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1.0 Introduction

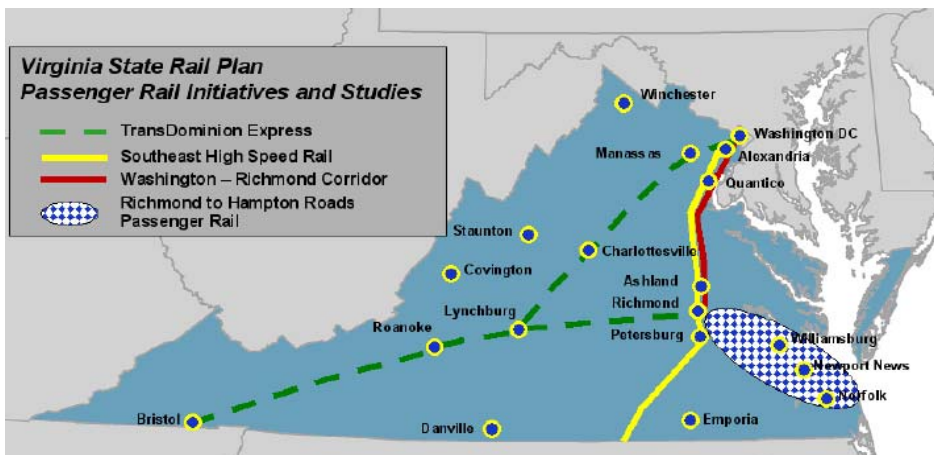
The Virginia Department of Rail and Public Transit (DRPT) contacted Amtrak in May 2007 to begin discussions on a cooperative effort to develop a strategic plan identifying promising markets and routes which could lead to the implementation of enhanced intercity passenger rail services within the Commonwealth of Virginia.

The request was based on the recognition by the DRPT that continued public investment in passenger rail services is a key ingredient in the Commonwealth's comprehensive transportation network, and must be done wisely to maximize benefits for residents and visitors of the state, as well as to enhance freight rail capacity. Figure 1 depicts various passenger rail initiatives and studies being evaluated by DRPT.

Amtrak has agreed to provide the DRPT with a series of reports in two parts including both a long term and short term action plan. The Short-Term Action Plan discussed in this report identifies potential markets and service schedules that can be implemented in a short time frame and with minimal cost and also provides initial details regarding operating plans, expenses and equipment capital costs associated with the two recommended service options proposed for implementation in the near term. The Long Term Action Plan will be a collaborative state-wide rail passenger plan providing a vision and constructive guidance for future state investments in intercity, commuter and state services.

As part of its nationwide commitment to help advance the development of intercity passenger rail services, Amtrak is providing this evaluation of the short-term options and cost requirements (Short Term Action Plan) on a pro-bono basis using existing internal resources. To advance a fully-developed long-term plan, a supplemental resource will need to be identified.

Figure 1. Virginia State Rail Plan Map



1.0 Deliverables

- **Short Term Action Plan**

The Short Term Action Plan, as requested by the Commonwealth of Virginia, includes a high-level description of passenger rail service options that can be implemented within a two to six year time frame (to coincide with the state's 6-year improvement program funding cycle). It assumes agreement by the host railroads and minimal to moderate infrastructure investment. Included is a review of corridor development opportunities, which, based on Amtrak's experience, may serve as a basis for choosing future corridor services important to the Commonwealth. Also included is an initial estimate of required operating support for the two recommended service options, as well as estimated capital requirements to refurbish necessary equipment.

- **Short Term Action Plan - Infrastructure Requirements**

A detailed infrastructure investment plan can only be developed with host railroad participation and/or management of same (i.e., the CSX A-Line capacity study or the NS study from Richmond to Bristol). Depending on the goals of the project, specific route conditions and the existence or absence of prior modeling efforts, such studies can be complex and may require longer time frames. This report provides a preliminary detailed estimate of operating costs, revenue and ridership projections, likely capital costs such as rolling stock and costs associated with facilities for equipment and crew support, start-up costs such as crew training and qualifications, and potential timelines.

- **Long Term Action Plan**

The Long Term Action Plan will develop a comprehensive state rail plan and strategy for Virginia's future passenger rail transportation needs. Future development of the Long-Term Action Plan will require a fully-executed funding agreement between Amtrak and the Virginia DRPT to cover necessary expenses associated with engineering, modeling and other work necessary to produce the report.

The Long Term Action plan will include scenarios spanning 2010 to 2035 (to coincide with the state's long range planning horizon for its multi-modal transportation system plan), and work that is currently underway as well as outlining steps to maximize available funding to ensure optimization of resources.

The document will provide the Commonwealth with an action plan that ensures coordination with the future *South East High Speed Rail* network and other infrastructure and passenger rail initiatives on the East Coast.

The Long Term Action plan will set the framework to cooperatively improve existing infrastructure, passenger rail service and associated multi-modal links and serve as the basis for adding frequencies and services in the future.

3.0 Why Advance Passenger Rail Service in Virginia?

For nearly two centuries, the railroad has been part of Virginia's and the Nation's heritage and history. Trains enabled the development of our great inland cities and the settlement of our rural areas, and they opened up the West. But trains are not just part of our past; they are a significant part of our present and a critical part of our future for effective passenger and freight rail movements.

On a local level, passenger rail is a tried and true engine of economic development and growth. Studies show (see Addendum I, Public Benefits) that when passenger rail service is introduced into a community, retail establishments flourish, commercial and residential property values increase and people feel better about where they live and the transportation choices they are able to make in their daily lives.

On a regional level, passenger trains provide sensible and convenient intermodal connections between communities and other modal choices, such as bus, trolley, light rail, bicycle, airport and park and ride facilities, and expand economic development opportunities.

On a national level, passenger trains provide an economic means of expanding capacity, transportation options and connectivity, mobility for underserved populations, congestion mitigation, and jobs — not just in the railroad industry — but in its ancillary support industries which enable and stimulate economic development activity.

On a global level, passenger rail conserves energy, helps reduce greenhouse gas emissions reduces airborne particulate and toxic emissions, and provides an environmentally benign land use alternative to impermeable asphalt surfaces that contribute to the pollution of our waterways.

Any reliable, safe, on-time and sensible passenger rail transportation network must be cost effective and competitive with alternative modes. With limited and often competing resources proposed service scenarios must be carefully evaluated. Not every public benefit characteristic is as important to one region as it may be to another, but each service scenario will generally address one or more of the public benefit categories described in Addendum I - Public Benefits.

4.0 Overview of Current Passenger Rail Service in Virginia

Virginia is served by the two major east coast based Class I host railways, Norfolk Southern and CSX Transportation. These host railways primarily focus on freight movements. Until recently, both carriers' corporate headquarters were located in Virginia until CSX relocated theirs from Richmond to Jacksonville, FL. Two passenger rail operations, Virginia Railway Express (VRE) and Amtrak, currently operate on approximately 616 miles of track in Virginia. In 2006, Amtrak operated 20 daily intercity trains in the Commonwealth with 902,986 passengers either boarding or alighting within Virginia. On average, VRE's 32 daily trains provide ridership to over 15,000 passengers daily on its 89-mile route system. Additionally, Amtrak estimates that of the 3.7 million Amtrak passengers who annually use Washington D.C.'s Union Station, well over 1 million reside in Virginia.

Amtrak, under contract to VRE, operates commuter passenger trains on an 89-mile system connecting Washington, D.C., with Fredericksburg and Manassas, Virginia. From Union Station in the District of Columbia, the Fredericksburg and Manassas routes share the same rail line for approximately 9.6 miles, to a point just south of Alexandria, VA where they diverge. In Virginia, VRE utilizes the Norfolk Southern rail line to Manassas and the CSX rail line to Fredericksburg.

Amtrak's Northeast Corridor (NEC) Regional service operates from Boston, MA, to Richmond/Newport News, VA. Within Virginia, Regional service operates over 184 miles, and includes stops at Alexandria, Franconia/Springfield, Woodbridge, Quantico, Fredericksburg, Ashland, Richmond, Williamsburg and Newport News. In addition, Amtrak's long distance trains and the North Carolina funded *Carolinian* service from the Northeast through Washington D.C. serve many communities in Virginia, as well as those of many southern states to final destinations such as Charlotte, NC, Savannah, GA, Miami, FL, New Orleans, LA.

5.0 Short Term Action Plan

For the purpose of developing the Short Term Action Plan, Amtrak relied, in part, on previously conducted studies and the guidance of DRPT officials and Amtrak's experience with regard to market demand to utilize potentially available capacity among the host railroads.

To develop estimated operating subsidy requirements, Amtrak modeled the operation of the recommended service to both Newport News and Lynchburg for ridership and revenue as well as projected operating costs. While we believe the results of this analysis provide an accurate estimate of anticipated performance, many operating variables are still yet to be determined. As such, financial estimates must be updated prior to initiating new service in order to reflect updated host railroad expenses, as well as other expenses such as fuel that are likely to change prior to implementation.

6.0 Service Expansion Options

In its review and subsequent analysis of service expansion options, Amtrak was cognizant of the need to implement service with minimal capital outlay, lower operating cost through leveraging existing efficiencies, and the desire to implement service in a short timeframe. The various short term expansion options evaluated in this study are summarized in the table below. The key evaluation criteria for potential short term action included:

- Serves established markets with large population, tourism and/or business travel, or commuter demand.
- Lower operating costs and takes advantage of existing operating efficiencies - such as utilizing an existing slot on the Northeast Corridor (NEC).
- Minimal capital investment (based on Amtrak's experience and knowledge of the host railroad's infrastructure) pertaining to equipment, infrastructure and station facilities
- Ability to implement service in a short time frame (avoids institutional, environmental and contractual constraints)

Table 1. Service Expansion Options

Market (Host RR)	Service Goals	Analysis	Implementation Requirements / Effects	Concerns / Actions
Newport News to Washington (CSX)	Enhance service along Washington - Richmond Corridor to Main St. Station and Hampton Roads.	Adds service on corridor currently with the largest ridership base in state. Added service to Main St. Station. Connects two densely populated corridors. Provides additional modal choice along two congested highway corridors.	Route already hosts passenger trains. Stations and yard / service facilities are largely in place. Expected to have favorable operating characteristics.	Added service may require substantial new infrastructure investment prior to operation, particularly between Acca Yard and Richmond Airport area, due to high rail traffic volumes.
Lynchburg to Washington (NS)	Introduce Corridor Service to a region which currently has only limited long distance train service	Brings Corridor Service to a rapidly growing region in the state without a north/south interstate highway. Provides additional seat capacity on route segment that frequently sells out.	Current NS railroad infrastructure in excellent condition. Route already hosts long distance trains and has stations in place. Expected to have favorable operating characteristics.	While the route appears to have capability to add service, NS must ultimately make this determination. Potential overnight layover track must be approved by NS and Lynchburg.

Advancing Passenger Rail in the Commonwealth of Virginia Short-Term Action Plan

Market (Host RR)	Service Goals	Analysis	Implementation Requirements / Effects	Concerns / Actions
Roanoke to Washington (NS)	Extend Corridor Service to a region which currently has no train service	Brings Corridor Service to a rapidly growing region. Roanoke considered attractive new major destination. Adds a new segment of the Trans Dominion Express.	Current NS railroad infrastructure in excellent condition. Historic train service along route very competitive to auto travel. Expected to have favorable operating characteristics.	Heavy freight traffic along key NS route will require approval by NS. Determining acceptable route and infrastructure requirements through Lynchburg is a critical component. Several station locations appear to be well situated, but must be approved.
Roanoke to Washington via Buckingham Branch (CSX/BBR)	Extend Corridor Service to a region which currently has no train service via alternate route	Brings Corridor Service to a rapidly growing region in the state. Roanoke considered an attractive new major destination. Utilizes less heavily trafficked routes.	Portion of route already hosts passenger trains. Some stations are in place. Expected to have reasonable operating characteristics. Requires construction of a new layover facility, and potential improved connections at Waynesboro.	Route slower than alternative and would skip Lynchburg altogether. While appearing capable of operating a passenger service, no discussions with NS and Buckingham Branch RR are known. Quick implementation is problematic.
Richmond Main Street to Washington (CSX)	Enhance service between Washington and Main St. Station	Adds service on corridor currently with largest ridership base in state. Added service to Main St. Station. Provides additional modal choice along two congested highway corridors.	Portion of route already hosts passenger trains. CSX likely to require additional infrastructure before accepting additional service. Expected to have reasonable operating characteristics.	Early implementation likely to face significant resistance from CSX due to high rail traffic volumes at Richmond. Construction of a Main St. Station layover yard is problematic, as is a reverse movement to Staples Mill Station for layover
Richmond Staples Mill to Washington (CSX)	Enhance service between Washington and Staples Mill Station	Adds service on corridor currently with largest ridership base in state	Route already hosts passenger trains. Stations are in place. Requires expansion of new layover facilities.	Lack of layover space and less clear market goals support deferral of this alternative.
Trans Dominion Express Bristol to Richmond / Washington (NS)	Introduce service between Bristol and Richmond / Washington	Brings Corridor Service to many communities within the state with no current service. Establishes an east / west service connecting communities to Richmond. Projects must be developed in segments of independent utility based on ridership demands.	Nearly the entire route is freight only, with few station facilities and no layover / servicing points. Portion of a previously evaluated route through Farmville has been abandoned by NS. Expected to incur substantial operating costs. Phased implementation will be required to extend the service southwestward in the future from Lynchburg to Roanoke and other Virginia locations based on independent utility	While NS infrastructure is in excellent condition (except for abandoned portions), expected extended analysis and negotiations with freight railroad over access and infrastructure investments will likely prevent quick implementation. Based on previous studies, this extension would require significantly higher subsidies to implement.



7.0 Recommended Service Options

In reviewing the range of service options, only two potential services stand out as short term action opportunities for near term enhanced passenger rail service in Virginia. These two options are the:

- Newport News to Washington D.C.
- Lynchburg to Washington D.C.

These two options are discussed in detail below, as well as an option that combines both services into a single project. The other service expansion options noted in Table 1 are better suited to future consideration and will be included in Long Term Action planning effort.

It must be noted that if the Commonwealth chooses to implement both Newport News and Lynchburg options concurrently, additional equipment and possible schedule modifications will be necessary.

7.1 Newport News to Washington D.C.

This service expansion would provide passenger trains from Washington D.C. to Richmond - continuing to Newport News. This service is an attractive short term action option and offers the following benefits:

- Utilizes existing equipment (if operated without the Lynchburg service).
- Utilizes an existing NEC slot (with nearly 2,000 trains per day running on the NEC, operating slots are limited and service between New York and Washington must be carefully designed. Using an existing slot offers many advantages in avoiding rescheduling of multiple operators).
- Utilizes existing servicing and layover facilities.
- Efficient utilization of Amtrak's operating and service employees, including the ability to adjust crew assignments.
- Minimal impact to station staffing.
- Established client base (Newport News to/from northeast markets).
- Serves multiple regions in the state (Tidewater, Central and Northern Virginia).
- Utilizes DRPT funded investments in the Washington to Richmond Corridor.
- Serves largest population base in the Commonwealth.

7.1.1 Existing Corridor Conditions

Washington, D.C. to Richmond is the most densely populated transportation corridor in the Commonwealth. Interstate I-95 is at, or over, capacity. Additional rail service from Washington, D.C. to Richmond, VA would provide a competitive trip time and modal choice option, dampen the rate of highway traffic increases and may result in an overall reduction in highway miles traveled on I-95, and would also address the Commonwealth’s desire to augment frequencies to Richmond’s Main Street Station.

7.1.2 Proposed Service Description

The proposed additional service from Washington, D.C. to Richmond continuing to Newport News, would utilize an existing passenger trainset that currently terminates and overnights in Washington. The next morning the trainset becomes a northbound Amtrak Regional train to Boston, MA.

The proposed train schedule is shown in Table 2, and would extend service from Washington, D.C. departing at 4:35 p.m. (Monday through Friday) and would depart Washington at 4:00 p.m. on Saturday and Sunday. The train would make the regular station stops at Alexandria, Woodbridge, Quantico, Fredericksburg, Ashland, Staples Mill, and Main Street and continue to Williamsburg and Newport News, where it would layover for servicing. The train would begin its northbound journey at Newport News the next morning at 6:45 a.m., stopping at the same stations and arriving in Washington at 11:00 a.m.

Table 2. Newport News to Washington D.C. – Proposed Daily Schedule

	147/157	171		◀ Train Number ▶		184	488	
	Sa-Su	Mo-Fr		◀ Days of Operation ▶		Mo-Fr	Sa-Su	
	12 05P	12 35P	Dp	New York, NY	Ar	2 49P	2 43P	
	3 25P	4 10P	Ar	Washington, DC	Dp	11 30A	11 25A	
	4 00P	4 35P	Dp		Ar	11 00A	11 00A	
	TBD	TBD		Alexandria, VA		TBD	TBD	
	TBD	TBD		Fredericksburg, VA		TBD	TBD	
	TBD	TBD		Ashland, VA		TBD	TBD	
	6 15P	6 50P		Richmond, VA (Staples Mill Road)		8 35A	8 35A	
	6 42P	7 12P		Richmond, VA (Main Street Station)		8 02A	8 02A	
	TBD	TBD		Williamsburg, VA		TBD	TBD	
	8 20P	8 50P	Ar	Newport News, VA	Dp	6 45A	6 45A	

TBD (To Be Determined): These stations are listed for continuity purposes only. Additional station stops (if any) will be determined in the Short Term Action Plan, Part II.]



7.1.3 Equipment and Crews

The proposed alternative utilizes existing equipment with a service trainset configuration consisting of four passenger cars, one food service car and a diesel locomotive. The service extension to Newport News would eliminate the need for push-pull capability requiring either a cab car (a passenger car with an operating cab on one end that is used to control a train in the "push" mode, with the locomotive on the opposite end) or a second locomotive. This is significant due to three major considerations:

- Spare cab cars are presently not available in the Amtrak fleet;
- An additional locomotive is prohibitively inefficient due to additional fuel, maintenance costs and equipment carrying charges; and
- The capability to turn or store equipment terminating at Main Street station does not exist without creating significant impact to CSX operations in the greater Acca Yard area or requiring a substantial capital investment to construct acceptable layover facilities.

The use of available equipment and an existing location will enable the implementation of the proposed service (from an Amtrak operating perspective) with minimal lead time and lower cost to DRPT. Amtrak presently has employees who are FRA qualified to operate service in this corridor, but additional hiring would also be needed.

7.1.4 Infrastructure Components

The tracks between Washington D.C. and Newport News are generally classified as FRA Class 4 with an authorized maximum speed of 70 mph. The average scheduled speed between Washington and Richmond is 50 mph, an important component in assessing the competitiveness of passenger rail versus automobile travel. Competitive trip times, reliable service, and the overall on-time performance are key success factors.

Reliable, competitive service demands adequate infrastructure. Without it, the route is likely to experience congestion at key points and lengthy delays to passenger and freight trains. Identifying the appropriate future infrastructure needs is generally determined through network simulation and that may be undertaken in the Long Term Action Plan, as well as an assessment/confirmation of capital costs associated with rolling stock for the forecasted future traffic. However, since the recommended scenario involves adding or extending a single or very small number of new passenger trains in the short run, CSX is independently undertaking its own capacity assessment suitable for the short time frame. Further, this evaluation must be safeguarded to include commitments from the Commonwealth to make appropriate infrastructure improvements which ensure either capacity or reliability associated with the new service over a specific time period, as identified and agreed by all parties. Such a process, which Amtrak has participated in many times, has proven to provide a successful balance

between implementing a service in a short time frame while still providing assurance to the Host Railroad that their interests remain protected.

7.2 Lynchburg to Washington D.C. - Continuing to New York City

This service expansion would provide passenger trains from Lynchburg to Washington D.C. - continuing to New York City, NY. This service is an attractive short term action option and offers the following benefits:

- Utilizes existing equipment (if operated without the Newport News service).
- Utilizes an existing NEC schedule slot.
- Provides additional service to a major region in Virginia (Lynchburg – Roanoke Region) which is currently very underserved by passenger rail – only service is Amtrak's *Crescent* rail line.
- The facilities at Lynchburg's Kemper Street Station (owned by NS) appear to be sufficient for layover and servicing. Access and costs must be negotiated.
- Provides efficient utilization of Amtrak's operating and service employees, including the ability to adjust crew assignments.
- Has a minimal impact to Lynchburg Station staffing/hours of operation.

7.2.1 Proposed Service Description

The proposed service from Washington, D.C. to Lynchburg would utilize an existing trainset that currently terminates and overnights in Washington and is reversed the next morning, becoming a northbound Amtrak Regional train to New York.

The proposed train schedule is shown in Table 3, and would extend service from Washington at 4:52 p.m. (Sunday through Friday), but would depart at 3:50 p.m. on Saturday. The train would make regular station stops at Alexandria, Manassas, Culpepper, Charlottesville and Lynchburg where it would layover for servicing. The train would begin its northbound journey departing Lynchburg at 5:05 a.m. and arrive at Washington at 8:40 a.m. daily. The combination of the morning and evening trains would establish a good service pattern for business travel to and from Washington, D.C. – a first for this region. A bus connection to Roanoke and Bristol should be evaluated as a companion service (discussed in Section 7.2.4 below).

Table 3. Lynchburg to Washington D.C. – Proposed Daily Schedule

171/145	147		◀ Train Number ▶		174/164		
Su-Fr	Sa		◀ Days of Operation ▶		Daily		
12 05P	12 05P	Dp	New York, NY	Ar	12 40P		
4 10P	3 25P	Ar	Washington, DC	Dp	9 25A		
4 52P	3 50P	Dp		Ar	8 40A		
TBD	TBD		Alexandria, VA		TBD		
TBD	TBD		Manassas, VA		TBD		
TBD	TBD		Culpeper, VA		TBD		
7 09P	6 07P		Charlottesville, VA		6 13A		
8 25P	7 23P	Ar	Lynchburg, VA	Dp	5 05A		

TBD (To Be Determined): These stations are listed for continuity purposes only. Additional station stops (if any) will be determined in the Short Term Action Plan, Part II.

7.2.2 Equipment and Crews

The service extension to Lynchburg should not require the need for push-pull capability with either a cab car or second locomotive due to a suitable “wye” (tracks running off the main line, with the shape resembling the letter “Y”; used for turning cars and engines where no turntable is available) just south of the existing station facility. As previously stated, this is significant as bi-directional equipment sets (that include a cab car) are currently unavailable. To maintain operating efficiencies, the trainset must be compatible with the existing Amtrak Regional train consist which is comprised of four passenger cars, one food service car, and a diesel locomotive. Amtrak presently has qualified crews in this service corridor. but additional hiring would be necessary.

From an operating perspective, the use of existing equipment by extending Amtrak’s Regional service on an established route enables the short-term implementation of this option with minimal lead times and lower cost to the Commonwealth, while also maximizing revenue opportunities due to thru service to New York and/or Boston.

7.2.3 Infrastructure Components

Competitive trip times, reliable service, and the overall on-time performance contribute to the success of any new frequency. The new Lynchburg service is based on the assumption that the proposed time slot will be available. This corridor is presently maintained to FRA Class 4 standards (maximum authorized speed of 79 mph) with an average scheduled speed of 49 mph for the slower, long-distance Amtrak *Crescent* (due to dwell times, acceleration, tolerances used in schedule making, etc.), an important component in assessing the competitiveness of rail versus automobile travel.



Similar to the Newport News service analysis, reliable, competitive service for Lynchburg requires that the proper infrastructure is in place to support all classes of train service. Without it, the route is likely to experience congestion at key points and lengthy delays to passenger and freight trains. Identifying the appropriate future infrastructure needs is generally determined through a network simulation that will likely be undertaken in the Long Term Action Plan. The Long Term Action Plan will also, provide an assessment of capital costs associated with rolling stock.

However, since the recommended option involves adding or extending a single or very small number of new passenger trains in the short run, Amtrak believes NS and/or CSX can independently undertake their own capacity assessment suitable for short term. Further, this evaluation must be safeguarded to include commitments from the Commonwealth to make appropriate infrastructure improvements, over a specific period of time, as identified and agreed to by all parties. Such a process, which Amtrak has participated in many times, has proven to provide a successful balance between implementing a service in a short timeframe while still providing assurance to the host railroad their interests remain protected.

7.2.4 Service Extension to Roanoke

Amtrak recognizes the Commonwealth's desire to establish passenger rail service to Roanoke and eventually to Bristol (the *Trans Dominion Express*). In previous reviews of ridership and revenue potential, Amtrak was encouraged with the initial market findings related to a Roanoke service. We believe Roanoke serves as both a destination city and a major regional transportation center with close proximity to Virginia Tech at Blacksburg, and other nearby cities (Christiansburg, Radford, etc.).

A new passenger rail service to Lynchburg should be seen as a first step toward a future extension of passenger rail service to southwestern Virginia. A passenger rail service corridor to Roanoke and ultimately to Bristol, would need to be developed and implemented in phases based on minimum operable segments which are dependent on ridership demands, operating and capital costs associated with the service.

It may be possible to extend the proposed Lynchburg train to Roanoke, pending agreement on running times and schedule. However, this corridor is Norfolk Southern's main freight artery between the Appalachian coal fields to Hampton Roads, and with the construction of the Heartland Corridor Initiative, it is also one of the major east-west double-stack container train routes in the nation. As such, capacity issues must be carefully considered before assuming such an extension is feasible.

7.2.4.1 Dedicated Bus Service Option

To build a corridor incrementally, the Commonwealth may consider using dedicated bus service between connecting points west of Lynchburg as a short term practical step

between the implementation of this option and direct rail service to Roanoke and beyond. This approach was recently used in the state-supported *Downeaster* service in Maine, where a (contracted) bus frequency was added that replicated a proposed additional train frequency. After the completion of required capacity improvements to the rail corridor, an additional roundtrip train between Portland, ME and Boston's North Station replaced the bus service.

Although this option has not been considered in depth, the mechanics of such a multimodal alternative are well within Amtrak's capabilities. To emphasize this point, Amtrak's Northeast Corridor is the nation's busiest rail corridor — and Amtrak's state-supported bus network in California has more daily departures than Amtrak train departures in the Northeast Corridor. Amtrak's annual thruway (dedicated train to bus connection) bus ridership surpassed 1.2 million in fiscal year 2006.

7.1 Equipment Availability and Service Delivery

Amtrak has developed the potential service and schedule for Newport News and Lynchburg after carefully considering needs for the Northeast Corridor and future services in Virginia. **However, because nationwide (existing) fleet availability is extremely limited and Amtrak cannot draw down from other sources, only enough equipment is available near term to operate a single NEC extension as proposed for either Newport News or Lynchburg - but not both concurrently.** As such, DRPT and the Commonwealth would need to choose between the two options for near term implementation, since they are initially dependent on the utilization of existing Amtrak rolling stock. Once an option is selected, the remaining option (as well the combination of both options as a single project), must include acquisition of new or refurbished rolling stock. Also note, all recommended service scenarios and all other options discussed are for purposes of developing this evaluation and report. Service conditions and availability of resources, financial criteria change frequently. As such, Amtrak cannot and would not guarantee operations of these services until a formal Operating and Access Agreement, specifying the precise terms of the service, has been signed by all parties.

7.4 Lynchburg to Washington D.C. & Newport News to Washington D.C.

This service expansion option is the combination of the Newport News and Lynchburg services together into a single project. The two services combined would provide a balanced geographic approach for enhanced passenger rail service from Lynchburg and Newport News to Washington D.C. This service is an attractive short term action option and offers the following benefits:

- It would provide new services over the maximum number of markets within the Commonwealth.
- Facilitates a future westward expansion to Roanoke and Southwest Virginia.

- Existing, stored equipment compatible with Amtrak's Regional Service would need to be refurbished and utilized within the Amtrak's NEC fleet pool. Other equipment options may be possible but would need to be developed in considerable detail to assure compatibility with NEC operations before advancing to the next stage.

7.4.1 Service Description

The proposed train schedule is shown in Table 4. This alternative is an expression of both the eastern and western corridor options, which are mutually exclusive except for their shared trackage from the Alexandria/Franconia (AF) interlocking rail facility northward. Also in this option, Amtrak proposes the Amtrak's Regional Service extension south of Washington, thus eliminating any connection requirement in Washington's Union Station. These services must proceed northward to destinations beyond the Commonwealth to produce the highest revenue and ridership potential.

Table 4. Combined Newport News & Lynchburg to Washington – Proposed Daily Schedule

125	147/157	171/145	199		◀ Train Number ▶		174/164	184	488
Mo-Fr	Sa-Su	Su-Fr	Sa		◀ Days of Operation ▶		Daily	Mo-Fr	Sa-Su
11 35A	12 05P	12 35P	3 05P	Dp	New York, NY	Ar	12 40P	2 49P	2 43P
2 55P	3 25P	4 10P	6 25P	Ar	Washington, DC	Dp	9 25A	11 30A	11 25A
3 55P	4 00P	4 52P	7 30P	Dp		Ar	8 40A	11 00A	11 00A
TBD	TBD	TBD	TBD		Alexandria, VA		TBD	TBD	TBD
TBD	TBD				Fredericksburg, VA			TBD	TBD
TBD	TBD				Ashland, VA			TBD	TBD
6 20P	6 15P				Richmond, VA (Staples Mill Road)			8 35A	8 35A
6 47P	6 42P				Richmond, VA (Main Street Station)			8 02A	8 02A
TBD	TBD				Williamsburg, VA			TBD	TBD
8 25P	8 20P				Newport News, VA			6 45A	6 45A
		TBD	TBD		Manassas, VA		TBD		
		TBD	TBD		Culpeper, VA		TBD		
		7 09P	9 47P		Charlottesville, VA		6 13A		
		8 25P	10 59P	Ar	Lynchburg, VA	Dp	5 05A		

TBD (To Be Determined): These stations are listed for continuity purposes only. Additional station stops (if any) will be determined in the Short Term Action Plan, Part II.



7.4.2 Existing Conditions

Existing conditions are the same as those described for the Newport News service. Although this combined option offers a greater level of service; this option also has the greatest impact on the already “constrained to capacity” rail segment between Virginia Avenue in Washington D.C. and AF interlocking, just south of Alexandria Station. This right-of-way belongs to CSX and will continue to have capacity-related demands from increasing freight movements.

7.4.3 Host Railroad Access

As stated previously, details of any infrastructure agreements to accumulate additional services must be negotiated.

8.0 Operating Costs

Amtrak provides state-supported services in fourteen states, generally offering a turnkey operation that may include rolling stock, on-board operating crews, station staff, management and administrative support, maintenance of equipment, maintenance of way (tracks and signals), marketing and advertising, reservation sales and ticketing. These services are provided to the state’s Departments of Transportation or other relevant authority at costs based on services rendered. In total, state-supported services comprise approximately 45 percent of Amtrak’s average weekday departures.

When established in 1971, Amtrak was required to operate a basic system of corridor and long distance routes as designated by the United States Department of Transportation. Amtrak’s enabling legislation (Rail Passenger Service Act) provided for states to contract for additional service. Under this provision, known as Section 403(b), the percentage of costs paid by states changed many times. From 1971 to 1995, Amtrak bore the majority of operating losses attributable to state-supported service, since states paid only a percentage of avoidable costs. However, Section 403(b) of the Rail Passenger Service Act was repealed in 1997, and subsequent legislative directives and current funding levels preclude Amtrak from operating additional services unless those services are state-supported. Any expansion of rail passenger service in Virginia would therefore have to be state-supported

At the request of VDRPT, this report provides a preliminary assessment of the annual subsidy required to operate a new service between Newport News and Washington, D.C. and a new service from Lynchburg to Washington, D.C. Once all of the cost factors are known a final contract estimate will be prepared. A full detailed description of Amtrak’s route analysis process is discussed in Section 10 below.

Newport News to Washington D.C.

Based on the existing (FY07) state-supported service pricing policy, we estimate that operation of an additional roundtrip service between Newport News and Washington will require approximately \$1.7 Million in annual operating subsidy (FY08 dollars) as shown in Table 5. This estimate is contingent upon the operation of thru service to New York/Boston. Should operating conditions require connecting service, required subsidy levels will likely be higher due to the negative impact on passenger related revenue.

Lynchburg to Washington D.C.

Based on the existing (FY07) state-supported service pricing policy, we estimate that the operation of a new daily roundtrip service between Lynchburg and Washington will require approximately \$1.9 Million in annual operating subsidy (FY08 dollars) as shown in Table 6. This estimate is based on operation of thru service to/from New York/Boston with existing equipment.

Newport News to Washington D.C. and Lynchburg to Washington D.C.

Based on the existing (FY07) state-supported service pricing policy, we estimate that the combined operation of an additional roundtrip service between Newport News and Washington, plus a new daily roundtrip service between Lynchburg and Washington will require approximately \$3.6 Million in annual operating subsidy (FY08 dollars). This estimate is based on operation of thru service to/from New York/Boston with existing equipment.

The estimates provided above are based on Amtrak's existing state-supported service pricing policy and do not include one-time or on-going capital investments. In addition, the analysis reflects schedules that were developed as part of the Short Term Action Plan. As mentioned previously, schedules developed during this process are in part driven by the need to coordinate with existing train slots in Amtrak's Northeast Corridor. Further analysis, should the Commonwealth wish to continue its pursuit of providing additional passenger rail service, may consider optimizing schedules to improve revenue potential in exchange for higher initial capital costs for required equipment.

To provide a reliable overall estimate of capital needs will require negotiation with the host railroads and a thorough assessment of available equipment. While it is not possible to provide a reliable estimate of required capital needs until this additional analysis is completed, it is virtually certain that additional equipment will be needed. If this need is verified, a potential up front capital investment of between \$6 Million and \$8 Million would be required for overhaul and repair expenses associated with returning an existing passenger trainset to service.

Table 5. Draft Profit & (Loss) Estimate – Newport News to Washington D.C. (Boston Regional Train)

Washington to Newport News Service	
<u>Ridership and Revenue Estimate</u>	
Ridership	50,500
Passenger Related Revenue	\$ 2,325,986
<u>Major Cost Categories</u>	
Transportation	\$ 2,418,498
On-Board Services	\$ 255,851
Maintenance of Equipment	\$ 808,769
Res, Advertising and Sales Related	\$ 303,028
Station Services	\$ 93,190
Other	\$ 126,548
Total Estimated Direct Costs	\$ 4,005,884
Passenger Revenue - Direct Costs	\$(1,679,898)

Table 6. Draft Profit & (Loss) Estimate – Lynchburg to Washington D.C. (Boston Regional Train)

Washington to Lynchburg Service	
<u>Ridership and Revenue Estimate</u>	
Ridership	33,100
Passenger Related Revenue	\$ 2,002,123
<u>Major Cost Categories</u>	
Transportation	\$ 2,414,071
On-Board Services	\$ 243,864
Maintenance of Equipment	\$ 808,769
Res, Advertising and Sales Related	\$ 198,628
Station Services	\$ 93,190
Other	\$ 106,932
Total Estimated Direct Costs	\$ 3,865,455
Passenger Revenue - Direct Costs	\$(1,863,332)

8.1 Amtrak and Host Railroad Access

Under the Rail Passenger Service Act and the contracts between Amtrak and other railroads implementing its provisions, Amtrak has access rights to track owned by other railroads for the purpose of operating Intercity passenger trains. Payments for usage are based upon the incremental costs the host railroad incurs as a result of Amtrak's operations; any payments in excess of incremental costs must take into account the quality of service (e.g., on-time performance) the host railroad provides to Amtrak. If new or expanded Amtrak services would unreasonably interfere with the host's operations, capacity improvements (funded by some party other than the railroad) may be required before those Amtrak services can begin operating.

However, details pertaining to an actual time slot for any new service and other infrastructure requirements must be negotiated and agreed upon between the Commonwealth and CSX and/or Norfolk Southern.

9.0 Capital Costs

As mentioned in Section 8, prior to the start of service, states may be required to invest capital in the host railroad infrastructure so as to create additional capacity necessary to either maintain or improve freight operations as a result of the proposed passenger service. These capital investments may include, but are not limited to the following:

- Upgrade track and structures
- Upgrade signal systems
- Realign selected curves to permit higher operating speeds and reduce trip time
- Reconfigure, relocate, eliminate, or install interlockings to improve operating flexibility
- Install additional trackage to reliably accommodate increased passenger train levels
- Upgrade bridges and other infrastructure components such as grade separations
- Improve safety at highway-rail grade crossings
- Install right-of-way fencing
- Improve stations

Absent an engineering and field assessment of the track and structures and an agreement with the host railroads (which would be provided in a Long Term Plan), Amtrak cannot provide guidance at this time as to actual capital costs of the proposed short term or long term action options.

10.0 Amtrak's Corridor Planning Process

Amtrak's Corridor Planning Process will be used to further refine the Short Term Action Plan and to develop a Long Term Action Plan. The process has been tailored to and used in multiple planning environments throughout the United States. These environments include new services in rail corridors with no existing passenger rail and existing corridors that carry freight, commuter and intercity passenger rail.

The principal products of the planning process are:

- **Operationally feasible timetables:** reflect the desired levels of service in terms of travel times and frequencies consistent with the equipment (locomotives, coaches, or diesel multiple units) that are under consideration.
- **Capital investment programs:** refining the scope and budget for infrastructure (track, signal, yards, maintenance facilities, grade crossing and stations) and equipment investments (locomotives, coaches, diesel multiple units, maintenance equipment, etc.). These investment plans are tailored to the start-up schedules for the services and the constraints that exist in terms of freight railroad participation and capital funding constraints.
- **Operating revenue and ridership estimates:** based on travel demand models calibrated or adapted to the corridor environments and markets under consideration. Ridership and revenue estimates are derived from passenger rail service definitions as specified by the operating plans for the proposed rail services, pricing structure, access improvements (e.g., parking and multi-modal access), competitor service levels (automobile and air transport as appropriate), and current and future demographics (population, employment and related economic development assumptions) that define future travel demand markets.
- **Operating cost estimates:** based on train crew sizes; station staffing; maintenance requirements for right-of-way and equipment; and administrative management. These results are dependent on the approach toward service delivery (outsourcing, third party contracting, internal staffing and combinations thereof).
- **Multi-year financial pro forma profit and loss statements:** that includes multiple year forecasts of start-up operations as they evolve toward mature services.
- **Environmental reports:** as needed to enable funding of projects and support various federal and state environmental clearance requirements.
- **Formal planning reports:** as required to advance funding at the state and federal levels—particularly important if FTA funding is anticipated.
- **Contractual support:** as required for agreements with freight railroads and contractors for elements of service delivery. This can include right of way maintenance, equipment maintenance, station operations, train operations and combinations.

Amtrak uses an inclusive process incorporating all stakeholders in the planning process. For example, a rigorous analysis of right of way characteristics is conducted with host railroads. Through a series of operational modeling efforts, physically feasible operating plans are developed that are linked to and compatible with other services on the corridors (freight, commuter rail and intercity rail). This normally requires investments in track capacity, signals, yard and other facilities that, when implemented, provide the physical assets required to deliver operationally feasible operating plans.

For increasing levels of passenger rail service in terms of travel times and frequencies, existing infrastructure improvements are designed and tested through a simulation process to ensure that reliable operating time tables and service will be deliverable —for all operators — using the types of equipment and train characteristics that are envisioned for the new service.

Financial feasibility is tested through the development of demand model-based ridership and revenue estimates. Operating costs are estimated based on the staffing estimates for delivery required service (train crews, maintenance of equipment and station staffing, etc.) under different delivery scenarios — ranging from completely internal operations to selectively or totally outsourced operating and maintenance activities.

Depending on the circumstances, different types of environmental clearance reports may be required in order to advance projects. These range from a Finding of No Significant Impact, typically related to improvements that are wholly within an existing railroad right-of-way, to a full Environmental Impact Statement if significant additional land is taken or routes modified and improved that affect the external environment. These reports are also closely linked to federally required feasibility reports if there is Federal Transit Administration (FTA) funding requested.

While Amtrak follows a general rail planning process, the actual planning activity is tailored to the corridor situation. In addition, it can be developed in stages. Thus, the analysis could be taken through an initial feasibility phase that focuses on investment requirements to deliver various levels of service and the resulting capital and operating results. Based on these results, the state may adjust its objectives, establish funding needs, and proceed with the environmental clearance and other required products to bring to fruition.

Staffing of these comprehensive planning efforts often require several specialty firms, many of whom Amtrak has engaged under task order contracts. Given its knowledge of railroad operations along the NEC and in the Commonwealth of Virginia, Amtrak would tailor the sub-contracting scopes and products to the deliverables that are required for specific corridor planning that is anticipated by the DRPT.

11.0 Conclusion

This report provides a Short Term Action Plan for DRPT consisting of two rail service enhancement options that are reasonable “project ready” and could be implemented within an estimated one to six year timeframe. It is recognized that the I-95 corridor has the highest ridership potential and increased rail service between Richmond and Washington D.C. remains a very high priority for the Commonwealth; however, major infrastructure and operating issues exist that will take a relatively long time to resolve in this corridor. By comparison, the Lynchburg service has fewer technical and operating issues to be resolved, and a new passenger service in that corridor (referred to as the Route 29 Corridor) could be implemented much faster and at lower total costs (operating subsidies, trainset equipment, and capital improvements of the host rail line).

Based on the evaluation, Amtrak recommends that steps be taken by DRPT to implement the Lynchburg to Washington rail service as soon as possible – including any capital improvements needed to the existing rail line by the host railroad. Subsequent to implementing the Lynchburg service, Amtrak recommends that steps be taken by DRPT as soon as practical to implement the Newport News to Washington D.C. rail service, including capital funding to refurbish an existing Amtrak trainset to implement the additional rail service, as well as any capital improvements needed to the existing rail line by the host railroad.

The capital, operating and public benefits analysis included in this report provides the Commonwealth with further guidance towards fiscally responsible investment of limited public funds to maximize the impact of Virginia’s investments in passenger rail service. Amtrak appreciates the opportunity to engage in a collaborative effort with the DRPT to further analyze potential rail service and integrate its passenger rail plans into larger passenger rail initiatives.

Addendum 1 – Public Benefits

A-1.0 Highway Congestion Mitigation

- Since 1982, the average delay per highway rush-hour traveler has grown from 16 hours to 47 hours per year – in some areas, drivers lose as many as 93 hours per year to rush hour travel delays.¹ The number of urban areas with more than 20 hours of annual delay per rush hour traveler increased tenfold in the two decades between 1983 and 2003.²
- In 1955, there were 65 million vehicles on U.S. highways. Today there are 246 million. By 2055 this number is expected to reach 400 million.³
- Not only are there an increased number of cars on the road, each individual car is also being driven more. The 11,000 miles per year an average car was driven in 1990 increased to 12,000 fifteen years later.⁴
- The Texas Transportation Institute (TTI) estimates that congestion cost more than \$63 billion in wasted time and fuel in 2005. Individuals lose between \$800 and \$1,600 per year – in some areas, TTI has calculated, commuters effectively pay a “congestion tax” of \$2 per traveler each workday.⁵
- Infrastructure improvements made to enable passenger rail often benefit freight rail, which helps reduce congestion. A single intermodal freight train can carry the same load as 500 trucks;⁶ shippers would have to add 50 million additional trucks on the roadways if rail was not a viable alternative.⁷
- Interstate travel currently accounts for one quarter of vehicle miles traveled and the fastest growing segment of vehicle miles traveled.⁸ By 2020, 90 percent of Interstates will be at or exceeding capacity.⁹
- In large cities with rail transit in major corridors, congestion increases at a 42 percent lower rate than in non-rail cities. [*Projected Ridership for New Light Rail Starts: Issues of Accuracy and Impact on Congestion*, by Henry/Archer, *Proceedings of the 2001 APTA Rail Transit Conference*, p. 6]

A-2.0 Economic Development – National and Regional

- According to the U.S. Department of Transportation, every \$1 billion invested in transportation creates approximately 47,500 transportation-related as well as ancillary jobs (service industry, finance, etc.).¹⁰
- According to the *Wall Street Journal*, Washington D.C.'s Union Station now commands \$700 to \$800 in sales per square foot – more than twice the national average for shopping malls.¹¹ Many communities report a 10 to 15 percent premium sellers are able to charge for developable land near rail transit stations,¹² and premium rents can be commanded by residential and commercial units near rail. San Diego boasts a 17 percent price advantage for proximity to rail.¹³ A 2002 study in Texas documented that residential properties near rail transit stations rose in value over the period studied by 32.1 percent (while those without rail connections rose 19.5 percent) and that commercial properties near rail transit stations increased in value by 24.7 percent (while those without rail connections increased by less than half that rate).¹⁴

A-3.0 Mobility and Travel Choices

- One in five Americans age 65 and older does not drive,¹⁵ and the number of people aged 65 and older is expected to more than double between 2002 and 2030.¹⁶ While half of older non-drivers report having a medical condition that impedes their ability to travel,¹⁷ finances also play a role.¹⁸
- Americans spend triple the amount of money on driving as on health care, and 33 percent more on driving than on food. In fact, driving is second only to housing in terms of impact on a family's budget.¹⁹ Cities with the fewest transportation choices have the highest transportation costs per household. For example, the average Houston family spends 22 cents of every dollar on transportation, while one in transit-friendly Baltimore spends less than 15 cents.²⁰

A-4.0 Environmental Benefits and Energy Efficiency

- In 2002, transportation vehicles emitted 58 percent of the nation's carbon monoxide pollution, 45 percent of nitrogen oxides, 36 percent of volatile organic compounds, 4 percent of particulates, 78 percent of ammonia, and 5 percent of sulfur dioxide. Highway vehicles accounted for almost all of those carbon monoxide emissions, 78 percent of the nitrogen oxides, and 77 percent of volatile organic compounds.²¹
- Domestic airlines on average consume one fifth (20.5 percent) more energy per passenger mile than Amtrak, while cars consume over one quarter (27 percent) more than Amtrak. Looked at the other way around, Amtrak uses 17 percent and 21 percent less energy per passenger-mile than airlines and cars, respectively. The figures are even more

encouraging when additional factors are considered, such as the tendency of rail to stimulate pedestrian and transit friendly development. *[Statement by NARP Executive Director Ross B. Capon on new energy data from Oak Ridge National Laboratory]*

- Many state investments on behalf of passenger rail have served to benefit freight rail as well. Freight trains are responsible for 6-12 times less pollution per mile than trucks.²² The EPA estimates that for every ton-mile, a typical truck emits three times more nitrogen oxides and particulates than a locomotive, and much more greenhouse gases.²³
- By running on rails and ties that lie on water-permeable crushed rock trackbeds, railroads reduce the amount of impervious surface (paved roads, parking lots, and interchanges) required for transportation. Paved surfaces hasten erosion, wash toxic chemicals (including lead, copper, cadmium and zinc) into waterways, alter water temperature and thereby threaten aquatic life, and prevent filtration and recharge of groundwater supplies.²⁴ Studies have noted that when more than ten percent of the acreage of a watershed is covered in impervious surfaces, rivers and streams within the watershed become seriously degraded, but damage can be detected with as little as five percent coverage.²⁵

Endnotes

¹ "A new vision for the future Interstate system: Changing Function and Funding" by Dr. Anthony Kane, Director of Engineering and Technical Services for the American Association of State Highway and Transportation Officials (Jan. 22, 2007), slide 4

² "Annual study shows nation's traffic troubles growing worse", undated press release from Texas Transportation Institute accompanying release of the group's "2005 Urban Mobility Study"
http://tti.tamu.edu/infofor/media/archive.htm?news_id=3851

³ "Transportation: Invest in our Future," American Association of State Highway and Transportation Officials (Feb. 2007), p. 18, 20

⁴ Fuel Efficient Cars Dent States' Road Budgets," by Robert Guy Matthews in the *Wall Street Journal* (April 25, 2007)

⁵ "Urban Mobility Information: 2005 Annual Urban Mobility Report," Texas Transportation Institute. From Q&As on the website at <http://mobility.tamu.edu/ums/report>. See the Q&A "What does Congestion cost us?" which estimates a cost of \$794 per traveler. AASHTO calculates that all told, the American "congestion tax" each year is as high as \$1,600 per traveler "A new vision for the future Interstate system: Changing Function and Funding" by Dr. Anthony Kane, Director of Engineering and Technical Services for the American Association of State Highway and Transportation Officials (Jan. 22, 2007), slide 4.

⁶ "Overview of U.S. Freight Railroads", Association of American Railroads, (Jan. 2007), p. 6.

⁷ "State of Nation's Intercity Rail," Surface Transportation Policy Project, part of their Decoding Transportation Policy & Practice series #12 (Feb. 11, 2004), p. 1

⁸ "A new vision for the future Interstate system: Changing Function and Funding" by Dr. Anthony Kane, Director of Engineering and Technical Services for the American Association of State Highway and Transportation Officials, January 22, 2007. Slide 3

⁹ "Transportation: Invest in our Future," American Association of State Highway and Transportation Officials, February 2007. p. 18, 20

¹⁰ "The Benefits of Public Transportation," American Public Transportation Association and found at www.publictransportation.org, quoting the comments of then-Secretary Norman Mineta at a conference of the American Road and Transportation Builders Association on June 25, 2002 and found at www.publictransportation.org

¹¹ "Pricey Junction of Retail, Rail" by Ryan Chittum. *Wall Street Journal* (Jan. 31, 2007).

¹² "Mass transit fills apartments but adds to unit cost" by Bendix Anderson in *Housing Finance*, May 2004

¹³ ATPA 2006 factbook p. ix

¹⁴ APTA 2006 factbook p. ix

¹⁵ "Community Mobility Options: The Older Person's Interest" by Ari N. House, AARP Public Policy Institute (August 2005). www.aarp.org/research/housing-mobility/transportation/fs44r_com_mobility.html, citing an AARP analysis of statistics from the US DOT's National Household Travel Survey (2001).

¹⁶ "Re-imagining America: AARP's Blueprint for the Future", AARP (2005), p. 4, citing figures from the U.S. Department of Health and Human Service's Administration on Aging and Centers for Disease Control.

¹⁷ "Aging Americans: Stranded Without Options." Surface Transportation Policy Project, (2004).

¹⁸ "Community Mobility Options: The Older Person's Interest" by Ari N. House, AARP Public Policy Institute (Aug. 2005), citing an AARP analysis of statistics from US DOT's National Household Travel Survey of 2001 to conclude that residents 65+ with incomes below \$10,000 are 14 times as likely not to own a vehicle as households with the same age demographics but annual incomes over \$25,000

¹⁹ "Driven to Spend", Surface Transportation Policy Project (Mar. 19, 2000). Executive summary

²⁰ "Driven to Spend", Surface Transportation Policy Project (Mar. 19, 2000). Executive summary

²¹ "Transportation Statistics Annual Report", U.S. Department of Transportation, Research and Innovative Technology Administration. Bureau of Transportation Statistics, November 2005, p. 15

²² "State of the Nation's Intercity Rail," Surface Transportation Policy Project, part of its Decoding Transportation Policy & Practice series (#12), Feb. 11, 2004, p. 2

²³ "Overview of U.S. Freight Railroads", Association of American Railroads, January 2007. p. 7 The U.S. Environmental Protection Agency estimates that for every ton-mile, a typical truck emits roughly three times more nitrogen oxides and particulates than a locomotive."

²⁴ "Coastal Sprawl: The effects of Urban Design on Aquatic Ecosystems in the United States", by Dana Beach, prepared for the Pew Oceans Commission, 2002, p. 9-10.

²⁵ "Coastal Sprawl: The effects of Urban Design on Aquatic Ecosystems in the United States", by Dana Beach, prepared for the Pew Oceans Commission, 2002, p. 7