighborhoods of Hyde Park, Mt. Lookout, Linwood, and East End.

East End: The East End neighborhood is 2.1 square miles along Cincinnati's southern border and had a 2010 population of 1,518. The neighborhood extends about 6.5 miles along the Ohio River. At its southern-most end, it is adjacent to the Cincinnati Municipal Airport – Lunken Field.

East Walnut Hills: The East Walnut Hills neighborhood has an area of 0.6 square miles and a population of 3,794 in 2010. It borders Walnut Hills to the west and north, Evanston-East Walnut Hills to the north, Hyde Park to the east, and East End to the south. It is home to St. Ursula Academy and St. Francis DeSales Church.

Hyde Park: The Hyde Park neighborhood is a 2.9-square-mile area that was established in the 1890s. In 2010, the neighborhood had a population of 13,356. It is an up-scale neighborhood that is home to the Cincinnati Country Club. Hyde Park borders the city of Norwood to the north, as well as the neighborhoods of Oakley, Mt. Lookout, Columbia-Tusculum, East End, Evanston, and East Walnut Hills.

Linwood: The neighborhood of Linwood is 3.0-square-miles in area and had a population of 875 in 2010. Linwood is surrounded by the neighborhoods of Mt. Lookout, Columbia-Tusculum, East End, California, and Mt. Washington, as well as the Village of Fairfax to the north. Linwood is home to the Cincinnati Municipal Airport – Lunken Field.

Mt. Adams: Located just south of Eden Park is the 0.2-square-mile neighborhood of Mt. Adams. The neighborhood is also bordered by I-71, I-471, and the Columbia Parkway. The surrounding neighborhoods are Walnut Hills, the East End, the CBD-Riverfront, and Pendleton. The neighborhood had a population of 1,481 in 2010.

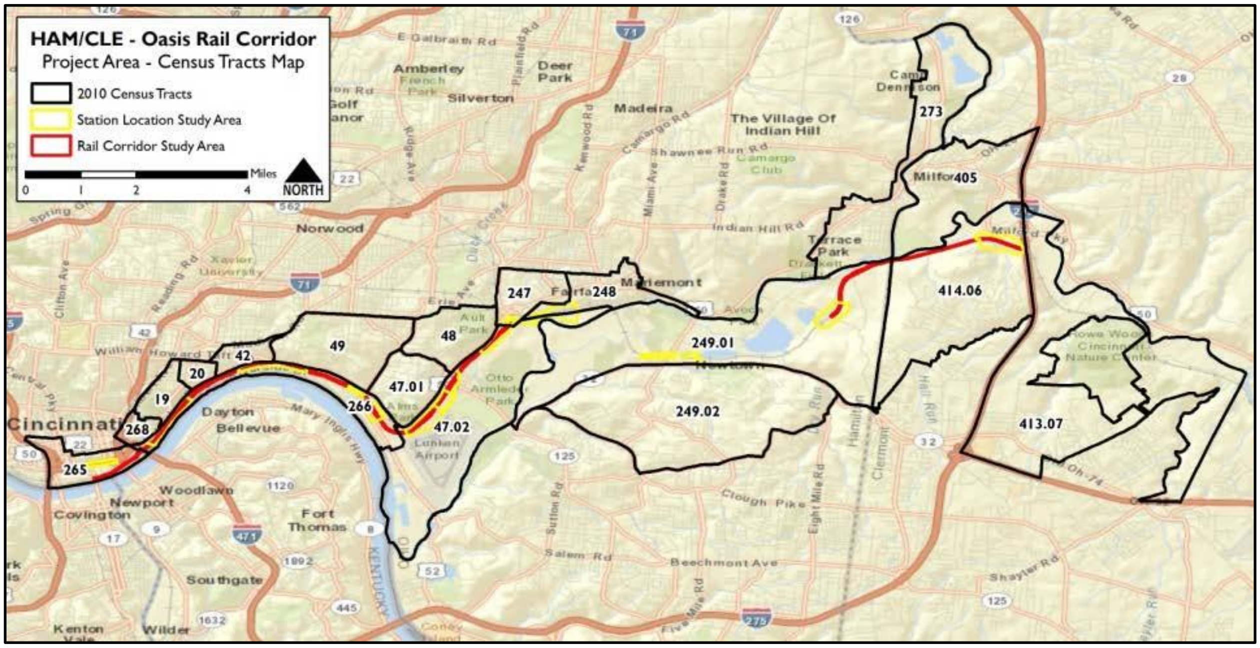
Mt. Lookout: Mt. Lookout is a 1.0 square-mile neighborhood with a 2010 population of 4,814. The neighborhood is home to the Cincinnati Observatory, which is located in the Observatory Historic District. Mt. Lookout is surrounded by the neighborhoods of Hyde Park, Columbia-Tusculum, Linwood, and Oakley, as well as the Village of Fairfax.

Walnut Hills: The neighborhood of Walnut Hills has an area of 1.5 square miles and a population in 2010 of 6,495. The north and western edges of this neighborhood mostly run along I-71. To the south of the neighborhood is Eden Park. Peeble's Corner Historic District, the Harriet Beecher Stowe House, and the C.H. Burroughs House are all located in Walnut Hills. Walnut Hills is bordered by the neighborhoods of Evanston, Evanston-East Walnut Hills, East Walnut Hills, the East End, Mt. Adams, Pendleton, and Mt. Auburn.

9.2 Population & Environmental Justice Characteristics

The socioeconomic data for the study area and the larger, surrounding areas came from the 2010 Census (http://factfinder2.census.gov) and the 2010 U.S. Census Bureau's American Community Survey. The data collected was done at the census tract level (shown in Exhibit 9-2) and includes the 18 tracts that intersect the station location and rail corridor study areas for this project.

Exhibit 9-2: Census Tracts Map



9.2.1 Population

Table 29 shows the 2010 populations of each of the 18 census tracts that are within or partially within the project study area, as well as the population for the larger, surrounding areas of the City of Cincinnati, the Cincinnati-Middletown Metro Area, Clermont County, Hamilton County, and the State of Ohio.

The census tracts that make up the study area have a combined population of just under 55,000. On average, 20 percent of the population of the census tracts in the study area are under the age of 18 and 12 percent are age 65 and older. Additionally, these tracts have a slightly higher female population, with an average of 51 percent female and 49 percent male.

The population in the study area is very similar to the larger, surrounding areas. The surrounding areas have a slightly higher youth population on average, but many of the individual census tracts in the study area have a similar youth population percentage. The elderly population in the surrounding areas is the same as most of the study area. The male-to-female ration for the larger, surrounding areas is also the same as the average for the study area. Overall, the population traits in the study area are very indicative of the larger, surrounding areas.

Table 28: Population

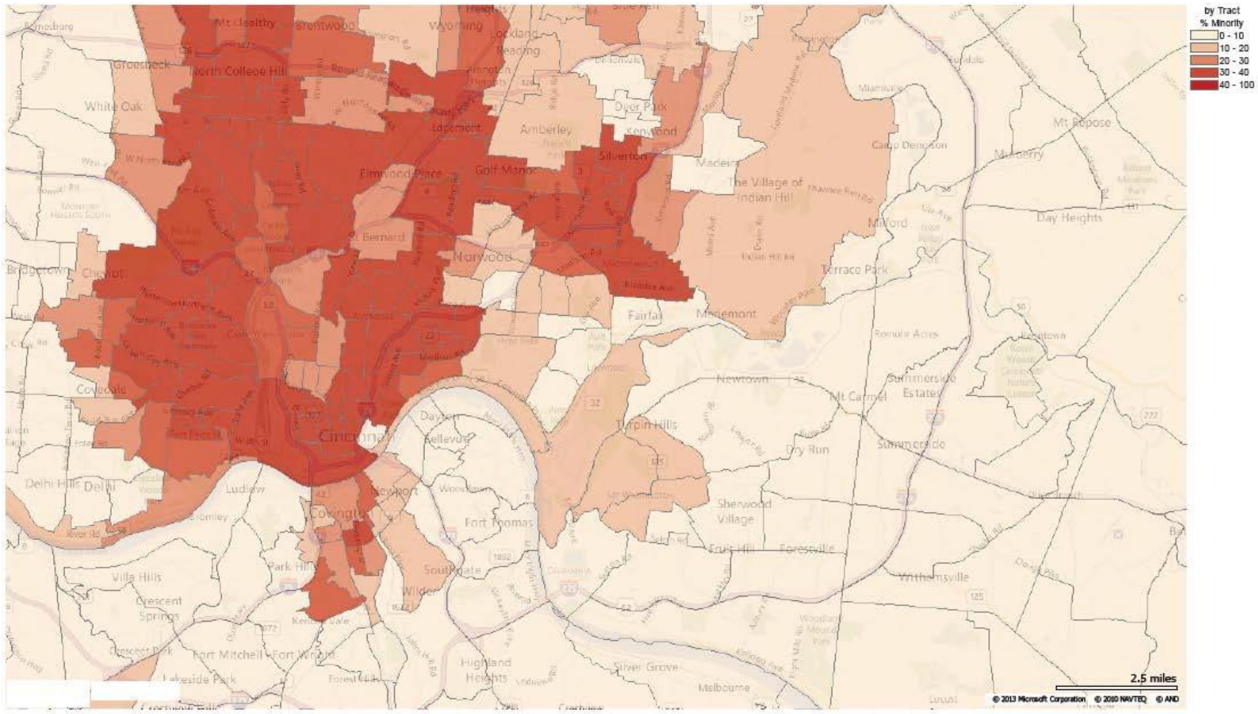
Tract / Area	2010 Population	% Under Age 18	% Age 65+	% Male	% Female
19	1,445	13%	8%	49%	51%
20	1,352	9%	16%	47%	53%
42	1,821	14%	16%	48%	52%
47.01	2,893	15%	11%	49%	51%
47.02	875	24%	8%	51%	49%
48	3,225	26%	10%	47%	53%
49	6,278	19%	12%	49%	51%
247	1,699	24%	11%	46%	54%
248	3,453	28%	12%	45%	55%
249.01	1,116	23%	13%	52%	48%
249.02	7,858	29%	11%	49%	51%
265	2,159	8%	12%	50%	50%
266	1,518	17%	11%	49%	51%
268	1,481	5%	15%	57%	43%
273	2,676	33%	11%	50%	50%
405	5,109	17%	24%	45%	55%
413.07	4,840	23%	12%	49%	51%
414.06	4,857	32%	8%	50%	50%
Totals	*54,655*	*20%*	*12%*	*49%*	*51%*
City of Cincinnati	296,943	22%	11%	48%	52%
Cincinnati-Middletown, OH-KY-IN Metro Area	2,130,151	25%	12%	49%	51%
Clermont County, Ohio	197,363	26%	12%	49%	51%
Hamilton County, Ohio	802,374	24%	13%	48%	52%
State of Ohio	11,536,504	24%	14%	49%	51%

Source: U.S. Census (www.census.gov), 2010 SF1 dataset.

9.2.2 Environmental Justice Populations

It is necessary to determine if one population group will experience disproportionately high and adverse environmental impacts compared to others. The concern about disproportionate impacts is a concept referred to as Environmental Justice (EJ). Executive Order 12898 and FHWA Order 6640.23A is to ensure Minority and Low-Income populations are not disproportionately impacted by ODOT projects. Per FHWA Order 6640.23A, a disproportionately high and adverse effect on a minority or low-income population means the adverse effect is predominately borne by such population or is appreciably more severe or greater in magnitude on the minority or low-income population than the adverse effect suffered by the non-minority or non low-income population (FHWA, Information: Guidance on Environmental Justice and NEPA, 12/16/11). Low-Income is defined as individuals/families below poverty as defined by the U.S. Department of Health and Human Services poverty guidelines.

Exhibit 9-3: Minority Population



With the goal of treating all population groups fairly, a planning level EJ analysis was prepared. Demographic data from the 2010 U.S. Census was compiled for each of the census tracts in the study area, as well as for the larger, surrounding areas. Low income and minority maps for the project area were obtained from the USEPA (2010) EnviroMapper, data from 2010 Demographics by census tract and are included in Exhibit 9-4. Table 30 shows the disadvantaged populations of each of the census tracts that are within or partially within the project study area, as well as the disadvantaged populations for the larger, surrounding areas in 2010.

Based on ODOT's EJ criteria, census tracts with greater than 40 percent disadvantaged populations are identified as noteworthy. Using this guideline, only two of the census tracts in the study area have a disadvantaged population of higher than 40 percent, making them noteworthy. The two are Tract 19, located in Walnut Hills, and Tract 265, located in the CBD. Both have a minority population of almost 49 percent. This number is on par with the average for the City of Cincinnati as a whole, but is much higher than the averages seen in the Cincinnati Metro Area and across the State of Ohio. Additionally, Tract 42, in East Walnut Hills, has a minority population of 39.5 percent, which puts it just below the 40 percent threshold. The average minority population for the study area as a whole is 15.6 percent, a number that is lower than that of the larger, surrounding areas of the City of Cincinnati (51.9%), the Cincinnati Metro Area (18.4%), Hamilton County (32.4%), and the State of Ohio (18.9%); it is higher than the average for Clermont County (5.1%). Most of the census tracts in the study area have a minority population between 4 percent and 16 percent, with just four census tracts having a considerably higher minority population (34% to 49%).

Exhibit 9-4: Population Below Poverty Level

The average percent of the population living below the poverty level in the study area is 11.0 percent. This number is much lower than the average for the City of Cincinnati (27.2%), but is about average with the rest of the larger, surrounding area (12.3% in the Cincinnati Metro Area, 9.3% in Clermont County, 15.4% in Hamilton County, and 14.2% in the State of Ohio). Most of the census tracts in the study area range from 2 percent to 23 percent of the total population falling below the poverty level; however, two tracts, Tracts 265 and 266, have averages around 30 percent. Tract 265 has the highest percent of its total population living below the poverty level at 33.1 percent; however, it is still under the 40 percent threshold. The average median household income ($69,360) and per capita income ($42,278) for the study area are both higher than the larger, surrounding areas.

The number of households with no access to a vehicle was also analyzed. Thirteen of the census tracts in the study area ranged from 0 percent to 11 percent of households not having access to vehicles, numbers that are similar to the surrounding areas of the Cincinnati Metro Area (8.2%), Clermont County (4.7%), and the State of Ohio (8.1%), and slightly below that of Hamilton County (12.5%). Four census tracts (Tracts 19, 42, 47.02, and 405) had around 25 percent of households not having access to vehicles, a number that is close to that of the City of Cincinnati (22.0%). Census Tract 265, located in Downtown Cincinnati, had the highest percentage of households without access to a vehicle at 50.4 percent.

Table 29: Disadvantaged Populations

Tract / Area	% Minority	% Population Below Poverty Level	Median Household Income ($)	Per Capita Income ($)	% No Vehicle Households
19	48.9%	19.5%	$46,750	$32,222	23.7%
20	34.7%	15.5%	$53,017	$51,187	11.1%
42	39.5%	17.4%	$34,255	$35,336	29.1%
47.01	8.1%	2.1%	$100,260	$61,490	3.9%
47.02	11.2%	22.7%	$26,143	$16,290	22.8%
48	6.8%	2.7%	$130,341	$58,633	1.1%
49	11.2%	10.2%	$81,910	$51,702	2.5%
247	6.3%	8.2%	$56,574	$24,731	5.2%
248	7.0%	3.6%	$79,671	$43,903	5.6%
249.01	6.6%	6.7%	$56,442	$29,767	2.5%
249.02	5.4%	2.2%	$108,262	$47,404	0.4%
265	48.8%	33.1%	$24,722	$45,069	50.4%
266	15.9%	27.5%	$45,592	$40,137	8.0%
268	8.8%	4.4%	$99,125	$79,981	5.7%
273	5.3%	3.3%	$101,172	$51,650	1.8%
405	6.4%	10.5%	$33,657	$25,619	20.6%
413.07	4.9%	4.5%	$64,342	$29,506	5.6%
414.06	4.9%	3.1%	$106,250	$36,378	0.9%
Average Per Tract	*15.6%*	*11.0%*	*$69,360*	*$42,278*	*11.2%*
City of Cincinnati	51.9%	27.2%	$33,681	$23,982	22.0%
Cincinnati-Middletown, OH-KY-IN Metro Area	18.4%	12.3%	$53,651	$27,725	8.2%
Clermont County, Ohio	5.1%	9.3%	$58,472	$27,900	4.7%
Hamilton County, Ohio	32.4%	15.4%	$48,234	$28,799	12.5%
State of Ohio	18.9%	14.2%	$47,358	$25,113	8.1%

Source: U.S. Census (www.census.gov), 2010 SF1 and ACS datasets.

Conclusions. The information presented above is meant to generally characterize the existing socioeconomic conditions within the OASIS rail corridor study area. By utilizing U.S. Census Bureau data, similarities and differences can be established in relation to larger areas. In this case, comparing the study area census tracts with the City of Cincinnati, the Cincinnati-Hamilton CMSA, Hamilton County, Clermont County, and the State of Ohio shows that the population in the study area is, on average, relatively similar to that of these larger, surrounding areas.

Two census tracts in the study area have higher than 40 percent minority population (Tracts 19 and 265) and one tract (Tract 42) approaches the 40 percent threshold at 39.5 percent. None of census tracts have higher than 40 percent of their population under the poverty level; however, Census Tract 265 has the highest at 33.1 percent.

9.3 Cultural Resources

A Phase I History/Architecture survey has been completed for the project. The reconnaissance survey was conducted in compliance with Section 106 of the National Historic Preservation Act of 1996, as amended. The project qualifies as an undertaking per Section 106, with the lead agency being the Federal Highway Administration (FHWA). Therefore, the purpose of the investigation is to determine whether historic properties are located within the proposed Area of Potential Effects (APE). The APE is defined as structures located 50 feet from existing railroad right of way starting at the Roebling Suspension Bridge to Wooster Pike and from Broadwell Road to IR 275 (Appendix A, Figure 1). In addition, the APE includes several 'station location study areas' developed by the stakeholders and defined by previous planning efforts. The information contained in this section can be found in more detail in the Phase 1 History/Architecture Report dated October 8, 2012.

With the proposed project located near downtown Cincinnati, a majority of the study area consists of urban, commercial, and residential development. A literature review conducted at the Ohio Historic Preservation Office (OHPO) indicates that 50 properties in the APE are listed on the National Register of Historic Places (NRHP), including 47 buildings, two cemeteries, and a set of brick arches from the 1872 Newport and Cincinnati Bridge. A number of other properties within the APE have been recorded in the Ohio Historic Inventory (OHI). Phase I history/architecture fieldwork was conducted on September 27-29 of 2010, October 15, 2010, and April 18- 9, 2012. The survey identified and documented 363 structures that were 50 years old or older. Many of these structures represent late 19th century and early 20th century dwellings, with a few commercial and industrial properties, such as the Baker & Handle Manufacturing Company (currently the I.T. Verdin Bell Factory), the East End Supply and Mars MFG. Co., as well as the Todi Toys Manufacturing Buildings.

Of the 363 documented structures in the APE, 50 are listed in the NRHP. As a result of this study, 13 additional properties are recommended as eligible for NRHP. Additionally, a Phase II investigation is recommended for the remaining structures on Hoff Avenue for their importance as an ethnically diverse neighborhood in the history of Cincinnati.

9.4 Parks and Recreation (Section 4(f) and Section 6(f))

Section 4(f) refers to consideration of property that is publicly owned parks and recreational lands, wildlife and waterfowl reserves, and historic properties. This section of this report is not intended to serve as a Section 4(f) evaluation, but merely to inform regarding the resources present within the project area and the potential for impacts. Should any of these resources be impacted, the Section 4(f) process will be used to ensure that no feasible and prudent alternative to the use of the land exists and that the action includes all possible planning to minimize harm to the property.

Parks and Recreation Areas. From the initial Red Flag review and project area mapping using the Cincinnati Area Geographic Information Systems (CAGIS), six parks, recreational areas, and playgrounds were identified within the study area. The six public parks within the study area are as follows:

- Smale Riverfront Park is a 45-acre park along the riverfront in Downtown Cincinnati. The park features the Cincinnati Bike and Visitor's Center, a stage and event lawn, fountains, and monuments. The park is currently under construction with Phase I completed and Phase II set to begin later in 2013.

- Sawyer Point, the Bicentennial Commons at Sawyer Point, and Yeatman's Cove are parks that stretch a mile along the Ohio River in Downtown Cincinnati. The parks feature a performance pavilion, tennis and volleyball courts, bike rentals, and playgrounds. Portions of these three parks received Land and Water Conservation funds in the 1970s and as such are considered Section 6(f) properties requiring coordination with the National Parks Service.
- Theodore M. Berry International Friendship Park is located along the Ohio River in the East End neighborhood, just east of the Sawyer Point/Yeatman's Cove parks. The park features sculptures and plants representing five continents as well as bike trails and walking paths.
- Linwood Park is located in Cincinnati's Linwood neighborhood. The park features baseball and softball fields, soccer fields, and open space.
- The Mariemont Gardens Park (South 80) is located in the Village of Mariemont. The park is located along the Little Miami River and features residential garden space and open green space.
- The Mariemont Municipal Swimming Pool is also located in the Village of Mariemont. In addition to swimming facilities, the Mariemont Municipal Swimming Pool also features ball courts and an area for grilling out.

Additionally, the study area is directly adjacent to six more public parks: Leblond Park and Recreation Complex, Schmidt Sports Complex/Schmidt Field Park and Boat Ramp, Alms Park, Airport Playfield Recreation Complex, Reeves Golf Course, and Robert W. Short Park. The current study area does not impact any of these parks.

Historic Resources. Both listed and eligible historic resources must be considered under Section 4(f). In the area of potential effects, there are 50 resources listed on the National Register of Historic Places (NRHP), 44 resources listed on the Ohio Historic Inventory, and 13 resources that have been recommended as eligible for the NRHP. A complete list of these resources can be found in the Cultural Resources Report.

Wild and Scenic Rivers. The Little Miami River, a State and National Scenic River, is located within the project area. Approximately 2,378 linear feet is located within the proposed Station Location 8 (Newtown). However, there are no known recreational uses within this segment of the river, or in the vicinity upstream/downstream of the project area. Because this segment of the Little Miami is not used for recreational purposes it is not a 4(f) resource.

Conclusions. Through this phase of ODOT's PDP, no Section 4(f) determinations have been made as impacts from the project are not yet known. A Section 4(f) evaluation will be conducted during the next phase of the ODOT PDP, during which time the alternatives will be used to define any expected impacts to Section 4(f) properties.

9.5 Ecological Resources

A field investigation of the study area was conducted June-July 2010, April 2012 and October 2012. The aquatic resources and terrestrial habitats, as well as endangered and threatened species were examined according to the Ohio Department of Transportation (ODOT), Ecological Manual (2005a). The report documents the ecological resources located in the project area (Segments 1, 2, and 4 and all 10 potential station locations), summarized below in tabular format. The information summarized in this section can be found in more detail in the Preliminary Determination Ecological Survey Report (PDESR) Ecological Survey Forms document dated January 15, 2013.

Table 30: Streams within the Project Area (Total Linear Feet)

Corridor Location	LRW	MWWH	WWH	EWWH	CWH	CLASS 1	MOD. CLASS 1	CLASS 2	MOD. CLASS 2	CLASS 3	MOD. CLASS 3
Railroad Corridor	0	0	4,673	0	0	0	270	0	135	75	0
RTC	0	0	0	0	0	0	0	0	0	0	0
Boathouse	0	0	2,989	0	0	0	0	0	0	0	0
East End	0	0	0	0	0	0	0	0	0	0	0
Columbia-Tusculum	0	0	0	0	0	0	0	0	0	0	0
Lunken Airport	0	0	0	0	0	0	0	0	0	0	0
Beechmont	0	0	0	0	0	0	0	0	0	0	0
Fairfax	0	0	2,554	0	0	0	0	0	0	0	0
Newtown	0	0	0	2,378	0	0	0	0	0	1,103	0
Ancor	0	0	0	0	0	0	0	0	0	0	0
MIlford	0	0	2,753	0	0	0	0	952	0	0	0
TOTAL	**0**	**0**	**11,911**	**0**	**0**	**0**	**0**	**952**	**0**	**1,103**	**0**

Definitions for Acronyms Used in Table 31:

LRW: Limited Resource Waters

MWWH: Modified Warm Water Habitat

WWH: Warm Water Habitat

EWWH: Exceptional Warm Water Habitat

CWH: Cold Water Habitat

Table 31: Wetlands within the Project Area (Total Acres)

Corridor Location	Provisional Wetland Category			
	Category 1	Mod. Category 2	Category 2	Category 3
Railroad Corridor	0	0	0	0
RTC	0	0	0	0
Boathouse	0	0	0	0
East End	0	0	0	0
Columbia-Tusculum	0	0	0	0
Lunken Airport	0.22	0	0	0
Beechmont	0	0	0	0
Fairfax	0	0	0	0
Newtown	0	0	0	0
Ancor	0	0	0.66	0
Milford	0	0	0	0
Total by Category	**0.22**		**0.66**	
Total Wetland Impacts = 0.88 acres				

Table 32: Ponds, Lakes, and Reservoirs within the Project Area (Total Acres)

Corridor I.D.	Pond	Lake	Reservoir
Railroad Corridor	0	0	0
RTC	0	0	0
Boathouse	0	0	0
East End	0	0	0
Columbia-Tusculum	0	0	0
Lunken Airport	0	0	0
Beechmont	0	0	0
Fairfax	0	0	0
Newtown	0	0	0
Ancor	0.05	0	0
Milford	0.49	0	0
Total impacts to Ponds = 0. 54 acres			

9.5.1 Threatened and Endangered Species

State Listed Species

Per Ohio Department of Natural Areas and Preserves (DNAP) records, two species, the state potentially threatened smooth buttonweed (*Spermacoce glabra*) and passion flower (*Passiflora incarnata*) were observed within the study area limits. Passion flower (*Passiflora incarnata*) was last observed in the study area limits in 2010. Smooth buttonweed (*Spermacoce glabra*) was last observed within the study area limits in 1986 and 2005. Within one mile of the study area limits, the following records were listed: Little Miami Kroger Hills State Reserve located northwest of the study area; Avoca Park located west of the study area; Ault Park located north of the study area; Eden Park located north of the study area; Little Miami Scenic River; caves/caverns, state endangered elephant ear (*Elliptio crassidens*) observed within the East Fork Little Miami River; state threatened threehorn wartyback (*Obliquaria reflexa*) observed within the East Fork and Little Miami Rivers; state threatened fawnsfoot (*Truncilla donaciformis*) observed within the East Fork and Little Miami Rivers; the species of concern deertoe (*Truncilla truncate*) observed within the East Fork and Little Miami Rivers; state species of concern river redhorse (*Moxostoma carinatum*) observed within the East Fork, Little Miami, and Ohio Rivers; state threatened mountain madtom (*Noturus eleutherus*) observed within the East Fork, Little Miami, and Ohio Rivers; state endangered northern madtom (*Noturus stigmosus*) observed within the Little Miami River; state endangered wartyback (*Quadrula nodulata*) observed within the East Fork and Little Miami Rivers; state threatened channel darter (*Percina copelandi*) observed within the Ohio River; state threatened river darter (*Percina shumardi*) observed within the Ohio River; state potentially threatened Carolina willow (*Salix caroliniana*) observed near the East Fork Little Miami River; state potentially threatened smooth buttonweed (*Spermacocoe glabra*) observed near the Ohio River; state endangered and federal species of concern loggerhead shrike (*Lanius ludovicianus*) observed south of the study area, state threatened and federal species of concern Kirtland's snake (*Clonophis kirtlandii*) observed northwest of the study area; state species of concern Sora rail (*Porzana carolina*) observed south of the study area; state potentially threatened passion flower (*Passiflora incarnata*) observed south of the study area, state threatened and federal species of concern Peregrin falcon (*Falco peregrinus*) observed south of the study area; the state and federally endangered running buffalo clover (*Trifolium stoloniferum*) observed north of the study area (Appendix D, ODNR-DNAP). No records of Indiana bat captures or winter hibernacula within five and ten miles of the study area, respectively, were indicated. Table 33 provides a list of Federally Listed Species.

Table 33: Federally Listed Species[1]

Scientific Name	Common Name	Listing	Discuss Presence of Suitable Habitat(s) (note designated critical habitat if present)
Myotis sodalis	Indiana Bat	Endangered	The Indiana bat is a migratory species that uses distinctly different habitats during summer and winter. In winter, the bats hibernate primarily in a few select mines or caves, none of which are known to occur within the study area. In spring, the females migrate to and inhabit suitable roosting and brooding trees (living or standing dead trees or snags with exfoliating, peeling or loose bark, split trunks and/or branches, or cavities) throughout summer (USFWS, 2007).
Cyprogenia stegaria	Fanshell	Endangered	The preferred habitat of the fanshell mussel consists of stable cobble and sand in rivers and large creeks (Watters et al, 2009). The adult shell is medium in size, thick and massive, circular to rather triangular; big river forms are inflated. The shell surface is dull, with a yellow or tan base color, patterned with radiating rows of green rays composed of microscopic flecks; pustules usually lighter in color (Watters et al, 2009). Currently in the Ohio River, the rayed bean is found near the confluence of the Ohio and Muskingum rivers; historically it occurred in the Ohio River at Portland, Marietta, Clarington, Portsmouth, and Cincinnati.

Scientific Name	Common Name	Listing	Discuss Presence of Suitable Habitat(s) (note designated critical habitat if present)
Lampsilis abrupta	Pink mucket pearly mussel	Endangered	The pink mucket pearly mussel is a large river species, found in the Ohio River mainstem and extirpated from the Muskingum and Scioto Rivers (Ohio range) (Watters et al, 2009). Habitat for the pink mucket pearly mussel consists of sandy mud and gravel of large rivers. This mollusk can be identified by its medium size, thick and very heavy, and oval to round shell that is very inflated. The shell is waxy yellow or tan, faint green rays usually present on juvenile shells (Watters et al, 2009. Currently it is found in the Ohio River mainstem, record for Hamilton County is listed (Watters et al, 2009).
Villosa fabalis	Rayed bean	Endangered	The rayed bean primarily inhabits sand and cobble of high quality streams and small rivers (Watters et al, 2009). The shell is small (about 3 inches), solid, rounded with wide low umbos. The color is yellowish to greenish with bold, often wavy continuous green rays. The current range for this species is within the Ohio River drainage basin (Watters, et al, 2009). The rayed bean mussel is listed for the East Fork Little Miami River and its drainage area where its preferred habitat occurs.
Plethobasus cyphyus	Sheepnose	Endangered	The sheepnose mussel is a large river species, namely the Ohio and Muskingum Rivers in Ohio (USFWS, 2002). Habitat for the sheepnose mussel consists of primarily larger streams that occur in shoal habitats with moderate to swift currents over coarse sand and gravel, however, it may also be found in mud, cobble, and boulder substrate. The elongate shell is somewhat yellowish without rays and is approximately 5 inches in length. It is smooth except for a single row of low, undulating knobs that radiate from the umbo to the posterior ventral margin (Watters et al, 2009). Within Hamilton and Clermont Counties, the sheepnose records are within the Ohio and Little Miami Rivers (Ohio Mussel Atlas).
Epioblasma triquetra	Snuffbox	Endangered	The snuffbox mussel inhabits small and medium sized streams as well as large rivers. It prefers swift currents and a substrate of gravel and sand with occasional cobble and boulders (USFWS, 2011).
Trifolium stoloniferum	Running buffalo clover	Endangered	Running buffalo clover prefers two types of habitat: shaded lawns and woodland with indirect sunlight. Shaded lawns are prevalent in areas with older homes, cemeteries, and parks and have a tendency to be frequently mowed. Woodland habitats with areas exposed to indirect sunlight are often found by openings along streams, trails, borders along woodlands, and alongside forest clearings (Selbo, 2003). Running buffalo clover is intolerant of full-sun or full-shade areas. Minor disturbances benefit the proliferation of running buffalo clover, but it cannot withstand major disturbances (USFWS, 2005b and 2007).

[1] List of species whose known range includes the county(ies) where the project is located.

Note: Please refer to Federally Listed Species –Suitable Habitat Summary Table for additional information on species specific habitat location(s)

Due to potential impacts to ecological resources, coordination with both federal and state agencies is expected. As such, a field survey, including but not limited to the mapping and evaluation of existing aquatic, wetland, terrestrial, and wildlife resources, will need to be completed within the preferred alignment footprint of the proposed project. The purpose of the survey will be to map and assess the existing ecological resources to meet the requirements for coordination under NEPA and to determine impacts and permitting requirements.

9.5.2 Noise Quality

The purpose of Part 772 of the Code of Federal Regulations (CFR) is to provide procedures for noise studies and noise abatement measures in order to help protect the public health and welfare, to supply noise abatement criteria and to establish requirements for information to be given to local officials for use in the planning and design of highways approved pursuant to Title 23 of the United States Codes (USC) (23 CFR 772.1). The noise analysis for this project will be conducted in accordance with the FTA document *Transit Noise and Vibration Impact Assessment* (May 2006). Specific details relating to the noise study can be found in the Noise & Vibration General Assessment document dated January 28, 2013.

As part of the Conceptual Alternatives Study, the study corridor was evaluated to identify current and potential noise sensitive areas (NSA) that may be impacted by the project alternatives. NSAs are areas sensitive to an increase in noise levels which are located within the study corridor. The NSAs in the project consist primarily of single and multi-family residential dwellings. Moderate noise/vibration impacts begin at 40 feet to 19 feet. Severe noise impacts begin at 18 feet. Aerial photography indicates that Noise Sensitive receptors that may experience moderate to severe impact are located in the following areas:

- Riverside/Kemper residential area
- Riverside/Collins residential area
- Riverside/Callahan residential area
- Riverside/Hoff residential area
- Riverside/St. Peters to Delta residential area
- Walworth/Delta Residential Area
- Airport Road to Robb Road
- Greenwood Road to Eastern Road
- Church Road to Whispering Wing Road

Further Noise/Vibration needs to be conducted in the form of a Detailed Noise and Vibration Analysis for each receptor identified within 40 feet of the rail system.

9.5.3 Vibration Analysis

The Vibration Screening Procedure, described in Chapter 9 of the FTA guidance document, was used to identify whether the proposed project could result in adverse vibration impact on receptors within the project corridor. According to the FTA guidance, a project that includes any type of steel-wheeled/steel rail vehicle would have the potential for vibration impact. The FTA has five Project Types for vibration screening. The OASIS project falls into Project Type 1-Conventional Commuter Railroad. Specific details relating to the noise study can be found in the *Noise & Vibration General Assessment* document dated January 28, 2013.

The criteria for environmental impact from ground-borne vibration and noise are based on the maximum root-mean-square (rms) vibration levels for repeated events of the same source. The limits ground-borne vibration are specified for three land use categories defined below:

- ***Vibration Category 1*** - High Sensitivity: This category includes buildings where vibration would interfere with operations within the building, including levels that may be well below those associated with human annoyance. Typical land uses covered by this category include vibration-sensitive research and manufacturing, hospitals with vibration-sensitive equipment, and university research operations.
- ***Vibration Category 2*** - Residential: This category covers all residential land uses and any buildings where people sleep, such as hotels and hospitals. No differentiation is made between different types of residential areas. The criteria apply to the transit-generated ground-borne vibration and noise whether the source is subway or surface running trains.
- ***Vibration Category 3*** - Institutional: This category includes schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference.

The screening distances are shown in Table 34 for the three types of land uses. The OASIS project is considered a conventional commuter railroad project type. Most of the sensitive receptors within the project limits are residential and fall into the Vibration Category 2 land use.

Table 34: Screening Distances for Vibration Assessment

	Critical Distance from ROW (feet)		
Type of Project	Category 1	Category 2	Category 3
Conventional Commuter Railroad	600	200	120
Rail Rapid Transit	600	200	120
Light Rail Transit	450	150	100
Intermediate Capacity Transit	200	100	50
Bus Projects	100	50	--

Impact Criteria

The criteria presented in Table 36 account for variation in project types as well as the frequency of events, which differ widely among transit projects. FTA Vibration Category 2 includes residential land uses or any building where people sleep. Most of the receptors within the project area would fall into this category. Ground-borne vibration (GBV) impact levels used in this analysis were taken from Table 8-1 of the FRA guidance document. The screening distance for vibration assessment for conventional commuter railroad concerning residential land use is 200 feet from the railroad right of way. Several receptor sites are located within this vibration screening distance. This project meets the criteria of warranting a General Vibration Assessment.

Table 35: Location of Potential Vibration Impact

Track Section/Location	Category 1	Category 2	Category 3			Total
			Park	School	Church	
Cincinnati Riverfront Station to the Boathouse	0	0	0	0	0	0
The Boathouse to Fairfax, Ohio	0	312	2	0	4	318
Fairfax, Ohio to Ancor	0	15	0	0	0	15
Ancor to Milford, Ohio	0	17	0	0	0	17
Total	**0**	**344**	**2**	**0**	**4**	**350**

As shown in Table 35, the Screening Assessment identified approximately 350 receptor sites that are located within the 200-foot and 120-foot screening distances. The sites warrant a more detailed vibration assessment. With the project having the potential for vibration impact, a General Vibration Assessment should be conducted for the proposed project.

9.5.4 Air Quality

Part 81 of the Code of Federal Regulations (CFR) provides procedures on air quality matters, which affect the public health and welfare and environmental quality of the natural and built habitat. The 1990 Clean Air Act is the cornerstone of these procedures and enforced by the U.S. Environmental Protection Agency (USEPA). Ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter and lead are the six pollutant defined as indicators of air quality by the USEPA. Threshold concentrations are established for these pollutants and designated as National Ambient Air Quality Standards (NAAQS).

USEPA air quality designations are categorized by area as: non-attainment, attainment or unclassifiable. When an area does not meet the air quality it is designated as a non-attainment area. The 8-Hour Ozone Standard requires monitoring of pollutant concentration being released into the atmosphere. Hamilton County is designated as a non-attainment area for the 8-Hour Ozone Standard (as of 2006) and for PM2.5[20] (as of 2005). However, as a commuter rail project, no adverse air quality impacts are anticipated. A shift to public transportation should reduce vehicle miles traveled and improve air quality within the region.

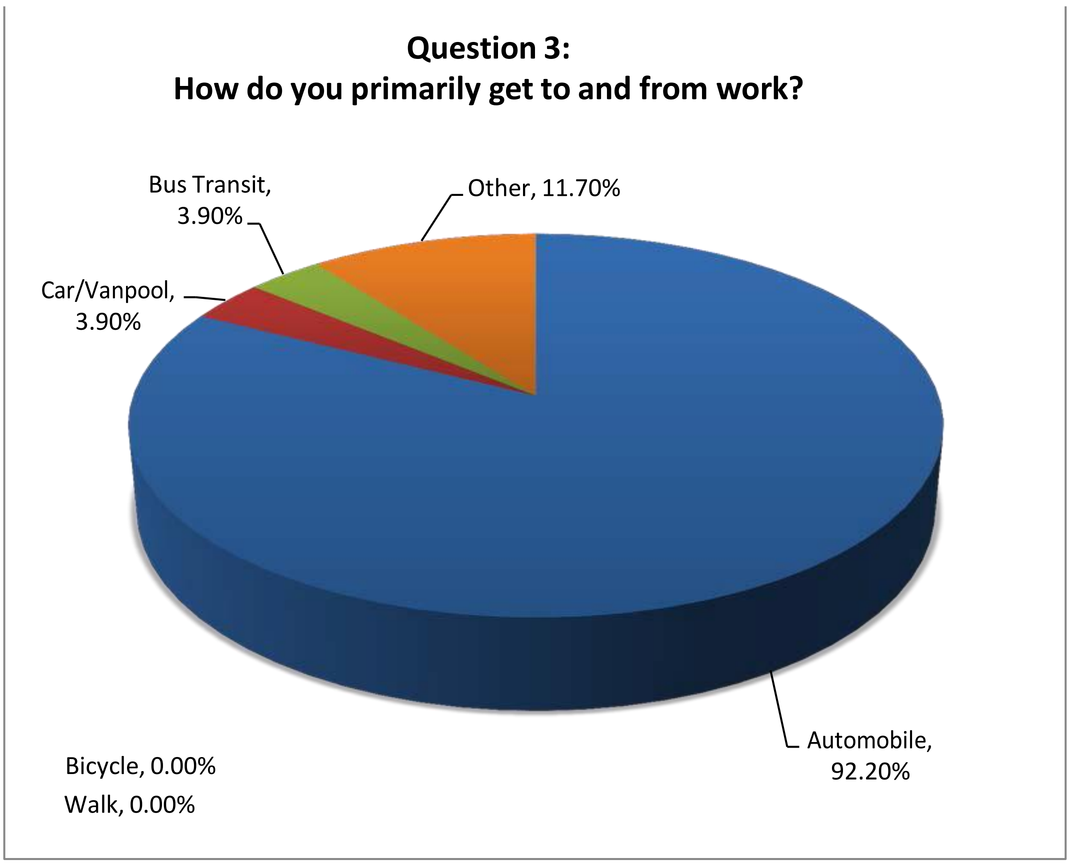
[20] PM 2.5 is “Particulate Matter less that 2.5micrometers in diameter. The term "particulate matter" (PM) includes both solid particles and liquid droplets found in air. Many manmade and natural sources emit PM directly or emit other pollutants that react in the atmosphere to form PM. These solid and liquid particles come in a wide range of sizes. Particles less than 2.5 micrometers in diameter (PM2.5) are referred to as "fine" particles and are believed to pose the largest health risks. Because of their small size (less than one-seventh the average width of a human hair), fine particles can lodge deeply into the lungs. (Source: USEPA)

10 FEEDBACK AND INPUT FROM PUBLIC OUTREACH MEETINGS

This section provides a summary of relevant, selected comments received from attendees at the three public meetings held throughout the corridor on the evenings of July 31 (at Milford High School in Milford), August 1 (at LeBlond Recreation Center near downtown Cincinnati), and August 2, 2012 (at Nagel Middle School in Forest Hills), and collected as the Comment Form Summary Report (September 2012), which can be found as Appendix C.

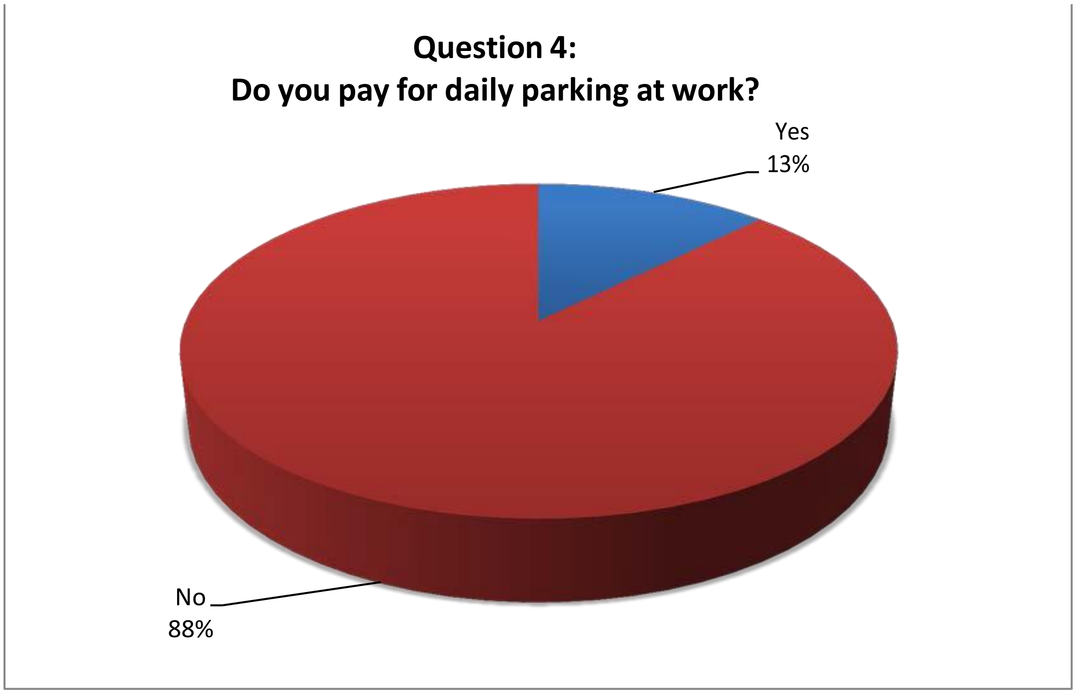
Responses to key questions and their implications to the OASIS planning process are included here:

Question 3: Primary Work Commute Travel Mode



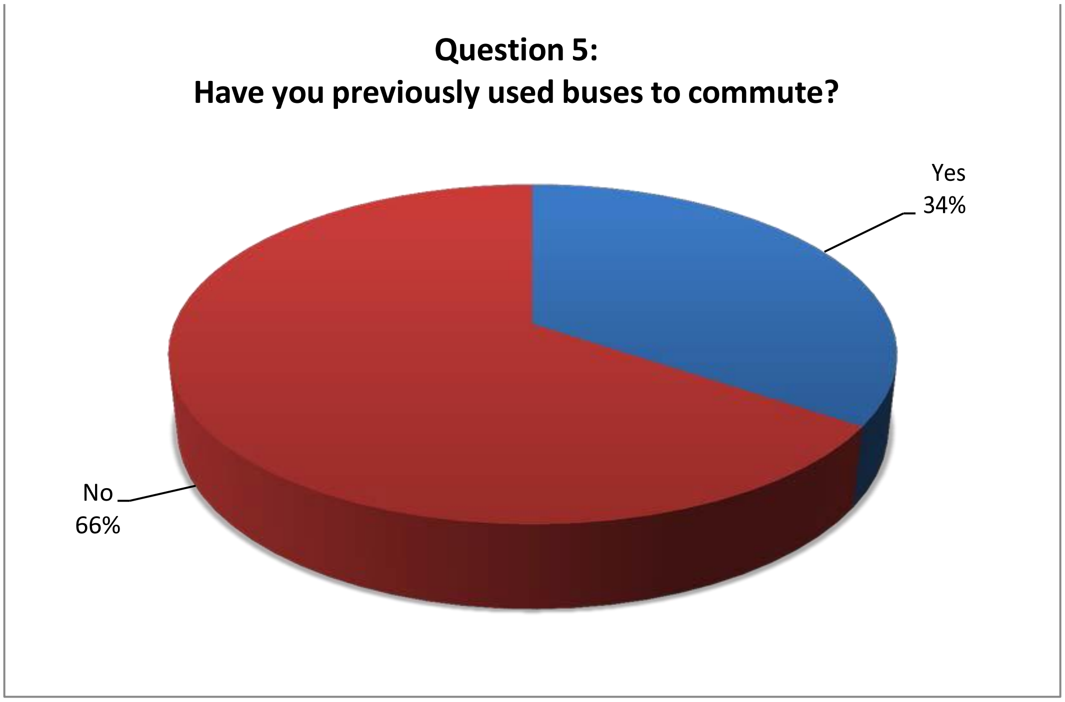
The vast majority of respondents indicated that they travel by automobile, with transit, carpooling, and "other" being the secondary modes used. Introduction of the Oasis Rail project could provide an attractive alternative for commuters.

Question 4: Do you pay for daily parking at work?



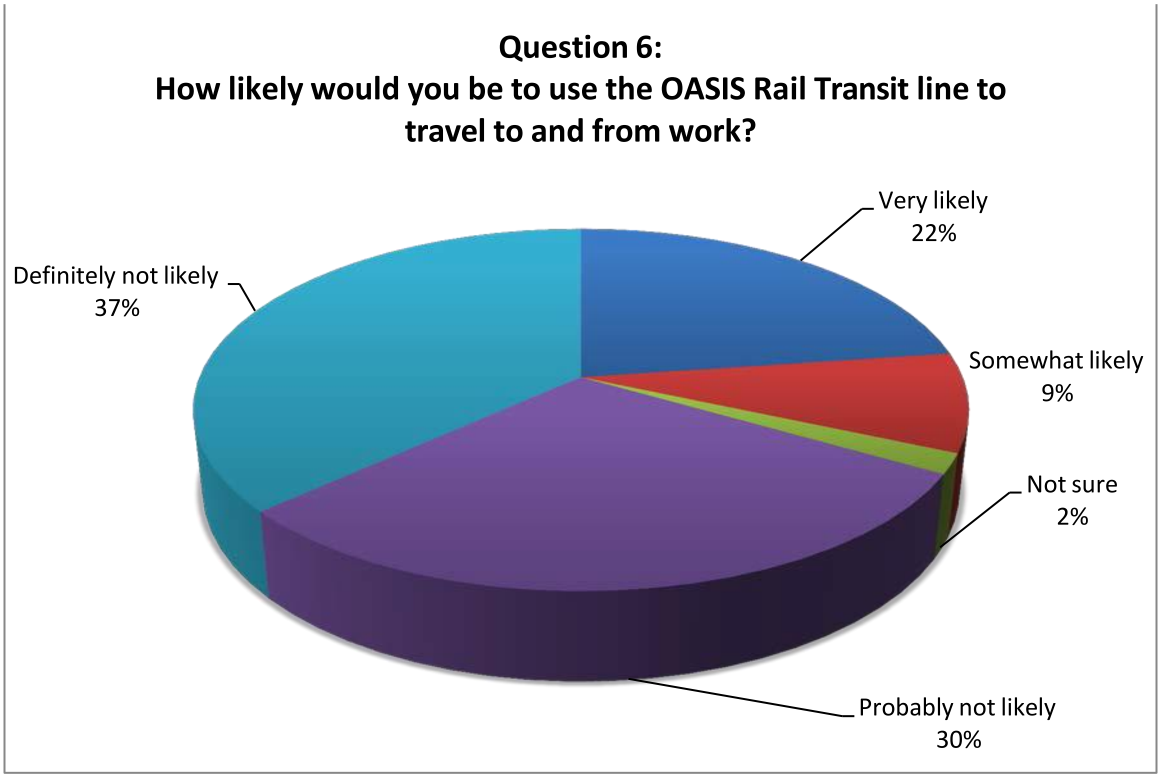
Only 13 percent of respondents indicated that they paid for parking at their work location. This response has implications for charging for parking at Park & Ride facilities at stations along the corridor, suggesting that adding new costs to a commute might reduce the relative attractiveness of rail travel versus continuing use of the automobile.

Question 5: Previous transit experience



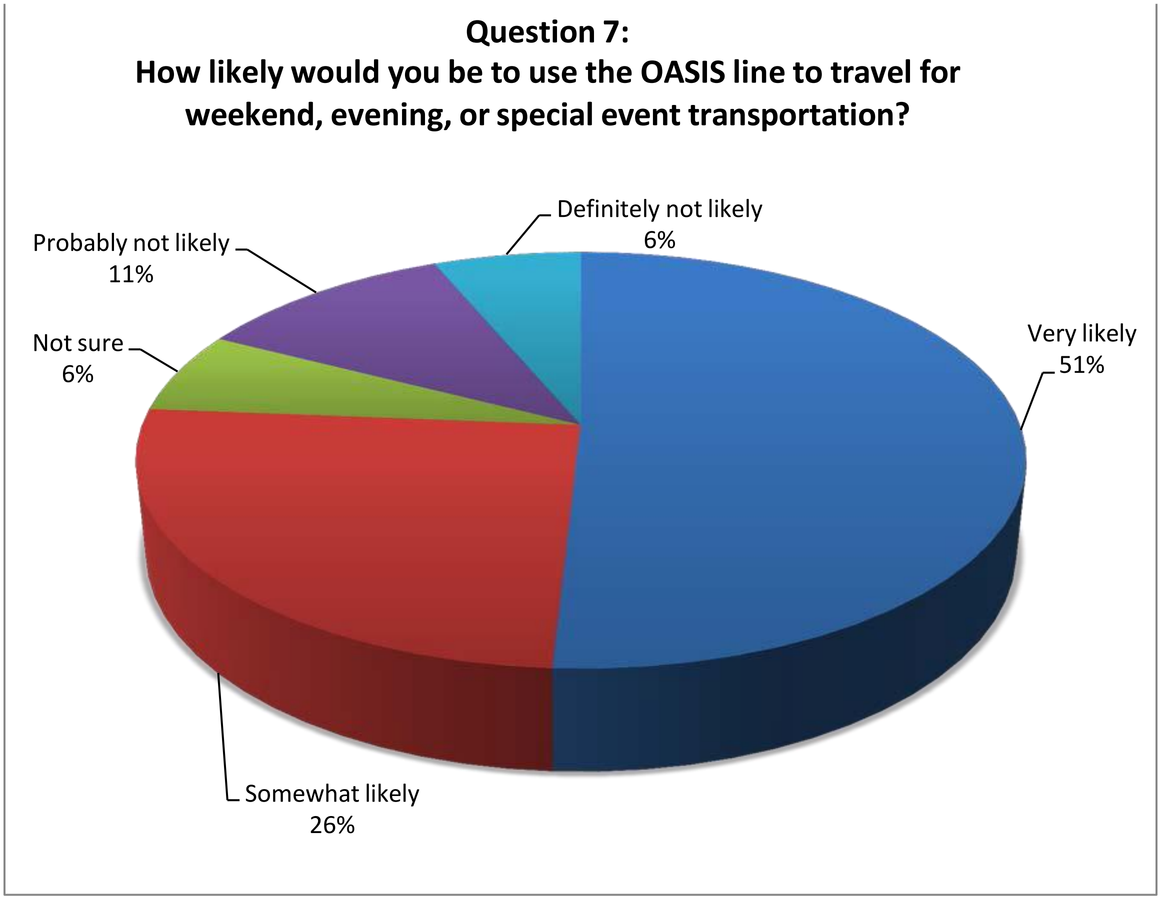
Only a third of survey respondents indicated past use of transit as a commute mode. Further comments chiefly involved the complexity of matching up bus and commute schedules, total travel time, and routing issues as reasons for this level of transit ridership experience. The implications of these responses reinforce that OASIS feeder services are available, convenient and are timed to minimize delays and facilitate an efficient transfer process for the traveler. This also shows that there is a large, untapped market for trying transit (in this case rail transit) as a new travel mode option.

Question 6: Likelihood of OASIS Rail Service Ridership



About 67 percent of respondents indicated "Definitely or Probably Not Likely" to this question of potential rail ridership. This may reflect the availability of free parking at work, a work destination not located in downtown Cincinnati, or the need for a car for work or errands during the day. Once the rail service was available, it might be considered as a more realistic option, whereas it is currently perceived of as still just a concept.

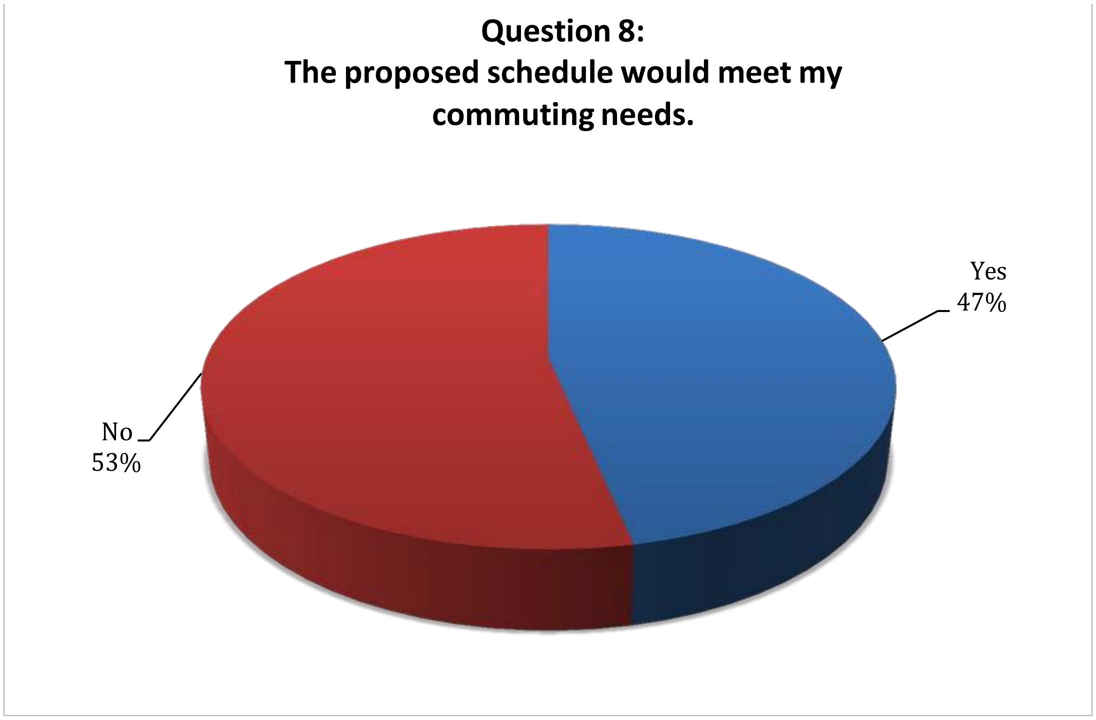
Question 7: Evening, Weekend and Special Event Service Ridership Potential



The expressed 77 percent likelihood of “Somewhat likely or Very Likely” to use the OASIS rail service points to a strong interest in options to reach events downtown by a means other than by automobile.

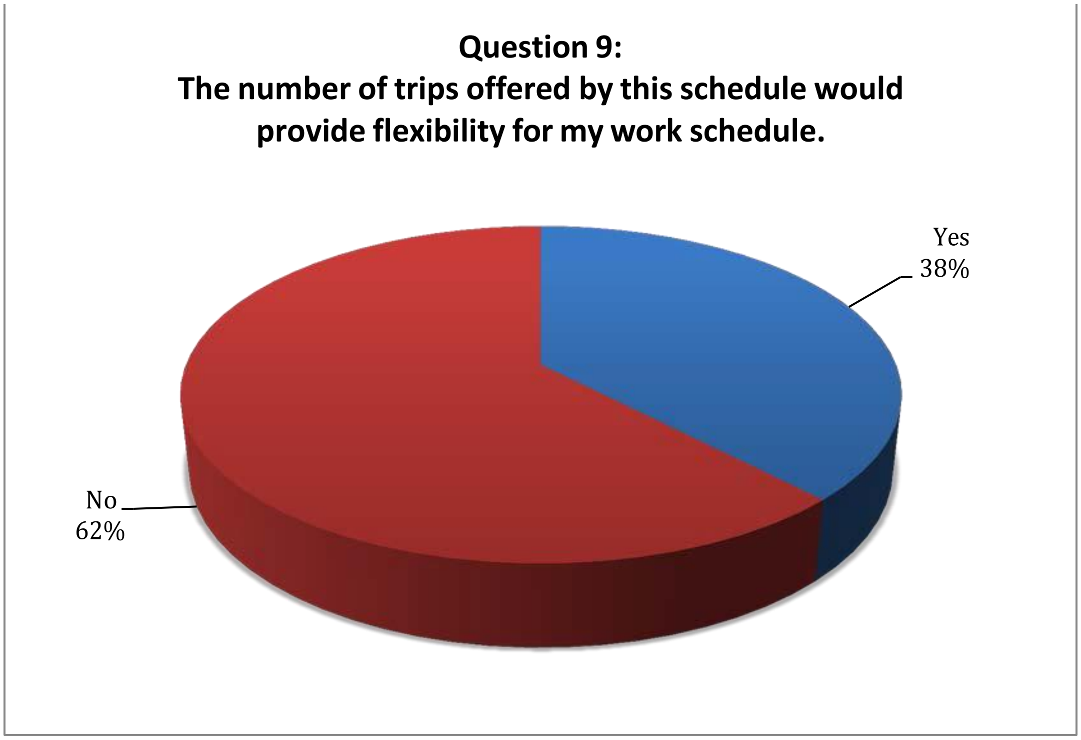
Implications of this question indicate that the addition of these services to the basic OASIS peak-period commute service would be welcomed. However, it might be more prudent to let the basic service take root as a travel option, and build on that success by adding additional services as ridership and revenue allowed, with the suggestion that such add-on services would be enthusiastically embraced by the corridor’s communities.

Question 8: Satisfaction with Proposed Service Schedule



Responses to this question indicate that about half of the respondents could use the proposed rail service for work travel. Evening, weekend and special event service may introduce new passengers to rail, further expanding the commuter market. Costs and service needs for these add-on services are described in Section 6.

Questions 9, 10 & 11: Number of Trips and Suggested Service Schedule Modifications



A majority of responses indicated a desire for additional trips beyond those shown in the Basic Service scenario. The responses to these questions show that further refinement of the service schedules to include the add-on services described in Section 6 would help meet these desires add would additional ridership beyond that already forecast. Desired changes include:

- Additional trip frequencies (24%) beyond those offered
- Fewer trip frequencies (26%)
- A faster travel time than the estimated 30 minutes (32%)
- A wider span of service beyond the peak-period service schedule along with additional trips (24%)
- Evening service (47%)
- Special Event service (84%)

After the OASIS rail service has been established, the public would like to see:

- More frequent service – 20 minute headways (42%)
- Less frequent service – 40 minutes or less (11%)
- A faster travel time (24%)
- Additional trips outside of the proposed peak-period service (55%)
- Additional mid-day trips beyond the two proposed (45%)
- Evening service (32%)

- Special Event service (26%)

The implications for these responses suggest that there will be pent-up demand for expanded service beyond the initial Basic Service. However, provision of service beyond the introductory option should be tempered by the availability of funding resources, and additional service should be provided based on ridership levels and perceived demand.

11 RECOMMENDATIONS AND NEXT STEPS

11.1 Recommendations

Based on previous work, the following recommendations are made regarding project characteristics:

Alignment

The preferred alignment follows the Sawyer Park Alternative 4 in Segment 1, and the SORTA owned north trackway in Segment 2. Shared use of the Norfolk Southern track is preferred for Segments 3 and 4. .

Stations

The initial operating plan should include stations at: Milford, Ancor, Newtown, Fairfax Redbank, Columbia Tusculum, and the RTC. The Boathouse may serve as a special event station. The Clare Yard may be an effective transit oriented development replacement for Fairfax if the NS will consider relocation of the yard. Combining the Newtown and Ancor stations along a relocated SR 32 may also encourage economic development.

Technology

The “alternatively compliant” vehicle such as the Stadler GTW 2/8 offers some advantages within the corridor, and continues to be the preferred vehicle. The newer FRA compliant vehicles such as the Nippon Sharyo may offer some advantages with respect to gaining access to the existing NS tracks, and should not be eliminated at this time.

11.2 Next Steps

Due to their technical, financial, and political complexity, major high capacity transit projects similar in nature to OASIS Rail Transit Project often take many years to plan, fund and ultimately implement. They are long in developing, but enduring and regionally formative in their impacts once created. Urban rail transportation is becoming more attractive as a significant portion of US metropolitan society, particularly the younger and oldest generations, are seeking transportation alternatives to the single occupancy car, and are looking to live in walkable, amenity rich neighborhoods with good transit access to other activity centers and communities.

The OASIS Rail Transit Project could be a logical first step element of a more extensive regional system. Oasis could potentially develop as part of a limited rail transit system to the east and northeast, or as part of a larger package of regional multi-modal improvements to be funded and built over many decades, similar in manner to the completion of the Interstate highways in and around Cincinnati over the past 50 years.

Developing a comprehensive funding approach for a transit project is an early challenge to be met in order to cover capital funding needs and ensure adequate operating resources. At the same time, projects that are advanced in planning and design can be more competitive for federal funding. The TIGER program and other components of the ARRA act passed in early 2009 are examples of unanticipated federal funding opportunities.

The next step in pursuing Federal New Starts funding for Oasis would be to request entry into Project Development. This would require identification of a project sponsor and demonstration that the community has the funding committed to complete Project Development.

It is also important to note that the FTA has advised project sponsors that Project Development must now be completed within two years for New Starts projects, which may be challenging for complex projects covering a large geographic area. FTA is now recommending that sponsors initiate any long lead-time work prior to entering Project Development. For the Oasis corridor, representative preliminary tasks could include advancing the station location analysis, entering discussions with the Norfolk Southern, refining design as appropriate pursuant to those discussions, and conducting environmental work within segment 3 consistent with work previously completed for other segments.

In summary, the logical next steps to advance the Oasis project include:

- Developing a scope, budget and funding for "pre" project development activities that would facilitate completion of Project Development within the 2 year schedule constraint
- Working towards funding to complete FTA Project Development within the New Starts program
- Identifying a project sponsor
- Developing a funding approach to implement and operate the overall project.