Keystone West
High Speed Rail Study

Feasibility Report & Preliminary Service Development Plan

Prepared for:

pennsylvania
DEPARTMENT OF TRANSPORTATION

and

Federal Railroad Administration (FRA)

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FINAL

August 2014

EXECUTIVE SUMMARY

The Pennsylvania Department of Transportation (PennDOT), in cooperation with the Federal Railroad Administration (FRA), Amtrak, and Norfolk Southern (NS), conducted the Keystone West High Speed Rail Study to evaluate the feasibility of options to reduce rail travel times and increase trip frequency on Amtrak's Keystone West portion (Harrisburg – Pittsburgh) of the Pennsylvanian service between New York City and Pittsburgh. **See Figure 1: Project Area Map.** It is important to note that this is a high-level, conceptual feasibility study. As such, the analyses relied on:

> ***Keystone West High-Speed Rail Study Goals***
>
> - *Extend higher speed rail service from Harrisburg to Pittsburgh.*
> - *Increase ridership on Keystone West.*
> - *Stimulate regional economic development.*

(a) information gleaned from prior studies and reports;
(b) secondary sources of readily-available data; and,
(c) planning-level techniques for engineering assessments, cost estimation, rail operations analyses, demand estimation, and impact assessment.

A detailed analysis of the purpose and need for this study is provided in the "Keystone West High Speed Rail Study, Project Purpose & Need (Final, May 2012)" report, contained in the project technical files. Briefly, needs include:

- There is currently only inconvenient, limited, once-daily passenger rail service
- A lengthy (5½-hour) travel time
- Lack of convenient multimodal travel options for underserved populations
- Lack of amenities and intermodal connections at existing stations
- No connecting service to State College—an area of high commuter population.

> ***Pennsylvanian Facts***
>
> 1. *Long time east-west passenger & freight link.*
> 2. *Heavy freight usage from the west to New York / Philadelphia.*
> 3. ***Keystone East** portion (Harrisburg to Philadelphia) offers high speed, electrified passenger rail service.*
> 4. *Amtrak owns Keystone East portion of the Pennsylvanian.*
> 5. ***Keystone West** portion (Pittsburgh to Harrisburg) owned by Norfolk Southern.*
> 6. *Since 1971, Amtrak has leased Keystone West portion to operate passenger rail service.*
> 7. *One round trip daily for passengers on Keystone West.*

The Keystone West corridor is characterized by urban development at both ends (Pittsburgh and Harrisburg) with intermediate stops at smaller boroughs and cities along the route. Topography ranges from rolling in the west, to mountainous in the central portions of the corridor near Johnstown and Altoona, to more gently sloping as the route approaches Harrisburg. The varying topography creates unique challenges for rail (passenger and freight service) transport, including winding alignments with steep grades and a narrow cross section.

> **Keystone West Intermediate Stops**
>
> Greensburg, Latrobe, Johnstown, Altoona, Tyrone, Huntingdon, and Lewistown

The study evaluated existing rail operations and infrastructure within the Keystone West corridor and identified potential improvements and conceptual alternatives to provide higher speed passenger rail service. The analysis of conceptual alternatives involved a two-tiered approach:

1. Identification & analysis of "full alternatives."
2. Evaluation of individual improvement components (options).

All alternatives were rooted in incrementally increasing speeds of passenger trains and providing the capacity for additional passenger train frequencies, while minimizing impacts to current Norfolk Southern operations and future opportunities. Conceptual alternatives included the Base Case (No-Build) Alternative along with four build alternatives, as presented in **Table ES-1**.

The types of improvements considered under each alternative included:

- curve modifications and curve straightening
- off-line alignments to bypass slow/circuitous sections
- adding tracks to increase capacity
- switch upgrades to allow higher speeds through transitions from one track to another
- addition of platforms to eliminate the need for trains travelling in opposing directions to share the tracks though station areas
- a rail spur connection or connecting bus service from the mainline to State College
- connecting bus service to other off-line communities
- more frequent passenger train service

Alternatives Analysis

Early Screening

a. Screening Metrics, including:
   - Purpose & Need
   - Public / Stakeholder feedback
   - Physical, financial, and institutional feasibility
b. Metrics ranked with 1 being least favorable & 5 most favorable

Detailed Study

a. Ridership forecasts
b. Operations analysis
c. Equipment considerations
d. Financial plan
e. Impact assessment
f. Benefits assessment
g. Phased implementation

Table ES-1: Summary of Screening Alternatives

Alternative	General Improvement Types	Estimated Right-of-Way Costs	Infrastructure Construction Cost	Metrics Screen Score*	Carried to Detailed Analysis?
No-Build	None	$0	$0	2	No
1	Curve modifications in existing right-of-way	$400,000	$1.5 billion	5	Yes
2	Alternative 1 improvements PLUS curve straightening and some new alignment at slow points	$14 million	$9.9 billion	5	Yes
3	Alternatives 1 and 2 improvements PLUS addition of a continuous third track	$16 million	$13.1 billion	3	Yes
4	All new electrified, two-track, passenger train only, high speed alignment on southerly route similar to PA Turnpike	$50 million	$38.3 billion	1	No

* 5 indicates the highest or best score and 1 indicates the lowest or worst score.

All alternatives, except the Base Case, would include either a rail connection from the Tyrone Amtrak Station to State College, or bus connection(s) from one or more existing rail stations to State College. The Base Case (No-Build) Alternative, with a metrics ranking of "2," and Alternative 4 (metrics ranking of "1") were eliminated from further consideration during the initial screening of alternatives. The Base Case does not address identified needs and Alternative 4 was dropped primarily based on financial feasibility and the probability of extensive impacts to the communities through which it would pass. Both also had the lowest ranking among alternatives considered.

Following the initial screening, additional details were developed for Alternatives 1, 2, and 3, including individual improvement options by station and alignment segments. **Table ES-2** provides a high-level summary of the improvements and capital costs, by route segment, for Alternatives 1, 2, and 3.

Table ES-2: Summary of Improvements and Costs for Alts 1, 2, and 3

Route Segment	Type(s) of Improvement	Alt 1 ($000's)	Alt 2 ($000's)	Alt 3 ($000's)
Pittsburgh-Greensburg	Capacity, Speed	275,027	275,027	504,239
Greensburg-Latrobe	Capacity, Speed	158,308	158,308	212,355
Latrobe-Johnstown	Capacity, Speed	4,054	29,275	827,552
Johnstown-Altoona	Capacity, Speed	100,944	610,799	1,314,298
Altoona-Tyrone	Capacity, Speed, Stations/Platforms	11,791	11,791	336,683
Tyrone-State College Spur	New Connection	71,887	71,887	71,887
Tyrone-Huntingdon	Capacity, Speed, Stations/Platforms	3,358	1,118,098	1,592,414
Huntingdon-Lewistown	Capacity, Speed, Stations/Platforms	573,322	6,385,249	6,205,988
Lewistown-Harrisburg	Capacity, Speed	275,250	1,279,147	2,002,480
Subtotal-Construction		**1,473,941**	**9,939,581**	**13,067,896**
Right-of-Way		400	14,000	16,000
Total Costs		**1,474,341**	**9,953,581**	**13,083,896**

Alternatives 1, 2, and 3 were studied and potential environmental effects developed based upon select environmental information and features collected from the Pennsylvania Spatial Data Access (PASDA) webpage.

A rail operations analysis assessed the performance aspects of Alternatives 1 and 2, and included a qualitative assessment of the performance aspects of Alternative 3. The results of the rail operations analysis predict the time savings shown in **Table ES-3** for each detailed study alternative.

Table ES-3: Time Savings by Alternative			
	Alternative 1	**Alternative 2**	**Alternative 3**
Eastbound	9 minutes +	35 minutes +	Alternative 2 time savings plus additional time savings due to fewer conflicts between passenger and freight trains; plus additional capacity and reliability due to continuous third track*
Westbound	Almost 5 minutes	29 minutes +	
* The additional time savings due to the addition of a third continuous track could not be quantified using the tools applied as part of this study.			

Pro forma schedules assuming increased service frequency were also developed. The schedules were developed using Alternative 2 as it incorporates all of the Alternative 1 improvements and all of the Alternative 3 improvements, with the exception of a continuous third line. Full implementation of Alternative 2, with an eight percent recovery time (the time required for a train to get back up to speed after a delay or a stop), results in an approximately 4-½ hours trip time, in either direction. This trip time was used along with an increase in service to two-round trips to create the frequency schedule that was used in ridership forecasting and the financial analysis.

In support of the ridership forecasts, an analysis was completed to determine how ridership would be affected by increased bus service to the Keystone West stations. The results of the ridership forecasting (demand estimates), with and without the connecting bus services, are presented in **Table ES-4**.

Table ES-4: Demand Estimate Summary							
	2012 Base Case	**2020**			**2035**		
		Base Case	**Alternative 2**		**Base Case**	**Alternative 2**	
			With Bus Service	**Without Bus Service**		**With Bus Service**	**Without Bus Service**
Keystone West ONLY	107,420	111,220	169,910	162,502	117,870	206,815	197,675
TOTAL Pennsylvanian	211,990	224,840	315,045	307,637	241,140	384,170	375,030

Finally, a financial analysis and assessment of benefits were developed—based primarily on using Alternative 2 infrastructure inputs as a baseline, as stated above in the pro forma schedule discussion —to provide information on expected ridership and revenue increases, capital cost needs, operating needs and expected benefits that would be realized should Alternative 2 be fully constructed. Even assuming the higher speeds and service frequencies that would result from full implementation of Alternative 2, at a construction cost of $9.9 billion, the forecast demand and corresponding passenger revenue estimates would result in a substantial increase in required operating subsidies. Although this effort was carried out at a conceptual level and more in-depth analyses would be required to produce more definitive conclusions, the results of the demand estimation and financial analysis suggest that a more detailed evaluation of demand, anticipated benefits, and funding availability will ensure that the most reasonable and prudent improvements, or combinations thereof, are advanced to construction.

Example Initial Improvement

Station & Platform improvements with one added daily round trip
- operations benefits
- more travel options

Future Considerations

1. Should improvements be constructed individually or in some combination?
2. Improvement options (or combinations thereof) must be prioritized.
3. Is there sufficient demand to justify cost of individual or combined improvements?

Realizing that it is unlikely that a program of improvements along the lines of Alternative 2 could be implemented all at once, potential improvements were developed in a manner that would allow them to be completed incrementally, based on need, expected benefits and funding availability. Incremental improvements along the corridor would offer a fiscally constrained approach to the long-term implementation of a full and complete alternative; and allow ridership to increase systematically in support of future improvements.

It must be noted that part of the analysis as to what improvements move forward, and what order (priority), must consist of evaluating whether there is sufficient demand available to justify the cost required to construct any individual or combined improvements. Because the presented improvement options offer varying levels of improvement at widely varying funding levels, whether constructed individually or in some combination of improvements, a determination on whether the improvement(s) are justified based on demand can only be made once they are prioritized for future action and decisions are made on whether to construct improvements individually or in some combination.

To aid in future discussions concerning what improvements could be advanced—considering fiscal constraints, in particular—a menu of possible improvement options was developed. This menu is included in **Appendix B** of the Feasibility Study / Preliminary Service Development Plan and available as a stand-alone document (*Keystone West High Speed Rail Study: Menu of Options*), that provides information on potential benefits, costs, right-of-way needs, and environmental considerations for each improvement. Ultimately, this information could be used to program potential projects through the State Transportation Improvement Program (STIP) development process.

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I. INTRODUCTION

The Pennsylvania Department of Transportation (PennDOT), in cooperation with the Federal Railroad Administration (FRA), Amtrak, and Norfolk Southern (NS), conducted this study to evaluate potential service improvements to the Harrisburg – Pittsburgh portion of Amtrak's Pennsylvanian service between New York City and Pittsburgh. See **Figure 1: Project Area Map**. The FRA made the study possible through a grant from its High Speed Intercity Passenger Rail (HSIPR) Program, which the Commonwealth of Pennsylvania matched at 50 percent.

Amtrak currently offers one round trip daily between Harrisburg and Pittsburgh (referred to herein as the Keystone West corridor). However, it is not an attractive choice for most travelers. At 5½ hours one way, the Pennsylvanian train service is not time competitive with automobile travel (3½ hours one way via the PA Turnpike, which bypasses intermediate station stops), and its limited frequency makes it inconvenient or impractical for many trips.

This Keystone West High Speed Rail Study is intended to identify and evaluate the feasibility of options to reduce rail travel times and increase trip frequency on Amtrak's Keystone West portion of the Pennsylvanian service. The study, which began in February 2011, provides PennDOT and other stakeholders with the information to support decision-making regarding the most appropriate next steps.

It is important to note that this is a high-level, conceptual feasibility study. As such, the analyses relied on (a) information gleaned from prior studies and reports, (b) secondary sources of readily-available data, and (c) planning-level techniques for engineering assessments, cost estimation, rail operations analyses, and demand estimation. Additional detailed technical investigation, analysis, and design would be required before undertaking any of the recommended actions.

A. History

The Keystone West corridor has long been an important east – west passenger and freight link across Pennsylvania. The Keystone line was originally constructed by the Pennsylvania Railroad (PRR) in the mid-1800s. The line was one of the most heavily used passenger and freight lines in the nation and prospered until the 1950s, when it began a gradual decline. Passenger service and ridership on the line peaked in the years immediately following World War II. In 1954, the PRR operated 22 daily round trips between Harrisburg and Pittsburgh. Passengers could choose from express service, limited-stop trains that approximated the current stopping pattern, and local service with as many as 14 passenger stops. In that era, trip times between the endpoints ranged from approximately 4¾ hours for trains with one intermediate stop, to approximately 7½ hours for trains with more frequent stops. Like other private railroads, the PRR's financial condition plummeted as the nation's highway system was expanded, city centers and overall population density declined, auto ownership and travel via personal vehicles increased, movement of lighter freight shifted from rail to trucks, and air travel became the preferred mode for longer-distance travel.

The steady financial decline of the private railroads led to numerous bankruptcies and mergers. Most major railroads were consolidated under six companies, including Penn Central. It was formed in 1968 through consolidation of the New York Central and the Pennsylvania Railroad (the New Haven and Hartford Railroad was added shortly thereafter). As was the case for all of the consolidated rail companies, Penn Central's railroad business struggled financially and eventually filed for bankruptcy in 1970. The federal government acquired its rail assets and placed oversight responsibility with the United States Railway Association (USRA).

Amtrak was created by the federal Rail Passenger Services Act, enacted in October 1970. Amtrak's statutory mission was to manage and operate a nationwide rail passenger system, thereby relieving the freight railroads of the burden of operating unprofitable long distance passenger services that represented a significant drain on their financial position.

Responsibility for Penn Central freight rail service and most rail infrastructure was eventually shifted to the Consolidated Rail Corporation (Conrail), which was formed in 1976 to operate an east – midwest freight rail system.

By the early 1980s, Conrail was generating profits. This led to the federal government's privatization of Conrail in 1987 through one of the largest initial public offerings in the nation's history. While still under Conrail ownership, the line across Pennsylvania was cleared for double-stack freight operations through a capital improvement program financed jointly by the Commonwealth and Conrail. In Spring 1997, Norfolk Southern (NS) and CSXT Corporation agreed to acquire Conrail through a joint stock purchase, with NS taking ownership of the Keystone West line.

NS continues to own and operate freight service on the Keystone West rail line, which is heavily utilized for moving freight from points west to New York and Philadelphia regional ports, and vice versa. Amtrak has operated varied levels of passenger rail service along the corridor, under an access agreement with NS, since assuming responsibility for passenger service in 1971.

As a precursor to this study, a review of previous studies related to the current Keystone West High Speed Rail Feasibility Study was conducted and documented in the *Keystone West High Speed Rail: Prior Studies Report* (August 2011).

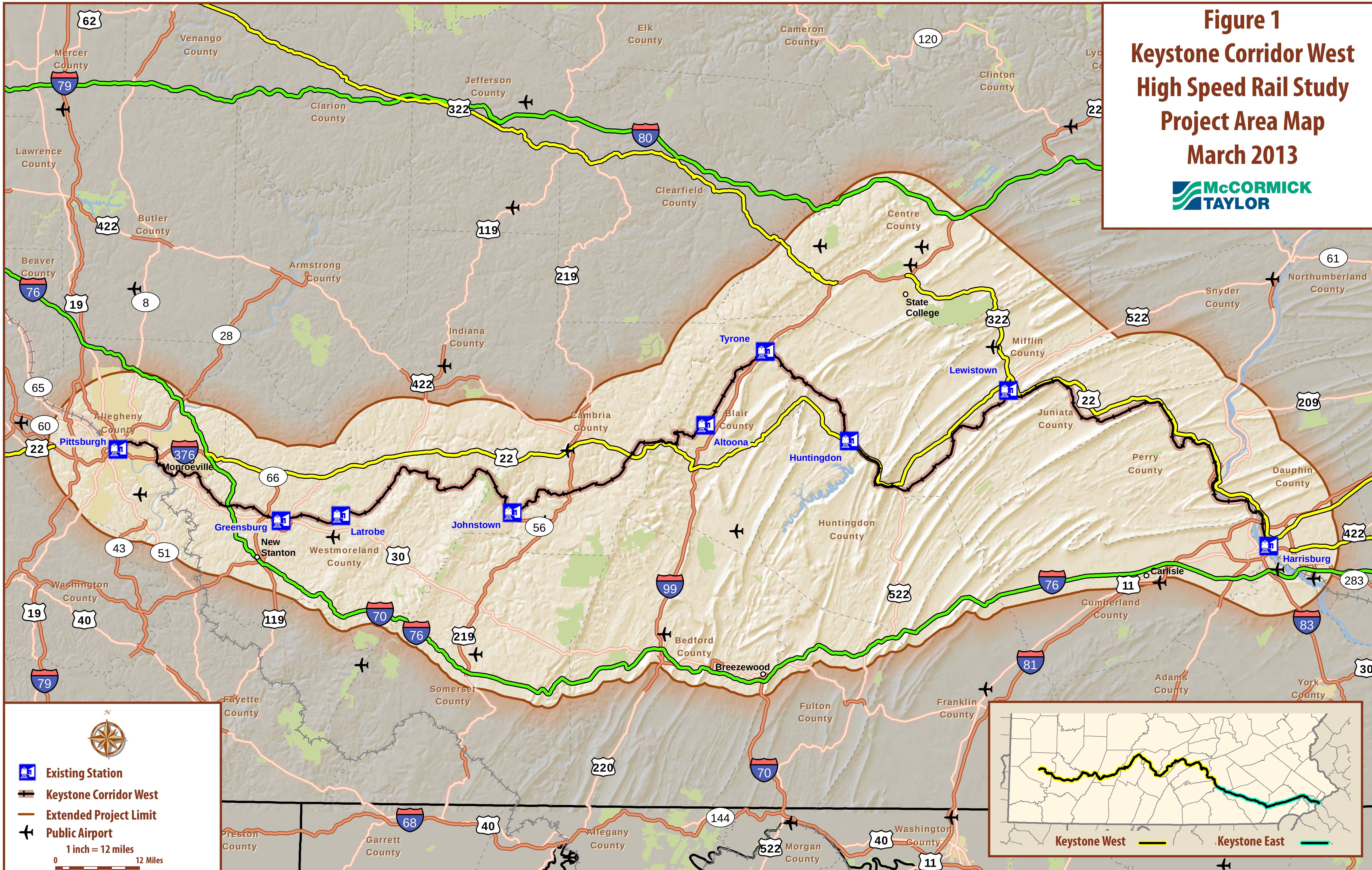


Figure 1
Keystone Corridor West High Speed Rail Study Project Area Map
March 2013

B. Corridor Infrastructure, Service Characteristics, and Demographics

Detailed information on existing transportation infrastructure, existing service characteristics and performance, and corridor demographics is provided in the *Keystone West High Speed Rail Study: Project Purpose and Need* (May 2012) report, contained in the project technical files.

For More Information

Keystone West High Speed Rail Study, "Project Purpose & Need, Final," May 2012.

1. Existing Transportation Infrastructure

Highways

The study corridor is supported by two parallel highways (U.S. 22 and U.S. 322) providing east – west movement of automobiles and trucks from south central Pennsylvania to western Pennsylvania. Additional parallel routes include I-80 to the north and the Pennsylvania Turnpike to the south. See **Figure 1: Project Area Map**.

U.S. 22 connects Harrisburg to downtown Pittsburgh. It also links to State College via U.S. 322 and U.S. 220/I-99, and carries a significant amount of traffic through the central part of Pennsylvania. Annual Average Daily Traffic (AADT) on U.S. 22 ranges from 5,000 to more than 10,000 vehicles per day between Harrisburg and Altoona, to 20,000 vehicles per day between Altoona and Ebensburg, to more than 50,000 vehicles per day as it becomes the Parkway East (U.S. 376) entering Pittsburgh. U.S. 22/U.S. 376 provides a direct connection to the PA Turnpike at the Monroeville interchange. U.S. 22 provides connections to Indiana, PA, via U.S. 422 at Ebensburg; Johnstown/Somerset/Pennsylvania Turnpike via U.S. 219 near Ebensburg; Bedford/Pennsylvania Turnpike via I-99 near Altoona; and U.S. 119 (North) at Blairsville. U.S. 119 (South) also provides a connection from U.S. 22 to Greensburg.

More than 15,000 vehicles, including more than 2,000 trucks, use U.S. 322 between Harrisburg and State College each day. Most of the truck traffic has long-haul destinations and is using U.S. 322 to access I-80 near Clearfield. The U.S. 22/U.S. 322 pair provides access to the Lewistown, State College, and Altoona metropolitan areas.

Interstate 80 provides some connectivity duplication of the Keystone corridor, but is a limited option because it is, on average, 50 or more miles north of both Harrisburg and Pittsburgh. I-80 connects to both Harrisburg and Pittsburgh—although by circuitous routes—via U.S. 15 in the Harrisburg area and I-79 in the Pittsburgh area. I-80 carries significant volumes of through traffic, particularly through truck traffic, with some segments of the interstate carrying nearly 50 percent trucks. Much of the truck traffic on I-80 has an origin and destination outside of Pennsylvania.

The Pennsylvania Turnpike provides a more direct connection between Harrisburg and Pittsburgh, and has interchanges at both cities for regional connectivity to many of the off-line communities served by the Keystone West corridor. The Pennsylvania Turnpike carries 25,000 to 35,000 vehicles per day between Carlisle and Harrisburg, and approximately 20,000 per day between Carlisle and Breezewood. Truck volumes along the Pennsylvania Turnpike are more than 5,000 per day, with some areas experiencing more than 7,000 trucks per day. Between Breezewood and New Stanton, the Turnpike handles more than 30,000 vehicles per day. The volume increases to more than 45,000 vehicles per day near the Monroeville Interchange and the connection to the Parkway East in Pittsburgh.

Aviation

There are several regional airports within the Keystone West corridor, most notably Harrisburg International and Pittsburgh International airports, which are the most significant commercial aviation hubs in the corridor. Publicly-owned airports are shown on **Figure 1: Project Area Map**. The majority of the airports in the corridor are general aviation airports (public and private) served by small planes.

There is currently no direct air service between Harrisburg and Pittsburgh. In order to fly between Harrisburg and Pittsburgh, a traveler must make at least a two-leg flight via an indirect route.

Intercity Bus

Intercity bus service in the Harrisburg – Pittsburgh corridor is provided by several operators, including Greyhound, Fullington, and MegaBus. A description of these providers and the extent of their services is provided in the *Keystone West High Speed Rail Study: Project Purpose and Need* (May 2012) report, contained in the project technical files. It should be noted that the express intercity (Harrisburg – Pittsburgh) service via the Turnpike does not serve the population centers located along the existing rail corridor (Lewistown, Huntingdon, Tyrone, Altoona, Johnstown, Latrobe, and Greensburg).

Freight Rail

NS's route between Harrisburg and Pittsburgh essentially consists of two main tracks. Both main tracks are equipped with Centralized Train Control (CTC) with crossovers located relatively frequently at intervals of approximately 10 to 15 miles along the corridor. Currently, Amtrak trains operate only on the NS Pittsburgh Line.

In the corridor's most mountainous territory (between Johnstown and Altoona), the line generally consists of triple track with only the middle track equipped with CTC. There are secondary routes such as Main Line Conemaugh (Johnstown – Pittsburgh) and the Port Perry Branch (Pitcairn – Pittsburgh) that provide alternative routings for freight trains, in effect creating redundancy and more line capacity. These parallel lines are used exclusively for movement of freight and provide two, and sometimes three, tracks of additional capacity along the western end of the line.

2. Existing Service Characteristics and Performance

High speed rail (HSR) is defined as passenger rail service that operates at 110 miles per hour (mph) or greater, a rate of speed significantly faster than normal rail service. In comparison, passenger trains along the Keystone West corridor between Harrisburg and Pittsburgh operate at speeds averaging 45 mph, with a maximum speed of 79 mph.

As discussed in **Section I.A, History**, the Keystone West corridor has undergone a series of ownership changes and a dramatic decline in ridership and decrease in passenger service over the years. NS currently owns the rail right-of-way and appurtenant infrastructure along the corridor (with the exception of passenger stations) and handles all dispatching. Amtrak operates passenger service under an agreement with NS that encompasses access fees, dispatching priorities, and other terms. While the Commonwealth previously subsidized operation of the Pennsylvanian, that arrangement was ended in 1993 when Amtrak advised PennDOT officials that the performance of the Pennsylvanian was sufficient for Amtrak to accept the route into the national system.

Amtrak's Pennsylvanian service between Harrisburg and Pittsburgh is affected by the line's primary use, which is the transport of coal, industrial products, and other freight by NS, the line's owner. The Pennsylvanian service is subject to constraints imposed by NS operations. This impacts the number of trips Amtrak can operate and the speeds at which passenger trains can travel. The Pennsylvanian service runs one round trip per day between Harrisburg and Pittsburgh, taking 5½ hours in each direction and stopping in Lewistown, Huntingdon, Tyrone, Altoona, Johnstown, Latrobe, and Greensburg. The travel time, when compared to automobile travel (3½ hours via the Pennsylvania Turnpike, which bypasses all intermediate communities), is neither an attractive nor convenient option for persons traveling between the end points. As would be expected, ridership on the line remains relatively low (203,392 in fiscal year (FY) 2010 compared to 1,215,785 on Keystone East between Harrisburg and Philadelphia).

Existing Railroad Infrastructure

Unlike Keystone East, the Keystone West line is not electrified, requiring diesel power for both freight and passenger trains. Keystone West traverses challenging topography, with steep grades and sharp curves limiting speeds.

As stated previously, NS's Pittsburgh Line from Harrisburg to Pittsburgh is essentially double track with three tracks over the most mountainous portion west of Altoona. There are secondary routes such as Main Line Conemaugh (Johnstown – Pittsburgh) and the Port Perry Branch (Pitcairn – Pittsburgh) that provide alternative routings for freight trains, in effect creating redundancy and more line capacity. On the double-tracked segments, there are crossovers located approximately every 10 to 15 miles. Originally, nearly the entire distance between Harrisburg and Pittsburgh was "four-tracked."

This route is heavily used for freight rail operating at varying speeds, which necessitates frequent crossovers by passenger rail service and limits the ability to schedule additional service. Additional crossover moves are necessary to access stations that only have platforms on one side of the track.

The line between Harrisburg and Pittsburgh is cab-signaled throughout its length. In double-track territory, both tracks are signaled in both directions. In triple-track territory, two of the tracks are signaled in one direction only, with the third track signaled in both directions.

Stations and Amenities

There are nine stations along the Keystone West corridor, including Harrisburg, Pittsburgh, and seven intermediate stations, ranging from large staffed stations to passenger shelters, as shown on **Figure 1: Project Area Map.** Latrobe,[1] Altoona, Tyrone, Huntingdon, and Lewistown have platforms for passenger boarding and alighting on one side of the tracks only, requiring trains to cross over when traveling east or west to be on the track where the platform is located. This rigid track selection requirement consumes additional line capacity versus scenarios where platforms are located on both tracks. In addition to slowing down the passenger trains, this platform/track configuration creates a potential conflict with freight trains traveling through the station areas.

The availability of basic station amenities and services such as support staff, ticketing services, inside waiting areas, restrooms, and baggage service all influence how potential riders perceive the convenience and utility of the rail service and ultimately their choice of travel mode. With only one Pennsylvanian rail trip in each direction at all corridor stations, station services and amenities have either been scaled back to minimal levels or completely eliminated as in the case of Tyrone. For instance, of the nine total stations, only one (Pittsburgh) offers baggage handling, and that is only for the Capitol Limited (Amtrak’s Washington, D.C., to Pittsburgh, PA, to Chicago, IL, route) since baggage handling is not offered for the Pennsylvanian. Five stations offer no means of purchasing a ticket on-site, five stations are not staffed, three do not offer inside restrooms, and five never have Amtrak customer support staff on site. The total absence or limited availability of such services is a substantial deterrent to travelers choosing to travel by rail. For example, the Tyrone “Station” essentially consists of a large trackside shelter with no services or amenities other than limited protection from the elements.

Although the Americans with Disabilities Act (ADA) of 1990 required that all intercity passenger rail stations (with the exception of flagstops such as Tyrone and Latrobe) meet ADA accessibility requirements by 2010, ADA requirements were not met at all of the stations as of March 2013.

Train Speeds and Travel Times

Passenger train operating speeds along the Keystone West line are limited to 70 or 79 mph, with many civil restrictions of 60 mph for intermodal freight trains. These include 50 mph for other freight and 45 mph for mineral freight. These differences in speeds pose a substantial operating challenge, particularly where only two tracks are available.

The current Pennsylvanian makes seven intermediate stops between Harrisburg and Pittsburgh with a scheduled service time of approximately 5½ hours. This equates to an average speed for passenger service of about 45 mph over the 250-mile route.

[1] Platform improvements at Latrobe Station were not evaluated as part of this study, because Latrobe Station is a flagstop location with minimal ridership and it is not an existing or proposed hub for transit access (such as Tyrone Station, which is proposed as a potential transit hub to State College).

Connecting Services at Stations

Depending on the station, there are various types of connecting transportation services currently available for Pennsylvanian passengers. See **Table 1: Connecting Services at Stations Serving the Pennsylvanian**. Although not shown in Table 1, parking is also an important factor for intermodal connecting services to be successful.

Table 1: Connecting Services at Stations Serving the Pennsylvanian

Station	Intercity Bus	Intercity Rail	Intracity Bus	Intracity Rail
Pittsburgh	X	X	X	X
Greensburg	X		X	
Latrobe			X	
Johnstown	X		X	
Altoona			X	
Tyrone				
Huntingdon				
Lewistown				
Harrisburg	X	X	X	

Ridership

Ridership data from 2007 to 2012 indicate that every intermediate station except Lewistown has been contributing to ridership increases on the Pennsylvanian. See **Table 2: Ridership by Station, 2007 to 2012**. For the six-year period ending in 2012, overall ridership was up nearly 18 percent, for an average annual increase of 3.56 percent. Changes in ridership ranged from Lewistown, which generally registered year-over-year losses in ridership, to Latrobe, which saw its ridership grow by 48 percent. Note that Table 2 provides historical ridership numbers. Future demand is documented in *Keystone West High Speed Rail Study: Passenger and Revenue Forecasts* (October 2013).

The most popular stations of origin and destination for trips along Keystone West are the larger cities served by the Pennsylvanian, including Harrisburg and Pittsburgh. The most common use of the service is for longer trips rather than for travel within the corridor. This is likely due to there being only one daily round trip available to travelers, which is not conducive to attracting shorter-distance trips. This is also an indication that a key market for Keystone West service enhancements will likely be travelers with origins and/or destinations east of Harrisburg.

Table 2: Ridership by Station, 2007 to 2012							
	2007	2008	2009	2010	2011	2012	Percent Change, 2007-12
Pittsburgh[1]	120,188	142,828	135,642	136,333	133,855	129,372	7.6%
Greensburg	10,296	12,882	12,393	14,000	13,097	13,395	30.1%
Latrobe	3,155	4,253	4,224	4,118	4,384	4,669	48.0%
Johnstown	17,368	19,206	20,485	22,779	23,573	23,964	38.0%
Altoona	23,909	25,415	26,669	25,185	25,800	26,978	12.8%
Tyrone	2,369	2,985	3,573	3,322	2,923	3,108	31.2%
Huntingdon	5,303	5,290	5,187	5,794	5,975	5,837	10.1%
Lewistown	11,005	10,674	10,118	9,238	8,200	8,315	-24.4%
Harrisburg[2]	464,924	527,056	539,167	547,257	543,423	571,217	22.9%
Total Pennsylvanian (New York City to Pittsburgh)[3]	180,140	200,999	199,484	203,392	207,422	212,006	17.7%

Notes: The numbers used in this report were updated from the numbers shown in the Purpose and Need report based on best available data and include ridership on all activity at the listed stations, including the Pennsylvanian (Keystone East and West) and Capitol Limited lines, as applicable. A separate breakout for Keystone West alone is not available.

[1] Ridership figures for Pittsburgh include trips on Amtrak's Capitol Limited that do not traverse any portion of Keystone West.

[2] The dominant portion of the Harrisburg ridership figures is for Keystone East trips that do not continue through to Keystone West.

[3] Pennsylvanian ridership totals are for all stations served by the Pennsylvanian and include only riders that used the Pennsylvanian.

Source: Amtrak Government Affairs Fact Sheets, 2007-12

Frequency of Service

Keystone West offers only one daily round trip between Harrisburg and Pittsburgh, also serving the seven intermediate stations. Such limited service all but precludes use for daily commuting of any type. While trip purpose information is not available for current riders, it most likely consists of leisure travel where time is of relatively less importance and the trips are not made on a frequent basis. While eastbound travelers could leave Pittsburgh in the morning and arrive in Harrisburg in time to conduct business that afternoon and the next morning (the equivalent of one full business day), westbound schedules would require two overnight stays in Pittsburgh to conduct the equivalent of one day of business since the westbound train arrives in Pittsburgh in the evening and eastbound departures are scheduled for early in the morning. Of course, rail travel offers passengers the advantage of being able to do work while on board.

3. Corridor Demographics

Detailed information on corridor demographics is provided in the *Keystone West High Speed Rail Study: Project Purpose and Need* (May 2012) report, contained in the project technical files. A brief overview follows.

The corridor study area encompasses portions of 24 counties and includes nearly 40 percent of the state's population. As such, the corridor's socioeconomic profile largely mirrors Pennsylvania as a whole, with some variation between east and west, and urban and rural areas offsetting each other.

Demographic analysis included counties such as Lancaster and Lebanon that are not within the Keystone West corridor. Their inclusion recognizes that even though residents of these counties live outside the Keystone West corridor, they represent both current and potential future users of passenger rail service.

Population estimates from 2009 put the study corridor's population at just over 4.79 million, reflecting a 3.5 percent increase over the past 20 years. Growth has varied widely across the corridor, with population gains in Central Pennsylvania being offset by losses in the west.

Much of the Keystone West line traverses a region with a population density averaging fewer than 500 residents per square mile. However, the major stations are located in the corridor's most densely populated areas, including the Pittsburgh and Harrisburg metropolitan areas that have more than 5,000 persons per square mile. Additionally, the existing alignment directly serves the Altoona and Johnstown metropolitan statistical areas (MSAs), and the State College MSA is close enough to attract riders from that area if attractive connections are available.

Another rail planning indicator is the number of households without access to a vehicle. Corridor-wide, this includes more than 82,000 households. As expected, the corridor's more urban counties have a greater proportion of households without access to a vehicle. In addition, Centre and Indiana counties, with their large student populations, have higher than normal percentages of households without access to a vehicle. Lancaster County, with its large Amish population, is the county with the highest incidence of households without access to a vehicle, at just over 6 percent. In fact, Amish residents frequently rely on rail service for intercity travel.

In addition to these county trends, certain communities have particularly high rates of households without access to a vehicle, such as Indiana, PA (50 percent). These are anomalies, however, as most municipalities in the corridor average less than 3 percent of households without access to a vehicle.

There are also large, contiguous rural areas in western Perry, upper Dauphin, and northern Franklin and Mifflin counties where there are higher than average rates of households without access to a vehicle. In some of the corridor's more urban areas, rates of households without access to a vehicle can vary widely, from 13 percent in Pittsburgh and Harrisburg to only 3.5 percent in Greensburg and Altoona.

While work trips are not the primary market for intercity passenger rail service, current travel habits and mode choices of residents can provide important insight into the potential demand for passenger rail service. Of the nearly 2.26 million workers who reside in the study corridor, nearly

90 percent rely on the private automobile as a means for their journey to work. Use of public transportation in the corridor is relatively low at 3.4 percent when compared to 5.4 percent statewide, with the notable exception of Allegheny County, with just over 10 percent of its resident workers using public transit. Less than 4 percent of the corridor's resident workers walk to work—a rate that is fairly constant across the corridor counties—with the notable exception of the university counties of Centre and Indiana, which have higher pedestrian rates associated with short trip distances.

Overall, the counties in the study corridor have a higher rate of senior residents than does Pennsylvania as a whole. One in six corridor residents is over the age of 65. Not only is the corridor's total senior population growing, but the *proportion* of seniors is growing rapidly as well. This is best seen in data for several counties, including Adams, with its share of senior population spiking by nearly 15 percentage points over the past decade. While the study corridor overall grew by just under one percent, its total population age 65+ grew by 2.5 percent. In addition to Adams County, increases in the senior population of other corridor counties have been driven by an influx of retirees from the suburban Washington and Baltimore metropolitan areas. Only a few counties in the study corridor lost substantial numbers of senior residents, including Allegheny (-21,500) and Cambria (-2,750).

In addition to the size and composition of total population, the U.S. Census Bureau tracks the total number of persons with disabilities. Within the study corridor, there are nearly 273,000 persons between the ages of 16 and 64 with a disability. Nearly 40,000 of these are within the City of Pittsburgh—the highest of any corridor jurisdiction.

According to the Census, there are nearly two million households within the study corridor, which comprises approximately 40 percent of all households in the state. Median household income varies widely from county to county, from a low of $36,369 in Mifflin County to a high of $60,400 in Cumberland County. The same is true when measuring by per capita income: Mifflin County registered the lowest among corridor counties at $18,733 while Cumberland County led with $29,820.

A majority of the study corridor counties have a mean travel time to work that is less than the state average of 25.4 minutes. A majority of corridor counties are within a few points of the state average, with the notable exceptions of 19.3 minutes in Centre County and over 30 minutes in the more isolated, rural counties of Fulton and Perry.

Major Travel Generators and Trip Attractors

Total population can serve as a rough proxy for trip generation/attraction. Pittsburgh and Harrisburg, which are the study corridor's termini, are the corridor's two largest municipalities with many major employers and trip attractors. Pittsburgh and Harrisburg, the state's second- and ninth-largest cities, respectively, are home to tens of thousands of jobs. Pittsburgh, the urban and economic activity center of a seven-county metropolitan region with 2.3 million residents, is the focal point for many of the region's workers.

According to a recent study, Pittsburgh's central business district (CBD) ranked sixth nationally in job density. While the city was built by jobs in steel and later in electronics, it has evolved over the past 40 years into a center for health care, education, and financial services. The largest employer is the University of Pittsburgh Medical Center (UPMC), with approximately 48,000 employees.

Underscoring its importance as a financial center, Pittsburgh is home to global financial institutions such as PNC Financial Services and Mellon Bank, in addition to seven Fortune 500 companies.

As the state's capital, Harrisburg has extensive public sector employment in state and federal government, which contributes to the region's financial stability. The presence of military installations, including the Naval Inventory Control Point (NAVICP) and New Cumberland Defense Depot Susquehanna (DDSE), also provide relatively stable, defense-related employment. Like Pittsburgh, the Harrisburg area is a major center for education, manufacturing, and business, in addition to being a transportation hub. Harrisburg's strategic position on the national interstate network and location among national markets led to the rise of warehousing and distribution in Central Pennsylvania.

State College, a major and growing urban center located north of the corridor, is an important economic center for the region. It is home to a variety of private sector jobs and the main campus of the Pennsylvania State University. There are a wide variety of employment opportunities associated not only with the university itself, but also with the private employers that have prospered along with the university. Beyond the employment considerations, State College has a large student population of more than 40,000.

The Keystone West corridor includes smaller cities that are regional employment centers, most notably Altoona, Greensburg, and Johnstown. These urban areas are metropolitan centers in their own right, with large numbers of jobs. Johnstown's labor shed, for example, is so expansive that it includes all of Cambria County as part of the defined metropolitan statistical area. Manufacturing, and particularly railroading and steel, helped Altoona and Johnstown, respectively, develop into the regional employment centers they are today.

Other smaller population and employment centers in the corridor, such as Huntingdon, Lewistown, and Tyrone, still represent important employment areas. These smaller areas have been defined by the U.S. Census as Micropolitan Statistical Areas, recognizing their importance to the state and national economy. The Micropolitan designation was first used in 2003 to identify areas outside the larger regional economic centers that have distinct economic and population characteristics.

The study corridor includes a diverse mix of major tourist attractions and other regional traffic generators, such as state and local parks, ski resorts, museums/historic sites, amusement parks, memorials, zoos, and sports arenas. The Pennsylvania Tourism Office does not have visitor information on specific destinations other than national park sites under the National Park Service. Visitor information on private operations such as Hersheypark, for example, is not available because this information is proprietary and confidential.

Journey to work commutation patterns vary widely throughout the corridor. As noted previously, commuters are not a primary target of intercity rail services. However, this data is included here since it provides a coarse indication of overall travel demand and the relative level of travel desire between communities within the study area. Inter-county commuting has increased in recent years, as some corridor counties (such as Perry) now "export" more than half of their resident workforce to other counties for employment. Other points serve as major destinations for workers within the corridor, such as the Pittsburgh and Harrisburg metropolitan areas.

The corridor's strongest inter-county commuting relationship exists between Allegheny and Westmoreland counties, with the exchange of workers numbering in the tens of thousands. Counties outside of the corridor such as Beaver and Butler also export substantial numbers of workers into Allegheny County. Similar commuting patterns exist on a smaller scale among Dauphin, York, and Cumberland counties, yet the exchange of workers still numbers in the tens of thousands. State College generates thousands of out-of-county work trips from Blair, Huntingdon, and Mifflin counties. Finally, there is relatively strong travel demand for journey-to-work trips between Blair and Cambria counties, with thousands of workers crossing county lines for employment.

C. Study Goals

The overall goal of the Keystone West High Speed Rail Project is to extend higher speed rail service from Harrisburg to Pittsburgh (Keystone East currently provides high speed rail service between Philadelphia and Harrisburg), thereby increasing ridership on the western portion of the Pennsylvanian line and stimulating regional economic development. Detailed study goals include evaluating strategies and alternatives to:

- Increase passenger train speeds and reduce travel times.
- Increase service frequency with a longer-range goal of three to four round trips daily.
- Improve access and connectivity.
- Improve passenger rail amenities to complement other improvements.
- Establish effective institutional partnerships that emphasize use of existing infrastructure, cost sharing/adequate funding, land use context, and value added and economic benefits.
- Stimulate economic development along the corridor and throughout the region.

II. PURPOSE AND NEED

A detailed analysis of the purpose and need for this study is provided in the *Keystone West High Speed Rail Study: Project Purpose and Need* (May 2012) report, contained in the project technical files. The referenced Purpose and Need study established important context and a broad foundation for this Feasibility Study and Preliminary Service Development Plan.

For More Information

Keystone West High Speed Rail Study, "Project Purpose & Need, Final," May 2012 AND "Passenger and Revenue Forecasts," October 2013

The purpose of this Feasibility Study and Preliminary Service Development Plan (PDSP) is to conduct a planning-level assessment of the physical, operational, and financial feasibility of creating an improved passenger rail service along the Harrisburg – Pittsburgh corridor. This service would address the identified needs, and the study provides a foundation for continued incremental improvements leading to progressively higher speed rail service on the line.

The following three subsections describe the unmet demand, identified needs, and key conclusions that came out of the needs analysis. The unmet demand section provides an overview of overall corridor demand, including the unmet demand for passenger rail service, along the entire Pennsylvanian route between NYC and Pittsburgh. The identified needs section overviews the demand-related project needs that would help address the unmet demand. Finally, several key conclusions are provided in the third subsection, which serve as a foundation for subsequent study phases and ultimately for a phased, long-term program of corridor improvements.

More Information on Estimates of Unmet Need [1]

Source	Assumptions	Estimate
P.R.I.I.A. Section 224 Pennsylvania Feasibility Studies Report, Amtrak/Parsons Brinkerhoff, Inc. 2009	Current Trip Times and fares, one additional frequency	144,000 Annual Ridership Increase
Keystone West High-Speed Rail; Passenger Forecasts, Whitehouse Group, 2013	Base Case – no change in trip time, frequency or fares	2020 –13,000 annual increase 2035 – 29,000 annual increase

[1] Figures represent an estimate of unmet need since no infrastructure or trip times improvements were assumed by Amtrak. The estimates produced by the Whitehouse Group are for the base case scenario. Latent demand that would be attracted under a build scenario would be in addition to these estimates.

A. Unmet Demand

Consistent with the planning-level nature of this study, a course estimate of overall corridor demand was prepared to quantify the unmet demand along the entire Pennsylvanian route between NYC and Pittsburgh. Under a no-build scenario, demand was projected to increase from approximately 212,000 in 2012 to approximately 225,000 in 2020 and 241,000 in 2035. Since these estimates were prepared using current trip times and service frequencies, they reflect a very minimal level of service and therefore represent a lower bound of demand along the corridor. An improved service with more attractive trip times, more frequent service, better connections to the Capitol Limited for travel west of Pittsburgh, and with more convenient intermodal connections, etc. could be expected to attract more riders. The growth in ridership experienced along Keystone East, following similar improvements to that line, attest to the fact that ridership responds when a service is improved to better meet the needs of travelers. A study completed by Amtrak (*P.R.I.I.A. Section 224 Pennsylvania Feasibility Studies Report,* Amtrak/Parsons Brinkerhoff, Inc, 2009) provides further evidence of unmet demand along Keystone West. That study predicted an annual increase of 144,000 trips along the Pennsylvanian route (after accounting for diversion from existing trains) solely from adding one daily round trip to the schedule. That estimate was for the first year following initiation of a second frequency and also was predicated on existing trip times. Therefore, while that estimate provides an indication of current (2009) unmet need, it does not fully account for total unmet needs along the corridor. A more complete estimate of demand, reflecting a comprehensive slate of infrastructure and service improvements, is summarized in **Section VII, Demand**, of this document, and detailed in the technical memorandum *Keystone West High Speed Rail Study: Passenger and Revenue Forecasts* (October 2013).

B. Identified Needs

To help address the unmet demand, an analysis was completed at the outset of the study to identify demand-related project needs as a precursor to finalizing the project scope and approach. The identified project needs are as follows:

- **Travel time between Harrisburg and Pittsburgh is lengthy (5½ hours)** – Reducing the current travel time of 5½ hours could encourage more travelers to choose passenger rail to satisfy a portion of their mobility needs within the corridor.
- **Frequency is limited to one trip per day; connections are inconvenient** – Increasing the service frequency from the current one daily round trip to provide more convenient arrival and departure times, and providing more convenient connections at end points, could make the rail service a viable alternative for travelers.
- **Convenient travel options between Harrisburg and Pittsburgh are lacking** – Providing a more balanced, multimodal transportation network between the endpoints of the corridor and for the intermediate communities could support state, regional, and local goals related to economic development, sustainable land use, environmental practices, energy conservation, etc.
- **East-West access for underserved populations and communities is lacking** – Improving rail service could provide a viable transportation alternative for underserved communities and segments of the population that cannot use or choose not to use the automobile mode that is currently the dominant mode of travel.
- **Rail service does not reach the potential ridership base in State College** – Providing an attractive connecting service between the growing State College/Centre County area (31 percent growth projected by the Chamber of Business & Industry of Centre County for the period 2000-2030) and the mainline of the rail service would better serve the

mobility needs of permanent residents, university students, and people attending special events in that area.

- **Amenities are lacking at existing service stations** – Improving the existing condition of rail station infrastructure and providing amenities such as platforms, weather protection, reasonably-priced parking, baggage handling, ticketing services, etc., could improve the attractiveness of rail service to potential riders at many stations.
- **Intermodal connections at stations are weak** – Improving intermodal connectivity at rail stops could enhance ridership.

C. Related Conclusions

Recognizing that demand, while an important consideration when evaluating the merits of potential investment in rail service, is not the sole factor that drives investment decisions, other considerations were also documented as part of the Purpose and Need Analysis. Several key conclusions from the Purpose and Need Analysis shaped the alternatives presented in this report. Each conclusion is summarized briefly below (more details on each are provided in the referenced Project Purpose and Need Report). These conclusions provide a foundation for subsequent study phases and ultimately for a phased, long-term program of corridor improvements.

- Improved corridor mobility and access is a supportable goal.
- Service and travel time disparities between the Keystone West and Keystone East corridors merit attention and long-term gap closure.
- The corridor has an extensive array of travel generators that bode well for market development.
- Improvements are needed to support rail network connectivity (within and beyond Pennsylvania).
- Community and economic development can be bolstered through improved corridor access and travel alternatives.
- Transportation system redundancy is strategically important for the corridor and the Commonwealth.
- Pennsylvania's unique sociodemographics underscore the need for a more multimodal approach to transportation planning and system development.
- The environmental benefits of rail passenger transportation justify reasonable efforts to promote this mode.
- A focus on improving existing transportation assets is a pragmatic approach in an era of fiscal constraint.
- The freight/passenger challenges demand innovative methods and institutional cooperation.

The topics mentioned above–unmet demand, identified project needs, and the related conclusions–will serve as the key metrics for comparing alternatives. A more detailed discussion of those metrics can be found in **Section IV, Alignment Alternatives**.

III. ENVIRONMENTAL OVERVIEW

This section presents an overview of the environmental and topographic challenges that are faced by the Keystone West corridor. From large river crossings to steep mountainous terrain and rural areas with limited accessibility to highly developed urban areas, the Keystone West corridor presents a variety of challenges. These challenges were identified early in the study, before developing improvement options, which allowed the project team to prepare more accurate preliminary concepts for consideration.

The Keystone West corridor—from its origins in the City of Pittsburgh, through the rural boroughs and small cities that were built by the railroad, to the City of Harrisburg—passes through industrial and scenic landscapes that tell the story of western and central Pennsylvania.

Based on the high-level nature of the study, the collection of detailed ground-level environmental resource information was not feasible. Therefore, readily available secondary source geospatial environmental data was collected for use in developing an environmental constraints map. Select environmental information and features were collected from the Pennsylvania Spatial Data Access (PASDA) webpage. Data was collected for a one-mile-wide corridor extending one-half-mile to each side of the existing Keystone West rail line.

Historic resource information was obtained from the Pennsylvania Historical and Museum Commission (PHMC) through their Cultural Resources Geographic Information System (CRGIS). In addition, the Pennsylvania Department of Conservation and Natural Resources (PA DCNR), the Pennsylvania Fish and Boat Commission (PFBC), the Pennsylvania Game Commission (PGC), and the U.S. Fish and Wildlife Service (USFWS) were contacted to compile information on the presence of threatened and endangered species along the project corridor.

The select environmental features shown on the Environmental Constraints Map include the following:

- Known hazardous waste sites
- National Wetland Inventory (NWI) wetlands
- Streams, waterways, lakes, and ponds
- Floodplains
- Known / high probability historic resources
- Threatened or endangered species areas of concern
- Public lands

Following the data collection process, all information was plotted on project area maps (**See Appendix A: Environmental Constraints Mapping**) for determining potential environmental impacts. This section provides a brief overview of the environmental features found within the Keystone West corridor, broken down by station-to-station segments. The corridor for purposes of this environmental overview is one-mile wide extending one-half-mile to each side of the existing Keystone West rail line. Potential environmental impacts are discussed in **Section IV.F**.

PITTSBURGH – GREENSBURG

This 31-mile section of the Keystone West corridor contains two major watersheds (the Monongahela River and Allegheny River watersheds) and passes over or near 13 larger streams, including the Monongahela and Allegheny rivers, and Little Sewickley and Turtle creeks. The Allegheny River watershed is a High Quality (HQ) watershed, meaning that special measures to protect water quality may be required for projects in that area. Two lakes (Herron Hill and Mountain Valley) are also located within this section of the corridor. The area between Pittsburgh Station and Greensburg Station is home to more eligible (105) and listed (39) National Register of Historic Places sites than any other segment of Keystone West. Two National Historic Landmarks and a large number of local and municipal parks/playgrounds (44) are also located along or near Keystone West in this area. There is only one coal mining operation in this section of the corridor; however, potential hazardous waste sites are numerous (including 256 storage tank locations, 15 residual/municipal waste operations, 23 brownfields, 191 captive hazardous waste operations, and 132 land recycling cleanup operations).

Pittsburgh – Greensburg is some of the most densely-developed land use in the entire Keystone West corridor. The area is densely to moderately developed throughout. No large tracts of undisturbed terrestrial habitat exist in this section. Few NWI wetlands and no known areas of threatened and/or endangered (T&E) species habitat are mapped in this area.

GREENSBURG – LATROBE

The 10 miles between Greensburg Station and Latrobe Station cross over or near six larger stream corridors, including Fourmile Run and Loyalhanna Creek, and pass two lakes or reservoirs. Eleven eligible and four listed National Register historic sites are found in this section of the corridor, along with eight local or municipal parks/playgrounds. Coal mining operations (four) are somewhat more prevalent than in the section to the west; however, much less hazardous waste potential exists in this area (eight storage tank locations, four residual/municipal waste operations, no brownfields, 24 captive hazardous waste operations, and 17 land recycling cleanup operations).

The Greensburg – Latrobe section of the corridor is moderately to sparsely developed with no large contiguous tracts of undeveloped terrestrial habitat. No NWI wetland areas and no T&E areas are mapped in this corridor segment.

LATROBE – JOHNSTOWN

Between Latrobe Station and Johnstown Station (37 miles) the corridor crosses or passes by 26 larger stream corridors, including the Conemaugh River, Stonycreek River, and Loyalhanna Creek, as well as two reservoirs/lakes. Three streams in this area—Trout Run, Tubmill Creek, and a portion of Baldwin Creek—are designated as Exceptional Value (EV) Waters. A portion of Baldwin Creek is also HQ along with eight other streams (Clark Run, Conemaugh River, Findley Run, Laurel Run, Miller Run, Poplar Run, Shannon Run, and Shirey Run). As mentioned, the EV and HQ designations require special measures to ensure that water quality is not degraded in these watersheds. National Register of Historic Places sites in this segment include 14 eligible sites and 11 listed sites, and there are two National Historic Landmarks. Nine local/municipal parks/playgrounds are found in this area, along with one state forest (Gallitzin), one state park

(Laurel Ridge), and two state game lands. Coal mining operations (30) are much more prevalent in this section of the corridor, along with 211 storage tank locations, six residual/municipal waste operations, 278 captive hazardous waste operations, 82 brownfields, and 333 land recycling cleanup locations.

Land in this portion of the Keystone West corridor is more sparsely developed, and numerous large contiguous undisturbed tracts of terrestrial land exist. NWI wetland areas have been mapped in this area, including a large wetland complex just east of Derry Borough. In addition, known areas of T&E species habitat begin just east of Derry.

JOHNSTOWN – ALTOONA

The 40 miles between Johnstown Station and Altoona Station contain some of the steepest topography of the entire corridor, along with 20 larger stream corridors (Conemaugh River and its branches/forks) and three lakes/reservoirs. One EV stream (Bens Creek) and four HQ streams (Saltlick Run, Noel's Creek, Mill Run, and Little Conemaugh River) exist in this section of the corridor. Thirty-two eligible and 11 listed National Register of Historic Places sites are found in this segment, along with seven National Historic Landmarks (including the Allegheny Portage Railroad) and two state game lands. Twenty coalmining operations and a significant amount of potential hazardous waste sites (25 storage tank locations, seven residual waste operations, four captive hazardous waste operations, 34 brownfields, and 13 land recycling cleanup operations) are located between these two stations.

Between Johnstown and Cresson, the land use is more developed than the area between Cresson and Altoona, where larger tracts of terrestrial habitat exist. Several NWI wetland complexes are mapped along the numerous stream corridors in this portion of the Keystone West corridor. Most of this area is mapped as T&E habitat. The largest areas of disturbed ground are also found in this area, especially near South Fork where large coal spoils can be found.

ALTOONA – TYRONE

Between Altoona and Tyrone, 15 miles of the Keystone West corridor cross over or pass one reservoir and 11 larger stream corridors, including the Little Juniata River. The Little Juniata River and Tipton Run are both HQ streams. No public (local, state, or national) parks or coal operations are located in this section. Potential hazardous waste areas consist of 12 storage tank locations, seven residual/municipal waste operations, five captive hazardous waste operations, one brownfield, and 11 land recycling cleanup locations).

Between Altoona and Tyrone the land use ranges from dense at Altoona, to moderately developed and sparse in some areas, to dense development at Tyrone. Large NWI wetlands exist along the Little Juniata River throughout this section of the corridor. This entire segment of the corridor is identified as T&E habitat.

TYRONE – HUNTINGDON

Within the 20 miles between the Tyrone Station and the Huntingdon Station, 10 larger stream corridors are found, including the Juniata River, Little Juniata River, and Spruce Creek. Six HQ streams are present in the corridor between Tyrone and Huntingdon, including the Juniata and Little Juniata rivers; Frankstown Branch; and Shaver, Spruce, and Standing Stone creeks. Six eligible and six listed National Register historic sites are within this segment of the corridor, as are one state forest (Rothrock) and one state game land. No coal operations, 18 storage tank locations, three residual/municipal waste operations, and 13 land recycling cleanup locations are found in this area. This segment of the corridor is where the karst geology of central Pennsylvania becomes evident. Areas of karst (typically limestone) are known for subsurface caverns and the potential for sinkhole development.

From Tyrone to Huntingdon the corridor is more sparsely developed with large tracts of agricultural land. Large wetland complexes exist along the Juniata River, especially near Petersburg Borough. This section of the corridor is known T&E habitat throughout.

HUNTINGDON – LEWISTOWN

The 37 miles between Huntingdon and Lewistown contains 24 larger stream valleys, including the Juniata River, Raystown Branch, and Standing Stone Creek. Twenty of these streams are listed as HQ watersheds (Juniata River, Standing Stone Creek, Hill Valley Creek, and the smaller runs: Beaverdam, Carlisle, Deep Hollow, Furnace, Granville, Maley Hollow, Minehart, Musser, Pike, Scrub, Shanks, Shaughnessy, Strodes, Sugar Grove, Town, Wakefield, and Wharton). Tuscarora State Forest and two state game lands are within the Keystone West corridor in this area, as are one National Historic Landmark, and seven eligible and six listed National Register of Historic Places sites. No coal operations and few potential hazardous waste sites are located in this area (two storage tank locations, six residual/municipal waste operations, one brownfield, and 12 land recycling cleanup locations). This segment of the corridor contains the most karst features of any of the mainline Keystone West segments, indicating a higher potential for subsurface caverns and sinkholes.

Most of this area is sparsely developed to undeveloped, with a few areas of more-developed land such as McVeytown. Abundant agricultural land exists throughout this section of the corridor, as do numerous NWI wetland complexes along the Juniata River. This entire section of the corridor is also known T&E habitat.

LEWISTOWN – HARRISBURG

Between Lewistown Station and Harrisburg Station, the 60 miles of Keystone West corridor cross over or pass 36 larger stream corridors (including the Juniata and Susquehanna rivers) and three lakes or reservoirs. Eight HQ streams exist in this section of the corridor, including the Juniata and Susquehanna rivers; Buffalo, Clark, East Licking, and Kishacoquillas creeks; and Granville and Macedonia runs. Three local/municipal parks, Tuscarora State Forest, and five state game lands are found in this area. No coal operations and no karst geology is within this segment of the corridor; however, there are 217 storage tank locations, 15 residual/municipal waste operations, two captive hazardous waste operations, five brownfields, and 70 land recycling cleanup locations.

The Lewistown – Harrisburg section starts off sparsely developed and becomes more densely developed near Harrisburg. Few NWI wetlands exist in this corridor, but the entire segment is known T&E habitat.

TYRONE – STATE COLLEGE (SPUR)

Along the 17-mile spur from Tyrone to Lemont are 21 stream corridors, including Bald Eagle Creek and the Little Juniata River. Laurel Run and portions of Bald Eagle Creek, Big Fill Run, and Wallace Run are EV streams. HQ watersheds include the Little Juniata River, Buffalo Run, Logan Branch, Slab Cabin Run, Spring Creek, and portions of Bald Eagle Creek. Eight eligible and two listed National Register of Historic Places sites, four local/municipal parks, one state fish culture station, and one state game land are also located in this area. No coal operations are found along this spur; however, there are 179 storage tank locations, 18 residual/municipal waste operations, 37 captive hazardous waste operations, and 54 land recycling cleanup locations. This spur area also contains the highest incidence of karst geology in the study corridor, indicating the greatest potential for sinkholes.

Land use along this spur is sparsely developed to undeveloped. Large areas of agricultural land are present in the northern reaches of the spur corridor. Numerous NWI wetlands exist and this area is also known T&E habitat.

IV. ALIGNMENT ALTERNATIVES

A. Approach

> **For More Information**
>
> Keystone West High Speed Rail Study, Documentation for Project File, "Refined Conceptual Alternatives Assessment," December 2012.

The analysis of conceptual alternatives involved a two-phased approach. The first phase identified and conducted a high-level screening of potential alternatives, and produced a short list of alternatives based on (a) feasibility of implementation from an engineering, cost, and environmental impact perspective, and (b) their relative abilities to satisfy project goals. During the second phase, the shortlisted alternatives were subject to additional analyses that focused primarily on refining the scope of individual project elements, conducting a conceptual engineering analysis, refining estimated capital costs, and assessing environmental considerations in more detail. Following that effort, an operational analysis was completed to assess potential time savings demand, estimates were prepared, a financial analysis conducted and economic benefits analyzed.

Since the alternatives analysis was conducted in the context of a conceptual feasibility study, the objective of this analysis was not limited to recommending a single alternative. Rather, the focus was on identifying a "menu of options" for incrementally increasing speeds of passenger trains and providing the capacity for additional passenger train frequencies, while not adversely affecting current Norfolk Southern operations and future opportunities.

As was the case for most of the work completed under this feasibility study, previous studies and reports were the primary resources used for identifying alignment alternatives and the individual elements of each alternative. The following discussion uses a National Environmental Policy Act (NEPA)-like approach to alternatives analysis, which includes a comparison of full alternatives. In this context, "full alternative" encompasses all relevant improvements between logical termini at the corridor ends (Pittsburgh and Harrisburg). Recognizing that under today's tight fiscal constraints construction of a 250-mile-long improvement alternative could prove to be unrealistic, interim improvements were also analyzed as a set of independent options—each would produce benefits even if the others weren't constructed (i.e., independent utility).

B. Alternatives Development

Previous studies revealed a number of common elements regarding possible improvements for passenger rail service between Harrisburg and Pittsburgh. Each of these elements could stand alone or be combined with others. The list below explores possible types of improvements that could be undertaken to enhance service between Harrisburg and Pittsburgh. Each of these improvement types was considered during the development of conceptual alternatives:

- **Add track, including passing sidings, to increase capacity –** Most of these improvements could be accomplished mainly within the existing right-of-way, but some projects would require involvement of off-line areas.

- **Straighten curves –** Softening track curvature can allow higher operating speeds. While some curve straightening could be done within existing right-of-way, most would likely require some property acquisition.
- **Improve curves –** Modifying existing curvature to maximize superelevation (*banked turns*) and lengthen spirals could increase speed by 5 to 10 mph. Superelevation would be restricted by NS maximums for freight operations anywhere that mixed operations are contemplated. Most curve modification work would occur within existing right-of-way.
- **Construct off-line alignments –** These improvements, located primarily on new right-of-way, would provide straighter, higher speed track where curve straightening is not feasible.
- **Add station tracks –** This would allow for more efficient platforming of passenger trains without disrupting freight movements.
- **Construct high speed turnouts** (*in the context of this study,* "*turnouts" are devices that enable trains to be guided from one track to another*) – The highest speed existing turnout on Keystone West is capable of a 45 mph turnout speed. High speed tangential turnouts are currently available that enable trains to operate through them at up to 80 mph. Use of the turnouts would require modification of the NS signal system.
- **Install concrete ties –** Concrete ties are desirable on higher speed lines as they provide a smoother ride.
- **Complete grade separations –** While grade separation may only nominally increase speed or capacity, it is recommended on high speed lines for safety reasons.
- **Construct high platforms –** These may not increase running speeds or capacity, but they do allow for easier loading and unloading at busy stations, which reduces dwell times and overall travel time. High platforms are also an important aspect of ADA compliance. However, they can cause freight train clearance issues at stations for double-stack and/or wide loads.
- **Add service to State College –** All of the alternatives include provision for either a rail spur or bus service connection to State College.

There are a number of constraints that affect the identification of alternatives, their scope, and their costs, not the least of which is the fact that NS is the sole owner of the right-of-way and tracks. In early communications with NS on this project, the following expectations were stated by NS regarding use of their facilities for enhanced passenger operations:

- Provision of sufficient infrastructure for passenger trains and freight trains to operate without delay to either.
- Provision of sufficient infrastructure so that each type of train can operate without conflict.
- Compensation to NS for the use of its facilities and an assurance that all incremental costs to NS will be covered.
- NS dispatch control of all trains on its lines.
- Full liability protection for NS.
- Provision of separate tracks for passenger trains operating in excess of 79 mph, and separate right-of-way for passenger trains in excess of 90 mph.

C. Alternatives Considered

After reviewing the previous information along with existing track alignment information, topography, and using the purpose and need statement to guide alternatives development, four conceptual alternatives were identified for evaluation and screening. It should be noted that no field surveys were completed as part of the initial identification. Screening of alternatives and all capital cost estimates were based on extensive assumptions regarding factors that affect quantities. All alternatives except Alternative 4 were designed to make maximum utilization of the existing NS mainline. Alternative 4 represents a more visionary alternative that could deliver true high speed rail service, albeit at a much higher cost.

As explained in the Technical Memorandum *Keystone West High Speed Rail Feasibility Study: Refined Conceptual Alternatives*, four alignment alternatives were identified as summarized in **Table 3: Summary of All Alignment Alternatives Considered**.

Table 3: Summary of All Alignment Alternatives Considered

Alternative/Capital Infrastructure Cost / (Order of Magnitude Right-of-Way Cost)	Description/Rationale
Base Case	**Existing Alignment and Infrastructure Without Further Improvements**
Alternative 1/ $1.5 billion / ($400,000)	**Existing Alignment, Modest Infrastructure Improvements** – Improvements confined to existing right-of-way and the fewest challenges to implement. This alternative provides slight capacity and speed improvements, and is the least expensive alternative.
Alternative 2/ $9.9 billion / ($14M)	**Existing Alignment, With Major Improvements and Some New Off-Line Sections** – Includes all improvements from Alternative 1 plus additional improvements that would require property acquisition at key locations and, in some instances, require significant lead time to implement. This alternative provides for greater capacity and speed improvements than Alternative 1, and is more expensive than Alternative 1.
Alternative 3/ $13.1 billion / ($16M)	**Existing Alignment, With Major Improvements and Some New Off-Line Sections and Additional Track or Tracks for Entire Route** – Improvements which may require large amount of property acquisition and lead time. This alternative is more expensive but provides for greater capacity and speed improvements than Alternatives 1 and 2. The addition of a continuous third track would allow more frequent passenger service with less chance of disruption to NS operations.
Alternative 4/ $38.2 billion / ($50M)	**Passenger-Only High Speed Tracks on New Alignment** – Improvements that require maximum property acquisition and potential impact, lead time, and funding; but result in true high speed rail service with no significant capacity limitations while providing the fastest, most direct route/service between the corridor endpoints. The existing line would be maintained for freight and regional/local passenger service.

The costs listed above represent conceptual capital cost estimates that were prepared based on quantities estimated from secondary sources (aerial imagery, topographic mapping, track charts of the existing railroad, etc.) but without the benefit of original field work or surveys. Sufficient preliminary work had been done to permit a high-level assessment of physical feasibility (civil, environmental, etc.); and initial discussions were held with key stakeholders including

PennDOT, Norfolk Southern, and Amtrak to get an early indication of institutional acceptance of various approaches to improving Keystone West passenger rail service. A qualitative assessment was also completed to ascertain the relative abilities of the alternatives to achieve the study objectives for more frequent and faster passenger rail service as well as non-service related factors (e.g. economic development, community revitalization, etc.).

D. Screening and Shortlisting of Alternatives

1. Metrics Evaluation

Unlike a detailed corridor study where multiple alternatives are defined in detail (capital costs, fare and level-of-service elasticities, environmental and other impacts, demand, ongoing operating costs and deficits, etc.), the Keystone West Study was commissioned as a conceptual feasibility study to identify alternatives and to present realistic options for improving passenger rail service along the corridor. Knowing that the cost of detailing each alignment alternative would be prohibitive given the study budget, a two-tiered approach was employed that included (1) an early definition/evaluation/filtering of alignment alternatives to identify realistic alignment alternative(s) that would be the subject of (2) a more detailed study including ridership forecasts, operations alternatives, equipment considerations, financial plan, phased implementation considerations, etc. To accomplish this, PennDOT and the Study team prepared planning-level descriptions of alignment alternatives and completed a systematic comparison of alternatives that focused on (a) the ability of the alignment alternatives to satisfy stated project goals and identified needs, and (b) an assessment of probable costs, impacts, feasibility, probability of public and stakeholder acceptance, and benefits. All of the evaluation metrics can be traced back to study goals, objectives and feasibility considerations. PennDOT and the consultant team collaboratively developed the metrics, based on the Purpose and Needs analysis and feedback from public and stakeholder (including Amtrak and Norfolk Southern) outreach activities. To assure a balanced approach regarding feasibility, metrics were developed to represent physical, financial and institutional feasibility. Operational feasibility was not a key factor for the preliminary screening since the focus, at this point, was on alternative alignments with the intention of evaluating operational feasibility only for the shortlisted alternatives (see **Section V, Rail Operations**). Although no formal weighting of the metrics was employed, emphasis was placed on feasibility as a means of prioritizing feasible study outcomes rather than otherwise attractive alternatives that had little probability of being implemented.

While a true high speed rail line traversing the Commonwealth would position Pennsylvania as an integral link in a potential regional/national high speed rail network and would likely create significant mobility and economic benefits over the long term, past experience has demonstrated that the probability of implementation of this most ambitious approach can be low. Several states including California, Florida and Texas have attempted to launch major high speed rail projects, only to have most of them falter for lack of adequate institutional support and financing. Pennsylvania attempted to launch a true high speed rail initiative between Philadelphia and Pittsburgh in the 1980s, but that effort also was aborted with no resulting improvements in rail infrastructure service. Recognizing the history and the success rate of these proposals and knowing that the current passenger rail service along the Keystone West corridor (one round trip daily) is at a minimal level, PennDOT and the study team elected to focus study efforts on incrementally higher passenger rail speeds and service levels. With a 250-mile corridor in which to identify and evaluate feasible options, an early screening of alignment/infrastructure alternatives was conducted to focus the remaining study resources and activity on options that have a reasonable likelihood of implementation. This is consistent with the conceptual nature of the study and the emphasis on feasibility.

Based on the information compiled during the initial phases of the study, the Infrastructure/Alignment Alternatives were screened for feasibility and ability to satisfy identified project needs, using metrics shown in **Table 4: Alternatives Metrics Screening** (a more detailed description for each of the metrics related to project goals and needs is included in **Appendix C, Explanation of Alternatives Evaluation Metrics**). As previously noted, this was done to ensure that the remaining study resources would be spent on work that could lead to realistic infrastructure and service improvement options that reasonably addressed project objectives and identified needs. The application of the metrics was simply a tool used to help inform the decision making process–not to dictate the final decision as to which alternative(s) to advance for further study.

The No-Build Alternative would meet the metrics related to feasibility only because it would continue the existing alignment and infrastructure with only maintenance type improvements. Metrics related to costs, phased implementation, physical feasibility, etc. really do not apply as the No-Build would have no increased costs above existing maintenance, would not require implementation, and would require no physical work or disturbances, beyond maintenance. However, when the No-Build option is considered against the Project Goals, Objectives, and Needs it would not do anything to improve the existing Keystone West service; therefore, it is unable to meet any of the established goals, objectives or needs.

The build alternatives would each meet, to some extent, the project goals, objectives and needs. Because this study was established with the goal of providing high speed passenger rail, Alternative 4, which is entirely on new alignment and the only alternative to truly provide high speed passenger rail, would best meet the needs for travel between the corridor endpoints. Passengers with at least one end of their trip at one of the intermediate stations may realize only a partial benefit or perhaps no benefit at all. Alternatives 2 and 3 provide similar improvements with the only difference between the two being that through addition of a continuous third set of tracks, Alternative 3 provides additional capacity beyond Alternative 2. Both Alternatives 2 and 3 would reduce travel times to approximately 4½ hours, but neither would be able to achieve true high speed rail. Alternative 1 would improve travel times, but to a significantly lesser extent than Alternatives 2 and 3.

All build alternatives would include the option for increased service frequency. However, Alternative 4, due to providing an entirely new alignment dedicated to passenger rail, and Alternative 3, by providing a new continuous third track, would have the ability to increase service frequency.

Alternatives 1, 2, and 3 would improve access and connectivity at the existing stations to similar levels due to providing similar improvements at the existing stations. Alternative 4 would improve access and connectivity between Harrisburg and Pittsburgh, but would bypass the existing stations and the communities that have come to rely upon train service. Therefore, Alternative 4 was assessed to improve overall access and connectivity to a lesser degree than the other build alternatives.

All of the build alternatives would improve amenities at existing (or proposed in the case of Alternative 4) rail stations to a similar level. However, because Alternative 1 is proposed as the "low-cost" option and would not include all of the same station improvements as Alternatives 2 and 3, it was assessed to improve amenities to a lesser degree.

Table 4: Alternatives Metrics Screening						
	No-build	**ALT 1**	**ALT 2**	**ALT 3**	**ALT 4**	**Comment**
Metrics Related to Project Goals, Objectives and Needs						
Increasing passenger train speeds and reducing travel times (4½ hours nearer term, 3½ to 4 hours longer term)[1]	1	3	4	4	3	Alternative 1 would improve travel times by approximately 5 minutes westbound and 9 minutes eastbound; Alternatives 2 and 3 would decrease westbound travel by 30 minutes and eastbound by 35 minutes (plus reductions in recovery times in both directions), Alternative 3 would add more capacity; Alternative 4 would be true high speed rail (all new alignment), but would primarily benefit only the endpoint communities and through travelers.
Increasing service frequency (2 daily round trips near term, three to four daily round trips longer term)[1]	1	4	4	5	4	All options would add an additional service frequency; Alternatives 3 and 4 would add capacity and more opportunity for additional frequencies. However, Alternative 4 would only benefit endpoint communities and through travelers.
Improving access and connectivity (better connections at Pittsburgh for travel to/from the West, better intermodal connections to State College and other stations, where warranted)[1]	1	4	4	4	3	Alternative 4 would improve connectivity; however, due to the new alignment the connection to State College would be compromised due to distance, as would access/connectivity for intermediate station stops.
Improving passenger rail amenities to complement other improvements[1]	1	4	5	5	5	Alternative 1 includes amenity improvements similar to the other three build alternatives, but with some downscaling of the improvement due to the nature of the alternative (low cost)
Stimulating economic development along the corridor and throughout the region (temporary and permanent jobs, community revitalization, role for PA rail supply industry, support for tourism, etc.)[1]	1	3	4	4	2	Alternative 4 would relocate Keystone West to a new corridor and would construct new stations outside of existing communities; therefore, while the improvements could stimulate development at the existing end stations (Pittsburgh and Harrisburg), the existing interior stations would not benefit.

Table 4: Alternatives Metrics Screening						
	No-build	**ALT 1**	**ALT 2**	**ALT 3**	**ALT 4**	**Comment**
Metrics Related to Feasibility						
Capital cost/ initial and ongoing financial feasibility[1]	5	4	3	2	1	While the No-Build was rated a 5 for this criteria due to not requiring additional capital investment or operating cost outlays, it is possible that by not improving the line ridership will not be sufficient to support continued operation into the future. The scoring of the remaining alternatives reflects their respective levels of required capital and operating cost outlays
Physical (civil) feasibility[1]	5	4	3	2	1	The No-Build would have no impediments to implementation since no improvements are involved. Of the build alternatives, Alternative 1 would involve the fewest challenges and be the easiest to construct.
Suitability for phased implementation[1]	1	5	5	5	2	The No-Build does not include any improvements, therefore phased implementation is not applicable. Alternatives 1, 2, and 3 could be implemented in a phased fashion while yielding partial benefits with each phase. Alternative 4 would not produce meaningful benefits unless the entire line was built.
Probable environmental impact/feasibility[1]	5	4	3	2	1	The No-Build would have no environmental impacts or feasibility concerns. Alternative 1, which consists of the fewest improvements, mostly contained within existing right-of-way, would have less environmental impacts and would have fewer feasibility concerns. Alternatives 2 and 3 would have similar impacts and feasibility; however, Alternative 3 due to the continuous third track would create more impacts and have more feasibility issues related to right-of-way. Alternative 4 due to being completely on new alignment would be the least feasible alternative and would create the most impacts.

Table 4: Alternatives Metrics Screening						
	No-build	**ALT 1**	**ALT 2**	**ALT 3**	**ALT 4**	**Comment**
Probable institutional feasibility/acceptance/potential for partnerships[1]	4	4	3	3	1	Norfolk Southern would likely prefer the No-Build. Amtrak, PA's rail industry suppliers, and communities that currently host intermediate point rail stations would likely prefer Alternatives 1, 2, or 3. Alternative 4 would likely be viewed less favorably by communities at current intermediate stops since they would be bypassed by a new alignment. Environmental opposition is likely for Alternative 4.
Probable public acceptance/support[1]	1	3	4	4	2	The No-Build is perceived by many as not providing an adequate level of service. The cost and land requirements of Alternative 4 could likely generate much opposition.
Total Average Metric Score	**2.36**	**3.82**	**3.82**	**3.64**	**2.27**	Sum of scores divided by number of metrics (11)
Total Metric "Score" ranking	**2**	**5**	**5**	**3**	**1**	Ranking of the sum of scores divided by number of metrics (11) – Note that there is no ranking of "4" as Alternatives 1 and 2 had equal average rankings and therefore, both have been assigned a ranking of "5".

NOTES: [1] For each metric, a value of "1" indicates the least favorable score and "5" indicates the most favorable score

Alternatives 1, 2, and 3 would optimize the use of existing infrastructure much better than Alternative 4, which is predominantly on new alignment. Alternatives 1, 2, and 3 would also support sound land use practices and encourage value-added development around existing stations, which Alternative 4, due to being on new alignment, would not. Therefore, Alternative 4 was ranked lower for establishing effective institutional partnerships compared to the other build alternatives.

Similarly, because Alternative 4 is on new alignment and would move the Keystone West corridor out of the communities that currently depend upon passenger rail service, it was ranked lower for stimulating economic development. Alternative 1 was assessed lower than Alternatives 2 and 3 because it will not provide as much improvement in travel time.

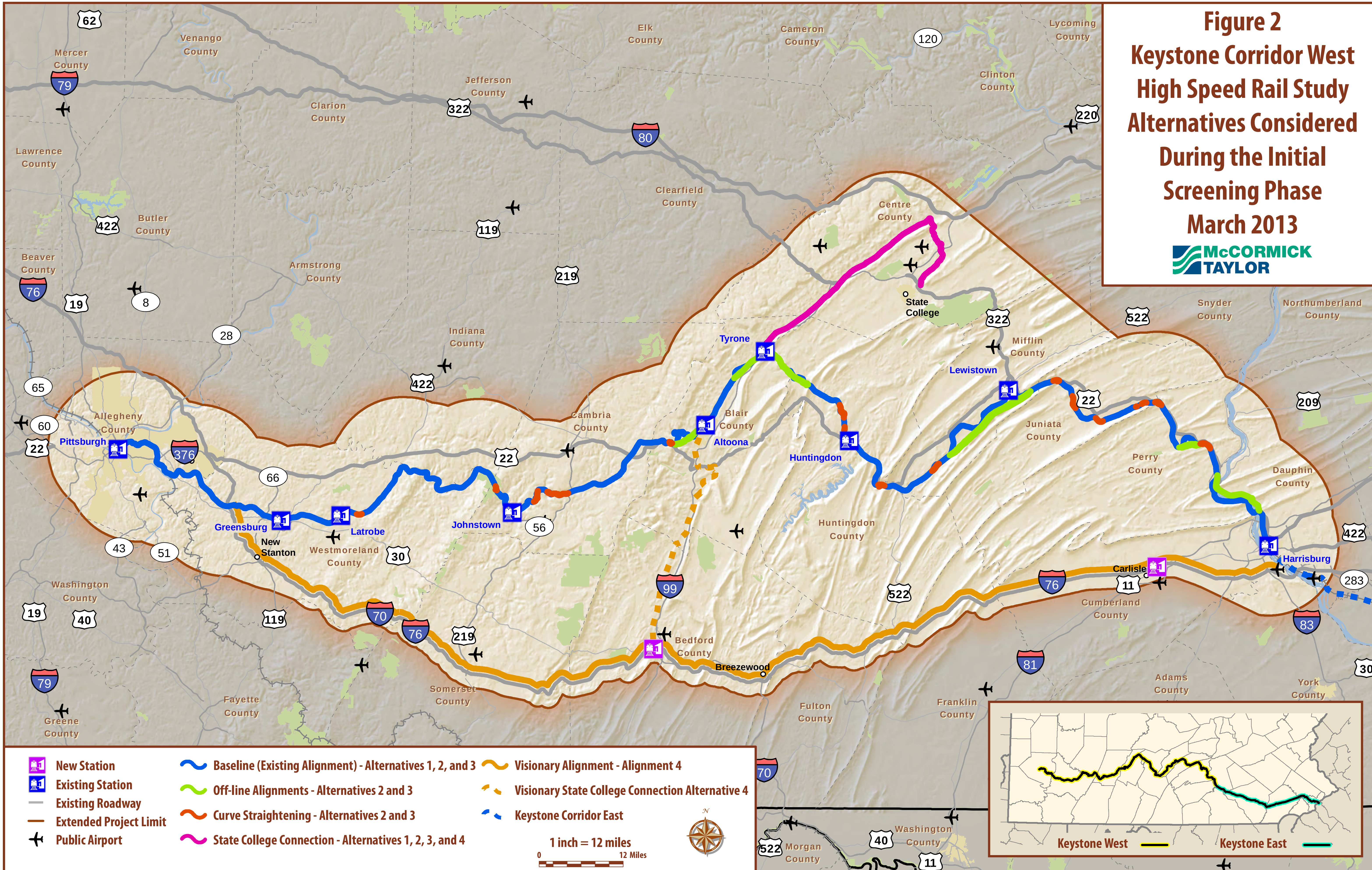
The evaluation of feasibility took into account the effort and cost to construct each alternative, the amount of right-of-way that would be required, the ability to construct on or near the existing alignment (which would minimize environmental impacts and permitting requirements), the probability of public and institutional support, and the degree to which the alternatives would lend themselves to phased implementation in segments with independent utility. Alternative 4, due to being the most costly, requiring construction on a new alignment, and being the most invasive environmentally, was ranked the lowest in all feasibility categories. Alternatives 2 and 3, due to providing similar improvements and having similar levels of environmental impacts, were ranked equal for most of the feasibility categories, with Alternative 3 ranked slightly lower for costs and physical feasibility due to the addition of the continuous third track. Alternative 1 was proposed as the minimal improvement option with the lowest costs; therefore, it ranked highest for most of the feasibility categories. Alternative 1 was ranked lower for public acceptance due to the fact that it provides the lowest level of improvement travel time and capacity and would therefore be the least attractive option to current and potential riders. Since the "phased implementation metric" was deemed to be not applicable for the No-Build, a score of 1 was assigned.

An average metric ranking was calculated for each alternative by summing all individual metric rankings for that alternative and dividing by 11, the number of evaluation metrics. The alternatives were then ranked from 1 to 5, with 1 being the least desirable alternative based on the average metric ranking. Alternative 4 ranked the lowest due to costs, a new alignment that moves away from established communities, the most potential environmental impacts, and the low probability to establish institutional partnerships (due to moving away from communities) and to garner public support. The No-Build Alternative, due to not meeting any of the project objectives, goals, or needs, ranked second lowest (despite having no impacts). Alternative 3 ranked slightly lower than Alternatives 1 and 2, mainly due to its greater impacts and higher cost resulting from the continuous third track. Alternatives 1 and 2 ranked the same and are the highest ranking alternatives. Alternatives 1 and 2 provide many similar improvements, but Alternative 1 includes fewer curve straightening components and no off-line alignments.

Figure 2: Alternatives Considered During the Initial Screening Phase, provides a general overview of each Alignment Alternative that was conceptually evaluated. Detailed mapping of the alignment alternatives are presented in **Appendix A, Environmental Constraints Mapping**, and **Appendix B, Improvement Option Details**. A list of engineering assumptions is documented in Section II.B., Engineering Assumptions, and Appendix 3, Detailed Cost Estimates for Alternatives 1, 2, 3, and 4, of the *Keystone West High Speed Rail Study: Refined Conceptual Alternatives Assessment* (December 2012), contained in the project technical files.

Figure 2
Keystone Corridor West High Speed Rail Study Alternatives Considered During the Initial Screening Phase
March 2013

McCORMICK TAYLOR



Alternative 4 would provide the maximum passenger rail capacity and speed improvement of the alternatives considered. Alternative 4 would provide the operator of the passenger rail service with virtually no material capacity constraints in the foreseeable future. With a theoretical minimum top speed of 110 mph and only four stops, the time savings would be approximately 3 hours and 50 minutes, allowing a Harrisburg to Pittsburgh commute of approximately 1 hour and 40 minutes compared to the current trip time of 5 hours and 30 minutes. Given the high cost of Alternative 4, required property acquisition, environmental considerations, and probable lead time, Alternative 4 was not selected for further analysis. Arguably, the construction costs may well be understated since the 25 percent contingency may not fully account for the fact that an entirely new corridor would have to be assembled and no field surveys were done to refine the cost estimates.

Alternatives 1, 2, and 3, which were the alternatives shortlisted for further analysis, are discussed in **Section E, Shortlisted Alternatives**.

2. Eliminated Alternatives

The Base Case (No-Build) Alternative and Alternative 4 were eliminated from further consideration based on the metrics evaluation. Each of these alternatives and additional rationale for eliminating them from further consideration is summarized below.

Base Case Alternative – Existing Alignment and Infrastructure without Further Improvements: The existing Norfolk Southern (NS) line between Harrisburg and Pittsburgh is approximately 250 miles long and is essentially a rationalized version of the former Pennsylvania Railroad mainline. As previously discussed, intermediate passenger station stops are located at Lewistown, Huntingdon, Tyrone, Altoona, Johnstown, Latrobe, and Greensburg. The line traverses challenging topography that results in slower speeds due to grades and numerous speed restrictions related to curves and topography. The route is mostly double track with three tracks over the most mountainous portion west of Altoona. There are secondary routes such as the Main Line Conemaugh (Johnstown – Pittsburgh) and the Port Perry Branch (Pitcairn – Pittsburgh) that provide alternative routings for freight trains, in effect creating redundancy and more line capacity in those stretches. On the double-tracked segments, there are crossovers located approximately every 10 to 15 miles. Passenger trains currently operate at speeds averaging 45 mph with a maximum speed of 79 mph. Unlike the Keystone East corridor between Harrisburg and Philadelphia, Keystone West is not electrified. Any proposal to add electrification would be very costly and likely opposed by Norfolk Southern, since Keystone West is a double-stack route with more demanding clearance requirements than Keystone East.

Over time, available tracks were reduced from four tracks to two. Generally, the middle tracks (tracks 2 and 3) were preserved and the outside tracks (tracks 1 and 4) were removed. However, the two remaining tracks use the full former four-track right-of-way in many areas to smooth the horizontal curvature and to meet modern standards for horizontal clearance.

The line between Harrisburg and Pittsburgh is cab-signaled throughout its length. In double-track territory, both tracks are signaled in both directions. In triple-track territory, two of the tracks are signaled in one direction only, with the third track signaled in both directions.

This route is primarily used for freight rail, operating at varying speeds, which necessitates frequent crossovers by passenger rail service and limits the ability to schedule additional service. The Pennsylvanian service is subject to constraints imposed by NS operations. This impacts the number of trips Amtrak can operate and the speeds at which passenger trains can travel. The Pennsylvanian service runs one round trip per day between Harrisburg and Pittsburgh, taking approximately 5½ hours in each direction with stops at all intermediate stations. Latrobe, Altoona, Tyrone, Huntingdon, and Lewistown have platforms on one side only, which complicates both passenger and freight operations and adversely impacts travel times for Amtrak passengers. The trip time, when compared to automobile travel between the endpoints via the Pennsylvania Turnpike (3½ hours), is neither an attractive nor convenient option for trips that do not originate or end at intermediate points along the rail line. Greyhound intercity bus trip times for express travel via the Pennsylvania Turnpike are approximately four hours, while local service via Routes 22/322 takes 6¾ hours. As would be expected, ridership on Keystone West remains relatively low (203,392 in FY 2010 compared to 1,215,785 for Keystone East, which benefits from more frequent service at 14 round trips daily and higher speeds—110 mph maximum).

The physical and operational constraints of the existing Keystone West track alignment and capacity will impede the objectives of achieving higher speeds in the corridor and increasing frequencies. These barriers can only be overcome by constructing infrastructure enhancements along the existing alignment and/or constructing new off-line alignments. For example, Horseshoe Curve near Altoona cannot be navigated at high rates of speed. In addition, the shared use by freight and passenger trains and numerous existing at-grade crossings pose impediments to a higher speed rail objective.

Review of the existing track alignment and information gathered in previous studies shows that the existing track alignment and operating conditions present limitations that must be addressed for whatever alternatives might be explored. To summarize, the limitations of the No-Build Alternative include:

- Existing line is mostly double track for the entire length. This limits track capacity for passenger trains.
- Latrobe, Altoona, Tyrone, Huntingdon, and Lewistown have platforms on one side only.
- Track and right-of-way are owned by Norfolk Southern. Any solution that involves this track and right-of-way must be approved by NS and must not interfere with their existing and planned freight operations, including parallel service roads.

Previous studies concluded that the Base Case (No-Build) Alternative, without enhancements, cannot meet project goals while simultaneously satisfying NS requirements (specifically, the study completed by the Woodside Consulting Group, dated February 2005, which involved a full simulation of combined freight and passenger traffic on the line). The study team did not uncover any compelling information that contradicts those conclusions. Existing service levels and speeds cannot be meaningfully improved and therefore travel times for rail passengers will remain at approximately 5½ hours, and rail ridership will remain low. This alternative does not adequately address identified project needs and does not satisfy the project goals of increasing passenger rail service frequency, reducing passenger rail travel times, providing a meaningful passenger rail modal alternative to auto travel, and stimulating economic development along the line.

Alternative 4 – Passenger-Only High Speed Tracks on New Alignment: The premise for Alternative 4 was to identify an alternative that would represent true high speed rail service that would work best in the context of a larger regional or national high speed rail network. Alternative 4 would create a new electrified, two-track, passenger-train-only, high speed alignment generally following a direct, southerly route similar to the Pennsylvania Turnpike. This route would be designed to achieve a minimum speed of 110 mph. The new tracks would connect to the Keystone East corridor in the vicinity of Highspire. They would connect to the existing NS Keystone West line in the vicinity of Westmoreland City. The tracks would then follow the existing alignment into Pittsburgh (unless a new outlying station for Pittsburgh was constructed, which is not included in the cost estimate). Another alternative not included in the cost estimate is local commuter service from Westmoreland City to Pittsburgh.

Proposed multimodal stations would be constructed at Westmoreland City, Bedford, and Carlisle. A third main track would connect Carlisle to the Harrisburg Transportation Center and through to Highspire. Traditional “local” service would be maintained along the existing Keystone West line to all existing stations.

A rail spur or bus service would connect the proposed multimodal Bedford Station to Altoona and State College. The proposed rail connection would require new track or tracks on new right-of-way from the multimodal passenger station in Bedford to Sproul. From Sproul to Brooks Mill, an existing short line owned by the Everett Railroad could be used. From Brooks Mill to Hollidaysburg, the track of the Hollidaysburg and Roaring Spring Railroad could be used. From Hollidaysburg to Altoona, the NS Cove Secondary could be used. From Altoona, the service could continue to State College on the NS Keystone West line and on the proposed rail connections from Tyrone to State College. From Bedford to Sproul, the line would have no restrictions on service; however, where the track would be shared with freight companies, speed and capacity constraints would occur as previously discussed. There is no current estimate of travel time for a conceptual passenger run from Bedford to State College. The preceding discussion is purely for the purpose of presenting a conceptual approach for connecting Altoona and State College to the new Alternative 4 alignment, but the costs for doing so are not included in the estimate for Alternative 4. Alternatively, a proposed bus connection could be initiated from Bedford to State College or Altoona along I-99.

Alternative 4 was the only true high speed alternative considered. However, at more than $38.1 billion (plus estimated right-of-way costs of $50 million), it has the highest price tag by far and would require the greatest amount of property acquisition and lead time. The key components of Alternative 4 and estimated costs are shown in **Table 5: Alternative 4 – Passenger-Only High Speed Tracks on New Alignment**. The listed costs include all direct costs, mobilization/demobilization, permitting, overhead, contingency at 25 percent, engineering, and construction management. A separate right-of-way cost estimate is also included. Costs for rail spurs to off-line communities and capital costs related to connecting bus services are not included.

Table 5: Alternative 4 – Passenger-Only High Speed Tracks on New Alignment (not selected for further analysis)		
Components/Features	**Improvements**	**Preliminary Estimated Cost ($000s)**
NEW DOUBLE TRACK LINE (electrified) from Harrisburg to Pittsburgh ∗ Essentially follow path of PA Turnpike ∗ Connection to Keystone East at Highspire ∗ Connection to existing NS line at Westmoreland City ∗ Add a second station track to Pittsburgh ∗ Includes new bridges, tunnels, access roads, support yard control center, etc.	Would offer the passenger service provider total control of number of trains and schedule. Eliminates conflicts with freight trains. Could achieve HSR speeds over majority of length.	$37,987,293
NEW STATIONS ∗ Carlisle ∗ Bedford ∗ Westmoreland City		$78,584
RAIL CONNECTION from Tyrone Amtrak Station to State College or BUS SERVICE to State College from one or more stations.	Provides connection to State College and Penn State University Park Campus.	$95,183
Total Estimated Infrastructure Cost		**$38,161,060**
Total Estimated Right-of-Way Cost		**$**50,000

E. Shortlisted Alternatives

Alternative 1 – Existing Alignment with Modest Infrastructure Improvements: Alternative 1 improvements would generally be confined to the existing right-of-way and could be implemented in a shorter period of time than any of the other build alternatives. This alternative would provide for modest capacity and speed improvements and, at slightly less than $1.5 billion, would be the least expensive build alternative evaluated. **Table 6: Alternative 1 – Existing Alignment, Modest Infrastructure Improvements**, summarizes the infrastructure components of Alternative 1 along with conceptual cost estimates. The listed costs include all direct costs, mobilization/demobilization, permitting, overhead, contingency at 25 percent, engineering, and construction management. Right-of-way costs are not included for individual improvements, but a right-of-way cost estimate is provided for each alternative.

The benefits of Alternative 1 include:

- Improvement to existing operations by creating more track capacity in the critical areas of Harrisburg, Altoona – Johnstown, and Pittsburgh by installing passing sidings/tracks along the route at various locations. This would reduce conflicts between freight and passenger trains, thus reducing the need for passenger trains to wait for a freight train to clear a particular block.
- Increased passenger train speeds due to curve modifications at 126 locations along the existing line. These modifications would be done within design criteria for freight trains, but would offer some modest speed increases along the route.
- Addition of platforms at Altoona, Tyrone, Huntingdon, and Lewistown, allowing for direct passenger platform loading on both eastbound and westbound tracks at these stations. This would eliminate the Amtrak wait time required for freight trains to clear crossovers to access platforms on the opposite side of the tracks and eliminate running opposite to the primary direction of travel. Additional right-of-way could be required in the vicinity of stations to add new platforms.
- Provision of a rail or bus connection to State College. The rail connection would extend north from Tyrone Station using the tracks of the Nittany and Bald Eagle Railroad, a short line that runs from Tyrone to Milesburg, Bellefonte, and Lemont. The line is a single-track freight line owned by the North Shore Railroad Company. The track is relatively slow speed and would require physical upgrades for passenger operations. With only one track, capacity problems and conflicts would need to be addressed before freight and passenger trains could share this track. With the track ending in Lemont, a three-mile track extension would be needed to reach State College and serve the Penn State campus. A new station would also need to be built. Bus service rather than a rail extension to State College would be less costly and offer greater flexibility.
- Although not specifically delineated or financially analyzed as part of the Phase I screening of alternatives, bus connections serving other stations could offer additional access and connectivity, with the most likely bus connections occurring at Harrisburg, Lewistown, Altoona, Johnstown, and Greensburg stations.

- Alternative 1 is the least expensive build alternative considered, but would also provide the least reduction in trip time for passenger rail travel between Harrisburg and Pittsburgh.

Alternative 2 – Major Improvements to Existing Alignment: While Alternative 2 represents a significantly more aggressive approach than Alternative 1, it still was based on the premise of making maximum use of the existing rail alignment. As noted earlier, all elements of Alternative 1 were incorporated into Alternative 2 unless they became redundant due to more ambitious proposals. In addition, more extensive improvements, including a number of off-line alignments (to bypass congested areas and/or slow sections through challenging topography) were added to more fully address the goals of increasing service frequency and reducing trip times. While providing for greater capacity and speed improvements than Alternative 1, Alternative 2, at approximately $9.9 billion, would cost nearly seven times as much as Alternative 1. Property acquisition would be needed at key locations, requiring lead time for implementing certain components.

Alternative 2 would improve existing operations by taking advantage of the same additional track capacity and speed increases offered by Alternative 1. In addition, Alternative 2 would decrease the proposed running times by adding new, off-line alignments at existing slow points. These new alignments would be designed for maximum speeds and would not be restricted by grade or curvature from achieving higher speeds. Exact curvatures would be determined during a future engineering study. These off-line alignments would require extensive property acquisition. The new off-line alignments would be constructed with grade separations for all rail-roadway conflicts, which does not increase speed or capacity, but is a recommended safety practice on higher speed tracks.

Curve straightening would be conducted at 35 curves on the existing alignment to enable higher speeds. Property acquisition would likely be needed in order to make the necessary improvements for many of these curves.

The infrastructure components and corresponding costs for Alternative 2 are presented in **Table 7: Alternative 2 – Major Improvements to Existing Alignment**. The listed costs include all direct costs, mobilization/demobilization, permitting, overhead, contingency at 25 percent, engineering, and construction management.

The costs shown for a connection to State College are for a rail connection since the focus of this portion of the analysis is on alternative alignments and infrastructure costs. Costs associated with the bus connection option are presented in the analysis of connecting bus service (see **Section VI, Connecting Bus Service**).

Table 6: Alternative 1 – Existing Alignment, Modest Infrastructure Improvements					
Ref #	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/Benefit**	**Cost ($000s)**
			PITTSBURGH – GREENSBURG		
104	Freight Bypass Track	Pittsburgh Station	1.1 miles new track, turnouts, and related communications and signaling (C&S) improvements	Capacity	8,170
110	Additional Passing Siding and Renew Existing Passing Siding	Rade – Traff Milepost (MP) 325.0 – MP 336.5	11.5 miles new siding, 11.5-mile access road, 3.2 miles rehabilitate existing siding, 6 new bridges, 17 rail/highway grade separations, retaining walls, turnouts, C&S	Capacity	265,323
111.8	Curve Modifications	Greensburg – Pittsburgh	modified superelevation and/or straightening of curves	Speed	1,534
			GREENSBURG – LATROBE		
109	New Passing Siding	Pack – Trobe MP 300.5 – MP 312.7	12.2 miles new siding, 12-mile access road, 2 new bridges, 7 rail/highway grade separations, 4 grade crossing upgrades, turnouts, C&S	Capacity	158,105
111.7	Curve Modifications	Latrobe – Greensburg	modified superelevation and/or straightening of curves	Speed	203
			LATROBE – JOHNSTOWN		
111.6	Curve Modifications	Johnstown – Latrobe	modified superelevation and/or straightening of curves	Speed	4,054
			JOHNSTOWN – ALTOONA		
101	Additional Track	Cresson – Johnstown	24 miles of new track and related improvements (1 new bridge, rehabilitate 14 bridges, turnouts, C&S, etc.)	Capacity/Speed	97,901
111.5	Curve Modifications	Altoona – Johnstown	modified superelevation and/or straightening of curves	Speed	3,043
			ALTOONA – TYRONE		
103.3	Station Improvements	Altoona	Add 1 high platform, new pedestrian bridge, garage modifications, elevators, 1 gauntlet track, signal improvements	Capacity/Time Savings	11,432
111.4	Curve Modifications	Tyrone – Altoona	modified superelevation and/or straightening of curves	Speed	359
			TYRONE – HUNTINGDON		
103.2	Station Improvements	Tyrone	Add second low-level platform, waiting room and shelters, parking, misc. improvements	Capacity/Time Savings	925
111.3	Curve Modifications	Huntingdon – Tyrone	modified superelevation and/or straightening of curves	Speed	2,433
			TYRONE – STATE COLLEGE (SPUR)		
112	Rail Spur to State College	Tyrone (MP 313) – Lemont	10,000 wood tie replacements, 5 miles of new rail on curves, 8 new rail bridges, rehabilitate 4 bridges, renew 31 timber/asphalt crossings and 10 full-depth rubber crossings, line and surface 45 track miles, 1 high-level platform, shelter, parking, C&S	Access/New Market	71,887

Table 6: Alternative 1 – Existing Alignment, Modest Infrastructure Improvements					
Ref #	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/Benefit**	**Cost ($000s)**
			HUNTINGDON – LEWISTOWN		
103.1	Station Improvements	Huntingdon	Add second low-level platform, parking, misc. improvements	Capacity/Time Savings	950
107	Additional Passing Siding and Renew Existing Passing Siding	McVey – Jacks MP 179.6 – MP 191.3	11.7 miles new siding track and shift existing track, 12-mile access road, 2 new bridges, 1 private road crossing, 4 rail/highway grade separations, retaining walls, turnouts, C&S	Capacity	190,834
108	Additional Passing Siding and Renew Existing Passing Siding	Tunnel – Gray MP 212.9 – MP 223.3	reopen Spruce Creek Tunnel ($27.5M), 10.4 miles new siding track and shift existing track, 4 grade crossing modifications, 10-mile access road, 14 new bridges, 5 rail/highway grade separations, retaining walls, turnouts, C&S	Capacity	380,084
111.2	Curve Modifications	Lewistown – Huntingdon	modified superelevation and/or straightening of curves	Speed	1,454
			LEWISTOWN – HARRISBURG		
102	Additional Track	Harris – Rockville	3.5 miles new track and related improvements (turnouts, 1 bridge rehab, C&S, etc.)	Capacity/Speed	12,899
103.4	Station Improvements	Lewistown	new low-level platform (200 linear feet)	Capacity/Time Savings	660
105	Additional Passing Siding and Renew Existing Passing Siding	Cannon – Port MP 113.2 – MP 133.5	14.6 miles new siding, 5.7 miles renew existing siding, 5 grade crossings, relocate industrial side track, rehab 7 bridges, 6 new bridges, 14.6-mile rail access road, 3 rail/highway grade separations, turnouts, C&S	Capacity	179,285
106	Additional Passing Siding and Renew Existing Passing Siding	Hawthorne – Lewis MP 160.0 – MP 165.7	5.7 miles new siding track and shift existing track, 6.3 miles renew existing siding, 3 rail/highway grade separations, turnouts, C&S	Capacity	79,618
111.1	Curve Modifications	Harrisburg – Lewistown	modified superelevation and/or straightening of curves	Speed	2,788
				TOTAL ALTERNATIVE 1 CAPITAL COST	**1,473,941**
				TOTAL ESTIMATED RIGHT-OF-WAY COST	**400**

Table 7: Alternative 2 – Major Improvements to Existing Alignment					
Ref #	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/Benefit**	**Cost ($000s)**
PITTSBURGH – GREENSBURG					
204	Freight Bypass Track	Pittsburgh Station	1.1 miles new track, turnouts, and related communications and signaling (C&S) improvements	Capacity	8,170
210	Additional Passing Siding and Renew Existing Passing Siding	Rade – Traff MP 325.0 – MP 336.5	11.5 miles new siding, 11.5-mile access road, 3.2 miles rehab existing siding, 6 new bridges, 17 rail/highway grade separations, retaining walls, turnouts, C&S	Capacity	265,323
211.8	Curve Modifications	Greensburg – Pittsburgh	modified superelevation and/or straightening of curves	Speed	1,534
GREENSBURG – LATROBE					
209	New Passing Siding	Pack – Trobe MP 300.5 – MP 312.7	12.2 miles new siding, 12-mile access road, 2 new bridges, 7 rail/highway grade separations, 4 grade crossing upgrades, turnouts, C&S	Capacity	158,105
211.7	Curve Modifications	Latrobe – Greensburg	modified superelevation and/or straightening of curves	Speed	203
LATROBE – JOHNSTOWN					
211.6	Curve Modifications	Johnstown – Latrobe	modified superelevation and/or straightening of curves	Speed	4,054
218.5	Curve Straightening	Johnstown – Latrobe	new track, track relocation, cut/fill, 1 highway grade separation, access road, retaining walls, C&S	Speed	25,221
JOHNSTOWN – ALTOONA					
201	Additional Track	Cresson – Johnstown	24 miles of new track and related improvements (1 new bridge, rehab 14 bridges, turnouts, C&S, etc.)	Capacity/Speed	97,901
211.5	Curve Modifications	Altoona – Johnstown	modified superelevation and/or straightening of curves	Speed	3,043
217	Off-line alignment, double track, passenger-only due to grades	Horseshoe Curve Bypass MP 237.2 – MP 244.3	9.3 miles new double track, 1 new rail/rail grade separation, 1 rail highway grade separation ($216.1M), extensive cut/fill ($42.4M), extensive C&S and turnouts	Speed/Capacity	334,769

Table 7: Alternative 2 – Major Improvements to Existing Alignment					
Ref #	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/Benefit**	**Cost ($000s)**
218.4	Curve Straightening	Altoona – Johnstown	new track, track relocation, extensive cut/fill ($55.0M), and retaining walls ($23.9M), 4.9-mile access road, 2 new bridges ($61.4M), 1 highway grade separation, C&S	Speed	175,086
ALTOONA – TYRONE					
203.3	Station Improvements	Altoona	Add 1 high platform, new pedestrian bridge, garage modifications, elevators, 1 gauntlet track, signal improvements	Capacity/Time Savings	11,432
211.4	Curve Modifications	Tyrone – Altoona	modified superelevation and/or straightening of curves	Speed	359
TYRONE – HUNTINGDON					
203.2	Station Improvements	Tyrone	Add second low-level platform, waiting room and shelters, parking, misc. improvements	Capacity/Time Savings	925
211.3	Curve Modifications	Huntingdon – Tyrone	modified superelevation and/or straightening of curves	Speed	2,433
216	Off-line Alignment, double track	Tyrone vicinity MP 213.17 – MP 230.55	12 miles new double track, 15 miles track relocation, 12 new grade crossings, extensive excavation along Juniata River ($520.5M), 13.7-mile access road, 3.4 miles roadway separation, relocate Tyrone Platform, 12 new RR bridges, 2 grade separation structures, retaining walls, turnouts, C&S	Speed/Capacity	1,037,357
218.3	Curve Straightening	Huntingdon – Tyrone	new track, track relocation, extensive cut/fill ($59.1M) and retaining walls ($11.1M), access road, highway relocation, C&S	Speed	77,383
TYRONE – STATE COLLEGE (SPUR)					
212	Rail Spur to State College	Tyrone (MP 313) – Lemont	10,000 wood tie replacement, 5 miles of new rail on curves, 8 new RR bridges, rehab 4 bridges, renew 31 timber/asphalt crossings and 10 full-depth rubber crossings, line and surface 45 track miles, 1 high-level platform, shelter, parking, C&S	Access/New Market	71,887

Table 7: Alternative 2 – Major Improvements to Existing Alignment					
Ref #	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/Benefit**	**Cost ($000s)**
HUNTINGDON – LEWISTOWN					
203.1	Station Improvements	Huntingdon	Add second low-level platform, parking. misc. improvements	Capacity/Time Savings	950
207	Additional Passing Siding and Renew Existing Passing Siding	McVey – Jacks MP 179.6 – MP 191.3	11.7 miles new siding track and shift existing track, 12-mile access road, 2 new bridges, 1 private road crossing, 4 rail/highway grade separations, retaining walls, turnouts, C&S	Capacity	190,834
208	Additional Passing Siding and Renew Existing Passing Siding	Tunnel – Gray MP 212.9 – MP 223.3	reopen Spruce Creek Tunnel ($27.5M), 10.4 miles new siding track and shift existing track, 4 grade crossing modifications, 10-mile access road, 14 new bridges, 5 rail/highway grade separations, retaining walls, turnouts, C&S	Capacity	371,576
211.2	Curve Modifications	Lewistown – Huntingdon	modified superelevation and/or straightening of curves	Speed	1,454
215	Off-line Alignment, double track, concrete tie	Bypass of Lewistown, Granville, McVeytown MP 160.0 – MP 182.5	extensive cut/fill ($5,337M), 22.5 miles new double-track rail, 15-mile access road, relocate Lewistown Station with 2 platforms & amenities, 1 new RR bridge, 3 rail/highway grade separations, 5 grade crossings, turnouts, C&S	Speed/Capacity	5,624,683
218.2	Curve Straightening	Lewistown – Huntingdon	new track, track relocation, extensive cut/fill ($45.8M), 2 new bridges ($144.9M), C&S	Speed	195,752
LEWISTOWN – HARRISBURG					
202	Additional Track	Harris – Rockville	3.5 miles new track and related improvements (turnouts, 1 bridge rehab, C&S, etc.)	Capacity/Speed	12,899

Table 7: Alternative 2 – Major Improvements to Existing Alignment					
Ref #	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/Benefit**	**Cost ($000s)**
205	Additional Passing Siding and Renew Existing Passing Siding	Cannon – Port MP 113.2 – MP 133.5	14.6 miles new siding, 5.7 miles renew existing siding, 5 grade crossings, relocate industrial side track, rehab 7 bridges, 6 new bridges, 14.6-mile rail access road, 3 rail/highway grade separations, turnouts, C&S	Capacity	179,285
206	Additional Passing Siding and Renew Existing Passing Siding	Hawthorne – Lewis MP 160.0 – MP 165.7	5.7 miles new siding track and shift existing track, 6.3 miles renew existing siding, 3 rail/highway grade separations, turnouts, C&S	Capacity	79,618
211.1	Curve Modifications	Harrisburg – Lewistown	modified superelevation and/or straightening of curves	Speed	2,788
213	Off-line Alignment, double track	Rockville – Duncannon MP 209 (Buffalo Line) – MP 121.6 (Pgh Line)	6.3 miles new track, 3.4 miles upgrade existing track, 1 new bridge ($304.5M), 10-mile access road, 1 major new interlocking, 4 new timber/asphalt crossings, retaining walls, turnouts, extensive C&S,	Speed/Capacity	394,424
214	Off-line Alignment, double track	Ferguson's Curve MP 128 – MP 131.8	extensive cut/fill ($394.2M), 3.8 miles new double-track RR, 3.0-mile access road, 1 rail/highway grade separation, 1 new interlocking, turnouts, C&S, utilities	Speed/Capacity	435,356
218.1	Curve Straightening	Harrisburg – Lewistown	new track, relocation, extensive cut/fill ($141.3M), 6.3-mile access road, retaining walls, C&S	Speed	174,777
				TOTAL ALTERNATIVE 2 CAPITAL COST	**9,939,581**
				TOTAL ESTIMATED RIGHT-OF-WAY COST	**14,000**

Alternative 2 includes all of the station/platform improvements discussed under Alternative 1 and also a rail or bus connection to State College. The rail connection would be from the Tyrone Amtrak Station as discussed in Alternative 1. Connecting bus service at stations such as Harrisburg, Lewistown, Altoona, Johnstown, or Greensburg would complement the rail service by improving access and connectivity.

Alternative 2 would provide all of the capacity and speed improvements included in Alternative 1, plus additional speed improvements due to the straighter off-line alignments and curve modifications. The former PA High Speed Rail Feasibility Study estimated the time savings for the off-line alignments and curve modifications to be approximately 60 minutes, which would meet or exceed the near-term goal of reducing the travel time between Harrisburg and Pittsburgh from 5½ to approximately 4½ hours. Estimated time savings associated with the operational improvements offered by Alternative 2 are discussed in more detail in the operations analysis section of this report.

Alternative 3 – Existing Alignment with Additional Track or Tracks for Entire Route: Alternative 3 incorporates the new off-line alignments from Alternative 2 along with the curve modifications and curve straightening suggested in Alternatives 1 and 2 for all existing tracks. In addition, Alternative 3 would further enhance capacity and improve operations by creating a continuous third track along the entire corridor, to the extent possible within the existing right-of-way of the original four-track railroad. Since the two existing tracks have been re-positioned within the existing right-of-way to smooth curves, and modern horizontal clearance standards consume more total width, existing right-of-way may not be adequate at many locations to support addition of the proposed new track.

As with Alternatives 1 and 2, Alternative 3 would include either a rail connection from the Tyrone Amtrak Station to State College, or bus connection(s) from one or more existing rail stations to State College. Bus connections serving other off-line communities could offer additional access and connectivity, with the most likely connections occurring at Harrisburg, Lewistown, Altoona, Johnstown, and Greensburg.

The third track would result in greater capacity enhancements and travel time reductions than Alternatives 1 and 2. The additional speed improvement over Alternative 2 would result primarily from reduction in potential conflicts and “hold times” for passenger and freight trains traveling in either the same direction (due to the speed differential for passenger and freight trains) or opposite directions. At just over $13 billion, it is also more expensive and would require a larger amount of property acquisition and lead time to gain the necessary approvals, acquire the land, and construct the improvements. The infrastructure components and corresponding costs for Alternative 3 are presented in **Table 8: Alternative 3 – Existing Alignment with Additional Track or Tracks for Entire Route**. The listed costs include all direct costs, mobilization/demobilization, permitting, overhead, contingency at 25 percent, engineering, and construction management. A separate estimate of right-of-way cost is included in Table 8, but capital costs related to connecting bus services are not included.

Alternative 3 offers all of the capacity and speed improvements that would occur with Alternative 2. In addition, greater capacity improvements (due to the new track) and a greater reduction in trip times (due to reduced freight-passenger train conflicts) would also be realized. Estimated time savings associated with the operational improvements offered by Alternative 3 are discussed in **Section V, Rail Operations,** of this report.

Table 8: Alternative 3 – Existing Alignment with Additional Track or Tracks for Entire Route					
Ref #	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/ Benefits**	**Cost ($000s)**
PITTSBURGH – GREENSBURG					
310	Freight Bypass to support Continuous Third Track	Pittsburgh Station	track, turnouts, C&S	Capacity	8,170
308	Add Continuous Third Track	Greensburg – Pittsburgh	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	Additional Capacity/Time Savings	494,535
311.8	Curve Modifications	Greensburg – Pittsburgh	modified superelevation and/or straightening of curves	Speed	1,534
GREENSBURG – LATROBE					
307	Add Continuous Third Track	Latrobe – Greensburg	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	Additional Capacity/Time Savings	212,152
311.7	Curve Modifications	Latrobe – Greensburg	modified superelevation and/or straightening of curves	Speed	203
LATROBE – JOHNSTOWN					
306	Add Continuous Third Track	Johnstown – Latrobe	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	Additional Capacity/Time Savings	798,277
311.6	Curve Modifications	Johnstown – Latrobe	modified superelevation and/or straightening of curves	Speed	4,054
313.5	Curve Straightening	Johnstown – Latrobe	new track, track relocation, cut/fill, 1 highway grade separation, access road, retaining walls, C&S	Speed	25,221
JOHNSTOWN – ALTOONA					
305	Add Continuous Third Track	Altoona – Johnstown	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Reopen Gallitzin Tunnel, extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	Additional Capacity/Time Savings	801,400

Table 8: Alternative 3 – Existing Alignment with Additional Track or Tracks for Entire Route					
Ref #	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/ Benefits**	**Cost ($000s)**
311.5	Curve Modifications	Altoona – Johnstown	modified superelevation and/or straightening of curves	Speed	3,043
312.5	Off-line alignment, double track, passenger-only due to grades	Horseshoe Curve Bypass MP 237.2 – MP 244.3	9.3 miles new double track, 1 new rail/rail grade separation, 1 rail highway grade separation ($216.1M), extensive cut/fill ($42.4M), extensive C&S and turnouts	Speed/Capacity	334,769
313.4	Curve Straightening	Altoona – Johnstown	new track, track relocation, extensive cut/fill ($55.0M), and retaining walls ($23.9M), 4.9-mile access road, 2 new bridges ($61.4M), 1 highway grade separation, C&S	Speed	175,086
ALTOONA – TYRONE					
309.3	Alternative 3 Station Improvements	Altoona Station	2 new gauntlet tracks & signal upgrades, 2 new high platforms, new pedestrian bridge, 3 elevators, garage modifications, misc. improvements	Capacity/Time Savings	15,669
304	Add Continuous Third Track	Tyrone – Altoona	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	Additional Capacity/Time Savings	320,655
311.4	Curve Modifications	Tyrone – Altoona	modified superelevation and/or straightening of curves	Speed	359
TYRONE – HUNTINGDON					
309.2	Alternative 3 Station Improvements	Tyrone Station	2 new gauntlet tracks, signal upgrades, 2 new high platforms, new waiting room & shelters, parking, misc. improvements	Capacity/Time Savings	13,655
303	Add Continuous Third Track	Huntingdon – Tyrone	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Reopen Spruce Creek Tunnel, extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	Additional Capacity/Time Savings	461,913
311.3	Curve Modifications	Huntingdon – Tyrone	modified superelevation and/or straightening of curves	Speed	2,433

Table 8: Alternative 3 – Existing Alignment with Additional Track or Tracks for Entire Route					
Ref #	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/ Benefits**	**Cost ($000s)**
312.4	Off-line alignment, double track	Tyrone vicinity	12 miles new double track, 15 miles track relocation, 12 new grade crossings, extensive excavation along Juniata River ($520.5M), 13.7-mile access road, 3.4 miles roadway separation, 12 new RR bridges, 2 grade separation structures, retaining walls, turnouts, C&S,	Speed/Capacity	1,037,030
313.3	Curve Straightening	Huntingdon – Tyrone	new track, track relocation, extensive cut/fill ($59.1M) and retaining walls ($11.1M), access road, highway relocation, C&S	Speed	77,383
TYRONE – STATE COLLEGE (SPUR)					
314	Rail Spur to State College	Tyrone (MP 313) – Lemont	10,000 wood tie replacement, 5 miles of new rail on curves, 8 new RR bridges, rehab 4 bridges, renew 31 timber/asphalt crossings and 10 full-depth rubber crossings, line and surface 45 track miles, 1 high-level platform, shelter, parking, C&S	Access/New Market	71,887
HUNTINGDON – LEWISTOWN					
309.1	Alternative 3 Station Improvements	Huntingdon Station	2 new gauntlet tracks & signal upgrades, 2 new high platforms, misc. improvements	Capacity/Time Savings	14,416
302	Add Continuous Third Track	Lewistown – Huntingdon	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, 20 grade separations, access roads, retaining walls, etc.	Additional Capacity/Time Savings	369,683
311.2	Curve Modifications	Lewistown – Huntingdon	modified superelevation and/or straightening of curves	Speed	1,454
312.3	Off-line alignment, double track, concrete tie	Bypass of Lewistown, Granville, McVeytown MP 160.0 – MP182.5	extensive cut/fill ($5,337M), 22.5 miles new double-track rail, 15-mile access road, relocate Lewistown Station with 2 platforms & amenities, 1 new RR bridge, 3 rail/highway grade separations, 5 grade crossings, turnouts, C&S	Speed/Capacity	5,624,683
313.2	Curve Straightening	Lewistown – Huntingdon	new track, track relocation, extensive cut/fill ($45.8M), 2 new bridges ($144.9M), C&S	Speed	195,752

Table 8: Alternative 3 – Existing Alignment with Additional Track or Tracks for Entire Route					
Ref #	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/ Benefits**	**Cost ($000s)**
LEWISTOWN – HARRISBURG					
301	Add Continuous Third Track	Harrisburg – Lewistown	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	Additional Capacity/Time Savings	995,135
311.1	Curve Modifications	Harrisburg – Lewistown	modified superelevation and/or straightening of curves	Speed	2,788
312.1	Off-line alignment, double track	Rockville to Duncannon MP 209 (Buffalo Line) – MP 121.6 (Pgh Line)	6.3 miles new track, 3.4 miles upgrade existing track, 1 new bridge ($304.5M), 10-mile access road, 1 major new interlocking, 4 new timber/asphalt crossings, retaining walls, turnouts, extensive C&S	Speed/Capacity	394,424
312.2	Off-line alignment, double track	Ferguson's Curve MP 128 – MP 131.8	extensive cut/fill ($394.2M), 3.8 miles new double-track RR, 3.0-mile access road, 1 rail/highway grade separation, 1 new interlocking, turnouts, C&S, utilities	Speed/Capacity	435,356
313.1	Curve Straightening	Harrisburg – Lewistown	new track, relocation, extensive cut/fill ($141.3M), 6.3-mile access road, retaining walls, C&S	Speed	174,777
TOTAL ALTERNATIVE 3 CAPITAL COST					**13,067,896**
TOTAL ESTIMATED RIGHT-OF-WAY COST					**16,000**

F. Environmental Impacts

As mentioned in **Section III, Environmental Overview**, readily available secondary source geospatial environmental data was collected for use in developing an environmental constraints map (See **Appendix A: Environmental Constraints Mapping**). Potential effects were calculated for each type of improvement located between each railroad station segment and for shortlisted alternatives only (Alternatives 1, 2, and 3). Environmental impacts for the proposed improvement types for shortlisted Alternatives 1, 2, and 3 are presented in **Table 9: Potential Environmental Impacts (Alternatives 1, 2, and 3)**.

Potential environmental impacts are presented by improvement type with location information on each improvement provided from milepost (MP) to MP and by station-to-station corridor segment. Reference numbers are provided to designate those improvements that are part of each alternative. The length of each improvement is provided as well as the potential effects according to several environmental resource categories, defined as:

- Known Hazardous Waste Sites – sites identified through Pennsylvania Department of Environmental Protection (PA DEP) as known locations of hazardous waste operations, spills, clean-up sites, or sites listed on an environmental database (such as Resource Conservation and Recovery Act (RCRA), Captive Hazardous Waste Generators, etc.).
- National Wetland Inventory (NWI) Wetlands – a database of potential wetland areas mapped based on aerial photography by the U.S. Fish and Wildlife Service (USFWS).
- Water Resources – lakes, ponds, streams/rivers, and floodplains mapped by PA DEP using U.S. Geological Survey (USGS) topological surveys, aerial mapping, and Federal Emergency Management Agency (FEMA) floodplain mapping.
- Known/High-Probability Historic Resources – a database of resources that have been mapped by the Pennsylvania Historical and Museum Commission (PHMC) based on past cultural resource studies. The database contains information on structures/resources that have been evaluated for eligibility for the National Register of Historic Places and determined Ineligible (I), Eligible (E), Listed (L), or Unknown (U), i.e., no determination of eligibility has been made. The database also contains information on known National Historic Landmarks (N).
- Threatened and Endangered Species – information gained from the Pennsylvania Natural Heritage Program (PNHP) that gathers and provides information on the location and status of important ecological resources, including resources listed as threatened and endangered by the USFWS, PA DEP, PA Game Commission (PGC), and PA Department of Conservation and Natural Resources (PA DCNR).
- Public Lands – known locations of national/state forests and parks, state game lands, and local/municipal parks and playgrounds, based on mapping available from the National Park Service, PA DEP, PGC, PA DCNR, and USGS topographic mapping.

1. Potential Permitting Requirements

With regard to permitting requirements, if funding was available to construct any alternative as a full alternative, permitting would be very complicated due to the length of each alternative and the types of improvements involved. Any of the full alternatives, if constructed as one project, would require an individual National Pollutant Discharge Elimination System (NPDES) permit, a Chapter 105 / Joint U.S. Army Corps of Engineers Water Obstruction Permit, and Coast Guard permits for any work in / across navigable waterways, such as the Susquehanna River. Permitting any full alternative would require environmental clearances for threatened and endangered species, cultural resources, etc., which would be extremely costly due to the length of each alternative.

As mentioned in following sections of this report, it is much more likely that the individual improvements that make up each alternative would be constructed as individual projects with logical termini and independent utility. Individual improvements may be grouped together as a project as allowed by available funding. If improvements were grouped, permitting requirements would differ depending on what improvements were grouped and the extent of impacts of each individual improvement. **Table 9** includes footnotes in the "Type of Improvement" column that indicate what permitting might be expected for the listed independent improvement. It should not be assumed that if improvements are grouped that the provided assessment of permitting requirements could just be combined, as grouping improvements could push environmental impact thresholds (such as those required for wetlands) to a level that would require a different type of permit than would be required if the improvements were completed separately. However, each improvement in **Table 9** is footnoted with the following information, which is provided for planning purposes only:

1. Improvement anticipated to require no permitting.
2. Improvement anticipated to require only a General Permit for Water Obstruction (Chapter 105). NPDES permit would only be required if disturbance is greater than one acre.
3. Improvement anticipated to require individual Water Obstruction permit (Joint Permit) and a NPDES permit.

Table 9 also provides information on potential environmental impacts by improvement, a subtotal for each station-to-station segment, and totals for Alternative 1, Alternative 2, and Alternative 3.

Table 9: Potential Environmental Impacts (Alternatives 1, 2, and 3)

Improvement Type Reference #			Type of Improvement	MP from	MP to	Length (miles)	Known Hazardous Waste Sites	National Wetland Inventory (NWI) Wetlands		Water Resources					Known/High-Probability Historic Resources					Threatened and Endangered Species	Public Lands	
										Lakes and Ponds		Streams and Rivers		Floodplains								
															# of sites impacted							
Alt. 1	Alt. 2	Alt. 3					# of sites impacted	# of Wetlands	Acres	# of sites impacted	Acres	# of Crossings	Linear Feet	Acres	I*	E*	L*	N*	U*	Species (Common Name)	# of sites impacted	Acres
PITTSBURGH – GREENSBURG																						
104	204	310	Freight Bypass Track at Pittsburgh[1]	352.4	353.1	0.7	0	0	0.00	0	0.00	0	0	0.00	0	0	0	0	0	-	0	0.00
110	210		Passing Siding Rade – Traff (11.5 mi)[3]	325	337.3	12.3	5	0	0.00	0	0.00	22	593	13.52	0	1	0	0	0	Great Blue Heron	1	0.16
		308	Additional (Third) Track Greensburg – Pittsburgh (21.9 mi)[3]	322	353	31	0	0	0.00	0	0.00	27	586	0.00	0	0	0	0	0	-	0	0.00
111.8	211.8	311.8	Curve Modification Greensburg – Pittsburgh[2]	322	353	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pittsburgh – Greensburg Subtotals							**5**	**0**	**0**	**0**	**0**	**49**	**1,179**	**13.52**	**0**	**1**	**0**	**0**	**0**	Great Blue Heron	**1**	**0.16**
GREENSBURG – LATROBE																						
109	209		Passing Siding Pack – Latrobe (12.2 mi)[3]	300.1	313	12.9	4	1	0.57	0	0.00	17	381	1.84	0	1	0	0	0	Great Blue Heron, Allegheny Woodrat, Northern Long-eared Bat, Small-footed Bat, Bat Hibernaculum	0	0.00
		307	Additional (Third) Track Latrobe – Green (9.8 mi)[3]	312.3	322	9.7	0	0	0.00	0	0.00	10	255	0.00	0	0	0	0	0	-	0	0.00
111.7	211.7	311.7	Curve Modification Latrobe – Greensburg[2]	312.3	322	9.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Greensburg – Latrobe Subtotals							**4**	**1**	**0.57**	**0**	**0**	**27**	**636**	**1.84**	**0**	**1**	**0**	**0**	**0**	Great Blue Heron, Allegheny Woodrat, Northern Long-eared Bat, Small-footed Bat, Bat Hibernaculum	**0**	**0**
LATROBE – JOHNSTOWN																						
		306	Additional (Third) Track Johnstown – Latrobe (37.8 mi)[3]	275.1	312.3	37.2	0	0	0.00	0	0.00	30	1,320	0.00	0	0	0	0	0	-	0	0.00
111.6	211.6	311.6	Curve Modification Johnstown – Latrobe[2]	275.1	312.3	37.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	218.5	313.5	Curve Straightening Johnstown – Latrobe[2]	275.1	312.3	37.2	0	1	0.87	0	0.00	0	0	9.30	0	1	0	0	0	-	1	0.77
Latrobe – Johnstown Subtotals							**0**	**1**	**0.87**	**0**	**0**	**30**	**1,320**	**9.30**	**0**	**1**	**0**	**0**	**0**	-	**1**	**0.77**
JOHNSTOWN – ALTOONA																						
101	201		Additional Track Cresson – Johnstown (24 mi)[3]	251	275.3	24.3	0	0	0.00	0	0.00	25	595	0.00	0	0	0	0	0	-	0	0.00

Table 9: Potential Environmental Impacts (Alternatives 1, 2, and 3)																						
Improvement Type Reference #			Type of Improvement	MP from	MP to	Length (miles)	Known Hazardous Waste Sites	National Wetland Inventory (NWI) Wetlands		Water Resources: Lakes and Ponds		Water Resources: Streams and Rivers		Water Resources: Floodplains	Known/High-Probability Historic Resources					Threatened and Endangered Species	Public Lands	
Alt. 1	Alt. 2	Alt. 3					# of sites impacted	# of Wetlands	Acres	# of sites impacted	Acres	# of Crossings	Linear Feet	Acres	# of sites impacted: I*	E*	L*	N*	U*	Species (Common Name)	# of sites impacted	Acres
		305	Additional (Third) Track Altoona – Johnstown (29 mi)[3]	236.4	275.1	38.7	0	0	0.00	0	0.00	40	1,472	0.00	0	0	0	0	0	-	0	0.00
111.5	211.5	311.5	Curve Modification Altoona – Johnstown[2]	236.4	275.1	38.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	217	312.5	Off-Line Horseshoe Curve (9.3 mi)[3]	237.7	244.2	6.5	1	0	0.00	0	0.00	6	1,560	26.82	0	1	0	0	0	Indiana Bat, Small-footed Bat, Northern Long-eared Bat, Bat Hibernaculum	0	0.00
	218.4	313.4	Curve Straightening Altoona – Johnstown[3]	236.4	275.1	38.7	0	1	5.66	0	0.00	4	1,313	15.52	0	1	0	0	0	Indiana Bat, Northern Long-eared Bat	1	10.05
Johnstown – Altoona Subtotals							**1**	**1**	**5.66**	**0**	**0**	**75**	**4,940**	**42.34**	**0**	**2**	**0**	**0**	**0**	Indiana Bat, Small-footed Bat, Northern Long-eared Bat, Bat Hibernaculum	**1**	**10.05**
ALTOONA – TYRONE																						
103.3	203.3	309.3	Platform/Station Work (Altoona)[1]	236	236.7	0.7	2	0	0.00	0	0.00	0	0	0.00	1	1	0	0	1	Indiana Bat, Small-footed Bat, Northern Long-eared Bat, Bat Hibernaculum	0	0.00
		304	Additional (Third) Track Tyrone – Altoona (14.3 mi)[3]	222.2	236.4	14.2	0	0	0.00	0	0.00	21	557	0.00	0	0	0	0	0	-	0	0.00
111.4	211.4	311.4	Curve Modification Tyrone – Altoona[2]	222.2	236.4	14.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Altoona – Tyrone Subtotals							**2**	**0**	**0**	**0**	**0**	**21**	**557**	**0**	**1**	**1**	**0**	**0**	**1**	Indiana Bat, Small-footed Bat, Northern Long-eared Bat, Bat Hibernaculum	**0**	**0**
TYRONE – HUNTINGDON																						
103.2	203.2	309.2	Platform/Station Work (Tyrone)[1]	222	222.3	0.3	0	0	0.00	0	0.00	0	0	0.00	0	1	0	0	0	Indiana Bat, Northern Long-eared Bat, Small-footed Bat, Bat Hibernaculum	0	0.00
		303	Additional (Third) Track Huntingdon – Tyrone (19.7 mi)[3]	202.4	222.2	19.8	0	0	0.00	0	0.00	24	2,946	0.00	0	0	0	0	0	-	0	0.00
111.3	211.3	311.3	Curve Modification Huntingdon – Tyrone[2]	202.4	222.2	19.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	216	312.4	Off-Line Tyrone (12 mi)[3]	213.5	228.4	14.9	1	6	0.24	1	0.01	20	1,783	46.05	0	2	1	0	3	Small-footed Bat, Northern Long-eared Bat, Indiana Bat, Spreading Rockcress, White Camas, Bat Hibernaculum	2	1.74

Table 9: Potential Environmental Impacts (Alternatives 1, 2, and 3)

Improvement Type Reference #			Type of Improvement	MP from	MP to	Length (miles)	Known Hazardous Waste Sites	National Wetland Inventory (NWI) Wetlands		Water Resources – Lakes and Ponds		Water Resources – Streams and Rivers		Water Resources – Floodplains	Known/High-Probability Historic Resources (# of sites impacted)					Threatened and Endangered Species	Public Lands	
Alt. 1	Alt. 2	Alt. 3					# of sites impacted	# of Wetlands	Acres	# of sites impacted	Acres	# of Crossings	Linear Feet	Acres	I*	E*	L*	N*	U*	Species (Common Name)	# of sites impacted	Acres
	218.3	313.3	Curve Straightening Huntingdon – Tyrone[3]	202.4	222.2	19.8	0	1	1.32	0	0.00	1	10	2.36	0	1	0	0	0	Northeastern Bulrush, Indiana Bat, Small-footed Bat, Northern Long-eared Bat, Bat Hibernaculum	0	0.00
			Tyrone – Huntingdon Subtotals				**1**	**7**	**1.56**	**1**	**0.01**	**45**	**4,739**	**48.41**	**0**	**4**	**1**	**0**	**3**	Indiana Bat, Northern Long-eared Bat, Small-footed Bat, Bat Hibernaculum, Spreading Rockcress, White Camas, Northeastern Bulrush	**2**	**1.74**
TYRONE – STATE COLLEGE (SPUR)																						
112	212	314	Spur – State College[3]			43	0	0	0.00	0	0.00	54	834	0.00	0	0	0	0	0	-	0	0.00
			Tyrone – State College (Spur) Subtotals				**0**	**0**	**0**	**0**	**0**	**54**	**834**	**0**	**0**	**0**	**0**	**0**	**0**	-	**0**	**0**
HUNTINGDON – LEWISTOWN																						
103.1	203.1	309.1	Platform/Station Work (Huntingdon)[1]	202	202.5	0.5	1	1	0.88	0	0.00	0	0	0.11	0	1	0	0	0	Indiana Bat	0	0.00
107	207		Passing Siding McVey – Jacks (11.7 mi)[3]	179.3	191.4	12.1	1	4	4.81	0	0.00	11	1,075	12.72	0	1	0	0	0	Indiana Bat, Allegheny Woodrat, Virginia Mallow, Thick-leaved Meadow Rue	0	0.00
108	208		Passing Siding Tunnel – Gray (10.4 mi)[3]	212.7	223.4	10.7	0	7	3.97	0	0.00	19	2,768	40.23	0	1	2	0	5	Indiana Bat, Small-footed Bat, Northern Long-eared Bat, Bat Hibernaculum, Spreading Rockcress, White Camas	2	20.33
		302	Additional (Third) Track Lewistown – Huntingdon (15.5 mi)[3]	165.6	202.4	36.8	0	0	0.00	0	0.00	49	2,470	0.00	0	0	0	0	0	-	0	0.00
111.2	211.2	311.2	Curve Modification Lewistown – Huntingdon[2]	165.6	202.4	36.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	215	312.3	Off-Line Lewistown (45mi) (including new station)[3]	161.8	180.6	18.8	0	1	0.00	0	0.00	26	5,225	13.66	0	1	0	0	0	Indiana Bat, Northern Long-eared Bat, Allegheny Woodrat, Bald Eagle	1	3.44
	218.2	313.2	Curve Straightening Lewistown – Huntingdon[3]	165.6	202.4	36.8	0	2	7.77	0	0.00	4	719	22.23	0	1	0	0	0	Indiana Bat, Allegheny Woodrat, Virginia Mallow, Thick-leaved Meadow Rue	0	0.00
			Huntingdon – Lewistown Subtotals				**2**	**15**	**17.43**	**0**	**0**	**109**	**12,257**	**88.95**	**0**	**5**	**2**	**0**	**5**	Indiana Bat, Allegheny Woodrat, Virginia Mallow, Thick-leaved Meadow Rue, Small-footed Bat, Northern Long-eared Bat, Bat Hibernaculum, Spreading Rockcress, White Camas, Bald	**3**	**23.77**

Improvement Type Reference #			Type of Improvement	MP from	MP to	Length (miles)	Known Hazardous Waste Sites	National Wetland Inventory (NWI) Wetlands		Water Resources: Lakes and Ponds		Water Resources: Streams and Rivers		Water Resources: Floodplains	Known/High-Probability Historic Resources					Threatened and Endangered Species	Public Lands	
Alt. 1	Alt. 2	Alt. 3					# of sites impacted	# of Wetlands	Acres	# of sites impacted	Acres	# of Crossings	Linear Feet	Acres	# of sites impacted: I*	E*	L*	N*	U*	Species (Common Name)	# of sites impacted	Acres
																				Eagle		
LEWISTOWN – HARRISBURG																						
102	202		Additional Track Harrisburg – Rockville (3.5 mi)[3]	104.9	109.6	4.7	0	0	0.00	0	0.00	0	0	0.00	0	0	0	0	0	-	0	0.00
103.4			Lewistown Low-Level Platform[1]	104.9	104.9	0	0	0	0.00	0	0.00	0	0	0.00	0	0	0	0	0	-	0	0.00
105	205		Passing Siding Cannon – Port (14.6 mi)[3]	119	133.4	14.4	1	6	1.68	0	0.00	15	465	18.35	0	2	1	0	0	Bald Eagle, Wild Senna, Common Hop-tree, Oblique Milkweed, Puttyroot, Cranefly Orchid, Flat-stemmed Spike-rush	1	18.39
106	206		Passing Siding Hawthorne – Lewis (5.7 mi)[3]	159.6	165.8	6.2	0	0	0.00	0	0.00	11	110	0.26	0	2	0	0	0	Indiana Bat, Northern Long-eared Bat, Allegheny Woodrat, Bald Eagle, Wild Senna	0	0.00
		301	Additional (Third) Track Harrisburg – Lewistown (44.8 mi)[3]	104.9	165.6	60.7	0	0	0.00	0	0.00	51	4,986	0.00	0	0	0	0	0	-	0	0.00
111.1	211.1	311.1	Curve Modification Harrisburg – Lewistown[2]	104.9	165.6	60.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	213	312.1	Off-Line Rockville – Duncannon (6.3 mi)[3]	109.9	121.1	11.2	1	5	1.92	0	0.00	9	3,553	49.38	1	4	0	0	1	Bald Eagle, Allegheny Woodrat, Yellow-crowned Night-Heron, Great Egret, Wild Senna	1	0.46
	214	312.2	Off-Line Ferguson's Curve (3.8 mi)[3]	126.8	131.2	4.4	1	1	0.02	0	0.00	3	590	1.53	0	1	0	0	0	Puttyroot, Cranefly Orchid, Flat-stemmed Spike-rush	1	4.14
	218.1	313.1	Curve Straightening Harrisburg – Lewistown[3]	104.9	165.6	60.7	0	2	2.72	0	0.00	8	93	37.66	0	1	0	0	0	Indiana Bat, Bald Eagle, Common Hop-tree, Oblique Milkweed, Puttyroot, Cranefly Orchid, Wild Senna, Northern Long-eared Bat, Allegheny Woodrat	2	10.96
Lewistown – Harrisburg Subtotals							**3**	**14**	**6.34**	**0**	**0**	**97**	**9,797**	**107.18**	**1**	**10**	**1**	**0**	**1**	Bald Eagle, Wild Senna, Common Hop-tree, Oblique Milkweed, Puttyroot, Cranefly Orchid, Flat-stemmed Spike-rush , Indiana Bat, Northern Long-eared Bat, Allegheny Woodrat, Yellow-crowned Night-Heron, Great Egret, Puttyroot,	**5**	**33.94**

Table 9: Potential Environmental Impacts (Alternatives 1, 2, and 3)

Table 9: Potential Environmental Impacts (Alternatives 1, 2, and 3)																						
Improvement Type Reference #			Type of Improvement	MP from	MP to	Length (miles)	Known Hazardous Waste Sites	National Wetland Inventory (NWI) Wetlands		Water Resources: Lakes and Ponds		Water Resources: Streams and Rivers		Water Resources: Floodplains	Known/High-Probability Historic Resources					Threatened and Endangered Species	Public Lands	
Alt. 1	Alt. 2	Alt. 3					# of sites impacted	# of Wetlands	Acres	# of sites impacted	Acres	# of Crossings	Linear Feet	Acres	# of sites impacted: I*	E*	L*	N*	U*	Species (Common Name)	# of sites impacted	Acres
																				Flat-stemmed Spike-rush		
			FULL ALTERNATIVE 1 TOTALS				**14**	**19**	**11.91**	**0**	**0**	**174**	**6,821**	**87.03**	**1**	**11**	**3**	**0**	**6**	Great Blue Heron, Allegheny Woodrat, Northern Long-eared Bat, Small-footed Bat, Bat Hibernaculum, Indiana Bat, Northern Long-eared Bat, Spreading Rockcress, White Camas, Northeastern Bulrush, Virginia Mallow, Thick-leaved Meadow Rue, Bald Eagle, Wild Senna, Common Hop-tree, Oblique Milkweed, Puttyroot, Cranefly Orchid, Flat-stemmed Spike-rush, Yellow-crowned Night-Heron, Great Egret	**4**	**38.88**
			FULL ALTERNATIVE 2 TOTALS				**18**	**39**	**32.44**	**1**	**0.01**	**255**	**21,667**	**311.54**	**2**	**25**	**4**	**0**	**10**		**13**	**70.43**
			FULL ALTERNATIVE 3 TOTALS				**7**	**21**	**21.41**	**1**	**0.01**	**387**	**30,272**	**224.61**	**2**	**17**	**1**	**0**	**5**		**9**	**31.56**

[1] Improvement anticipated to require no permitting.

[2] Improvement anticipated to require only a General Permit for Water Obstruction (Chapter 105). NPDES permit would only be required if disturbance is greater than one acre.

[3] Improvement anticipated to require individual Water Obstruction permit (Joint Permit) and a NPDES permit.

V. RAIL OPERATIONS

This section documents the rail operations analysis used to assess the performance impacts of Alternatives 1, 2, and 3. Complete documentation of this study's rail operations analysis is included in a Technical Memorandum titled *Keystone West High Speed Rail Study: Operations Analysis of Proposed Infrastructure Modifications for Supporting High Speed Rail* (October 7, 2013).

Given the conceptual nature of this feasibility study, the project team used prior studies and other readily available resources in completing the various tasks. In the case of rail operations analyses, this was particularly important since the study team and PennDOT recognized that (a) a comprehensive rail operations analysis encompassing all modes would not be doable within the available budget; and (b) that Norfolk Southern was not willing to provide the data that would be necessary to support such an analysis.

A. Methodology and Assumptions

> **For More Information**
>
> Keystone West High Speed Rail Study, Draft Technical Memorandum, "Operations Analysis of Proposed Infrastructure Modifications for Supporting High Speed Rail," October 2013

In reviewing prior studies related to Keystone West, a study completed in 2005 (*Keystone West Passenger Train Study*, prepared for Norfolk Southern Corporation and PennDOT, The Woodside Consulting Group, Inc., February 2005) (Woodside Study) provided useful information regarding the feasibility of operating more frequent passenger train service on the line while not adversely impacting combined freight and passenger train operations. The Woodside Study used Berkeley Simulation's Rail Traffic Controller (RTC) network simulation modeling software to test the operation of two additional daily round trip passenger trains (for a total of three passenger trains daily) operating in mixed traffic with Norfolk Southern freight trains. The Woodside Study concluded that with infrastructure improvements at select locations at a cost of approximately $110 million (presumed to be in 2005 dollars), the network performance after adding two daily Amtrak round trips would be about equal to the base case scenario (i.e. one Amtrak round trip daily on then-existing infrastructure). It is noteworthy that the Woodside Study was completed prior to the 2008-2009 financial crisis and before the recent severe downturn in demand for domestic steam coal and in particular Appalachian coal, which has negatively impacted freight traffic on this corridor. Although the Woodside Study assumed no reduction in passenger train trip times, its conclusions coupled with the fact that Alternative 2 (the primary focus of the Memorandum) includes nearly $10 billion in proposed capital improvements, suggest that the findings of this study are reasonable. It is assumed that the additional capital investment proposed as part of this study should more than compensate for the fact that the Woodside Study used passenger train travel times close to current Amtrak schedules, while this study assumed shorter trip times on the improved infrastructure.

This conceptual feasibility study only assessed the prospective performance of passenger trains on a hypothetically unimpeded railroad. Therefore, the potential conflicts between passenger and freight trains are not directly accounted for in this analysis. However, the Woodside Study conclusions strongly suggest that this study's findings were realistic. The more limited approach used for this study was necessary for several reasons:

- a full-scale network simulation was beyond the scope of this conceptual feasibility study;
- information on the extent and timing of freight-related movements was not available to the study team; and
- it was felt that a full network simulation would be more meaningful after this study is completed and policy decisions are made regarding the level and type of infrastructure and operations improvements that are desired, their implementation timeframes, the level of stakeholder support, and the financial capacity to undertake such improvements.

Industry-recognized rail simulation software, RAILSIM® Version 8 Train Performance Calculator (TPC), was used to analyze the various proposed infrastructure improvements. This software simulates the operation of a single train on a single track; therefore, the effects of conflicting traffic on travel time are not reflected in the results. However, the simulations do account for the vertical profile and horizontal alignment of the modeled track, civil (i.e., imposed by a civil authority) and curve (i.e., resulting from alignment constraints) speed restrictions (including those related to diverging routes), station stops/dwells, and the performance capabilities of rolling stock (locomotives and railcars).

Information for the Base Case (No-Build) infrastructure was compiled primarily from materials supplied by Amtrak and Norfolk Southern (NS). The territory modeled for this study encompasses NS's Pittsburgh Line, eastward from Pittsburgh onto a portion of NS's Harrisburg Division and then to Amtrak's Harrisburg Line for a short distance and terminating at Harrisburg Station. Amtrak's public timetable rounds the overall length of the study corridor to 249 miles.

Where the data was incomplete or ambiguous, assumptions were made using the best available reference materials and the study team's knowledge of the line. For example, platform lengths were not precisely delineated in any of the data sources. Therefore, the lengths and locations of the station platforms were estimated using Google Earth®, where possible, and otherwise were assumed to be 600 feet. A platform location shown on the NS track charts was assumed to be the center of the platform. None of the assumptions made at this stage were viewed as introducing significant risk as to the validity of the analysis.

The current equipment set (locomotives, coaches, café cars, etc.) for the Amtrak Pennsylvanian service was assumed for the purposes of both the Base Case simulation/calibration and the Alternative 2 improvement scenario analysis. This approach allowed the simulation effort to demonstrate the time savings that may be expected with the existing equipment before analyzing alternative equipment types.

Information regarding the equipment set currently in use for the Amtrak Pennsylvanian was obtained from Amtrak records. The train is comprised of one P42 Diesel Locomotive, one business class Amfleet I coach, one Amfleet Dinette car, three Amfleet II coaches, and one

Amfleet 1 coach. Equipment characteristics[2] include passenger capacity, braking and acceleration parameters, and physical characteristics such as weight and length. Characteristics for the assembled train are given in **Table 10: Pennsylvanian Consist General Characteristics**. [*Note: "Consist" means the cars which make up a train; also a list of those cars.*]

Table 10: Pennsylvanian Consist General Characteristics	
Locomotives	1 P42 Diesel
Coaches, number	6
Overall Train Length	581 feet
Overall Loaded Train Weight	456.41 tons
Passenger Capacity (seated)	443
P42 Locomotive Horsepower	4250 HP

For the purposes of these simulations, the trains were conservatively assumed to carry a full seated load of 443 passengers (84 per coach and 23 in the dinette car).

Two other types of equipment were tested to assess their abilities to contribute to running time savings: (1) a three-car Colorado Railcar DMU train, and (2) a passenger train with 12 Talgo Series VII passenger coaches pulled by a GE P42 diesel locomotive (the same locomotive as used by the existing Pennsylvanian). For consistency, car counts for the alternative equipment types were assigned to accommodate the same passenger capacity as the existing Amtrak equipment to allow evaluation of the travel time impacts attributable solely to the performance capabilities of the rolling stock.

The reference schedule used to analyze the results of the simulations was constructed from the Pennsylvanian timetables found on the Amtrak website. The times listed for normal weekday operation are shown in **Table 11: 2012 Amtrak Pennsylvanian Published Weekday Schedule**.

Table 11: 2012 Amtrak Pennsylvanian Published Weekday Schedule		
Station	**Eastbound Schedule (read down)**	**Westbound Schedule (read up)**
Pittsburgh	7:20 a.m. Dep.	8:05 p.m. Arr.
Greensburg	8:01 Dep.	6:52 Dep.
Latrobe	8:11 Dep.	6:41 Dep.
Johnstown	8:51 Arr. 8:54 Dep.	6:00 Dep.
Altoona	9:48 Arr. 9:51 Dep.	5:06 Dep.
Tyrone	10:07 Dep.	4:48 Dep.
Huntingdon	10:34 Dep.	4:22 Dep.
Lewistown	11:11 Dep.	3:46 Dep.
Harrisburg	12:45 p.m. Arr.	2:36 p.m. Dep.
Dep. = Departure	Arr. = Arrival	

[2] From the RAILSIM rolling stock library.

More complete documentation of this study's rail operations analysis is included in a Technical Memorandum titled *Keystone West High Speed Rail Study: Operations Analysis of Proposed Infrastructure Modifications for Supporting High Speed Rail* (October 7, 2013).

The following detailed operations analysis was based on Infrastructure Alternative 2. Since Alternative 2 included all Alternative 1 infrastructure improvements (with a few minor exceptions where more ambitious Alternative 2 improvements made certain Alternative 1 improvements redundant) and the operations analysis calculated time savings by type of improvement, the trip time benefits for Alternative 1 could be closely approximated by subtracting the savings due to the off-line alignment improvements included in Alternative 2. The primary rationale for the Alternative 3 improvements, beyond Alternative 2, is to improve capacity and reduce train delays. While some improvement in running time would result from the addition of a continuous third track as contemplated under Alternative 3, quantifying those benefits cannot be adequately modeled with a TPC tool. A discussion of Alternatives 1 and 3 operations analysis is provided at the end of Section B.

B. Model Validation and Simulation Results

Figures 3 and 4 display the results of the model validation process. The differences between the actual elapsed times and the simulation results can be explained by the fact that recovery times (the time required for a train to get back up to speed after a delay or a stop) are included in the schedule times (blue lines), but not in the TPC simulation results (red lines). All other factors such as track speeds, dwell times at stations, crossover moves required to access platforms on the opposite side of the track (eastbound only), speed restrictions, etc., are included in both the schedule times and the base case simulation. The variances are particularly noteworthy at the endpoints, which suggest that Amtrak's schedule allocates most of the recovery time to those locations. The simulation results suggest that the current schedules include approximately 35 minutes of recovery time in the eastbound direction and a total of nearly 45 minutes westbound (approximately 12 percent and 16 percent, respectively). FRA's suggested standard for recovery time is 7 percent, although a somewhat higher percentage could be justified on Keystone West due to the heavy volume of freight traffic.

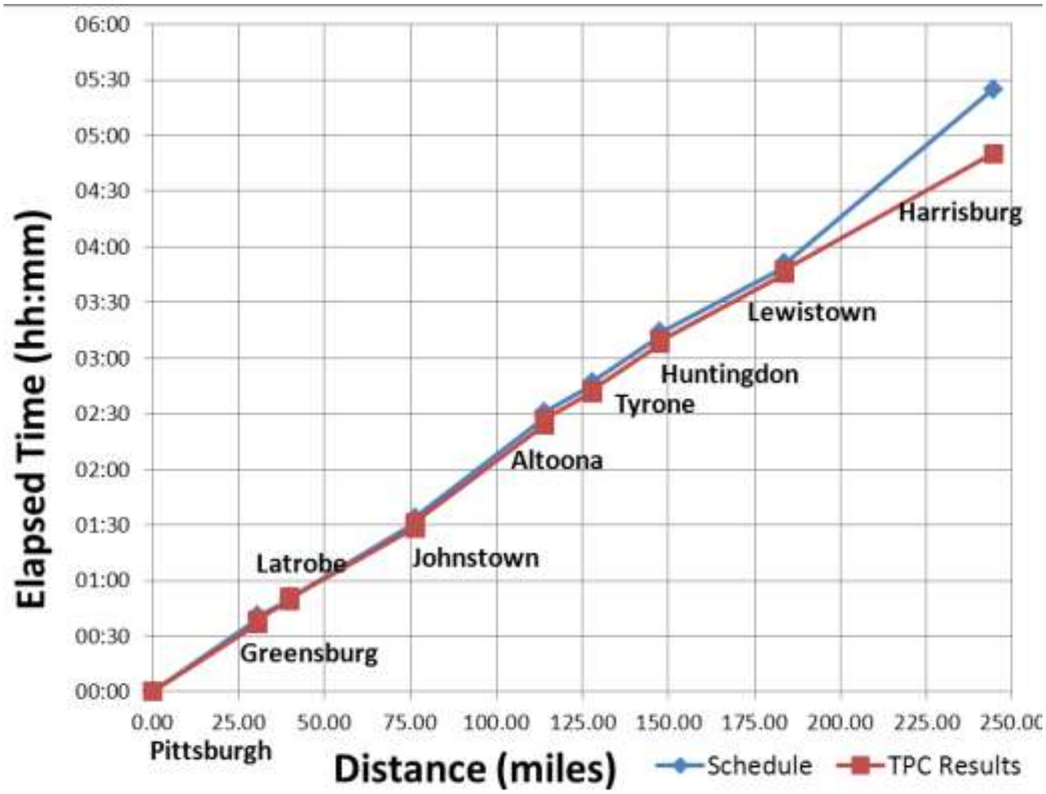


Figure 3: Eastbound Elapsed Time as a Function of Distance for Existing Alignment

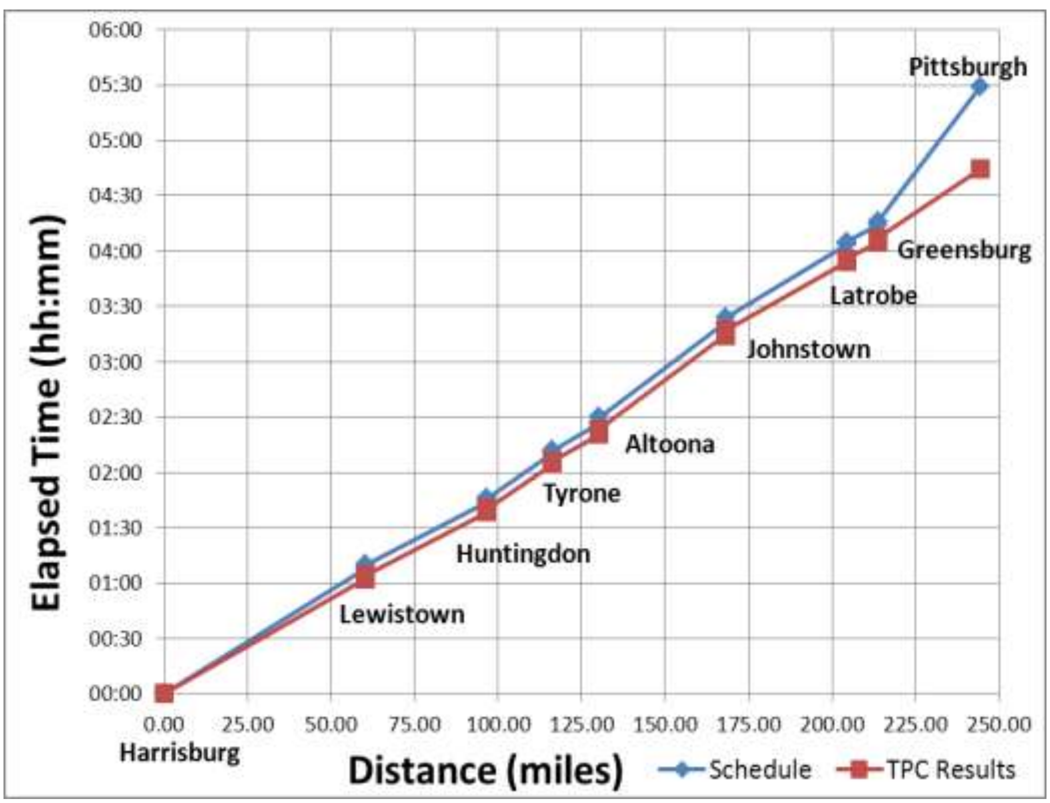


Figure 4: Westbound Elapsed Time as a Function of Distance for Existing Alignment

The following **simulated run time results for Alternative 2** reflect all infrastructure improvements proposed under Alternative 2. The improvements were added to the model incrementally, and in the following order, to determine the time savings due to the individual infrastructure improvement categories:

- platform access improvements,
- changes to superelevation and under-balance for some existing curves,
- addition of off-corridor alignments, and
- straightening of some existing curves.

The off-corridor alignment projects yield time savings due to both the higher maximum design speeds for those sections and because they shorten the distance traveled.

Table 12: Comparative Distances for Alternative 2 'Bypass' Alignments lists each proposed bypass project and its length relative to the existing mileage between the anticipated junction points. Note that if all of the bypass projects were constructed, the corridor would be shortened by up to 13.4 miles for passenger trains based on conceptual engineering estimates. **Appendix B, Improvement Option Details**, provides a table that shows by each individual improvement option the estimated time savings, infrastructure costs, anticipated environmental concerns, etc. to allow for future prioritizing of improvements.

Table 12: Comparative Distances for Alternative 2 'Bypass' Alignments

Off-Corridor Alignment	Existing Distance (miles)	Proposed Distance (miles)	Difference (miles)
Horseshoe Curve	8.15	4.64	3.51
Tyrone	17.38	13.38	4.00
Lewistown	21.19	16.65	4.54
Ferguson's Curve	4.16	3.82	0.34
Rockville – Duncannon	11.70	10.73	0.97
Total	**62.58**	**49.22**	**13.36**

Table 13: Eastbound TPC Running Times for Alternative 2, presents the eastbound results for the Alternative 2 infrastructure improvements as compared to the simulation results for the Base Case alignment.

Table 13: Eastbound TPC Running Times for Alternative 2 (all times shown are hh:mm:ss)							
Station		Base Case Model		Alternative 2 Model		Alternative 2 vs. Base	
		Clock Time	Incremental Time	Clock Time	Incremental Time	Time Savings	%
Pittsburgh	Depart	7:20:00		7:20:00			
Greensburg	Arrive	7:56:48	0:36:48	7:56:12	0:36:12	0:00:36	1.6%
Greensburg	Depart	7:58:48	0:02:00	7:58:12	0:02:00	0:00:00	0.0%
Latrobe	Arrive	8:09:20	0:10:32	8:08:44	0:10:32	0:00:00	0.0%
Latrobe	Depart	8:10:50	0:01:30	8:10:14	0:01:30	0:00:00	0.0%
Johnstown	Arrive	8:48:20	0:37:30	8:47:27	0:37:13	0:00:17	0.8%
Johnstown	Depart	8:51:20	0:03:00	8:50:27	0:03:00	0:00:00	0.0%
Altoona	Arrive	9:44:13	0:52:53	9:33:20	0:42:53	0:10:00	18.9%
Altoona	Depart	9:47:13	0:03:00	9:36:20	0:03:00	0:00:00	0.0%
Tyrone	Arrive	10:01:17	0:14:04	9:47:46	0:11:26	0:02:38	18.7%
Tyrone	Depart	10:02:47	0:01:30	9:49:16	0:01:30	0:00:00	0.0%
Huntingdon	Arrive	10:27:37	0:24:50	10:06:07	0:16:51	0:07:59	32.1%
Huntingdon	Depart	10:29:37	0:02:00	10:08:07	0:02:00	0:00:00	0.0%
Lewistown	Arrive	11:05:37	0:36:00	10:37:15	0:29:08	0:06:52	19.1%
Lewistown	Depart	11:07:37	0:02:00	10:39:15	0:02:00	0:00:00	0.0%
Harrisburg	Arrive	12:10:17	1:02:40	11:34:50	0:55:35	0:07:05	11.3%
Total Time			**4:50:17**		**4:14:50**	**0:35:27**	**12.2%**

In the case of the eastbound trip times, Alternative 2 is projected to produce 35 minutes of time savings (12.2 percent) compared to the Base Case infrastructure. The incremental differences show where these time savings occur.

Figure 5: Eastbound Elapsed Time as a Function of Distance for Alternative 2, plots cumulative eastbound elapsed time versus miles traveled. The blue and red lines show the elapsed times for the existing conditions and for Alternative 2. This figure shows the steady improvement in trip time as the distance increases. The divergence after Johnstown indicates the benefits from the more ambitious improvements in the eastern section of the alignment.

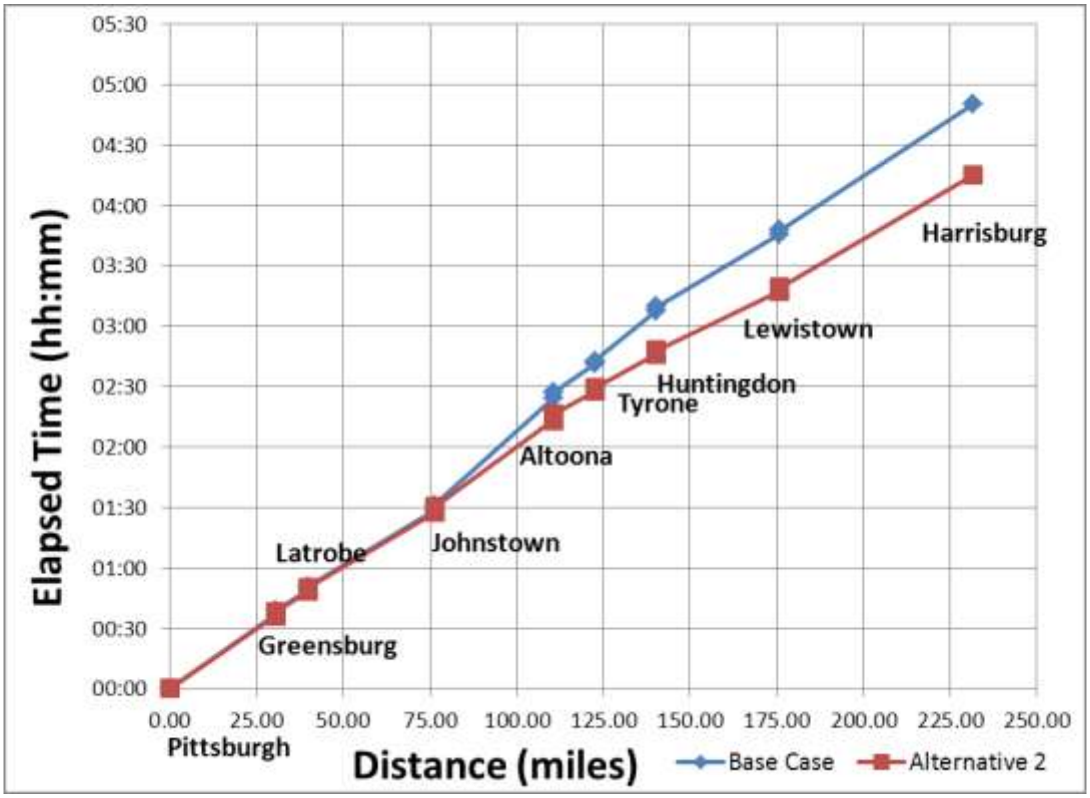


Figure 5: Eastbound Elapsed Time as a Function of Distance for Alternative 2

Table 14: Westbound TPC Running Times for Alternative 2 gives the westbound results for Alternative 2.

Table 14: Westbound TPC Running Times for Alternative 2
(all times shown are hh:mm:ss)

Station		Base Case Model		Alternative 2 Model		Alternative 2 vs. Base	
		Clock Time	Incremental Time	Clock Time	Incremental Time	Time Savings	%
Harrisburg	Depart	14:36:00		14:36:00			
Lewistown	Arrive	15:38:31	1:02:31	15:30:56	0:54:56	0:07:35	12.1%
Lewistown	Depart	15:40:31	0:02:00	15:32:56	0:02:00	0:00:00	0.0%
Huntingdon	Arrive	16:14:31	0:34:00	16:02:24	0:29:28	0:04:32	13.3%
Huntingdon	Depart	16:16:31	0:02:00	16:04:24	0:02:00	0:00:00	0.0%
Tyrone	Arrive	16:40:37	0:24:06	16:21:43	0:17:19	0:06:47	28.1%
Tyrone	Depart	16:42:07	0:01:30	16:23:13	0:01:30	0:00:00	0.0%
Altoona	Arrive	16:56:37	0:14:30	16:35:32	0:12:19	0:02:11	15.1%
Altoona	Depart	16:59:37	0:03:00	16:38:32	0:03:00	0:00:00	0.0%
Johnstown	Arrive	17:50:06	0:50:29	17:21:23	0:42:51	0:07:38	15.1%
Johnstown	Depart	17:53:06	0:03:00	17:24:23	0:03:00	0:00:00	0.0%
Latrobe	Arrive	18:30:12	0:37:06	18:01:09	0:36:46	0:00:20	0.9%
Latrobe	Depart	18:31:42	0:01:30	18:02:39	0:01:30	0:00:00	0.0%
Greensburg	Arrive	18:40:52	0:09:10	18:11:49	0:09:10	0:00:00	0.0%
Greensburg	Depart	18:42:52	0:02:00	18:13:49	0:02:00	0:00:00	0.0%
Pittsburgh	Arrive	19:20:12	0:37:20	18:50:50	0:37:01	0:00:19	0.8%
Total Time			**4:44:12**		**4:14:50**	**0:29:22**	**10.3%**

In the westbound direction, the overall trip time savings is more than 29 minutes (10.3 percent) compared with the simulated Base Case. This trip time improvement is slightly less than in the eastbound direction. This is to be expected since the eastbound train, in addition to benefiting from the curve modifications, off-corridor alignments, and curve straightening, also benefits from platform access improvements that eliminate some crossover moves that slow the train.

The incremental westbound time differences are similar to those that were observed in the eastbound direction.

Figure 6: Westbound Elapsed Time as a Function of Distance for Alternative 2, shows the plot of cumulative westbound elapsed time against distance. As noted in the eastbound direction, the most divergence appears toward the eastern end, with only small incremental divergence between the two lines after Johnstown. This reflects the fact that most of the alignment improvements occur in the eastern section of the corridor.

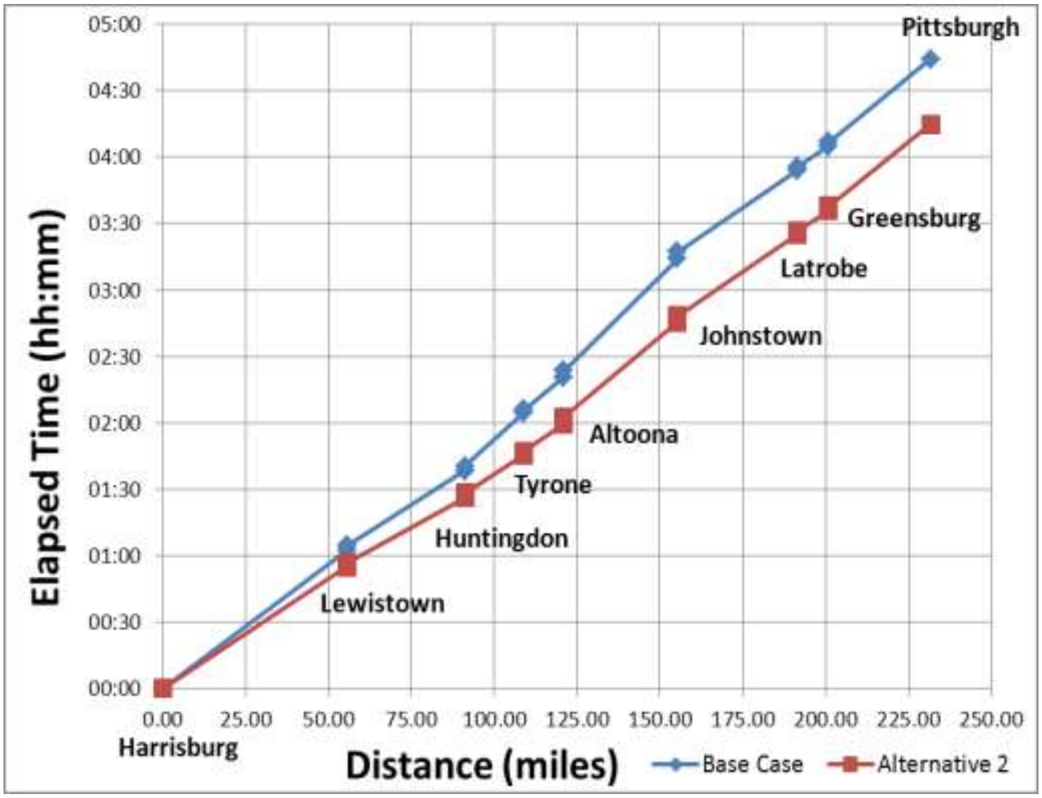


Figure 6: Westbound Elapsed Time as a Function of Distance for Alternative 2

The next topic evaluated was the **time savings for each category of improvement**. Two non-station locations had to be established along the route (labeled "Mifflin" and "Ferguson" in the tables that follow) so that each of the five off-corridor alignments could be analyzed separately. Those five off-corridor alignments and their locations are:

1. Horseshoe Curve – between Johnstown and Altoona
2. Tyrone – between Altoona and Huntingdon
3. Lewistown – between Huntingdon and Mifflin
4. Ferguson's Curve – between Mifflin and Ferguson
5. Rockville to Duncannon – between Ferguson and Harrisburg

Table 15: Eastbound Time Savings by Category of Improvement – Alternative 2 shows the eastbound time savings, by category of improvement, for each station-to-station segment. For example, the off-corridor alignment for Tyrone accounts for all of the time savings between Altoona and Huntingdon (9 minutes, 7 seconds). Similarly, the off-corridor alignment from Rockville to Duncannon accounts for the 53-second improvement in trip time between Ferguson and Harrisburg. As expected, the off-corridor alignment category yields the most time savings.

Table 15: Eastbound Time Savings by Category of Improvement – Alternative 2 (all times shown are hh:mm:ss)					
Segment	**Platform Access**	**Curve Modifications**	**Off-Corridor Alignments**	**Curve Straightening**	**Total Time Savings**
Pittsburgh – Greensburg	0:00:00	0:00:36	0:00:00	0:00:00	**0:00:36**
Greensburg – Latrobe	0:00:00	0:00:00	0:00:00	0:00:00	**0:00:00**
Latrobe – Johnstown	0:00:00	0:00:14	0:00:00	0:00:03	**0:00:17**
Johnstown – Altoona	0:00:00	0:00:27	0:08:35	0:00:58	**0:10:00**
Altoona – Tyrone	0:00:00	0:00:05	0:02:33	0:00:00	**0:02:38**
Tyrone – Huntingdon	0:00:54	0:00:18	0:06:34	0:00:13	**0:07:59**
Huntingdon – Lewistown	0:02:07	0:00:09	0:03:48	0:00:48	**0:06:52**
Lewistown – Mifflin	0:01:05	0:00:03	0:03:50	0:00:10	**0:05:08**
Mifflin – Ferguson	0:00:11	0:00:02	0:00:00	0:00:45	**0:00:58**
Ferguson – Harrisburg	0:00:00	0:00:06	0:00:53	0:00:00	**0:00:59**
Total Time	**0:04:17**	**0:02:00**	**0:26:13**	**0:02:57**	**0:35:27**

Table 16: Westbound Time Savings by Category of Improvement – Alternative 2, displays the westbound time savings, by category of improvement, for each station-to-station segment. In both **Table 15** and **Table 16**, it is worth noting that between Ferguson and Mifflin, the time savings due to the segment's off-corridor alignment that bypasses Ferguson's Curve is nominal (16 seconds westbound and zero eastbound). Because the territory is relatively high speed already, the gains from an off-corridor alignment would be relatively small. In addition, there is a 60 mph speed restriction at each end of the off-corridor alignment, which is enough to offset the benefits gained from this improvement. As in the eastbound direction, the off-corridor alignments category produced the greatest time savings. The platform access projects only affect eastbound trains and, as indicated in the table, there are no time savings attributable to that category in the westbound direction.

Table 16: Westbound Time Savings by Category of Improvement – Alternative 2 (all times shown are hh:mm:ss)

Segment	Platform Access	Curve Modifications	Off-Corridor Alignments	Curve Straightening	Total Time Savings
Harrisburg – Ferguson	N/A	0:00:10	0:02:09	0:00:00	**0:02:19**
Ferguson – Mifflin	N/A	0:00:01	0:00:16	0:00:48	**0:01:05**
Mifflin – Lewistown	N/A	0:00:02	0:03:59	0:00:09	**0:04:10**
Lewistown – Huntingdon	N/A	0:00:07	0:03:42	0:00:44	**0:04:33**
Huntingdon – Tyrone	N/A	0:00:17	0:06:16	0:00:13	**0:06:46**
Tyrone – Altoona	N/A	0:00:06	0:02:05	0:00:00	**0:02:11**
Altoona – Johnstown	N/A	0:00:26	0:06:01	0:01:10	**0:07:37**
Johnstown – Latrobe	N/A	0:00:14	0:00:00	0:00:07	**0:00:21**
Latrobe – Greensburg	N/A	0:00:00	0:00:00	0:00:00	**0:00:00**
Greensburg – Pittsburgh	N/A	0:00:18	0:00:00	0:00:02	**0:00:20**
Total Time	**0:00:00**	**0:01:41**	**0:24:28**	**0:03:13**	**0:29:22**

Figure 7: Eastbound Time Savings for Alternative 2 Improvements displays the eastbound time savings. The gains from the individual off-corridor alignments are apparent, with the exception of the Ferguson's Curve off-corridor alignment as discussed above.

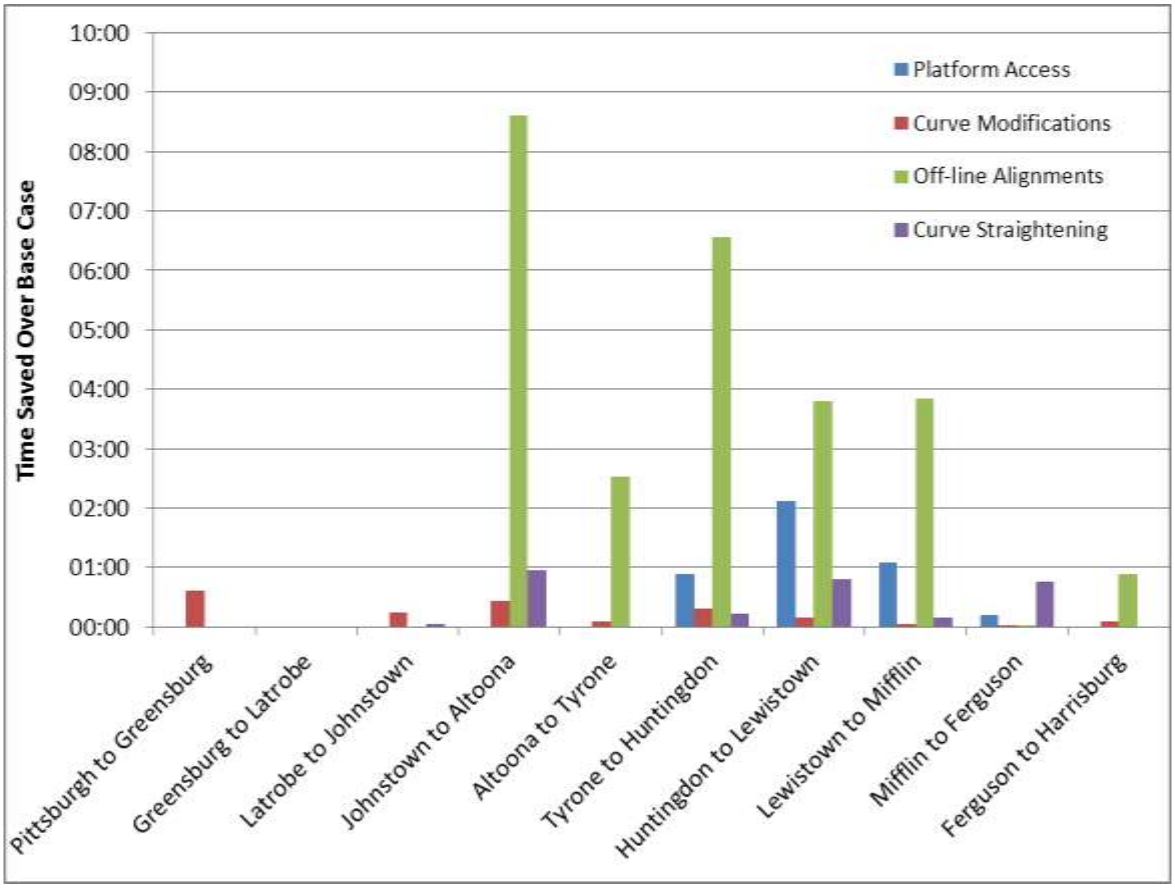


Figure 7: Eastbound Time Savings for Alternative 2 Improvements

Figure 8: Westbound Time Savings for Alternative 2 Improvements displays the corresponding westbound results. As in the eastbound direction, the off-corridor alignments provide the largest time savings, except for the Ferguson Curve bypass, which only provides 16 seconds of time savings. Overall, this off-corridor alignment is too short to substantially overcome the assumed 60 mph diverging speed restriction at each end.

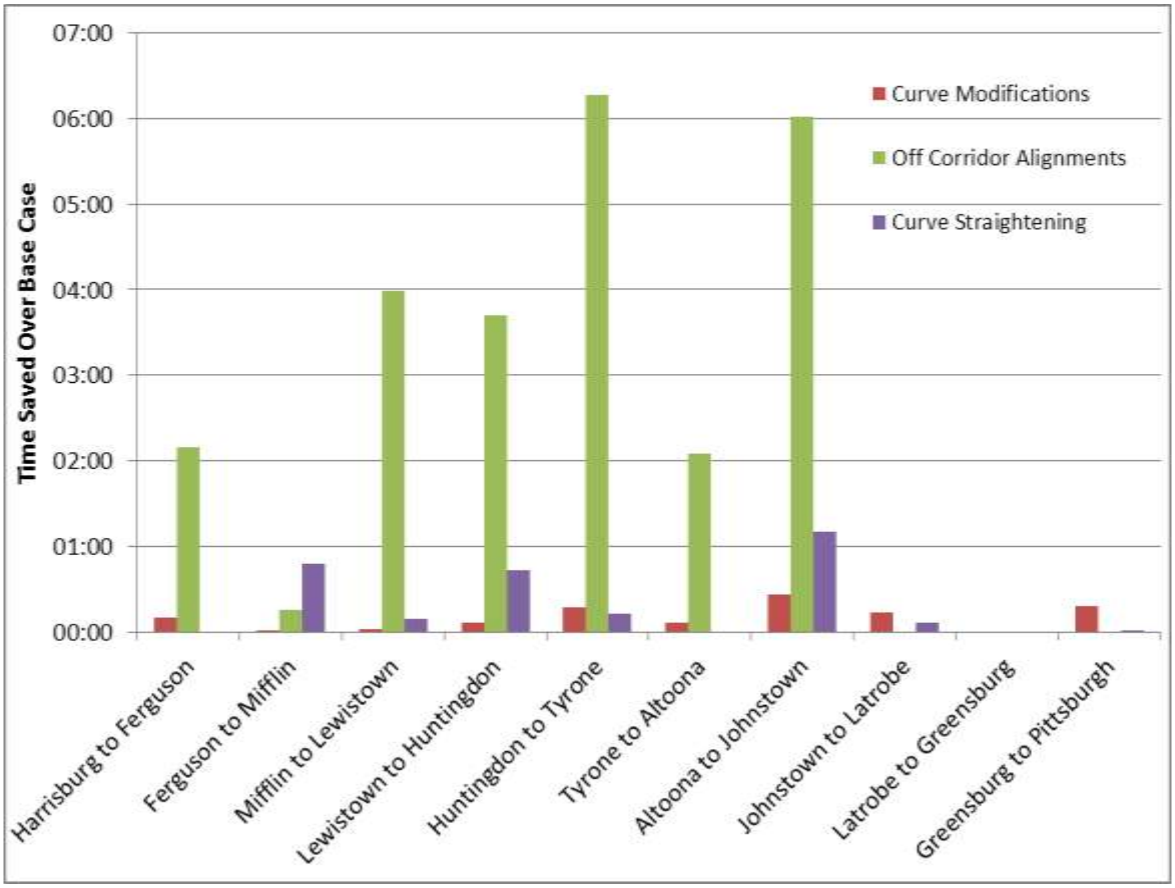


Figure 8: Westbound Time Savings for Alternative 2 Improvements

As mentioned earlier, the Alternative 1 improvements were modeled as part of Alternative 2. The major difference between the two alternatives is that Alternative 2 includes off-line alignments. Removing the off-line improvements from the Alternative 2 operations analysis results in the following time savings from Alternative 1 (**Table 17: Time Savings by Type of Improvement – Alternative 1**).

Table 17: Time Savings by Type of Improvement – Alternative 1					
	Platform Access	**Curve Modifications**	**Off-line Alignments**	**Curve Straightening**	**Total**
East	0:04:16	0:02:00	0:00:00	0:02:57	0:09:13
West	0:00:00	0:01:41	0:00:00	0:03:13	0:04:54

As Table 17 indicates, over four minutes can be saved in the eastbound direction solely by adding platforms at Altoona, Tyrone, Huntingdon, and Lewistown. Advancing these projects could represent a worthy strategy for a low-cost, "early action" program of improvements. Additional benefits could be gained by including the station area improvements included in Alternative 2, including assuring that adequate parking is available. The time savings may actually be greater due to the increase in operational capacity and elimination of unexpected delays caused by waiting for opposing traffic to complete crossover moves. A more precise estimate of time savings would require a full simulation of combined freight and passenger train traffic on the line. Advancing the platform projects would also represent a significant step forward in terms of having the capacity to accommodate additional passenger train frequencies without having an unreasonable adverse impact on NS operations. The **potential performance improvements that can be expected from Alternative 3** are discussed below and represent a qualitative assessment (the rationale for doing a more limited, qualitative assessment of Alternative 3 was explained earlier in the discussion of the operations analysis methodology).

The key characteristic that distinguishes Alternative 3 from Alternative 2 is the provision of a continuous third track throughout the length of the Keystone West corridor. Although the additional third track does not impact maximum train speeds, average train speeds would likely increase somewhat as a result of the added operational capacity, which would mitigate potential conflicts between freight and passenger trains that share the line. Norfolk Southern agreed to supply only very limited information concerning its existing traffic volume and anticipated future volumes. NS reported that as of 2012 approximately 50 to 70 train movements occurred daily on the Pittsburgh Line (Pittsburgh – Harrisburg including a small portion of the Harrisburg Division), not including an unspecified number of light-engine movements associated with manned helper operations based at Altoona.[3] The carrier underscored that it is a "core route" and "one of the most challenging in [their] network to operate."[4] The carrier declined to provide a forward-looking traffic forecast except to state that it anticipated significant volume growth over the next two decades. Taken at face value, this volume estimate puts the Pittsburgh Line in a group of high-volume, heavily-trafficked, critical freight rail corridors in the U.S.

A comprehensive network simulation, including all traffic on the line, would be a logical next step in support of an active, funded program of proposed infrastructure improvements in order to quantitatively evaluate proposed capacity benefits. Absent full network simulation, only broad qualitative remarks on this topic can be supported based on experience with other city pair rail corridors in the U.S. and Canada. Notably, a continuous or nearly seamless third main track between Pittsburgh and Harrisburg should dramatically improve passenger train operational reliability and reduce signal delays caused by interference from other trains—notably slower-moving freight trains. The significant differences in operating performance between passenger trains and heavy-haul freight trains (such as unit coal or grain trains, and to a lesser extent traditional boxcar or general merchandise trains) are amplified on a mountain railroad such as this corridor. Freight trains are typically slow to accelerate even on level track, are often incapable of

[3] May 23, 2012 teleconference with Norfolk Southern Railway representatives. A "light-engine" is a locomotive (or locomotives coupled together) operating without cars. A "manned helper operation" involves independently-operated locomotives assisting another train over a limited distance to provide additional traction and/or braking power due to operating conditions, typically grades. Unlike radio-controlled "distributed power"-type operation, a manned helper remains with a train for a limited distance or over a specific operating territory and then uncouples to subsequently assist another train. Once a manned helper uncouples or "cuts off" from a train it was assigned to assist, it becomes an independent movement that will operate from that point under its own specific authority from the train dispatcher.
[4] Ibid.

accelerating at all on upgrades (in fact are sometimes decelerating due to gravity), and must be kept under careful control on downgrades to avoid operating incidents.

When passenger trains—and, to a lesser extent, intermodal (IM) trains—are introduced in this environment, there should be either two or more tracks available for same-direction traffic, or efficient and strategically located overtake sidings to support attractive passenger train transit times. This is especially true on corridors such as Keystone West where there is significant freight traffic volume and challenging terrain.

The former Pennsylvania Railroad Main Line consisted of three to four main tracks from about 1900 until it was aggressively downsized by successor Conrail in the 1980s, by which time the corridor's traditional passenger train traffic and mail and express business had been almost entirely lost to motor carriers and airlines. Moreover, the practical limitations on train length and weight that were relevant during the steam era had changed greatly, largely because of advances in locomotive technology including dynamic brakes. This meant that fewer individual train movements (and therefore fewer locomotives and employees) could produce more ton-miles per train-mile and per train-hour. Thus, operations required fewer tracks.

Although best practices for track center-to-center spacing have changed since the steam era, favoring a more generous distance to support mechanized maintenance-of-way gangs and improve safety, it should be possible to construct a new third track on the existing "four-track" right-of-way without the need to acquire daunting amounts of adjacent property. The nominal assumption here is that, in most instances, three tracks on more generous centers should fit where four tracks on traditional centers had once existed. The third track could either be a prioritized passenger track or it could be a shared track fully integrated with the existing infrastructure to accommodate passenger and intermodal trains only—perhaps with minimum requirements imposed for horsepower-per-ton and an axle load limit. The resulting reduction in train conflicts due to the disparate speeds for passenger and freight trains and conflicts due to opposing traffic would considerably improve operating reliability. The incremental capacity realized could support increasing the daily service frequency in each direction within this study's objective of approximately three to four trains in each direction daily.

C. Analysis of Alternative Equipment Types

Recognizing the substantial costs and lead time required to implement the infrastructure improvements, alternative equipment types were also evaluated for their ability to achieve time savings at a lesser cost and in a shorter timeframe. Simulations were performed using the Colorado Railcar Diesel Multiple Unit (DMU) and Talgo™ ("Pendulino") trains on the existing alignment, to which the only changes assumed were the platform access improvements at Altoona, Tyrone, Huntingdon, and Lewistown stations. It is important to note that at the time of analysis Talgo had not yet actually deployed in regular revenue service an FRA-compliant locomotive that meets buff strength requirements for operating in the North American railroad environment. Therefore, it was conservatively assumed that a conventional diesel-electric locomotive consistent with Amtrak's existing fleet would be utilized. This is similar to the existing method of operation on the Cascade corridor between Portland, Oregon, and Vancouver, BC, Canada. Modest further improvements in trip time would be expected if a lighter locomotive with better acceleration capability could be used. A full discussion on the Alterative Equipment Types analysis is contained in **Appendix D**. A brief summary of the analysis follows.

The Alternative Equipment analysis considered two options to the trains currently running the Keystone West. These included the Colorado Railcar Diesel Multiple Units (DMUs) and a Talgo consist similar to the one in use by Amtrak's Cascade service in the Pacific Northwest. For both train types, a full seated load was assumed.

The DMU train used in the analysis consisted of a single-level motorized car, a bi-level trailer, and a bi-level motorized car, providing approximately the same seating capacity (468 seats) as the existing Amtrak Pennsylvanian (443 seats) but no onboard food service (a café car option is not available). It is unlikely that the bi-level variant of this equipment would actually be considered for use on the Keystone West corridor. However, more reliable performance data was on file for the bi-level vehicle, which was operating in scheduled revenue service on Tri-Rail (SFRTA) in southern Florida at the time this study was prepared.

The Talgo consist used in the analysis consisted of one P42 diesel with 12 coaches providing seating for up to 480 passengers. Talgo coaches have a suspension system designed to take curves more comfortably at higher speeds than conventional equipment. Accordingly, for simulations that used the Talgo coaches, the curve speeds were updated to reflect this capability. The Talgo Series VII passenger coach specifications were taken from published Talgo material.

Analysis results showed that the Colorado Railcar DMU produces very similar results to the existing Amtrak Pennsylvanian equipment, with the elapsed time between Pittsburgh and Altoona being identical. The total time savings over the entire route is only 38 seconds; therefore, there is essentially no meaningful time difference between the Amtrak equipment and the DMU equipment. The Talgo train demonstrates significantly larger gains in overall travel time (17 minutes, 7 seconds over the course of the trip). The time savings is due mostly to the increased speeds at which the Talgo train negotiates curves. The running times for all equipment types assume that only the platform improvements have been completed.

While the preceding analysis quantifies the potential time savings of the alternative equipment types, there are other factors that are important when considering alternative types of rolling stock. Some pros and cons, other than running time implications, which should be considered as part of any plan to introduce alternative equipment types on the Keystone West line, include:

- Compliance with federal crashworthiness ("buff strength") regulations - Talgo equipment does not meet federal crashworthiness requirements and could only be operated under a waiver granted by FRA as occurred with Amtrak service in the Pacific Northwest.
- Passenger comfort - Passenger comfort over a 250-mile corridor with a four- to five-hour terminal-to-terminal transit time requires food and beverage service. The DMU is intended for short hauls and lacks some of the comfort and amenities typical of intercity equipment. The Talgo train is better equipped for intercity corridor service such as Keystone West.
- Maintainability and expandability - Amtrak has no recent experience maintaining DMU vehicles, no existing parts inventory, and no training program. Such DMU equipment has very limited capability to inter-operate with conventional passenger coaches in the same

train. Somewhat similarly, Amtrak currently has no East Coast maintenance facility to maintain Talgo equipment. A dedicated maintenance facility would therefore be required. In addition, both types of equipment are sufficiently unique that a captive fleet would need to be maintained.

Additional details on all three of these issues are contained in **Appendix D, Analysis of Alternative Equipment Types**.

D. Operations Analysis Conclusions

The Train Performance Calculator (TPC) results predict that the Alternative 2 program of improvements could yield a significant improvement in overall trip time between Pittsburgh and Harrisburg. A comprehensive network analysis would be required to confirm that the passenger train service frequency and trip times modeled for this study are realistic when integrated with freight traffic on the line. The Woodside Study (2005) showed that three daily passenger train round trips is a realistic service scenario provided infrastructure improvements are carried out to prevent deterioration in network performance for both passenger and freight trains. The Woodside Study's conclusions coupled with the nearly $10 billion of infrastructure improvements assumed as part of Alternative 2, strongly suggest that the preliminary predictions of network performance produced by this study are reasonable.

Assuming continued use of conventional equipment (identical or similar to the locomotives and coaches currently in use by Amtrak on the Pennsylvanian), overall trip time improvement would be about 35 minutes in the eastbound direction and about 29 minutes in the westbound direction, for a total round trip savings of approximately 64 minutes. The largest contribution to trip time reduction is attributable to proposed off-right-of-way (bypass) alignments that would shorten the route and allow for higher speeds. They may also help to mitigate train traffic congestion, although this could not be measured using the methods employed for this study. For the purposes of this study, speed restrictions were upgraded for the exact locations of curves, whereas in existing territory, some curve speed restrictions are extended beyond the mathematical limits of the curves for a variety of practical and/or historical reasons. Therefore, it is possible that the trip time could be somewhat further improved by revisiting the existing speed restrictions adjacent to the curve modifications and curve straightening proposed and assumed in this study. Although not quantified as part of this analysis, it is reasonable to assume that many of the proposed infrastructure improvements would result in operational reliability and capacity improvements that could yield additional time savings compared to existing Amtrak schedules. The improvements could also justify some reduction in schedule recovery times.

After adding eight percent schedule recovery time to the predicted Alternative 2 base times, running times of approximately 4 hours, 35 minutes can be expected in both directions. Compared to the existing Amtrak schedule, this represents net time savings of approximately 50 minutes eastbound and 54 minutes westbound.

The primary difference between Alternative 1 and Alternative 2 is the addition of several off-line alignments under Alternative 2. By subtracting the time savings attributable to the off-line alignments, the time savings for Alternative 1 versus the simulated Base Case were calculated to be 9 minutes, 13 seconds eastbound and 4 minutes, 54 seconds westbound. The difference in savings, by direction, is due to the fact that the replacement of "missing" platforms at four stations primarily benefits eastbound traffic.

In addition to all of the improvements associated with Alternative 2, the Alternative 3 improvement program proposes additional tracks and passing sidings that in effect would create a continuous third track throughout the entire line. These additional improvements cannot be evaluated by TPC methods since only a single unimpeded train is considered in isolation, and none of the incremental Alternative 3 improvements would directly result in higher speeds. Rather, the primary benefit of the incremental Alternative 3 improvements would be increased capacity, which would provide more operating flexibility and reliability. This would benefit both passenger and freight operations by reducing delays due to traffic congestion to an even greater extent than Alternative 2. There are significant differences in operating performance (hence speed) between freight and passenger trains, particularly in mountainous terrain where vertical profile has a substantial influence on the operation of heavy freight trains. These improvements could be quantified through a full network simulation if further studies are commissioned.

As a lower-cost alternative to the proposed infrastructure modifications, the round trip travel time could be reduced by approximately 38 minutes by implementing only the four proposed local platform access projects (4 minutes, 17 seconds) and using Talgo passenger coaches (17 minutes, 7 seconds eastbound and 16 minutes, 58 seconds westbound). This is 60 percent of the 65-minute round trip travel time savings achieved by the full implementation of Alternative 2 in combination with conventional Amtrak equipment. However, it must be noted that this calculation was carried out as a purely theoretical exercise since the Talgo equipment tested does not meet FRA crash worthiness standards. The use of Talgo coaches would require a dedicated maintenance facility equipped to handle that equipment and (at present) a special FRA waiver to crashworthiness regulations. The policy and practical implications of pursuing such a waiver should be carefully evaluated in advance of any serious discussions leading to procurement of that type of equipment. In addition, Norfolk Southern approval would be required. Any equipment type that is different from Amtrak's current or anticipated future standard fleet in any operational or technical respect introduces additional maintenance challenges and expenses, as well as potential inter-operability limitations. The use of a Colorado Railcar DMU or similar consist would provide little or no advantage over the existing equipment in terms of unimpeded trip time. Moreover, despite being FRA-compliant, this DMU equipment was not designed for long-distance travel.

E. Pro Forma Operating Plans (Schedules)

It is essential to note that the entire foregoing analysis was completed after removing estimated schedule recovery times from the current Amtrak schedules. For a multi-tracked railroad, the FRA rule of thumb for recovery time is about seven percent, which would add about 20 minutes to the "unimpeded" trip times predicted by the TPC model. Clearly, the current schedule recovery time for the Pennsylvanian exceeds that (approximately 35 minutes eastbound and 45 minutes westbound). This is not surprising given the high probability of freight train "interference" and the need to execute repeated crossover movements. Improvements to station platform facilities should begin to build the case for reducing the amount of recovery time included in the current schedule. Addition of overtake facilities would further support reductions in recovery time.

Nonetheless, it is vital to provide an adequate schedule recovery time to account for the inevitable minor delays that can and will occur even when railroad operations are normal and fluid. Therefore, before using the above analysis to support the schedule development, 8 percent recovery time should be assumed to account for the FRA minimum of 7 percent, and an additional 1 percent to reflect the heavy freight usage of this line. The resulting recovery times add approximately 23 minutes to the trip times used for Alternative 2 baseline simulations for both eastbound and westbound travel. It should be noted that while some reduction from current Amtrak practice is supportable, any adjustment is subject to negotiation with both Amtrak and Norfolk Southern prior to taking effect.

After adjusting the Alternative 2 simulated base times by adding the 8 percent schedule recovery time, the net time savings compared to the current Amtrak schedule are approximately 50 minutes eastbound and approximately 54 minutes westbound. The larger westbound time savings (despite the fact that the platform projects only benefit eastbound trains) is attributable to a larger reduction in schedule recovery time in that direction. The time savings after adding the 8 percent recovery times are summarized in **Table 18: Time Savings for Alternative 2 with 8 Percent Recovery Times**.

Table 18: Time Savings for Alternative 2 with 8 Percent Recovery Times

	Amtrak Existing Schedule	Amtrak Modeled Base Plus 8% Recovery	Time Savings over Existing Schedule	TPC Alt 2 Model Plus 8% Recovery	Time Savings over Existing Schedule	Platforms Only with 8% Recovery and Talgo	Time Savings over Existing Schedule
Eastbound	5:25:00	5:13:30	0:11:30	4:35:13	0:49:47	4:50:24	0:34:36
Westbound	5:29:00	5:06:56	0:22:04	4:35:13	0:53:47	4:48:37	0:40:23
Round Trip	10:54:00	10:20:27	0:33:33	9:10:26	1:43:34	9:39:00	1:15:00

Pro forma operating plans (i.e., schedules) were developed based on the predicted running times for Alternative 2, after adjusting for schedule recovery time. The resulting trip times were approximately 4 hours, 35 minutes in both directions.

Despite the predicted speed gains noted above for the Talgo equipment, schedule development conservatively assumed the use of conventional equipment similar to what Amtrak currently uses on the Pennsylvanian. This is an acknowledgement that there are regulatory and practical impediments that would not permit a routine procurement and deployment of that type of equipment. **Key assumptions for purposes of schedule development** are as follows:

- service frequency of either two or three round trips daily, depending on the schedule option;
- all Alternative 2 infrastructure improvements implemented;
- eight percent schedule recovery, which is slightly more conservative than the FRA minimum; and

- conventional locomotive and coach equipment similar to what Amtrak currently uses for the Pennsylvanian.

The key scheduling objectives were:

- Aim to provide for the possibility of same-day round trip travel between the endpoints in both directions.
- Achieve the best connections possible with the existing Capitol Limited (Nos. 29/30) at Pittsburgh, recognizing the considerable constraints to achieving a truly attractive connection while also achieving other objectives.
- Account for connections to/from Keystone East trains at Harrisburg.
- To the extent practicable, respect the existing Pennsylvanian arrival and departure time slots at Philadelphia and New York City.
- Maximize intercity market attraction, but also consider commute opportunities at either end as a secondary objective.
- Aim for efficient utilization of equipment and labor.

Due to the fact that Keystone West is one link in service connecting more distant intercity markets, schedule development was more involved than simply providing optimal service patterns between Harrisburg and Pittsburgh. As indicated in the above list of scheduling objectives, the schedule development process had to be sensitive to factors such as connections to Keystone East and Capital Limited services, probable availability of time slots for trains continuing through to Philadelphia and New York City, utility of the service for longer distance travelers, realistic departure and arrival times for major markets, the fact that forced transfers are a known deterrent to ridership, etc. Recognizing that there are inherent internal conflicts within the full set of objectives and numerous external constraints, an attempt was made to achieve a reasonable balance while focusing on realistic options. As an example, a better distribution of arrival/departure times throughout the day for travel within the Keystone West Corridor might seem desirable, but overall demand could suffer if that results in a schedule with unrealistic arrivals and/or departures from major connecting markets. Given the relatively modest service levels evaluated (maximum of three round trips on Keystone West), numerous compromises to ideal outcomes on any one objective were required.

The two-frequency operating plan is presented in **Table 19: Two-Frequency Schedule**.

Table 19: Two-Frequency Schedule

Read Down						Read Up	
601 (none)	From PHL/NY			< Connecting Train >		Thru to PHL/NY	620, 612[1] (none)
<u>41</u>	<u>43</u>	Mile		< Train Number >		<u>42</u>	<u>40</u>
(Proposed)	(Existing)					(Existing)	(Proposed)
7:30 a.m.	2:36 p.m.	195	Dep.	**Harrisburg**	Arr.	12:45 p.m.	7:55 p.m.
8:31 a.m.	3:37 p.m.	256	Arr.	**Lewistown**	Dep.	11:45 a.m.	6:55 p.m.
9:05 a.m.	4:11 p.m.	293	Arr.	**Huntingdon**	Dep.	11:11 a.m.	6:21 p.m.
9:25 a.m.	4:31 p.m.	313	Arr.	**Tyrone**	Dep.	10:51 a.m.	6:01 p.m.
9:42 a.m.	4:48 p.m.	327	Arr.	**Altoona**	Dep.	10:37 a.m.	5:47 p.m.
10:31 a.m.	5:37 p.m.	366	Arr.	**Johnstown**	Dep.	9:47 a.m.	4:57 p.m.
11:13 a.m.	6:19 p.m.	403	Arr.	**Latrobe**	Dep.	9:04 a.m.	4:14 p.m.
11:25 a.m.	6:31 p.m.	413	Arr.	**Greensburg**	Dep.	8:51 a.m.	4:01 p.m.
12:05 p.m.	7:11 p.m.	444	Arr.	**Pittsburgh**	Dep.	8:10 a.m.	3:20 p.m.
	29			< Connecting Train >		*30*	
Layover	NY/PHL			< Turns from >		Layover	41
44	Layover			< Turns To >		NY/PHL	39 Layover
A	B			< trainsets >		C	A

Note: Train numbers "41" and "44" are used for illustration and clarity; they are not official train numbers and may conflict with other Amtrak train numbers already in use on another corridor. Trains 42 and 43 already exist and their timings at Harrisburg have been retained intentionally. Train 43 would arrive at Pittsburgh earlier and Train 42 would leave later than at present due to faster speeds resulting from assumed infrastructure improvements.

[1] No onward eastbound connecting train available in current schedule on Saturday.

The most obvious benefit of the two-frequency schedule is that rail travel options would essentially be doubled along the corridor. More specifically, benefits to users would include:

- A business trip from Harrisburg to Pittsburgh would require at most one overnight stay, unlike the current schedule which requires two overnights in Pittsburgh.
- A same-day trip from Harrisburg to Pittsburgh and return would be possible, though with very limited time to conduct business.
- Although not ideal, it is conceivable that individuals with a flexible work schedule could use the service to commute from Pittsburgh to Altoona and back to Pittsburgh.
- The schedule generally is suited to the needs of intercity travelers, although the layover in Pittsburgh for connection to the westbound Capitol Limited is still unattractive.
- In the event of a bad misconnect in Pittsburgh due to unplanned operational or equipment problems, eastbound connecting passengers would have an opportunity to continue to their onward destinations the same day instead of having to either wait a full 24 hours in Pittsburgh (thus necessitating overnight accommodations) or seeking alternative transportation.
- The schedule does not disrupt service patterns for persons accustomed to the current schedule, and by matching the Harrisburg arrival and departure times for the new

frequency with existing Keystone East trains, there is an opportunity to operate the new eastbound and westbound trains as through trains to/from Philadelphia and New York, thereby providing a one-seat ride for all users of the service.

Although a 7:30 westbound departure from Harrisburg might appear, at first glance, to be too early for connecting travelers from the east, train 601 from Philadelphia is a well patronized train that provides a convenient connection (or could be through-routed if Amtrak agrees and has the necessary equipment) for passengers with destinations west of Harrisburg. From an implementation standpoint, the schedule attempts to minimize complexity and optimize labor and equipment efficiency by intentionally providing for connections to existing trains. If the new trains are not operated as through trains for the full length of the corridor, a locomotive change at Harrisburg would be required, since Keystone East trains operate with electric locomotives but no electrification is available along Keystone West. Additional information regarding equipment and facility needs is presented in the financial section of this report.

The three-frequency operating plan is presented in **Table 20: Three-Frequency Schedule**.

Table 20: Three-Frequency Schedule

Read Down					Read Up			
601	From PHL/NY	647		< Connecting Train >	648	To PHL/NY	*(See Note 1)*	620, 612
41	43	45		< Train Number >	40	42	42 (Alt.)	44
(Proposed)	(Existing)	(Proposed)	Mile		(Proposed)	(Existing)	(Proposed)	(Proposed)
7:30 a.m.	2:36 p.m.	5:40 p.m.	195	Dep. **Harrisburg** Arr.	10:35 a.m.	12:45 p.m.	3:05 p.m.	7:55 p.m.
8:31 a.m.	3:37 p.m.	6:41 p.m.	256	Arr. **Lewistown** Dep.	9:35 a.m.	11:45 a.m.	2:05 p.m.	6:55 p.m.
9:05 a.m.	4:11 p.m.	7:15 p.m.	293	Arr. **Huntingdon** Dep.	9:01 a.m.	11:11 a.m.	1:31 p.m.	6:21 p.m.
9:25 a.m.	4:31 p.m.	7:35 p.m.	313	Arr. **Tyrone** Dep.	8:41 a.m.	10:51 a.m.	1:11 p.m.	6:01 p.m.
9:42 a.m.	4:48 p.m.	7:52 p.m.	327	Arr. **Altoona** Dep.	8:27 a.m.	10:37 a.m.	12:57 p.m.	5:47 p.m.
10:31 a.m.	5:37 p.m.	8:41 p.m.	366	Arr. **Johnstown** Dep.	7:37 a.m.	9:47 a.m.	12:07 p.m.	4:57 p.m.
11:13 a.m.	6:19 p.m.	9:23 p.m.	403	Arr. **Latrobe** Dep.	6:54 a.m.	9:04 a.m.	11:24 a.m.	4:14 p.m.
11:25 a.m.	6:31 p.m.	9:35 p.m.	413	Arr. **Greensburg** Dep.	6:41 a.m.	8:51 a.m.	11:11 a.m.	4:01 p.m.
12:05 p.m.	7:11 p.m.	10:15 p.m.	444	Arr. **Pittsburgh** Dep.	6:00 a.m.	8:10 a.m.	10:30 a.m.	3:20 p.m.
		29		< Connecting Train >	30			
Layover	NY/PHL	40		< Turns from >	Layover	Layover	Layover	41
44	Layover	Layover		< Turns To >	45	PHL/NY	PHL/NY?	Layover
A	B	D		< trainsets >	D	C	C	A

Note: Train numbers “40,”“41,”“44,”and “45” are used for illustration and clarity; they are not official train numbers and may conflict with other Amtrak train numbers already in use on another corridor. Trains 42 and 43 already exist and their timings at Harrisburg have been retained intentionally.

1. Alternate schedule shown for Train 42 to better distribute service throughout the day assumes either Amtrak’s ability to accommodate continuation of this train as a one-seat ride Harrisburg – Philadelphia and potentially Philadelphia – New York, or a connection with an existing Keystone East train (would be Train 652 M-F today). If there would be a one-seat ride east of Harrisburg in only one direction, equipment cycling would need to be balanced by including the Keystone East (HBG – PHL) equipment in the pool.

The three-frequency plan offers all of the benefits of the two-frequency option plus:

- A much improved connection opportunity to the Capitol Limited in both directions, saving through passengers three hours westbound and slightly more than two hours eastbound. Proposed Train 44 could operate later subject to negotiations with the host railroad, but the last eastward connection at Harrisburg currently departs at 9:15 p.m. on weekdays, 8:20 p.m. on Sundays, and 7:05 p.m. on Saturdays—the latter already resulting in a misconnect with proposed Train 44 on that day only.
- Permits completion of a same-day business trip from Pittsburgh to Harrisburg and return, with ample time to conduct business in Harrisburg.
- Offers reasonable commute options, in both directions, between Harrisburg and Altoona.
- Achieves a better distribution of travel options by offering morning, mid-day and evening departures in each direction.

Per Note 1 of **Table 20**, if existing Pennsylvanian Train 42 is completely rescheduled to offer a later (and therefore more uniformly distributed) choice of departure times from Pittsburgh for eastbound travelers, there is no assurance at this writing that Amtrak would be able to continue to accommodate this as an existing one-seat ride to New York City (i.e., no transfer required at Harrisburg) in a different schedule slot. Productive discussion with Amtrak on this question would begin with a specific proposal, especially as the retiming would have the train leaving Philadelphia for New York during the evening peak period.

After review of the operating analysis and the schedule options presented above, it was determined that the two-frequency operating plan would be used for purposes of preparing ridership forecasts and the financial analysis that are described in subsequent sections.

VI. CONNECTING BUS SERVICE

An assessment of potential connecting bus services from rail stations to off-line communities was performed to identify routes that could extend the market area of the Keystone West rail service. Criteria used to assess the merits of providing connecting bus service to off-line communities were proximity to the rail line and the presence of population centers and major trip generators. Special considerations such as colleges and universities that might exhibit higher per capita ridership tendencies due to factors such as income and/or auto ownership characteristics were also assessed. The full analysis is documented in the *Keystone West High Speed Rail Study: Bus Connector Corridors White Paper* (February 2013), maintained in the project files.

In many areas of the U.S., intercity bus routes connect Amtrak train stations to areas not directly served by one of their rail lines. "Thruway Motorcoach" service is designed to provide convenient connections between bus and rail, and to ensure reliable transfers between the two services. A variety of highway corridors that intersect the Keystone West rail line were examined as potential candidates for Thruway-type bus connector service. The corridors that were evaluated are shown in **Table 21: Corridors Evaluated for Connecting Bus Service**, with a bold italic font used to identify the corridors selected for further consideration:

Table 21: Corridors Evaluated for Connecting Bus Service			
Amtrak Station	**Off-Line Community**	**Description**	**Assessment**
Harrisburg	Carlisle	22.6 miles southwest of Harrisburg, military facility, population 18,682	Capital Area Transit in Harrisburg currently provides service to/from Carlisle and it is assumed this service could be adjusted to meet train schedules.
	Hershey	13.5 miles east of Harrisburg, medical and tourist facilities, population 13,026	Capital Area Transit in Harrisburg currently provides seasonal service to Hersheypark; however, it is assumed that Hershey does not provide enough demand year-round to warrant a bus connector.
	York	***24 miles southeast of Harrisburg, York College, population 43,718***	***Rabbittransit in York currently provides commuter bus service to/from Harrisburg directly serving the train station that meets the 7:30 a.m. train. Bus service to meet other trains should be considered.***
Lewistown	***State College***	***Urbanized area 33 miles northwest of Lewistown, Penn State University, population 39,898***	***Proximity and large student population offer potential connection for new State College bus service.***

Table 21: Corridors Evaluated for Connecting Bus Service			
Amtrak Station	**Off-Line Community**	**Description**	**Assessment**
Tyrone	***State College***	***26.5 miles northeast of Tyrone, Penn State University, population 39,898***	***Proximity and large student population offer potential connection for new State College bus service.***
Altoona	***State College***	***Urbanized area 43 miles northeast of Altoona, Penn State University, population 39,898***	***Proximity and large student population offer potential connection for new State College bus service. PSU Branch campus is located in Altoona and served by AMTRAN.***
	Bedford	39 miles south of Altoona, historic/recreational activities, population 2,838	Bedford appears to be too small with too little demand for bus/rail connections.
Johnstown	***Indiana***	***Urbanized area 27.5 miles northwest of Johnstown, Indiana University of PA, population 14,988***	***Proximity offers potential for new connecting bus service.***
	Somerset	31.5 miles south of Johnstown, recreational areas, population 6,306	Somerset appears to be too small with too little demand for bus/rail connections.
Latrobe	***Indiana***	***32 miles northeast of Latrobe, Indiana University of PA, population 14,988***	***Proximity offers potential for new connecting bus service.***
Greensburg	Connellsville	26 miles south of Greensburg, population 8,341	Connellsville appears to be too small with too little demand for bus/rail connections.
	Indiana	***35.4 miles northeast of Greensburg, Indiana University of PA, population 14,988***	***Proximity offers potential for new connecting bus service.***

Based on proximity to the rail line, population, and major generators located in the off-line communities, three communities were identified for further consideration: Indiana, State College, and York.

Connections to the rail line from Indiana were considered at Greensburg, Latrobe, and Johnstown. Johnstown was selected as the most logical connection, based on trip times for the bus service and the combined trip times for bus/rail trips from Indiana to Pittsburgh and Harrisburg.

For State College, several options for connecting to Keystone West were evaluated, including Altoona, Tyrone, and a split Tyrone/Lewistown service for westbound/eastbound travel. The split

Tyrone/Lewistown service was judged as having the best potential to maximize ridership out of the State College area.

For trips originating in or destined to York, Harrisburg was chosen as the preferred rail station connection since public transportation is currently available between the two cities, and, although York residents destined for points east of Harrisburg would likely connect to Amtrak at Lancaster, that potential connection was considered outside the scope of this Keystone West study and therefore was not evaluated.

Using the two-frequency rail schedule discussed in the Rail Operations Analysis section, the sample bus schedules shown in **Table 22: York, PA – Harrisburg, PA Connecting Bus Schedule** were developed for the selected corridors. All schedules are designed to have a 20-minute layover at the train station to allow adequate time for transfers.

Table 22: York, PA – Harrisburg, PA Connecting Bus Schedule								
Westbound					Eastbound			
AM	Bus Arrival	Bus Departure	Train Arrival		PM	Bus Arrival	Bus Departure	Train Arrival
York		6:25			York		11:40	
Harrisburg	7:20	7:40	7:30		Harrisburg	12:35	12:55	12:45
York	8:35				York	1:50		
PM					**PM**			
York		1:30			York		6:50	
Harrisburg	2:25	2:45	2:36		Harrisburg	7:45	8:05	7:55
York	3:40				York	9:00		
Note: Two vehicles are required to operate the service.								

The York to Harrisburg schedule is designed to travel as express service using Interstate 83.

Table 23: State College, PA – Tyrone, PA/Lewistown, PA Connecting Bus Schedule

Tyrone Connection						Lewistown Connection				
			Train Arrival						Train Arrival	
AM Trips	**Bus Arrival**	**Bus Departure**	**West-bound**	**East-bound**		**AM Trips**	**Bus Arrival**	**Bus Departure**	**West-bound**	**East-bound**
State College		8:35				State College		7:30		
Tyrone	9:15	9:35	925			Lewistown	8:20	8:40		8:31
State College	10:15	10:45				State College	9:30	10:00		
Lewistown	11:35	11:55		11:45		Tyrone	10:40	11:00	10:51	
State College	12:45					State College	11:40			
			Train Arrival						Train Arrival	
PM Trips	**Bus Arrival**	**Bus Departure**	**West-bound**	**East-bound**		**PM Trips**	**Bus Arrival**	**Bus Departure**	**West-bound**	**East-bound**
State College		3:40				State College		2:35		
Tyrone	4:20	4:40	4:31			Lewistown	3:25	3:45		3:37
State College	5:20	5:55				State College	4:30	5:10		
Lewistown	6:45	7:05		6:55		Tyrone	5:50	6:10	6:01	
State College	7:55						6:50			
Note: Two vehicles are required to operate the service.										

The bus schedule for the State College connector service would originate at the Bryce Jordan Center on the campus of Penn State University. The route is designed as express service with the majority of the route to Tyrone using Interstate 99, while the route to Lewistown would travel on U.S. Route 322 West. No interim stops are planned for the service.

Table 24: Indiana, PA – Johnstown, PA Connecting Bus Schedule								
Westbound					Eastbound			
AM	Bus Arrival	Bus Departure	Train Arrival		AM	Bus Arrival	Bus Departure	Train Arrival
Indiana		9:26			Indiana		8:42	
Johnstown	10:21	10:41	10:31		Johnstown	9:37	9:57	9:47
Indiana	11:36				Indiana	10:52		
PM					**PM**			
Indiana		4:32			Indiana		3:52	
Johnstown	5:27	5:47	5:37		Johnstown	4:47	5:07	4:57
Indiana	6:42				Indiana	6:02		
Note: Two vehicles are required to operate the service.								

The bus connector service between Indiana and the Johnstown Amtrak station would travel on more "local" roadways (primarily PA Route 56) than the State College and York routes, resulting in somewhat slower bus operating speeds. No interim stops are planned for the Indiana – Johnstown route.

Daily and annual vehicle miles required to operate the above schedules are presented in **Table 25: Connecting Bus Services – Vehicle Miles of Operation**.

Table 25: Connecting Bus Services – Vehicle Miles of Operation		
Corridor	Daily Vehicle Miles	Annual Vehicle Miles
Indiana – Johnstown	232.0	84,448
State College – Tyrone/Lewistown	565.2	205,733
York – Harrisburg	211.6	77,022
Total	1,009	367,203
Notes: Vehicle mile figures include both revenue miles and required deadhead miles. Annual vehicle miles is based on daily service.		

Potential ridership and financial considerations associated with the connecting bus services are discussed in the Demand and Financial sections, respectively, of this report.

VII. DEMAND

> **For More Information**
>
> Keystone Corridor West High Speed Rail, "Passenger Forecasts," April 15, 2013.

This section describes the demand estimation assumptions, methodology, and results that provide the basis for the financial analysis as well as the analysis of benefits presented in subsequent sections. Although Alternative 2 infrastructure improvements were used as the primary basis for the demand analysis, two other alternatives were also tested. Alternative 2A, consisting of constructing only the platform and station improvements at Lewistown, Huntingdon, Tyrone, and Altoona, was tested as a low-cost, early-action alternative. Alternative 2C is characterized by the same infrastructure and trip times as Alternative 2, but with the addition of a third daily round trip to the schedule. Fares for all alternatives were assumed to be the same since trips times and service frequencies (i.e., level of service) were not sufficiently different to warrant different fare levels. Also, the demand modeling tools applied (including elasticities) were adapted from other corridors rather than having been developed specifically for Keystone West. Using the same fare for all alternatives helped to isolate the differences in demand due to the infrastructure improvements and service frequency which are the primary factors being tested as part of this Feasibility Study and Preliminary Service Development Plan (PSDP). If a decision is made to advance the PSDP to a complete Service Development Plan meeting all FRA requirements, more rigorous demand modeling, including testing of fare elasticity, will be completed. All alternatives included connecting bus services to Indiana, State College, and York. A complete description of the demand analyses is documented in the Technical Memorandum *Keystone West High Speed Rail Study: Passenger and Revenue Forecasts* (October 2013). Note that the Technical Memorandum includes an Alternative 2B, which was part of the demand analysis, but only for the purposes of testing bus ridership. Alternative 2B was never intended to be a standalone alternative and, therefore, has not been included in this demand summary.

Table 26: Assumptions for Demand Analysis lists the key assumptions for the demand analysis.

Table 26: Assumptions for Demand Analysis	
Description	**Assumption**
Base Year	• 2012
Planning Horizon	• Intermediate: 2020 • Long-range: 2035
Socioeconomic growth factors for Base Case (No-Build) Alternative	• Developed at the county level using data from the Pennsylvania Data Center website
Base Case (No-Build) Alternative	• Eastbound trip time – 5:25 (hrs:min) • Westbound trip time – 5:29
Alternative 2 Infrastructure – Full implementation of Alternative 2 ($9.9 billion)	• Eastbound trip time – 4:35 (hrs:min) • Westbound trip time – 4:35
Alternative 2A Infrastructure – Construct platform and station improvements at Lewistown, Huntingdon, Tyrone, and Altoona ($14.3 million)	• Eastbound trip time – 5:09 (hrs:min) • Westbound trip time – 5:07
Alternative 2C Infrastructure – Full implementation of Alternative 2 ($9.9 billion), enhanced level of service	• Eastbound trip time – 4:35 (hrs:min) • Westbound trip time – 4:35
Demand Elasticity	• Low bound – Chicago to Iowa City High Speed Intercity Passenger Rail Program • High bound – Amtrak IVTT Corridor Model 300+ Miles • Details provided in **Table 27: Elasticities Used in the Pivot Point Analysis**
Gas Price Sensitivity	• $4.00 base assumption • $5.00 per gallon and $6.00 per gallon demand elasticity – research done by Victoria Transportation Institute and the American Public Transportation Association
Service Levels	• Alternative 2 – two round trips daily • Alternative 2A – two round trips daily • Alternative 2C – three round trips daily
Connecting Bus Service	• Same for all alternatives • Indiana, PA – Johnstown Rail Station • State College, PA – Tyrone/ Lewistown stations • York, PA – Harrisburg Station
Fares	• Existing Amtrak fares for all alternatives

A. Methodology

In order to develop a defensible yet cost-effective forecasting procedure suitable for a conceptual feasibility study, the most current data sources were used and a Pivot Point Analysis technique was employed. **Figure 9: Pivot Point Analysis** illustrates the following steps: (1) complete a market analysis to identify the existing demand, by mode, within the Keystone West corridor, (2) develop service characteristics for each alternative, (3) estimate travel demand at each station, (4) perform reasonableness checks on all outputs, and (5) test alternatives.

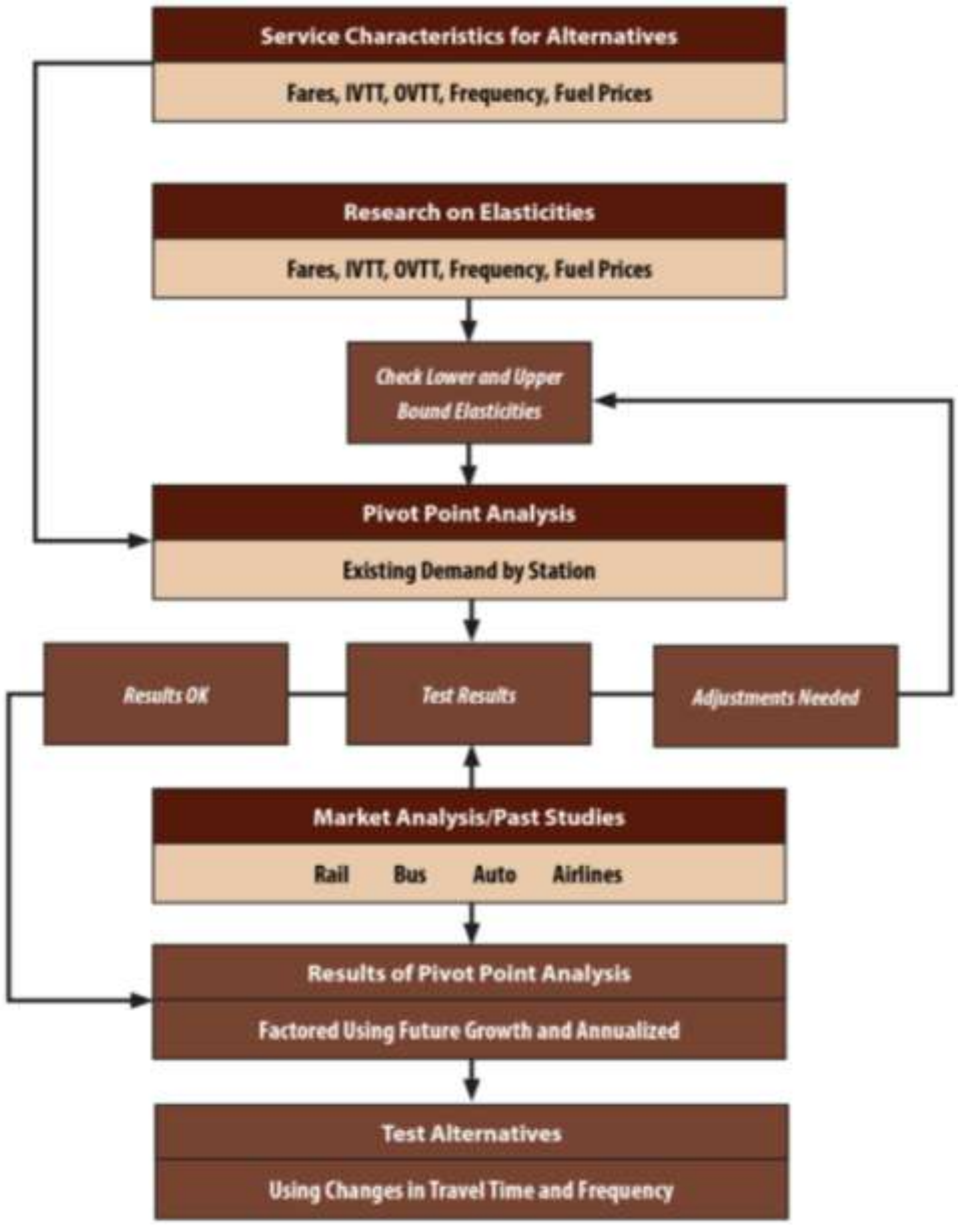


Figure 9: Pivot Point Analysis

The background data consists of three components:

- The relationships observed between service characteristics and travel demand, called "elasticities."
- The service characteristics for each route segment for the scenarios examined.
- Ridership and travel patterns information.

Elasticities were developed from a literature review of passenger rail and high speed rail studies conducted within the past 10 years. In order to account for a range in elasticities observed in these different studies, lower and upper bounds were established for each service characteristic. Lower-bound elasticities were drawn from *Chicago to Iowa City High-Speed Intercity Passenger Rail Program Service Development Plan* (August 6, 2010). Higher-bound elasticities were obtained from "In-vehicle Travel Time (IVTT), Amtrak Corridor Model + 300 miles," produced in 2010. The elasticities are presented in **Table 27: Elasticities Used in the Pivot Point Analysis**.

Table 27: Elasticities Used in the Pivot Point Analysis

Source	Date	Travel Time	
		Low	HIgh
Chicago to Iowa City High Speed Intercity Passenger Rail Program, Service Development Plan August 6, 2010 – ES.11 Appendix H: Amtrak Updates to Feasibility Studies, August 2, 2010	August 6, 2010	-1.2	-1.4
		HSR Frequencies	
Source	**Date**	**Low**	**High**
Amtrak Corridor Model + 300 miles	2010	0.30	0.50

Base year train ridership data and Base Case data for the three service characteristics were obtained either directly from Amtrak or from Amtrak's website.

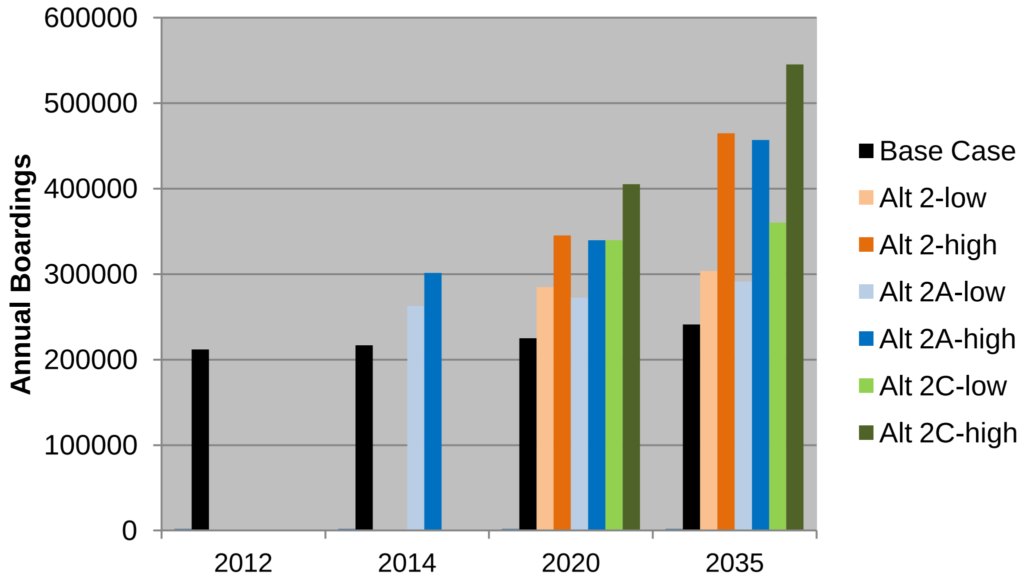
The three key service characteristics included:

- travel time, in minutes, by direction for each station-to-station route segment,
- service frequency, and
- regular fares for weekday service.

Data on annual ridership, along with station-to-station flows, was obtained from Amtrak. Service characteristics for the three build alternatives were produced as part of the alternatives assessment and rail operations analysis phases of this study.

B. Ridership Forecasts

The results of applying the above assumptions and procedures are presented in **Figure 10: Annual Boardings Pennsylvanian, Entire NYC – Pittsburgh Route** for the Base Case and for all three build alternatives. Only Alternative 2A results are shown for 2014 because the full Alternative 2 could not realistically be constructed that soon.



Notes: Lower-bound elasticities from Chicago to Iowa City High Speed Intercity Passenger Rail Program, August 6, 2010
Higher-bound elasticities from IVTT, Amtrak Corridor Model +300 miles, 2010

Figure 10: Annual Boardings Pennsylvanian, Entire NYC – Pittsburgh Route

As expected, Alternative 2C generates the highest demand, since it offers trip times equal to or better than the other alternatives, but also offers the highest level of service of all the alternatives. A particularly interesting result is that Alternative 2A can generate a large portion of the increase in boardings generated by Alternative 2, but at a fraction of the cost. This suggests that, within the range of trip times and service frequencies tested, the demand is much more sensitive to service frequency than it is to trip time. However, when comparing Alternatives 2 and 2A, it is important to note that many of the Alternative 2 capital improvements would result in important capacity benefits that could not be measured by the rail operations analysis techniques used for this study, and those capacity benefits are not fully exploited by the addition of only one round trip. If there was a desire to add additional service to the schedule, Alternative 2 would clearly be better positioned to accommodate that growth, but the extent of the capacity benefits would have to be determined through more detailed analyses, including a full network simulation of combined passenger and freight train movements.

The data that supports Figure 10 is displayed in **Table 28: Base Year and Forecast Annual Boardings Pennsylvanian, NYC – Pittsburgh**.

Table 28: Base Year and Forecast Annual Boardings Pennsylvanian, NYC – Pittsburgh				
Alternative	**2012**	**2014**	**2020**	**2035**
Base Case	211,990	216,700	224,840	241,140
Alternative 2-low			284,840	303,680
Alternative 2-high			345,250	464,640
Alternative 2A-low		262,700	272,600	291,200
Alternative 2A-high		301,520	339,580	457,000
Alternative 2C-low			339,440	360,290
Alternative 2C-high			405,160	545,280

Notes: Lower-bound elasticities from Chicago to Iowa City High Speed Intercity Passenger Rail Program, August 6, 2010
Higher-bound elasticities from IVTT, Amtrak Corridor Model +300 miles, 2010

Although Alternative 2C has the potential to generate the highest demand, the balance of this section focuses on Alternative 2 since it is the basis for the financial plan. This decision was made due to the uncertainties associated with not performing a full network simulation of combined freight and passenger trains, which would be necessary to confirm that:

(a) capacity would exist for a third daily train, and

(b) the assumed trip times for Alternative 2C are achievable with the third round trip added to the already heavy traffic levels on the line.

Table 29: Alternative 2 Annual Boardings displays the results of a more detailed examination of Alternative 2. Alternative 2 is compared to the Base Case for 2020 and 2035. The midpoint of the high and low demand forecasts for each station along the Keystone West portion of the route are shown separately, while the midpoints of the forecasts for all stations east of Harrisburg are aggregated to one amount.

Table 29: Alternative 2 Annual Boardings (based on midpoints of low-high demand forecasts)

Station / Segment	2012		2020				2035		
	Actual		Base Case	Alt 2	Percent Increase		Base Case	Alt 2	Percent Increase
Pittsburgh	41,300		42,770	64,750	51.4%		45,330	78,800	73.8%
Greensburg	7,110		7,370	11,065	50.1%		7,810	13,600	74.1%
Latrobe	2,380		2,470	3,670	48.6%		2,610	4,540	73.9%
Johnstown	12,890		13,350	21,385	60.2%		14,150	26,140	84.7%
Altoona	12,830		13,280	20,455	54.0%		14,080	24,710	75.5%
Tyrone	1,500		1,550	3,165	104.2%		1,640	3,860	135.4%
Huntingdon	3,030		3,120	4,930	58.0%		3,300	5,975	81.1%
Lewistown	3,860		3,990	7,960	99.5%		4,230	9,835	132.5%
Harrisburg	22,520		23,320	32,530	39.5%		24,720	39,355	59.2%
Keystone West Subtotal	107,420		111,220	169,910	52.8%		117,870	206,815	75.5%
East of Harrisburg	104,570		113,620	145,135	27.7%		123,270	177,355	43.9%
Total PA'n	211,990		224,840	315,045	40.1%		241,140	384,170	59.3%

The largest increase in boardings occurs along Keystone West, which is to be expected since that is where all of the Alternative 2 capital improvements would occur. The large percent increases at Tyrone and Lewistown are attributable, in part, to the bus connector service to/from State College and the relatively low base year numbers for those two stations. In 2020, Alternative 2 boardings are forecast to be 52.8 percent higher than the Base Case along Keystone West and 27.7 percent higher than the Base Case along the rest of the route. In 2035, the comparable percentages are 75.5 percent for Keystone West and 43.9 percent for the rest of the route.

Since no improvements to trip time were assumed east of Harrisburg, the growth rate in demand for that route segment is likely attributable to trends in the socioeconomic data, the addition of one daily round trip to the schedule, and any increase in passenger flows to/from Keystone West stations.

The comparison of Alternative 2 to the Base Case for 2020 and 2025 is displayed graphically in **Figure 11: Alternative 2 Boardings versus Base Case – 2012, 2020, and 2035**.

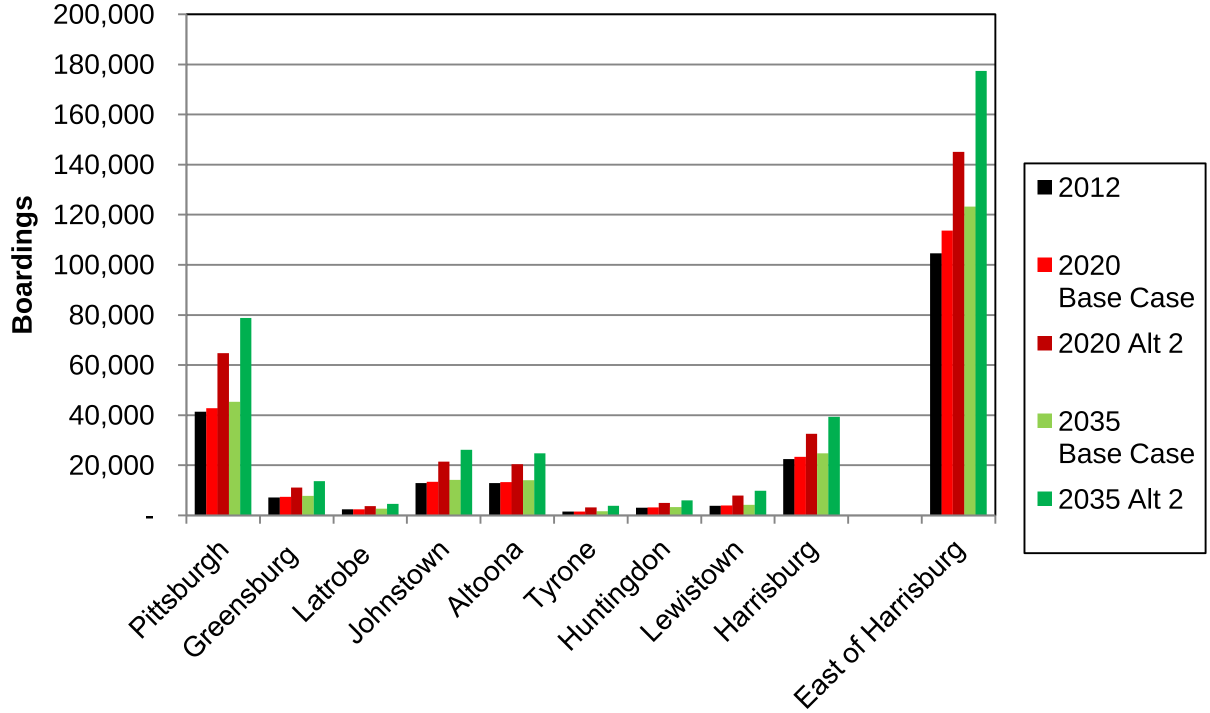


Figure 11: Alternative 2 Boardings versus Base Case – 2012, 2020, and 2035
(based on midpoint of low-high forecasts)

Since Alternative 2 includes connecting bus services from Keystone West rail stations to Indiana, State College, and York, Pennsylvania, it was necessary to identify the ridership on the bus services to support an evaluation of the benefits of that service in relation to the costs and also to isolate the number of rail boardings that would occur without bus service. **Table 30: Alternative 2 Estimated Annual Connecting Bus Boardings** shows two-way annual boardings for the connecting bus services in 2020 and 2035.

Table 30: Alternative 2 Estimated Annual Connecting Bus Boardings (two-way trips: midpoint of low-high forecasts)

Connecting Bus Route	2020	2035
State College to:		
Tyrone	1,590	1,960
Lewistown	3,980	5,000
Total	5,570	6,960
Indiana to Johnstown	4,650	5,730
York to Harrisburg	8,300	10,160
Total All Bus Services	18,520	22,850

The connecting bus services would attract a total of 18,520 two-way trips in 2020 and 22,850 in 2035, which would account for 9,260 and 11,425 (half of 18,520 and 22,850) of the total rail boardings at these four stations in 2020 and 2035, respectively. If the bus service was not operated, the rail boardings would not necessarily be reduced by these full amounts. Some of the travelers making the bus-rail connection would still take the train if the connecting bus service was unavailable, using an alternative mode to get to the rail station. For planning purposes, it is assumed that 20 percent of the identified bus-rail trips would still occur if no connecting service was provided. Therefore, rail boardings would be reduced by 7,408 in 2020 and 9,140 in 2035 (80 percent of 9,260 and 80 percent of 11,425). The estimated reductions in rail boardings, due to removing connecting bus service from Alternative 2, are displayed in **Table 31: Reductions in Alternative 2 Rail Boardings if Bus Service is NOT Provided**, and the adjusted rail boardings for 2020 and 2035 are displayed in **Table 32: Alternative 2 Boardings Without Bus Service – 2012, 2020, and 2035**. Table 32 uses a bold/italic font to denote boardings that are affected by the elimination of bus service from Alternative 2.

Table 31: Reductions in Alternative 2 Rail Boardings if Bus Service is NOT Provided

(80% of one-way bus-rail trips estimated to be lost)

Rail Station	2020	2035
Tyrone	636	784
Lewistown	1,592	2,000
Johnstown	1,860	2,292
Harrisburg	3,320	4,064
Total All Bus Services	7,408	9,140

Table 32: Alternative 2 Boardings Without Bus Service – 2012, 2020, and 2035 (based on midpoints of low-high demand forecasts)

Station	2012	2020			2035		
	Actual	Base Case	Alt 2	%	Base Case	Alt 2	%
Pittsburgh	41,300	42,770	64,750	51.4%	45,330	78,800	73.8%
Greensburg	7,110	7,370	11,065	50.1%	7,810	13,600	74.1%
Latrobe	2,380	2,470	3,670	48.6%	2,610	4,540	73.9%
Johnstown	12,890	13,350	***19,525***	***46.3%***	14,150	***23,848***	***68.5%***
Altoona	12,830	13,280	20,455	54.0%	14,080	24,710	75.5%
Tyrone	1,500	1,550	***2,529***	***63.2%***	1,640	***3,076***	***87.6%***
Huntingdon	3,030	3,120	4,930	58.0%	3,300	5,975	81.1%
Lewistown	3,860	3,990	***6,368***	***59.6%***	4,230	***7,835***	***85.2%***
Harrisburg	22,520	23,320	***29,210***	***25.3%***	24,720	***35,291***	***42.8%***
Subtotal	107,420	111,220	162,502	46.1%	117,870	***197,675***	***67.7%***
East of Harrisburg	104,570	113,620	145,135	27.7%	123,270	177,355	43.9%
Total PA'n	211,990	224,840	***307,637***	***36.8%***	241,140	***375,030***	***55.5%***

C. Impact of Rising Gas Prices

The potential impact of rising gas prices on the demand forecasts was also evaluated. That evaluation relied on demand elasticity research completed by the Victoria Transport Institute (VTI) and the American Public Transportation Association (APTA). Both VTI and APTA published results in 2010 that documented short-term change in rail ridership relative to shifts in gas prices. Assumptions used in the analysis included:

- The relationship of costs between the competing modes are the same in 2035 as they are today in 2012 dollars.
- Vehicle technology and fuel use in 2035 has not changed significantly.
- Ninety percent of the new rail riders are diverting from the auto mode and the remaining 10 percent are diverted from an existing mass transportation mode such as airlines or private buses.
- Rail fares are constant, which might not occur if rail operating costs increase due to increasing fuel costs.

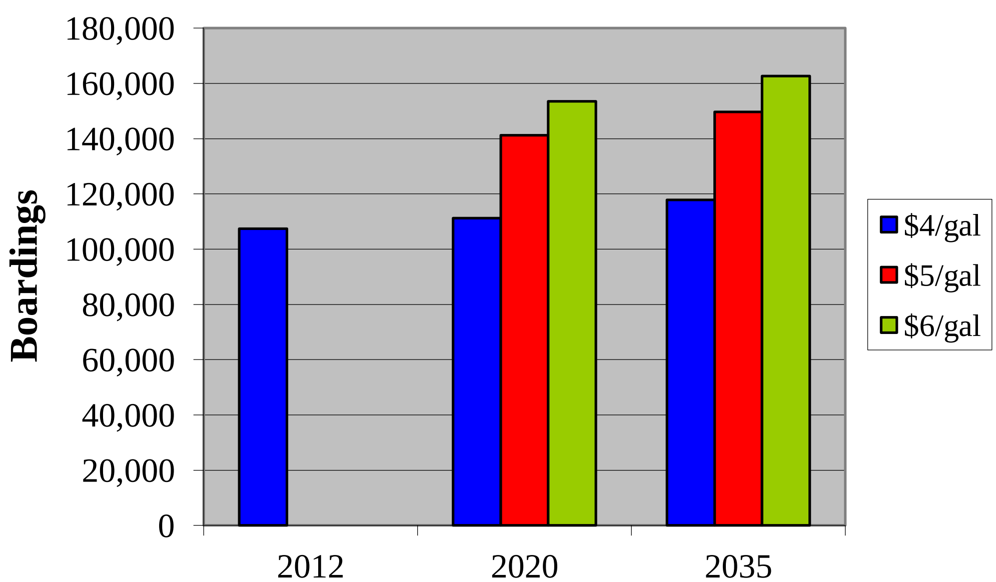
Two levels of gas price increases were evaluated: a gas price increase from $4 to $5 and an increase from $4 to $6. The analysis used constant 2012 dollars. **Table 33: Impact of Increases in Gas Price on Base Case Keystone West Rail Boardings by Cost per Gal, 2020 and 2035**, shows the estimated impact of rising gas prices using the Base Case in 2020 and 2035. An increase in the price of gas from the current $4.00 to $5.00 per gallon would result in a projected 27 percent increase in rail boardings with the Base Case scenario, while a gas price increase from $4 to $6 per gallon would result in a projected 38 percent increase in boardings.

Table 33: Impact of Increases in Gas Price on Base Case Keystone West Rail Boardings by Cost Per Gallon, 2020 and 2035

Forecast Year	$4 per gallon	$5 per gallon	Increase in Boardings over $4 gas	$6 per gallon	Increase in Boardings over $4 gas
2020	111,220	141,249	27.0%	153,484	38.0%
2035	117,870	149,695	27.0%	162,661	38.0%

Note: All gas prices in constant 2012 dollars. Elasticities for $4 to $5 increase and $4 to $6 increase are based on APTA's Potential Impact of Gasoline Prices on U.S. Public Transportation Ridership, 2011-2012.

While the numbers in Table 33 above illustrate the impact of rising gas prices on the Base Case (No-Build) Alternative, similar rates of increase in rail boardings could be expected with Alternative 2. The shifts due to fluctuating gas prices are illustrated graphically in **Figure 12: Impact of Increases in Gas Prices on Base Case Rail Boardings for 2020 and 2035**.



Note: Elasticities for $4 to $5 increase and $4 to $6 increase are based on APTA's *Potential Impact of Gasoline Prices on U.S. Public Transportation Ridership, 2011-2012*.

Figure 12: Impact of Increases in Gas Prices on Base Case Rail Boardings for 2020 and 2035

D. Demand Summary

Three infrastructure/service alternatives were evaluated to assess the demand that might be expected for the planning horizon year of 2035 and for an intermediate benchmark year of 2020. The alternatives consisted of (a) full implementation of Alternative 2 at a cost of $9.9 billion, with two daily round trips; (b) Alternative 2A consisting of only constructing second platforms and related station improvements at Altoona, Tyrone, Huntingdon, and Lewistown at a cost of $14.3 million, with two round trips; and (c) Alternative 2C which assumes full implementation of Alternative 2 infrastructure improvements and three daily round trips. All alternatives assumed the addition of connecting bus services between Indiana and Johnstown Station, State College and Tyrone/Lewistown stations, and between York and Harrisburg Station. All alternatives offer reductions in trip times, with the greatest reductions offered by Alternatives 2 and 2C. The forecasting methodology that was used relied on relationships between travel demand and service attributes documented in studies of similar services/corridors in other areas of the U.S. That approach permitted the development of a range for the demand estimates based on the different experiences of those communities.

Using the midpoint of the low-high range of demand forecasts, Alternative 2 rail boardings along Keystone West are projected to increase from approximately 107,000 in 2012 to approximately 170,000 in 2020 and 207,000 in 2035. Connecting bus services to Indiana, State College, and York collectively would attract approximately 18,520 two-way trips in 2020 and 22,850 two-way trips in 2035. Demand appears to be increased by improvements to frequency first, travel time second, and dedicated bus connections third. If the connecting bus service was not provided, the forecast total rail boardings along Keystone West would be approximately 7,400 less in 2020 (80 percent of one-way bus trips) and 9,100 less in 2035.

In relative terms, Alternative 2A, which only includes platform additions and station area improvements, generates surprisingly high demand given the modest capital investment. However, Alternative 2 would substantially increase capacity and service reliability along the line—two attributes that could not be assessed using the planning-level rail operations analysis tools that were applied.

If the price of gas increases from $4.00 per gallon to $5.00 or $6.00, the demand forecasts for 2020 and 2035 can be expected to increase by approximately 27 and 38 percent, respectively, over projected rail boardings using $4 per gallon gas pricing.

This section focused on the relative benefits of the alternatives based solely on demand. A discussion of other benefits and costs for Alternative 2 are presented later in this report.

VIII. FINANCIAL PLAN

Consistent with the level of analysis elsewhere in this study, this financial analysis relies primarily on readily available sources of information, and is carried to a level appropriate for a conceptual feasibility study. Preparation of a more thorough financial plan(s) would be a part of more detailed studies of the corridor and/or specific projects.

A. General Assumptions

All costs are presented in 2012 dollars unless otherwise noted. Alternative 2 infrastructure improvements and the two-frequency schedule (one additional round trip on a daily basis) were used as a basis for all costs. Although the infrastructure costs associated with a rail spur to State College are included in the capital cost estimate, connecting bus services for State College, York, and Indiana, Pennsylvania, were assumed for purposes of estimating operating expense and revenue. To be consistent with the terms of the federal Passenger Rail Infrastructure and Improvement Act (PRIIA), which requires the Commonwealth to finance deficits on the Pennsylvanian for the entire route segment within Pennsylvania, the financial analysis considers the full Pittsburgh – Philadelphia route segment rather than just Keystone West. This approach also captures the ridership benefits that will accrue to Keystone East as a result of investment in Keystone West infrastructure. Revenue calculations are based on the midpoint of the low-high range of demand estimates. Other key assumptions that were applied in the development of the cost estimates are described as part of the discussions of the various cost categories.

B. Infrastructure Assumptions and Estimated Capital Costs

The assumptions used for estimating the costs of infrastructure improvements are explained in the Alternatives section of this report and a more detailed explanation is documented in technical reports retained in the project files. Direct costs were estimated for each project element and the following multipliers were added, consistent with the planning-level basis for the estimates:

- mobilization/demobilization and permitting – 3 percent
- general conditions/site overhead – 8 percent
- contingency – 25 percent
- engineering – 8 percent
- construction management and inspection – 8 percent

Estimated right-of-way costs are also included in **Table 34: Estimated Infrastructure Capital Costs**. The capital improvements currently being advanced at the Harrisburg Transportation Center are assumed to be financed from other sources. The estimated capital costs for the infrastructure component of Alternative 2 are presented in Table 34 and an estimate of cash flow (not including right-of-way costs) is presented in **Table 35: Estimated Planning Year Cash Flow for Infrastructure Improvements**.

Table 34: Estimated Infrastructure Capital Costs	
Estimated Direct Cost	$6,071,179,636
Mobilization/Demobilization @ 3%	$182,135,389
Permitting @ 1.5%	$93,799,725
Subtotal	$6,347,114,750
General Conditions/Site Overhead @ 8%	$507,769,180
Subtotal	$6,854,883,930
Contingency @ 25%	$1,713,720,983
Subtotal	$8,568,604,913
Engineering @ 8%	$685,488,393
Construction Management & Inspection @ 8%	$685,488,393
ALTERNATIVE 2 – TOTAL ESTIMATED INFRASTRUCTURE COST:	**$9,939,581,699**
Property/Right-of-Way Acquisitions	**$14,000,000**

Table 35: Estimated Planning Year Cash Flow for Infrastructure Improvements (2012 dollars, millions) (not adjusted to year of expenditure)

Infrastructure Category	Total Cost	Planning Year Cash Flow[1]									
	Year	1	2	3	4	5	6	7	8	9	10
Additional Track within Existing ROW	**$110.8**	$44.3	$66.5	-	-	-	-	-	-	-	-
Additional Platforms/ Station Improvements	**$13.3**	$1.3	$2.7	$3.3	$3.3	$2.7	-	-	-	-	-
Freight Bypass Track at Pittsburgh	**$8.2**	$7.4	$0.8	-	-	-	-	-	-	-	-
New/Extended Passing Sidings	**$1,244.7**	$124.5	$186.7	$186.7	$248.9	$248.9	$248.9	-	-	-	-
Curve Modifications	**$15.9**	-	-	$7.9	$7.9	-	-	-	-	-	-
Rail Spur to State College	**$71.9**	-	-	-	-	$7.2	$18.0	$18.0	$18.0	$7.2	$3.6
Off-line Alignments	**$7,826.6**	$391.3	$391.3	$782.7	$1,174.0	$1,565.3	$1,565.3	$782.7	$782.7	$391.3	-
Curve Straightening	**$648.2**	-	$64.8	$129.6	$162.1	$194.5	$97.2	-	-	-	-
Total Cash Flow	**$9,939.6**	**$568.8**	**$712.8**	**$1,110.3**	**$1,596.3**	**$2,018.6**	**$1,929.5**	**$800.6**	**$800.6**	**$398.5**	**$3.6**

[1] Details may not sum to totals due to rounding.

The categories of project costs presented in the cash flow estimate are organized in a manner that acknowledges that certain types of work would likely be performed by Norfolk Southern, while outside contractors or a combination of the two might be used for other tasks. The above cash flow estimate is based solely on the estimated time required for permitting and to design and physically construct the improvements. Considerations such as public involvement, right-of-way acquisition, mitigation of environmental impacts, funding availability, freight capital projects that may consume Norfolk Southern's capacity, regulatory delays, and other factors—each of which could add considerable time—are not reflected in the cash flow timing. If the project is advanced and further studies are commissioned, more detailed information would be collected and analyses performed to provide a basis for a refined cash flow schedule pursuant to a more detailed financial plan.

C. Rolling Stock Assumptions & Cost Estimate

Historically, Amtrak has provided the rolling stock for any services operating under agreement with the Commonwealth. Given the modest increases in service being considered for Keystone West (one additional frequency per day), it is likely that arrangement would continue. Therefore, it is assumed that Amtrak will continue to own and maintain all rolling stock and that the Commonwealth will be charged through an "equipment capital charge" that is part of annual operating budgets. Known capital charges for the existing Pennsylvanian were assumed to represent a sound basis for estimating equipment costs associated with service expansion. An implicit underlying assumption is that Amtrak will have equipment available to provide for the proposed modest increase in service. Given the levels of demand forecast for 2020 and 2035, the existing consist size should be adequate for each of the four trainsets that would be required for the two-frequency schedule. As of 2012, one complete Pennsylvanian consist for the peak requirement on the Philadelphia – Pittsburgh segment (two complete consists are required for daily service) was comprised of:

- one diesel locomotive
- five coaches (one of which is business class)
- one dinette

The peak equipment requirement occurs on Sundays, with one less coach utilized on other days. Amtrak provides spares from its equipment pool.

Since the schedule for the additional frequency on the Pennsylvanian service was designed to meet current Keystone East arrivals and departures at Harrisburg, it is assumed that rolling stock currently in use for the Philadelphia – NYC segment (and the operating cost financing for continuation of those trips) will continue to be available and the costs will continue to be borne by Amtrak. Based on the above assumptions and on financial information provided by Amtrak and PennDOT, the incremental annual equipment capital charge for the Philadelphia – Pittsburgh segment of an additional daily round trip is estimated at $960,000 (2012 dollars). The costs associated with spare units are included in the estimated capital charge. In the event that Amtrak does not have the equipment necessary to operate the additional service, procurement of the required equipment would add considerable capital costs and lead time prior to implementation of the new service. A worst-case estimate can be drawn from an analysis completed in 2009 by Amtrak, pursuant to PRIIA, which estimated capital outlays for equipment to operate one additional round trip on the Pennsylvanian service at $88 million. The estimate included three diesel locomotives, three electric locomotives, 10 coaches, and three food service cars. Based on the type and amount of equipment listed with that estimate, it appears that three complete sets of locomotives (two plus one spare) were assumed for the entire Pittsburgh – Philadelphia – NYC route, including electric locomotives for the Philadelphia – NYC segment. In reality, the cost to the Commonwealth should be less assuming that Amtrak would, at a minimum, continue to shoulder the equipment and operating costs for the portion of the Pennsylvanian service east of Philadelphia. Subtracting the cost of the three electric locomotives from the $88 million would reduce that estimate considerably.

D. Operating Expense Assumptions & Operating Costs Estimates for Rail Service

Current operating costs for the Pennsylvanian were used as a basis for estimating operating costs for the additional frequency. Amtrak's pending PRIIA pricing policy was assumed as a basis for determining which costs, or portions of costs, are allocable to Pennsylvania. **Table 36: Basis for Estimated Operating Expenses Charged to the Commonwealth, Philadelphia – Pittsburgh Segment of the Pennsylvanian** provides a summary of the composition of operating costs used for this analysis, which is consistent with Amtrak's PRIIA pricing policy.

Table 36: Basis for Estimated Operating Expenses Charged to the Commonwealth, Philadelphia – Pittsburgh Segment of the Pennsylvanian

Costs Included	Allocated Portion of Costs Included	Costs Not Included
Third-Party Railroad Costs **Route Costs** • crew costs • maintenance of equipment • route advertising and sales • reservations and call centers • stations • commissions and concessions • block and tower • terminal costs • insurance	**Additives** • marketing • train and equipment • maintenance of equipment • on board services • police • general and administration	**"Other" Costs** • supervision/training/overhead • maintenance of way support • maintenance of equipment and other yard operations • national marketing • national police, environmental, and safety • track and equipment overhead and operations management • OBS and commissary • utilities • other G&A

One additional round trip between Philadelphia and Pittsburgh would require the operation of 257,690 additional train miles annually, calculated as follows:

353 one-way route miles x 2 trains/day x 365 days/year = 257,690

Actual base year (2012) cost for the existing Pennsylvanian, which includes a use charge for rolling stock, was reported by Amtrak and PennDOT to be $12.153 million and this same amount is used as the base year cost for the second round trip. Operating expenses estimated using this approach should be considered a conservative estimate since various subcategories of existing operating expense represent fixed costs or costs that would not vary in direct proportion to the increase in service. Economies of scale should be realized as a result of expanding service from one round trip daily to two round trips.

E. Revenue Assumptions

The midpoint of the high-low demand estimates, Amtrak's 2012 fare structure, and 2010 station-to-station flow data were used as a basis for projecting revenue. No fare discount plans were assumed in estimating demand and passenger revenues. The complete fare matrix used for both demand forecasts and estimation of passenger revenue is presented in **Table 37: Amtrak Pennsylvanian One-Way Fares (dollars) – 2012 Base**.

Table 37: Amtrak Pennsylvanian One-Way Fares (dollars) – 2012 Base

Stations	PGH	GNB	LAB	JST	ALT	TYR	HGD	LEW	HAR
Pittsburgh (PGH)		$9.50	$9.50	$15.00	$20.00	$20.00	$25.00	$33.00	$39.00
Greensburg (GNB)	$9.50		$5.50	$11.00	$16.00	$16.00	$21.00	$24.00	$35.00
Latrobe (LAB)	$9.50	$5.50		$11.00	$16.00	$16.00	$21.00	$24.00	$35.00
Johnstown (JST)	$15.00	$11.00	$11.00		$11.00	$11.00	$15.00	$20.00	$29.00
Altoona (ALT)	$20.00	$16.00	$16.00	$11.00		$5.50	$9.50	$15.00	$24.00
Tyrone (TYR)	$20.00	$16.00	$16.00	$11.00	$5.50		$9.50	$15.00	$24.00
Huntingdon (HGD)	$25.00	$21.00	$21.00	$15.00	$9.50	$10.00		$11.00	$17.00
Lewiston (LEW)	$33.00	$24.00	$24.00	$20.00	$15.00	$15.00	$11.00		$13.00
Harrisburg (HAR)	$39.00	$35.00	$35.00	$29.00	$24.00	$24.00	$17.00	$13.00	
Elizabethtown (ELT)	$49.00	$45.00	$45.00	$38.00	$33.00	$33.00	$25.00	$19.00	$6.50
Lancaster (LNC)	$49.00	$49.00	$49.00	$43.00	$35.00	$35.00	$28.00	$21.00	$8.00
Exton (EXT)	$49.00	$49.00	$49.00	$45.00	$38.00	$37.00	$31.00	$26.00	$17.50
Paoli (PAO)	$49.00	$49.00	$49.00	$49.00	$43.00	$41.00	$35.00	$28.00	$21.00
Ardmore (ARD)	$49.00	$49.00	$49.00	$49.00	$49.00	$45.00	$38.00	$33.00	$23.00
Philadelphia (PHL)	$52.00	$49.00	$49.00	$49.00	$46.00	$45.00	$38.00	$33.00	$25.00
Trenton, NJ (TRE)	$69.00	$69.00	$67.00	$60.00	$55.00	$55.00	$49.00	$41.00	$39.00
Newark, NJ (NWK)	$69.00	$69.00	$68.00	$68.00	$67.00	$63.00	$58.00	$53.00	$51.00
New York, NY (NYC)	$70.00	$70.00	$69.00	$69.00	$67.00	$63.00	$58.00	$54.00	$52.00

Using the above assumptions, the resulting estimates of operating expense, revenue, annual equipment charge, and deficit for 2020 and 2035 are presented in **Table 38: Rail Operating Expense, Revenue, Deficit, and Equipment Capital Charge**. All amounts are in constant 2012 dollars.

Table 38: Rail Operating Expense, Revenue, Deficit, and Equipment Capital Charge (2012 dollars)			
Pittsburgh – Philadelphia Route Segment			
	Actual[1]	Estimate	Estimate
Operating Budget Category	**2012 Existing Pennsylvanian 1-Frequency $000s**	**2020 Alt 2 2-Frequency $000s**	**2035 Alt 2 2-Frequency $000s**
Third-Party Costs	$2,295	$4,590	$4,590
Route Costs	$7,886	$15,772	$15,772
Additives	$1,973	$3,945	$3,945
Total Operating Cost	**$12,153**	**$24,307**	**$24,307**
Revenue			
Fares[2]	**$7,783**	**$10,305**	**$12,561**
Food Service	$436	$577	$703
Other	$80	$106	$130
Total Operating Revenue	**$8,299**	$10,988	$13,394
Total Operating Deficit	**$3,855**	**$13,318**	**$10,913**
Equipment Capital Charge[3]	**$960**	**$1,921**	**$1,921**
Total Recurring Annual Cost	**$4,815**	**$15,239**	**$12,834**

[1] Source: Amtrak/PennDOT
[2] Forecast revenue for 2020 and 2035 based on midpoints of low-high demand and revenue projections.
[3] Equipment capital charge for 2020 and 2035 based on four trainsets, plus spares.

Operating Statistics: Philadelphia – Pittsburgh Segment			
	2012	**2020**	**2035**
Boardings	175,950	262,670	320,080
Passenger Miles	37,931,100	57,871,750	70,554,750
Average Trip Length (miles)		220	220
Average Fare (dollars)		$39	$39

With rail service levels and expenses doubling and ridership increasing at a significantly lesser rate, the estimated operating deficits for rail increase considerably. As mentioned previously, the estimated operating expense and deficit figures for Alternative 2 in both future years examined represent very conservative estimates since not all categories of expense would double when service levels are doubled.

F. Financial Analysis for Connecting Bus Service

The estimated costs for connecting bus services are based on providing daily, dedicated bus connections between Indiana, Pennsylvania, and the Johnstown rail station; between State College and the Tyrone/Lewistown rail stations; and between York and the Harrisburg rail station. All bus schedules are designed to meet trains in the two-frequency rail schedule discussed in the rail operations analysis. Level-of-service data for the three bus routes are shown in **Table 39: Connecting Bus Services – Annual Vehicle Miles and Vehicle Hours**.

Table 39: Connecting Bus Services – Annual Vehicle Miles and Vehicle Hours

Route	Annual Vehicle Miles	Annual Vehicle Hours
Indiana – Johnstown	84,448	3,351
State College – Tyrone/Lewistown	205,733	7,128
York – Harrisburg	77,022	3,406
Total All Bus Services	**367,203**	**13,885**

Note: Based on daily service.

Cost per vehicle mile was used as the basis for estimating costs. Using vehicle hours as the basis would result in a lower operating cost estimate (due to the higher than average speeds for these services), but vehicle miles was consciously chosen to provide a conservative estimate of costs for this conceptual feasibility study. Unit costs per vehicle mile for the public transit providers operating in the three off-line communities were obtained from the Pennsylvania Public Transportation Annual Performance Report for Fiscal Year 2010-11 and updated to the 2012 base used throughout this study. Estimated 2012 operating expense for the three connecting bus services is shown in **Table 40: Connecting Bus Services – Annual Vehicle Miles and Operating Expense**.

Table 40: Connecting Bus Services – Annual Vehicle Miles and Operating Expense (2012 dollars)			
Route	**Annual Vehicle Miles**	**Operating Cost/Mile**	**Operating Cost**
Indiana – Johnstown	84,448	$4.86	$410,417
State College – Tyrone/Lewistown	205,733	$6.80	$1,398,984
York – Harrisburg	77,022	$5.96	$459,051
Total All Bus Services	**367,203**		**$2,268,453**

Note: Based on daily service.

Fares for the connecting bus services were developed after completing a review of Amtrak Thruway Bus fares for similar service, intercity bus fares along Keystone West, and fares charged by public transit authorities for similar services along Keystone West. The fares charged by public transit authorities operating in the communities where connecting bus services are proposed were judged the most relevant for use in estimating demand and farebox revenues for these services. No fare discounts were taken into consideration for this analysis. **Table 41: Connecting Bus Services – Fares, Demand, and Farebox Revenue** lists the fares for the individual bus services and the resulting demand and farebox revenue estimates at the forecast levels of demand for 2020 and 2035.

Table 41: Connecting Bus Services – Fares, Demand, and Farebox Revenue (2012 dollars)					
Route	**One-way Fare**	**Annual Trips 2020**	**Annual Revenue 2020**	**Annual Trips 2035**	**Annual Revenue 2035**
Indiana – Johnstown	$4.00	4,650	$18,600	5,730	$22,920
State College – Tyrone	$5.00	1,590	$7,950	1,960	$9,800
State College – Lewistown	$4.00	3,980	$15,920	5,000	$20,000
York – Harrisburg	$3.50	8,300	$29,050	10,160	$35,560
Total All Bus Services		18,520	$71,520	22,850	$88,280

Note: Based on daily service.

Table 42: Connecting Bus Services – Estimated 2020 and 2035 Financial Performance summarizes the expected financial performance of the three bus services for 2020 and 2035 using constant 2012 dollars.

Table 42: Connecting Bus Services – Estimated 2020 and 2035 Financial Performance (constant 2012 dollars)								
	2020				2035			
Route	**Demand**	**Expense**	**Revenue**	**Deficit**	**Demand**	**Expense**	**Revenue**	**Deficit**
Indiana – Johnstown	4,650	$410,417	$18,600	$391,817	5,730	$410,417	$22,920	$387,497
State College – Tyrone/ Lewistown	5,570	$1,398,984	$23,870	$1,375,114	6,960	$1,398,984	$29,800	$1,369,184
York – Harrisburg	8,300	$459,051	$29,050	$430,001	10,160	$459,051	$35,560	$423,491
Total All Bus Services	**18,520**	**$2,268,453**	**$71,520**	**$2,196,933**	**22,850**	**$2,268,453**	**$88,280**	**$2,180,173**

In light of the large deficits that are projected for the bus services, a more detailed assessment of the merits of operating the services on a less-than-daily basis should be conducted prior to service implementation to determine if a better balance can be achieved between demand, costs, and benefits. That type of evaluation would have to be done on an individual corridor basis due to the varying nature of the markets. For example, the university towns of Indiana and State College would have different day-of-week ridership patterns than York.

Estimated capital costs for the connecting bus services are shown in **Table 43: Connecting Bus Services – Vehicle Costs**. Capital costs associated with improvements to rail stations are included in the rail infrastructure costs discussed previously. It is assumed that existing bus stops, shelters, storage, and maintenance facilities located in the affected communities could accommodate these services. It is also assumed that the costs for vehicle spares are included in the operating costs presented above.

Table 43: Connecting Bus Services – Vehicle Costs (2012 dollars)			
Route	**Buses Required**	**Unit Cost**	**Total Cost**
Indiana – Johnstown	2	$350,000	**$700,000**
State College – Tyrone/Lewistown	2	$350,000	**$700,000**
York – Harrisburg	2	$350,000	**$700,000**
Total All Bus Services	**6**	**$350,000**	**$2,100,000**

Note: Capital cost for vehicles based on 40-foot diesel buses.

Total vehicle costs are estimated at $2.1 million based on 40-foot diesel buses. Although the demand could possibly be accommodated by smaller vehicles for most trips, the larger vehicles are recommended due to the length of the trips, potential peaking on certain days or at certain times of the year (particularly for Indiana and State College), and also from a fleet compatibility standpoint. If a fueling station for alternative fuel is available in one or more communities and alternative fuel vehicles are preferred, the estimated unit cost of new vehicles would increase by about 50 percent, to approximately $525,000, with a corresponding increase in total vehicle costs. Suppliers of alternative fuels may be willing to offset a portion of the incremental costs. The final decision on optimal vehicle type(s) should be made by the individual transit authorities based on the demand for the individual routes and other local factors.

Due to the considerable capital outlay that would be required for new vehicles, it may be preferable to start with used and/or rehabilitated vehicles until a test period establishes the actual level of demand and whether or not all services are sustainable. This strategy has the potential to significantly reduce costs and risks.

Other considerations that could help maximize connecting ridership and revenue include joint marketing and joint ticketing to enhance public awareness, perception of the rail/bus connection as a seamless service, and the overall convenience of the services.

G. Total Bus & Rail Costs

The total of the rail and bus operating expense, revenue, and deficits presented above are summarized in **Table 44: Total Alternative 2 Rail and Bus Operating Budget**. All amounts are based on daily service for both bus and rail.

Table 44: Total Alternative 2 Rail and Bus Operating Budget (constant 2012 dollars)

	2012 Existing Pennsylvanian / No Bus $000s	2020 Alt 2 2-Frequency w/Bus $000s	2035 Alt 2 2-Frequency w/Bus $000s
Rail			
Operating Expense	$12,153	$24,307	$24,307
Operating Revenue	$8,299	$10,988	$13,394
Operating Deficit	$3,855	$13,318	$10,913
Equipment Charge	$960	$1,921	$1,921
Total Annual Rail Deficit	$4,815	$15,239	$12,834
Bus			
Operating Expense	NA	$2,268	$2,268
Operating Revenue	NA	$72	$88
Total Annual Bus Deficit	NA	$2,196	$2,180
Total Annual Rail and Bus Operating Deficit	**$4,815**	**$17,435**	**$15,014**

Total capital costs for bus and rail are presented in **Table 45: Total Alternative 2 Rail and Bus Capital Costs**.

Table 45: Total Alternative 2 Rail and Bus Capital Costs (2012 dollars, $000s)	
Rail Infrastructure Capital Costs[1]	$9,939,582
Bus Capital Costs	$2,100
Total Capital Costs	**$9,941,682**

[1]Rail equipment capital costs treated as a recurring annual "use charge" in the operating budget.

H. Funding

Pennsylvania's program of state support for public transportation modes ranks among the largest in the U.S. More than one billion dollars in state funding is provided annually across multiple programs including intercity bus and intercity passenger rail, as shown in **Table 46: Pennsylvania State Support for Public Transportation**, which illustrates the breadth and depth of state funding programs.

Table 46: Pennsylvania State Support for Public Transportation

Program	2011-2012 State Funding ($000s)
Mass Transit Operating	$790,236
Capital and Asset Improvement	$190,504
Persons With Disabilities	$6,803
Intercity Bus	$1,671
Intercity Passenger Rail Operating	$8,991
Intercity Passenger Rail Capital Match	$1,467
Community Transportation Capital	$18,229
Rail Safety	$450
Demonstration/Research/Technical Assistance	$8,900
Shared-Ride Program for Senior Citizens	$79,000
TOTAL	**$1,106,251**

Once a specific program of rail improvements is decided upon, funding will likely come from many sources. Understanding what funding is available and for what purpose will be essential to assemble a comprehensive and sustainable financial plan. Detailed information on state and federal funding sources that could potentially be used to help fund improvements to Keystone West infrastructure and service levels is provided in **Appendix E**.

Other states and regions that are actively pursuing high speed rail projects have used many of the federal programs mentioned in **Appendix E, State and Federal Funding Sources**. In addition, various dedicated funding sources have been established to provide matching funds and to advance selected improvements without federal funding. The efforts of select states including California, North Carolina, Florida, and the coalition of Midwest states (centered on Chicago), are summarized in the separate Draft Technical Memorandum *Keystone West High Speed Rail Study: Intercity Passenger Rail Funding Options Review* (April 2013).

Pennsylvania offers one of the largest programs of state support for public transportation in the nation. However, only a relatively small amount of the total funding is used for intercity rail projects and services. While the Commonwealth has the latitude to adjust the distribution formulas for existing programs to provide modest amounts of additional funding for intercity rail, the extent of any such adjustments could not address the level of costs associated with a rail improvement program as ambitious as full implementation of Alternative 2. At nearly $10 billion, such an undertaking would likely require new sources of state funding involving both grants and loans, public-private partnerships, success in capturing significant federal funds, and partnerships with local entities for station area improvements. If a decision is made to advance a significant program of improvements that is beyond the capacity of current funding programs, the funding sources being utilized by other states and regions could provide useful models worth exploring.

If a more modest program of “early action improvements” is advanced, it is conceivable that existing federal and state programs could provide the necessary funds.

I. Financial Risks

Although there are a number of financial risks that could affect the feasibility and implementation of the infrastructure and service improvements, the Commonwealth has a long and successful track record of working with both Amtrak and Norfolk Southern to advance projects of mutual interest. The double-stack freight project completed along Keystone West in the 1990s, several intermodal facilities projects that involved NS-PennDOT cooperation, funding the $145 million PennDOT-Amtrak Keystone Corridor (East) Capital Improvement Program, and ongoing joint PennDOT-Amtrak capital improvements along the Keystone Corridor provide ample evidence of the key parties working together to address and overcome unforeseen risks. That successful track record would form a strong institutional foundation for addressing the following types of risks that may arise with this project:

- Conceptual Basis for Cost Estimates – Although contingencies typically applied to concept-level costs have been employed for the estimates, more detailed studies of specific projects could significantly alter the estimated costs. Since most of the capital projects could be implemented independent of other projects, these risks can be addressed and appropriate mitigation strategies developed as better information becomes known. A decision not to pursue a particular project or group of projects would not jeopardize the entire program.
- Right-of-Way Issues – Right-of-way costs have been estimated for each alternative using the methodology documented in the Memorandum contained in **Appendix B**. The cost and time to acquire the necessary properties could have a significant impact on the feasibility and cost of certain improvements—most notably the off-line alignment projects. Prior to implementation, detailed corridor studies would be required that would quantify the costs in more detail and related risks and include mitigation strategies.
- Maintenance of Traffic – Norfolk Southern will expect that provisions be made for the orderly movement of freight trains across the line during any construction programs being

advanced primarily for the benefit of passenger service. Given the nature and scale of various improvements discussed in this report, that could present a considerable challenge and cost. When those major improvement projects are advanced, maintenance-of-traffic plans and corresponding financial strategies would be developed.

- Private Ownership of Keystone West – While attempts were made to account for the fact that Keystone West is a very busy privately-owned railroad, detailed discussions were not conducted with Norfolk Southern to reach an understanding on key issues that would impact the cost of the program of improvements. For example, while access fees are addressed in the operating expense estimate, there is no guarantee that the fees for service expansion would mimic current fees that Amtrak pays. Liability issues could present an even larger financial consideration/risk since Norfolk Southern views any increase in passenger service as a substantial risk for which they would not be liable, aside from the presence of more passenger trains.
- Available Funding – Perhaps the biggest risk is the absence of known funding sources to fully implement a capital improvement program of the magnitude of Alternative 2. The approach used for this study attempts to address that risk by presenting a menu of improvement projects, many of which have independent utility and could be implemented in an incremental fashion. As discussed elsewhere in this report, adding second platforms at select stations is an example of cost-effective, staged implementation that would have mutual benefits for both Norfolk Southern and passenger trains and could be accomplished at a modest cost.
- Legislative Changes – Just as PRIIA restructured the financial relationship between Amtrak and state governments, new legislation always has the potential to present unforeseen risks. However, just as PRIIA provided ample lead time for the affected parties to reach agreement on terms that meet the requirements imposed by that law, any new legislation would likely provide similar lead time to assess the consequences and devise strategies—financial and otherwise—to comply.
- Institutional Factors – There has been considerable debate over the years regarding federal financial support for Amtrak and whether parts of Amtrak should be privatized. Reductions in federal financial support would clearly have an impact on the cost-benefit balance as it currently exists from the Commonwealth’s perspective. Privatization of either the owner or operator roles that Amtrak currently fulfills would present both challenges and potential opportunities. This risk is largely outside of the Commonwealth’s control; however, as with the risk of legislation changing the ground rules, any major institutional shifts would likely come with ample advance notice and a transition period.

IX. BENEFITS

A. Transportation Efficiency Benefits

The improvements to rail transportation service provided under Alternative 2 would yield a variety of travel-related benefits, both direct and indirect. **Table 47: Travel-Related Benefits of Alternative 2** summarizes the benefits.

> ***For More Information***
>
> Keystone Corridor West High Speed Rail, Draft Technical Memorandum, "Estimation of Benefits," April 29, 2013.

Table 47: Travel-Related Benefits of Alternative 2

Benefit	Direct/ Indirect	Description
Travel Time Savings Base Passengers	Direct	Passengers who would have traveled by rail under the Base Case (No-Build) enjoy a reduction in trip time.
Travel Time Savings Incremental Passengers	Direct	Passengers induced to ride by rail enjoy a "consumer surplus" proportional to the reduced rail travel time (consumer surplus concept explained in the text below).
Travel Time Savings Freight	Direct	Freight shippers experience savings in inventory holding cost due to reduced travel time.
Automobile Operating Cost Savings	Direct	Travel diverted from road to rail avoids automobile operating costs.
Accident Cost Savings Diverted Trips	Direct and Indirect	Accident costs are reduced by diverting travel from road to rail, which has much lower accident rates. These savings are experienced by the diverted travelers (direct) as well as remaining road travelers and the public (indirect).
Accident Cost Savings Route Enhancements	Direct	Rail travel on the improved segment becomes even safer compared to the Base Case (No-Build).
Increased Schedule Reliability Passengers and Freight	Direct	Improvements increase on-time performance.
Increased Scheduling Options Passengers	Direct	Doubling the number of train departures per day greatly increases scheduling flexibility for rail passengers.
Air Pollution Reduction	Indirect	Air pollution costs are reduced by diverting travel from road to rail, which has much lower air emissions rates per passenger mile.

Rail projects can also potentially have a variety of benefits associated with reducing road congestion. However, a substantial amount of road traffic must be diverted for road congestion reduction to be realized, and the levels of diversion with Alternative 2 are not expected to meet this threshold.

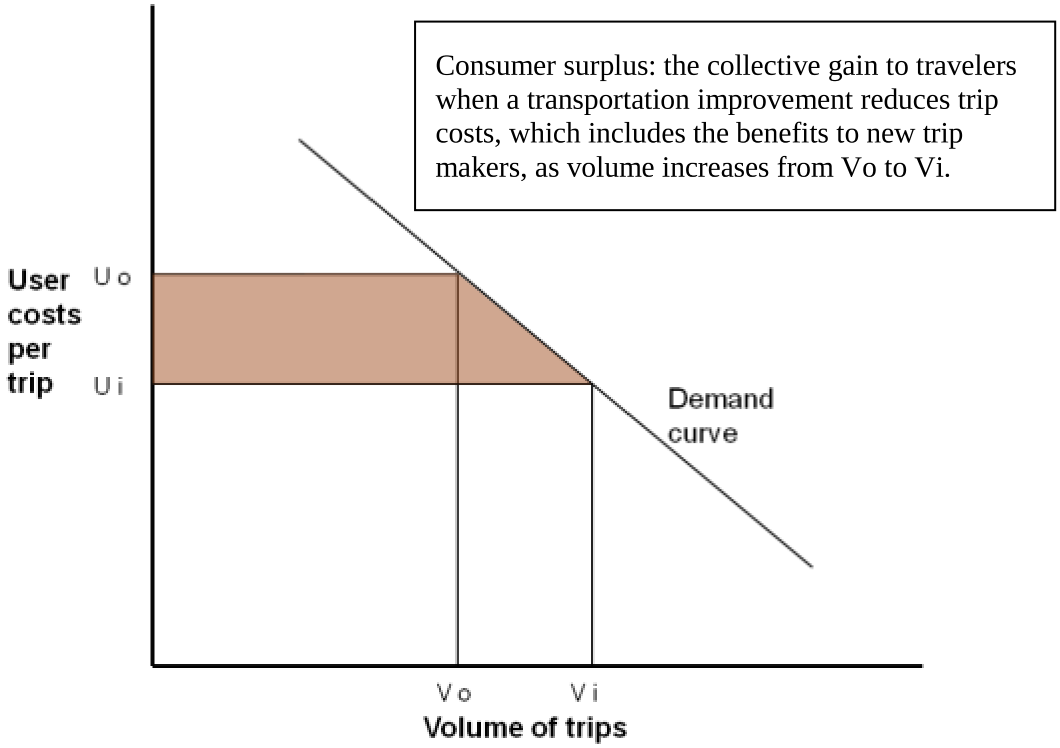
1. Passenger Travel Time Savings

The route improvements over the 250-mile project length are estimated to reduce the trip time by a simple average of 50 minutes, or approximately 0.2 minutes per mile. Passengers who are projected to be rail passengers under the Base Case (No-Build) Alternative would enjoy a travel time savings benefit. The valuation of this benefit uses U.S. Department of Transportation (U.S. DOT) published guidance for placing a value per hour on travel time savings, as detailed in a separate Draft Technical Memorandum *Keystone West High Speed Rail Study: Estimation of Benefits* (April 2013). The estimation of passenger miles that would experience travel time savings required a number of steps to account for average trip length at each boarding place and direction of travel combined with affected route miles for each such boarding location and direction. These calculations are presented in the Draft Technical Memorandum.

New rail trips induced by the improvements also benefit from the travel time savings. The estimation of these benefits can be conceptualized using the notion of "consumer surplus." Consumer surplus is the difference between what a consumer is willing to pay and the amount he or she actually has to pay. At all consumption levels, there are consumers who are not paying as much as they would be willing to pay. When the travel time of a rail trip goes down (thus reducing one "cost" of the trip), as with Alternative 2, there are additional travelers (new to rail) who would be willing to "pay" more in travel time cost for the rail trip than they are required to pay. Some of these new travelers are willing to pay considerably more than the new travel time cost (i.e., they would not mind a longer trip and thus have relatively high consumer surplus), and some are willing to pay only a very small amount more than the new travel cost (they would only tolerate a slightly longer trip and thus have a low consumer surplus). The consumer surplus for all of the additional trips assumes that this willingness to pay decreases in a straight line as the number of passengers increases, and thus can be estimated by the equation for the area of a triangle, where the height is the difference in travel time cost and the width is the number of additional trips, as follows.

Consumer Surplus for incremental rail trips =
½ x (travel time cost savings per trip) x (number of additional trips)

The concept of consumer surplus is illustrated graphically in **Figure 13: Consumer Surplus**, and explained in further detail in the Draft Technical Memorandum *Keystone West High Speed Rail Study: Estimation of Benefits* (April 2013).



Source: TCRP Report 78, Estimating the Benefits and Costs of Public Transit Projects: A Guidebook for Practitioners, National Academy Press, Washington D.C., 2002.

Figure 13: Consumer Surplus

Consumer surplus is the most appropriate measure of the travel time savings benefits to the induced travelers (new travel that would not occur without the improvements). This approach makes some simplifying assumptions, e.g., treating all of the incremental travel as if it is induced by the travel time savings, when in fact the demand modeling completed for this study estimated that demand would increase for two reasons—travel time savings and the convenience of an additional daily train. In reality, both types of induced demand would have travel time savings as a consumer surplus benefit component.

A summary of the travel time savings benefits is presented in **Table 48: Value of Travel Time Saved for Alternative 2**.

Table 48: Value of Travel Time Saved for Alternative 2			
	Affected Passenger Miles	**Value of Time Savings/Mile**	**Value of Travel Time Savings (Year 2012 $000s)**
2020			
Base Case (No-Build) Passengers	31,118,130	$0.097	$3,011
Incremental Passengers	14,492,983	$0.048	$701
Total			$3,712
2035			
Base Case (No-Build) Passengers	33,278,304	$0.123	$4,086
Incremental Passengers	22,365,644	$0.061	$1,373
Total			$5,459

2. Benefits of Mode Shift

The improved rail service of Alternative 2 would induce travelers to change their travel mode. This benefits estimate uses the simplifying assumption that all of the additional boardings and passenger miles represent a diversion of travel from automobile to rail. This assumption by no means necessarily leads to an overestimate of overall travel-related benefits; diverted trips from other modes and new induced trips would have other benefits that are not readily quantifiable and are not included here. Each trip shifted from road to rail travel saves automobile operating costs, reduces air pollution, and reduces the likelihood of injury, fatality, and property damage in an accident. A summary of the benefits from diverting trips from auto to rail is presented in **Table 49: Summary of Benefits of Mode Shift from Auto to Rail**. Detailed calculations and data sources are presented in a Draft Technical Memorandum *Keystone West High Speed Rail Study: Estimation of Benefits* (April 2013).

Table 49: Summary of Benefits of Mode Shift from Auto to Rail

	Avoided Costs per Thousand Passenger Miles	Diverted Passenger Auto Miles (thousands)		Avoided Costs (Year 2012 dollars x 1,000)	
		2020	2035	2020	2035
Vehicle Operating	$150.00	20,255	32,933	$3,038	$4,940
Air Pollution	$1.79			$36	$59
Crashes	$8.06			$126	$205
Total	$159.85			$3,200	$5,204

3. Components Included in Mode Shift Benefits

Vehicle operating cost savings per passenger mile diversion uses the IRS allowance for *variable* operating cost (24 cents per mile), divided by the average national vehicle occupancy of 1.6 persons per vehicle. Air pollution cost savings per passenger mile uses the published national air pollution cost per vehicle mile adjusted by average vehicle occupancy. Pollution savings per passenger mile are then reduced to account for the fact that rail travel also has associated (but lower) air emissions. Accident costs per passenger mile are computed in a similar manner, using published automobile crash costs per vehicle mile and adjusting by vehicle occupancy and applying a ratio to reduce the crash costs savings to account for the fact that rail travel has some accident risk.

4. Components Not Included in Mode Shift Benefits

This analysis did not calculate the benefit of reduced accident *likelihood* on the Keystone West corridor resulting from the corridor improvements. Changes in toll revenues on the Pennsylvania Turnpike are not included, as they are not regarded as an overall cost or benefit to Pennsylvanians. Rather, the reduced toll payments are a benefit to the diverted auto travelers and a loss to the Turnpike Commission, resulting in no net effect. The additional travel time spent on rail versus auto for a portion of the diverted auto travelers was also not included. Those diverted travelers who are covering the entire route segment between Harrisburg and Pittsburgh will spend approximately 30 percent more time on the train than they would spend driving. However, they (and all diverted travelers) may very well have more valuable travel time by train than by car due to the amenities of train travel and the ability to make productive use of rail travel time. As a result, the increased travel time may be partly offset by a lower travel time cost per hour. Because it is not possible to estimate how many of the incremental trips include the entire route segment, along with the possibility that the additional time may be offset by lower rail value of travel time, it was determined to not include this effect.

5. Estimation of Passenger Miles

The passenger miles diverted estimation uses the incremental passenger miles from Alternative 2 versus the Base Case (No-Build) Alternative. An adjustment was necessary to account for the fact that some of the route for some of the passengers would be longer by rail than by auto. Calculations described in the Draft Technical Memorandum, *Keystone West High Speed Rail Study: Estimation of Benefits* (April 2013) indicate that reducing the incremental passenger miles by two million would roughly account for the difference in road versus rail miles and thereby provide a reasonably good estimate of the diverted passenger road miles of automobile travel.

6. Summary of Travel Efficiency Benefits Values

Table 50: Alternative 2 Summary of Benefits summarizes the estimated benefits of Alternative 2 in Year 2035. Benefits that could be estimated are substantial, at more than $10.5 million per year in Year 2035. Year 2035 benefits are reasonably representative of the average travel benefits that would accrue each year after full build-out of Alternative 2. The largest monetized benefit component is automobile operating cost savings, estimated at nearly $5 million, which is almost half of all monetized benefits. The second largest estimated benefit value is the travel time savings to Base Case passengers. More than one-third of monetized benefits are in the form of travel time savings to Base Case passengers.

Table 50: Alternative 2 Summary of Benefits

Benefit	Value for Year 2020 (in Year 2012 dollars x 1,000)	Value for Year 2035 (in Year 2012 dollars x 1,000)	Percent of Monetized Benefit for Year 2035
Travel Time Savings Base Passengers	$3,011	$4,086	38%
Travel Time Savings Incremental Passengers	$701	$1,373	13%
Automobile Operating Cost Savings	$3,038	$4,940	46%
Accident Cost Savings Diverted Trips	$126	$205	2%
Air Pollution Reduction	$36	$59	<1%
Total Monetized Benefits	$6,912	$10,663	100%
Travel Time Savings Freight	Not Quantifiable for this Study		
Accident Cost Savings Route Enhancements			
Increased Schedule Reliability Passengers and Freight			
Increased Scheduling Options Passengers			

Note: Assumes full build-out of Alternative 2.

B. Economic Impacts: Direct and Indirect

The construction phase of the Alternative 2 improvements has the potential for substantial positive economic impacts. The direct investment of roughly $9.9 billion in capital spending will produce multiplier economic impacts as the payments to suppliers and workers directly involved in the project are spent and re-spent. Pennsylvania is in a particularly good position to benefit from rail investment due to the presence of major rail equipment suppliers. For example, Amtrak reported 2012 expenditures in Pennsylvania of more than $203 million for goods and services and approximately $193 million in employee wages. Similarly, ongoing spending on operations for the additional train and bus service would produce both direct and multiplier economic impacts.

A planning-level estimate of multiplier employment impacts can be calculated using data presented in a national-level study of economic impacts of public transportation investment. The multipliers in that study were converted to 2012 dollars and applied to the estimated incremental capital and operations spending associated with Alternative 2. The multipliers and results are presented in **Table 51: Economic Impact of Capital Spending**, and **Table 52: Economic Impact of Additional Operations Spending for Alternative 2**.

Table 51: Economic Impact of Capital Spending (Job-Years for Total Project[1])

Impact Type	Jobs Generated per $1 Million Capital Investment[2]	Incremental Jobs from Alternative 2 $9,940 Million Investment
Direct	7.6	75,126
Indirect and Induced	13.8	137,264
Total	**21.4**	**212,390**

[1] Each job counted represents one job for one year.
[2] Source: American Public Transportation Association, Economic Impact of Public Transportation Investment, 2009. Converted to 2012 using U.S. Bureau of Economic Analysis Implicit GDP Price Deflator.

The economic multiplier effect for the capital spending is estimated at more than 75,000 job-years of employment directly occupied on the capital projects over an assumed 10-year projected construction period, amounting to an average of 7,500 jobs per year. Due to the stimulative effect of this spending, the additional multiplier impact is estimated at roughly 212,000 job-years or an average of 21,200 jobs per year over the 10-year period. The job multipliers are from a national-level study and applicable nationwide. The actual number of jobs created in Pennsylvania would be somewhat lower due to some of the spending going out of state.

Table 52: Economic Impact of Additional Operations Spending for Alternative 2 (Jobs per Year)

Impact Type	Jobs Generated per $1 million Operations Spending[1]	Incremental Jobs from Alternative 2 $14.4 million Additional Operations Spending
Direct	19.6	282
Indirect and Induced	18.3	265
Total	**37.9**	**547**

[1] Source: American Public Transportation Association, *Economic Impact of Public Transportation Investment*, 2009. Converted to 2012 using U.S. Bureau of Economic Analysis Implicit GDP Price Deflator.

The economic multiplier effect for annual operations spending is estimated at more than 282 jobs directly associated with the additional service, plus an additional 265 indirect and induced jobs, for 547 jobs per year. As with the capital spending multiplier, the job effects in Pennsylvania would be somewhat lower due to some of the spending going out of state.

The multiplier economic impact can also be expressed in output (total value of goods and services sold) and labor income. The impact values, from the above-referenced APTA report, applied to the incremental spending associated with Alternative 2 are presented in **Table 53: Output and Labor Income Impact of Alternative 2**.

Table 53: Output and Labor Income Impact of Alternative 2

	Impact per Dollar[1]		Total Impact ($ million, in 2012 dollars)	
	Capital Spending	Operations Spending	Capital Spending	Operations Spending
Output	$3	$3.8	$29,819	$55
Labor Income	$1.1	$1.8	$10,934	$26

[1] Source: American Public Transportation Association, *Economic Impact of Public Transportation Investment* (2009).

The capital spending output multiplier value above means that for each dollar in direct capital spending on public transportation, total output increases by three dollars—the dollar of direct spending on the project plus two dollars in indirect and induced output increases. The labor income multiplier means that for each dollar in capital spending, labor income to workers in direct, indirect, and induced jobs totals $1.10. When applied to the roughly $9.9 billion capital spending, these multipliers project an increase in national economic output of $29.8 billion and an additional $10.9 billion of labor income over the project construction period. The operations multiplier impact of the approximately $14 million in annual spending is estimated as a total output (sales) value of $55 million per year and a total labor income of $26 million per year.

The economic effects described above are only those stimulative effects resulting from additional spending. The transportation benefits of the project would also affect the economy through means such as expanding the market reach of enterprises along the route and improving productivity.

C. Other Benefits

1. Community Benefits

Render Pennsylvania / Keystone West Region a More Attractive Place to Live and Conduct Business: World-class companies seeking to locate in thriving areas with talented and educated employment pools, cultural amenities, and high quality of life are attracted to regions with efficient transportation access and mobility. Although western Pennsylvania is served by a large-scale highway network, with connections to international airports and major waterways, serious congestion is experienced on the major arteries that approach Pittsburgh from the east. In addition, no direct air service is currently available between Harrisburg and Pittsburgh even though previous service was well patronized, particularly by business travelers. The addition of higher speed rail would augment this network in meaningful ways and offer additional incentives for companies to locate along this corridor. Bringing new business and industry to the region is vital to enable it to compete on a global scale and become a destination for both experienced workers and recent college graduates looking to establish stable, family-sustaining careers.

Revitalize Downtown Areas: Enhanced rail service that improves connectivity between communities would promote local and regional mobility and access, and increase opportunities to support the economic growth of downtowns and station areas. This could help to reverse the trend experienced by older communities along the corridor that have lost population and industry and experienced the associated decline in the local economy. Many of these communities have utilized other methods to leverage local assets, such as remaining employment centers, schools, and recreational and historic amenities, to retain existing populations. By combining these efforts with improved modal connections and the opportunity to develop and revitalize corridors and neighborhoods surrounding the station areas, these communities would enhance the value of their local assets.

Improve Access for Regional Activity Centers, including Private Industry, Higher Education, and Medical Facilities: Private companies, universities, and medical centers along the Keystone West corridor could expand their reach into markets that are currently difficult to serve. Whether it is a company looking to distribute products and services to geocentric markets, or universities wanting to attract broader student bases, or medical centers seeking to increase their geographic region, access to higher speed rail can augment business and economic development strategies, and subsequent growth. Penn State University, in particular, represents a large potential market if a cost effective and convenient service connection can be established between the State College area and the Keystone West line.

Reduced rail travel times can increase market linkages between rail destinations and enable institutions and industries to expand into untapped or underserved markets over a larger area. Just as roadway congestion and delay can inhibit access by visitors and consumers, increased passenger rail speeds between destinations can foster a more cohesive market presence and encourage consumers to travel longer distances to access these goods and services.

Support Pennsylvania Rail Supply Industry: Any proposed capital improvements along this corridor create an opportunity to benefit Pennsylvania's rail supply industry through the need for equipment, materials, and labor. Any construction or reconstruction would result in the need for additional rail infrastructure, along with labor to install it, which could be a benefit to the many Pennsylvania companies that provide such materials, equipment, and expertise. If increases in service result in the need for additional rolling stock, an opportunity may be created for Pennsylvania businesses that build, furnish and test such equipment.

Beyond physical improvements and needs, there is the opportunity to use passenger trains for the movement of certain goods and materials. For example, higher speed rail can be an efficient way to distribute time-sensitive smaller parcels and packages, which would also enhance the financial performance of the passenger train service. Although Amtrak previously opted to discontinue mail and express service on the Pennsylvanian, increased frequency of service and faster trips times could present an opportunity to reevaluate the benefit/cost of providing that type of service.

Support Major Employers, Developers, and Existing Generators/Attractors: Businesses that choose to locate or expand their operations within proximity of higher speed rail would catalyze other development, such as supporting retail and commercial amenities for employees and visitors. Hotels, restaurants, and retail centers located at or near rail stops would benefit from increased pedestrian activity. In addition, these secondary uses would most likely require additional local infrastructure improvements, including adjacent transportation, communications, and utility networks that could benefit the station area sites as a whole.

Provide Access to a Larger Labor Pool: Although regular commutes are not the primary market of the type of rail service being evaluated as part of this study, the fact that the line does serve a number of urbanized areas within relatively close proximity of one another would likely lead to some use by commuters, as is currently experienced on the Keystone East service. In particular, it is reasonable to expect this to occur at both ends of the line in the Pittsburgh and Harrisburg commuter sheds. As a result of enhancements to rail line infrastructure, service, and access enhancements, employers located near station sites could attract workers from greater distances. Proposed multimodal connections at stations would also offer commuters increased travel options to access employment sites from station areas. This increased access would offer employers additional flexibility in hiring the necessary personnel by reducing geographic limitations, while in turn opening more job opportunities to the resident labor force along the corridor.

Create "Permanent" Jobs, Expand Tax Base, and Increase Tax Revenue: The spin-off from the upgrades along the Keystone West corridor and station area development could result in high-density mixed-use developments including new residential, commercial, and retail activity. Towns that have stations and ensuing development along the corridor can leverage these station site investments to increase residents and jobs, thereby boosting their tax base and revenues.

Induce Travel: Transportation efficiencies can induce travel demand, resulting in new and additional trips to local and regional destinations. The addition of higher speed rail to an otherwise congested highway corridor should encourage travelers to take advantage of improved mobility and transportation capacity, more convenient connections, and reduced delays. Increased travel demand can improve economic conditions for travel-related industries, such as hotels, restaurants, fueling stations, and other transportation-related businesses.

Enhance Access to Tourist Attractions and Strengthen Economic Base: The Keystone West corridor, home to the Carnegie Science Center, the Pittsburgh Zoo & PPG Aquarium, Gettysburg Battlefields, Hersheypark, and the National Civil War Museum, as well as numerous sports stadiums, museums, parks, and first-rate educational institutions, already attracts visitors from the region and across the U.S. As station area sites and communities adapt to support higher speed rail, new conveniences would emerge, including more densely populated downtowns and walkable commercial and mixed-use districts that would attract additional visitors. Shopping centers, retail outlets, theaters, entertainment complexes, and restaurants would complement local attractions, including recreational and cultural resources. These developments would be within walking distance of the station areas, reducing the need to drive and encouraging day trips as well as longer stays. Additionally, communities with rail station sites and conference centers would be attractive to businesses and industries looking for conference and hotel space.

2. Energy Conservation and Environment

Energy Conservation

High gas prices and the effects of energy consumption on the environment have influenced travel preferences and behaviors over the past several years. Rail service is "green" compared to other modes of transportation and requires less fuel per passenger mile than cars or planes. Concerns about global warming, greenhouse gases, and their effects relative to quality of life have increased. By increasing rail ridership, automobiles can be removed from (or not added to) roadways, thus reducing congestion and improving air quality in the region. The development of higher speed rail can also alleviate airport congestion and help mitigate the need for airport expansion. The financial and environmental expense of developing and expanding airports makes high speed rail the comparatively cheaper mode for providing regional mobility to major metropolitan areas. Rail service promotes concentrated development (transit-oriented development), which is in keeping with livability and sustainability trends being promoted by U.S. DOT and other agencies. Although no direct air service presently exists between Harrisburg and Pittsburgh, improvement to the frequency and speed of Keystone West service, coupled with Amtrak's Keystone East and Northeast Corridor services, has the potential to reduce demand for air travel between Pittsburgh International and several major East Coast airports.

Higher speed rail uses less energy than cars or planes to transport people. It has been found to be 17 percent more fuel-efficient than airlines per passenger-mile and 21 percent more efficient than automobiles (Passenger Rail Working Group, December 2007).[5] Note that calculating the specific energy savings is dependent on the energy form used to power the trains (electric, diesel, etc.), the number of stops, and the number of passengers choosing to use the train.

Available data (from 2005) shows that intercity passenger rail is more energy efficient than either automobile or air transportation (Passenger Rail Working Group, December 2007), which are viewed as the primary competition for higher speed rail service along the corridor. The data below shows the energy consumption in British thermal units (BTUs) of various modes per passenger mile:

- Automobile – 3,445 BTUs/passenger mile
- U.S. Air Travel – 3,264 BTUs/passenger mile
- Passenger Rail – 2,709 BTUs/passenger mile
- Intercity Bus – 932 BTUs/passenger mile

While intercity bus offers a more attractive energy consumption profile than intercity rail based on the above data, energy consumption is only one factor to consider when assessing longer-term strategies for meeting mobility needs along the corridor. Direct express bus service between the end points of the Keystone West corridor (Harrisburg and Pittsburgh) offers attractive travel times; however, direct service would not serve the intermediate communities along the Pennsylvanian route (Lewistown, Huntington, Tyrone, Altoona, Johnstown, Latrobe, and

[5] The 17 percent and 21 percent, as well as the BTUs/passenger mile come from "Vision for the Future – U.S. Intercity Passenger Rail Network through 2050" prepared by the Passenger Rail Working Group, December 6, 2007.

Greensburg). In addition, bus service is more vulnerable to inclement weather (particularly through the mountains). Bus service is slower between intermediate communities due to losing the advantage of the more direct Pennsylvania Turnpike route and the need to divert from major roadways to access downtown terminals. Finally, bus service capacity expansion during heavy travel periods cannot be addressed as easily as passenger rail, where coaches can be added to trains. Encouraging the use of rail transportation and enhancing the availability of this mode could increase energy efficiency.

Energy savings from public transportation also contributes to our national and economic security by making America less dependent on foreign oil or on new sources of drilling. A rail system that offers viable alternatives to other modes of transportation is a critical part of improving air quality, reducing greenhouse gas emissions, reducing fuel consumption, improving security, and supporting land use and related sustainability initiatives, all of which greatly influence quality of life.

Environment

Air Quality and Greenhouse Gas Emissions: In 2005, 83 percent of the greenhouse gas (GHG) emissions generated from energy use (residential, commercial, industrial, and transportation) in the U.S. consisted of carbon dioxide (CO_2) from the combustion of fossil fuels such as coal, petroleum, and natural gas. Every gallon of gasoline burned produces about 20 pounds of CO_2 emissions. U.S. CO_2 emissions have grown by an average of 1.2 percent annually since 1990. The transportation sector contributes about one-third of these emissions (Passenger Rail Working Group, December 2007). Any solution to the global warming crisis will need to involve reduction of the CO_2 emissions contributed by transportation. The average intercity passenger train produces 60 percent fewer CO_2 emissions per passenger mile than the average auto and one-half the GHG emissions of an airplane (Passenger Rail Working Group, December 2007). Additionally, these benefits do not reflect intercity passenger rail's ability to stimulate energy-efficient, pedestrian-friendly real estate development.

Federal and state energy and climate policies primarily focus on vehicle fuel efficiency and the carbon content of the fuel itself. In reality, the most significant factor in the growth of CO_2 emissions is vehicle miles traveled (VMT). Although some of the largest metropolitan areas have experienced VMT declines in the past decade, overall VMT increased by 4.3 percent, 3.2 percent, and 2.5 percent in the 1970s, 1980s, and 1990s, respectively (Passenger Rail Working Group, December 2007). VMT is increasing faster than the U.S. population is increasing and faster than vehicle registrations. A large share of the VMT increase can be attributed to the effects of the urban/suburban environment that causes longer, more numerous single-occupancy vehicle usage.

Because trains use less energy per passenger mile they result in lower CO_2 emissions per passenger than automobiles. Studies have shown as much as a 71 percent reduction in CO_2 by train/passenger mile compared to automobiles and a 76 percent reduction compared to air travel. **Table 50: Alternative 2 Summary of Benefits**, shows potential air pollution reduction benefits in dollars, if Alternative 2 improvements were made to Keystone West. Train travel could therefore have a positive effect on air quality and contribute to lower GHG emissions. As noted in the discussion of energy consumption above, intercity bus service exhibits attractive energy consumption characteristics; however, other factors may negate its more favorable position on this one metric.

In November 2007, the United Nations' Intergovernmental Panel on Climate Change released its final report with recommendations for policy makers aimed at reducing GHG emissions. The report stressed the need to adopt policies that mitigate/reverse GHG impacts, align land use and infrastructure planning, and shift from road to rail transport systems.

Noise: There are currently numerous at-grade crossings along the Keystone West corridor, making it necessary for conductors to sound the trains' whistles as they approach these crossings. Eliminating at-grade crossings would eliminate whistle noise, and would also increase safety for trains, automobiles, and pedestrians. It is acknowledged that there may be an additional noise impact due to additional train frequencies that are contemplated as part of this study. The noise level may not increase, but the frequency of noise incidents would increase somewhat with the addition of trips.

Land Use and Economics: Intermodal hubs, cross connection activity occurring there, and resultant development can provide an economic stimulus for the communities where stations are located. Transit-oriented development (TOD)—high density, mixed-use development around a station—can increase economic activity throughout a community.

With TOD, transit is treated as a community asset that can be used to leverage high quality development and, in turn, create land use patterns and forms that promote transit use, walking and biking, and reduce automobile dependency. Because every transit trip starts and ends with walking, creating a safe and comfortable environment for pedestrians is an important part of TOD. A comfortable pedestrian environment is achieved through the careful design and planning of streets, buildings, and public spaces, and the incorporation of appropriate mix of land uses.

Communities: Many people are attracted to communities that have a variety of transportation options. Linking these options with community land use strategies results in travel patterns that are more efficient and convenient, and decrease dependency on the automobile. Creating walkable, compact communities with sound design supports smart growth strategies and sustainable communities' principles.

3. Sound Land Use Planning

The traditional approach to transportation planning responds to travel demand and congestion by adding capacity. However, the rate of road building has been unable to keep pace with the increase in demand. Planning around station areas and along the rail corridor in general would aim to foster high density, mixed-use, walkable development that reduces the use of cars. Over the last decade it has become clear that planning must address the travel demand side of the equation through trip reduction, modal alternatives, and Smart Growth/land use planning.

Leveraging Existing Investments, Reinvesting, and Creating New Value: One of the tenets of "Smart Growth" is investing (and reinvesting) in older, developed areas. Redevelopment, infill development, and development that is mixed use or at higher densities can lead to less reliance on the private automobile, slowing the growth of traffic congestion, reducing vehicle miles traveled and related greenhouse gas emissions, and alleviating the need for highway expansion. If planned properly, higher speed rail would reinvigorate downtowns and draw new riders to local public transportation systems, boost ridership, and enhance the cost effectiveness of local and regional transit.

The Keystone West corridor high speed rail project has the potential to produce economic and environmental benefits for the state and the communities in which stations are located. The stations could offer an important anchor for community revitalization. This would increase property values, generate new opportunities for development, and facilitate the development of more livable, walkable urban districts and communities. Businesses seeking better transportation options for their current employees and an expanded labor pool can be expected to concentrate in these areas, producing stronger business districts that support increased retail, service, and entertainment activity. Simply put, investing in upgrades to develop higher-speed rail on existing corridors promotes an efficient allocation of limited resources and maximizes the utilization of existing infrastructure where feasible.

Achieving Sustainability: Investment in higher speed rail is important for the state's economic competitiveness and for more sustainable growth. Key to the success of the system is ensuring that higher speed rail results in real changes in the development patterns across the state. Each rail station area can become a dense and walkable district with significant employment and other important destinations and activities. Unlike auto-dependent development, growth that is transit-oriented can preserve substantial areas of remaining farmland and open space.

Between 1992 and 2005, developed land in Pennsylvania increased by over 131 percent, from approximately 1.2 million acres in 1992 to almost 2.8 million acres in 2005, despite the fact that the state's population only grew 4.5 percent. Pennsylvania's sprawling form of development continues to convert land at alarming rates. A 1998 study for the National Resources Defense Council showed that low density sprawl is costly, inefficient, and inequitable. Sprawl uses more resources, such as fuel, than traditional city and town development, and requires costly extensions of infrastructure, such as public water and sewer service.

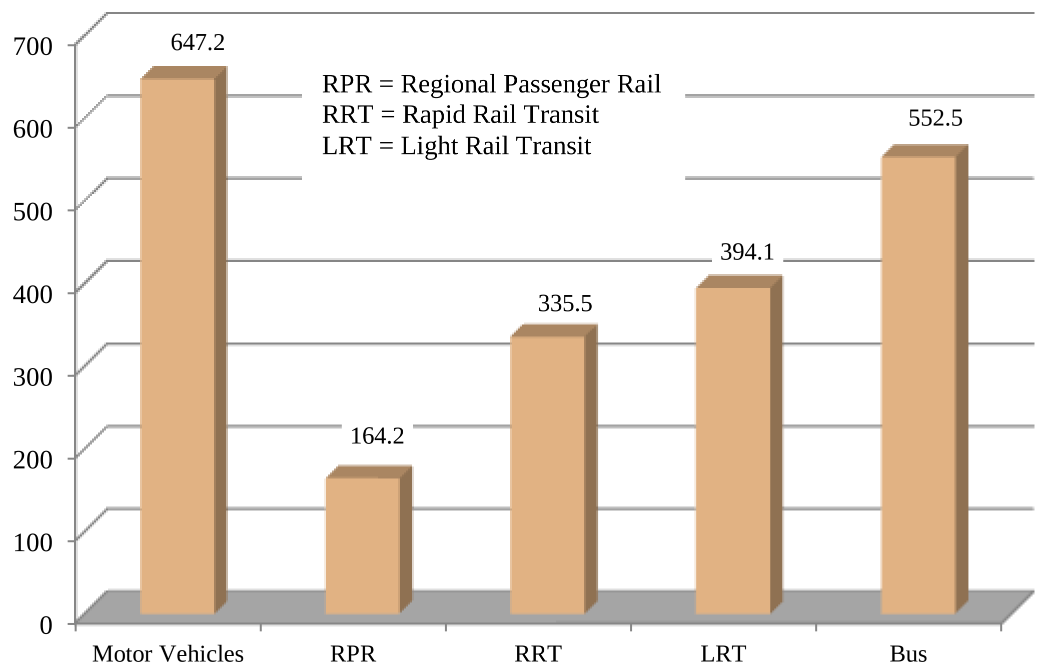
Sustainable growth, such as that achievable along the Keystone West corridor and station sites, offers housing near work, provides multimodal transit, and creates economic growth that is equitable and benefits all residents. However, major investments in land use changes around the stations would be necessary to fully realize the benefits of high speed rail and ancillary community and economic development. If such investment does not occur, both the economic and environmental benefits may be substantially reduced.

Overall, higher speed rail provides a major opportunity to reshape the surrounding environment to reflect principles of center-focused growth and place-making. However, in order for high speed rail to work for communities, it must be seamlessly integrated with regional transit networks and transit-oriented development, creating an intermodal system that connects station areas with other transit services and bicycling and pedestrian facilities.

4. Safety

Comparative Safety Record of Passenger Rail Versus Other Modes: Passenger rail has consistently been one of the safest modes of ground transportation in the U.S. **Figure 14: U.S. Average Injuries + Fatalities per Billion Passenger Miles (Averaged for 2002-2004)**, published by the organization *Light Rail Now!*, illustrates the number of fatalities and injuries per billion passenger miles, by mode. The chart is based on 2002-2004 data for the modes shown. Although passenger rail, as represented by the regional passenger rail (RPR) bar, is based on safety records of RPR services, these statistics should be representative of the relative level of accident exposure for the Harrisburg – Pittsburgh service that is the subject of this study. **Table 50: Alternative 2 Summary of Benefits**, shows, in dollars, and anticipated accident cost savings due to diverted trips if Alternative 2 improvements were made to Keystone West.

Even after accounting for the circuitous routing of the passenger rail line when compared to the most direct highway route between the two cities, passenger rail would still have a superior safety record. To the extent that more travelers are attracted from parallel highways to improved rail service, accidents and fatalities could be expected to decrease on the highways. In fairness, it must be noted that the Pennsylvania Turnpike, as a limited access facility, would likely have a safety record better than the average for all highway travel that is represented in **Figure 14**.



Source: *Light Rail Now!*

Figure 14: U.S. Average Injuries + Fatalities per Billion Passenger Miles (Averaged for 2002-2004)

Grade Crossing Eliminations and/or Upgrades: Based on preliminary estimates of existing at-grade crossings and the protection provided at each, more than 40 at-grade crossings exist along the Keystone West corridor between Harrisburg and Pittsburgh. Of these, nearly 60 percent are completely unprotected (have passive protection) and the remainder have some type of active protection such as flashing warning lights and automatic crossing gates. Safety records along the corridor indicate that nine accidents have occurred at these at-grade crossings in the last five years (2007-2011), including one fatality.

The rail improvements within this corridor have the potential to begin to address these existing at-grade rail crossings. Infrastructure improvements along the corridor that either eliminate these crossings or offer an off-line solution could be considered to address these existing concerns.

Lessen Potential Conflicts between Freight and Passenger Rail: Improvements to the Keystone West corridor have the potential to lessen or eliminate the conflicts between freight and passenger rail, depending on the solution(s) selected. Currently, two passenger trains per day (one in each direction between Harrisburg and Pittsburgh) make the trip along the route, and encounter numerous freight trains along the same route (which is owned by NS). Infrastructure improvements could reduce or eliminate these conflicts. Although passenger/freight conflicts may not be substantial now, the problem can be expected to worsen as freight demand and passenger service both increase along the corridor.

Alternative/Safe Mode of Travel for Aging Population and Non-Drivers: The number of Americans age 75 and older is projected to grow from about 16.6 million, or 6 percent of the U.S. population, in 2000 to 46 million, or 11.4 percent of the population, by 2050.[6] Public transportation must expand to support the needs of this growing population segment. Intercity passenger rail is one mobility option that can serve as an important choice for those who cannot or choose not to drive.

For Pennsylvania, this is an even more pronounced trend. Pennsylvania has one of the largest (in both absolute and relative terms) populations of older people in the nation. With a current ranking of fifth nationally, Pennsylvania is home to nearly 2 million people age 65 and older.

The state ranks second in its share of senior population (65+ population as a percent of total population). Only Florida has a greater proportion of older persons than Pennsylvania's 15.3 percent. By 2030, Pennsylvania is expected to have more than 2.8 million people age 65 and older, comprising an estimated 22.6 percent of the population. This represents a growth rate of more than 50 percent for the older age group compared to total state population growth of 4 percent. Many of Pennsylvania's older citizens reside in rural areas—31 percent compared to a national average of 25 percent—and the number of rural seniors is growing at twice the rate of those in urban areas. As the state’s population continues to age, transportation challenges for this market segment will only continue to intensify.[7]

5. Regional Opportunities/Parity – Keystone East Compared to Keystone West

Amtrak service between Philadelphia and Harrisburg (Keystone East) and the communities along the line have experienced a resurgence in passenger rail over the past decade. After years of minimal investment in the infrastructure, declining service levels, and falling ridership, the trend has been successfully reversed. In 2002, PennDOT and Amtrak reached agreement on a joint, $145 million Keystone East Capital Improvement Program that encompassed installation of

[6] From *Vision for the Future – U.S. Intercity Passenger Rail Network through 2050* prepared by Passenger Rail Working Group, December 2007

[7] Extracted from http://gerontology.ssri.psu.edu/aging-and-pennsylvania

continuous welded rail, roadbed upgrades including concrete ties in many locations, new switches, and the first upgrade to the signal system since its installation in the 1930s. The improvements were completed in 2006, resulting in an increase in the maximum train speed from 90 mph to 110 mph and a 30-minute reduction in travel time—to 90 minutes—for travel between the endpoints. An all-electric fleet was deployed on the line for the first time since the 1980s, and service was gradually increased to the present 14 round trips each weekday. Ridership has increased every year since 2006, producing a cumulative gain of 40 percent and record ridership levels.

PennDOT and Amtrak continue to partner on improvements such as upgrading outdated and inefficient switches, station improvements and relocations, and parking. The line also benefits from direct service to New York on some trains and convenient connections to Amtrak's Northeast Corridor service for all other trains. The line has attracted many commuters and business travelers that find the service more convenient and competitively priced compared to travel by automobile. Because the Keystone East rail service does not experience traffic congestion as do the eastern sections of the Pennsylvania Turnpike and the Schuylkill Expressway, the train is an attractive option for travelers.

The dramatic turnaround on Keystone East was facilitated by Amtrak's ownership of the line, which is a key difference from Keystone West. Nonetheless, Keystone West has the potential to reverse the decline in passenger service and support community revitalization along the line. As with Keystone East, passenger rail service would be unaffected by congestion on parallel roadways. It would also be less prone than roadways to issues caused by inclement weather, particularly through the mountains.

Central and Eastern Pennsylvania counties typically fare far better than their western counterparts during the full range of economic cycles, be they prosperous times or serious recessions as experienced during the past few years. The attractive and convenient transportation infrastructure that is characteristic of Eastern Pennsylvania, including the Keystone East service, is a widely-recognized factor in retaining and attracting business and industry to the area. To experience the same types of benefits realized in eastern Pennsylvania, the Keystone West passenger rail line would need to be upgraded to include faster service, increased frequencies, upgraded stations and parking, on-board amenities appropriate for longer-distance travel, and better connections at Pittsburgh for trips that originate or end west of Pittsburgh. Establishing the institutional partnerships necessary to advance significant public and public/private investment will be a critical success factor in any such initiative.

6. Quality of Life

High speed rail makes two places that were once far apart seem closer together by making travel between them easier and faster. As a result, cities are better connected, employment opportunities are increased, economies are boosted, access to life-sustaining resources is improved, and quality of life is enhanced. Higher speed rail will improve regional access to life-enriching resources such as hospitals, universities, cultural institutions, and tourist and recreational attractions.

Higher speed rail in the Keystone West corridor would provide new travel opportunities for those who do not drive or prefer not to drive. This is important, considering Pennsylvania's aging population is the fifth largest and one of the fastest growing in the nation. Pennsylvania has nearly 1.5 million licensed drivers aged 65 and older (almost 17 percent of the driving population). By 2020 there will be roughly 40 million senior drivers on the road. Amtrak already provides a critical long distance mobility option for the elderly, which would be further enhanced through the introduction of new higher speed rail systems.

Higher speed rail development has the potential to provide for much-needed access to new employment opportunities for low- and moderate-income households. Some of the employment opportunities will be directly tied to higher speed rail; for example, jobs that are associated with the construction, operations, local manufacturing, and maintenance of rail infrastructure. Other opportunities will be more indirect, such as firms relocating or residents earning higher incomes because they commute to other job centers on the rail system.

7. Establish the Foundation for Being an Integral Part of a National High Speed Rail Network

The Keystone West corridor between Harrisburg and Pittsburgh is a component of Amtrak's Pennsylvanian service from New York City to Pittsburgh. It provides a service connection from major East Coast cities to the Capitol Limited at Pittsburgh, which provides service to Cleveland and Chicago and connections beyond. The Keystone West corridor is an integral part of the passenger rail connection between multiple major East Coast cities and the Midwest.

Given its significant role in providing connectivity between the East Coast and Midwest—including Amtrak's Chicago hub—the Keystone West corridor would be an integral leg of a national high speed rail network. Any improvements made along this corridor (incremental or otherwise) would support the implementation of a national plan for development of a high speed rail network, which is earning substantial support at the state and national levels.

At the local level, the Keystone Corridor is a significant travel corridor connecting Pennsylvania's two largest cities (Pittsburgh and Philadelphia), with interconnections to areas with substantial population and employers (Lancaster and Harrisburg). Extension of the existing high speed rail service on the Keystone East line to points west of Harrisburg would enhance this corridor as an alternative to automobile or air travel across Pennsylvania. Similarly, improvements made to this corridor that would ultimately support the implementation of full high speed rail and complete a high speed connection between Pittsburgh and Philadelphia would be important not only to local business, personal, and recreational travelers, but for out-of-state travelers coming from or going to major connecting cities.

8. Strengthen Existing or Create New Institutional Partnerships for Future Success

Federal-State-Local: New rail development has the potential to create new and expand existing long-term institutional and operational partnerships at all levels of private and governmental agencies and entities. Existing partnerships between transportation agencies (traditionally highway- and transit-focused) and local governments should be expanded and encouraged. Bringing together land use and infrastructure planning can result in improved investments that better address transportation needs. Instead of focusing on a roadway system, thinking of the overall highway, railroad, transit, and other transportation modes as a transportation system will encourage federal-state-local partnerships and regional planning efforts. Building on the efforts that are already linking federal and state planning and investments with local planning on the highway side of the transportation system, linkages with railroad and transit agencies should also be developed. This linkage is even more beneficial to rail investment, as land use and development decisions have a greater impact on the feasibility of freight and passenger rail service and future growth and ridership.

Public-Private Partnerships: Public investment in rail infrastructure will benefit both the private freight rail entities and higher speed passenger rail. Looking at the freight rail companies as a private entity and the passenger rail services as a public entity, this collaboration could be a desirable public-private partnership (described in more detail in the next section). Other opportunities exist for private investment at rail stations and other facilities that will attract people, increase ridership, and facilitate development that is needed in the areas along the Keystone West corridor. Going forward, these opportunities will likely exist in the more urban areas and may be partnered with other public investment programs within the City of Pittsburgh or the City of Harrisburg. Similar programs across the country are being advanced to facilitate investment and encourage the use of private dollars in areas beyond just the rail infrastructure to make higher speed rail service a reality. These areas are a significant opportunity to make higher speed rail a success in Pennsylvania and may require additional investment beyond the rail infrastructure to facilitate connections to other modes and land uses.

Freight-Passenger Cooperation: Current development trends, energy policy, and federal priorities have brought passenger rail service to the forefront of promising investments for our nation's future. Just as the Interstate Highway System met U.S. needs in the middle of the last century, better rail service will serve an important purpose during this century and beyond. That being said, most U.S. rail infrastructure has been maintained and expanded by freight rail companies. If higher speed passenger rail service is to be successful on joint-use corridors, both parties need to develop a true investment-level partnership that will be mutually beneficial moving forward. The ultimate public-private partnership is to leverage what the private freight rail partners have done well with an infusion of public investment in upgraded infrastructure that will improve both freight and passenger rail—not develop one at the expense of the other or yield two mediocre systems of moving goods and people.

9. System Redundancy

Capacity, frequency, and speed improvements to the Keystone West passenger rail line have the potential to create an important resource in the event of a major service disruption on parallel roadways, breakdowns in the air passenger system, and emergency situations. The Three Mile Island accident in the late 1970s is an example of an incident that resulted in many residents evacuating the area, and passenger rail could be one element of a comprehensive plan to move large numbers of people in the event an emergency evacuation order is issued.

X. GOVERNANCE ISSUES AND OPTIONS

> **For More Information**
>
> Keystone Corridor West High Speed Rail, Technical Memorandum, "Intercity Passenger Rail Governance Structures Review," March 7, 2013

The information summarized in this section is discussed in more detail in the Technical Memorandum *Keystone West High Speed Rail Study: Intercity Passenger Rail Governance Structures Review* (March 2013). New or expanded intercity rail service often presents significant and complex institutional challenges. Given the nature of intercity rail service, the challenges and opportunities can span multiple states and regions, various transportation operators, and the public and private sectors. The Keystone West corridor, which is one segment of a route traversing three states, is certainly subject to such challenges. With Norfolk Southern (NS) owning the infrastructure and handling all dispatching, Amtrak operating the passenger service, and rail stations that are typically owned by or on a long-term lease to local entities, any major initiatives along the corridor will require close coordination among several parties and possibly new arrangements between organizational parties (such as Amtrak, NS, and the state). By contrast, on Keystone East, Amtrak owns the infrastructure and dispatches and operates the passenger service. The levels of passenger service and performance vary dramatically between Keystone East and Keystone West, which reflects, in part, the contrasting institutional arrangements.

The referenced Technical Memorandum contains detailed summaries of Pennsylvania's current and historical institutional context as well as examples from around the nation. The summaries include information on institutional roles and responsibilities, ownership, management, operations, and funding and financing for both conventional passenger rail and high speed rail. This information is briefly overviewed in the following sections. The key institutional roles associated with passenger rail service, as used in the following sections, are:

Ownership – The entity that owns the right-of-way and infrastructure and is responsible for planning, capital improvements, and maintenance of the capital plant.

Management – The entity responsible for planning, marketing, financing, and implementation.

Operation – The entity that employs and trains the necessary labor, generally (but not always) procures and owns the rolling stock, and is responsible for all aspects of day-to-day service delivery, including maintenance of equipment.

A. Pennsylvania – Current Practice

1. Institutional Roles and Responsibilities

All passenger rail service in Pennsylvania is currently operated by Amtrak on infrastructure owned by private freight railroads, except the Keystone East line between Harrisburg and Philadelphia, which is owned by Amtrak. Amtrak handles day-to-day management, operation, and maintenance of all passenger services and collaborates with PennDOT on state-subsidized services.

Amtrak is solely responsible for procurement, maintenance, and safety inspection of all passenger rail rolling stock. The respective owners of the infrastructure along the individual routes handle the planning, implementation, and funding of capital projects, with the state also playing an active role in project planning and funding for Keystone East. Rail stations are owned either by Amtrak or a local entity, and PennDOT has participated in the planning and funding of local rail station improvements.

PennDOT's role in the management of the State Passenger Rail Assistance Program is carried out under the direction of the Deputy Secretary for Local and Area Transportation, and is housed within the Bureau of Public Transportation.

2. Ownership, Management, and State Role

As stated, all passenger rail service in Pennsylvania is operated by Amtrak on infrastructure owned by Amtrak or private freight railroads.

The Keystone East and the Northeast Corridor (NEC) services are the only higher speed rail services currently in operation in Pennsylvania. All aspects of the NEC service are managed solely by Amtrak with the benefit of substantial federal financial support and oversight. Keystone East service is managed and operated by Amtrak in cooperation with PennDOT with regard to scheduling, marketing, fares, and station needs.

3. Funding and Financing

State funding for passenger rail programs is provided through a combination of federal pass-through funds and funding authorized by Pennsylvania Act 44 of 2007. The pass-through federal funding is derived from the FTA Rail Modernization Allocation (Section 5309). No local funds are provided for passenger rail services. However, local funding is occasionally provided in support of rail station improvement projects.

There is currently no separate category of state funding for high speed rail. State funds allocated to this study were awarded from Pennsylvania Act 44 discretionary funds and the federal funding was obtained under a High Speed Intercity Passenger Rail "Track 3" Planning Grant program.

B. Other States

The following information on institutional roles and responsibilities, ownership and management, and funding/financing from other states and regions provides examples of how other regions are addressing the challenges of providing both intercity passenger rail and high speed rail services. This information has been summarized from the aforementioned Technical Memorandum on Governance Structures Review.

1. Institutional Roles and Responsibilities

In California, the California Department of Transportation (Caltrans) Division of Rail (DOR) manages and coordinates statewide intercity passenger rail. Caltrans contracts with Amtrak to provide daily operation and maintenance of Amtrak California service. The California High-Speed Rail Authority (CHSRA) was established by the California High-Speed Rail Act (S.B. 1420, Chapter 796 of the California Statutes of 1996) with the goal of developing and implementing high speed intercity rail service.

Intercity passenger rail in the Midwest spans multiple states. Each state is responsible for the organizational structure associated with the various initiatives and operations of current interstate operations within its borders. There is, however, collaboration among the states for planning, funding coordination, and high speed rail efforts. Collaborative efforts include the Midwest Interstate Passenger Rail Commission (MIPRC), the Midwest Regional Rail Initiative (MWRRI), and the Illinois and Midwest High Speed Rail Commission.

There are currently six Amtrak routes operating in North Carolina, with the North Carolina DOT responsible for coordinating funding, equipment availability, and agreements with Amtrak on the two state-assisted lines (the Piedmont and the Carolinian). The state also leads many of the station improvement projects throughout the state.

In Florida, two operators provide intercity passenger rail service: Amtrak and the South Florida Regional Transportation Authority (Tri-Rail). A third operator, SunRail, is expected to begin operations in 2014. In 2001 the Florida High Speed Rail Authority (FHSRA) was established under an amendment to the state constitution mandating that the state establish a high speed rail network; however, the amendment was subsequently repealed in 2004 and the authority has been inactive since that time.

2. Ownership and Management

As in Pennsylvania, California's passenger rail service is operated by Amtrak. Caltrans manages two routes and the Capital Corridor Joint Powers Authority (CCJPA) manages one route. Ownership of lines and rolling stock varies, spanning Amtrak, Caltrans, and local/private entities.

Amtrak operates all passenger rail service in the Midwest with rail management/ownership by various entities including state DOTs and private railroads.

Passenger rail service in North Carolina is operated and managed primarily by Amtrak with NCDOT having a role in the management of state-supported routes. Current owners of the rail lines being studied as potential high speed rail lines include NCDOT, the North Carolina Railroad Company (NCRR), CSX, and NS.

In Florida, intercity passenger rail service is provided by Amtrak and in South Florida by Tri-Rail. There are no current known plans for high speed rail in Florida.

3. Funding and Financing

Funding for intercity passenger rail service in California is provided by Public Transportation Account (PTA) funds, State Highway Account, and Proposition 1B (Highway Safety, Traffic Reduction, Air Quality, and Port Security Bond Act of 2006). High speed rail in California is funded through Proposition 1A (Safe, Reliable High Speed Passenger Train Bond Act).

Funding in the Midwest is provided through several mechanisms, including the FRA High Speed and Intercity Passenger Rail (HSIPR) grant program funds, state funds, American Recovery and Reinvestment Act (ARRA) funds, and UP Railroad funds.

North Carolina financially supports the Piedmont and Carolinian services that include six trains daily serving nine stations. In 2010, the North Carolina Mobility Fund was created as a way to generate new dollars for transportation projects of statewide or regional significance. ARRA funds have also been used in North Carolina.

Amtrak intercity passenger rail operations in Florida are not subsidized by the state. Tri-Rail and SunRail, however, are funded by the Florida DOT, with funding also provided by federal and local governments in an effort to mitigate regional congestion. In 2010, Florida was awarded nearly $2 billion as part of the federal High Speed Rail Development Initiative, which represented approximately half of the cost of the Tampa – Orlando segment. However, Florida's governor rejected the funds (as did the governors of Wisconsin and Ohio) due to concerns about funding the remainder of the project. The funding was redistributed by U.S. DOT.

C. Institutional Options for High Speed Rail Initiatives in Pennsylvania

Any discussion of future institutional options for Keystone West is most meaningful in the context of the entire Pennsylvanian route. A prior study completed in the 1990s for Keystone East (*Keystone Corridor Assessment and Business Plan* (May 22, 1996) completed by R.L. Banks and Associates, Inc., for the Commonwealth of Pennsylvania, Department of Transportation) reviewed the same topics covered in this report and analyzed options for passenger rail service ownership, management, and operation for that line. The following discussion employs the structure of the earlier analyses, but incorporates changes that have occurred since that study was completed. It also addresses important differences between the Keystone East and overall Pennsylvanian services.

1. Ownership Options

The Keystone West rail line is a heavily-used, strategic segment of the Norfolk Southern rail network. The importance of Keystone West and the City of Harrisburg to NS's overall business strategy is evidenced by recent NS investments in intermodal facilities in Harrisburg and nearby locations. These investments were driven, in part, by freight traffic on Keystone West. For the foreseeable future, it is assumed that NS would not entertain the notion of another entity acquiring the line and leasing it back to NS for their operations. A more probable approach would be for the Commonwealth to partner with NS on capital improvements that have mutual capacity and speed benefits for both passenger and freight trains, in exchange for accommodating enhanced passenger rail service. Many of the infrastructure improvements identified in this report would produce such benefits.

The Keystone East portion of the route could be a candidate for alternative ownership. There have been previous discussions at the national level about reorganizing or privatizing all or various parts of Amtrak. Potential alternative owners could be the Commonwealth, the Southeastern Pennsylvania Transportation Authority (SEPTA), or a private entity. One potential drawback of separate entities having ownership and operating responsibilities would be potential conflicts of interest regarding maintenance priorities and standards. Moreover, if only the Keystone East line were to be assumed by a new owner, it would create a scenario in which three separate owners would be responsible for the infrastructure over which the Pennsylvanian operates, which could complicate rather than streamline the institutional arrangements. A key consideration in any ownership shift should be maximizing eligibility for federal capital grants for infrastructure improvements. Regardless of the alternative, Congressional approval would likely be required before Amtrak could divest ownership of its segments.

The opportunities and responsibilities of the owner, listed in **Table 54: Ownership Opportunities and Responsibilities**, were identified in the aforementioned 1996 study. They are presented here to help inform any future consideration of changes in ownership.

Table 54: Ownership Opportunities and Responsibilities

Opportunities:	**Responsibilities:**
• Achieve long-term goals	• Environmental requirements
• Add and modify service	• Liability/indemnification/insurance limits
• Ensure acceptable access	• Maintenance of way, structures, etc.
• Implement new technology	• Property taxes
• Make physical improvements	• Public policy implications
• Realize other revenues	• Real estate management
• Maintain operational control	• *Labor/workforce arrangements*

Note: Secondary opportunities or responsibilities are shown in *italics*; all others are primary.
Source: *Keystone Corridor Assessment and Business Plan* completed by R.L. Banks and Associates, Inc., for the Commonwealth of Pennsylvania, Department of Transportation, May 22, 1996.

2. Management Options

As evidenced by the varied approaches in use by other states, there are multiple options for the management role. Examples include:

<u>Public Manager</u> – This could be Amtrak (current arrangement), SEPTA, the Commonwealth, or a new entity such as a legislatively-created commission or authority whose sole mission is the improvement of passenger rail service in Pennsylvania, including high speed rail initiatives.

<u>Private Manager</u> – This could be a railroad company, a "turnkey" railroad management-only company, or a turnkey manager/operator company. Under a private manager arrangement, the Commonwealth would set policy, performance standards, and other parameters such as marketing strategies and fare policies which the private manager would implement. The private manager would be competitively procured by and responsible to the Commonwealth for state-supported rail services.

If track ownership remains unchanged, the manager would have to negotiate with the host railroads for use of their lines. Opportunities and responsibilities of the manager are summarized in **Table 55: Manager Opportunities and Responsibilities**.

Table 55: Manager Opportunities and Responsibilities

Opportunities:	Responsibilities:
• Achieve long-term goals • Implement marketing and fare policies • Specify or change operators • *Add or modify service* • *Influence service quality* • *Require performance-based contracting (potentially with incentives for significant growth)*	• Financial risk • Capital improvement funding • Equipment supply and maintenance • Liability/indemnification/insurance limits • Public policy ramifications • *Environmental responsibility* • *Labor/workforce arrangements* • *Passenger security*

Note: Secondary opportunities or responsibilities are shown in *italics*; all others are primary.
Source: *Keystone Corridor Assessment and Business Plan* completed by R.L. Banks and Associates, Inc., for the Commonwealth of Pennsylvania, Department of Transportation, May 22, 1996

3. Operator Options

Unlike the Keystone East line, which is wholly within Pennsylvania and therefore might more easily lend itself to alternative institutional approaches, the Pennsylvanian originates at Penn Station, New York, and traverses a significant stretch of Amtrak's NEC before entering Pennsylvania and following the Amtrak-owned Keystone East corridor prior to entering NS's right-of-way. Therefore, any alternative operator (or manager on the operator's behalf) would have to negotiate access agreements with both Amtrak and NS. If offering one-seat rides through Harrisburg (current practice) is not essential, then it would be easier to consider alternative operator arrangements for Keystone West. Several drawbacks to a split–operator scenario are (a) transfers are a known deterrent to use of the rail service, (b) there would be inherent inefficiencies and potential conflicts in the areas of labor and equipment, and (c) seamless marketing and fare arrangements would , which are critical to success, would be challenging.

In terms of public operator options, Amtrak and SEPTA would appear to be the only realistic options short of establishing a new state or regional rail authority. Although SEPTA already has access agreements with Amtrak and could be a legitimate alternative operator of Keystone East service, it is doubtful that SEPTA would be interested or legally empowered to operate the full length of the Pennsylvanian route, which includes Keystone West.

Under a private operator scenario, the Commonwealth (in a new role as manager) could choose to negotiate the agreements for operating rights with the railroads and then contract with an operator to exercise those rights on behalf of the Commonwealth. In the context of only one route with a relatively infrequent level of service, it is questionable whether such a strategy would be beneficial. The opportunities and responsibilities for the rail service operator are summarized in **Table 56: Operator Opportunities and Responsibilities**.

Table 56: Operator Opportunities and Responsibilities

Opportunities:	Responsibilities:
• Ability to influence service quality • Potential profit (for private operator)	• Labor/workforce arrangements • Liability/indemnification/insurance limits • Operational safety • Passenger security • Train operations • *Environmental requirements*

Note: Secondary opportunities or responsibilities are shown in *italics*; all others are primary.
Source: *Keystone Corridor Assessment and Business Plan* completed by R.L. Banks and Associates, Inc., for the Commonwealth of Pennsylvania, Department of Transportation, May 22, 1996

Much has changed since the Keystone West High Speed Rail Feasibility Study was initiated. In particular, the focus has shifted to higher speed rail that makes maximum use of the existing NS line, and relatively modest service expansion. In that context, it is reasonable to assume that the current governance approach being utilized in Pennsylvania could suffice to start advancing some of the more modest improvements to Keystone West. In fact, precedents exist in the form of the state-Conrail collaboration on the double-stack improvements to the NS line (while under Conrail ownership) in the 1990s, and the Keystone (East) Corridor Improvement Program (KCIP) completed approximately five years ago though a collaboration of the Commonwealth and Amtrak. The station improvement projects, in particular, are examples of projects that could be effectively advanced within the current governance structure. As part of a longer-range plan, this could be a beneficial step to establish and strengthen working relationships in advance of any larger initiative that may benefit from an institutional shift.

If there is a commitment to implement a program of rail improvements on a scale similar to full implementation of the Alternative 2 infrastructure scenario ($9.9 billion including major realignments on new rights-of-way), both the PennDOT staffing and the funding components of governance are topics that could require a substantial departure from current practice. This is due to the fact that (a) advancing a $9.9 billion capital improvement program is likely larger than could be effectively managed by several part-time employees, and (b) the projected costs of Alternative 2 are several orders of magnitude beyond the scale of the prior projects mentioned above, and well beyond historical passenger rail funding levels available to and managed by PennDOT. PRIIA lays out a direction in which primary responsibility for funding any deficits incurred in the operation of the Pennsylvanian would shift from Amtrak to the Commonwealth. This could add to the need to consider alternative passenger rail funding models if existing services are to be preserved and service expansion initiatives advanced.

Several points can be drawn from this discussion on governance:

1. An overarching observation from the above review of rail initiatives of selected states is that they often involved (a) establishing new entities with the sole purpose of advancing rail programs overall or specific rail proposals, and (b) funding levels substantially above the amounts allocated to rail service in Pennsylvania. However, it is also apparent that putting an institutional structure and dedicated funding in place does not guarantee successful implementation.

2. There is no single-model, fix-all solution. Any new institutional arrangement for Keystone West or other lines will require substantial consensus-building by the various stakeholders to forge any workable approach.

3. Public-private partnerships in this arena are extremely challenging, and, in order to be feasible, require that the operating requirements and future opportunities of each entity are not compromised.

4. In the context of a major rail initiative, strategic public sector investments coupled with sufficient risk-taking by other parties is essential. This includes financial and other risks such as operations, legal liability, etc.

5. The lack of long-term, stable funding has often been a major barrier to multijurisdictional high speed rail initiatives. In several instances, the necessary institutional structure was put in place and plans developed, only to see the effort aborted due to policy decisions that repealed previously-approved funding.

6. Federal funding should be considered with some degree of caution, as it has spurred numerous initiatives in many states that have not come to fruition.

7. While modest, incremental capital investment and service improvements along Keystone West can likely be advanced within the current institutional framework, an ambitious high speed rail initiative would likely require significant shifts in funding mechanisms and funding levels, and in PennDOT’s capacity to exercise appropriate oversight over increased funding and project implementation.

XI. STAKEHOLDER AND PUBLIC COORDINATION

This study is a high-level, conceptual feasibility study intended to evaluate the possibility of providing higher speed rail service along the Keystone West portion of Amtrak's Pennsylvanian route. Given the scope of the study (conceptual feasibility), and the fact that the corridor is 250 miles long covering portions of 24 counties, affecting more than five million residents, traditional stakeholder and public coordination was not feasible. In order to disseminate information on the study and provide a means for the public to offer input in as expeditious manner possible, the following communication strategy was implemented:

- Verify outreach strategy and contacts for key stakeholders (legislators, media, metropolitan planning organizations/rural planning organizations (MPOs/RPOs)), in coordination with PennDOT.
- Develop a Project Overview and briefing packet for key stakeholders, including an introductory letter.
- Develop an outreach strategy and materials for citizens who have contacted PennDOT expressing specific interest in the project.
- Provide Keystone West information on PlantheKeystone.com, a website primarily geared toward Keystone East improvements.
- Provide follow-up information to stakeholders to update status near completion of the feasibility study.

The briefing packet provided to key stakeholders contained four informational sheets:

1. "About the Project," which provided details on who was leading the study, information on the existing Keystone West corridor, and a definition of high speed rail.
2. "About the Feasibility Study," which provided a general overview of the feasibility study and the analyses that would be conducted, the purpose of the study, and potential benefits.
3. "FAQs," a Frequently Asked Questions list that addressed what is the Keystone West, who provides service in this corridor, the study schedule, and how to provide input. A link to the Plan the Keystone website (http://www.planthekeystone.com/) was provided.
4. "Contact Information," which was provided as a means for people to obtain more information or provide input on the study.

This informational briefing was mailed to 54 legislative contacts within the project corridor, including Pennsylvania and U.S. representatives and senators. It was also distributed to 16 municipal entities and six planning entities in the project area, along with 39 media outlets, including newspapers, radio stations, and television stations. The informational sheets could then be used by the legislators and others to provide information to their constituents, including how their constituents could contact study team members for more information or to provide input.

The Plan the Keystone website was initiated as part of a study evaluating potential infrastructure investments for Keystone East stations (Harrisburg – Philadelphia) and their surrounding areas with the goal of enhancing passenger service and strengthening the communities served by the Keystone line. For this study of potential improvements aimed at providing higher speed rail service for Keystone West, PennDOT decided to use the same website, as it was already established and people interested in the Keystone Corridor and its service options were already familiar with and accessing the website. To that end, a page was added to the website for the Keystone West, which consisted of the information provided in the previously mentioned legislative informational briefings. The website provided an additional means for the public to obtain information on the study and to provide input. As part of the website, a list of Frequently Asked Questions (FAQs) about the Keystone Corridor West was provided. The FAQs addressed questions related to the purpose of the study, benefits of Keystone West, how higher speed rail differs from Maglev, and information on environmental considerations and how to get more information. An e-mail address (keystonewest@planthekeystone.com) was provided for interested persons to ask questions, submit input and obtaining more information on the Keystone West study. Finally, contact information (mailing address and phone numbers) were provided for key PennDOT staff involved in the study to provide another way for interested parties to offer input.

Additionally, two Special Interest Group meetings were held; one with Western Pennsylvanians for Passenger Rail (WPPR) and one with the Southwestern Pennsylvania Commission (SPC). WPPR (http://www.wpprrail.org/) is a group of citizens who promote passenger rail service and travel in the western part of the Commonwealth. Early in the study, the same information provided to the legislators was provided to WPPR in meeting format, which enabled them to provide study information and contacts to their group members. WPPR also placed on their website a link to the Keystone West web information. A presentation, similar to that provided to WPPR, was also made to SPC, the regional planning agency serving the Greater Pittsburgh 10-county area. Information provided to SPC was intended to assist them with future planning of transportation improvements in their region. SPC was made aware of the study and will be provided with information on potential improvements, including costs, that are conceptually developed, which will allow SPC to evaluate potential funding for the Keystone West improvements in its region.

In summary, per the scope of work, the following stakeholder activities have been conducted to date:

a. Verified Key Stakeholders with PennDOT Bureau of Public Transportation, Office of Legislative Affairs, and Central Press Office

b. Distributed a Project Overview / Briefing Packet, including a project introductory letter, to Key Stakeholders (Legislators, Media and MPOs/RPOs).

c. The ***Plan The Keystone*** website was organized to use for citizens who contacted PennDOT expressing specific interest in the project.

d. Modified the ***Plan The Keystone*** website to accommodate Keystone Corridor West (KCW) information

- Uploaded the electronic Project Overview / Briefing
- Provided a site map for KCW web pages

e. Conducted meetings as requested with interested groups

- Western Pennsylvanians for Passenger Rail
- Southwestern Pennsylvania Commission

Following this Preliminary Service Development Plan and Feasibility Study, additional outreach would occur with those individuals and groups that were communicated with at the onset of this study. The purpose of that outreach will be to provide a summary of the study findings and to help in identifying any "next steps" moving forward.

XII. NEXT STEPS & IMPROVEMENT OPTIONS

This study evaluated and developed conceptual improvements aimed at enhancing passenger rail service within the Keystone West corridor. As mentioned, a NEPA-like alternatives analysis was completed comparing full alternatives; however, due to fiscal constraints, it is recognized that construction of any full alternative as a complete package is unlikely to occur. Therefore, smaller and separate improvement options with independent utility were analyzed under each alternative. This allows for a well-planned implementation of fiscally-responsible independent improvements over a number of years instead of attempting full implementation of any one complete alternative. For this reason, no preferred alternative has been identified in this document. Instead, for each improvement option included under the shortlisted alternatives, information has been provided on potential benefits, costs, right-of-way (ROW) considerations, and environmental considerations for each improvement. This information, attached to this document as **Appendix B: Improvement Option Details**, can be used to program potential projects through the State Transportation Improvement Program (STIP) development process. The STIP is the official programming document used by PennDOT to allocate federal transportation funding.

Development of the STIP begins at the regional level. Each of Pennsylvania's metropolitan and rural planning organizations (MPOs and RPOs)—such as SPC—develops a long-range transportation plan. The plan sets a vision, goals, and objectives for a 20-year planning horizon. The LRTPs must be fiscally balanced and are the basis for development of a list of prioritized proposals to be placed on each MPO/RPO region's Transportation Improvement Program (TIP), which are four-year plans. These regional TIPs are incorporated into the STIP. PennDOT also develops an official state programming document, the Twelve-Year Program (TYP), which includes the next 12 years of prioritized projects.

PennDOT will work with the MPOs/RPOs in the Keystone West corridor to evaluate the potential for funding the proposed Keystone West improvements. To aid in the evaluation, **Table 57: Improvement Options with Purpose/Benefits and Costs**, has been developed. **Table 57** also provides a general idea of the anticipated difficulty of implementation of each improvement. Level 1 projects are generally low cost improvements, mostly within existing right-of-way. They are typically non-complex and have limited or no adverse impacts upon the environment and are expected to be relatively straightforward to implement. Level 2 projects have a higher cost associated with them and may require some, but not extensive, amounts of additional right-of-way. They would be considered moderately complex and may have adverse impacts upon the environment. They would present a greater level of difficulty to implement. Level 3 projects are generally the costliest improvements and require additional right-of-way. They would be complex projects with greater impacts upon the built and natural environments, and would present the greatest challenges in terms of design and construction.

The menu of options approach was taken because of the high costs involved with attempting to implement any single alternative as a whole. Limited transportation funding makes it nearly impossible to undertake such a large investment at any one time. Therefore, the improvement options were developed to be smaller standalone improvements that, developed over time, will work together to provide sequentially enhanced service along the Keystone West line. Considering components individually, but incrementally, allows for phased completion of improvements in a planned manner while properly evaluating overall effects on the natural, cultural, and social environments; total anticipated costs; and service benefits.

It is anticipated that work performed during future phases of the planning effort would include those tasks necessary to prepare a Final Service Development Plan, design and obtain required clearances/permits for any improvement(s), and construct the improvement(s), such as:

- Coordination with Norfolk Southern to better gauge their willingness to cooperate with future improvement implementation and to build their support for the improvements.
- Development of a staged implementation plan for the improvements documented in **Table 57: Improvement Options with Purpose/Benefits and Costs** or some subset of those improvements, based on coordination with Amtrak, Norfolk Southern, other stakeholders, and the public.
- Completing a full rail operations network analysis that would account for both passenger and freight trains, including evaluation of potential conflicts.
- Preparation of refined demand estimates using a model developed specifically for this corridor (not just elasticities borrowed from other research as was done for this Feasibility Study/Preliminary Service Development Plan).
- Preparation of a detailed financial plan with annual capital operating costs, fare elasticity analyses, revenues, etc., projected out 25 to 30 years.
- Refining the engineering design (Conceptual Engineering), impact/benefit analyses, and cost estimates (including construction and operation and maintenance costs) for a particular alignment or set of improvement options. This would include obtaining an environmental decision (Environmental Documentation) for National Environmental Policy Act (NEPA) compliance and any permitting required for the proposed improvement(s), as preliminarily identified in **Table 9, Potential Environmental Impacts (Alternatives 1, 2, and 3)**. Note that no assessment on required level of NEPA documentation has been provided, as the required NEPA documentation (and permitting) would depend on whether improvements were designed/constructed as individual projects, as groups of improvements, or as a full alternative. Development of any one of the full alternatives would be anticipated to require an Environmental Impact Statement (EIS).
- Final design/engineering of proposed improvement(s).
- Preparation of a detailed funding plan that shows how the annual capital costs and operating subsidies would be financed.
- Stakeholder and public involvement/coordination activities to build support for proposed improvements (this should be completed in conjunction with the Final Service Development Plan and continue through final design of any improvements).

- Completion of a detailed analysis of direct and indirect benefits of any proposed improvement(s).

The cost of each of these steps and the timeframe to complete would be dependent on what improvement option(s) is moved forward. The first step needs to be coordination between FRA, PennDOT, Amtrak, and Norfolk Southern to evaluate the improvements presented in the following table and to prioritize them for future action. **See Appendix F, Keystone West Future Work Plan / Schedule.**

It must be noted that part of the analysis as to what improvements move forward, and what order (priority), must consist of evaluating whether there is sufficient demand available to justify the cost required to construct any individual or combined improvements. Because the presented improvement options offer varying levels of improvement at widely varying funding levels, whether constructed individually or in some combination of improvements, a determination on whether the improvement(s) are justified based on demand can only be made once they are prioritized for future action and decisions are made on whether to construct improvements individually or in some combination.

Table 57: Improvement Options with Purpose/Benefits and Costs										
Alt. 1 Ref #	**Alt. 2 Ref #**	**Alt. 3 Ref #**	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/ Benefits**	**Alt. 1 Cost ($000s)**	**Alt. 2 Cost ($000s)**	**Alt. 3 Cost ($000s)**	**Anticipated Difficulty of Implementation 1= Least 2 = Moderate 3 = Most**
PITTSBURGH – GREENSBURG										
104	204	310	Freight Bypass Track	Pittsburgh Station	1.1 miles new track, turnouts and related C&S improvements	Capacity	8,170	8,170	8,170	1
110	210		Additional Passing Siding and Renew Existing Passing Siding	Rade – Traff MP 325.0 – MP 336.5	11.5 miles new siding, 11.5-mile access road, 3.2 miles rehab existing siding, 6 new bridges, 17 rail/highway grade separations, retaining walls, turnouts, C&S	Capacity	265,323	265,323		3
111.8	211.8	311.8	Curve Modifications	Greensburg – Pittsburgh	Modified superelevation and/or straightening of curves	Speed	1,534	1,534	1,534	1
		308	Add Continuous Third Track	Greensburg – Pittsburgh	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	Additional Capacity/ Time Savings			494,535	3
GREENSBURG – LATROBE										
109	209		New Passing Siding	Pack – Trobe MP 300.5 – MP 312.7	12.2 miles new siding, 12-mile access road, 2 new bridges, 7 rail/highway grade separations, 4 grade crossing upgrades, turnouts, C&S	Capacity	158,105	158,105		2

Table 57: Improvement Options with Purpose/Benefits and Costs										
Alt. 1 Ref #	**Alt. 2 Ref #**	**Alt. 3 Ref #**	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/ Benefits**	**Alt. 1 Cost ($000s)**	**Alt. 2 Cost ($000s)**	**Alt. 3 Cost ($000s)**	**Anticipated Difficulty of Implementation 1= Least 2 = Moderate 3 = Most**
111.7	211.7	311.7	Curve Modifications	Latrobe – Greensburg	Modified superelevation and/or straightening of curves	Speed	203	203	203	1
		307	Add Continuous Third Track	Latrobe – Greensburg	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	Additional Capacity/ Time Savings			212,152	3
LATROBE – JOHNSTOWN										
111.6	211.6	311.6	Curve Modifications	Johnstown – Latrobe	Modified superelevation and/or straightening of curves	Speed	4,054	4,054	4,054	1
	218.5	313.5	Curve Straightening	Johnstown – Latrobe	New track, track relocation, cut/fill, 1 highway grade separation, access road, retaining walls, C&S	Speed		25,221	25,221	2
		306	Add Continuous Third Track	Johnstown – Latrobe	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	Additional Capacity/ Time Savings			798,277	3

Table 57: Improvement Options with Purpose/Benefits and Costs										
Alt. 1 Ref #	**Alt. 2 Ref #**	**Alt. 3 Ref #**	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/ Benefits**	**Alt. 1 Cost ($000s)**	**Alt. 2 Cost ($000s)**	**Alt. 3 Cost ($000s)**	**Anticipated Difficulty of Implementation 1= Least 2 = Moderate 3 = Most**
JOHNSTOWN – ALTOONA										
101	201		Additional Track	Cresson – Johnstown	24 miles of new track and related improvements (1 new bridge, rehab 14 bridges, turnouts, C&S, etc.)	Capacity/ Speed	97,901	97,901		3
111.5	211.5	311.5	Curve Modifications	Altoona – Johnstown	Modified superelevation and/or straightening of curves	Speed	3,043	3,043	3,043	1
	217	312.5	Off-line Alignment, double track, passenger-only due to grades	Horseshoe Curve Bypass MP 237.2 – MP 244.3	9.3 miles new double track, 1 new rail/rail grade separation, 1 rail highway grade separation ($216.1M), extensive cut/fill ($42.4M), extensive C&S and turnouts	Speed/ Capacity		334,769	334,769	3
	218.4	313.4	Curve Straightening	Altoona – Johnstown	New track, track relocation, extensive cut/fill ($55.0M), and retaining walls ($23.9M), 4.9-mile access road, 2 new bridges ($61.4M), 1 highway grade separation, C&S	Speed		175,086	175,086	3

Table 57: Improvement Options with Purpose/Benefits and Costs										
Alt. 1 Ref #	**Alt. 2 Ref #**	**Alt. 3 Ref #**	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/ Benefits**	**Alt. 1 Cost ($000s)**	**Alt. 2 Cost ($000s)**	**Alt. 3 Cost ($000s)**	**Anticipated Difficulty of Implementation 1= Least 2 = Moderate 3 = Most**
		305	Add Continuous Third Track	Altoona – Johnstown	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Reopen Gallitzin Tunnel, extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	Additional Capacity/ Time Savings			801,400	3
ALTOONA – TYRONE										
103.3	203.3		Station Improvements	Altoona	Add 1 high platform, new pedestrian bridge, garage modifications, elevators, 1 gauntlet track, signal improvements	Capacity/ Time Savings	11,432	11,432		1
		309.3	Alt 3 Station Improvements	Altoona Station	2 new gauntlet tracks & signal upgrades, 2 new high platforms, new pedestrian bridge, 3 elevators, garage modifications, misc. improvements	Capacity/ Time Savings			15,669	2
111.4	211.4	311.4	Curve Modifications	Tyrone – Altoona	Modified superelevation and/or straightening of curves	Speed	359	359	359	1

Table 57: Improvement Options with Purpose/Benefits and Costs										
Alt. 1 Ref #	**Alt. 2 Ref #**	**Alt. 3 Ref #**	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/ Benefits**	**Alt. 1 Cost ($000s)**	**Alt. 2 Cost ($000s)**	**Alt. 3 Cost ($000s)**	**Anticipated Difficulty of Implementation 1= Least 2 = Moderate 3 = Most**
		304	Add Continuous Third Track	Tyrone – Altoona	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	Additional Capacity/ Time Savings			320,655	3
TYRONE – HUNTINGDON										
103.2	203.2		Station Improvements	Tyrone	Add second low-level platform, waiting room and shelters, parking, misc. improvements	Capacity/ Time Savings	925	925		1
		309.2	Alt 3 Station Improvements	Tyrone Station	2 new gauntlet tracks, signal upgrades, 2 new high platforms, new waiting room & shelters, parking, misc. improvements	Capacity/ Time Savings			13,655	1
111.3	211.3	311.3	Curve Modifications	Huntingdon – Tyrone	Modified superelevation and/or straightening of curves	Speed	2,433	2,433	2,433	1

Table 57: Improvement Options with Purpose/Benefits and Costs										
Alt. 1 Ref #	**Alt. 2 Ref #**	**Alt. 3 Ref #**	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/ Benefits**	**Alt. 1 Cost ($000s)**	**Alt. 2 Cost ($000s)**	**Alt. 3 Cost ($000s)**	**Anticipated Difficulty of Implementation 1= Least 2 = Moderate 3 = Most**
	216	312.4	Off-line Alignment, double track	Tyrone vicinity MP 213.17 – MP 230.55	12 miles new double track, 15 miles track relocation, 12 new grade crossings, extensive excavation along Juniata River ($520.5M), 13.7-mile access road, 3.4 miles roadway separation, 12 new RR bridges, 2 grade separation structures, retaining walls, turnouts, C&S,	Speed/ Capacity		1,037,357	1,037,030	3
	218.3	313.3	Curve Straightening	Huntingdon – Tyrone	New track, track relocation, extensive cut/fill ($59.1M) and retaining walls ($11.1M), access road, highway relocation, C&S	Speed		77,383	77,383	2
		303	Add Continuous Third Track	Huntingdon – Tyrone	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Reopen Spruce Creek Tunnel, extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	Additional Capacity/ Time Savings			461,913	3

Table 57: Improvement Options with Purpose/Benefits and Costs										
Alt. 1 Ref #	**Alt. 2 Ref #**	**Alt. 3 Ref #**	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/ Benefits**	**Alt. 1 Cost ($000s)**	**Alt. 2 Cost ($000s)**	**Alt. 3 Cost ($000s)**	**Anticipated Difficulty of Implementation 1= Least 2 = Moderate 3 = Most**
TYRONE – STATE COLLEGE (SPUR)										
112	212	314	Rail Spur to State College	Tyrone (MP 313) – Lemont	10,000 wood tie replacement, 5 miles of new rail on curves, 8 new RR bridges, rehab 4 bridges, renew 31 timber/asphalt crossings and 10 full-depth rubber crossings, line and surface 45 track miles, 1 high-level platform, shelter, parking, C&S	Access/ New Market	71,887	71,887	71,887	2
HUNTINGDON – LEWISTOWN										
103.1	203.1		Station Improvements	Huntingdon	Add second low-level platform, parking, misc. improvements	Capacity/ Time Savings	950	950		1
		309.1	Alt 3 Station Improvements	Huntingdon Station	2 new gauntlet tracks & signal upgrades, 2 new high platforms, misc. improvements	Capacity/ Time Savings			14,416	1
107	207		Additional Passing Siding and Renew Existing Passing Siding	McVey – Jacks MP 179.6 – MP 191.3	11.7 miles new siding track and shift existing track, 12-mile access road, 2 new bridges, 1 private road crossing, 2 new bridges, 4 rail/highway grade separations, retaining walls, turnouts, C&S	Capacity	190,834	190,834		2

Table 57: Improvement Options with Purpose/Benefits and Costs										
Alt. 1 Ref #	**Alt. 2 Ref #**	**Alt. 3 Ref #**	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/ Benefits**	**Alt. 1 Cost ($000s)**	**Alt. 2 Cost ($000s)**	**Alt. 3 Cost ($000s)**	**Anticipated Difficulty of Implementation 1= Least 2 = Moderate 3 = Most**
108	208		Additional Passing Siding and Renew Existing Passing Siding	Tunnel – Gray MP 212.9 – MP 223.3	Reopen Spruce Creek Tunnel ($27.5M), 10.4 miles new siding track and shift existing track, 4 grade crossing modifications, 10-mile access road, 14 new bridges, 5 rail/highway grade separations, retaining walls, turnouts, C&S	Capacity	380,084	371,576		3
111.2	211.2	311.2	Curve Modifications	Lewistown – Huntingdon	Modified superelevation and/or straightening of curves	Speed	1,454	1,454	1,454	1
	215	312.3	Off-line Alignment, double track, concrete tie	Bypass of Lewistown, Granville, McVeytown MP 160.0 – MP182.5	Extensive cut/fill ($5,337M), 22.5 miles new double-track rail, 15-mile access road, relocate Lewistown Station with 2 platforms & amenities, 1 new RR bridge, 3 rail/highway grade separations, 5 grade crossings, turnouts, C&S	Speed/ Capacity		5,624,683	5,624,683	3
	218.2	313.2	Curve Straightening	Lewistown – Huntingdon	New track, track relocation, extensive cut/fill ($45.8M), 2 new bridges ($144.9M), C&S	Speed		195,752	195,752	3

Table 57: Improvement Options with Purpose/Benefits and Costs										
Alt. 1 Ref #	**Alt. 2 Ref #**	**Alt. 3 Ref #**	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/ Benefits**	**Alt. 1 Cost ($000s)**	**Alt. 2 Cost ($000s)**	**Alt. 3 Cost ($000s)**	**Anticipated Difficulty of Implementation 1= Least 2 = Moderate 3 = Most**
		302	Add Continuous Third Track	Lewistown – Huntingdon	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, 20 grade separations, access roads, retaining walls, etc.	Additional Capacity/ Time Savings			369,683	3
LEWISTOWN – HARRISBURG										
102	202		Additional Track	Harris – Rockville	3.5 miles new track and related improvements (turnouts, 1 bridge rehab, C&S, etc.)	Capacity/ Speed	12,899	12,899		1
103.4			Station Improvements	Lewistown Station	Low-level Platforms	Capacity/ Speed	660			1
105	205		Additional Passing Siding and Renew Existing Passing Siding	Cannon – Port MP 113.2 – MP 133.5	14.6 miles new siding, 5.7 miles renew existing siding, 5 grade crossings, relocate industrial side track, rehab 7 bridges, 6 new bridges, 14.6-mile rail access road, 3 rail/highway grade separations, turnouts, C&S	Capacity	179,285	179,285		2

Table 57: Improvement Options with Purpose/Benefits and Costs										
Alt. 1 Ref #	**Alt. 2 Ref #**	**Alt. 3 Ref #**	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/ Benefits**	**Alt. 1 Cost ($000s)**	**Alt. 2 Cost ($000s)**	**Alt. 3 Cost ($000s)**	**Anticipated Difficulty of Implementation 1= Least 2 = Moderate 3 = Most**
106	206		Additional Passing Siding and Renew Existing Passing Siding	Hawthorne – Lewis MP 160.0 – MP 165.7	5.7 miles new siding track and shift existing track, 6.3 miles renew existing siding, 3 rail/highway grade separations, turnouts, C&S	Capacity	79,618	79,618		2
111.1	211.1	311.1	Curve Modifications	Harrisburg – Lewistown	Modified superelevation and/or straightening of curves	Speed	2,788	2,788	2,788	1
	213	312.1	Off-line Alignment, double track	Rockville – Duncannon MP 209 (Buffalo Line) – MP 121.6 (Pgh Line)	6.3 miles new track, 3.4 miles upgrade existing track, 1 new bridge ($304.5M), 10-mile access road, 1 major new interlocking, 4 new timber/asphalt crossings, retaining walls, turnouts, extensive C&S,	Speed/ Capacity		394,424	394,424	3
	214	312.2	Off-line Alignment, double track	Ferguson's Curve MP 128 – MP 131.8	Extensive cut/fill ($394.2M), 3.8 miles new double-track RR, 3.0-mile access road, 1 rail/highway grade separation, 1 new interlocking, turnouts, C&S, utilities	Speed/ Capacity		435,356	435,356	3
	218.1	313.1	Curve Straightening	Harrisburg – Lewistown	New track, relocation, extensive cut/fill ($141.3M), 6.3-mile access road, retaining walls, C&S	Speed		174,777	174,777	3

Table 57: Improvement Options with Purpose/Benefits and Costs										
Alt. 1 Ref #	**Alt. 2 Ref #**	**Alt. 3 Ref #**	**Type of Improvement**	**Location**	**Summary Description**	**Purpose/ Benefits**	**Alt. 1 Cost ($000s)**	**Alt. 2 Cost ($000s)**	**Alt. 3 Cost ($000s)**	**Anticipated Difficulty of Implementation 1= Least 2 = Moderate 3 = Most**
		301	Add Continuous Third Track	Harrisburg – Lewistown	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	Additional Capacity/ Time Savings			995,135	3
TOTAL ALTERNATIVE 1 CAPITAL COST							**1,473,941**			**3**
TOTAL ALTERNATIVE 2 CAPITAL COST								**9,939,581**		**3**
TOTAL ALTERNATIVE 3 CAPITAL COST									**13,067,896**	**3**
TOTAL ALTERNATIVE 1 ESTIMATED RIGHT-OF-WAY COST							**400**			
TOTAL ALTERNATIVE 2 ESTIMATED RIGHT-OF-WAY COST								**14,000**		
TOTAL ALTERNATIVE 3 ESTIMATED RIGHT-OF-WAY COST									**16,000**	

A. Lower Cost Option

Following completion of this Feasibility Report / Preliminary Service Development Plan (FR/PSDP), it was decided that it was necessary to develop an improvement option with a cost of less than $500M. The option proposed herein is not a preferred alternative nor a suggestion on what should be built first. The option was developed simply as one of multiple options to a systematic approach at corridor improvements and, predominately, to provide an option costing less than $500M.

At the onset of the Feasibility Study, the Project Team was tasked with developing and evaluating the feasibility of a range of conceptual alternatives that would reduce travel times and allow for increased trip frequency on the Keystone West. No dollar amount was set that constituted what defined a "lower cost" option and the overall intent of the study was to determine the feasibility of various means to reduce travel times and increase service frequency; therefore, alternatives were developed with the primary goal of reducing travel times and adding additional frequencies. Costs were a factor but not the driving force behind alternative development. Because the resulting alternatives (Alternatives 1, 2, 3, and 4) were quite costly, the Menu of Options (February 2014) document was developed. The Menu provides the means of grouping individual improvements in almost any manner to meet available funding levels, including completing improvements as individual projects. The Menu of Options (February 2014) provides information on numerous small scale improvements with independent utility and separate purpose and need. Any of these small scale improvements would individually and collectively (in many conceivable combinations) contribute to the larger goal of improving the Keystone Corridor West.

1. Overview of the Lower Cost (under $500M) Option

Individual improvement components were selected from the Keystone West Menu of Options (February 2014) report in order to develop an option that costs under $500M. Improvement types were chosen to be lower costs, have minimal requirements for additional right-of-way, have fewer environmental impacts, and be easier to implement, but also with the intent of improving travel times on the Keystone West. Selected project types include predominantly platform/station improvements and curve modifications.

Table 58: Lower Cost (under $500M) Option A, presents those improvements that could be included under such an option. Because of the criteria used to select projects for inclusion in Option A, the selected improvements would all be constructed either within existing right-of-way or with minimal need for new right-of-way thereby minimizing right-of-way costs.

Table 58: Lower Cost (under $500M) Option A

Alternative Reference Numbers	Type of Improvement	Location	Summary Description	Expected Benefits Purpose	Loaded Costs – except ROW ($000)	ROW	Implementation (3 = most difficult 2 = moderate 1 = least difficult)
104 / 204 / 310	Freight Bypass Track	Pittsburgh Station	1.1 miles new track, turnouts, and related C&S improvements	Capacity	8,170	Existing	1
111.7 / 211.7 / 311.7	Curve Modifications	Latrobe – Greensburg	Modified superelevation and/or straightening of curves	Speed	203	Mostly existing	1
111.8 / 211.8 / 311.8	Curve Modifications	Greensburg – Pittsburgh	Modified superelevation and/or straightening of curves	Speed	1,534	Mostly existing	1
101 / 201	Additional Track	Cresson – Johnstown	24 miles of new track and related improvements (1 new bridge, rehab 14 bridges, turnouts, C&S, etc.)	Capacity / Speed	97,901	Existing	3
218.4 / 313.4	Curve Straightening	Altoona – Johnstown	New track, track relocation, extensive cut/fill ($55.0M), and retaining walls ($23.9M), 4.9-mile access road, 2 new bridges ($61.4M), 1 highway grade separation, C&S	Speed	175,086	Some new at each curve	3
218.5 / 313.5	Curve Straightening	Johnstown – Latrobe	New track, track relocation, cut/fill, 1 highway grade separation, access road, retaining walls, C&S	Speed	25,221	Some new at each curve	2
111.5 / 211.5 / 311.5	Curve Modifications	Altoona – Johnstown	Modified superelevation and/or straightening of curves	Speed	3,043	Mostly existing	1
111.6 / 211.6 / 311.6	Curve Modifications	Johnstown – Latrobe	Modified superelevation and/or straightening of curves	Speed	4,054	Mostly existing	1
309.3	Alt 3 Station Improvements	Altoona Station	New gauntlet tracks & signal upgrades, 2 new high platforms, new pedestrian bridge, 3 elevators, garage modifications, misc. improvements	Capacity / Time Savings	15,669	Mostly existing	2

Table 58: Lower Cost (under $500M) Option A							
Alternative Reference Numbers	**Type of Improvement**	**Location**	**Summary Description**	**Expected Benefits Purpose**	**Loaded Costs – except ROW ($000)**	**ROW**	**Implementation (3 = most difficult 2 = moderate 1 = least difficult)**
309.1	Alt 3 Station Improvements	Huntingdon Station	New gauntlet tracks & signal upgrades, 1 new high platform, misc. improvements	Capacity / Time Savings	14,416	Mostly existing	1
218.3 / 313.3	Curve Straightening	Huntingdon – Tyrone	New track, track relocation, extensive cut/fill ($59.1M) and retaining walls ($11.1M), access road, highway relocation, C&S	Speed	77,383	Some new at each curve	2
309.2	Alt 3 Station Improvements	Tyrone Station	New gauntlet tracks & signal upgrades, 2 new high platforms, new waiting room & shelters, misc. improvements	Capacity / Time Savings	13,655	Mostly existing	1
111.4 / 211.4 / 311.4	Curve Modifications	Tyrone – Altoona	Modified superelevation and/or straightening of curves	Speed	359	Mostly existing	1
111.3 / 211.3 / 311.3	Curve Modifications	Huntingdon – Tyrone	Modified superelevation and/or straightening of curves	Speed	2,433	Mostly existing	1
102 / 202	Additional Track	Harris – Rockville	3.5 miles new track and related improvements (turnouts, 1 bridge rehab, C&S, etc.)	Capacity / Speed	12,899	Existing	1
103.4	Station Improvements	Lewistown Station	Low-Level Platforms	Capacity / Speed	660	Existing	1
111.1 / 211.1 / 311.1	Curve Modifications	Harrisburg – Lewistown	Modified superelevation and/or straightening of curves	Speed	2,788	Mostly existing	1
111.2 / 211.2 / 311.2	Curve Modifications	Lewistown – Huntingdon	Modified superelevation and/or straightening of curves	Speed	1,454	Mostly existing	1
Note costs do not include R/W; therefore, the costs were kept under $500M to leave room for R/W costs.			**LOW-COST OPTION A TOTAL**	**capacity / speed / time savings / access / new markets**	**456,928**	**Existing to Mostly on Existing**	**1**

2. Adding Additional Frequencies

Appendix A to the *Operations Analysis of Proposed Infrastructure Modifications for Supporting High Speed Rail Technical Memorandum* (October 2013) fully addresses scheduling considerations for two Operating Plan (train schedule) variants. Both a Two-Frequency and a Three-Frequency schedule were developed that assumed full implementation of Alternative 2 infrastructure improvements identified in the FR/PSDP. The operating plans can be viewed as a plausible progression of incremental service improvement -- building upon the existing single daily service frequency. The operating plans deliberately schedule the existing Pennsylvanian to arrive and depart Harrisburg on its existing (Spring 2012) timings. This is an acknowledgement of the challenging reality of scheduling traffic into and out of stations in both Philadelphia and New York on the Northeast Corridor (NEC). It is more pragmatic to start with what is already in place than to presume the future existence of NEC schedule slots that may or may not become available. Today, significant portions of the NEC are at or approaching capacity saturation during peak and shoulder-peak periods, which naturally reflects the times of day when travel demand is highest and therefore those schedule “slots” are the most desirable. They are in finite supply and, broadly, are already fully subscribed by existing NEC trains.

The earliest departures included in the schedules for the Keystone West segment are 7:30 AM westbound and 8:10 AM eastbound. The equivalent of one full day of work requires at most one overnight stay at either end point.

Although the Lower Cost Option A includes less infrastructure investment than Alternative 2, which would result in slower speeds, the departure times in the previously developed schedules remain valid and only the times at intermediate stops and at the endpoints would have to be adjusted based upon refined operations analyses.

3. Anticipated Ridership

Although it is not practical to replicate the complete rail operations and demand analysis procedures that were applied during the course of the study to Lower Cost Option A that has been identified as the study is drawing to a close, probable levels of demand can be qualitatively assessed using the information produced for the basic infrastructure alternatives and operating plans that were evaluated.

Lower Cost Option A with all of the platform and station improvements, an assortment of curve modification improvements and two daily round trips is closest in its characteristics to Demand Alternative 2A (refer to the *Technical Memorandum on Passenger and Revenue Forecasts* (October 2013) for a full explanation and analysis of Demand Alternative 2A) which included all platform and station improvements, two round trips and connecting bus services to select off-line communities; but none of the more costly off-line alignment projects.

Although time savings for Lower Cost Option A would be slightly less than Alternative 2A due to the inclusion of only the station/platform projects and the curve modification projects in Lower Cost Option A, the differences in total trip times between endpoints would be less than 2 minutes. A difference of $\pm$2 minutes over the course of a trip of approximately five hours in duration would not materially impact the validity of the conceptual demand estimates. The demand analyses for the previously-analyzed infrastructure/operating plans showed that ridership is much more sensitive to trip frequency than to modest shifts in trip times, which further supports the notion that Demand Alternative 2A can provide a rough approximation of expected ridership on Lower Cost Option A since the service frequency is identical for both. The heightened sensitivity to service frequency is to be expected since adding one round trip amounts to a doubling of the base level of service. The range of the demand estimates for the previous alternatives is shown in this excerpt from the *Technical Memorandum on Demand Estimation*, and Lower Cost Option A demand can be expected to fall in the range of demand forecast for Alternative 2A.

Table 59: Annual Ridership Observed and Forecasted between Harrisburg & Pittsburgh

Scenario / Year	2012	2014	2020	2035
No – Build	211,990	216,700	224,840	241,140
Alt. 2A (low)		262,700	272,600	291,200
Alt. 2A (high)		301,520	339,580	457,000

Reference: This table is an excerpt from "Technical Documentation, Passenger and Revenue Forecasts, October 25, 2013." It summarizes the annual Amtrak ridership observed for 2012 and forecasted between Pittsburgh and Harrisburg for the Demand Alternative 2A that included station / platform improvements, two daily round trips, and new bus connections at Harrisburg, State College and Johnstown Stations, categorized by analysis year and scenario.

4. Analysis of fares

As explained in **Section VII. Demand**, existing fares were used as a basis for demand estimation for the various alternatives. The use of existing fares to evaluate potential demand reflects the fact that (a) no empirical data (such as surveys or historical fare/demand analyses) was available from which to derive elasticties specific to this corridor; and (b) this approach was consistent with the conceptual nature of other key components of the study including the work on conceptual engineering, rail operations analysis and potential environmental impacts. Also, using the same fare for all alternatives helped to isolate the differences in demand due to the infrastructure improvements and service frequency which are the primary factors being tested as part of the conceptual FR/PSDP. This would also apply to this new Lower-Cost Option A.

Should a full-scale Final Service Development Plan be commissioned, all of the preliminary, conceptual work would be refined and carried out in more detail, and that would be the appropriate time to refine demand estimates and the definition of alternatives based on the effects of alternative fare levels. From a practical standpoint, if higher fares had been tested (lower fares should not be part of the analysis since Amtrak and PennDOT struggle to find the resources to finance current deficits on the Pennsylvanian), it seems logical to assume that higher fares would only serve to suppress forecast levels of demand, which are already a concern. This would be especially true for a lower cost alternative, such as Lower Cost Option A, which would only have minimal improvements in trip time.

XIII. REFERENCES

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PennDOT, *Keystone West High Speed Rail Study: Passenger and Revenue Forecasts* (October 25, 2013).

APPENDIX A
Environmental Constraints Mapping

Appendix A is provided as a separate volume due to its size.

APPENDIX B
Improvement Option Details

APPENDIX B
Improvement Option Details

The following menu of options also provides a general idea of the anticipated difficulty of implementation of each improvement. Level 1 projects are generally low cost improvements, mostly within existing right-of-way. They are typically non-complex and have limited or no adverse impacts upon the environment and are expected to be relatively straightforward to implement. Level 2 projects have a higher cost associated with them and may require some, but not extensive, amounts of additional right-of-way. They would be considered moderately complex and may have adverse impacts upon the environment. They would present a greater level of difficulty to implement. Level 3 projects are generally the costliest improvements and require additional right-of-way. They would be complex projects with greater impacts upon the built and natural environments, and would present the greatest challenges in terms of design and construction.

The following notes apply to the Menu of Options table and are provided at the end of the table.

NOTES:

[1] 100 series numbers = Alternative 1; 200 series numbers = Alternative 2; 300 series numbers = Alternative 3.

[2] ROW = Right-of-Way. Also, see the Memorandum and spreadsheet that follows the Menu of Options for the Right-of-Way Order of Magnitude cost estimate methodology and details.

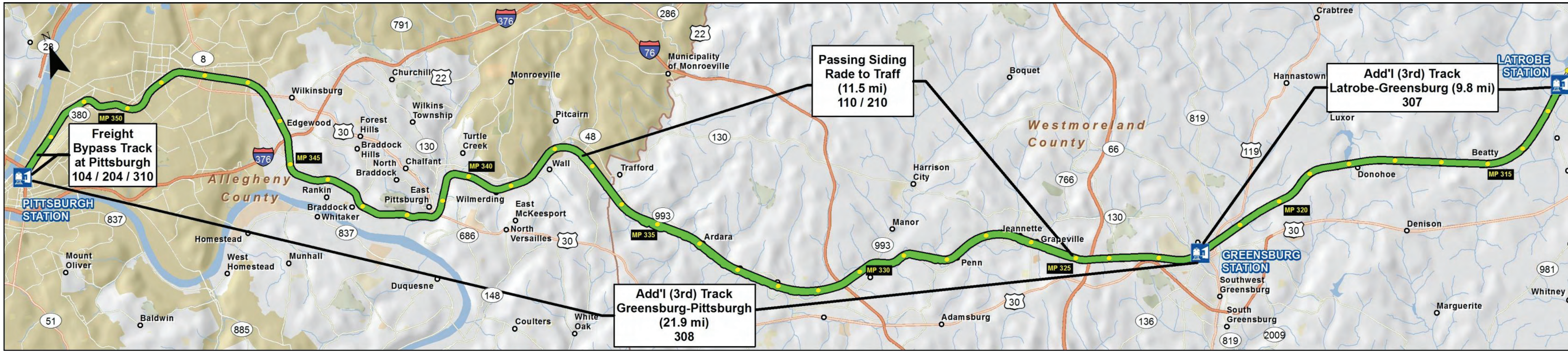
[3] Based on the total time savings in both directions.

[4] Based on available background and secondary source data and mapping.

A Time savings would be expected, but exact time savings are not known based on this conceptual feasibility study.

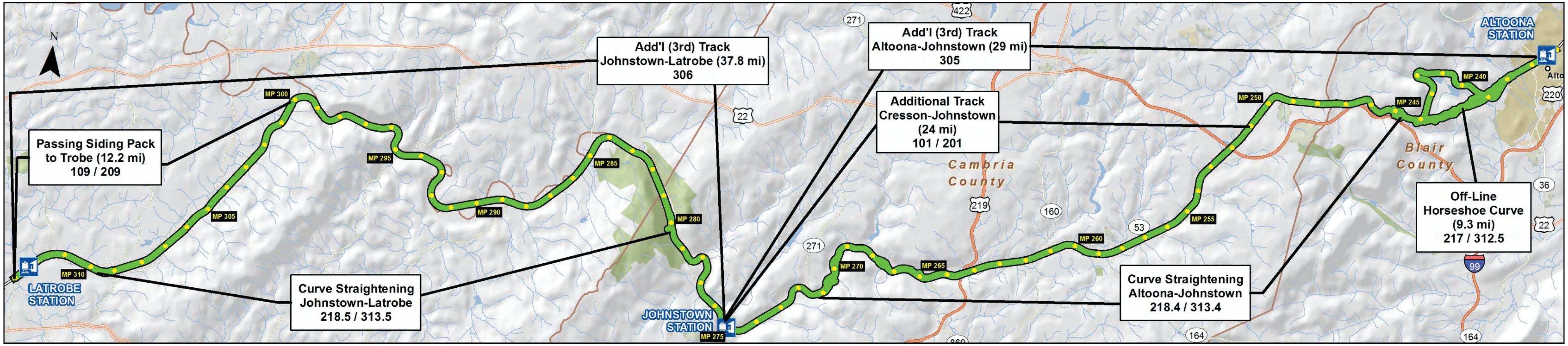
B The primary purpose of the station improvement projects is to reduce the occurrence of unplanned delays to both passenger and freight trains that arise due to the need for eastbound passenger trains to make crossover moves and run on the primary westbound track to access platforms for loading/unloading. A related and equally important benefit is that the project(s) will also add capacity that will support additional passenger train frequencies.

PITTSBURGH – LATROBE



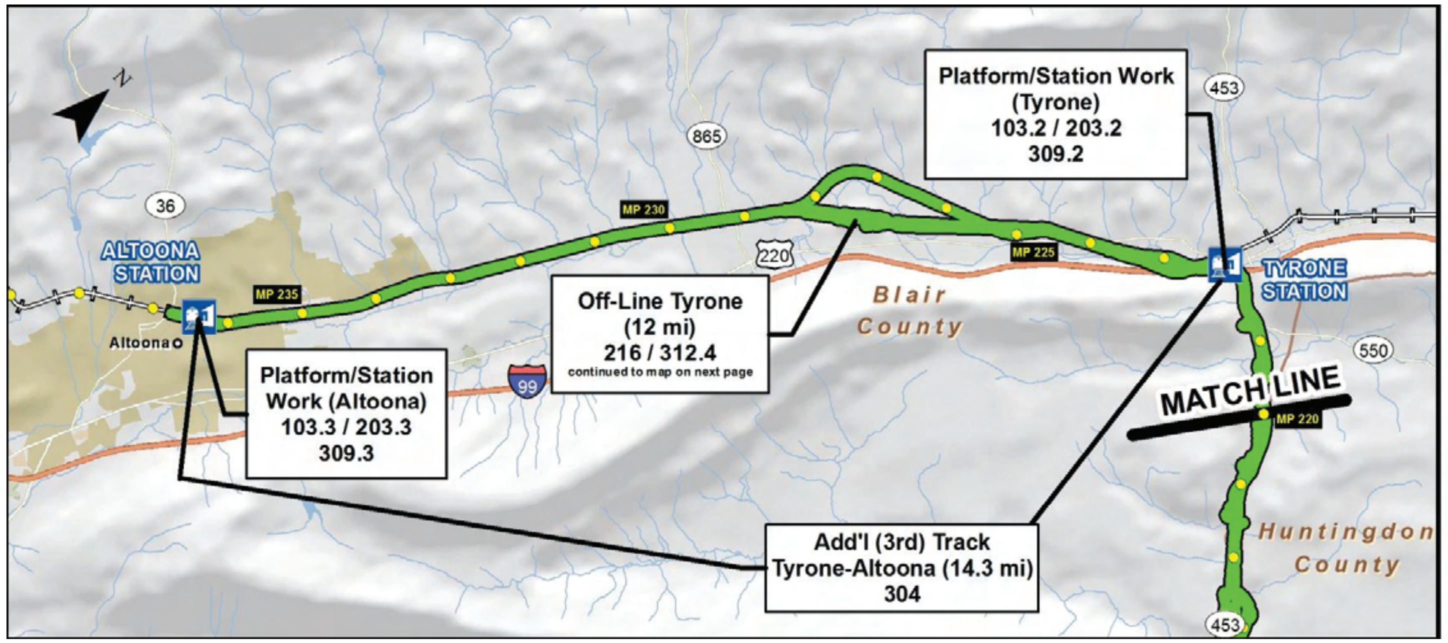
Alternative Reference Numbers[1]	Type of Improvement	Location	Summary Description	Expected Benefits			Loaded Costs – except ROW[2] ($000s)	Cost / Benefit ($000s / second)[3]	ROW	Environmental Considerations[4]					Implementation (3 = most difficult 2 = moderate 1 = least difficult)
				Time (h:m:s)		Purpose				Stream Crossings	Wetland Impacts	T&E Species	Historic Resources	Hazardous Waste	
				East	West					# / LF	# / Acres	#	#	Y / N	
104 / 204 / 310	Freight Bypass Track	Pittsburgh Station	1.1 miles new track, turnouts, and related C&S improvements	NA	NA	Capacity	8,170	-	Existing	0 / 0	0 / 0	0	0	N	1
110 / 210	Additional Passing Siding and Renew Existing Passing Siding	Rade – Traff MPs 325.0 – 336.5	11.5 miles new siding, 11.5-mile access road, 3.2 miles rehab existing siding, 6 new bridges, 17 rail/highway grade separations, retaining walls, turnouts, C&S	NA	NA	Capacity	265,323	-	Mostly new	22 / 593	0 / 0	1	1	Y	3
307	Add Continuous Third Track	Latrobe – Greensburg	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	See Note A		Additional Capacity/Time Savings	212,152	-	Mostly new	10 / 255	0 / 0	0	0	N	3
308	Add Continuous Third Track	Greensburg – Pittsburgh	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	See Note A		Additional Capacity/Time Savings	494,535	-	Mostly new	27 / 586	0 / 0	0	0	N	3
111.7 / 211.7 / 311.7	Curve Modifications	Latrobe – Greensburg	Modified superelevation and/or straightening of curves	0:00:00	0:00:00	Speed	203	-	Mostly existing	0 / 0	0 / 0	0	0	N	1
111.8 / 211.8 / 311.8	Curve Modifications	Greensburg – Pittsburgh	Modified superelevation and/or straightening of curves	0:00:36	0:00:18	Speed	1,534	28	Mostly existing	0 / 0	0 / 0	0	0	N	1

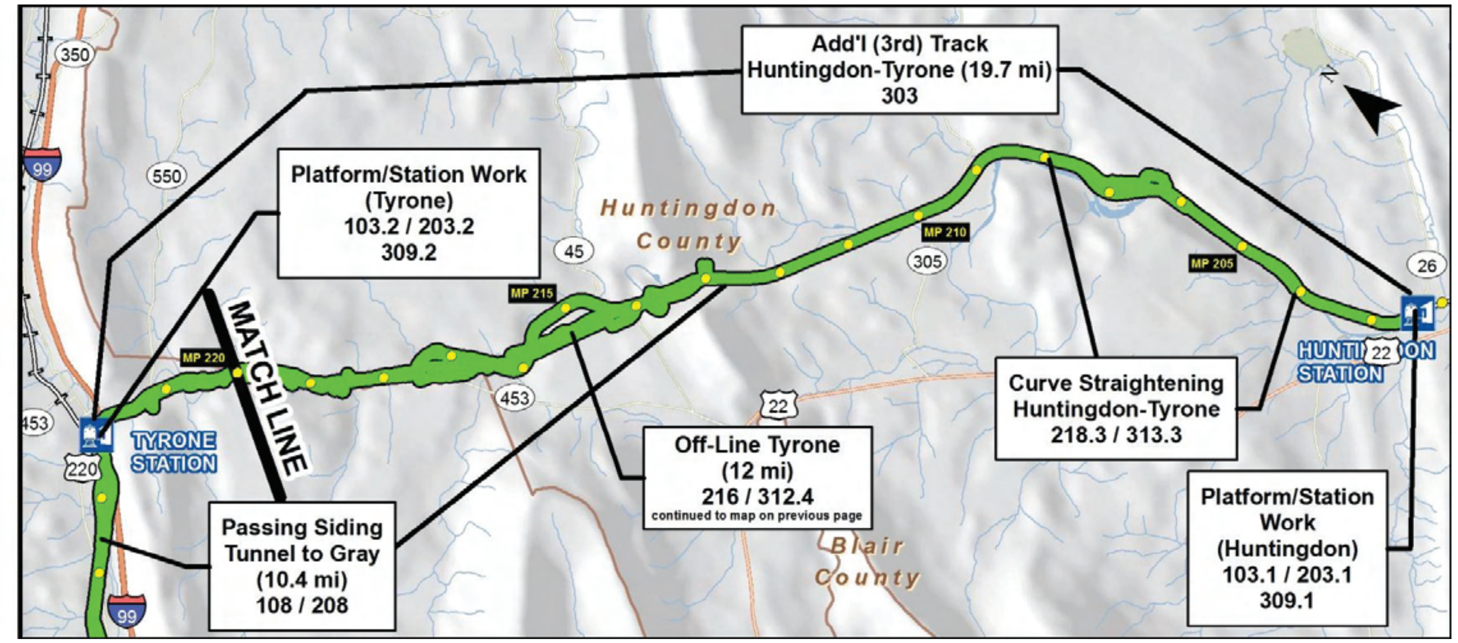
LATROBE – ALTOONA



Alternative Reference Numbers[1]	Type of Improvement	Location	Summary Description	Expected Benefits			Loaded Costs – except ROW[2] ($000s)	Cost / Benefit ($000s / second)[3]	ROW	Environmental Considerations[4]					Implementation (3 = most difficult 2 = moderate 1 = least difficult)
				Time (h:m:s)		Purpose				Stream Cross-ings	Wetland Impacts	T&E Species	Historic Resources	Hazardous Waste	
				East	West					# / LF	# / Acres	#	#	Y / N	
101 / 201	Additional Track	Cresson – Johnstown	24 miles of new track and related improvements (1 new bridge, rehab 14 bridges, turnouts, C&S, etc.)	See Note A		Capacity / Speed	97,901	-	Existing	25 / 595	0 / 0	0	0	N	3
109 / 209	New Passing Siding	Pack – Trobe MPs 300.5 – 312.7	12.2 miles new siding, 12-mile access road, 2 new bridges, 7 rail/highway grade separations, 4 grade crossing upgrades, turnouts, C&S	NA	NA	Capacity	158,105	-	Mostly existing	17 / 381	1 / 0.57	5	1	Y	2
217 / 312.5	Off-line Alignment, double track, passenger-only due to grades	Horseshoe Curve Bypass MP 237.2 – MP 244.3	9.3 miles new double track, 1 new rail/rail grade separation, 1 rail highway grade separation ($216.1M), extensive cut/fill ($42.4M), extensive C&S and turnouts	0:08:36	0:06:01	Speed / Capacity	334,769	382	Approx. 4.5 miles new	6 / 1,560	0 / 0	0	1	Y	3
218.4 / 313.4	Curve Straightening	Altoona – Johnstown	New track, track relocation, extensive cut/fill ($55.0M), and retaining walls ($23.9M), 4.9-mile access road, 2 new bridges ($61.4M), 1 highway grade separation, C&S	0:00:58	0:01:10	Speed	175,086	1,386	Some new at each curve	4 / 1,313	1 / 5.66	2	1	N	3
218.5 / 313.5	Curve Straightening	Johnstown – Latrobe	New track, track relocation, cut/fill, 1 highway grade separation, access road, retaining walls, C&S	0:00:03	0:00:07	Speed	25,221	2,522	Some new at each curve	0 / 0	1 / 0.87	0	1	N	2
305	Add Continuous Third Track	Altoona – Johnstown	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Reopen Gallitzin Tunnel, extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	See Note A		Additional Capacity / Time Savings	801,400	-	Mostly new	40 / 1,472	0 / 0	0	0	N	3
306	Add Continuous Third Track	Johnstown – Latrobe	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	See Note A		Additional Capacity / Time Savings	798,277	-	Mostly new	30 / 1,320	0 / 0	0	0	N	3
111.5 / 211.5 / 311.5	Curve Modifications	Altoona – Johnstown	Modified superelevation and/or straightening of curves	0:00:27	0:00:26	Speed	3,043	57	Mostly existing	0 / 0	0 / 0	0	0	N	1
111.6 / 211.6 / 311.6	Curve Modifications	Johnstown – Latrobe	Modified superelevation and/or straightening of curves	0:00:14	0:00:14	Speed	4,054	145	Mostly existing	0 / 0	0 / 0	0	0	N	1

ALTOONA – HUNTINGDON

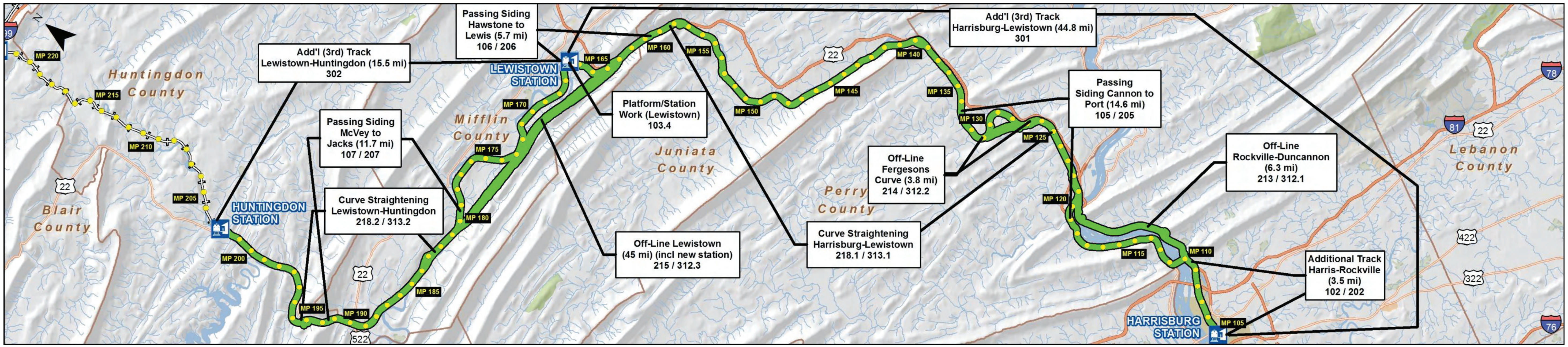




Alternative Reference Numbers[1]	Type of Improvement	Location	Summary Description	Expected Benefits			Loaded Costs – except ROW[2] ($000s)	Cost / Benefit ($000s / second)[3]	ROW	Environmental Considerations[4]					Implementation (3 = most difficult 2 = moderate 1 = least difficult)
				Time (h:m:s)		Purpose				Stream Crossings	Wetland Impacts	T&E Species	Historic Resources	Hazardous Waste	
				East	West					# / LF	# / Acres	#	#	Y / N	
103.3 / 203.3	Station Improvements	Altoona	Add 1 high platform, new pedestrian bridge, garage modifications, elevators, 1 gauntlet track, signal improvements	See Note B		Capacity / Time Savings	11,432	-	Existing	0 / 0	0 / 0	4	3	Y	1
309.3	Alt 3 Station Improvements	Altoona Station	2 new gauntlet tracks & signal upgrades, 2 new high platforms, new pedestrian bridge, 3 elevators, garage modifications, misc. improvements	See Note B		Capacity / Time Savings	15,669	-	Mostly existing	0 / 0	0 / 0	4	3	Y	2
103.1 / 203.1	Station Improvements	Huntingdon	Add second low-level platform, parking, misc. improvements	See Note B		Capacity / Time Savings	950	-	Existing	0 / 0	1 / 0.88	1	1	Y	1
309.1	Alt 3 Station Improvements	Huntingdon Station	2 new gauntlet tracks & signal upgrades, 2 new high platforms, misc. improvements	See Note B		Capacity / Time Savings	14,416	-	Mostly existing	0 / 0	1 / 0.88	1	1	Y	1
108 / 208	Additional Passing Siding and Renew Existing Passing Siding	Tunnel – Gray MPs 212.9 – 223.3	Reopen Spruce Creek Tunnel ($27.5M), 10.4 miles new siding track and shift existing track, 4 grade crossing modifications, 10-mile access road, 14 new bridges, 5 rail/highway grade separations, retaining walls, turnouts, C&S	NA	NA	Capacity	380,084 (108) / 371,576 (208)	-	Mostly existing	19 / 2,768	7 / 3.97	6	8	N	3
216 / 312.4	Off-line Alignment, double track	Tyrone vicinity MP 213.17 – MP 230.55	12 miles new double track, 15 miles track relocation, 12 new grade crossings, extensive excavation along Juniata River ($520.5M), 13.7-mile access road, 3.4 miles roadway separation, 12 new RR bridges, 2 grade separation structures, retaining walls, turnouts, C&S	0:09:06	0:08:21	Speed / Capacity	1,037,357 (216) / 1,037,030 (312.4)	990	18 miles of new	20 / 1,783	6 / 0.24	6	6	Y	3

ALTOONA – HUNTINGDON															
Alternative Reference Numbers[1]	**Type of Improvement**	**Location**	**Summary Description**	**Expected Benefits**			**Loaded Costs – except ROW[2] ($000s)**	**Cost / Benefit ($000s / second)[3]**	**ROW**	**Environmental Considerations[4]**					**Implementation (3 = most difficult 2 = moderate 1 = least difficult)**
				Time (h:m:s)		**Purpose**				**Stream Crossings**	**Wetland Impacts**	**T&E Species**	**Historic Resources**	**Hazardous Waste**	
				East	**West**					**# / LF**	**# / Acres**	**#**	**#**	**Y / N**	
218.3 / 313.3	Curve Straightening	Huntingdon – Tyrone	New track, track relocation, extensive cut/fill ($59.1M) and retaining walls ($11.1M), access road, highway relocation, C&S	0:00:13	0:00:13	Speed	77,383	2,976	Some new at each curve	1 / 10	1 / 1.32	5	1	N	2
303	Add Continuous Third Track	Huntingdon – Tyrone	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Reopen Spruce Creek Tunnel, extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	See Note A		Additional Capacity / Time Savings	461,913	-	Mostly new	24 / 2,946	0 / 0	0	0	N	3
304	Add Continuous Third Track	Tyrone – Altoona	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	See Note A		Additional Capacity / Time Savings	320,655	-	Mostly new	21 / 557	0 / 0	0	0	N	3
103.2 / 203.2	Station Improvements	Tyrone	Add second low-level platform, waiting room and shelters, parking, misc. improvements	0:00:00	0:00:00	Capacity / Time Savings	925	0	Existing	0 / 0	0 / 0	4	1	N	1
309.2	Alt 3 Station Improvements	Tyrone Station	2 new gauntlet tracks, signal upgrades, 2 new high platforms, new waiting room & shelters, parking, misc. improvements	See Note B		Capacity / Time Savings	13,655	-	Mostly existing	0 / 0	0 / 0	4	1	N	1
111.4 / 211.4 / 311.4	Curve Modifications	Tyrone – Altoona	Modified superelevation and/or straightening of curves	0:00:05	0:00:06	Speed	359	33	Mostly existing	0 / 0	0 / 0	0	0	N	1
111.3 / 211.3 / 311.3	Curve Modifications	Huntingdon – Tyrone	Modified superelevation and/or straightening of curves	0:00:18	0:00:17	Speed	2,433	70	Mostly existing	0 / 0	0 / 0	0	0	N	1

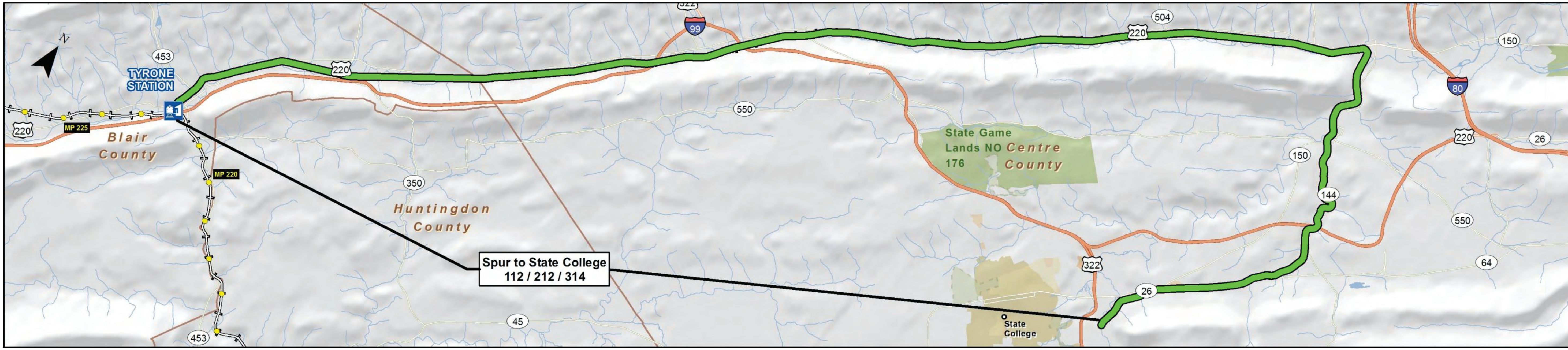
HUNTINGDON – HARRISBURG



Alternative Reference Numbers[1]	Type of Improvement	Location	Summary Description	Expected Benefits: Time (h:m:s) East	Expected Benefits: Time (h:m:s) West	Expected Benefits: Purpose	Loaded Costs – except ROW[2] ($000s)	Cost / Benefit ($000s / second)[3]	ROW	Environmental Considerations[4]: Stream Cross-ings # / LF	Wetland Impacts # / Acres	T&E Species #	Historic Resources #	Hazardous Waste Y / N	Implemen-tation (3 = most difficult 2 = moderate 1 = least difficult)
102 / 202	Additional Track	Harris – Rockville	3.5 miles new track and related improvements (turnouts, 1 bridge rehab, C&S, etc.)	See Note A		Capacity / Speed	12,899	-	Existing	0 / 0	0 / 0	0	0	N	1
103.4	Station Improvements	Lewistown Station	Low-Level Platforms	See Note B		Capacity / Speed	660	-	Existing	0 / 0	0 / 0	0	0	N	1
105 / 205	Additional Passing Siding and Renew Existing Passing Siding	Cannon – Port MPs 113.2 – 133.5	14.6 miles new siding, 5.7 miles renew existing siding, 5 grade crossings, relocate industrial side track, rehab 7 bridges, 6 new bridges, 14.6-mile rail access road, 3 rail/highway grade separations, turnouts, C&S	NA	NA	Capacity	179,285	-	Mostly existing	15 / 465	6 / 1.68	7	3	Y	2
106 / 206	Additional Passing Siding and Renew Existing Passing Siding	Hawstone – Lewis MPs 160.0 – 165.7	5.7 miles new siding track and shift existing track, 6.3 miles renew existing siding, 3 rail/highway grade separations, turnouts, C&S	NA	NA	Capacity	79,618	-	Mostly existing	11 / 110	0 / 0	5	2	N	2
107 / 207	Additional Passing Siding and Renew Existing Passing Siding	McVey – Jacks MPs 179.6 – 191.3	11.7 miles new siding track and shift existing track, 12-mile access road, 2 new bridges, 1 private road crossing, 2 new bridges, 4 rail/highway grade separations, retaining walls, turnouts, C&S	NA	NA	Capacity	190,834	-	Mostly existing	11 / 1,075	6 / 4.81	4	1	Y	2
213 / 312.1	Off-line Alignment, double track	Rockville – Duncannon MP 209 (Buffalo Line) – MP 121.6 (Pgh Line)	6.3 miles new track, 3.4 miles upgrade existing track, 1 new bridge ($304.5M), 10-mile access road, 1 major new interlocking, 4 new timber/asphalt crossings, retaining walls, turnouts, extensive C&S	0:00:53	0:02:09	Speed / Capacity	394,424	2,167	Extensive new	9 / 3,553	5 / 1.92	5	6	Y	3

HUNTINGDON – HARRISBURG (continued)																
Alternative Reference Numbers[1]	Type of Improvement	Location	Summary Description	Expected Benefits: Time (h:m:s) East	Expected Benefits: Time (h:m:s) West	Expected Benefits: Purpose	Loaded Costs – except ROW[2] ($000s)	Cost / Benefit ($000s / second)[3]	ROW	Environmental Considerations[4]: Stream Cross-ings # / LF	Wetland Impacts # / Acres	T&E Species #	Historic Resources #	Hazardous Waste Y / N	Implemen-tation (3 = most difficult 2 = moderate 1 = least difficult)
214 / 312.2	Off-line Alignment, double track	Ferguson's Curve MP 128 – MP 131.8	Extensive cut/fill ($394.2M), 3.8 miles new double-track RR, 3.0-mile access road, 1 rail/highway grade separation, 1 new interlocking, turnouts, C&S, utilities	0:00:00	0:00:16	Speed / Capacity	435,356	27,210	Extensive new	3 / 590	1 / 0.02	3	1	Y	3
215 / 312.3	Off-line Alignment, double track, concrete tie	Bypass of Lewistown, Granville, McVeytown MP 160.0 – MP182.5	Extensive cut/fill ($5,337M), 22.5 miles new double-track rail, 15-mile access road, relocate Lewistown Station with 2 platforms & amenities, 1 new RR bridge, 3 rail/highway grade separations, 5 grade crossings, turnouts, C&S	0:07:38	0:07:41	Speed / Capacity	5,624,683	6,120	Extensive new	26 / 5,225	1 / 0	4	1	N	3
218.1 / 313.1	Curve Straightening	Harrisburg – Lewistown	New track, relocation, extensive cut/fill ($141.3M), 6.3-mile access road, retaining walls, C&S	0:00:55	0:00:57	Speed	174,777	1,560	Some new at each curve	8 / 93	2 / 2.72	9	1	N	3
218.2 / 313.2	Curve Straightening	Lewistown – Huntingdon	New track, track relocation, extensive cut/fill ($45.8M), 2 new bridges ($144.9M), C&S	0:00:48	0:00:44	Speed	195,752	2,128	Some new at each curve	4 / 719	2 / 7.77	4	1	N	3
301	Add Continuous Third Track	Harrisburg – Lewistown	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, grade separations, access roads, retaining walls, etc.	See Note A	-	Additional Capacity / Time Savings	995,135	-	Mostly new	51 / 4,986	0 / 0	0	0	N	3
302	Add Continuous Third Track	Lewistown – Huntingdon	Incremental costs (above all Alt 2 improvements) to achieve continuous third track. Extensive cut/fill, new/rehab bridges, new track, C&S, grade crossings, 20 grade separations, access roads, retaining walls, etc.	See Note A	-	Additional Capacity/ Time Savings	369,683	-	Mostly new	49 / 2,470	0 / 0	0	0	N	3
111.1 / 211.1 / 311.1	Curve Modifications	Harrisburg – Lewistown	Modified superelevation and/or straightening of curves	0:00:11	0:00:13	Speed	2,788	116	Mostly existing	0 / 0	0 / 0	0	0	N	1
111.2 / 211.2 / 311.2	Curve Modifications	Lewistown – Huntingdon	Modified superelevation and/or straightening of curves	0:00:09	0:00:07	Speed	1,454	91	Mostly existing	0 / 0	0 / 0	0	0	N	1

RAIL SPUR TO STATE COLLEGE



Alternative Reference Numbers[1]	Type of Improvement	Location	Summary Description	Expected Benefits			Loaded Costs – except ROW[2] ($000s)	Cost / Benefit ($000s / second)[3]	ROW	Environmental Considerations[4]					Implementation (3 = most difficult 2 = moderate 1 = least difficult)
				Time (h:m:s)		Purpose				Stream Crossings	Wetland Impacts	T&E Species	Historic Resources	Hazardous Waste	
				East	West					# / LF	# / Acres	#	#	Y / N	
112 / 212 / 314	Rail Spur to State College	Tyrone (MP 313) – Lemont	10,000 wood tie replacement, 5 miles of new rail on curves, 8 new RR bridges, rehab 4 bridges, renew 31 timber/asphalt crossings and 10 full-depth rubber crossings, line and surface 45 track miles, 1 high-level platform, shelter, parking, C&S	N/A	N/A	Access/New Market	71,887	-	Mostly on private railroad property	54 / 834	0 / 0	0	0	N	2

NOTES:

[1] 100 Series numbers = Alternative 1; 200 Series numbers = Alternative 2; 300 Series numbers = Alternative 3.

[2] ROW = Right-of-Way.

[3] Based on the total time savings in both directions.

[4] Based on available background and secondary source data and mapping.

A Time savings would be expected, but exact time savings are not known based on this conceptual feasibility study.

B The primary purpose of the station improvement projects is to reduce the occurrence of unplanned delays to both passenger and freight trains that arise due to the need for eastbound passenger trains to make crossover moves and run on the primary westbound track to access platforms for loading/unloading. A related and equally important benefit is that the project(s) will also add capacity that will support additional passenger train frequencies.

MEMORANDUM

TO: Richard C. Shannon, P.E., McCormick Taylor, Inc.
Dawn C. Noel, P.E., McCormick Taylor, Inc.

FROM: Chad J. Decker, P.E., PTOE, Dawood Engineering, Inc.

DATE: December 23, 2013

RE: **Keystone West High Speed Rail Study**
Feasibility Report – Preliminary Service Development Plan
Order of Magnitude Right-of-Way Cost Analysis

This memorandum summarizes the process and assumptions of the Order of Magnitude Right-of-Way cost analysis for the future Right-of-Way acquisition estimated for the various improvements identified in the Keystone West High Speed Rail Study.

Geographic Information System Analysis

Estimating the required Right-of-Way areas and costs for the improvements to the Keystone West portion of Amtrak's Pennsylvania passenger rail line involved the utilization of ArcMap 10.1 Geographic Information System (GIS) software. The land use file that we incorporated was the PEMAP Program for Land Cover for Pennsylvania, 2005, which was developed by Penn State University. We obtained this file via the Pennsylvania Spatial Data Access (PASDA) web site. We then classified this land cover file into the following three land types:

- Residential
- Commercial
- Undeveloped / Agricultural

Samples of county level property values were then obtained to create representative land value coefficients for these land use types in the various counties that the railway travels through. The representative sampling involved identifying five (5) properties of each of the three land use types along the rail line. The deed number, acreage, and the assessed land value were collected. These property values were averaged and multiplied by the county specific common level ratios obtained from Evans-legal.com. Blair and Indiana County did not have any available web-based deed research applications so the values from the neighboring counties were used for estimating purposes for Alternatives 1-3. Only one property value of each land use was measured for Allegheny since the improvements in this county were minimal and did not show any additional large right of way needs. No building condemnations were assumed fro alternatives 1-3.

Alternative 4's analysis used the same land designations as Alternatives 1, 2 and 3. The counties affected by Alternative 4, except for Cumberland, Dauphin, and York, were given values from the county immediately north of them to provide representative land values. Unless otherwise noted, building condemnations were also not evaluated in this exercise as it was assumed that any final design would attempt to deviate from major impacts to residential communities. Additionally, these cost estimates did not account for any additional acquisition that may be required due to constraints that limit either access or reasonable use of a property.

Determination of Required Right-of-Way Areas

Following determination of the land value coefficients, ArcMap 10.1 GIS software was used to determine the required Right-of-Way take per improvement and the associated land use areas. The "alternatives.shp" shapefile provided by McCormick Taylor, Inc. was partitioned to represent each individual upgrade from Appendix B that required a Right-of-Way take for Alternatives 1-3. New rail alignments and the addition of third rail improvements were represented by generating a buffer area surrounding the proposed rail line. For double track lines, the existing Right-of-Way width, assumed to be 43', was clipped from the shapefiles representing each improvement scenario. A total Right-of-Way width of 58' was assumed on alignments where the construction of a third track has been proposed. Any cut / fill areas extending beyond these Right-of-Way limits were maintained.

Alternative 4's path has been assumed to run parallel to the PA Turnpike (within 1,000 feet) from Carlisle to Westmoreland County. It has also been assumed that 150 feet of Right-of-Way will be required to construct the high speed rail route on relatively flat areas and 300 feet of Right-of-Way width will be required in mountainous areas. Typical sections for Alternative 4 are attached to this memorandum. The proposed route of Alternative 4 was assumed to be the same as Alternative 3 from the Westmoreland County line to the City of Pittsburgh, and cost of this section was added to the Alternative 4 estimate. The eastern end of Alternative 4's proposed route from Carlisle to Middletown switched from paralleling the north side of the PA Turnpike to a route south of the PA Turnpike which terminated at the proposed Middletown station.

To estimate the Right-of-Way acquisition costs for the eastern terminus of Alternative 4, it was assumed total property acquisitions for residential and commercial properties in Dauphin, Cumberland and York counties due to the density of development along the proposed path. This is in contrast to the rest of the alternatives where partial takes were assumed.

Once the estimated Right-of-Way areas were established, the GIS software was used to perform an intersect operation with the land use file. This provided estimated Right-of-Way areas classified per each land use. The appropriate land value coefficients were then applied to the estimated Right-of-Way requirements for each improvement. The results for Alternatives 1, 2, and 3 can be found in the following table, which can be incorporated into Appendix B of the Final Report. The estimated cost of the minimum Required Right-of-Way for Alternative 4 is $49,770,000.

If you have any questions of comments, please contact me by phone at (717) 732-8576 or by e-mail at cdecker@dawood.cc.

Cc: Robert Myers, EIT, Dawood Engineering, Inc.
Scott Bechard, AICP, Dawood Engineering, Inc.
Douglas Quick, Dawood Engineering, Inc.

Keystone West

High Speed Rail Study

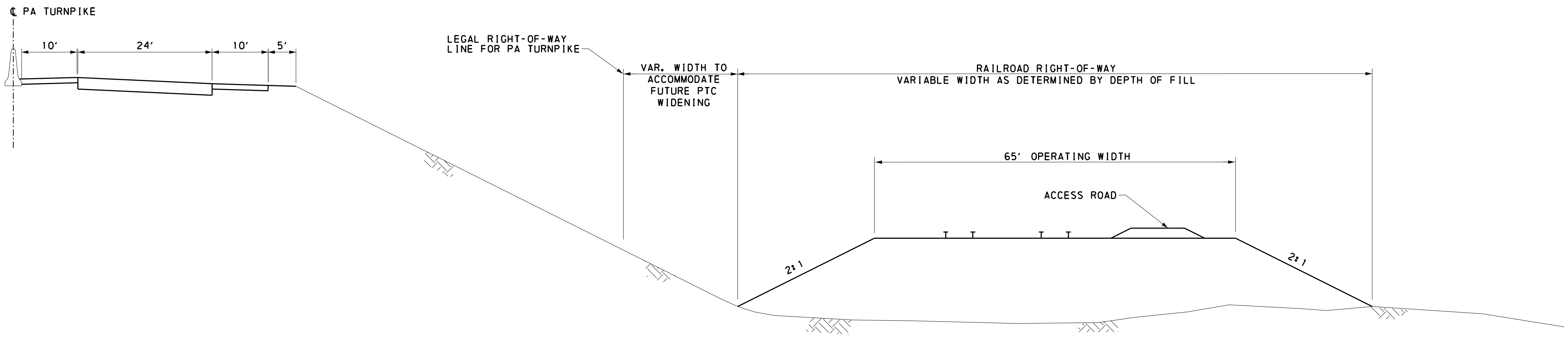
Order of Magnitude Costing for Required Right of Way

Improvement	Alt 1	Alt 2	Alt 3
104/204/310	Existing	Existing	Existing
110/210	391,944	391,944	N/A
307	N/A	N/A	59,770
308	N/A	N/A	622,328
111.7/211.7/311.7	Negligible	Negligible	Negligible
111.8/211.8/311.8	Negligible	Negligible	Negligible
101/201	Existing	Existing	Existing
109/209	Negligible	Negligible	Negligible
217/312.5	N/A	1,316,273	1,316,273
218.4/313.4	N/A	70,851	70,851
218.5/313.5	N/A	24,243	24,243
305	N/A	N/A	202,430
306	N/A	N/A	162,295
111.5/211.5/311.5	Negligible	Negligible	Negligible
111.6/211.6/311.6	Negligible	Negligible	Negligible
103.3/203.3	Existing	Existing	N/A
309.3	N/A	N/A	Negligible
103.1/203.1	Negligible	Negligible	N/A
309.1	N/A	N/A	Negligible
108/208	Negligible	Negligible	N/A
216/312.4	N/A	806,274	806,274
218.3/313.3	N/A	76,480	76,480
303	N/A	N/A	76,775
304	N/A	N/A	204,497
103.2/203.2	Existing	Existing	N/A
309.2	N/A	N/A	Negligible
111.4/211.4/311.4	Negligible	Negligible	Negligible
111.3/211.3/311.3	Negligible	Negligible	Negligible
102/202	Existing	Existing	N/A
103.4	Existing	N/A	N/A
105/205	Negligible	Negligible	N/A
106/206	Negligible	Negligible	N/A
107/207	Negligible	Negligible	N/A
213/312.1	N/A	472,716	472,716
214/312.2	N/A	275,936	275,936
215/312.3	N/A	9,685,755	9,685,755
218.1/313.1	N/A	615,701	615,701
218.2/313.2	N/A	167,464	167,464
301	N/A	N/A	870,217
302	N/A	N/A	415,529
111.1/211.1/311.1	Negligible	Negligible	Negligible
111.2/211.2/311.2	Negligible	Negligible	Negligible
112/212/314	Private RR	Private RR	Private RR
Totals	$391,944	$13,903,635	$16,125,532

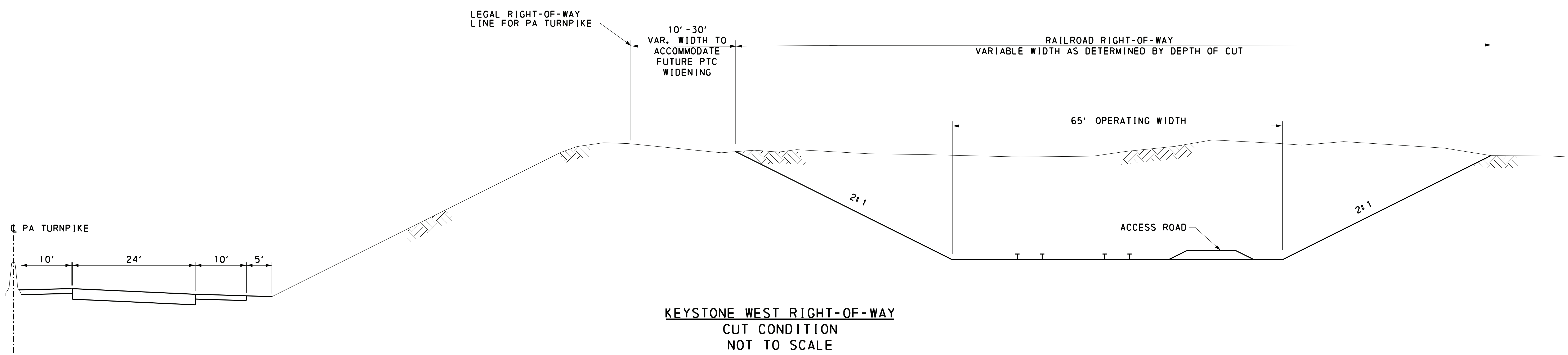
ALTERNATIVE 4 RIGHT-OF-WAY COST CALCULATIONS

	Allegheny	acreage	Value	Cost		
Rural	1648622.669	37.84716872	17907.50	677748.1738		
Residential	549433.2738	12.61325238	12445.71	156980.8813		
Commercial	49794.84194	1.143132276	95287.50	108926.2167		
				943655.2719		
	Blair	Acreage	Value	Cost		
Rural	21552706.28	494.78	1106.164	547310.10		
Residential	3620707.82	83.12	30642.94	2547041.61		
Commercial	31618.62	0.73	31333.20	22743.63		
				3117095.34		
	Bedford	Acreage	Value			
Rural	26033102.00	597.64	1106.164	661085.40		
Residential	1915516.00	43.97	30642.94	1347498.67		
Commercial	48851.00	1.12	31333.2	35139.08		
				2043723.15		
	Cumberland	Acreage	Value			
Rural	41967256.00	963.44	4148.4	3996716.36		
Residential	1334111.00	30.63	218486.3	6691574.29		
Commercial	91919.00	2.11	426911.6	900856.00		
				11589146.66		
	Dauphin	Acreage	Value			
Rural	1665358.00	38.23	35468.33	1356002.46		
Residential	1086576.00	24.94	937211.40	23378131.64		
Commercial	336813.00	7.73	294449.00	2276727.53		
				27010861.62		
	Franklin	Acreage	Huntington	Perry	Value	Cost
Rural	9793204.00	224.82	970.4655075	4501.82	3221.375508	724232.9547
Residential	298757.00	6.86	21237.55604	55179.62	48827.36604	334883.3195
Commercial	34394.00	0.79	22161.71411	50786.8	47555.11411	37548.45258
					Total	1096664.727
	Fulton	Acreage	Huntington			
Rural	14472683.00	332.25	970.4655075	322434.34		
Residential	850687.00	19.53	21237.55604	414750.07		
Commercial	1221.00	0.03	22161.71411	621.20		
				737805.60		
	Huntingdon	Acreage	Huntington			
Rural	2207310.00	50.67	970.4655075	49176.27		
Residential	86546.00	1.99	21237.55604	42195.26		
commercial		0.00	22161.71411	0.00		
				91371.53		
	Sommerset	Acreage	Cambria			
Rural	22696480.00	521.04	227.09	118322.86		
Residential	1192567.00	27.38	11333.25	310276.86		
Commercial	57692.00	1.32	11190.45	14820.92		
				443420.64		
	Westmoreland	Acreage	Value			
Rural	25944132.00	595.60	2760.68	1644245.10		

Residential	859963.00	19.74	12898.61	254644.80	
Commercial	28589.00	0.66	29588.44	19419.28	
				1918309.18	
	York	Acreage	value		
Rural	4974932.00	114.2087236	3952.90	451455.6635	
Residential	60395.00	1.386478421	235462.00	326462.9819	
Commercial	906.00	0.020798898	11440.35	237.9466736	
				778156.5921	
Total value:	$49,770,210.30				



KEYSTONE WEST RIGHT-OF-WAY
FILL CONDITION
NOT TO SCALE



KEYSTONE WEST RIGHT-OF-WAY
CUT CONDITION
NOT TO SCALE

APPENDIX C
Explanation of Alternatives Evaluation Metrics

Explanation of Alternatives Evaluation Metrics

1. **Increasing passenger train speeds and reducing travel times**
   - Short term goal of reducing the travel time from 5½ to 4½ hours
   - Mid-term goal of reducing the travel time to 4 hours or less
   - Longer-term goal of 3½ hours between endpoints
   - Achieve incremental improvements at various locations along the corridor by mitigating or eliminating speed restrictions
   - Implement improvements to track, signals, equipment, station areas, etc, to mitigate or eliminate bottlenecks and/or facilitate smoother and faster passenger and freight train movements
   - Create more sections of maximum speed track and increase maximum speed from 79 mph to 110 mph, where feasible
2. **Increasing service frequency with a longer-range goal of three-four round trips daily**
   - Addition of at least one round trip daily by the end of 2014
   - Incrementally increase round trip service frequency as improvements are implemented and ridership grows
   - Implement partial-route frequencies as appropriate to address travel markets for central-western Pennsylvania and central-eastern Pennsylvania
3. **Improving access and connectivity**
   - Optimize coordination with Keystone East services to facilitate travel and build ridership between Keystone West stations and points east of Harrisburg
   - Improve connections at Pittsburgh for travel to/from points to the west
   - Provide effective bus or rail connections between State College and the Keystone West corridor
   - Introduce connecting thruway bus service at select stations to improve access to/from other communities and major activity centers that are not directly served by the rail line and station locations
   - Address deficiencies of current station infrastructure including intermodal connections, parking, ADA compliance, passenger comfort, safety, etc.
4. **Improving passenger rail amenities to complement other improvements**
   - Effectively brand, market and promote passenger rail service
   - Emphasize on-board amenities that provide a travel experience equal to or superior to competing modes
   - Improve passenger amenities such as baggage handling, inside waiting area, passenger assistance, etc.
5. **Stimulating economic development along the corridor and throughout the region**
   - Improved rail service would help strengthen the downtown area in communities where existing stations are located; stations can offer an important platform for community revitalization
   - Pennsylvania's extensive rail supply industry would benefit from an improved Keystone West corridor
   - Achieve outcomes that parallel what has been accomplished along the Keystone East line between Philadelphia and Harrisburg where infrastructure and service improvements

have led to a resurgence in passenger rail ridership as well as encouraged investment in the existing communities served by the line

6. **Capital Cost**

- Order of magnitude ROW costs
- Order of magnitude fully-loaded construction costs
- Ability to provide attractive service to maintain existing ridership and generate new riders

7. **Physical (civil) Feasibility**

- Project requires no new river crossings
- Right-of-way requirements are low or can be constructed entirely within existing right-of-way
- Anticipated earth moving (waste / borrow) is low

8. **Adaptability for Phased Implementation**

- Project can be divided into discrete components for implementation
- Discrete components are individually manageable and affordable
- Discrete components have independent utility

9. **Probably Environmental Impact/Feasibility**

- No large, new river crossings
- Project constructed within or mostly within existing right-of-way
- No permits required or only general permits required
- Project constructed on or adjacent to existing alignment

10. **Probable Institutional Feasibility/Acceptance/Potential for Partnerships**

- FRA – realistic funding expectations, regulatory compliance, national goals for HSR, etc.
- Legislature's goals and expectations for improved service, willingness to advance funding, impact on state tax base, etc.
- PennDOT's goals, funding availability, sustainability, etc.
- NS expectations regarding use of their facilities, liability, impact on freight operations, etc.
- Amtrak goals, operational considerations, funding availability, etc.
- County and municipal impacts on community revitalization, economic development goals, potential community disruption, tax base, proximity of and access to improved rail services, etc.
- Private interests – potential for partnerships for infrastructure improvements, economic development, financing, operations, etc.

11. **Probable Public Acceptance**

- Mobility needs and expectations
- Affordability – both cost to use the improved rail service, potential tax consequences, impact on property values, etc.
- Community enhancement vs. community disruption
- Proximity/access for population centers to the improved rail line

APPENDIX D
Analysis of Alternative Equipment Types

Analysis of Alternative Equipment Types

Recognizing the substantial costs and lead time required to implement the infrastructure improvements, alternative equipment types were also evaluated for their ability to achieve time savings at a lesser cost and in a shorter timeframe. Simulations were performed using the Colorado Railcar Diesel Multiple Unit (DMU) and Talgo™ ("Pendulino") trains on the existing alignment, to which the only changes assumed were the platform access improvements at Altoona, Tyrone, Huntingdon, and Lewistown stations. It is important to note that at the time of analysis Talgo had not yet actually deployed in regular revenue service an FRA-compliant locomotive that meets buff strength requirements for operating in the North American railroad environment. Therefore, it was conservatively assumed that a conventional diesel-electric locomotive consistent with Amtrak's existing fleet would be utilized. This is similar to the existing method of operation on the Cascade corridor between Portland, Oregon, and Vancouver, BC, Canada. Modest further improvements in trip time would be expected if a lighter locomotive with better acceleration capability could be used.

Although Colorado Railcar Diesel Multiple Units (DMUs) are no longer manufactured, a number of interested stakeholders have suggested that improved trip times could be cost-effectively achieved with DMUs. Therefore, a three-car consist of this DMU model was taken from the RAILSIM Rolling Stock Library and used in these simulations as representative of the DMU class of equipment. This train comprised a single-level motorized car, a bi-level trailer, and a bi-level motorized car, providing approximately the same seating capacity (468 seats) as the existing Amtrak Pennsylvanian (443 seats) but no onboard food service (a café car option is not available). A full seated load was assumed. Characteristics for the assembled DMU train are given in **Table D-1: Colorado Railcar DMU Consist Characteristics**.

Table D-1: Colorado Railcar DMU Consist Characteristics	
Cars	3
Overall Train Length	255 feet
Overall Loaded Train Weight	263 tons
Passenger Capacity (seated)	468
DMU Horsepower	2400 HP

It is unlikely that the bi-level variant of this equipment would actually be considered for use on the Keystone West corridor. However, more reliable performance data was on file for the bi-level vehicle, which was operating in scheduled revenue service on Tri-Rail (SFRTA) in southern Florida at the time this study was prepared.

The Talgo consist is similar to one used by Amtrak's Cascade service in the Pacific Northwest. Talgo coaches have a suspension system designed to take curves more comfortably at higher speeds than conventional equipment. Accordingly, for simulations that used the Talgo coaches, the curve speeds were updated to reflect this capability.

The Talgo Series VII passenger coach specifications were taken from published Talgo material. A full seated load was assumed. The characteristics of the assembled train are shown in **Table D-2: Talgo Consist Characteristics**.

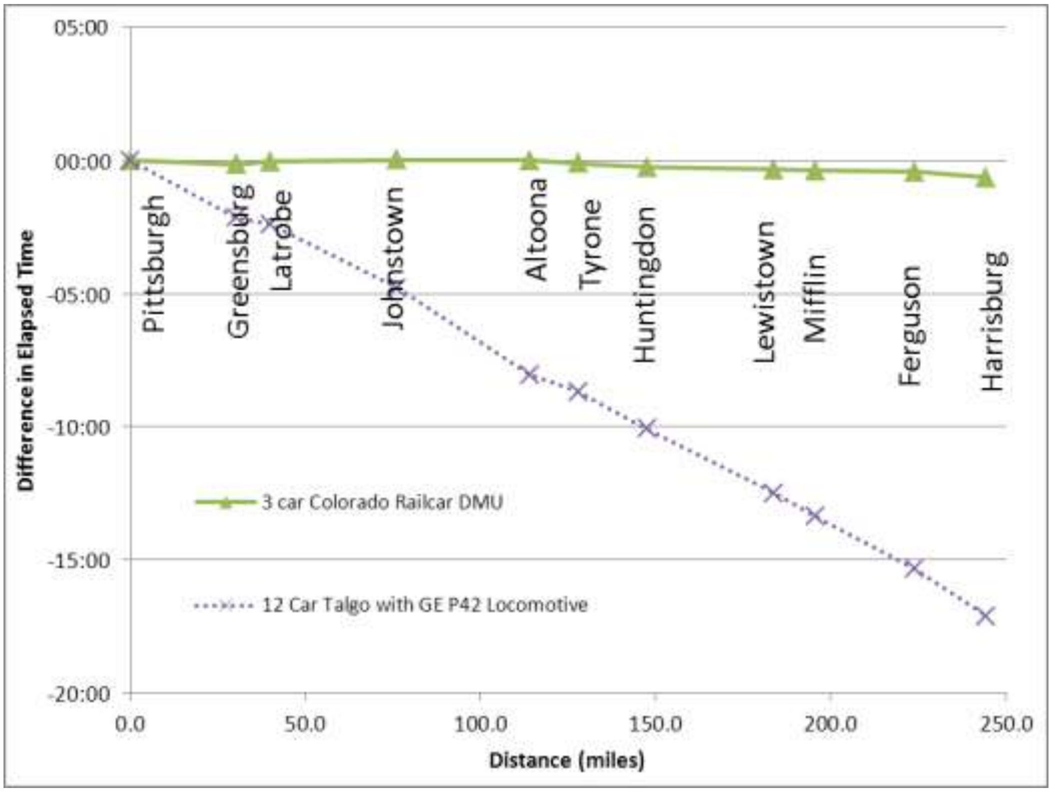
Table D-2: Talgo Consist Characteristics	
Locomotives	1 P42 Diesel
Coaches, number	12
Overall Train Length	586 feet
Overall Loaded Train Weight	338 tons
Passenger Capacity (seated)	480
P42 Locomotive Horsepower	4250 HP

Table D-3: Eastbound Elapsed Time by Consist displays the eastbound station-to-station running times and elapsed time for the three consists considered. The Colorado Railcar DMU produces very similar results to the existing Amtrak Pennsylvanian equipment, with the elapsed time between Pittsburgh and Altoona being identical. The total time savings over the entire route is 38 seconds. This is not surprising given that the speed profile of the track is the same for both scenarios, and any running time difference would therefore be a result of the acceleration or deceleration differences between the two types of equipment. Even that potential advantage is muted due to the relatively few stops that occur over the 249-mile route. Since the 38-second difference is not a material amount in the context of the nearly five-hour base time, and is likely within the margin of error for the methodologies utilized, there is essentially no meaningful time difference between the Amtrak equipment and the DMU equipment. These predictions are also consistent with observations of DMU operations in a real-world operating environment. It has been reported that engineers tend to be more conservative with train handling than what the DMU manufacturer states the vehicle is capable of, and, in some instances, the DMUs were exhibiting slightly more difficulty meeting schedules.

On the other hand, the Talgo consist gradually builds a time advantage, when compared to conventional Amtrak equipment, as it traverses each route segment. The Talgo train demonstrates significantly larger gains in overall travel time (17 minutes, 7 seconds over the course of the trip). The time savings is due mostly to the increased speeds at which the Talgo train negotiates curves. The running times for all equipment types assume that only the platform improvements have been completed.

Table D-3: Eastbound Elapsed Time by Consist (all times shown are hh:mm:ss)								
RAILSIM® Train Performance Calculator Running Time Analysis								
Keystone Corridor West – Eastbound Travel Elapsed Time by Consist								
			Amtrak Pennsylvanian	3-car Colorado Railcar DMU		12-Car Talgo with GE P42 Locomotive		
Dwell			Elapsed Time	Elapsed Time	Diff. from Existing Consist	Elapsed Time	Diff. from Existing Consist	
Pittsburgh	Depart	**N/A**	0:00:00	0:00:00	0:00:00	0:00:00	0:00:00	
Greensburg	Depart	**02:00**	0:38:48	0:38:40	-0:00:08	0:36:39	-0:02:10	
Latrobe	Depart	**01:30**	0:50:50	0:50:48	-0:00:03	0:48:26	-0:02:24	
Johnstown	Depart	**03:00**	1:31:20	1:31:20	0:00:01	1:26:31	-0:04:48	
Altoona	Depart	**03:00**	2:27:13	2:27:13	-0:00:00	2:19:11	-0:08:03	
Tyrone	Depart	**01:30**	2:42:47	2:42:41	-0:00:06	2:34:05	-0:08:42	
Huntingdon	Depart	**02:00**	3:08:43	3:08:28	-0:00:15	2:58:39	-0:10:04	
Lewistown	Depart	**02:00**	3:44:36	3:44:16	-0:00:20	3:32:06	-0:12:30	
Mifflin	Pass	**00:00**	3:56:58	3:56:35	-0:00:23	3:43:36	-0:13:22	
Ferguson	Pass	**00:00**	4:22:27	4:22:02	-0:00:25	4:07:07	-0:15:20	
Harrisburg	Arrive	**N/A**	4:46:00	4:45:22	-0:00:38	4:28:53	-0:17:07	
Total		**15:00**	**4:46:00**	**4:45:22**	**-0:00:38**	**4:28:53**	**-0:17:07**	
Note: Assumes only platform access improvements at Altoona, Tyrone, Huntingdon, and Lewistown stations.								

Figure 1D: Eastbound Cumulative Time Savings (Reduction) over Existing Amtrak Consist, displays the eastbound time savings provided by the Talgo and the Colorado Railcar consists, compared to current Amtrak equipment (indicated by the horizontal line at 00:00).



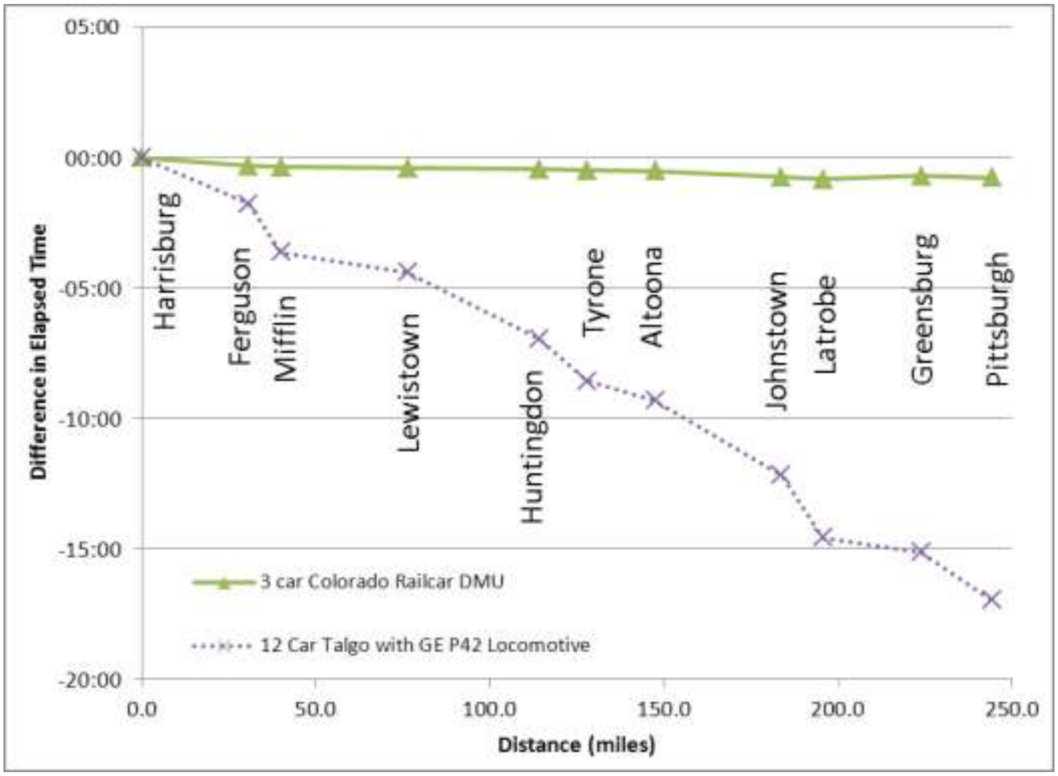
Notes:
1. Assumes only platform access improvements at Altoona, Tyrone, Huntingdon, and Lewistown stations.
2. The 00:00 line represents existing Amtrak equipment.

Figure 1D: Eastbound Cumulative Time Savings (Reduction) over Existing Amtrak Consist

Table D-4: Westbound Elapsed Time by Consist, provides the westbound results for the comparison of equipment types. As in the eastbound direction, the Colorado Railcar DMU yielded only incidental time savings (46 seconds) compared to current Amtrak equipment, whereas the Talgo equipment yielded greater time savings of approximately 17 minutes.

Table D-4: Westbound Elapsed Time by Consist (all times shown are hh:mm:ss)							
RAILSIM® Train Performance Calculator Running Time Analysis							
Keystone Corridor West – Westbound Travel Elapsed Time by Consist							
			Amtrak Pennsylvanian	3-car Colorado Railcar DMU		12-Car Talgo with GE P42 Locomotive	
Dwell			Elapsed Time	Elapsed Time	Diff. from Existing Consist	Elapsed Time	Diff. from Existing Consist
Harrisburg	Depart	**N/A**	0:00:00	0:00:00	0:00:00	0:00:00	0:00:00
Ferguson	Pass	**00:00**	0:24:58	0:24:38	-0:00:20	0:23:11	-0:01:47
Mifflin	Pass	**00:00**	0:50:19	0:49:57	-0:00:22	0:46:41	-0:03:38
Lewistown	Depart	**02:00**	1:04:31	1:04:06	-0:00:25	1:00:06	-0:04:25
Huntingdon	Depart	**02:00**	1:40:31	1:40:04	-0:00:27	1:33:34	-0:06:57
Tyrone	Depart	**01:30**	2:06:07	2:05:37	-0:00:30	1:57:32	-0:08:35
Altoona	Depart	**03:00**	2:23:37	2:23:06	-0:00:31	2:14:18	-0:09:19
Johnstown	Depart	**03:00**	3:17:06	3:16:20	-0:00:46	3:04:55	-0:12:11
Latrobe	Depart	**01:30**	3:55:42	3:54:51	-0:00:51	3:41:07	-0:14:35
Greensburg	Depart	**02:00**	4:06:52	4:06:09	-0:00:43	3:51:44	-0:15:08
Pittsburgh	Arrive	**N/A**	4:44:12	4:43:26	-0:00:46	4:27:14	-0:16:58
Total		**15:00**	**4:44:12**	**4:43:26**	**-0:00:46**	**4:27:14**	**-0:16:58**
Note: Assumes only platform access improvements at Altoona, Tyrone, Huntingdon, and Lewistown stations.							

Figure 2D: Westbound Cumulative Time Savings (Reduction) over Existing Amtrak Consist, illustrates the westbound comparison of the two alternative equipment types and the Amtrak rolling stock (indicated by the horizontal line at 00:00) in terms of elapsed time savings.



Notes: 1. Assumes only platform access improvements at Altoona, Tyrone, Huntingdon, and Lewistown stations.
2. The 00:00 line represents existing Amtrak equipment.

Figure 2D: Westbound Cumulative Time Savings (Reduction) over Existing Amtrak Consist

While the preceding analysis quantifies the potential time savings of the alternative equipment types, there are other factors that are important when considering alternative types of rolling stock. Some pros and cons, other than running time implications, which should be considered as part of any plan to introduce alternative equipment types on the Keystone West line, include:

- The most compelling issue with alternative rolling stock types is compliance with federal crashworthiness ("buff strength") regulations, either by complete objective compliance with existing and anticipated specifications or by a realistic possibility of receiving a waiver. Lacking one or the other, there is little prospect such equipment could be operated in mixed passenger/freight traffic and consequently little value in any analysis except for illustrative purposes.

- The next most important issue is passenger comfort. Some novel designs were attempted in the 1950s and early 1960s that were not successful in part because ride quality was poor or amenities were unsatisfactory. For equipment to be successful over a 250-mile corridor with a four- to five-hour terminal-to-terminal transit time, food and beverage service is essential. The equipment therefore must be able to accommodate this, as Amtrak's existing Amfleet café cars and "Amdinettes" currently do.

Both types of alternative equipment considered here are currently in use in North America. Each offers a level of passenger comfort and amenities consistent with the anticipated type of service for which the equipment was intended. The DMU is generally intended for short-haul use such as in a commuter territory associated with a metropolitan area, and therefore lacks some of the comfort and amenities typical of intercity equipment. The Talgo train is intended for intercity corridor service such as Keystone West.

- Arguably the third most important consideration is maintainability and expandability, both of which have operational implications and also financial implications. Any equipment type that is different from Amtrak's standard fleet (in operational or technical aspects) introduces additional maintenance challenges and expenses, and potential inter-operability limitations. For this reason, the Colorado Railcar DMU was designed to utilize commercially-available, off-the-shelf components. However, Amtrak has no recent experience maintaining diesel multiple-unit vehicles, no existing parts inventory, and no training program. Such DMU equipment has very limited capability to inter-operate with conventional passenger coaches in the same train. Somewhat similarly, Amtrak currently has no East Coast maintenance facility to maintain Talgo equipment, and although such equipment is operated by Amtrak in the Pacific Northwest, it does not commingle with the rest of Amtrak's long-distance fleet. A dedicated maintenance facility would therefore be required. Maintenance facility issues also surfaced in connection with Talgo equipment that was being constructed for the State of Wisconsin. While Talgo equipment could operate through to Philadelphia, there is no existing maintenance facility there to support such equipment; therefore an overnight layover at that terminal is not realistic. In addition, both types of equipment are sufficiently unique that a captive fleet would need to be maintained, including dedicated spares, because it would not be possible to use existing or anticipated Amtrak equipment to address equipment breakdowns or to increase capacity in anticipation of higher-than-usual travel demand (such as over holidays).

APPENDIX E

State & Federal Funding Sources

Pennsylvania State Funding Sources

Pennsylvania offers a variety of funding sources for both capital and operating assistance for intercity passenger rail and public transportation. Although the Commonwealth currently subsidizes only one intercity rail service (Keystone East), the funding sources described are exhaustive and include sources that are not currently being used for intercity passenger rail. A number of funding sources that are restricted to local public transportation projects and services are included since they represent potential sources for funding of connecting bus service. Since most state funding programs require local matching funds, these local sources are also discussed, where applicable.

Existing Sources of Capital Funding

Funding for capital investments from state and local sources within Pennsylvania is described below.

<u>State Act 44 Funding:</u> Act 44 of 2007 established average annual funding for transit capital and operating costs of $414 million through 2017. The Act established a Public Transportation Trust Fund (PTTF) based on anticipated contributions from the Pennsylvania Turnpike Commission, Public Transportation Assistance Fund (PTAF), State Sales and Use Tax (4.4 percent of statewide revenue from this source is dedicated to public transportation), and lottery funds. The fund was established to create a sustainable, dedicated revenue stream for public transportation services, while linking funding to needs and how well the service providers are performing.

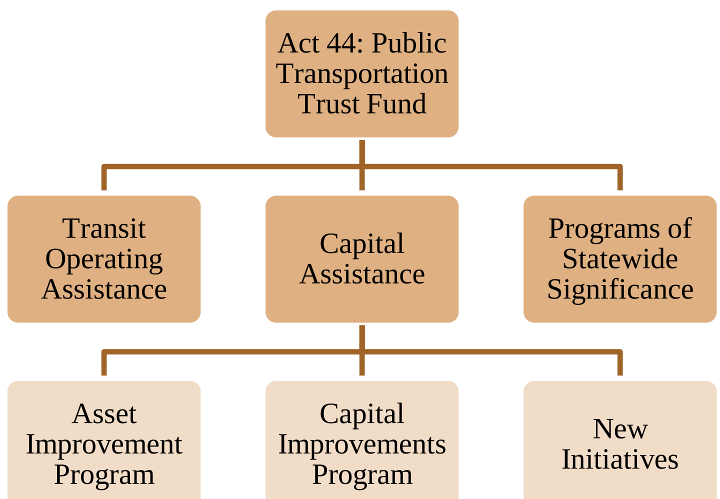


Figure 1E: Act 44 Public Transportation Trust Fund

Act 44 funding is used for the Keystone East Service capital improvements through the Programs of Statewide Significance (**See Figure 1E: Act 44 Public Transportation Trust Fund**). This category of funds provides the local match necessary to take advantage of capital improvement funding from the FRA's high speed rail program and the federal stimulus funds—American Recovery and Reinvestment Act (ARRA), described under federal funding sources.

A significant portion of the funding levels originally expected to be available from Act 44 were predicated on tolling I-80. Because the Federal Highway Administration (FHWA) did not approve the Commonwealth's I-80 tolling proposal, actual funding from this source has been reduced substantially, which constrains investment in new initiatives for both local transit projects and projects with broader regional or statewide benefits.

State Capital Budget Funding: The Commonwealth annually develops capital budgets that include line item project descriptions and corresponding dollar amounts. This source has provided substantial and reliable capital funding for public transportation improvements. Examples of eligible projects include land acquisition, replacement vehicles and service expansion vehicles, renovation or construction of administration and maintenance facilities, shop tools and equipment, service vehicles, rail cars, rail line construction or reconstruction, etc. While intercity rail projects are eligible and have received funding from this source in the past, by policy the bulk of these funds are allocated to local transit systems for transit capital projects.

State Public Transportation Assistance Funds (PTAF): This source, authorized by Act 26 of 1991, represents dedicated funding derived from a variety of state revenue sources, and is distributed to transit systems based upon statutory formulas. A portion of PTAF funding is dedicated for capital projects only, with the remaining PTAF funds used for either "asset maintenance" or capital projects, at the discretion of the local transit system. Certain lease costs are also eligible. The PTAF funding share can be up to 96 2/3 percent of total project costs. Funding from this source, which totals $180 million annually, has been incorporated into Act 44 funding and is used in support of local transit only.

State Act 3 Funding: Dedicated transit funding from Act 3 has been in place since 1997. The funding is derived from a statutory percentage of the revenue generated by the State Sales and Use Tax, and is distributed to local transit operators based upon statutory formulas. Like PTAF, a portion of Act 3 funding is restricted for capital projects only, with the balance used for either operating or capital expenses, but generally applied to operating budgets by local transit agencies. This funding source has also been incorporated into the Act 44 consolidated funding structure.

State Department of Community and Economic Development (DCED) Funds: Certain capital projects are eligible for discretionary grant funding administered by DCED and awarded to projects that contribute toward the economic development goals of the Commonwealth. Historically, rail projects benefiting from this source have been rail station area development, redevelopment, and access projects.

Local Capital Funding: Local funding for capital improvements is available primarily from those areas that are served by state-subsidized transit systems, with most of the funds provided by larger urbanized areas. These funds are generally used to leverage federal and state funding for transit capital projects. These improvements can be large projects such as train stations, right-of-way purchases, grade crossings, construction of new rail or bus infrastructure, vehicles, etc., or smaller-scale projects such as bus shelters, shop tools and equipment, bicycle racks for buses, etc. Although it is unlikely that funding would be available from these sources to support intercity passenger rail projects, connecting bus services to rail stations could benefit from this source.

Existing Sources of Operating Funding

State funding sources for rail and transit operations within Pennsylvania are described below. Many of the funding sources cannot be used for intercity passenger rail operations; however, they are included as operating funding options for local bus service to and from rail stations.

PA State Act 44 Funding: Though use for capital improvements is allowed, the bulk of the money dedicated for public transportation through Act 44 is used to subsidize transit operations. In FY 2007-08 (in its first year of existence) Act 44 provided $774 million in funding for this purpose for systems throughout the state. That amount was well above average in large part because of an initial spike in revenue derived from an increase in Pennsylvania Turnpike tolls. Subsequent annual funding increases have been more modest.

PennDOT funds Keystone East service, based on a negotiated agreement with Amtrak, entirely from the Act 44 Programs of Statewide Significance funding category. The contract between the Commonwealth and Amtrak in FY 2011-12 was for approximately $9 million, which could change substantially based on the terms of PRIIA. Effective October 1, 2013, PRIIA also requires state financial support for the existing once-daily round trip on the Pennsylvanian service. The exact level of state support and the source of funds remain to be determined.

State Operating Assistance Funding: Operating assistance funds are incorporated in the Act 44 funding structure and are distributed to local transit systems based on statutory formulas. This operating assistance is for local transit and is not available for intercity passenger rail. However, this could be a potential funding source for connecting bus services.

State Act 3 Funding: This dedicated funding source is derived from a percentage of the State Sales and Use Tax, which is distributed to local transit operators based upon statutory formulas now embodied in Act 44. A portion of this funding (approximately 70 percent) can be used to pay for operating costs and could be a potential funding source for connecting bus services.

State Lottery Funds: State lottery funding is used to support grants awarded to local transit operators to cover operating losses incurred in the provision of both fixed route and demand-response transit services to senior citizens. The reimbursement provisions are established in statute and generally do not directly apply to intercity passenger rail. However, bus services connecting to rail stations would generally be eligible under this program.

Local Operating Assistance Funding: The local funding shares are often provided through funds advanced through municipalities and counties served by the local transit systems. The funds are often agreed to for multiple years to ensure the sustainability of the system over a prolonged, uninterrupted, but finite period of time. The funding is generally used to leverage federal and state funding and could be used to support connecting bus services, but is not a likely source of intercity rail funding due to the nature of intercity services that traverse many local jurisdictions.

Federal Funding Sources

Federal discretionary funding programs provide the bulk of capital funding for large intercity rail projects. Rarely are federal funds used for operations, with Amtrak being a significant exception. This section describes the federal funding programs and their potential applicability to the Keystone West corridor.

Competitive Discretionary Grants

Several types of competitive discretionary grants are available for capital projects, with the selection of projects typically based on established performance criteria that evaluate the expected benefits of improvements compared to the project's cost.

High-Speed Intercity Passenger Rail Program (HSIPR): The High-Speed Intercity Passenger Rail Program addresses long-term high and higher speed passenger transport needs in key corridors throughout the country. There is more than $10 billion in federal funding available through this program and currently there are 150 projects being funded. A total of $8 billion has been made available through the ARRA legislation. Additional funding of $2.1 billion has been made available through annual federal appropriations for FY 2009 and FY 2010. To date, 50 construction projects in 19 states and the District of Columbia worth more than $3.2 billion are either complete, under construction, or set to begin construction in the near future. In federal FY 2011, this program provided $750 million and leveraged an additional $750 million (50/50) match from the states.

This program is currently not accepting applications. However, if the funding program continues and Keystone West project engineering is completed, this may be a viable funding source for intercity rail projects in the future.

Railroad Rehabilitation & Improvement Financing (RRIF) – not continued as part of MAP-21: The Railroad Rehabilitation & Improvement Financing program provides financial assistance for local rail line relocation and improvement projects that involve a shift in lateral or vertical alignment and mitigate the adverse effects of rail traffic on safety, motor vehicle traffic flow, community quality of life, or economic development. This program is currently not accepting applications and has not been continued as part of MAP-21.

Transportation Investment Generating Economic Recovery (TIGER): The Transportation Investment Generating Economic Recovery, or TIGER Discretionary Grant program, is a U.S. DOT-wide, multimodal program that includes investing in critical rail projects across the country. The program provides funding for construction-ready projects and would therefore not be available for Keystone West improvements until engineering has been completed. TIGER funds are awarded on a competitive basis for projects that will have a significant impact on the nation, a region, or a metropolitan area. Initially created as part of the stimulus program, four rounds of TIGER grants have been approved. Four rounds of funding approvals have provided $3.1 billion to 218 projects. The latest round was funded by appropriations legislation signed in November 2012. Subject to legislative appropriations, the program is funded on an annual basis with the FY 2012 Appropriations Act providing $500 million, available through September 30, 2013, for National Infrastructure Investments.

Railway-Highway Crossing Hazard Elimination: The purpose of the program is to provide funding for safety improvements at both public and private highway-rail grade crossings along the 11 federally designated high speed rail corridors, including Keystone West. This program is jointly administered by FRA and FHWA. Pennsylvania did not receive any of the $10.2 million awarded in FY 2012. These funds could be used to eliminate at-grade crossings to enhance safety and support increased passenger rail speeds.

American Recovery and Reinvestment Act of 2009 (ARRA): In February 2009, the American Recovery and Reinvestment Act of 2009 (or "stimulus") was passed into law. The three immediate goals of the Recovery Act are to:

- create new jobs and save existing jobs,
- spur economic activity and invest in long-term growth, and
- foster unprecedented levels of accountability and transparency in government spending.

The Recovery Act provides $840 billion in tax cuts and benefits, funding for entitlement programs (such as unemployment), and funding for federal contracts, grants, and loans.

In 2011, the original expenditure estimate of $787 billion was increased to $840 billion to be in line with the President's 2012 budget as well as scoring changes made by the Congressional Budget Office since the enactment of the Recovery Act. As of June 2012, a total of $37 billion had been spent on transportation projects, including highways, airports, railroads, and high speed rail corridors, as shown in **Table E-1: Total Transportation Funding Breakdown**.

Table E-1: Total Transportation Funding Breakdown

Total Transportation Funding (in millions)	**$37,296**
Federal Highway Administration – Highway Infrastructure Investment, Recovery Act	$25,732
Federal Transit Administration – Transit Capital Assistance, Recovery Act	$6,540
Federal Railroad Administration – Capital Grants to the National Railroad Passenger Corporation	$1,302
Federal Aviation Administration – Grants-in-aid for Airports, Recovery Act	$1,074
Office of the Secretary of Transportation – Supplemental Discretionary Grants	$991
Federal Railroad Administration – Capital Assistance for High Speed Rail Corridors	$965
Federal Transit Administration – Fixed Guideway Infrastructure Investment, Recovery Act	$692

Of the $9.3 billion in projects awarded in Pennsylvania, $1.4 billion went to transportation projects. This includes funding at the following levels for intercity passenger rail projects:

- Grade crossing elimination on three remaining grade crossings along the Keystone East corridor, including $18 million in federal funding with a $2.33 million state and local match and $1 million from Amtrak.
- Funding for state interlocking at Harrisburg, which is funded with ARRA funds at 100 percent at a level of $40 million for final design and construction.

- Funding for other Keystone East interlockings (preliminary engineering only) at a federal funding level of $6.3 million with a $700,000 state and local match.
- Automatic Block Signaling (ABS)/centralized control for signal improvements outside of Philadelphia at a federal funding level of $1.35 million and a $1.5 million state and local match.

Formula Funding Programs

Section 5307 and 5309 Funding: Section 5307 federal funding is made available to urbanized areas and to governors for transit capital and operating assistance projects in urbanized areas and for transportation-related planning activities. Only urbanized areas with populations under 200,000 can use these funds for operating assistance.

Section 5309 "Fixed Guideway Modernization Funding" is awarded (by statutory formula) to eligible public bodies and agencies for use on eligible activities. These include capital projects to modernize or improve existing fixed guideway systems, including purchase and rehabilitation of rolling stock, track, line equipment, structures, signals and communications, power equipment and substations, passenger stations and terminals, security equipment and systems, and maintenance facilities and equipment. Also eligible is operational support equipment including computer hardware and software, system extensions, and preventive maintenance. Keystone East service qualifies for Section 5309 funding through apportionments made to the Harrisburg, Lancaster, and Philadelphia urbanized areas. Current Section 5309 funding available to Keystone East totals approximately $12 to $13 million per year and is used for capital improvements along the line. Keystone West service is not directly eligible for either of these categories of funding, although intermodal facilities could qualify for Section 5307 funds.

Dedicated Grant Programs

Amtrak Capital Grants: FRA is responsible for administering federal capital grants to Amtrak, which are being used for capital projects along Amtrak's system, primarily on the Northeast Corridor. However, the Keystone East line is owned by Amtrak and also benefits from this funding source.

Operation Lifesaver, Inc. (OLI): A national not-for-profit rail safety organization, OLI receives funding to support its public education efforts to reduce collisions between trains and motor vehicles at highway-rail grade crossings, and to discourage illegal trespassing along railroad rights-of-way. Although increasing rail speeds is not the primary focus of OLI, a reduction in the number of grade crossings could help reduce trip times along intercity passenger rail routes.

Loan Programs

Railroad Rehabilitation & Improvement Financing (RRIF) Program: Aside from providing grants, this program provides direct loans and loan guarantees to acquire, improve, or rehabilitate intermodal or rail equipment or facilities, including track, bridges, yards, buildings, and shops; refinance outstanding debt incurred for the purposes listed above; and develop or establish new intermodal or railroad facilities. The RRIF program was established by the Transportation Equity Act for the 21st Century (TEA-21) and amended by the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users

(SAFETEA-LU). Under this program the FRA administrator is authorized to provide direct loans and loan guarantees, up to $35 billion, to finance development of railroad infrastructure. Up to $7 billion is reserved for projects benefitting freight railroads other than Class I carriers.

The funding may be used to:

- acquire, improve, or rehabilitate intermodal or rail equipment or facilities, including track, components of track, bridges, yards, buildings, and shops;
- refinance outstanding debt incurred for the purposes listed above; and
- develop or establish new intermodal or railroad facilities.

Direct loans can fund up to 100 percent of a railroad project with repayment periods of up to 35 years and interest rates equal to the government's cost of borrowing. Eligible borrowers include railroads, state and local governments, government-sponsored authorities and corporations, joint ventures that include at least one railroad, and limited-option freight shippers who intend to construct a new rail connection.

In FY 2011 Amtrak received $562.9 million from this program, which continues to accept applications.

Transportation Infrastructure Finance and Innovation Act (TIFIA): This is a U.S. DOT program, which makes three forms of credit assistance available for surface transportation projects of national or regional significance:

- Secured (direct) loans
- Loan guarantees
- Standby lines of credit

TIFIA credit assistance provides improved access to capital markets, flexible repayment terms, and potentially more favorable interest rates than can be found in private capital markets for similar instruments. TIFIA can help advance qualified, large-scale projects that otherwise might be delayed or deferred because of size, complexity, or uncertainty over the timing of revenues. No intercity rail projects have taken advantage of this financing as of yet; however, it has been used for transit projects in Washington, D.C., California, and New York City. The program is ongoing and is accepting applications.

Eligible projects include the design and construction of stations, track, and related infrastructure, purchase of vehicles, and any other type of project that is eligible for grant assistance under Chapter 53 of Title 49 of the United States Code (U.S.C.). Additionally, intercity bus vehicles and facilities are eligible to receive TIFIA assistance.

To qualify for TIFIA assistance, a project must meet the following criteria:

- Minimum project cost: $50 million (intelligent transportation system projects are subject to a $15 million minimum).
- Federal funding cannot exceed 33 percent of eligible costs or the amount of senior debt if the TIFIA loan does not have an investment grade rating.
- Senior debt obligations must receive an investment grade rating.
- The project must have a dedicated revenue source to pledge as repayment on the TIFIA loan.

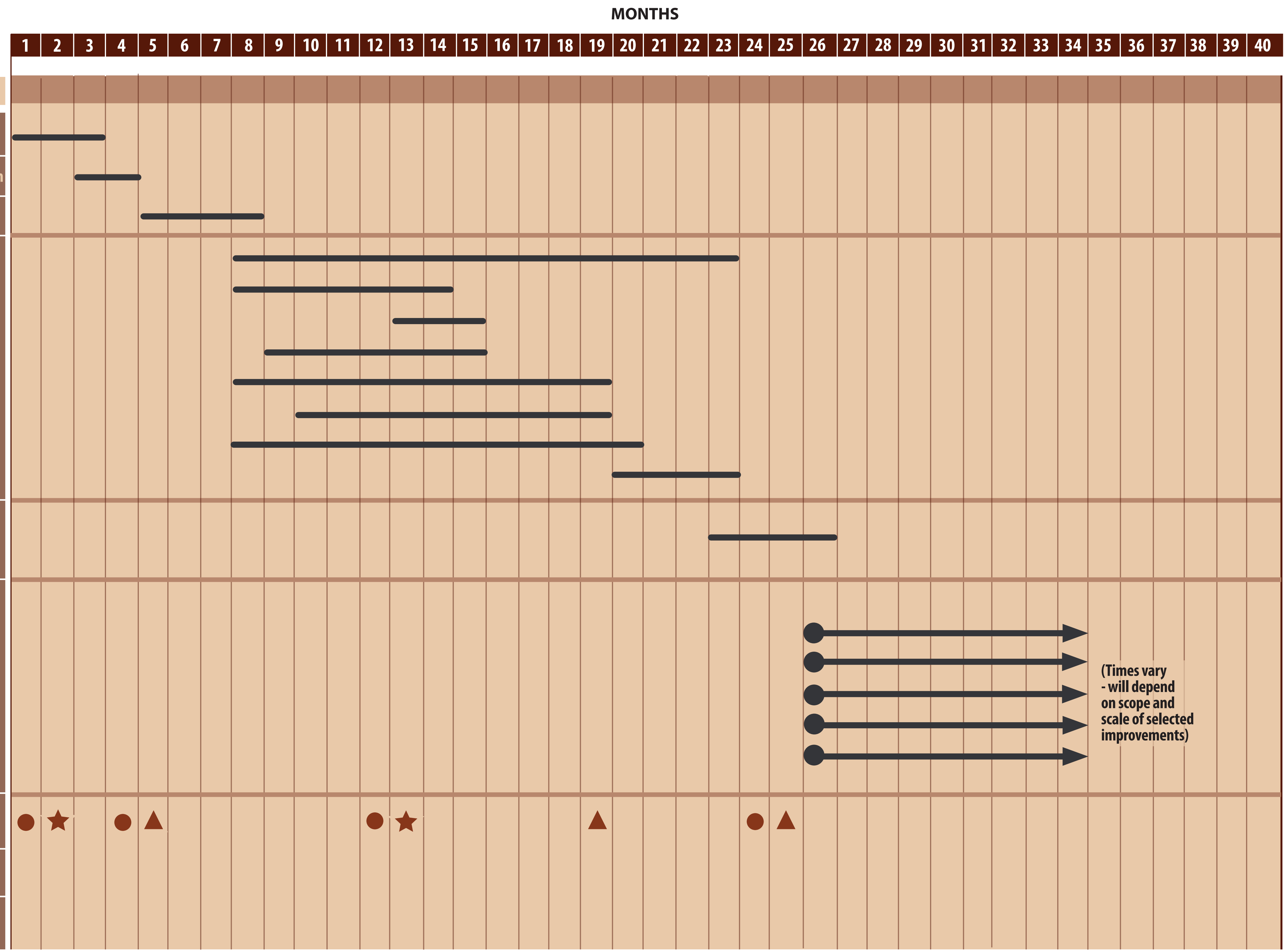
APPENDIX F
Keystone West Future Work Plan / Schedule

KEYSTONE WEST
High Speed Rail Study

Future Work Plan*

January 2014

Involved Parties/Agencies	Activity
PennDOT, FRA, MPO/RPO, Amtrak, Norfolk Southern	Prioritize "Early Action" Improvements
	Develop Preliminary Staged Implementation Plan
	Work Order Development / Contracting, etc.
PennDOT / FRA	Prepare Final Service Development Plan(s)
	• *Full Rail Operations Network Analysis*
	• *Refined Demand Estimates*
	• *Refined Conceptual Engineering*
	• *Detailed 20 - 30 year Financial Plan*
	• *Detailed Direct/Indirect Benefits Analysis*
	• *Host Railroad Buy-In*
	• *Detailed Funding Plan*
PennDOT / FRA, MPO/RPO, Amtrak	Refine Priorities and Develop Final Staged Implementation Plan
PennDOT / FRA	Design, Environmental Clearance/Permitting
	• *Environmental Document / Decision*
	• *Final Design*
	• *Permitting*
	• *Right-of-Way Clearance*
	• *Utility Clearance*
Amtrak, Norfolk Southern, Public	Stakeholder / Public Coordination Activity
	Construction Bidding**
	Construction**



Notes:

* Assumes individual improvements or groups of improvements to be advanced, not advancement of any full Alternative.

** Would start following completion of Design, Environmental Clearance/Permitting.

Key:

★ - Public Meeting ▲ - Direct Mailing (Newsletter, survey, flyer, etc.) ● - Special Purpose Meeting