

COMPREHENSIVE OPERATIONS ANALYSIS FOR HAMPTON ROADS TRANSIT EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

A. BACKGROUND

Hampton Roads Transit (HRT) provides comprehensive transit service to the Hampton Roads metropolitan area. HRT serves a population of almost 1.4 million people in a service area of approximately 527 square miles, which includes seven different jurisdictions. The services offered include traditional bus service, Handi-Ride paratransit service, paddlewheel ferry service, Travel Demand Management services through TrafFIX, and Light Rail Transit expected to begin service by 2010. HRT provides several types of fixed route bus service, including:

- Traditional bus service in several cities (54 routes)
- Peninsula Commuter Service (11 routes)
- Portsmouth LOOP shuttle
- Metro Area Express (MAX) service (7 routes)
- Seasonal VB Wave
- Norfolk Electric Transit (NET) shuttle bus
- Norfolk Downtown Shuttle
- Naval Station Norfolk Shuttle

This Comprehensive Operations Analysis (COA) focused on 52 routes selected by HRT. Weekend ridership activity and seasonal routes were not examined as part of this study due to time and funding limitations.

B. WHY A COA?

Public transit, like any business, can be efficient and effective only if it understands the markets it serves, the needs of its customers, and how well it is doing in matching its products to the markets. Unlike many retail operations, transit does not receive detailed information each time a purchase is made. While a transit operator can determine from farebox records how many people have boarded a bus in a day, those records do not reveal anything about the characteristics of the customer, the specific trip for which the bus was used (e.g. origin, destination, purpose) or the quality of service that was provided. While new technologies are gradually being adopted by the transit industry to better track both customer activity and service provided (e.g. smart-card based fare collection, Automatic Vehicle Location, Automatic Passenger Counters), these systems are still not in wide use. Developing information about services provided and services used requires special studies to collect and process data.

The data collected and analyses conducted in a COA provides a transit agencies with a wealth of objective information for use in business planning, including use of services provided and how those services meet the needs of the customers. The COA identifies the strengths and weaknesses of the operations including those services that are the best performing and those that need attention. This, in turn, helps define actions that the agency can take to improve efficiency and effectiveness.

C. UNDERSTANDING THE DATA

Once data that describe the markets are in hand, a transit agency can begin to assess if available resources are being correctly deployed, or if alternative strategies would result in a more effective service. Transit is by nature a conservative industry. Over time, the residents of the community served by transit develop patterns of activity and travel based on the transit service provided. Decisions about where to live, purchase a car, medical facilities, favored shops, etc. are made based on the transit operations.

People grow to depend on specific services. As markets shift over time, the transit operator may find that services that were once well used are attracting fewer riders and that needs for service are developing in other locations. Shifting resources to target the new markets may seem appropriate. However, instituting a change in services will almost always reduce the quality of service for some existing riders while improving service in areas from which new riders are anticipated. The riders for whom service will change can be quite vocal in their objections while the hoped for new riders will be silent. Undertaking changes in service patterns must be done with recognition of this reality. Change must be introduced incrementally. When feasible, new services should be introduced and new markets established before older services are reduced or terminated. Change must not be seen as a zero-sum game in which new markets are served at the expense of old. Nonetheless, transit agencies cannot continue to provide inefficient services. Agencies must be willing to make changes when sound data have been collected and proper studies have been conducted to demonstrate that change is required to maintain the efficiency of the overall transit system.

A Comprehensive Operational Analysis (COA) is a process developed in the transit industry to support the business planning function of transit agencies. Regular, periodic COAs permit transit agencies to not only understand the current use and performance of their system but also to understand how the performance and use of the system is changing over time. Where necessary, corrective actions can then be identified and implemented that respond to changing conditions, that work to strengthen poorly performing services, and that target resources to developing markets. HRT's last transit study was conducted in 2001.

Major Components of the HRT COA:

- Stakeholder Interviews
- Review of Existing Conditions
 - Routes operated (Frequency, Span, Ridership)
 - Ridership
 - Demographics
 - On-time performance
 - On-board survey of riders
- Route Performance Analysis
 - Performance measures
 - Route ranking and evaluation
- Analysis and Development of Recommended Actions
 - Operations
 - Amenities
 - Transfer centers
 - Fleet mix and operations
 - Service expansion (geographic, service types)

- Implementation and Financial Plan
- Input to Statewide Plan

C.1. STAKEHOLDER INTERVIEWS

The COA's stakeholder participation process included 28 one-on-one interviews with stakeholders throughout the Hampton Roads region. Although the stakeholders represent different aspects of the community, their messages were similar. Stakeholders appreciate HRT service and that the fixed route bus service is striving to serve individuals. Stakeholders also agree that HRT operates a good service within the budget but that the current funding level is not adequate to meet the broader transit needs of the Hampton Roads community, and that an effective transportation system is essential for the economic health of the Hampton Roads region. The HRT staff, operators and planners, who utilize HRT service, as outlined in the COA, also identified opportunities for specific route improvements.

C.2. EXISTING SERVICES

The map below displays the HRT service area and the selected HRT routes for this study. For the purpose of this study, the focus was on the weekday local bus routes. In addition, express routes that are not part of the MAX system were also studied (Route 64 – Crossroads and Route 121 – NNTC/Williamsburg). The table below lists the routes studied as part of this COA.

Figure 1: HRT COA Study Routes

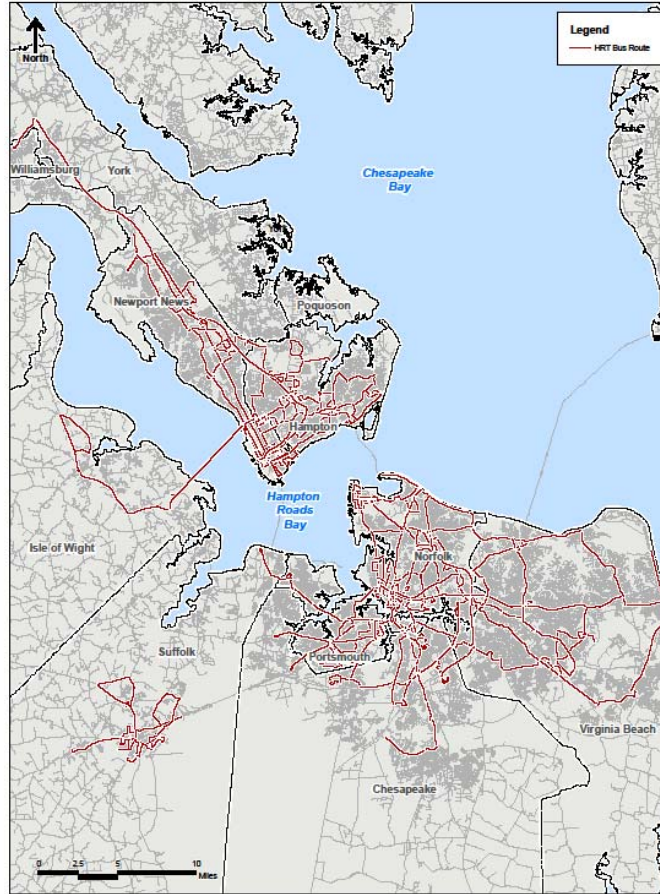


Table 1: HRT COA Study Routes

Route	Route Name	Route	Route Name
1	Granby Street	57	Deep Creek Boulevard
2	Hampton Boulevard	58	Bainbridge Boulevard
3	Chesapeake Boulevard	64	Smithfield
4	Church Street	71	Obici
5	Willoughby	72	Holland Road/Paul Decamp
6	South Norfolk/Robert Hall	73	Kingsboro/Wilroy Road
8	Tidewater Drive	74	Lake Kennedy/South Suffolk
9	Sewells Point Road	101	Kecoughtan
11	Colonial Avenue	102	Queen Street
12	Indian River Road	103	Shell Road
13	Campostella/Battlefield Blvd	104	Newsome Park
15	Crosstown	105	Briarfield Road
18	Ballentine Boulevard	106	Warwick Boulevard
20	Virginia Beach Boulevard	107	Denbigh Boulevard
23	Princess Anne Road	109	Buckroe
25	Newtown Road	110	Thomas Nelson Community College

Route	Route Name	Route	Route Name
26	Bow Creek Boulevard	111	Riverside
27	Northampton	112	Jefferson Avenue
29	Great Neck/Lynnhaven	114	Weaver Road
33	General Booth Boulevard	115	Fox Hill Road
36	Holland Road	116	Mall Hall
41	Cradock	117	Phoebus
44	Midtown	118	Magruder Boulevard
45	Portsmouth Boulevard	119	Oyster Point
47	High Street	120	Mallory
50	Academy Park	121	Williamsburg

Data for each of the 52 study routes was compiled into route profiles which include:

- Jurisdiction Served
- Type of Service
- Major Generators Served
- Transfer Centers
- Service Span
- Service Frequency
- Number of Trips
- Route Length
- Run Time
- Turnbacks
- Ridership
- Revenue Vehicle Miles
- Revenue Vehicle Hours
- Demographics within ¼ mile
- Route map

In addition to the route profiles, the COA documents historic HRT performance trends and key findings from previous transit studies.

C.3. RIDERSHIP

Ridership counts by boarding/alighting location were conducted for each of the selected study routes in the HRT system during a period from the last week in September 2008, until the last week of October 2008. Consultant team staff rode each route and manually counted the number of passengers boarding and alighting passengers at each location. From these data, the bus load—the number of passengers onboard the bus—was calculated for each trip leg between every stop on the route. These three types of data—boardings, alightings, and passenger loads—each provide a more in-depth understanding of different aspects of the system.

Studying boardings and alightings reveals which bus stops have the highest demand. The most used stops are good candidates for rider amenities, such as benches and bus shelters. Additionally, identifying the maximum load point—the location on the route having the greatest number of riders—is used to determine route segments that could benefit from additional service and higher service frequency. Evaluating route loads shows the most popular, and crowded portion of each route. This information is important for planning service frequency and scheduling appropriately sized vehicles. These data also identify the stops and route segments with the lowest demonstrated demand. Stops and route segments that are not frequently used should be considered for adjustments that will effectively serve more riders. Table 2 illustrates the on-off count data for a portion of one direction of HRT route 3.

Table 2: Example of Ridership Data Collected

Route 3 - Inbound Ridership										
Order	Description	Route 3-A			Route 3-B			Totals		
		ON	OFF	LOAD	ON	OFF	LOAD	ON	OFF	LOAD
69	Lafayette & Orleans	0	0	27	0	0	73	0	0	100
70	Lafayette & Orleans 2	0	0	27	0	0	73	0	0	100
71	26th & Waverly	1	1	27	0	0	73	1	1	100
72	27th & Leo	2	0	29	0	2	71	2	2	100
73	27th & Gazel	0	0	29	0	0	71	0	0	100
74	27th & Fawn	0	0	29	0	0	71	0	0	100
75	Monticello & 25th	3	10	22	8	7	72	11	17	94
76	Monticello & 19th	0	0	22	4	1	75	4	1	97
77	Monticello & 18th	0	0	22	1	2	74	1	2	96
78	Monticello & 15th	0	0	22	0	0	74	0	0	96
79	Cedar Grove	0	22	0	0	74	0	0	96	0
Totals		45	45		147	147		192	192	

C.4. DEMOGRAPHICS

An examination of Hampton Roads’ population and available HRT services provides a foundation for evaluating how well existing service matches the general population’s transportation needs. Demographic data from the 2000 Census reveal concentrations of potentially transit-dependent persons in the Hampton Roads area. Ridership demand for a transit system is often correlated to specific demographic characteristics: persons living below the poverty line, persons with mobility limitations, persons age 65 and older, households with no vehicle available, and—to a lesser extent—households with one vehicle. Persons falling into one or more of these categories will likely have difficulty accessing major destinations, such as medical facilities, government offices, employment centers, and shopping areas without adequate transit service. Within Hampton Roads, areas with high concentrations of population with these demographic traits benefit from fixed-route bus service, since there is often an appropriate density of bus riders to support regular bus service.

Additionally, areas with high population and household densities may also be appropriate locations for fixed-route bus service. Regardless of the characteristics of the population, areas with high population and household densities will also include choice riders. The concentration of many choice riders over a small geographic area makes bus service a viable option. High population and household densities also suggest a development pattern conducive to transit service: compact development, often mixed use, with limited, expensive, or inconvenient parking. In many cases, the areas with the highest population densities also have the highest concentrations of population with potentially transit-dependent demographic traits.

One of the most effective means for identifying potential service gaps based on demographic characteristics is to overlay HRT’s existing route network on a map displaying the concentration of populations with transit-dependent traits. As part of the COA, maps were developed for each of the five demographic indicators of transit need identified, and also for

population and housing density. The maps then were used to identify potential expansion opportunities within the region.

The analysis reveals the highest concentrations of populations whose characteristics indicate a propensity to use transit throughout Hampton City, Newport News City, Portsmouth, and Norfolk. These four jurisdictions have higher population densities, more urbanized development patterns, and more extensive HRT service networks. Therefore, there were no gaps found when analyzing data at the census tract level.

Outside this “core” area are areas with lower population densities and more suburban development patterns. Transit service in these areas is typically designed to carry riders into the more densely populated “core” areas. The service is less extensive and does leave areas where service gaps can be identified. Areas along the Chesapeake and Virginia Beach border repeatedly surfaced as having a potential need for service. The southern tip of York County also presents an expansion opportunity based on demographic indicators of transit need. Additionally, the northeastern portion of Virginia Beach shows population densities similar to those found in the “core” areas. This area could potentially benefit from expanded service.

C.5. ON-TIME PERFORMANCE

Operating a bus system on time is essential for establishing a reliable service. By adhering to the published bus schedule, HRT garners the confidence of current riders and generates a perception within the community that the bus system is a dependable mode of transportation. Observation of bus arrival and departure times at key locations also helps HRT determine if the times provided when scheduling buses are appropriate given current driving conditions. Adjustments, scheduling a faster run or providing more time for a trip, can then be made.

On-time performance data were collected at 19 key time points and transfer centers served by 47 bus routes between October 1 and October 20, 2008. At each location the times were noted for all trips arriving and departing between 7AM and 7PM, and compared to the scheduled arrival and departure times from HRT headway sheets to determine the number of minutes a trip deviated from the published schedule. For the purpose of this analysis, all arrivals and departures that occurred at any point before the scheduled time (one minute or more) are classified as early. All arrivals and departures that occurred more than five minutes after the scheduled time are classified as late. Only trips that arrive late or depart early or late are considered not on time since early arrivals generally do not disrupt a rider’s trip. A route by route analysis of on-time performance is contained in the COA report.

The current on-time performance of the HRT system may contribute to the perception among riders that bus service in Hampton Roads is unreliable. With nearly 40 percent of observed buses arriving late or departing early or late (outside of the five minute on-time window after a scheduled stop), it would be difficult for a rider to plan a trip and have confidence in arriving at their destination on time.

Certain routes with specific, persistent issues—either running late or early—have been identified for further investigation. By adjusting routes and schedules, drivers will have a more appropriate schedule to follow, reducing the potential to run early or late. Addressing the importance of on-time performance in driver training may also help improve schedule adherence.

Even when these schedule deviations may not affect riders' trips, such as late departures that arrive at subsequent stops on time, it is important to make adjustments when possible. This may be as simple as updating the published schedule. These minor "tweaks" allow riders to know what to expect. This can reduce anxiety and improve the confidence riders have in the service,

C.6. ON-BOARD SURVEY

The HRT COA Team conducted an on-board survey to gain an understanding of the characteristics and travel patterns of current transit users. The survey was conducted on board buses collecting information from bus riders as they travel. The survey results provide information about the trips made, travel behavior, and demographic characteristics of the riders. The information gathered through the on-board surveys provided input to the Study Team to develop improvement recommendations, enabling HRT to enhance the transit system by aligning service to the needs of riders.

The HRT COA on-board survey was conducted in September and October 2008 on 52 routes (additional surveys were collected for Routes 15 and 41 in January 2009). Routes were surveyed on weekdays. The surveys were taken on every other bus trip between the start of the service to 2:00 PM. The survey was administered by a surveyor who interviewed riding passengers. This method improves the quality of the data collected during the survey. The Survey questionnaire is provided in the COA. The Study Team collected 2,348 completed interviews for the system.

The Study Team collected ridership for each surveyed trip. These counts were used to factor the surveys to account for the total number of riders on each route during the survey period. A further factor that takes into consideration the proportion of surveyed trips to total daily trips was used to expand the survey results to reflect total daily ridership. These factored results provide information on the characteristics of HRT riders on surveyed routes.

An analysis of the data collected from the survey respondents found more females (54%) responded to the survey than males. The average age of survey respondents was 40. More than a third of the respondents have an annual household income of less than \$20,000. Most respondents were using the HRT service to travel from home to work. This is not surprising considering that the survey was conducted in the first half of the day. Most respondents access HRT by walking to the bus stop. The majority also walk to their destination upon exiting the bus. Most respondents (57%) pay cash in order to ride. Seventy-three percent of respondents use HRT at least five days a week. Almost a quarter of the respondents responded that they would have not made their trip if HRT was not available to them. This is not surprising considering that over half of the respondents do not have a working vehicle at home.

Some of the common comments received as part of the survey are associated with the customer service side of transit. Many respondents commented that it can be difficult to access schedule and route information. Few stops have route information available to the riders and many of the buses do not carry the correct route schedule associated with the route the bus is operating. It was also commented that many of the HRT drivers could improve their customer service by being more friendly and knowledgeable about HRT services. Many respondents would also like to see more amenities such as benches, shelters, and trash cans installed throughout the system. These items improve the customer experience. Overall, it should be acknowledged that HRT has many new riders coming to the

system, and that most of their ridership is using the service to access employment. Improvements to the “user friendliness” of the system and recognizing that HRT can be an important tool in economic development are key items that come out of the survey.

C.7. OPERATIONS ANALYSIS

An essential function of a Comprehensive Operations Analysis is to thoroughly evaluate the performance of the routes making up a transit system. By examining the HRT system from a variety of different angles—economic, historic trends, ridership, etc.—it is possible to isolate both the best and poorest performing routes. This information is invaluable in making decisions on how to improve HRT service. In a climate where every resource available to a transit agency is precious, HRT must find ways to increase support for the most successful services, which will have the largest impact on its riders, and ways to improve the underperforming services to minimize their potential drain on the system. In any transit system, there will be routes that are winners and losers in both financial and ridership terms; not every route can operate at a high level of productivity with a strong farebox recovery, nor should it. Robust system service coverage often means offering routes capable of connecting riders to less popular destinations. This evaluation of route performance in the COA provides the information necessary to strike the appropriate balance between the needs of riders, operational concerns, and funding restraints to maximize the efficiency and effectiveness of the bus system. This evaluation of route performance addresses many different aspects of HRT system operations, including routes, transfer centers, bus stop amenities, and costs. These and additional topics are covered in the COA evaluation:

- Cost Analysis
- Trend Analysis
- Origin-Destination Analysis
- Service Frequency Level of Service (LOS) Evaluation
- Revenue to Platform Hour Ratio
- Working Session Recommendations
- Operations Recommendations

Five performance measures were used measure how well the system is operating from a financial standpoint:

- Passengers per Revenue-Hour (see Figure 2)
- Farebox Recovery Ratio (see Figure 3)
- Subsidy per Revenue-Hour (see Figure 4)
- Subsidy per Passenger (see Figure 5)
- Operating Expense per Boarding (see Figure 6)

These measures were used to analyze individual route performance. This allowed for an ordinal ranking of the routes by each of the measures as well as a composite ranking that accounted for all measures together.

C.8. ORIGINS AND DESTINATIONS

Survey data collected regarding trip characteristics and travel behaviors help demonstrate how HRT service is used. The information gathered through on-board surveys not only reveals the transportation needs the service is currently meeting, but also suggests the types of trips that residents are not turning to HRT to make. Survey results can offer suggestions on what type of service is most valuable to residents and what type of new service could potentially benefit the region.

Passengers need to use HRT for a wider variety of reasons other than just commuting. The reported trip origins and destinations reflect this variety of trip purposes. Trip origins and destinations were mapped for each study route in the HRT system. The COA presents the findings along with maps of each route displaying trip origins and destinations of surveyed passengers.

Figures 7 and 8 show the trip origins and destinations of the surveyed passengers for the entire system. The trip origins and destinations depicted in the following figures are based on survey responses and represent a sample of trip origins and destinations for each route. The majority of trip origins and destinations are located in the higher density urban areas of Hampton, Newport News, Norfolk, and Portsmouth.

Figure 2: Passengers per Revenue Hour

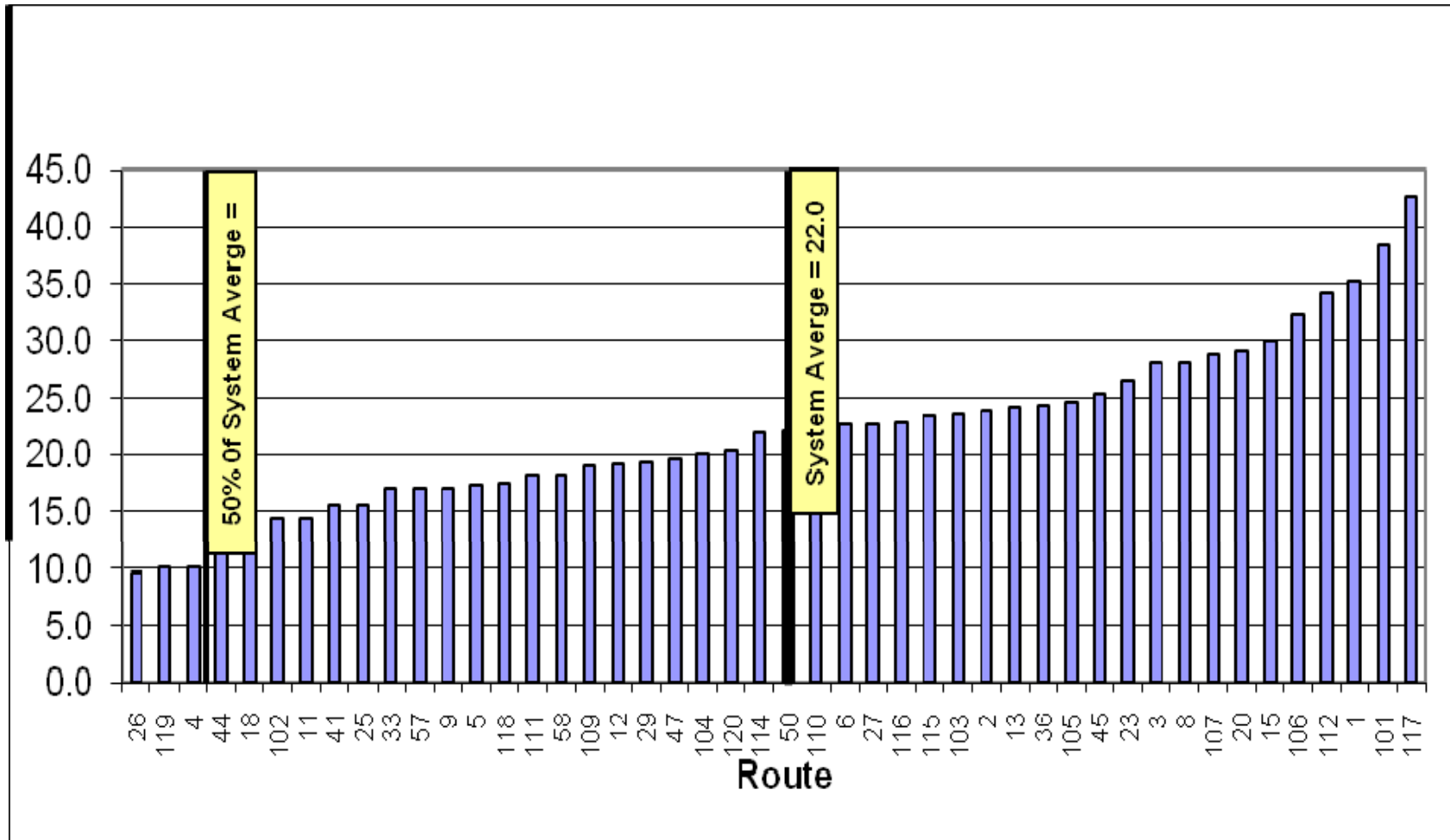


Figure 3: Farebox Recovery Ratio

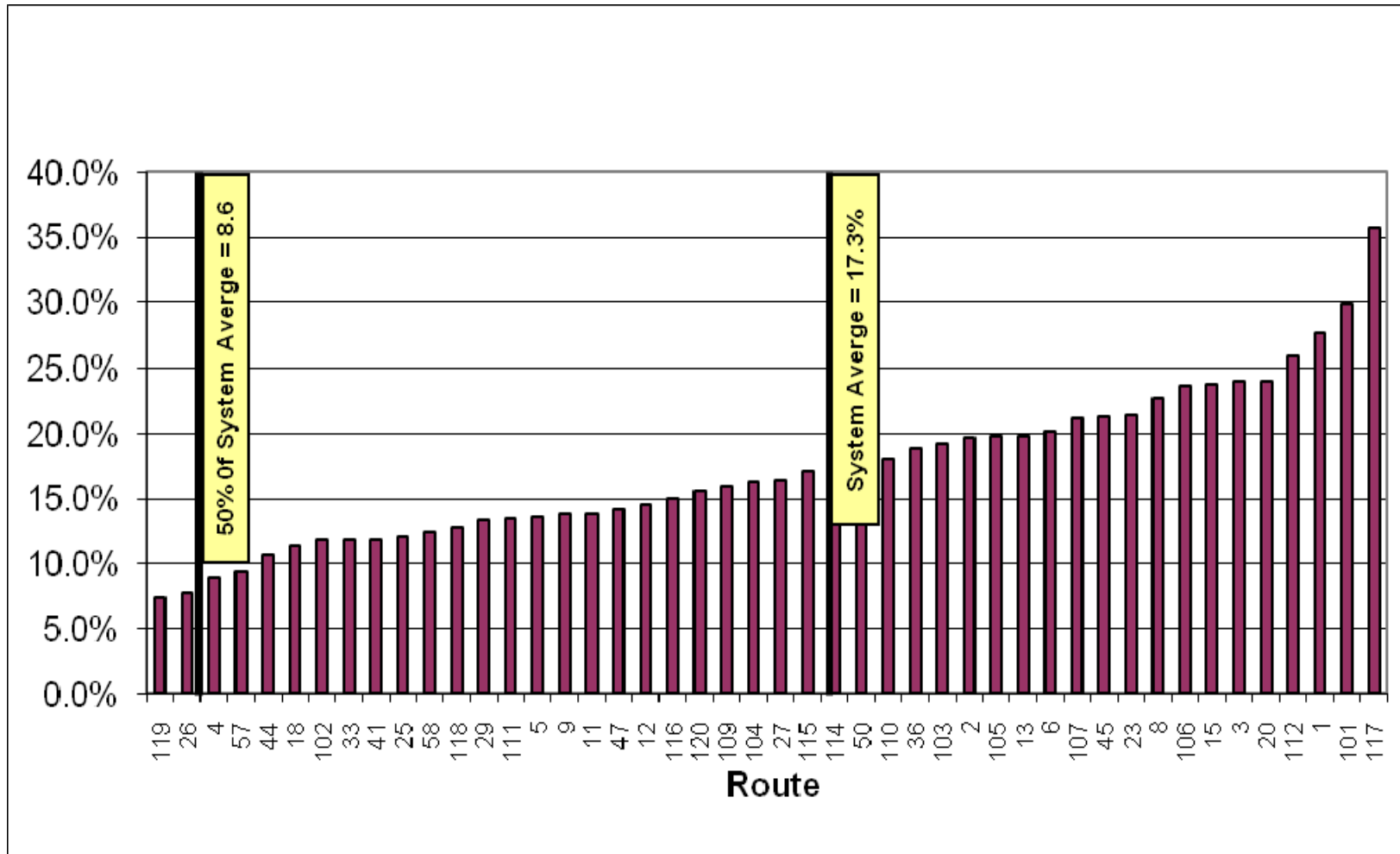


Figure 4: Subsidy per Revenue Hour

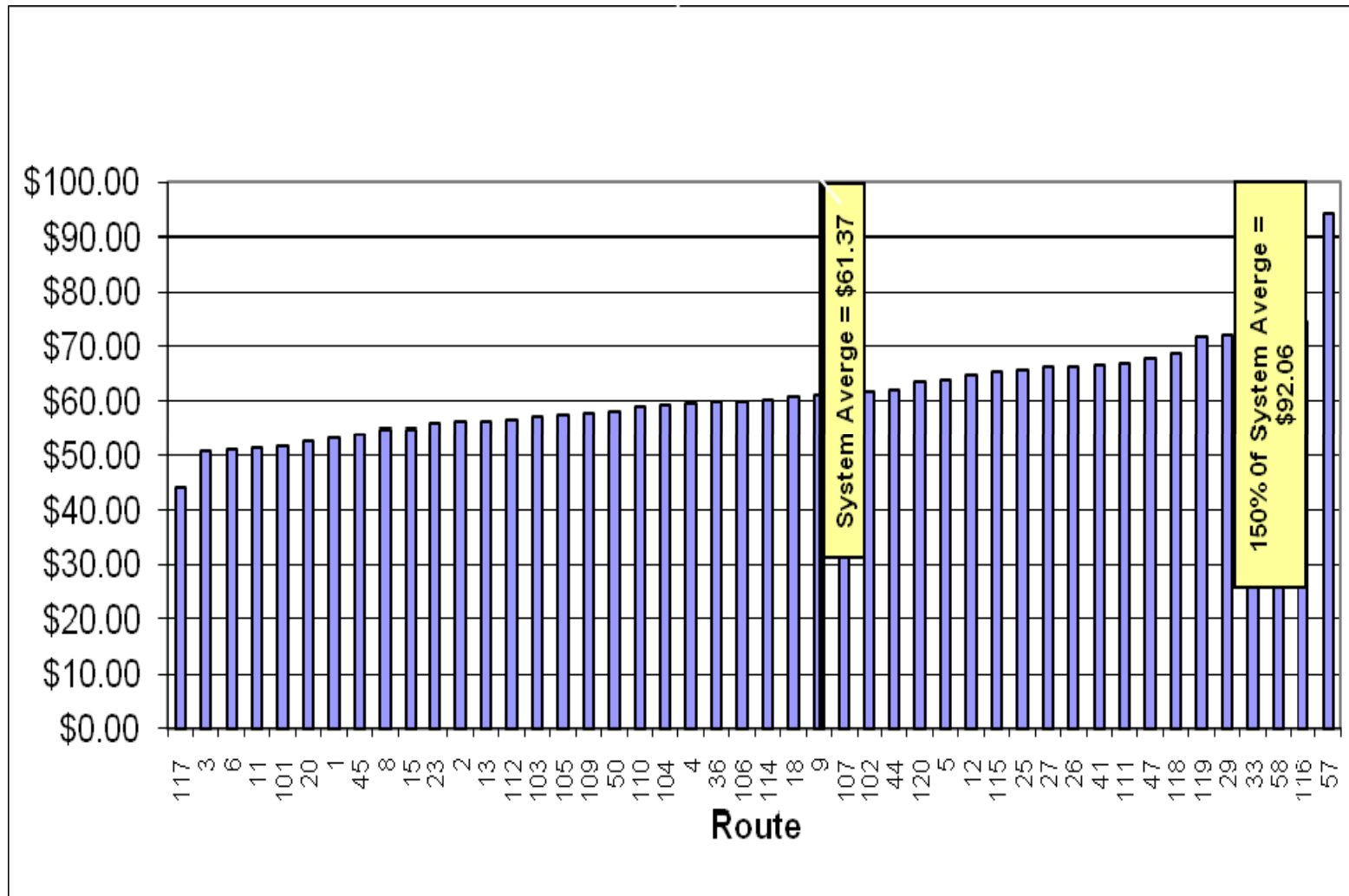


Figure 5: Subsidy per Passenger

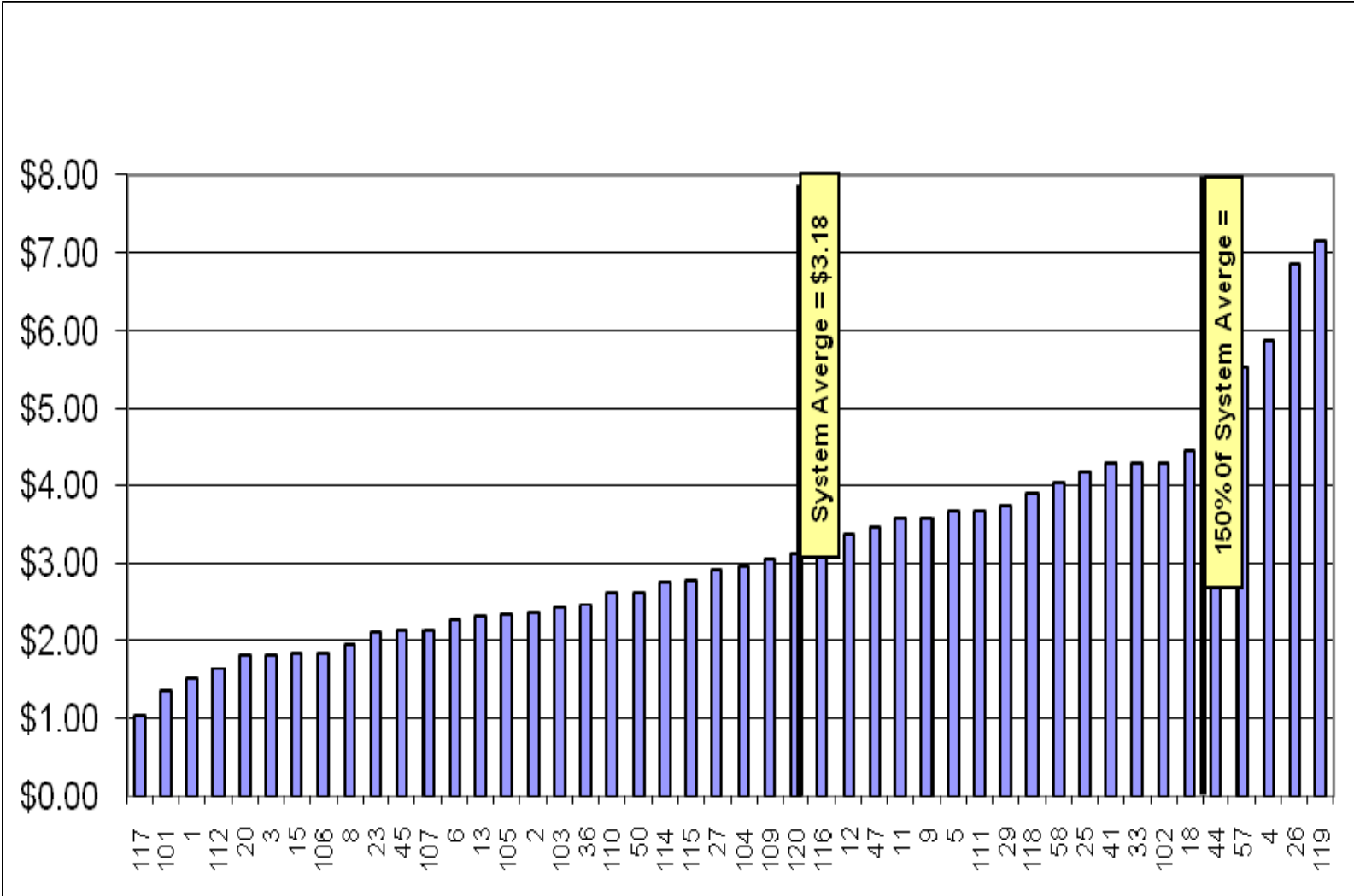


Figure 6: Operating Expense per Boarding

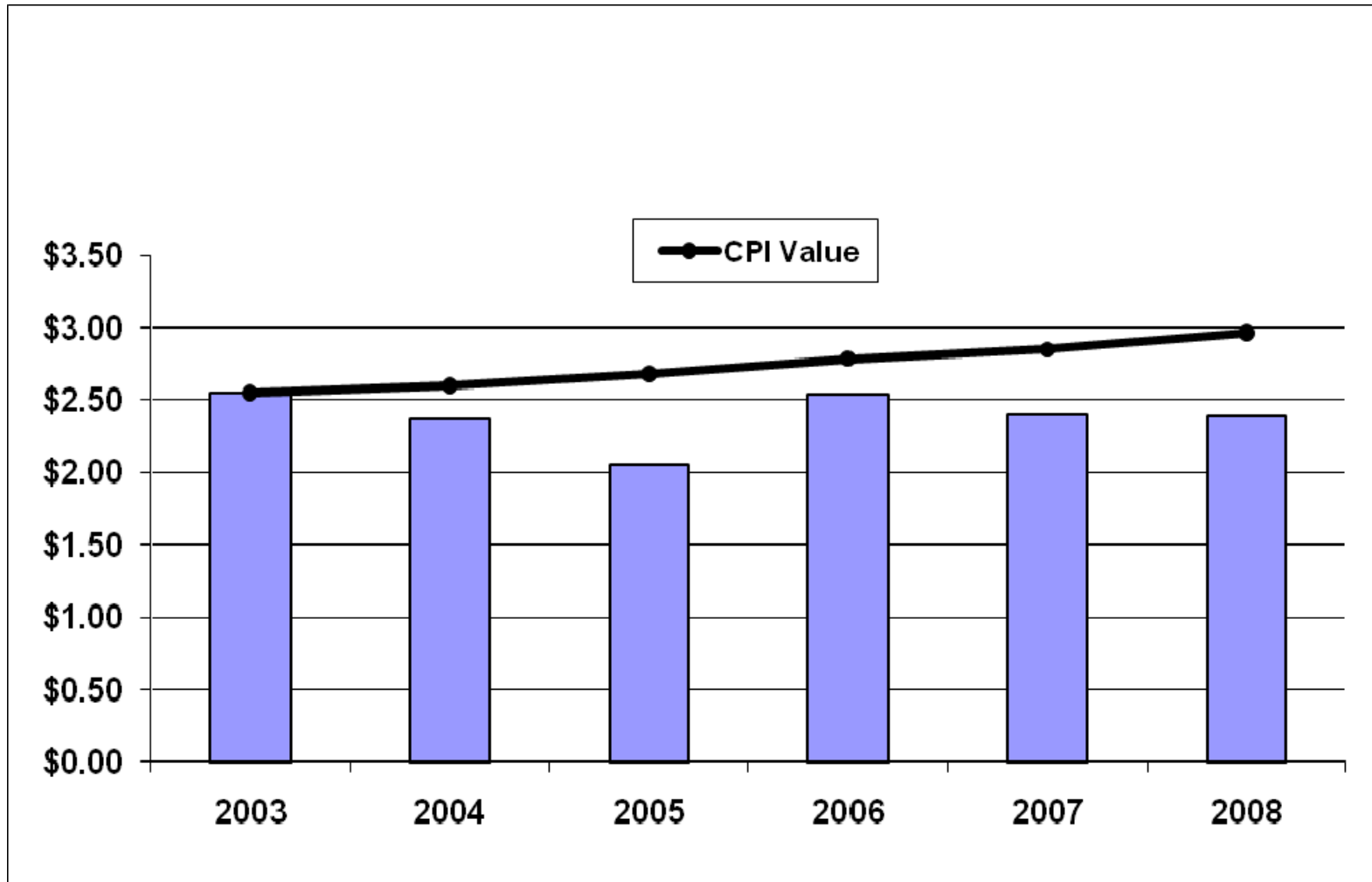


Figure 7: HRT Passenger Trip Origins for COA Study Routes

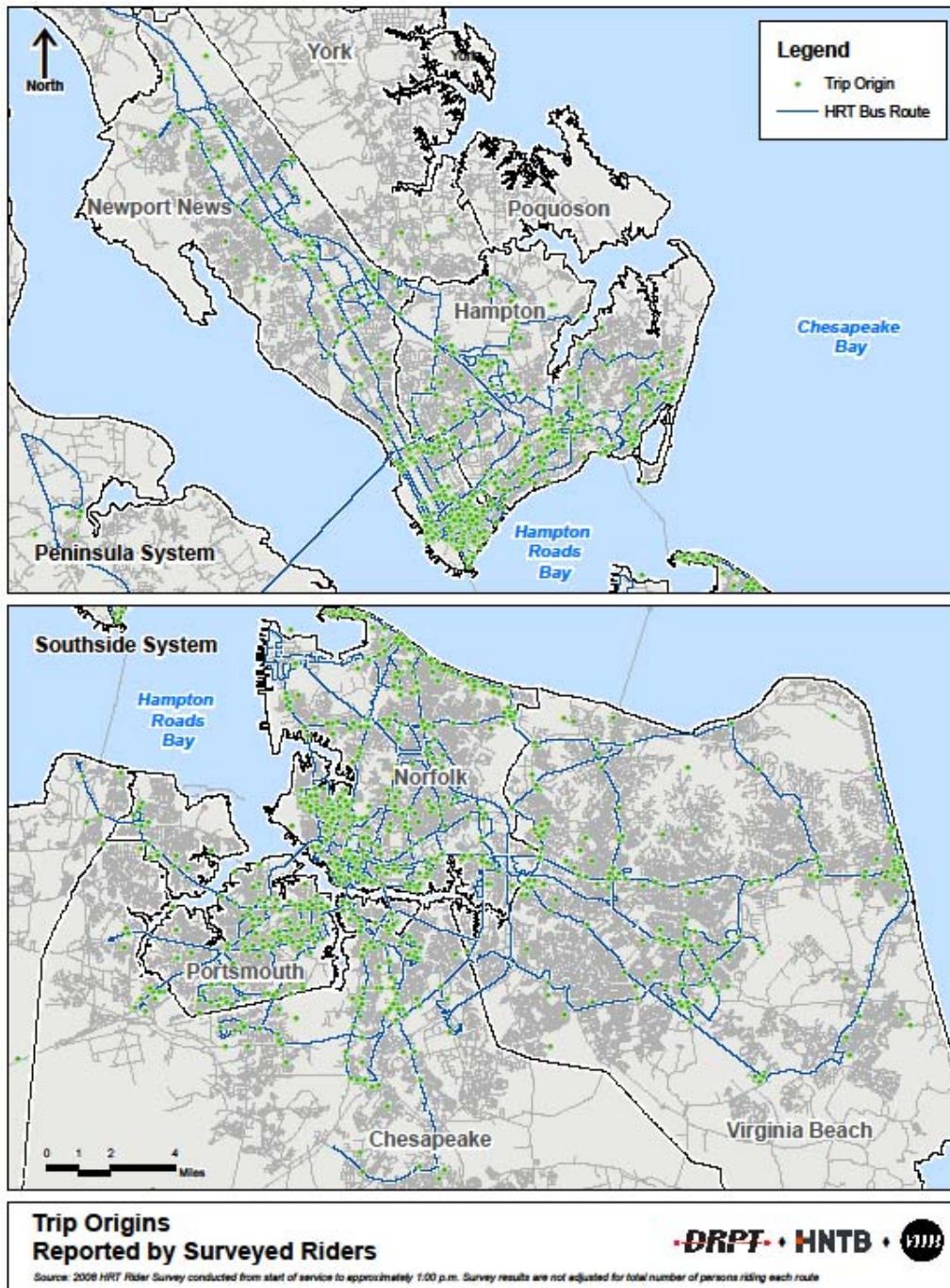
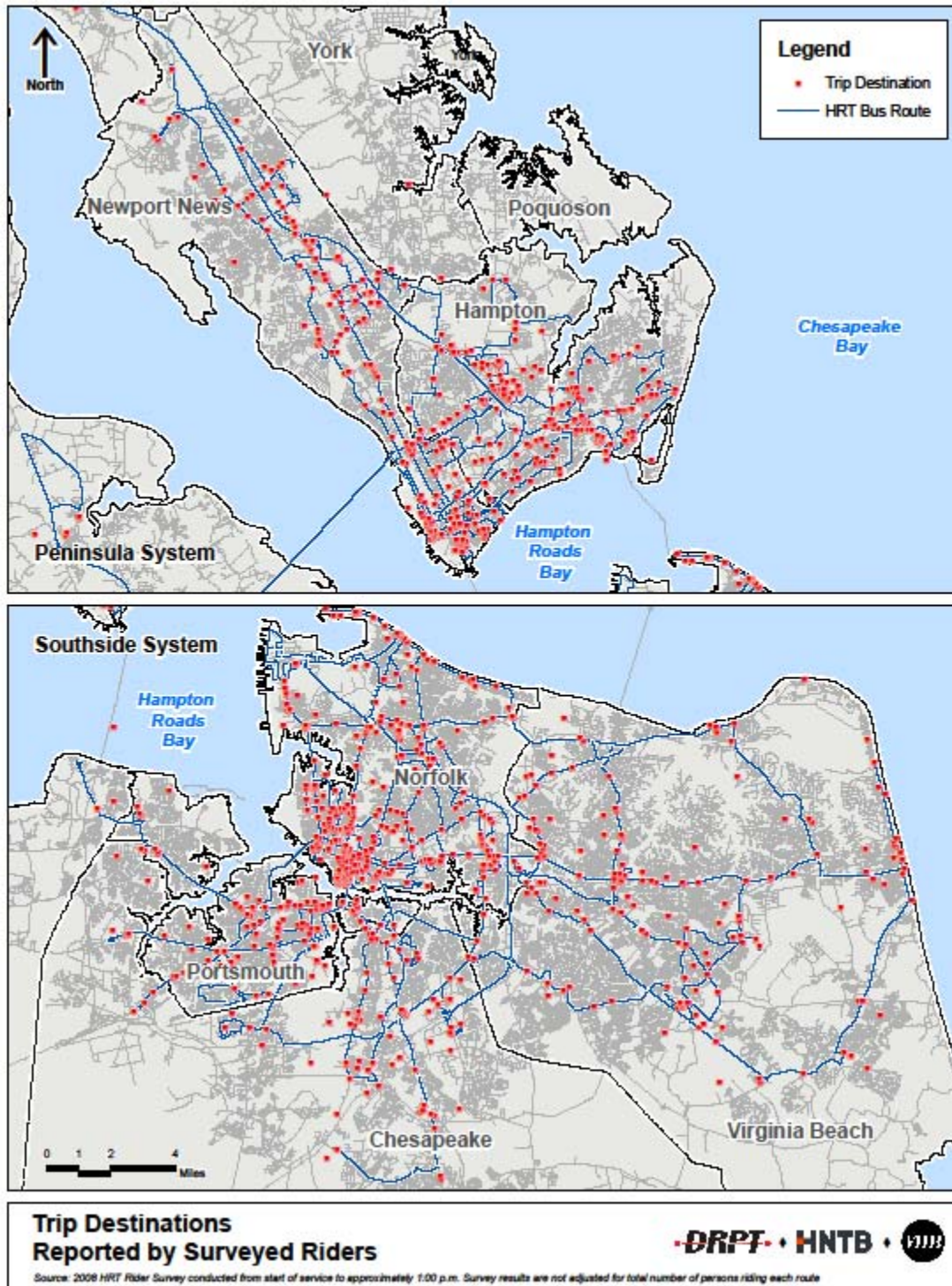
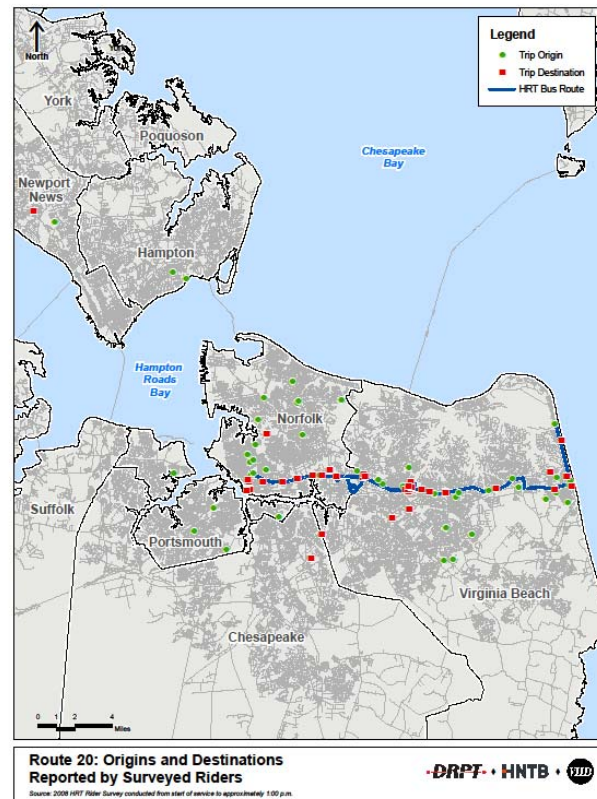


Figure 8: HRT Passenger Destinations for COA Study Routes



For each surveyed route a map illustrating the origins and destinations or riders is included in the COA report. A map of Route 20 is provided here as a sample. Route 20 provides cross-town service from Downtown Norfolk to Virginia Beach. Passengers indicated a variety of origins in the Hampton Roads area including in Newport News, Hampton, Norfolk, Portsmouth, Chesapeake, and Virginia Beach. Many of the origins do not occur along the route. In contrast, many destinations do occur along the route, particularly in Norfolk and a cluster in central Virginia Beach.



C.9. ROUTE RECOMMENDATIONS

The objectives used to develop the HRT route recommendations are:

- Avoid disruptions to riders
- Improve on-time performance
- Reduce run time
- Increase service span
- Eliminate unused route deviations
- Reduce operating cost

The following factors were examined in formulating the recommendations:

- Demographic analysis
- On-time performance
- Stakeholder interviews and comments
- Trip origin and destination maps based upon rider surveys
- Current route schedules and public timetables
- Route ridership data including surveyed on-off counts and data received from HRT
- Overall route performance

The following system-wide recommendations were developed:

- All routes serving colleges/universities should have a service span to at least 10 PM
- All fixed-routes should have a service span till at least 9 PM
- All routes should have a frequency or 30 minutes or better (at a minimum, during the peak hours)

Recommendations that pertain more specifically to a single route or a group of routes are presented in table Table 3. The implementation schedule has three time horizons for when changes should occur – First Year, Short-Term, and Long-Term. First Year changes should occur during the next fiscal year, FY10. These changes are identified for First-Year implementation because they require only minor increases in service. The majority of these recommendations are associated with service modifications designed to address on-time performance issues. The actions associated with service additions and major route changes are recommended for implementation during years 2 – 5 (Short-Term). This accounts for the majority of the remainder of the proposed recommendations. No determination was made as to what year in this time frame any of the recommendations should be implemented or how many should occur on an annual basis. It should be noted that certain recommendations must be coordinated with other changes. These changes that must be implemented concurrently are indicated by the –Group designation in the table below.

The effects of the short term recommendations include:

- Vehicles required will increase from 163 to 167
- Daily revenue hours will increase from 1646:23 to 1807:21

Long-term recommendations go beyond the five year time horizon of the COA study. These recommendations either require further analysis or would be cost intensive undertakings. Changes proposed for the Suffolk routes should occur in this time horizon because HRT just took over their operation in October 2008. Minor changes should be made to them during the next five years in an effort to improve their performance. During this time, further analysis can be conducted by HRT as additional data are developed related to operation and use of these routes. The other two long-term recommendations are associated with major service improvements. Increasing all of the study routes to 30-minute headways would be costly, involving not only operating costs, but also capital costs. This would require doubling the vehicle requirements for certain routes. Initially, it would be less costly to improve headways to 30 minutes during the peak hours. Eventually, the goal should be to provide at least 30 minute frequency on all routes throughout the HRT service span. Additionally, extending the service span to at least 9 p.m. for all routes would require increased operational costs associated with the added revenue hours.

Table 3: Recommended Service Changes

Route	Proposed Changes
1	Cut route at Amphibious Base. Southern portion will be added to Route 36.
2	No routing changes. Examine the schedule between Norfolk General and Cedar Grove (too much time currently)
3	No changes
4	Remove route segments south of Princess Anne Rd on the east side. Convert route into a one way loop that travels Princess Anne RD between Cedar Grove and Norfolk General
5	Remove segment of Route 5 that operates between Tidewater & Bayside and Wards Corner. Extend route down Tidewater to Little Creek and then east on Little Creek, serving Evelyn T. Butts transfer point
6	Revise the schedule so that Route 6 and Route 13 operate their common segments 30 minutes apart. Extend route out to Greenbrier Mall.
8	Remove segment traveling between Evelyn T. Butts and the Amphibious Base This segment is added to Route 15-A.
9	Remove Route 9 service on Widgeon and Philpotts Roads. Route 9 will terminate at Norfolk State University.
11	Reduce midday headway to 1 hour
12	No routing changes. Extend service hours until 10 p.m. to serve TCC.
13	Offset Route 13 and Route 6 schedules by 30 minutes. Extend service out to Greenbrier Mall. Terminate route at Chesapeake General Hospital.
15	Discontinue service out to Robert Hall Shopping Center. Split route into two segments at Evelyn T. Butts Transfer Center. Route 15 - A will travel between Naval Station Norfolk and the Amphibious Base and 15 - B will travel between Evelyn T. Butts and Greenbrier Mall.
18	Terminate route at Norfolk State University. Headways can be increased to 40 minutes.
20	Implement bus preemption along Virginia Beach Blvd. Connect route with Newington Station when LRT complete.
23	Eliminate route segment along Woodis Avenue and Front Street. Route will terminate at Best Square without traveling to the Riverside Corporate Center.
25	Route the Route 25 down Kempsville RD and Providence RD to provide new service. Increase service span to 10 p.m. to serve TCC.
26	Discontinue service to TCC. Reroute the route north along Rosemont, west along Bonney RD, north on Thalia RD and into Pembroke East.
27	No changes
29	Split route at the Hilltop Shopping Center. Remove service on Mill Dam RD. Discontinue routing into Hospital parking lot via Will O Wisp (install signal with pedestrian controls and crosswalk at this intersection). Service span should be increase to 10 p.m. to serve TCC.
33	No routing changes. Extend service hours until 10 p.m. to serve TCC.
36	Join removed segment of Route 1 to Route 36. Extend service until 10 p.m. to serve TCC.
41	Extend service to the Cavalier Business park during peak hours. Revise schedule to a "clock-face" schedule.
44	Eliminate the 44-Cutback. Extend the full route down Frederick BLVD to continue service to Wal-mart.
45	Add the Route 57 segment traveling outbound from the Victory Crossing Shopping Center out Airline Blvd to Route 45.

Route	Proposed Changes
47	No routing changes. Revise public timetable to account for recent addition of TCC. Extend service span until 10 p.m. to serve TCC.
50	No changes
57	Remove segment traveling outbound from Victory Crossing Shopping Center out Airline BLVD. Extend service to Greenbrier Mall.
58	Eliminate service on Campostella RD between Great Bridge and Battlefield to the Robert Hall Shopping Center. Extend service down Dominion BLVD, left onto Grassfield PKWY, left onto Cahoon PKWY, right onto Cedar RD, left onto Battlefield BLVD and terminate at Chesapeake General Hospital. Extend service span until 10 p.m. to serve TCC.
64	No changes
71	Route would operate between Downtown and Hilltop RD.
72	Route would operate along Washington ST between Paul D Camp Community College and the Magnolia Park-n-Ride.
73	Routes would be converted to demand responsive service that pick up passengers and carry them into bus plaza to connect with Routes 71 & 72.
74	
101	No changes
102	No changes
103	No changes
104	No changes
105	Extend service to the Sentara Careplace.
106	Terminate route at the Park-n-Ride located near Old Courthouse & Warwick.
107	Terminate route at Patrick Henry Mall.
109	Eliminate
110	No changes
111	Route 111 will provide service in both directions to the Newport News/Williamsburg International Airport.
112	Cut route at Thimble Shoals BLVD and Jefferson AVE. This would discontinue service to Riverside Hospital and Christopher Newport University.
114	Discontinue inbound loop to enter NET Center, by turning left at Marshall DR. Eliminate service along Power Plant PKWY and instead turn left on Aberdeen RD. Remove service along Armistead AVE, and reroute down Mercury BLVD.
115	Combine Route 115 and Route 120 with minor routing changes to cover loss of Route 109. The routes would operate trips in opposite directions, offset to increase service availability.
116	Route 116 will be split into two routes. Route 16 - A will travel along Jefferson Avenue out to the Oakland Industrial Park and terminate at Lee Hall Industrial Park before returning to Patrick Henry Mall using the same route. Route 16 - B would travel to the Wal-Mart down Bland Boulevard and Warwick Boulevard, making a stop in the Cobblestone at Lees Mill before going into Fort Eustis and returning using the same route.
117	Increase headway from 1 hour to 30 minutes.
118	Operate Gateway BLVD loop as on-call service. Shorten trip within Langley Research Park by cutting across park at Research DR.
119	Extend route down J. Clyde Morris BLVD to serve Riverside Hospital and Christopher Newport University. Extend service span to 10 p.m. for CNU.

Route	Proposed Changes
120	See changes proposed for Route 115
121	No changes
GRN (5)	New service will operate demand response service south of Greenbrier Mall.
LUC	Neighborhood circulator providing service to residential areas west of Warwick BLVD and connecting to Patrick Henry Mall.

The Route 4 maps below are an example of the individual route maps in the COA to show recommended changes. Route 4 currently performs poorly, and as a result, the portion below Princess Anne Road on the eastern side of the route is proposed for elimination based on its weak ridership. Route 4 is also proposed to be converted to a one-way loop. This change will dramatically impact the revenue hours and vehicle requirement for the route. Revenue hours would decrease from 25 hours and 2 minutes to 15 hours. The number of vehicles required to operate the route would decrease from two to one. These changes will also mean impacts to the customer. Service will be cut along Wood Street, Monticello Avenue, and Church Street, and south of Princess Anne Boulevard. The conversion of the route to a one-way loop will reduce service frequency as well as potentially require customers to ride the route longer in order to return to their destination. However, the reduced costs of operation would improve the performance of this route relative to other HRT services.

Figure 9: Recommendations

Route 4 Existing

Route 4 Proposed



C.10. RECOMMENDED NEW SERVICES

This service evaluation yielded recommendations for new services that could be offered by HRT. These recommendations resulted from analysis of service gaps based on a transit-needs analysis using demographics and comments from the stakeholders.

- Greenbrier Connector – This service would be a demand response service that would provide public transportation to areas south of Greenbrier Mall. There were comments that requested service around Kempsville Road and Great Bridge Road south of Interstate 64. This service would bring riders up to Greenbrier Mall, where they could then access the larger HRT system. Service would operate 7 a.m. to 7 p.m. and require the use of one vehicle, preferably a cutaway.
- Lucas Creek Connector – This route would operate as a neighborhood circulator, serving the area west of Warwick Boulevard. The connector would provide transfer options to routes traveling Warwick Boulevard and Patrick Henry Mall. The route would travel down Oyster Point Road, right onto Warwick Boulevard, left onto Menchville Road, right onto Youngs Road, right onto Lucas Creek Road, right onto Denbigh Boulevard and then return to the mall. Service would be provided from 7 a.m. to 7 p.m. and require the use of one vehicle, preferably a cutaway.
- Greenbrier Circulator – This service would differ from the proposed demand response service in the Greenbrier area, serving as a connection between major points of interest and employment centers in the Greenbrier development. This route would be similar to the NET service in Downtown Norfolk. Fares for riding this circulator should be greatly reduced or free. The target audience would be visitors and workers, as Greenbrier has been flagged as a major destination for employment, shopping, and entertainment.
- Birdneck Circulator – This circulator is proposed for the area between Laskin Road, I-264, Little Neck Creek, and Great Neck Creek. This area was identified as an area in Virginia Beach with a concentration of non-drivers not within a mile of an HRT bus stop. This circulator would connect this area, which lies between existing HRT routes, while providing connections to the Pacific & 19th Transit Center and shopping destinations at Hilltop.

C.11. Amenities Recommendations

Passenger amenities, such as benches and shelters, enhance the physical environment of a bus stop by offering a comfortable location for waiting passengers to sit. A bus shelter also offers the added comfort of protecting passengers from the weather. While every passenger would like to have amenities like these at each bus stop they use, it is impractical to install a shelter or bench at every bus stop location. The cost of this action would be prohibitive.

For the purpose of this study, a passenger threshold of 25 boardings per day was used to warrant having a bench installed and 50 boardings per day was used to warrant having a shelter installed. As a complete inventory of currently available shelters and benches does not exist, the COA may include stops where amenities have already been installed. The study concluded that 71 stops had more than 50 boardings a day and would warrant a shelter;

180 stops had more than 25 boardings a day and would not warrant a bench. Because a location has been identified as meeting the threshold for a bench or shelter does not mean that one should be installed; further work is required to survey the location to determine the feasibility of installation.

C.12. TRANSFER CENTER RECOMMENDATIONS

The Hampton Roads Transit bus system comprises over 60 interlaced routes covering nine jurisdictions in the Hampton Roads area: Chesapeake City, Hampton City, Isle of Wight County, Newport News City, Norfolk City, Portsmouth City, Suffolk City, Virginia Beach City, and Williamsburg City. Since Hampton Roads is a diverse region with many nodes of activity spread over a large geographical area, the HRT bus network must be capable of accommodating travel between any two points in the service area. The HRT system offers the most complete service coverage in the densely populated and more developed urban core of the region—Hampton City, Newport News City, Norfolk City, Portsmouth City—where routes crisscross one another and provide the greatest mobility for riders. Outside of this area, less extensive service connects popular destinations via major corridors. All of these routes are linked together through a series of 43 transfer centers, where timed transfers are scheduled to improve the convenience of transferring between routes. The design of the HRT bus network—a spider web of routes linked together through transfer centers—allows HRT to efficiently operate the system while enabling riders to access destinations in all corners of the HRT service area.

The route modifications suggested in the COA led to a recommendation regarding the Robert Hall Boulevard Shopping Center Transfer Center. To improve system operations and access for riders, it was recommended that HRT relocate this transfer center to Greenbrier Mall, located just east of the current transfer center location. Bus service to the Robert Hall Shopping Center would be retained. Discussed in detail in the COA, the relocation of the transfer center from the Robert Hall Boulevard Shopping Center to the Greenbrier Mall has several advantages from both operational and passenger perspectives..

Finally, the Cedar Grove Transfer Center does not serve riders well in its current location. Further studies should be conducted to determine alternative locations for this transfer center.

C.13. TRANSFER ANALYSIS

Rider transfer patterns were identified using data collected during the on-board rider survey. Once the survey results were factored, the responses were aggregated to provide an estimate of the number of daily transfers made between route pairs. The most common route pairs were then mapped together to aid visual analysis of the potential to combine or alter the routes to eliminate the need for transferring.

Trips requiring transfers account for a significant portion of all trips made on the HRT bus system. For the survey period, the 52 routes included in the survey had an estimated 32,714 daily linked trips, which is a full trip made from an origin to destination regardless of transfers. Analysis of the findings show that: 31.0 percent of trips required one transfer, 6.2 percent of trips required two transfers, and 0.9 percent of trips required three transfers. The majority of HRT bus trips were made directly without a transfer (61.9 percent).

Figure 10: Breakdown of HRT Transfer Activity

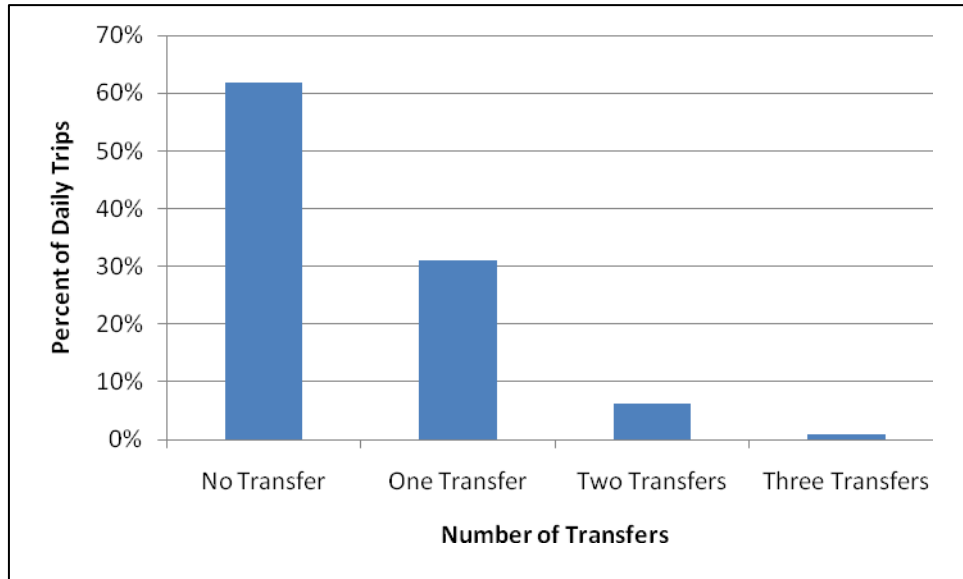


Table 4 shows the top 20 route pairs between which riders transferred. The number of estimated daily transfers between route pairs ranges from approximately 158 to 608. Routes 15 and 20 are by far the most popular pair for transferring riders, accounting for 4.5 percent of all transfers made on the system, nearly double the next most commonly used route pair (Routes 1 and 8). In the list of top 20 transfer pairs below, Routes 1, 15, and 20 appear in the most route pairs, reflecting the high levels of ridership on these routes. The frequency of these routes demonstrates that there are a few major bus routes that move large numbers of people through the service area, which riders frequently pair with lower-ridership routes serving specific areas with less demand. Each of the route pairs identified offer potential opportunities to make service alterations that would reduce the need for riders to transfer to complete their trip. Although eliminating the need to transfer between the identified routes would certainly benefit some riders, there is not always an easy solution for making such a service alteration. In many cases, serving the needs of these transferring riders by significantly altering routes may have an adverse effect on a much larger segment of the riding population. It is therefore necessary to find a balance between maintaining consistency in the existing system operations with reducing the need for transfers.

Table 4: Top 20 Route Transfer Pairs

Route Transfer Pair		Factored Survey Results		
		Transfers	Percent	Rank
15	20	608.3	4.5%	1
1	8	294.1	2.2%	2
20	45	282.6	2.1%	3
8	15	243.5	1.8%	4
101	106	230.5	1.7%	5
1	15	219.8	1.6%	6
111	112	218.1	1.6%	7
3	15	215.7	1.6%	8
20	33	212.9	1.6%	9
2	15	211.6	1.5%	10
13	15	202.7	1.5%	11
106	112	201.6	1.5%	12
20	29	192.8	1.4%	13
15	23	183.6	1.3%	14
1	3	181.0	1.3%	15
111	116	180.1	1.3%	16
1	29	176.7	1.3%	17
1	45	161.0	1.2%	18
101	112	158.3	1.2%	19
3	8	158.0	1.2%	20

C.14. EXPANSION OF HRT SERVICES

The COA discusses enhancing current and implementing new bus service, as well as service expansion to additional geographic markets. Highlights of new service include two circulators. The proposed Greenbrier Circulator would differ from the proposed demand response service in the Greenbrier area, serving as a connection between major points of interest and employment centers in the Greenbrier development. This route would be similar to the NET service in Downtown Norfolk. Fares for riding this circulator should be greatly reduced or free. The target audience would be visitors and workers, as Greenbrier has been flagged as a major destination for employment, shopping, and entertainment. The further development of this area will contribute to this identified need. The addition of Greenbrier Mall as a transit center for HRT highlights the importance of Greenbrier in the greater transit network, and will allow for connections from this circulator to the region. The proposed Birdneck circulator would serve the area between Laskin Road, I-264, Little Neck Creek, and Great Neck Creek. This area was identified in HRTPO's *The Location of Non-Drivers in Hampton Roads* as an area in Virginia Beach with a concentration of non-drivers not within a mile of an HRT bus stop. This circulator would connect this area, which lies between existing HRT routes, while providing connections to the Pacific & 19th Transit Center and shopping destinations at Hilltop.

These circulators are in addition to the Greenbrier Connector and the Lucas Creek Connector. The Greenbrier Connector would provide a demand response service to individuals living and working around the Greenbrier Area. This area was highlighted in the demographic analysis as an area that showed some need for transit that currently was not being served. A demand response service was proposed because the demographic indicators showed levels that would not currently support fixed route service. This connector would

bring people to the new Greenbrier Mall Transfer Center where they could then connect with the larger HRT system. As ridership grows, this route could be transitioned to a fixed route.

The Lucas Creek Connector is a new fixed route service that would fill the gap in service coverage south and west of Warwick Boulevard in Newport News. This is another area that was highlighted in the demographic analysis as having individuals who have transit needs. The service would provide connections to the larger system along Warwick Boulevard and at Patrick Henry Mall. Due to the operating environment and projected ridership levels, this route should be served by a cutaway van and does not require a traditional city bus.

Highlights of enhancing existing service include frequency improvements and service span increases. The COA documents routes that are currently performing well and can be considered for improvements in service frequency. Short-term recommendations include extending the service span for university and college routes to 10 PM. Long-term recommendations include extending all service to at least 9 PM and increasing frequencies to 30 minutes.

While this Comprehensive Operations Analysis was being conducted, a Vision Plan was also being completed that sought to identify long term recommendations for expansion and addition of HRT services. That plan analyzed current (2000) and future (2034) regional demographic data to determine areas of future growth that could support expanded transit service. This expansion applies not only to areas that currently do not receive transit service from HRT, but also expansion of services within the existing system. The plan details geographic expansion of the HRT service area recommendations, as well as identifies corridors for future study of light rail, BRT and commuter rail service.

C.15. COSTS AND REVENUES

The COA has a detailed financial plan which includes operating costs, capital costs, revenue trends and revenue projections. The table shows HRT’s current operating and maintenance costs for the routes studied in the COA, and the costs that would be incurred if the COA recommendations are implemented.

Table 5: Operating Costs – Current and Proposed - for studied HRT services

Service Plan	Annual Operating Cost (Millions of 2008\$)
Current	\$38.3
Current Plus COA Route Recommendations	\$41.7
Current Plus COA Recommendations plus all services to 9 P.M	\$42.9
Current Plus COA Recommendations plus all services to 9 P.M plus half hour frequency	\$53.7

Based on the COA’s historical funding analysis, the table below summarizes funding sources for FY04 and FY08. In addition, the table documents FY14 funding projections by source.

Table 6: Historic and Projected Funding

	FY04	FY08	FY14
Operating Costs	\$50,225,060	\$72,070,343	\$86,868,645
Fares Collected	\$13,780,550	\$14,609,180	\$16,198,442
State Formula	\$10,112,578	\$11,135,500	\$13,262,725
Federal Assistance	\$15,012,329	\$17,082,896	\$19,716,900
Other Fare Revenue	\$663,463	\$1,186,941	\$2,102,738
Other Funds	\$1,099,271	\$547,417	\$1,133,160
Local Government			
Operating	\$10,000,445	\$22,515,748	\$ 34,454,679
Capital	\$1,425,773	\$1,522,952	\$1,374,000

FY 04 and FY 08 values in current year dollars

FY 14 estimates in 2008 dollars

D. CONCLUSION

The HRT COA study began with an extensive effort to collect data, including but not limited to stakeholders interviews, on-board surveys, ridership counts, on-time performance at key locations, and demographics. Cost, trend, transfer and origin-destination analyses were conducted to evaluate the performance of each route, as well as the overall system. Recommendations were developed for the short-term, mid-term and long-term, including amenities, transfer centers, fleet, agency organization, current service, new service, and service expansion. Finally, capital and operating costs were developed, as well as funding projections by source.

HRT is the largest transit provider in the state of Virginia, serving a population of almost 1.4 million people in a service area of approximately 527 square miles which includes seven different jurisdictions. This study revealed how integral HRT is in these communities. The COA recommendations will enable HRT to use its existing resources as efficiently as possible in order to provide a high quality bus service. The agency has tremendous opportunities to increase transit use in the region by providing a bus service which attracts both transit dependent and choice riders due to its efficiency, as well as its connections to future services such as light rail and commuter rail.