

## 5. *Infrastructure Capital Costs*

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### 5.1 *Background*

During the initial stages of the MWRRRI study, the infrastructure analysis involved developing corridor right-of-way improvements for all of the MWRRS corridors, paired with advances in train technology. For the first stage, infrastructure requirements were developed for each of the three scenarios (Conservative, Moderate and Aggressive) through discussions with the engineering staffs from the states and Amtrak along with a detailed review of previous engineering studies. Critical data for this analysis included existing condensed profile track data for each corridor. This data was entered into the *TRACKMAN*<sup>®</sup> Track Inventory Model and subsequently evaluated with each state and Amtrak at a series of review meetings. The data was then updated; in most corridors, the updates were based on recent hi-rail trip data, reports by engineers implementing track upgrades, and data from engineering reviews of the rights-of-way.

Using an interactive process with the states and Amtrak, improvements for each corridor were recommended. Comparisons were made between train technology performance at given levels of infrastructure improvement and the time saved per dollar spent. The extent of the infrastructure improvements was then estimated based on existing studies and interviews conducted with state and Amtrak representatives, and were then categorized by major component (track, bridges, etc.). Physical quantities for each category were estimated for each route. Unit costs were developed and applied to the quantities developed for each corridor to estimate the corridor and system infrastructure costs.

For the initial stage of the study, infrastructure improvements were staged to first provide improvements to all corridors to the Conservative Scenario level, and then to improve the most profitable corridors to the Moderate Scenario level. The technology and infrastructure improvements for the Conservative Scenario were defined as follows:

- Conventional locomotive-hauled rolling stock
- Top speed of 79- or 90-mph (via ROW improvements)
- New locomotives
- Implementation of up to 5" unbalance operation
- Improved track alignments and connections
- Installation of ITCS or similar technology (*i.e.*, ATCS Phase I) on segments above 79-mph
- Grade crossing upgrade and elimination program (3 percent per year)
- Upgrade of stations at appropriate locations

Technology and infrastructure improvements for the Moderate Scenario included the elements for the Conservative Scenario, such as advanced signaling, and were further defined as follows:

- Top speed of 110-mph (via equipment and ROW improvements)
- Either DMU rolling stock (*e.g.*, IC3 Flexliner with steerable trucks) or new locomotives with cars
- Implementation of up to 6" unbalance operation
- Major bypass program
- New line between Cleveland and Chicago via Ft. Wayne
- Grade crossing upgrade and elimination program (5-7 percent per year)

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- Station upgrade program

The initial study also investigated an Aggressive Scenario for infrastructure and technology that was determined to be not cost-effective for implementation prior to 2010. However, this higher speed scenario might be warranted for future improvements to specific corridors beyond 2010.

In the 2000 MWRRS Study, a review of the original implementation process revealed that while the conservative to moderate staging reduced the rate of capital expenditure for infrastructure, it increased the level of operating losses. Since each state held as a key objective the reduction or avoidance of operating losses, it was decided to revise the Implementation Plan. The states therefore requested that a revised Moderate Implementation Plan be investigated as an alternative to the Conservative to Moderate staging approach outlined in the Executive Summary and Final Report of the 1998 MWRRS Study. The implementation of infrastructure and train technology improvements was accelerated to a more ambitious program that would take the most profitable corridors directly and as quickly as possible to 110-mph, rather than improving these lines in a two-stage process. Under the revised Moderate Implementation Plan, significant schedule improvements and new rolling stock could be simultaneously introduced to maximize ridership impact and minimize operating losses.

The principles underlying the revised phasing of segment construction are as follows:

- Maximize the geographic coverage of the improvements
- Generate maximum and immediate improvements in corridors of greatest ridership and revenue potential relative to the investment required
- Delay full-scale improvements to segments (*e.g.*, Chicago-Milwaukee), branch lines (*e.g.*, Green Bay, Quincy, Grand Rapids, Port Huron) or corridors (*e.g.*, St. Louis-Kansas City) with high cost or lesser potential
- Maintain construction funding requirements at reasonable levels throughout the project

Revised timing and costs for planning, preliminary engineering, EIS, design and construction, and rolling stock acquisition were developed for each of six implementation phases. An update of segment design and construction costs for each route was developed. The intent of the revised Moderate Implementation Plan was to provide incremental, yet significant, improvements in service as early as possible, in as many corridors as possible. Note that not all segments for the fully completed MWRRS are improved to 110-mph; the 79-mph and 90-mph segments are generally consistent with those developed for the first implementation phase of the MWRRS.

## ***5.2 Infrastructure Assessment***

The infrastructure analysis completed in 2000 for the MWRRS involved a more detailed assessment of the rail rights-of-way and capacity, as well as a refinement and validation of the unit infrastructure costs used in the preliminary plan. This analysis accomplished the following objectives:

- Identify track capacity and engineering design parameters that are compatible with freight and other railroad operations
- Assess train capacity at Chicago Union Station with respect to the proposed MWRRS operations

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- Conduct a more detailed engineering assessment of the nine corridor rights-of-way comprising the MWRRS
  - Identify potential environmental issues on the corridors that might require remediation under the National Environmental Policy Act (NEPA)
  - Perform a more detailed assessment of the unit costs for each category of infrastructure improvements (*e.g.*, track, bridges/under and over, etc.)
  - Revise estimates of the physical quantities needed for each route for each category, as appropriate
  - Apply unit costs to these quantities to estimate corridor and system infrastructure costs
  - Employ infrastructure costs as part of the Business Plan to evaluate the revenue and ridership potential of the nine rail corridors that comprise the MWRRS

The infrastructure assumptions were further refined in 2004, which generally resulted in an increase in capital costs and the imposition of minor speed restrictions. It should be noted that these speed restrictions were not severe enough to affect the planned train schedules or demand forecasts that had been developed previously.

### ***5.2.1 Track Capacity Issues***

For the initial MWRRRI study, aside from maximum allowable track speed, the most critical factor associated with determining the infrastructure needs was available line capacity. The lines proposed for use in the MWRRS are mainly owned by private freight railroads that use them essentially for their own trains. In addition, in the Chicago area, there is an extensive commuter rail system operated by Metra, as well as Amtrak long-distance trains using many of the same lines.

While Amtrak has a legislated right to provide train service on these lines, an agreement is required from the private railroad operators regarding other conditions for Amtrak's use of their rights-of-way. The key issue is not only the level of capacity required to handle the current traffic, but the future levels of freight and passenger traffic on these lines as well. Where capacity is readily available, Amtrak can obtain access at incremental cost. Where capacity is unavailable or upgrading is required, the private rail lines will require an additional infrastructure investment. That level of investment is subject to negotiation and can be substantial.

To evaluate the potential requirements and investments for the MWRRS, an assessment was made of the potential improvements to line capacity that might be required. The freight railroads and Amtrak provided information on the existing traffic on each route. The different routes were assessed and three types of track mitigation measures were developed.

### ***Chicago-Area Routes***

The Chicago rail hub is heavily used by both freight and passenger rail services. On many routes, Metra runs very dense commuter services and, indicative of the intense freight activity in the Chicago area, freight rail traffic builds up at approaches to yards and manufacturing facilities. Significant route and capacity enhancements including a new *South-of-the-Lake* access route are already planned for this area, particularly for routes running south and east of Lake Michigan (*e.g.*, Chicago-Detroit, Chicago-Cleveland, Chicago-Cincinnati and Chicago-Carbondale). To the north of Chicago, significant route restructuring and/or capacity development is planned to

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provide a route to Milwaukee, Green Bay and Twin Cities. Additionally, four flyovers are planned on the Metra Heritage Corridor. The Metra Heritage Corridor extends from Union Station to Joliet Union Station along tracks owned predominantly by the CN Railroad. The line is crossed at grade by other railroads at four locations between Bridgeport (MP 3.5) and Argo (MP 13.1) resulting in frequent train delays for the Metra commuter trains and Amtrak service. The crossings are Panhandle Crossing (MP 5.1) crossed by NS and CSX; Corwith Junction (MP 6.6) crossed by BNSF; LeMoyne (MP 7.9) crossed by BRC; and Argo-CP Canal (MP 13.1) crossed by IHB.

The Chicago Regional Environmental and Transportation Efficiency program (CREATE) a public/private partnership, will improve passenger rail service, reduce motorist delay, ease traffic congestion, increase safety, and provide economic, environmental and energy benefits for the Chicago region. Because Chicago is the nation's transportation hub, the CREATE program will increase the efficiency and reliability of the nation's rail service. In addition, the project will preserve the footprint for the region's proposed high speed rail network.

### ***Heavily Used Freight Routes***

On heavily used freight routes such as Chicago-Cleveland, additional and significant route infrastructure is proposed. This new infrastructure can take the form of a new dedicated passenger track alongside existing track (as proposed for the Toledo-Cleveland segment), or the use of a lightly used parallel line (such as the Iowa Interstate route between Chicago and Omaha instead of the heavily used Union Pacific and Burlington Northern-Santa Fe routes).

### ***Lightly Used Freight Routes***

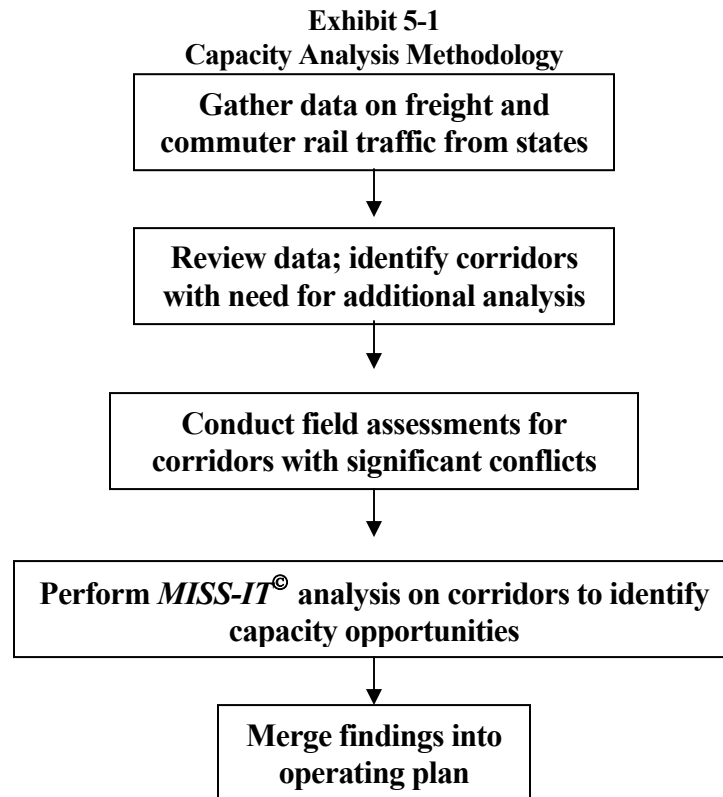
On many routes, recent consolidations or mergers of the railroads have resulted in a concentration of traffic onto a few routes leaving several only lightly used by local freight traffic. As a result, some of the MWRRS routes could encounter declining freight traffic or even abandonment. For example, the Big 4 route selected for the Indianapolis-Cincinnati segment carries only local freight traffic today. Where routes have fallen into disrepair or are lightly used, the lines will be improved to FRA Class 4 and 6 standards needed for 79- and 110-mph operations, respectively. In addition, a design standard of 10-mile long sidings every 50 miles on the lightly used routes was assumed.

Although these track, signaling and grade crossing mitigation measures provide a reasonable basis for developing infrastructure costs for the MWRRS, it should be noted that the track requirements of private railroad operations are heavily influenced by the level of consolidation in the industry. While the overall growth of freight traffic is significant, the increasing degree of freight railroad integration can have a significant impact on any line. In the next ten years, the freight railroads could consolidate further, concentrating traffic onto even fewer lines.

At this time, the industry view is that certain key freight lines into Chicago, which is a national freight traffic hub, will be increasingly used. As a result, the requirement for passenger-only access routes to Chicago is likely to become essential and is proposed by this study. However, away from Chicago and other Midwest regional centers, the investment assumptions are more conservative depending on the freight and passenger traffic density expected to operate over each line segment.

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More in-depth analysis of these issues is being undertaken, as certain freight railroads have become actively involved in the planning process for the MWRRS. The MWRRI Steering Committee is committed to working cooperatively with the freight railroads towards achieving solutions and building effective working relationships. Signals, sidings and the use of computer software can serve to increase capacity, perhaps more effectively than an entirely new line, and certainly at far less cost. Freight productivity can increase while permitting increased passenger access to the lines. The methodology used in the Capacity Analysis is depicted in Exhibit 5-1. Further discussion on freight and commuter railroads and shared access is discussed in Chapter 12, Institutional and Organizational Issues.



### **5.2.2 Detailed Engineering Assessment**

The engineering assessment was performed at a feasibility level, and was designed to provide an accurate database of the basic information needed to move the project forward and ensure that no fatal flaws exist that would nullify the conceptual analysis and findings. Exhibit 5-2 provides an order-of-magnitude estimate of the accuracy of capital estimates by project segment.

**Exhibit 5-2**  
**Typical Tasks of Transportation Project Development**

<i>Typical Project Task</i>	<i>Approximate Engineering Design Level</i>	<i>Approximate Cost Estimating Level of Accuracy</i>
Feasibility Study	0%	+ /- 30% or worse
Project Definition/ Advanced Planning	1-2%	+ / - 25%
Conceptual Engineering	10%	+ / - 20%
Preliminary Engineering	30%	+ / - 15%
Pre-Final	65%	+ / - 15%
Final Design/ Construction Documents	100%	+ / - 10% or better

### 5.2.3 *Infrastructure Assessment by Element*

A systematic engineering planning process was used to conduct an engineering assessment of the rail corridor and estimate the capital investments required to support a given passenger rail technology. The initial step in this process was to divide each route into logical segments and quantify the major infrastructure cost elements either present or required in each segment. The cost elements include:

- Track work
- Stations, terminals, and maintenance facilities
- Bridges/under
- Bridges/over
- Crossings
- Train control (signals and communications)

An engineering assessment of each corridor was accomplished by conducting field inspections of each segment. The field inspections were used to verify conditions at readily accessible points along the route and at the site of major structures and stations. The field inspections did not attempt to assess FRA track safety standards or the condition of structural elements, (e.g., bridges, overpasses). At each location, engineering notes were compiled and the physical track conditions were compared with the latest available track charts and other data provided by the railroads. These field inspections were coordinated with the appropriate state, host railroad and Amtrak.

#### ***Track Work***

During the field inspections, the condition of the track was noted and a determination made relative to the improvements required to accommodate a specific passenger train technology. These “limited” field inspections involved walking short segments of the track at several locations. The purpose was to assess the existing track’s suitability to accommodate joint freight and passenger operations based on current usage and FRA track safety standards, and to gather sufficient data to identify needed infrastructure improvements.

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Equally important to the physical condition of the track structure is each route's alignment. Curves may restrict speed and increase travel time. For passenger rail operations, it is essential to minimize the effect of the curvature of the route on passenger train speed. This can be accomplished by reducing the curvature or increasing the super-elevation. The curvature data contained within the *TRACKMAN*<sup>®</sup> files was reviewed to determine the most appropriate treatment.

### ***Modification of Curves***

While allowable super-elevations and cant deficiencies must ultimately be negotiated with the freight railroads, this study assumed a consistent MWRRS design standard of 6 inches super-elevation plus 3 inches cant deficiency for qualified equipment, leading to a maximum unbalance of 9 inches. The overall track standard defined for the MWRRS was to increase super-elevation to a maximum of 6 inches on dedicated passenger segments where possible. For lines without any freight operations, additional super-elevation might be possible, however, super-elevation on freight tracks is calculated so that a freight train traveling at 60-mph is in equilibrium. A number of curves may need to be modified to accommodate 110-mph operations. It is not envisioned that curves will be realigned due to the reconstruction cost and environmental considerations associated with this type of improvement. However, limited geometric modifications necessary to accommodate increased super-elevation and spiral lengths may be possible.

### ***Stations, Terminals, and Maintenance Facilities***

Existing stations and terminals were inspected and their general condition was noted for confirming capital cost allocation for each route. Based on the selected technology, station platforms may require lengthening. Additionally, substantial improvements in amenities within the stations are needed. The need for parking was also assessed.

Utilization of highly reliable train equipment is critical to achieving the financial goals inherent in the MWRRS plan. In particular, rolling stock must be readily available for revenue service on a daily basis; its propulsion components must provide routine high performance and rolling stock subsystems, such as HVAC, door and on-board passenger conveniences must be reliable and of high quality.

A proposed system maintenance facility concept plan was prepared. Specific locations for these facilities have not yet been identified. Conceptually, proposed locations by type of facility are as follows:

- Backshop Facility
  - Pontiac/Waterford, Michigan
- Service and Inspection Maintenance Facilities
  - Cleveland, Ohio
  - Cincinnati, Ohio
  - St. Louis, Missouri
  - Omaha, Nebraska
  - Madison, Wisconsin
  - Minneapolis, Minnesota
- Layover Facilities

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- Chicago, Illinois
  - Port Huron, Michigan
  - Holland, Michigan
  - Carbondale, Illinois
  - Kansas City, Missouri
  - Quincy, Illinois
  - Quad Cities, Illinois/Iowa
  - Milwaukee, Wisconsin
  - Green Bay, Wisconsin
  - Battle Creek/Kalamazoo, Michigan
  - Indianapolis, Indiana
  - Des Moines, Iowa

Chapter 7 provides further conceptual analysis of maintenance base siting options. HNTB's capital cost includes \$110 million for up to six service and inspection facilities, \$47 million for layover facilities and \$45 million for the Pontiac/Waterford system maintenance facility. This capital cost estimate was accepted without prejudice for developing the MWRRS business and financial plan.

### ***Train Service Access to Stations***

Train access to current and proposed stations is critical to on-time service. Several routes will require track reconstruction to reach downtown stations. This study did not include a planning analysis of access to each station in the Midwest region. However, access to Detroit, Toledo and Cincinnati were considered in separate studies authorized by Michigan, Ohio and Indiana, respectively. A planning level assumption was approved by Iowa for access to the Omaha, Nebraska station. Station access is described below.

#### ***Detroit Station***

The Chicago-Detroit route requires the installation of a new connection track in west Detroit to accommodate access to both the existing and the proposed New Center Station in Detroit.

Currently, Amtrak does not operate directly from the NS tracks to the Amtrak Detroit station at Woodward Avenue, but connects through Bay City Junction. The proposed route of the MWRRS will operate more directly, connecting from NS tracks to CN tracks at West Detroit with a new northwest quadrant-connecting track. The connecting track will include a new #20 turnout on the NS No. 1 main near MP 4.0 and a new #20 turnout at Vinewood on the CN. Additionally, crossovers are required north of Vinewood to allow the MWRRS to cross from the westernmost CN track to the easternmost Conrail Shared Assets track to serve the proposed New Center Station on the east side of the embankment.

A crossover will be required west of NS MP 4.0 to allow passenger trains to utilize the NS No. 2 main on the south side. Two crossovers will be required north of the New Center Station to allow passenger trains to cross to the CN tracks to travel on to Pontiac. This new service requires the construction of two miles of connecting track and the rehabilitation of two CN/CSAO tracks

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from Vinewood to Woodward Avenue, a distance of 2.5 miles. In addition, the CN bridges that are presently not in service must be inspected and repaired before the introduction of new passenger service.

#### *Toledo Station*

In order to ensure passenger train access to the Toledo Station, the western entrance will be reconstructed to accommodate four tracks. This reconstruction is necessary to alleviate freight congestion between the Airline Yard and the station. Additionally, east of the Toledo Station, the existing two-track swing bridge over the Maumee River would be replaced with a new three-track bridge, and the at-grade crossing with CSX at Vickers would be grade separated.

#### *Cincinnati Station*

The proposed reconstruction of the 110-mph rail segment between Shelbyville, Indiana and Cincinnati, Ohio requires access into a new terminal proposed for relocation in the western section of downtown Cincinnati.

#### *Iowa Stations*

Since service does not currently exist between Wyanet and Omaha on the Iowa Interstate right-of-way, access through Council Bluffs, Iowa across the Missouri River into Omaha is necessary. It is assumed that the entrance to the Omaha Station will utilize the Union Pacific Bridge over the Missouri River.

#### *Stations/Terminals*

For this study, a placeholder capital cost of stations and terminals was used depending on whether the station or terminal was constructed new or renovated. The capital cost spreadsheets in Appendix A9 contain the names of the stations and the placeholder assumption used.

#### ***Railroad Bridges***

A field inspection was conducted on a representative sampling of bridges along the routes. No attempt was made to determine the physical condition of the bridges or their suitability for current usage. An estimate was made of the cost to upgrade or widen the bridges to accommodate passenger rail operations. In many cases, new “flyover” bridges that grade separate rail/rail crossings and interlockings are needed to improve passenger train reliability. The cost to upgrade bridges along the routes was extrapolated from the estimated costs of the representative bridges. A complete inventory of existing bridges was developed for each route and each technology. The cost of new bridges required for new routes or bridge replacements were estimated only at a conceptual level.

Major railroad bridge construction is required on some routes, whereas other routes will require minimal upgrade of the bridges. On the Chicago-Detroit route, it is envisioned that there will be new bridges at Englewood, Illinois and Porter, Indiana as part of the construction of the *South-of-the-Lake* Corridor (SOLC). If the northern alignment of the SOLC is selected, a flyover will be needed near Buffington Harbor (MP 501.8) to transition from the north side to the south side of the NS mainline ending at MP 500.7, west of the EJ&E grade separation. A 5.5 mile elevated structure is required beginning 3 miles east of Buffington Harbor to the western edge of the Indiana Dunes National Lakeshore. If the southern alignment of the SOLC is selected, a flyover

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near Buffington Harbor is required to transition from the north side of the NS mainline onto a two track main on the property of CSX (old PRR right of way).

On the Chicago-Cleveland route, in addition to the bridges between Chicago and Buffington Harbor, two major flyover structures are needed in the Ft. Wayne-New Haven area. The proposed passenger service through Ft. Wayne will be on new, dedicated track. One flyover is required to transition from the north side of the NS tracks east of the proposed Ft. Wayne station to the south side. The second flyover is needed on the east end of New Haven to transition from the south side of the NS track onto the NS Maumee Woodburn Branch line. Another flyover structure is needed at Defiance to cross the CSX railroad. Between Delta and Cleveland, Ohio undergrade bridges will have to be expanded to accommodate the installation of a third track. Additionally, several bridges will require rehabilitation on the abutments and superstructure. This type of work includes pointing of stone abutment walls, painting of bridges, and replacement of some bearings. A new bridge across the Maumee River in Toledo; a flyover of the NS mainline over the CSX railroad east of Toledo; and a new bridge at the Cuyahoga River are required.

On the Chicago-Cincinnati route, undergrade bridges will be required to carry the Wanatah-Monon segment over several railroad structures and Route 421. Bridges on the segment between Shelbyville and Cincinnati will require either substantial rehabilitation or complete rebuilding, including the bridges located within the Ohio River Valley.

Future bridgework on the Chicago-St. Louis route will be minimal north of Springfield since the track structure and bridges have been upgraded or reconstructed under the on-going construction improvement program sponsored by the Illinois Department of Transportation. Bridgework between Springfield and Q Tower will be required when this segment of track is upgraded for 110-mph operations. Similarly, the Chicago-Carbondale and the Chicago-Quincy routes through Illinois require minimal bridgework since both routes are well maintained.

The level of bridge investment in the St. Louis-Kansas City line will depend on the capacity remediation strategy that is ultimately selected, as well as Union Pacific Railroad's participation in the cost of double-tracking the Osage and Gasconade River bridges.

The Chicago-Des Moines-Omaha route between Wyanet and Omaha requires major bridge upgrade or replacement, minor bridge upgrades, and replacement of culverts. Based on a 1997 field view, it was estimated, at that time, that four major upgrades or bridge replacements were needed between Omaha and Des Moines and three major upgrades or bridge replacements were needed between Des Moines and the Quad Cities. The locations of these bridges are reported in the *Iowa Rail Route Alternative Analysis* prepared by TEMS in June 1998.

The Chicago-Twin Cities route will require the construction of fourteen undergrade bridges between Watertown and Madison, Wisconsin. In addition, seven land bridge structures will be constructed across sensitive wetlands with soft subsoil. Minor bridge rehabilitation will be required throughout the remainder of the route. The branch line to Green Bay will require the rebuilding of several over bridges to accommodate 110-mph operations.

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### ***Highway/Railroad Crossing Eliminations***

In the initial segment of the MWRRI study, grade crossings were assessed for each scenario (conservative, moderate and aggressive). The focus was the increased level of train safety associated with reducing the number of grade crossings. In the Midwest region, a 300-mile corridor could easily have 350 public and private crossings. The philosophy to be adopted by the states on public/private crossings was reviewed and agreement was reached as to the level of investment to be allocated for closures and improvements. The allocation was determined by the minimum investment required to meet FRA standards and the level of investment acceptable to the states.

As agreed in the initial segment of the study, an important element of the MWRRS is the closure of five percent of the grade crossings in each corridor per year over a six-year period. Because of this program, approximately 30 percent of crossings would be closed by 2010 (subject to public approval), significantly improving safety in the MWRRS corridors.

### ***Highway/Railroad Grade Crossing Improvements***

The treatment of grade crossings to accommodate 110-mph operations is key to the success of passenger rail in the Midwest. Accordingly, the MWRRS adopted a policy to eliminate redundant or unnecessary crossings and to install the most sophisticated traffic control/warning devices compatible with the location of the crossing. Numerous grade crossings exist through downtown business areas and residential communities where 110-mph operations are essential to the success of the MWRRS. Additionally, in many rural areas of the Midwest, secondary roads parallel the railroad right-of-way. The treatment of crossings in close proximity to parallel roadways may include the installation of acceleration and deceleration lanes and/or the installation of traffic signals on the secondary roadway. This highway work has not been included in the capital cost estimates. Humped crossings that minimize sight distance for both train and passenger vehicles are another challenge that will require specific engineering solutions.

The recommended treatment of a grade crossing is a function of average daily traffic through the crossing, proximity of parallel roadways, width of roadway, and presence of pedestrian crossings. Proposed treatments include vehicle-arresting systems (a new technology now in demonstration stages), quad gates with and without median barriers, and extended gate arms with or without median barriers.

Private crossings are numerous throughout the Midwest region. The MWRRI Steering Committee has accepted the guideline of closing five percent of private crossings per year, subject to public approval as required. Where private crossings cannot be closed, electronic gated crossings (when approved by the host railroad) or single gates and flashers are recommended.

Four-quadrant gates may be installed in areas where warranted by the level of the average daily traffic. Extended gate arms with a counterweight and chain link fencing may be used in rural areas where average daily traffic is low. The gate arm of the existing flashers and gates may be extended to meet a 50-foot section of chain link fence that would be constructed at each quadrant of the crossing. For train operations of less than 80-mph, current technology – using flashers and gates – may be relied upon.

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In 2000, an inventory of crossings was prepared for each route. Representative crossings were inspected in several segments of each route and treatments recommended. Conceptual estimates were applied to all the crossings within each route so that capital costs could be developed.

### ***Signals and Communications (Train Control)***

Implementation of a state-of-the-art signal and communications system is integral to the successful implementation of the MWRRS. Improved signaling will increase track throughput and raise the efficiency, productivity and safety of the track. On 110-mph rail, overlay of state-of-the-art signal and communications system on the existing signal system along a given route are required. A state-of-the-art system is necessary to coordinate freight and passenger operations and permit joint service to share the same track. Subject to acceptance by the FRA and freight railroads, it is assumed that Positive Train Control (PTC) system technology will be applied to all routes with speeds over 80-mph.

There are several studies currently underway within the Midwest region evaluating different technologies. The Illinois Department of Transportation, in cooperation with FRA and the Association of American Railroads (AAR), is currently developing a Positive Train Control System on a 120-mile segment of the Union Pacific corridor between Chicago and St. Louis. Additionally, the FRA, the Michigan Department of Transportation and Amtrak instituted a \$39 million project in 1995 to upgrade tracks and to implement a 110-mph PTC System on a 65-mile portion of the Chicago-Detroit corridor between Kalamazoo and New Buffalo, Michigan. Wisconsin is working with Canadian Pacific Railway on a federally funded project to evaluate technical issues related to adapting PTC applications to “dark” un-signaled territory. These systems must be carefully evaluated to determine their compatibility with the needs of the MWRRS. Conservative per-mile unit cost estimates have been developed based on discussions with representatives of the various state departments of transportation, Amtrak and equipment manufacturers.

### ***Fencing***

The need for the fencing of passenger rail routes within the MWRRS will be determined by each state during the preliminary engineering assessment. For planning purposes, three types of fencing were assumed. Farm fencing at 4 feet high was assumed for rural areas; chain link fence at six feet high, was assumed for use near grade crossings in rural areas and along the routes through residential and commercial areas; and decorative aluminum or steel fencing was assumed for historic areas and in downtown business districts.

#### ***5.2.4 Infrastructure Assessment by Corridor***

The track structure on the nine routes in the MWRRS varies by FRA designated class of track. The Chicago-Detroit, Chicago-Cleveland, Chicago-Carbondale, Chicago-St. Louis, Chicago-Quincy, St. Louis-Kansas City and Chicago-Twin Cities routes are generally FRA Class 4 track capable of maintaining freight service at the maximum allowable speed of 60-mph and passenger service at the maximum allowable speed of 80-mph. Speed restrictions exist on each route depending on infrastructure conditions. In order to increase the passenger train speed from 80-mph (FRA Class 4 track) to 110-mph (FRA Class 6 track), upgrading of the track structure, installation of active warning systems at all grade crossings, fencing the route as necessary, and installation of PTC systems will be required. It should be noted that 49 CFR Part 213.9 (a) states

that the maximum allowable speed for FRA Class 4 track is 60-mph for freight trains and 80-mph for passenger trains. However 49 CFR Part 236.0 (d) states that where any train is operated at a speed of 80-mph or more, an automatic cab signal, automatic train stop, or automatic train control system must be installed. For this reason most railroads operate their Class 4 track at a maximum authorized speed of 79-mph. However, this report uses the maximum allowable speed of 80-mph as presented in 49 CFR Part 213.9(a).

The MWRRS consists of more than 3,371 route miles and 5,584 total track miles ranging from FRA Track class 2 through Class 6 after full build-out. A summary of the MWRRS by route is shown in Exhibit 5-3.

**Exhibit 5-3  
Summary of Track Mileage throughout the MWRRS**

<i>From</i>	<i>To</i>	<i>Through</i>	<i>Total Mileage</i>	<i>FRA Track Class</i>					<i>Total Track Mileage</i>
				<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	
Chicago	Pontiac	Detroit	301.7	0.4	56.5	99.7	3.0	298.6	458.2
Chicago	St. Louis	Springfield	283.5	5.0	25.2	96.2	0.0	206.5	332.9
Chicago	St. Paul	Madison	443.0	3.8	28.6	71.8	187.0	598.6	889.8
Port Huron	Battle Creek	Flint	158.4	0.8	36.8	187.7	0.0	0.0	225.3
Holland	Kalamazoo	Grand Rapids	74.1	0.5	5.3	78.6	0.0	0.0	84.4
Chicago	Cleveland	Fort Wayne	346.5	0.0	34.5	149.6	0.0	303.8	487.9
Chicago	Quincy	Galesburg	258.6	0.0	48.5	17.2	404.4	0.0	470.1
Chicago	Omaha	Quad Cities	475.1	0.0	77.5	514.2	204.0	0.0	795.7
Chicago	Cincinnati	Indianapolis	309.9	4.6	60.8	202.7	0.0	181.1	449.2
Milwaukee	Green Bay	West Bend	128.6	0.7	30.0	72.1	0.0	84.2	187.0
St. Louis	Kansas City	Jefferson City	283.0	3.8	33.6	28.4	500.2	0.0	566.0
Chicago	Carbondale	Champaign	308.4	2.4	43.3	103.2	488.6	0.0	637.5
<b>Totals</b>			<b>3,370.7</b>	<b>22.0</b>	<b>480.6</b>	<b>1,621.4</b>	<b>1,787.2</b>	<b>1,672.8</b>	<b>5,584.0</b>

The highest proposed speed in the route is summarized in Exhibit 5-4.

**Exhibit 5-4  
Typical Segments of Transportation Project Development**

<i>From</i>	<i>To</i>	<i>Through</i>	<i>Highest Proposed Passenger Train Speed (mph)</i>
Chicago	Pontiac	Detroit	110
Chicago	St. Louis	Springfield	110
Chicago	St. Paul	Madison	110
Port Huron	Battle Creek	Flint	79
Holland	Kalamazoo	Grand Rapids	79
Chicago	Cleveland	Fort Wayne	110
Chicago	Quincy	Galesburg	90

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Chicago	Omaha	Quad Cities	79/90 <sup>1</sup>
Chicago	Cincinnati	Indianapolis	110
Milwaukee	Green Bay	West Bend	110
St. Louis	Kansas City	Jefferson City	90
Chicago	Carbondale	Champaign	90

The final step in assessing the potential for 110-mph operations on MWRRS routes is determining if passenger service can be integrated with existing and projected freight service. This final integration of passenger and freight service will be a determining factor for the Chicago-Cleveland, Kansas City-St. Louis and Chicago-Twin Cities routes. To ensure proper integration, a detailed capacity and risk sensitivity analysis was completed. These analyses serve as a starting point for negotiations between the states and freight railroads. The planning assumptions presented here will continue to be refined based on the results of these railroad negotiations, and based on additional findings that may develop as this project progresses through the environmental impact assessment.

***Shared Use of Track on Detroit, Cleveland, Cincinnati Routes***

“Shared use” is defined as a joint use of common tracks by freight and passenger equipment. For planning purposes, the southern alignment of the *South-of-the-Lake* Corridor as presented in the *Northern Indiana/Northwestern Ohio Rerouting Study* was used. As such, the Chicago-Cincinnati and the Chicago-Cleveland routes will have shared trackage east of Buffington Harbor. The Chicago-Buffington Harbor segment for the Detroit, Cincinnati and Cleveland routes and the Buffington Harbor-Porter segment for the Detroit route will be dedicated for passenger trains. The southern alignment of the *South-of-the-Lake* Corridor will minimize service reliability problems that exist for the Chicago-Detroit and Chicago-Cleveland routes between Chicago and Porter, Indiana. Improvements, including the construction of a flyover structure, are proposed to eliminate reliability issues at Englewood. The proposed improvements will permit up to 110-mph operations between Chicago and Porter with minimal reliability issues.

***Chicago-Detroit and Michigan Branch Lines***

The Chicago-Detroit route proceeds on the existing alignment along the *South-of-the-Lake* Corridor to Porter. The corridor continues through Kalamazoo, Battle Creek, Detroit to Pontiac, Michigan. The branch lines serve Lansing, Flint and Port Huron on the existing Amtrak *Blue Water* route and Grand Rapids and Holland as an extension of the Kalamazoo service.

Amtrak and the Michigan Department of Transportation have invested considerable resources to upgrade the track structure from FRA Class 4 to Class 6 and have installed a Positive Train Control system between New Buffalo and Kalamazoo in order to permit 110-mph operations. Amtrak is currently operating at 90-mph in commercial service. Michigan DOT’s goal is to increase speeds to 110-mph by 2006. Continued upgrading of track infrastructure between Kalamazoo and Pontiac is planned. Individual infrastructure improvement projects in Battle Creek and West Detroit will reduce current reliability problems.

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<sup>1</sup> From Chicago to Wyandot on BNSF trackage the speed would be 90-mph; from Wyandot to Omaha on IAIS trackage the speed limit would be 79-mph.

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The track structure for the Michigan branch lines is generally FRA Class 4 track. It is envisioned that only minimal improvements, such as selected tie replacement and selected signal upgrades, will be necessary for continued operation and incorporation into the MWRRS. The Michigan branch lines consist of Battle Creek to Port Huron (157 miles) and Kalamazoo to Grand Rapids (78 miles).

### ***Chicago-Cleveland***

The Chicago-Cleveland route via Ft. Wayne uses the same route as the Chicago-Cincinnati route to Wanatah, Indiana. The route follows a CSX alignment to Ft. Wayne and then proceeds northeast following the Maumee & Western alignment to Liberty Center, Ohio. The route then proceeds north along the Indiana & Ohio right-of-way to Delta, which is approximately 25 miles west of Toledo. From Delta to Toledo, passenger trains will operate on the north side of the NS mainline.

Between Toledo and Cleveland, there are segments where 110-mph operation cannot be attained. Wherever possible, a dedicated 110-mph passenger track is to be constructed 28 feet from the centerline of the existing freight track. Junctions with major railroads along the alignment with restrictions, and major structures such as the causeway between Sandusky and Port Clinton, the bridge over the Huron River, and Vermillion Bridge will not be expanded to accommodate a third track. Speed restrictions in these areas will continue and passenger and freight trains will co-mingle. The third track will end at Berea.

The Berea-Cleveland segment has a maximum proposed speed of 79-mph due to the high volume of freight traffic. Here it is proposed that passenger trains would co-mingle with freight trains. The right-of-way is adjacent to rapid transit operations in this segment, so improvements would need to include mitigation for any conflict with these operations as well. The proposed improvements include the addition of a third track for passenger use and a fourth track that would provide additional freight capacity. Placeholder costs for improvements at Brookpark near the Ford plant and Rockport Yard, as well as a new river bridge crossing over the Cuyahoga River in Cleveland, were included in the cost estimates.

### ***Chicago-Indianapolis-Cincinnati***

The Chicago-Cincinnati route follows the *South-of-the-Lake* Corridor alignment via Tolleston, Indiana. From Tolleston to Wanatah, the alignment follows existing track owned and operated by CSX (as of the date of this report). South of Wanatah, the alignment proceeds south along abandoned right-of-way to Medaryville, then to an existing branch line track that requires a complete rebuild to Monon. Between Monon and Indianapolis, the alignment follows the existing Amtrak route. Sections of this segment will be upgraded to FRA Class 6 track to permit 110-mph operations. A segment of the track structure between Indianapolis and Shelbyville will also be upgraded to FRA Class 6 to permit 110-mph operations. The segment between Shelbyville, Indiana and Cincinnati, Ohio requires a major rebuild to FRA Class 6 for 110-mph operations. The entrance into Cincinnati will require substantial upgrade of the existing track to accommodate service to the downtown area. A crossover movement with the existing CSX track near Highway 50 is required. The selected alignment affects existing floodwall protection that would require closure across the passenger rail right-of-way. The entrance to the downtown area also proceeds through a waste facility to an area near the former Baltimore & Ohio Warehouse.

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### ***Chicago-Carbondale***

The Chicago-Carbondale route is mainly FRA Class 4 and is owned and operated by CN. The previously mentioned CREATE project will move the Carbondale passenger trains onto an alignment that follows the NS mainline to Grand Crossing, a distance of 9.6 miles from Chicago Union Station. At Grand Crossing, the Carbondale trains transition from the NS alignment onto the CN alignment. When the MWRRS is constructed, this transition from the MWRRS dedicated tracks along the north side will cross under the NS mainline onto the CN alignment. Grand Crossing will be reconstructed as part of the MWRRS program to permit a direct movement from the NS/Amtrak alignment onto the CN alignment.

The track structure immediately south of University Park to Kankakee will be upgraded from FRA Class 4 to Class 5 to permit 90-mph operations in this segment. The track structure is in good condition and mostly tangent track south of Kankakee. The route will be upgraded to FRA Class 5 by appropriate track improvements and the installation of PTC systems.

Speed restrictions will continue in Gilman, Rantoul, Champaign-Urbana, Mattoon, Effingham, Centralia and Du Quoin. The NS crossing at Tolono and CSX crossing north of Centralia will require speed restrictions of 60-mph. Except for these speed restrictions, passenger rail operations at 90-mph are possible.

### ***Chicago-St. Louis***

The Illinois Department of Transportation (IDOT) has completed several studies of the corridor including the *Chicago-St. Louis High-Speed Rail Study* as well as subsequent preliminary engineering and environmental impact studies. The Chicago-St. Louis route is currently FRA Class 4. The 120-mile mixed passenger/freight line between Mazonia and Springfield was upgraded to FRA Class 6, to accommodate 110-mph operations. Additionally, IDOT is proceeding with a project to design, develop and test a Positive Train Control system on this 120-mile segment.

### ***St. Louis-Kansas City***

The St. Louis-Kansas City route is an FRA Class 4 structure that is owned by Union Pacific (UP) and currently accommodates freight and passenger service. The passenger service can operate at speeds up to 75-mph between St. Louis and Jefferson City. Between Jefferson City and Kansas City, the maximum speed is 70-mph. As a result of the existing and projected freight service, it is envisioned that speeds, if increased, will only be increased to 90-mph following a detailed capacity analysis designed to ensure that Union Pacific Railroad can concur that freight operations are not impeded by the MWRRS service. Improvements are needed to the track structure in several segments to ensure reliability of passenger train operations.

### ***Chicago-Quincy***

The Chicago-Quincy route is currently an FRA Class 4 structure. Current speed restrictions will continue in this segment. Between Aurora and Quincy, the track structure will be upgraded to an FRA Class 5 to accommodate 90-mph operations. Speed restrictions will continue in Mendota, Princeton, Kewanee, Galesburg and Macomb. At the Buda and Bushnell junctions, 60-mph speeds will be required. There are reliability issues that require consideration at the Burlington Northern-Santa Fe (BNSF) yards near Galesburg.

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### ***Chicago-Des Moines-Omaha***

The Chicago-Des Moines-Omaha route shares track with the Chicago-Quincy route to Wyanet, Illinois. The track structure between Wyanet and Iowa will need substantial upgrading to FRA Class 4 to accommodate 80-mph operations. In addition, a connecting track will have to be installed at Wyanet to connect the BNSF and the Iowa Interstate System (IAIS). The IAIS currently uses the track between Wyanet, Illinois and Council Bluffs, Iowa for freight operations. Access into Omaha requires use of the right-of-way owned and operated by UP.

The track structure will be upgraded to accommodate passenger trains operating at 80-mph. Most bridges are timber trestles and require replacement. In some segments, the track structure requires complete rebuilding, whereas in other segments the track structure requires replacement of most ties and full resurfacing with ballast. Since speeds will not exceed 80-mph, moderate improvements, based on average daily traffic, to grade crossing protection is anticipated. Installation of signal and communications compatible with 80-mph operations is required.

### ***Chicago-Milwaukee-Twin Cities***

On the Chicago-Twin Cities route, a major rebuilding of the Chicago-Milwaukee segment is envisioned as presented in the *Chicago-Milwaukee High-Speed Rail Study* of 1995. The segment between Milwaukee and Watertown, Wisconsin is FRA Class 4 track that will require upgrading, installation of a second track between Pewaukee and Watertown and installation of a Positive Train Control System to accommodate operation of speeds up to 110-mph. The segment between Watertown and Madison requires a complete rebuilding since the track structure is FRA Class 1. The rebuilding will include the installation of Positive Train Control System to allow 110-mph operations. The segment between Madison and Portage, Wisconsin, will require a substantial upgrade from FRA Class 2 to FRA Class 6 to accommodate 110-mph operations. Between Portage, Wisconsin, and St. Paul, Minnesota, installation of a second track in selected areas and installation of passing sidings are required. A Positive Train Control System will also be required to accommodate 110-mph operations along most of the route and 90-mph operations between LaCrosse and Red Wing. The train speed is reduced between LaCrosse and Red Wing since the curvature of the alignment does not permit efficient operation above 90-mph.

### ***Milwaukee-Green Bay***

Green Bay does not currently have passenger rail service. In order to determine the most feasible route for providing service to Green Bay, the Wisconsin Department of Transportation commissioned TEMS to conduct an Alternative Analysis. The *Milwaukee-Green Bay Passenger Rail Alternatives Analysis* dated November 2001 concluded that the West Bend option was feasible, and was used for this planning level study. The right-of-way from Milwaukee to West Bend to Fond du Lac will be constructed to permit 110-mph operations. Between Fond du Lac and Appleton, improvements will be made to permit operations to 110-mph, and between Appleton and Green Bay, improvements will be made to permit operations to 80-mph. The density of freight traffic in this segment will not permit higher passenger speeds.

## **5.2.5 General Environmental Issues**

An environmental review was performed to identify fatal flaw environmental issues relating to the MWRRS passenger rail routes. The review studied issues that could impact implementation of the proposed passenger rail service and included a broad-scale evaluation of potential impacts

on the MWRRS. This environmental review did not provide the level of analysis consistent with an Environmental Assessment or an Environmental Impact Statement (EIS). Previous passenger rail reports were reviewed to identify applicable environmental issues:

- Chicago-Minneapolis/St. Paul: “South Route Modified (Study Route No. 4)” in the Technical Report 3, Tri-State Study of High-Speed Rail Service, TMS/Benesch, November 1990.
- Chicago-Milwaukee: Chicago-Milwaukee Rail Corridor Study - Task Six Phase II - Environmental Evaluation presented to WisDOT and IDOT, Envirodyne Engineers, Inc., March 1994.

Information from these reports was used to develop the environmental impact topology shown in Exhibit 5-5.

**Exhibit 5-5  
Environmental Conditions**

<i>Type of Impact</i>	<i>Environmental Effect</i>		
<b>Physical</b>	Water quality	Air quality	Wetlands
	Noise and vibration	Energy	Visual impacts
	Historical and archeological resources		
<b>Biological</b>	Shrinking biological diversity and fragmentation of natural habitats		Endangered species
<b>Socioeconomic</b>	Land use		Transportation and traffic impact
<b>Construction</b>	Air quality	Construction noise	Water quality
	Temporary access		

The anticipated impact, identified by a review of previous studies, generally depends on the type of condition and the route. The following is a brief overview highlighting items that might have environmental significance for the MWRRS:

- Reduced automobile use for intercity trips will improve air quality and energy consumption. Rail operations will also affect air quality and energy consumption.
- Noise impacts are likely to be minimal. As rail frequencies increase on existing corridors, noise from passing trains will increase. However, as speeds increase the duration of the noise impact will be brief. As at-grade crossings are eliminated (where possible), the noise impact from whistle blowing at crossings will be reduced. New alignments will experience increased noise, but that noise is likely to be less than a comparable volume of auto traffic.
- Land use impacts will be most noticeable in station vicinities, attracting additional investment and development for a positive impact on the community. A 110-mph passenger rail service will result in more productive use of travel time and will improve access to important markets and suppliers.
- Construction impacts are generally temporary and can be mitigated and include run-off and water-borne silt.
- Impacts on endangered and threatened species can only be identified through additional investigation.

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- Land near the historic trade and travel routes may harbor historical and archeological treasures. These are not likely to be encountered or impacted, except where additional right-of-way is needed for grade separation structures or for cross-country routes. Site-specific mitigation measures are typically developed when the location and size of such finds are known.

### ***Programmatic Environmental Impact Statement for the MWRRRI***

Pursuant to the National Environmental Policy Act (NEPA), if a proposed project requires a federal permit or has federal funding, a series of environmental analyses must be performed to identify probable environmental and community impacts. As the MWRRS will be funded by federal money, an environmental document is required. It is recommended that a Tier 1 EIS or a Programmatic EIS (PEIS) be undertaken to enhance the efficiency of conducting environmental reviews of large-scale projects. The PEIS serves as an initial screen by which various levels of environmental review, as defined by the National Environmental Policy Act (NEPA) are identified. For instance, PEIS screening identifies areas which are categorical exclusions, and provides the justification for this recommendation. This programmatic process also identifies those project areas that might require environmental assessments as well as components of the project that might necessitate full environmental impact review.

Aside from these purposes, the PEIS would also provide the federal review agencies and each MWRRRI state with a composite picture of sensitive, moderately sensitive, and not sensitive project segments. This level of analysis lays the groundwork for further environmental review and report preparation.

An important aspect of the PEIS for the MWRRS would be the Purpose and Need Statement, particularly the MWRRRI's background and legislative history. The Purpose and Need Statement will tie together the evolution of the project by citing all its completed technical reports, policies and related governmental efforts. The Purpose and Need Statement will be the basis of future Tier 2 documents resulting from the PEIS.

### ***Public Involvement for the PEIS***

The public involvement process will communicate the history of the MWRRRI, the future segments of the study process, and the findings of the PEIS. The basis of the public involvement approach begins with the preparation of a PEIS for the MWRRS. Specific tasks during the public involvement segment of the study should include a community advisory committee (CAC) with responsibility to develop an effective community involvement program and a technical advisory committee (TAC) representing federal, state and local agencies. Community information activities need to be developed to include presentation graphics, a study newsletter, study area displays, question logs and media liaisons. Finally, a web portal should be used for efficiently educating the public about the project and notification of on-call public meetings and hearings.

## ***5.2.6 Infrastructure Capital Costs***

### ***Infrastructure Cost Assumptions***

Estimates of the capital investment needed for each route were developed by applying unit costs to civil engineering quantities based on the conceptual planning of each route option for a given technology. The quantities were developed, without detailed surveys, from initial engineering analyses, existing large-scale mapping and limited site verification.

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The unit costs are detailed herein by infrastructure element. These unit costs include 7 percent for engineering and 15 percent for contingencies on infrastructure costs. In addition, the following items were included in the unit costs:

- 3 percent for a program manager and/or a general engineering consultant
- 4 percent for construction inspection/management during construction
- 2 percent for owner's management costs such as alternative analyses and environmental studies

A conceptual planning process was used to estimate the capital investment required for each route. The initial step was to identify the elements of the existing route infrastructure, (*i.e.*, track structures, stations, terminals and maintenance facilities, turnouts, bridges-under, bridges-over, crossings, signals and curves.)

Each infrastructure element includes several items requiring upgrading or construction to meet the route requirements of the selected passenger rail technology. The specific unit costs for each element of work are identified in Exhibit 5-6.

### ***Infrastructure Cost Estimates***

The infrastructure cost analysis was performed by applying the unit cost for an item of work to the physical quantity associated with each item of work. The estimated infrastructure cost by corridor and major system-wide facilities are given in Exhibit 5-7. The breakdown of these costs by segments within each route and the detail on the items of work are shown in Appendix A9.

St Louis-Kansas City segment costs have been subject to ongoing engineering analysis. The original estimate of \$314 million was for the St Louis-Kansas City track condition and signalling system upgrades only. After completing a line capacity analysis, TEMS recommended further improvements and added a placeholder cost of \$578 million for line capacity upgrades. This total placeholder cost of \$893 million was used in development of the Financial Plan, subject to field verification.

**Exhibit 5-6**  
**Unit Capital Costs by Infrastructure Element**

<i>Item No.</i>	<i>Description</i>	<i>Unit</i>	<i>2002 Unit Cost (Thousands \$)</i>
<b><i>Trackwork</i></b>			
1.1	110-mph on Existing Roadbed	per mile	\$ 993
1.2a	110-mph on New Roadbed	per mile	\$ 1,059
1.2b	110-mph on New Roadbed and New Embankment	per mile	\$ 1,492
1.2c	110-mph on New Roadbed and New Embankment (Double Track)	per mile	\$ 2,674
1.3	Timber and Surface w/ 33% Tie replacement	per mile	\$ 222
1.4	Timber and Surface w/ 66% Tie Replacement	per mile	\$ 331
1.5	Relay Track w/ 136# CWR	per mile	\$ 354
1.6	Freight Siding	per mile	\$ 912
1.65	Passenger Siding	per mile	\$ 1,376
1.71	Fencing, 4 ft Woven Wire (both sides)	per mile	\$ 51
1.72	Fencing, 6 ft Chain Link (both sides)	per mile	\$ 153
1.73	Fencing, 10 ft Chain Link (both sides)	per mile	\$ 175
1.74	Decorative Fencing (both sides)	per mile	\$ 394
1.8	Drainage Improvements	per mile	\$ 66
1.9a	Land Acquisition – Urban	per mile	\$ 327
1.9b	Land Acquisition – Rural	per mile	\$ 109
<b><i>Curves</i></b>			
9.1	Elevate and Surface Curves	per mile	\$ 58
9.2	Curvature Reduction	per mile	\$ 393
9.3	Elastic Fasteners	per mile	\$ 82
9.5	Realign Track for Curves	lump sum	
<b><i>Signals</i></b>			
8.1	Signals for Siding w/ High-Speed Turnout	each	\$ 1,268
8.2	Install CTC System (Single Track)	per mile	\$ 183
8.21	Install CTC System (Double Track)	per mile	\$ 300
8.3	Install PTC System	per mile	\$ 197
8.4	Electric Lock for Industry Turnout	each	\$ 103
8.5	Signals for Crossover	each	\$ 700
8.6	Signals for Turnout	each	\$ 400
<b><i>Stations / Facilities</i></b>			
2.1	Full Service – New	each	\$ 1,000
2.2	Full Service – Renovated	each	\$ 500
2.3	Terminal – New	each	\$ 2,000
2.4	Terminal – Renovated	each	\$ 1,000
2.5a	Maintenance (110-mph technology)	each	\$ 10,000
2.5b	Maintenance (150-mph technology)	each	\$ 86,000
2.5c	Maintenance (185-mph technology)	each	\$ 162,000
2.5	Maintenance Facility	each	\$ 45,351
2.6	Layover Facility	lump sum	varies
2.7	Service and Inspection Facility	lump sum	<b>varies</b>

<b>Turnouts</b>			
4.1	#24 High-Speed Turnout	each	\$ 450
4.2	#20 Turnout Timber	each	\$ 124
4.3	#10 Turnout Timber	each	\$ 69
4.4	#20 Turnout Concrete	each	\$ 249
4.5	#10 Turnout Concrete	each	\$ 118
4.6	#33 Crossover	each	\$ 1,136
4.7	#20 Crossover	each	\$ 710
<b>Bridges-Under</b>			
5.1	Four Lane Urban Expressway	each	\$ 4,835
5.2	Four Lane Rural Expressway	each	\$ 4,025
5.3	Two Lane Highway	each	\$ 3,054
5.4	Rail	each	\$ 3,054
5.5	Minor river	each	\$ 810
5.6	Major River	each	\$ 8,098
5.65	Double Track High (50') Level Bridge	per LF	\$ -
5.70	Rehab for 110	per LF	\$ 14
5.71	Convert Open Deck Bridge To Ballast Deck (Single Track)	per LF	\$ 4.7
5.72	Convert Open Deck Bridge To Ballast Deck (Double Track)	per LF	\$ 9.4
5.73	Single Track on Flyover Structure	per LF	\$ 6
5.8	Single Track on Approach Embankment w/ Retaining Wall	per LF	\$ 3
	Ballasted Concrete Deck Replacement Bridge	per LF	\$ 2.1
	Land Bridges	per LF	\$ 1.5
<b>Bridges-Over</b>			
6.1	Four Lane Urban Expressway	each	\$ 2,087
6.2	Four Lane Rural Expressway	each	\$ 2,929
6.3	Two Lane Highway	each	\$ 1,903
6.4	Rail	each	\$ 6,110
<b>Crossings</b>			
7.1	Private Closure	each	\$ 83
7.2	Four Quadrant Gates w/ Trapped Vehicle Detector	each	\$ 492
7.3	Four Quadrant Gates	each	\$ 288
7.31	Convert Dual Gates to Quad Gates	each	\$ 150
7.4a	Conventional Gates Single Mainline Track	each	\$ 166
7.4b	Conventional Gates Double Mainline Track	each	\$ 205
7.41	Convert Flashers Only to Dual Gate	each	\$ 50
7.5a	Single Gate with Median Barrier	each	\$ 180
7.5b	Convert Single Gate to Extended Arm	each	\$ 15
7.71	Pre-cast Panels without Roadway Improvements	each	\$ 80
7.72	Pre-cast Panels with Roadway Improvements	each	\$ 150
7.8	Michigan Type Grade Crossing Surface	each	\$ 15

### 5.2.7 Conclusion

Based on this engineering review and refinement process, the infrastructure improvements required to implement the MWRRS are estimated to cost \$6.6 billion. The infrastructure cost estimate shown in Exhibit 5-7 was increased in the latest analysis due largely to changes in routes, increases in operating speeds, and improvements to accommodate freight rail capacity needs. Major capital improvements include right-of-way modifications to track and track alignments to support 110-mph train speeds and to accommodate freight and commuter rail activity, plus upgrades to stations, highway/railroad grade crossings and signaling and communication systems.

**Exhibit 5-7  
Summary of Infrastructure Capital Costs by Route<sup>2</sup>**

<i>No.</i>	<i>Route</i>	<i>Cost Estimate \$2002 (thousands)</i>
a	Chicago Terminal Area	\$ 1,152,115
b	System Maintenance Facility	\$ 45,351
c	Chicago Union Station	\$ 15,000
1	Porter-Detroit / Pontiac	\$ 329,771
2	Battle Creek-Port Huron	\$ 67,029
3	Kalamazoo-Grand Rapids / Holland	\$ 27,178
4	Tolleston-Cleveland	\$ 1,087,640
5	Tolleston-Cincinnati	\$ 507,468
6	Grand Crossing-Carbondale	\$ 219,878
7	Joliet-St. Louis	\$ 243,256
8	St. Louis-Kansas City <sup>3</sup>	\$ 893,110
9	Aurora-Quincy	\$ 257,362
10	Wyandot-Omaha	\$ 360,207
11	Rondout-St. Paul	\$ 1,049,791
12	Milwaukee-Green Bay	\$ 311,717
13	Ticket Machines <sup>4</sup>	\$ 5,300
<b>Total</b>		<b>\$ 6,572,171</b>

<sup>2</sup> Cost estimates in Exhibit 5-7 match the HNTB detail cost spreadsheets. Infrastructure costs in Exhibits 8-4 and 8-5 allocate the costs of Chicago Terminal Area improvements to each route, thereby giving higher costs than are shown in for each route in Exhibit 5-7

<sup>3</sup> The original estimate of \$314 million was for St. Louis-Kansas City track condition and signalling upgrades; a placeholder cost of \$578 million was added for line capacity upgrades based on a unit-costing approach. This total cost of \$893 million in the current MWRRS Financial Plan is subject to revision as additional engineering work is completed on the proposed improvements.

<sup>4</sup> An additional \$5.3 million Placeholder Cost was added to this capital cost estimate to provide for the cost of adding a ticket machine at each of the 101 MWRRS stations, plus 5 machines at CUS, at \$50,000 per machine.