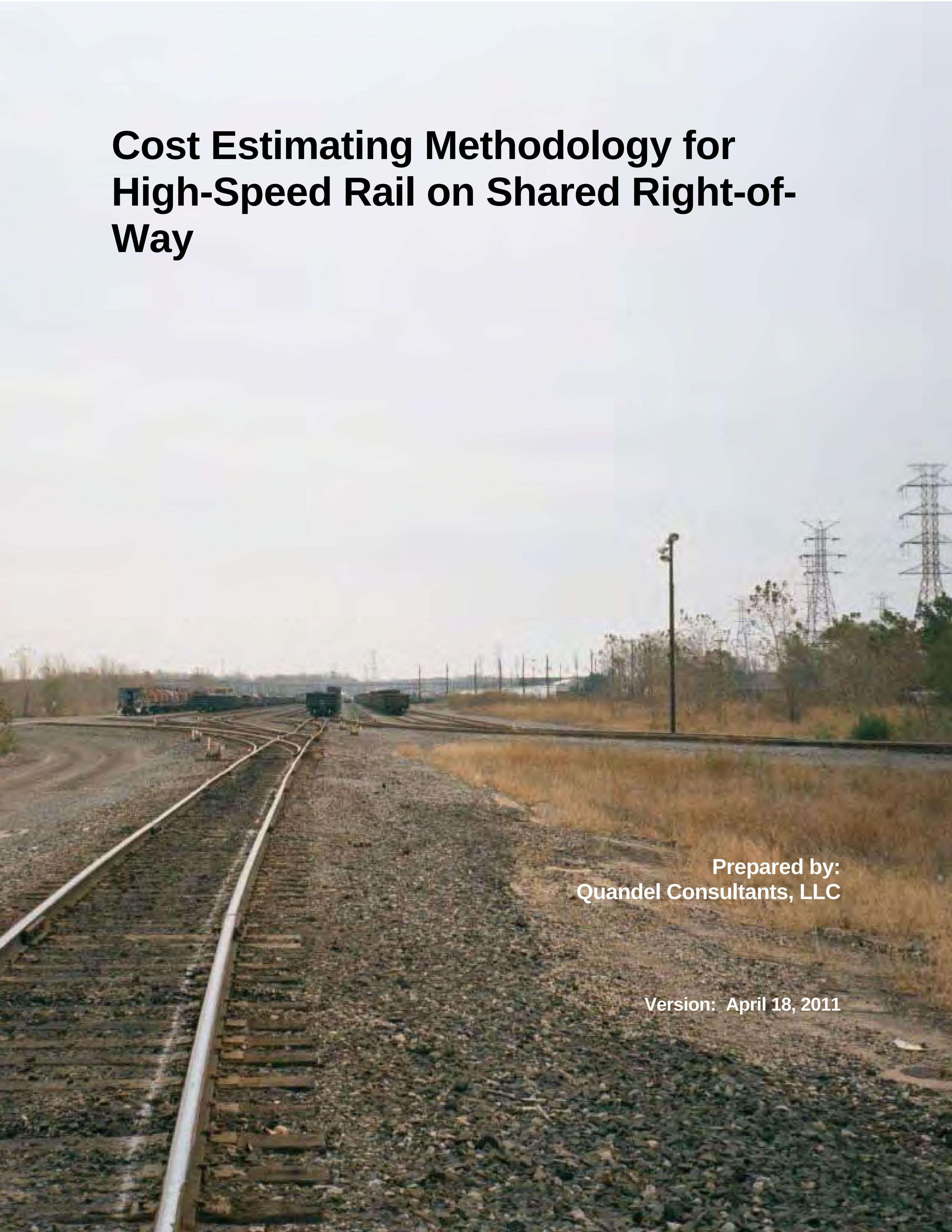
Appendix E – Cost Estimating Methodology for High-Speed Rail on Shared Right-of-Way



Cost Estimating Methodology for High-Speed Rail on Shared Right-of-Way

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Table of Contents

1. Introduction

This document provides a written methodology for establishing unit costs for pay items related to the proposed construction of high speed rail corridors on shared right-of-way and for the formulation of conceptual cost estimates for the reasonable alternatives and preferred alternative for the following projects:

- Midwest Regional Rail Initiative (MWRRI) Phase 7
- Northern Lights Express (SRF Consulting is Prime Consultant)
- Ohio PEIS (AECOM is Prime Consultant)
- Milwaukee-Twin Cities Identification of Reasonable Alternatives

These unit costs have been developed for route comparison purposes. Since the cost for stations, support facilities, and vehicles will remain essentially similar across the routes being compared, they have not been viewed as "discriminators" in the evaluation of the alternative routes and are not included in this discussion.

The cost estimates to be developed will be approached as a high level conceptual effort based on limited information regarding overall track and infrastructure conditions, railroad operations, and input from the owning railroad(s). The validity of these estimates rests on the assumptions that information gained from available railroad track charts and timetables, aerial mapping, input from state departments of transportation and visual observations of the railroads made from publicly accessible locations combined with the unit costs developed within this methodology will serve as a starting point for the continuing development of costs associated with proposed HSIPR programs.

The project team originally developed unit costs for the design and construction of high-speed passenger rail infrastructure on a series of previous planning projects. Initially the unit costs were applied to planned construction in the Midwest as a part of the Midwest Regional Rail Initiative. Later the costs were applied to capital cost estimates for high-speed rail in Florida, Ohio, Minnesota and Colorado.

The unit costs used for this effort were developed over time from detailed breakdowns of the units into their basic elements. The costs related to material, labor, equipment and overhead for these elements were accumulated and rolled up to provide an inclusive unit cost for the various components required to develop a high speed rail system. The unit costs have been refreshed and refined periodically to update them for inflation and changes in the approach to infrastructure development and technology. Most recently, on April 13, 2010, Quandel Consultants prepared a Technical Memorandum (Attached as Appendix A) outlining a strategy to update capital costs being used within the MWRRI. The unit costs employed by the MWRRI were originally developed as part of MWRRI Phase 3B in 1997. Those unit costs were based on previous high speed rail feasibility studies available at that time and cost information provided by Amtrak. Since then, each of the unit costs was updated to 2002 dollars, which were the most recent costs available for the MWRRI at the time of the update. Most recently, these 2002 costs have been updated to 2009 dollars using the inflation factors listed in the Producer Price Index (PPI) PCUBHVY 'PPI Inputs for Other Heavy Construction', which increased unit costs from 2002 by a factor of 1.43 (October 2009 was the most recent month for which PPI data was available at the time of the update).

For this cost methodology, the unit costs were updated to 2010 dollars. By again using the PPI, it was determined that March 2010 dollar values could be obtained by increasing the 2009 unit costs by an inflation factor of 1.035 (March 2010 was the most recent month for which PPI data was available at the time of this writing). Once the 2010 unit costs were derived, they were compared to current year industry cost estimates for railroad related construction; during this comparison, if a unit cost was found to be out of line with current trends, it was adjusted to better reflect current conditions in the market. The pay items and their associated unit costs were then reviewed for their applicability to the four projects mentioned above. Some of the line items were found to be not applicable to this effort and were removed; in a few cases, line items had to be added to completely address the infrastructure development being proposed for the HSR system. See Appendix B for the updated unit costs.

The revised base set of unit costs addresses typical passenger rail infrastructure construction elements expected to be found within proposed and future projects including: roadbed and trackwork, systems, facilities, structures, and grade crossings. The Unit Costs are reasonable for developing the capital costs under either normal contractor bidding procedures or under railroad force account agreements for construction.

2. Trackwork

The development of intercity passenger corridors with train operations up to 110 mph will require that the track and associated infrastructure have the ability to support the proposed speeds. Typically, freight operations occur over track complying with FRA Classes I through IV, allowing maximum speeds of 60 mph for freight and 79 mph for passenger trains; higher speed passenger operation will require track that complies with the requirements of FRA Classes V (80 mph for freight trains, 90 mph for passenger trains) & VI (110 mph for passenger trains and freight trains complying with 49 CFR Part 213.307, note 1)[1]. This means that existing tracks that will be required to support both passenger & freight operations will need to be upgraded and that new track will need to meet the higher standards required for operation at the speeds under consideration.

2.1. Design considerations

- Maximum speed on all routes will be 110 mph.
    - Where additional tracks are to be added and track center spacing of 30' cannot be provided, track speeds in excess of 79 mph will only be allowed as negotiated with the host railroad.
- For development of shared passenger & freight service operating on an existing corridor of a Class I Railroad, an additional main track will be constructed where freight levels require it.
    - For single track corridors with freight levels at and above twenty trains per day, an additional main track will be provided
    - Within corridors with two existing main tracks, freight levels of forty or more trains per day indicate the need for an additional main track
- For single track corridors where freight levels are below twenty trains per day passing sidings will be provided at regular intervals appropriate for the operations proposed:
    - 3 mile long sidings at nominal 20 mile intervals will be built for the use of freight trains being passed or meeting passenger trains. #15 turnouts within a Control Point will be used at each end of these sidings. A 500' Maintenance of Way spur will be added to these sidings. Sidings will be located to minimize excavation required for their construction.

[1] Department of Transportation, Federal Railroad Administration 49 CFR Part 213 Track Safety Standards; Final Rule June 22, 1998

- In single track territory on in double track segments where commuter trains operate, ten mile long sidings at nominal 50 mile intervals will be built for the use of passenger trains passing or meeting. #33 turnouts within a Control Point will be used at each end of these sidings. Sidings will be located to minimize excavation required for their construction.

- Where two or more main tracks are in operation, a #20 universal crossover within a Control Point will be installed every 20 miles. When possible, the universal crossover will be included within the Control Point established for a freight siding and/or a passenger siding.
- Rehabilitation guidelines for passenger operations:
  - Rail of a section that is not CWR and of at least a section of 132RE or greater will be replaced with CWR with a section of 136RE or 141RE based on the standard rail section of the owning railroad.
  - Where rail is to be replaced, it will be assumed that the new CWR noted will be of the standard section in use by the owner of the corridor segment being considered
  - Existing Class IV track will have at least 33%of the existing ties replaced and otherwise meet the requirements of Class V or VI track.
  - Existing Class III track will have at least 66% of the existing ties replaced and otherwise meet the requirements of Class V or VI track.
  - Existing Class I & II track will be removed & completely rebuilt from the subgrade up
  - Where appropriate, the track will be elevated and surfaced to address curvature issues related to operating speed and superelevation. As a placeholder, 10% of the corridor length will be assumed to require this effort.
- Fencing will be provided throughout the length of the route.
  - In municipalities, decorative fencing will be used.
  - At grade crossings and in residential areas, chain link fence will be provided.
  - Woven wire fencing will be used in all other locations.
- It is assumed that 25% of the existing private crossings within a corridor segment will be closed:
- The remaining private crossings will require the installation of crossing warning devices, at a minimum, flashers and gates
- Public crossings will require the presence of four quadrant gates at a minimum

2.2. New Track Construction

Where new track will be constructed within this program the primary unit of cost will be “HSR Track”. This unit is based on the typical section of the host railroad and is composed of the following:

- New 136 or 141 lb. Continuous Welded Rail
- 7” x 9” x 8’6” timber crossties spaced at 19.5” C-C, which results in 3249 per mile
  - 9”x11”x8’6” concrete ties can be used in place of timber crossties when needed; over recent years, relative costs have become closer and at times, scarcity of timber crossties in the market has led to concrete crossties becoming the only choice available. Concrete crossties are generally placed at 24” C-C, which results in 2640 per mile
- Two-13” double shouldered tie plates, four rail anchors, and eight track spikes (or corresponding rail seats and elastomeric fasteners) per tie
- 12” of Granite ballast (AREMA #4) placed to support the proper vertical and horizontal track alignment.

Depth of ballast is measured at the center of the tie. Additional ballast will be placed to fill the cribs between the ties and provide a ballast shoulder on the outside of each tie per the typical section required by the owning railroad.

The following figures depict railroad typical track sections:

Figure 1 – Typical Section - Single Main Track

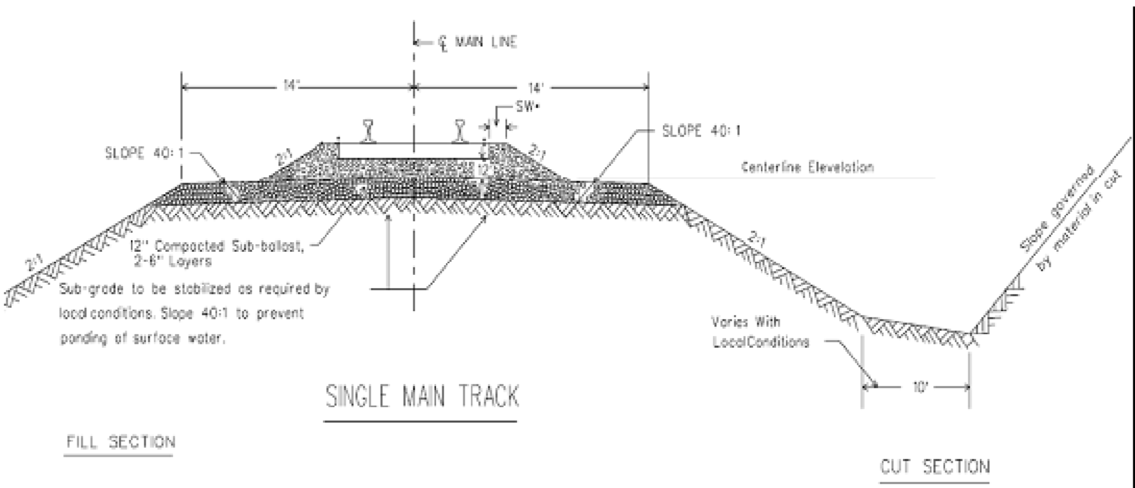


Figure 2 – Cross Section of a Double Main Track on Existing Roadbed

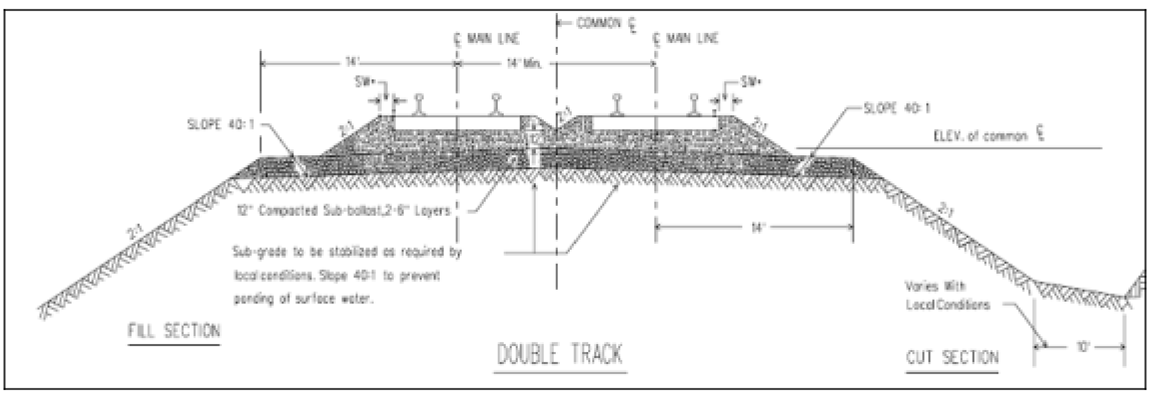
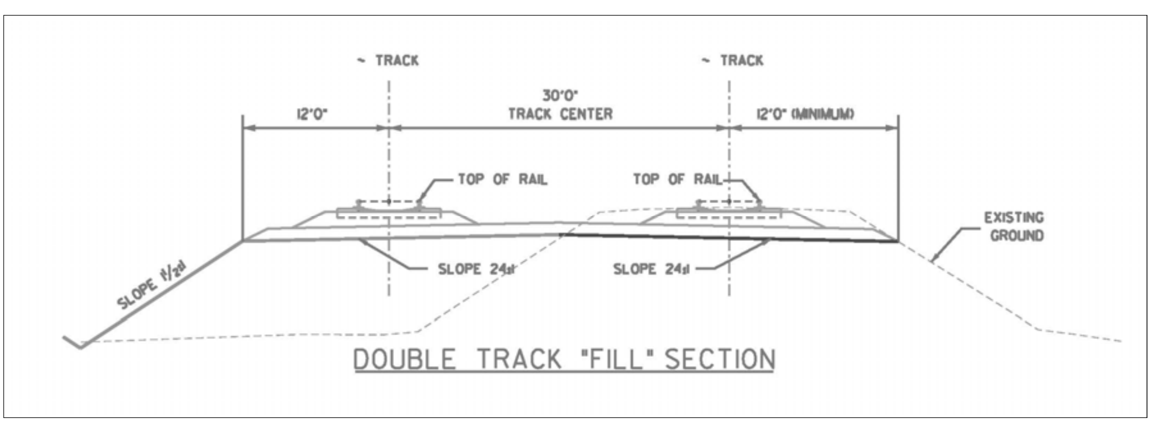


Figure 3 – Typical Section - Double Main Track on New Roadbed



2.2.1. HSR on Existing Roadbed

HSR on Existing Roadbed addresses the installation of a new track on an existing roadbed within an existing railroad right of way where track(s) has been removed. If there is an existing track present in the right of way, the new track will be built at an appropriate distance from it, generally using the same track centers as had been used before the historic second track had been removed. The track center to center distance is typically 14'. If there is no track in place, the new track will generally be centered in the right of way per the operating railroads typical track section. The work consists of leveling the roadbed, maintaining existing drainage, and placing a 6" ballast pad prior to track construction. "HSR Track" will be constructed on this base and the remaining 6" required ballast will be installed to allow final alignment and surfacing of the new track. The unit cost for this item is $1,123,000 per mile.

2.2.2. HSR on New Roadbed

HSR on New Roadbed is similar to the above, but requires subgrade preparation and the placement of 12" of compacted subballast before a ballast pad or the new track can be constructed. The unit cost for this item is $1,380,000 per mile.

2.2.3. HSR on New Roadbed with 30' Offset from Existing Track Centerline

This work item is used when building new HSR Track adjacent to an existing single or multiple main track system where the host railroad requires a minimum offset from existing operations; generally the minimum center to center offset is greater than 25' with the preferred offset being 30' from existing operations.

This work typically requires embankment widening and may also require property acquisition. Once the embankment work is completed, placement of 12" of compacted subballast, a ballast pad and the new track can be constructed. The unit cost for this item is $1,550,000 per mile.

2.2.4. HSR on New Roadbed & New Embankment

2.2.5. HSR on New Roadbed & New Embankment (Double Track)

These units are to be used when building track for HSR where no track or railroad right of way is present, or when the required track center distance to an existing freight operation places the proposed new track outside the limits of the existing roadbed and/or right of way limits. The work consists of site clearing the full width of additional roadbed or right of way (a minimum of 25 feet in width for single track and 50 feet in width for double track), preparing the subgrade (up to 5 feet above the surrounding ground elevation), establishing drainage patterns or maintaining existing drainage, and placing 12" of sub-ballast. "HSR Track" will then be constructed on this base. The unit costs for these items are $1,687,000 per mile for single track and $3,024,000 per mile for double track.

2.2.6. HSR Double Track on 15' Retained Earth Fill - This unit will be used when topographic conditions require an embankment to support the new track but the proper top of rail elevation cannot be provided within the existing right of way by an embankment using a standard 2:1 slope. The work consists of site clearing, building retaining walls to an average height of 15', placing properly compacted backfill material, providing for drainage, and placing 12" of sub-ballast on the retained earth fill. "HSR Track" will then be constructed on this base. The unit cost for this item is $15,972,000 per mile.

2.2.7. 3 Mile Long Freight Siding

2.2.8. 10 Mile Long Passenger Siding

This work consists of site clearing the full width of additional right of way required for the siding, generally 50 feet in width, preparing the roadbed and, maintaining existing drainage, and placing 12" of sub-ballast. "HSR Track" will then be constructed on this base. A #15 turnout will be installed at each end of a freight siding and a #33 turnout will be installed at each end of a passenger siding.

Separately, a 500' spur track, accessible via a #10 turnout, will be added to each freight siding (see section 6.2.2). A new Control Point will be established at each end of the proposed siding including access roadway (see section 6.2.1), and the new siding will be signalized and incorporated into the existing signal system in place on the adjacent main track.

The unit costs (for track construction only) are $4,288,000 for a 3 Mile Long Freight Siding and $14,496,000 for a 10 Mile Long Passenger Siding. New Control Point, M/W Spur & Roadway Access are added to the cost estimate in Sections 4 & 6 and not included in this Unit of Cost.

Note: for sidings in multiple track territory, a crossover (or crossovers) must be added to the new Control Points at both ends of the new siding to allow a train to access the siding from either track. For freight sidings, use a #15 crossover, for passenger sidings, use a #33 crossover. In addition to the crossover, signal work must be provided separately to add the additional trackwork to the signal system (Section 4).

2.3. Turnouts & Crossovers - This work includes:

- Removal and reclamation of the standard track section where the turnout or crossover will be placed
- Leveling of the roadbed and removing & stockpiling excess ballast for re-use
- Installation of a switch panel (or assembly and installation of a switch package) which includes all rods, plates, anchors, fasteners, 136/141 lb rail, switch points, stock rails, frog and wood or concrete ties and field welds to place the turnout into operation
- Ballast – placed to ensure 12" under the ties
- Filter fabric for the footprint of the turnout to be installed
- Track surfacing to ensure proper vertical and horizontal alignment of the turnout and the track that it is connected to
- Provision of a measure to protect the operating components of the turnout from freezing due to snow and ice: these include but are not limited to hot or cold air blowers and electric cal-rod heaters
- Crossovers will include a section of track (after the frogs of each turnout) with special timbers used until the track separates enough to allow standard "HSR Track on New Roadbed" to be constructed completing the connection between the opposite ends of the crossover.

The various types of turnouts to be used for HSR are:

2.3.1. <u>#33 Turnout - Timber Ties</u> - The unit cost for this item is $696,000 each.

2.3.2. <u>#24 Turnout - Timber Ties</u> - The unit cost for this item is $509,000 each.

2.3.3. <u>#20 Turnout – Timber Ties</u> - The unit cost for this item is $183,000 each.

2.3.4. <u>#15 Turnout – Timber Ties</u> - The unit cost for this item is $148,000 each.

2.3.5. #10 Turnout – Timber Ties - The unit cost for this item is $105,000 each.

2.3.6. 16'6" Double Switch Point Derail – Timber Ties- The unit cost for this item is $34,000 each.

2.3.7. #20 Turnout – Concrete Ties - The unit cost for this item is $282,000 each.

2.3.8. #15 Turnout – Concrete Ties - The unit cost for this item is $155,000 each.

2.3.9. #10 Turnout – Concrete Ties - The unit cost for this item is $133,000 each.

2.3.10. #33 Crossover - The unit cost for this item is $1,285,000 each.

2.3.11. #20 Crossover -The unit cost for this item is $563,000 each.

2.4. Track Improvements

Based on the above discussion, several categories of track improvements and types of track construction have been developed within MWRRI. These categories form the basis for the MWRRI Unit Costs and are discussed below.

2.4.1. Tie & Surface w/ 33% Tie Replacement - This work consists of removing 1/3 of the ties and replacing them with new ties. Additionally, 600 tons of ballast per mile will be placed to support the tie renewal. Assuming 19.5" tie spacing and 3249 ties per mile, this would result in the renewal of 1083 ties per mile. The unit cost for this item is $251,000 per mile.

2.4.2. Tie & Surface w/ 66% Tie Replacement - This work consists of removing 2/3 of the ties and replacing them with new ties. Additionally, 600 tons of ballast per mile will be placed in the work area to support the tie renewal. Assuming 19.5" tie spacing and 3249 ties per mile, this would result in the renewal of 2166 ties per mile. The unit cost for this item is $374,000 per mile.

2.4.3. Relay Rail with 136/141 # CWR - This work consists of removing existing rail, spikes, plates, and anchors and installing new 136 or 141 lb CWR and appropriate plates, fasteners and longitudinal restraints on existing crossties. The unit cost for this item is $400,000 per mile.

2.4.4. Surface Curves and Adjust Superelevation - The work consists of mechanized tamping of the track to provide a continuously smooth running surface for trains. The spirals and superelevation within the full body of the curves are to be adjusted to the degree required for increased operating speed. The trackwork will require the placement of approximately 1200 tons (976 cubic yards) of ballast per mile of track. It is assumed that appropriate tie renewal has taken place before the curves are adjusted. The unit cost for this item is $66,000 per mile.

2.4.5. Curvature Reduction - The work consists of designing and constructing a new track alignment through curved sections of existing track that will better support the operation of higher speed passenger trains. In the field this means that track will be realigned using special mechanized equipment designed for this purpose. The realignment will consist of adjusting the tangent–spiral–curve–spiral–tangent relationship which includes reducing the existing degree of curvature and lengthening the spirals in some locations. The realignment will require limited grading and sub-ballast placement to allow the track to be moved. The trackwork will require the placement of approximately 1200 tons (976 cubic yards) of ballast per mile of track. It is assumed that appropriate tie renewal has taken place before the curves are adjusted. The unit cost for this item is $444,000 per mile.

2.4.6. Elastic Rail Fasteners - This work includes removing and reclaiming existing tie plates, cut spikes and rail anchors, and installing two specialized tie plates with pad, eight lag screws, and four elastomeric clips per tie. This improvement is applied in curves in high speed territory to reduce future maintenance required to keep track in proper alignment and gauge. The unit cost for this item is $93,000 per mile.

2.5. Site Work Related to HSR Track Construction

2.5.1. Highway Barrier Type 5

2.5.2. Highway Barrier Type 6

This work includes the installation of a concrete roadside barrier for highways that run parallel to a railroad and are within 50' of the railroad centerline. The barrier shall meet the requirements of Test Level 5 or Test Level 6 as established in NCHRP Report 350. Type 5 (Test Level 5) is to be used in straight roadway sections and Type 6 (Test Level 6) is to be used in curved roadway sections. The AASHTO Roadside Design Guide shall be used to select the type of barrier that meets the NCHRP standards. The cost of these pay items include all materials and installation of the barrier per lineal foot. The unit costs for these items are $200 per LF for Type 5 barriers, and $1,300 per LF for Type 6 barriers.

2.5.3. Fencing, 4 ft Woven Wire (both sides of the railroad right of way) - This work includes the installation of 4 ft galvanized steel woven wire right-of-way fencing. Included in the cost are the fencing and post materials, clearing and grubbing of the area at the right-of-way line, and installation costs. The unit cost for this item is $58,000 per mile.

2.5.4. Fencing, 6 ft Chain Link (both sides of the railroad right of way) - This work includes the installation of 6 ft galvanized steel chain link right-of-way fencing. Included in the cost are the fencing and post materials, clearing and grubbing of the area at the right-of-way line, and installation costs. The unit cost for this item is $173,000 per mile.

2.5.5. Fencing, 10 ft Chain Link (both sides of the railroad right of way) - This work includes the installation of 10 ft galvanized steel chain link right-of-way fencing. Included in the cost are the fencing and post materials, clearing and grubbing of the area at the right-of-way line, and installation costs. The unit cost for this item is $198,000 per mile.

2.5.6. Decorative Fencing (both sides of the railroad right of way) - This work includes the installation of decorative right-of-way fencing. The type of fencing will be determined by the municipality in which the fence is installed. Included in the cost are the fencing and post materials, clearing and grubbing of the area at the right-of-way line, and installation costs. The unit cost for this item is $446,000 per mile.

2.5.7. Drainage Improvements (cross country) - This work includes the installation of drainage pipe, assumed to be a maximum of 30" in diameter, at locations where new track or track sidings will be installed and/or embankment widened. It is assumed that 2 drainage pipes per mile of improvements will be installed. The unit cost for this item is $75,000 per mile.

2.6. Land Acquisition - To estimate land values, two units have been identified:

2.6.1. Land Acquisition Rural (e.g., farmland)

2.6.2. Land Acquisition Urban (e.g., high density residential, commercial, and industrial areas)

- Where the alignment falls within an existing railroad or publicly-owned right-of-way it has been assumed that no land acquisition cost will be required for that particular right-of-way.
- Where the geometric requirements take the alignment outside of the railroad or publicly owned right of way, it has been assumed that additional right-of-way, a minimum of 50' in width, will be needed for cases where land is required to expand an existing right-of-way.
- The cost development for land acquisition assumes the need for a strip of land 50' wide by 1 mile long, roughly 6.06 acres. The per acre cost for land acquisition for urban and rural settings in MN & WI was obtained from local sources.
- The unit cost for Land Acquisition – Rural is $185,680 per mile; for Land Acquisition – Urban, the cost is $557,580 per mile.

3. Structures

Similar to track infrastructure, bridges and structures will require significant capital investment to provide the capability to support new HSR passenger service on new alignments, new passenger service on existing or historical freight lines, or combined passenger & freight service along existing freight lines.

3.1. Design Considerations

General design considerations have been established to guide conceptual planning and are listed below.

- Bridges generally include superstructure, substructure, appropriate wing walls and embankment retention systems, and approach treatments in both directions from the bridge
- All timber pile trestle bridges will be completely replaced with the appropriate new bridge type based on the owning railroads standards for the operation or AREMA suggested practices
- Other than wooden structures within an existing rail corridor, structures will be rehabilitated for use as part of the proposed HSR system where possible and practical to bring them into a state of good repair. It is assumed that rehabilitation will take place where the rehabilitation cost is less than or equal to 50% of the cost of bridge replacement. Rehabilitation could include pointing of stone abutment walls, repair of spalling concrete, painting of bridges, waterproofing and replacement of bearings.
- In areas where the proposed service will allow the use of the historical track centers between an unoccupied roadbed and an adjacent existing and operating track (double track right of way), all bridges for both the existing and proposed track alignments will be rehabilitated to the required level of service or be replaced
- In areas where the proposed service will travel under existing bridges carrying highway, railroad or pedestrian traffic over the alignment, the addition of a new track at various track centers may be infeasible due to insufficient portal opening to accommodate the new track. In these instances, the overhead bridge will be replaced to accommodate the proposed alignment.
    - In some cases, it may be possible to modify the piers, abutments and other structural features of the existing overhead bridge to accommodate the new track. However, the extent to which this will be possible requires more a more detailed engineering study which is not conducted at the conceptual level. Since that is the case, a conservative assumption is made that unless there is a clear indication that the existing portals will allow the construction of a new track or tracks, the overhead structure will be replaced.

- Tunnels and very large river bridges will maintain the existing number of tracks at the existing track centers. At these locations in single track territory, a 3 mile long siding will be provided for freight trains on either side of the tunnel or bridge.
- In areas where the proposed alignment prevents the use of existing bridges or where there are no existing bridges, new bridges will be built as needed.

Structure Categories

Structures expected for the development of HSR include bridges that carry the railroad over an environmental feature, for instance, a river; these bridges are categorized as “undergrade”. Bridges that carry an environmental feature over a railroad, for instance, a two lane highway, are categorized as “overhead”. Additionally, other structures such as tunnels, structural culverts and retaining walls are included in this section. The type size and location of these structures will be determined during Preliminary Engineering; for these conceptual cost estimates, general categories of structures and their unit costs have been developed based on their function and an estimate of required cross section and approximate cost per square foot and are listed below. These costs are for the structures and their typical components only; the cost of any track features must be priced separately.

3.2. Bridges – Undergrade

This group of unit costs is intended to capture the level of effort required to allow the addition of a new track parallel and adjacent to an existing track as it passes over a variety of obstacles in the environment. Generally, the work will include provision of new abutments or abutment extensions, necessary grading and earth retention system to control the embankment at the abutments, any new piers or pier modification necessary and the placement of a new superstructure and track on the substructure at these locations.

3.2.1. Four Lane Urban Expressway - The unit cost for this item is $5,468,000 each.

3.2.2. Four Lane Rural Expressway - The unit cost for this item is $4,552,000 each.

3.2.3. Two Lane Highway - The unit cost for this item is $3,454,000 each.

3.2.4. Rail - The unit cost for this item is $3,454,000 each.

3.2.5. Minor River – generally, this bridge type is less than 100’ between abutments with relatively short span lengths. The unit cost for this item is $916,000 each.

3.2.6. Major River - generally, this bridge type is up to several hundred feet between abutments with significant span lengths. The unit cost for this item is $9,158,000 each. Bridges having distances between abutments greater than several hundred feet should be included separately as a special allocation, specific to a given location.

3.2.7. Double Track High (50’) Bridge - The unit cost for this item is $14,000 per lineal foot.

3.2.8. Ballasted Deck Replacement Bridge - The unit cost for this item is $3,200 per lineal foot.

3.2.9. Rehabilitate Existing Bridge for Higher Passenger Speeds (90-110 mph) - The unit cost for this item is $1,580 per Lineal Foot

3.2.10. Convert open deck bridge to ballast deck (single track) - The unit cost for this item is $5,000 per lineal foot.

3.2.11. Convert open deck bridge to ballast deck (double track) - The unit cost for this item is $10,575 per lineal foot.

3.2.12. Single Track on Flyover/Elevated Structure - The unit cost for this item is $10,231 per lineal foot.

3.2.13. Double Track on Flyover/Elevated Structure - The unit cost for this item is $17,904 per lineal foot.

3.2.14. Land Bridges - The unit cost for this item is $3,000 per lineal foot.

3.3. Bridges – Overhead

This group of unit costs is intended to capture the level of effort required to allow the addition of a new track parallel and adjacent to an existing track as it passes under a variety of overhead bridges along the chosen route. Generally, the work will include modifications to the existing overhead structures to allow sufficient room for the new track to be added without causing close clearances or other problems in relation to the existing track and the existing overhead bridge.

3.3.1. Four Lane Urban Expressway - The unit cost for this item is $3,312,000 each.

3.3.2. Four Lane Rural Expressway - The unit cost for this item is $2,360,000 each.

3.3.3. Two Lane Highway - The unit cost for this item is $2,152,000 each.

3.3.4. Rail - The unit cost for this item is $6,909,000 each.

3.4. Other Structures

3.4.1. Culvert Extensions - This work includes the installation of a culvert extension in locations where a new track will be built parallel and adjacent to an existing track. The culvert extension consists of a new pipe starting at the end of the existing culvert and extending to the edge of the embankment that the new track will be built upon. The cost includes connection to the existing pipe, associated grading, headwall and embankment retention associated with the culvert. It is assumed that the extension will consist of a maximum size of 36" reinforced concrete pipe. One culvert extension will be installed per mile of improvements on average. The unit cost for this item is $58,000 per mile.

3.4.2. Single Track on Approach Embankment with Retaining Wall – This work is to be performed in cases where there are significant changes in the vertical alignment of a proposed new single HSR track approaching an existing or new structure over an obstacle in the environment. It consists of providing the proper combination of embankment and retaining wall to support the grade change of the single HSR track on both sides of the structure. The unit cost for Single Track on Approach Embankment with Retaining Wall is $5,115 per lineal foot.

3.4.3. Double Track on Approach Embankment w/ Retaining Wall - Similar to Single Track on Approach Embankment with Retaining Wall, Double Track on Approach Embankment with Retaining Wall addresses changes in vertical alignment as a new double HSR Track approaching an existing or new structure over an obstacle in the environment. The unit cost for this item is $9,378 per lineal foot.

3.4.4. <u>Two Bore Long Tunnel - The unit cost for this item is $45,540 per route foot.</u>

3.4.5. <u>Single Bore Short Tunnel - The unit cost for this item is $25,875 per lineal foot.</u>

4. Systems

In all instances where passenger rail service is proposed to operate at speeds between 79 mph and 110 mph, a Centralized Traffic Control (CTC) signal system must be provided. Additionally, for the service to comply with FRA safety requirements, a Positive Train Control (PTC) signal system must be provided by 12/31/2015. These systems are designed to allow safe service when passenger and freight operations are mingled as well as safe operations at higher speeds.

4.1. Design Considerations

General design considerations have been established to guide conceptual planning and are listed below.

- All signal elements include hardware and software to design, procure, install and operate the element under consideration. This includes "signals", "communications" & "dispatch" components which together make up the interactive remote controlled signal system.
- At all locations where a train can change from one track to another, or divert from the main track to a siding, yard or railroad using remote controlled switches, a Control Point (CP) must be established. The control point links the track infrastructure and circuitry to a communications network allowing the dispatcher to maintain or change the route of a given train, as well as allow it to proceed or cause it to stop. Significant components are the remotely controlled powered switch machine, cable connecting it to logical and relays and microprocessor based control and communication equipment housed in a wayside building, a communications link between the control point and the remote dispatcher, signals to provide a train approaching from any direction with visual indications governing its movement, and a provision of commercial electrical power and backup to operate the various elements.
- At locations where a connection to an rail served industry is required, protection must be provided so that a freight or passenger train cannot be unintentionally diverted into the industry track and also so that a railcar or other vehicle occupying the siding cannot access the main track without permission from the dispatcher controlling the main line railroad. Typically at these locations, a switch is installed and "electric lock" protection is provided at the switch. Along the siding, a derail is placed as a measure to prevent an uncontrolled movement from the siding to the main or vice versa. The electric lock prevents opening the switch without the knowledge of and direct permission from the dispatcher in charge of the railroad. When the switch is opened, the track circuitry "notifies" the dispatcher and wayside signals in either direction.
- Interconnection of railroad signal control equipment and traffic signal control equipment will be considered where a signalized highway intersection exists in close proximity to a railroad crossing. Interconnection allows the normal operation of the traffic signals controlling the intersection to be preempted to operate in a special control mode when trains are approaching (see MUTCD Sections 8D.07 and 10D.05). A preemption sequence compatible with railroad crossing active warning devices such as gates and flashing lights is extremely important to provide safe vehicular, pedestrian, and train movements. Such preemption serves to ensure

that the actions of these separate traffic control devices complement rather than conflict with each other."[2]

Since almost all locations where interconnection will be considered are unique in terms of physical placement of the highway and railroad, traffic volumes for each mode and other features particular to a location, the design of any interconnection will be different as will the costs. Additionally, owning railroads and local and state authorities are likely to have their own design preferences for interconnection and close coordination between the two will be required. For these reasons and the complexity of the subject, the development of a standard cost of interconnection is not included in this methodology.

- Following a series of deadly rail accidents at various locations in the U. S., Congress passed the Rail Safety Improvement Act of 2008 (RSIA08). The RSIA mandates that PTC systems be installed by December 31, 2015 on all railroad mainline tracks that carry intercity passengers, commuters, or are part of a Class I railroad system carrying at least 5 million gross tons of freight annually and carrying any amount of poison-or toxic-by inhalation (PIH or TIH) hazardous materials. The affected railroads were required to submit their PTC Implementation Plans to the FRA for approval by April 16, 2010. Forty railroads submitted PTC Implementation Plans and other related documents in response to that mandate.
- Several of the short lines and regional railroads whose routes may potentially become part of the MWRRI network did not submit PTC Implementation Plans to the FRA because they believed that their current operations did not meet the federal requirements to do so. Many of the short lines and regional railroads which will host MWRRI routes currently operate under Track Warrant Control (TWC) systems (also known as "dark territory") and do not now use higher level signal systems in their operations. For high speed passenger train operations over routes that are in this category, each involved short line or regional railroad will need to design and install a signal system as a foundation over which the PTC system can be overlaid. (All presently-proposed PTC systems are designed to be overlays to existing systems.)

4.2. Signal Categories

General signal categories have been developed based on their function and are discussed below.

4.2.1. Install CTC System (Single Track)

4.2.2. Install CTC System (Double Track)

This signal system will serve as a foundation for the FRA mandated PTC system overlay. Installation of a CTC system includes all communications and central dispatch equipment, track circuitry, and wayside signaling to control the flow of rail traffic to avoid safety issues and collisions between trains. The unit costs for these items are $207,000 per mile for single track and $339,000 per mile for double track.

4.2.3. Install PTC System

[2] PREEMPTION OF TRAFFIC SIGNALS NEAR RAILROAD CROSSINGS, INSTITUTE OF TRANSPORTATION ENGINEERS, ***DRAFT VERSION 10,*** July 1, 2003

Installation of a PTC System includes all communications and central dispatch equipment, track circuitry, and wayside signaling to comply with the requirements of the Rail Safety Improvement Act of 2008 (RSIA08) which calls for the implementation of PTC by 12/30/2015.

All presently-proposed PTC systems are designed to be overlays to existing systems and a stand-alone PTC system is not currently available. The railroads have submitted plans to FRA to use one or more of the following three PTC systems in the MWRRI service territory:

<u>ITCS</u>	Amtrak
<u>ETMS</u>	BNSF & KCT
<u>V-ETMS</u>	BNSF, Amtrak, CRSH, NICTD, KCT, CSX, NS, CN, KCS, TRRA, CP, Metra, & UP

The unit cost for this item is $177,000 per route mile.

4.2.4. <u>Electric Lock and Derail for Industry Turnout</u>

This work involves the installation of electric lock protection and associated derail at an industry turnout. The pay item includes costs for the electric lock and layout, the wayside case, foundation, and components within the case, commercial power and power connection materials, track connections, the double switch point derail and the battery, battery box and all wire connections. Additionally, the work includes intermediate signal modifications and track circuit modifications to tie the new Electric Lock Switch location into the existing signal system. The unit cost for this item is $116,000 each.

4.2.5. <u>New Control Point for an End of Siding Turnout – single track</u>

4.2.6. <u>New Control Point for an End of Siding Turnout and Crossover – double track</u>

4.2.7. <u>New Control Point for a Universal Crossover</u>

This work involves installing all power operated switch machines, hardware, software, communications, cabinets and housings, and commercial power to establish and operate a new Control Point (CP). Additionally, the work includes intermediate signal modifications and track circuit modifications to tie the new CP into the existing CTC signal system present on the tracks leading into the CP. The unit cost for:

- the new End of Siding CP in single track (for a turnout only) is $650,000,
- the new End of Siding CP in double track (for a turnout and crossover) is $1,296,000
- the new Universal Crossover CP is $1,619,000

4.2.8. Signal Work to Add a Turnout to an Existing Control Point

4.2.9. Signal Work to Add a Crossover to an Existing Control Point

This work involves installing all signal components needed to put the turnout, crossover, or combination of turnouts and crossovers into operation within the CP. Some of the included components are the power operated switch machine, associated controllers, wiring/cabling and hot air blowers. The unit costs for these items to be added to an existing CP are:

- $452,000 for each turnout
- $792,000 for each crossover

4.2.10. Traffic Signal Preemption

4.2.11. Traffic Signal Preemption & Intersection signalization

This work involves installing all signal components needed to provide traffic signal preemption and traffic signal preemption with intersection signalization at a highway railroad at-grade crossing and place the crossing warning system in service. Some of the included components are the power drop, associated controllers, communications, and wiring/cabling and housing for the required equipment. The unit costs for these items are:

- $75,000 for Traffic signal preemption
- $300,000 for Traffic signal preemption with Intersection signalization

5. Crossings

The treatment of grade crossings to accommodate 110 mph operations is a major challenge to planning a high-speed rail system. Highway/railroad crossing safety will play a critical role in future project development phases and a variety of devices will be considered to improve safety, including roadway geometric improvements, median barriers, barrier gates, traffic channelization devices, wayside horns, fencing and the potential closure of crossings.

FRA guidelines require the use of four quadrant gates with constant warning time activation at public crossings for 110 mph passenger operations. Constant - warning time systems are essential to accommodate the large differential in speed between freight and passenger trains. The treatment and design of improved safety and warning devices will need further development to identify specifications and various approaches that may be advanced as part of an integrated program.

5.1. Design Considerations

Grade crossing improvements are a significant component of the capital cost estimates for passenger rail service. For the purpose of establishing a reasonable cost estimate at the conceptual design stage, the following design parameters are proposed.

- Where passenger speeds are greater than 79 mph, 25 percent of the existing crossings on the route will be closed

- Where speeds do not exceed 79 mph, private crossings will not be affected
- Where passenger speeds are greater than 79 mph, train warning systems at public crossings will be upgraded to four quadrant gates with enhanced train detection/prediction/notification capabilities, and private crossings will be upgraded to standard two quadrant gates and flashers
- Where passenger speeds do not exceed 79 mph, train warning systems will be upgraded to standard two quadrant gates and flashers with constant warning time and private crossings will be upgraded to standard two quadrant gates and flashers
- Precast crossing surface panels will be installed at all public crossings on existing track at locations where trackwork related to passenger service takes place
- Precast crossing surface panels will be installed on both new and existing tracks and the roadway will be re-profiled where new track is constructed through the crossing

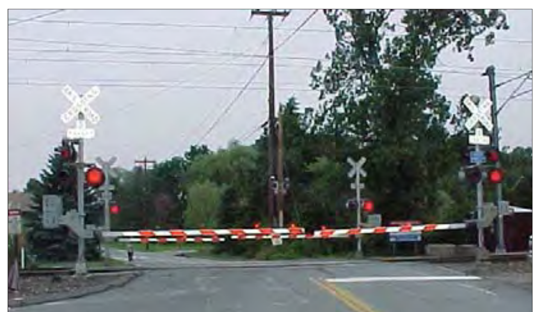
5.2. Crossing Improvement Categories

5.2.1. Crossing Closure

This work consists of completely removing the crossing surface and roadway approaches that lead across the tracks within railroad right of way. If there are any warning devices, those will be removed as well. The estimate includes the cost of modest improvements such as barricades/roadway closure treatments and alternate connection to an existing roadway. The unit cost for this item is $94,000 each.

5.2.2. Four Quadrant Gates

The work consists of installing a warning system where a roadway crosses a railroad at-grade. The four-quadrant gate system includes all hardware, software, wiring, communication equipment and commercial power with battery backup to operate the warning system. A power drop is required at each at-grade crossing. The unit cost for this item is $326,000 each.



Four Quadrant Gates at the School Street crossing on the Northeast Corridor High Speed Rail Line in Mystic, CT. (*Volpe Center photo*)

5.2.3. Four Quadrant Gates w/ Trapped Vehicle Detector

The work consists of installing a warning system where a roadway crosses a railroad at-grade. The four-quadrant gate with vehicle presence detection system includes all hardware, software, wiring, communication equipment and commercial power with battery backup to operate the warning system. A power drop is required at each at-grade crossing. The unit cost for this item is $556,000 each.

5.2.4. Convert Dual Gates to Quad Gates

Work for converting a dual gate warning system to a quad gate system includes the installation of two additional gates at each crossing and the associated software and communications changes necessary to integrate the new gates into the electrical and communications systems that the existing system utilizes. The unit cost for this item is $170,000 each.

5.2.5. <u>Conventional Gates/single mainline track</u>

5.2.6. <u>Conventional Gates/ double mainline track</u>

Work to install conventional gates for a single mainline track includes all hardware, software, wiring, communication equipment and commercial power with battery backup to operate the warning system. Additional measures for a double mainline track include the installation of <u>Manual on Uniform Traffic Control Devices (MUCTD)</u> -approved signs that specify “2 TRACKS” located on the same post as the crossbucks. The unit costs for these items are $188,000 each for single track and $232,000 each for double track.

5.2.7. <u>Convert Flashers Only to Dual Gate</u>

This work includes adding crossing barrier gates in two highway quadrants to an existing warning system consisting of flashing lights, warning bell and crossbucks to provide a dual gate warning system for the at-grade crossing. Costs for this pay item include all hardware, software, wiring, communication equipment and commercial power with battery backup to operate the modified warning system. The unit cost for this item is $57,000 each.

5.2.8. <u>Dual Gate with Median Barrier</u>

Work consists of installation of conventional gates including all hardware, software, wiring, communication equipment and commercial power with battery backup to operate the warning system. The work also includes design and construction of a median barrier between opposing lanes of traffic on both approaches to the crossing and required modifications, re-profiling and paving to the roadway surfaces as well as precast crossing surface panels within the limits of the track structure. The unit cost for this item is $204,000 each.

5.2.9. <u>Convert Dual Gates to Extended Arm</u>

This work includes the installation of an extended arm on an existing crossing device. The cost also includes the parts and labor to modify or replace, as necessary, the motor mechanism and balance weights to support the extended arm. The unit cost for this item is $17,000 each.

5.2.10. <u>Precast Panels without Roadway Improvements</u>

5.2.11. <u>Precast Panels with Roadway Improvements</u>

This work includes installing prefabricated concrete and steel crossing surface panels at a grade crossing. The crossing panels are placed within the track structure at the crossing to form a smooth running surface for vehicular traffic. The top surface of the panel will be level with the top of rail. The width of the crossing treatment will include and extend beyond associated sidewalks if present. At a minimum, the crossing panels will extend 2' beyond the paved roadway surface or sidewalk.

Where roadway improvements are required, roadway crown and superelevation in the approach pavement will be eliminated at or tapered into the crossing to match the grade and profile of the track. Additionally, the elevation of the approach pavement will be reconstructed to equal the top of rail for a minimum of 2 ft beyond the outer rail of the outermost track in each direction. Finally, the roadway surface must be within +/- 3" of the top of rail at a distance of 30' from the outermost rail unless track superelevation dictates otherwise. The unit costs for these items are $90,000 each without roadway improvements and $170,000 each with roadway improvements.

6. Allocations for Special Elements (Placeholders)

6.1. The methodology includes placeholders as conservative estimates for large and/or complex engineering projects that have not been estimated on the basis of unit costs and quantities. Placeholders are used where detailed engineering requirements are not fully known and provide lump sum budget approximations based on expert opinion rather than on an engineering estimate. These approximations will require close attention as the project moves through further phases of development. The following list highlights some of the key placeholder categories that are assumed in this analysis.

- Bottleneck mitigation

- Rail capacity preservation at yards, junctions and complex interchange networks


- Areas where the addition or expansion of railroad infrastructure is likely to impact adjacent public infrastructure


- Areas of known environmental concerns where the extent of impacts and required mitigation measures are uncertain.

Some Special Elements have been identified and assigned a cost based on previous experience with similar efforts; these are shown in the following sections. Additionally, it is expected that special elements based on the previously listed placeholder categories will be added to the cost estimate(s) based on field reviews of existing conditions and other background investigations of the proposed routes.

6.2. Allocations

Yards - In order to effectively estimate the capital costs that would be incurred to extend High Speed Rail (HSR) operations through congested freight yard and terminal areas in cities and towns without the expense of performing extensive due diligence efforts in the earliest planning stages, three categories have been established based on the expected level of capital expenditure required to mitigate the conflicts between freight and passenger traffic. Based on an investigation of six yard areas along two routes, infrastructure requirements and corresponding capital costs were derived and evaluated in terms of magnitude.

Category A: Smaller town sidings or yards and key junctions with a lower level of freight activity
Category B: Active Mainline Yards & Terminals with moderate to heavy freight activity
Category C: Major Terminal Areas with heavy freight activity and complex interchanges

A detailed evaluation of the locations considered that fall into this Category, along with the suggested infrastructure improvements and costs required to mitigate passenger & freight conflicts, is included as part of Appendix C to this document.

6.2.1. Category A has been assigned a placeholder value of $10,000,000

6.2.2. Category B has been assigned a placeholder value of $30,700,000

6.2.3. Category C has been assigned a placeholder value of $37,400,000

Track Access

6.2.4. Access to Signal/Switch Location

In order to facilitate maintenance of the railroad infrastructure, access roadways will be provided for control points, wayside signal locations, industry switch locations, and significant bridges. A 12' wide gravel road will be constructed to allow maintenance vehicles access to the right of way from a local road along with pullout locations to allow for vehicles to turn around. The unit cost for this item is $100,000 each.

6.2.5. Maintenance of Way Spur Track

To provide access for track maintenance activities in high speed territory, Maintenance of Way spur tracks will be placed at 20 mile intervals and associated with freight sidings. The spur will provide 500' of storage for track machinery to clear main tracks overnight. Additionally, it can be used as a bad order set-out track for freight trains. A power-operated #10 turnout will be used for access to the spur and split-rail derail will be installed to protect the main track and siding. A wheel stop will be provided to allow for the use of an end-of-car ramp to load/unload flat cars of track machinery. A 12' gravel access road will be constructed to allow maintenance vehicles to access the track from a local road. The unit cost for this item is $673,000 each.

Other Placeholders

6.2.6. Rail-Rail Flyovers

No rail-rail crossings (crossing diamonds), will be allowed in track segments with authorized maximum speed above 79 mph and where traffic levels would likely create delays for the proposed HSR passenger corridor. Existing crossing locations where the HSR is not operating on the "senior" railroad or where existing traffic levels on either or both of the crossing lines would be likely to impact on time performance are locations that would indicate that further investigation of the situation is needed.

If proven to be necessary, a grade separation ("flyover") will be constructed to carry the high-speed passenger route over the intersecting rail line. It is assumed that the flyover to be constructed would be a double track flyover built on a combination of embankment, retained earth and structure and that a grade of 1% would be used to accommodate freight operations. If a 1.5% grade were to be agreed to by the freight operator, savings approaching 30% could be realized. If the freight operation were left at grade and a single track flyover was built for passenger use only, savings of over 50% (compared to the double track flyover with a 1% grade) could be realized by avoiding the cost of a second track as well as being able to use a 2% grade. A placeholder of $40,000,000 has been used for cost estimating purposes.

7. Contingency & Soft Costs

Contingencies are an allowance for unexpected costs added to the estimated construction costs based on past experience for projects in early stages of definition. Their purpose is to account for items and conditions that cannot be identified with certainty during the conceptual design phase of the project. Contingency costs are added as an overall percentage of the total construction cost. The contingency for this level of detail is set at 30% of the estimated direct construction cost elements. The contingency percentage is expected to be reduced as the project advances into more detailed engineering and conceptual uncertainties are investigated and resolved. Contingencies should not be considered as potential savings. The contingency amount is expected to be expended within the project; typically, as the project develops, contingency amounts are transferred to construction cost as project details are investigated during continued design. In effect, project uncertainties become known project elements as the project matures.

Soft Costs are associated with the planning, design and coordination of the project. These include design engineering, insurance and bonding, program management, construction management and inspection, and engineering services during construction. The percentage for each project element is as follows:

Design Engineering	10%
Insurance and Bonding	2%
Program Management	4%
Construction Management & Inspection	6%
Engineering Services During Construction	2%
Total Soft Costs	24%

Appendix A: Capital Cost Technical Memorandum

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Technical Memorandum

Subject:	**Midwest Regional Rail Initiative – Phase VII** **Strategy to Update Capital Costs**
Prepared For:	**Wisconsin Department of Transportation**
Prepared By:	**Quandel Consultants, LLC**
CC:	
Date:	**April 18, 2011**

Background

The FRA Statement of Work for Task 3, Update MWRRI System Capital Costs states that "the Grantee will use proper AAR, ENR cost indices, as appropriate, and adjust corridor improvement levels to account for speed changes (IDOT), on-going capacity analysis (MoDOT, WisDOT) and other system changes".

The current unit costs employed by the MWRRI were originally developed as part of MWRRI Phase 3B in 1997. Those unit costs were based on previous high speed rail feasibility studies available at that time and cost information provided by Amtrak. Each of these unit costs has since been inflated to 2002 dollars, which are the most recent costs available for the MWRRI. The MWRRI 2002 unit costs were evaluated by peer panels, freight railroads, and contractors, and were determined to be sufficiently accurate for developing capital cost estimates for "force account" construction by the host railroads.

The purpose of this technical memorandum is to determine the appropriate cost index or indices to use in adjusting unit prices and to verify that the adjusted unit prices are reasonably in line with unit costs currently used by the freight railroads.

Available Cost Escalation Indices

Several different cost indices are used to monitor construction costs in the United States. One widely-used index is the Construction Cost Index (CCI) maintained by Engineering News Record. The CCI is a general purpose index used to track the cost of 200 hours of union labor (including fringe benefits), 1.128 tons of Portland cement, 25 cwt of fabricated structural steel, and 1,088 board-ft of 2x4 lumber. ENR also tracks a Building Cost Index (BCI), which uses the same material inputs as the CCI but with a labor component based on the wage rate for carpenters, bricklayers, and iron workers. Each of these indices is tracked nationally according to a 20-city average, and locally for each of the 20 different cities. Though both the CCI and BCI capture general construction cost trends, they are best suited for tracking building construction costs and regional cost differences.

Though some of the state DOT's also publish highway construction cost indices, such as those available from CalTrans and the Washington DOT, none publish any railroad construction cost data. Within the rail industry, the American Association of Railroads (AAR) publishes a Railroad Cost Recovery index that tracks changes in input prices to railroad operations. Some of these inputs, such as the price of diesel fuel and the cost of wages and benefits for railroad workers, are more appropriate for monitoring costs within the railroad industry. However, the AAR indices don't capture the changes in construction costs. As of this time no cost data or cost index are available from the FRA.

Producer Price Index

The Bureau of Labor Statistics (BLS) publishes monthly Producer Price Indices (PPI) for a defined set of industries. In the absence of actual construction cost data, PPI data provide an easy to use and readily available source for updating MWRRI capital costs. The indices measure the average change in prices received by domestic producers for goods sold outside of the industry. Each index is comprised of a fixed set of producer outputs that are representative of the industry as a whole. Several of these indices are used for cost escalation and adjustment in construction projects. The BLS does publish some construction-related PPI indices, such as the Highway and Street Construction Index (PPI Series ID *PCUBHWY*). Since the PCUBHWY is heavily influenced by the cost of petroleum products for items such as asphalt, it is not appropriate for tracking rail construction costs.

An index better suited to capture the cost increases associated with high-speed rail is the *Material and Supply Inputs to Other Heavy Construction* index (PPI Series ID *PCUBHVY*). Table 1 shows the top 25 weighted inputs to *PCUBHVY.* The index includes 'Fabricated Structural Metal Manufacturing', 'Other Concrete Product Manufacturing, and 'Other Commercial & Service Machinery Manufacturing', and 'Petroleum Refineries' as some of the most heavily weighted sectors in the index. Many of these input costs are associated with high-speed rail construction items, such as diesel fuel and heavy equipment, which have risen faster than the costs of general construction materials as a whole since 2002. Using the *PCUBHVY* index to escalate MWRRI costs from June 2002 through October 2009 (the most recently finalized index value) produces a cost escalation factor of 1.431. The PCUBHVY index and the method for calculating the escalation factor are shown in Table 2.

Table 3 shows the MWRRI unit costs updated using the PCUBHVY index. Costs are reduced to 'pure construction' unit costs for the purpose of comparing costs in this memorandum. Pure Construction unit costs remove the 31% soft costs included in the 2002 unit costs, and include only the materials and direct labor associated with each pay item.

1. Comparison of Updated Unit Costs to Other Available Data

   Other available unit cost data were compared to the newly updated unit costs to assess the validity of the PPI PCUBHVY updating methodology.

   a. Updated Phase 7 Unit Costs vs. a Multi-Index PPI Escalation

      Table 4 shows ten sample MWRRI pay items broken down into their original labor and material components. These cost breakdowns, taken from the 1998 MWRRI Phase 3B Report, are shown originally valued in 1993 dollars. This was the year that these particular sample pay items were developed into the 'subunit' costs and quantities shown in Table 4. Each of the sample pay item subunit costs is adjusted for inflation according to an appropriate PPI index, and is then summed to get an updated cost in 2009 dollars. Table 5 shows a comparison of the escalated sample unit costs in 2009 dollars, comparing the unit costs inflated using *PCUBHVY* vs. those inflated in Table 4. As Table 5 shows, the cost difference using the two methods is relatively small - less than $30,000 and 3% - for six of the ten items. The other four items show differences of between 15 and 65%. However, these differences are both positive and negative, and across all ten sample items the average difference in inflation methods is $14,820, or 6.1%.

      Table 4 also shows that a labor overhead rate of 85% was used in the original 1993 cost buildup. However, recent cost data obtained from cost estimates produced by several of the Class I freight railroads show current labor overhead rates range between 125% and 140%. The *PCUBHVY* index does include some finished goods components, which likely include any increases in labor overhead rates over time. But the index is not likely to capture the full magnitude of the cost increase when labor overhead is increased from 85% to 125% or more. Table 6 shows the resultant cost increase when the labor overhead rate increases from the 85% used in 1993 to an updated estimated rate of 133%.

      Note that some adjustments were made in Table 4 to account for certain changes in pay items since they were originally developed. Since the MWRRI now uses 136# rail as a standard, whereas the original 1993 cost buildup used 115#, the subunit cost of steel for 136# rail was increased by a factor of 136/115 = 1.18. Subunit quantities in the item 'Timber & Surface with 66% Tie replacement' were also updated to account for the new percentage of tie replacement, which has been increased from the original value of 60%. One assumption also made in Table 4 is that since the installation of concrete ties in mainline track construction is prevalent, the price of installing concrete and timber ties is converging. Thus the difference in wood vs. concrete ties can be ignored for the purpose of comparing the unit costs as a whole, and no adjustments were made to account for the more recent use of concrete ties in track construction.

b. Updated Phase 7 Unit Costs compared to Other Sample Unit Cost Data

Cost estimates for four different Midwest rail projects were also compared to the updated Phase 7 unit costs. Each of these estimates was developed separately by a different Class I freight railroad. The pay items in these jobs that were found to be similar to MWRRI pay items are listed and compared in Table 7. In most cases the unit cost estimates developed by the freights are greater than the MWRRI unit costs. Of the ten items compared in Table 7, seven items show freight estimated unit costs within 15% of the updated Phase 7 unit costs. The track work pay item, which is the most used pay item throughout the Midwest system, is within 10.5% of the freight estimated cost.

2. Unit Cost Adjustment and Final Unit Costs

Table 8 shows the unit cost adjustments and the draft Phase 7 unit costs. The draft Phase 7 unit costs are shown in October 2009 dollars, since October was the most recent month for which finalized PPI indices were published as of this writing. Table 8 also includes adjustments for the unit cost increases shown in Table 6 that were added based on the updated labor overhead rate. Additionally the average 6% cost increase over the *PCUBHVY* escalation, as shown in Table 6, was added to all track items to account for the increase in freight railroad labor overhead.

Based on the evidence discussed here we conclude that the *PCUBHVY* is the most appropriate index available for updating MWRRI unit costs. However, we also conclude that the use of this index alone does not fully capture the cost increases needed to produce estimates comparable to those used by the freight railroads in their construction estimates. Further cost adjustments are necessary in order to reconcile the difference in the cost estimation method used here, and the methods used by the freight railroads.

Table 1

PPI Index *Material and Supply Inputs to Other Heavy Construction (PCUBHVY)*

Top 25 Inputs By Weight

Sector	Relative Importance
Prefabricated metal buildings and components	12.786
Fabricated structural metal manufacturing	9.257
Petroleum refineries	8.057
Other concrete product manufacturing	6.112
Other commercial & service machinery mfg	5.101
Ready-mix concrete manufacturing	4.381
All other plastics product manufacturing	3.967
Concrete pipe manufacturing	3.464
Metal tank, heavy gauge, manufacturing	2.549
Other communication and energy wire mfg	2.463
Industrial valve manufacturing	2.102
Ornamental and architectural metal work mfg	2.017
Metal window and door manufacturing	2.000
Asphalt paving mixture & block mfg	1.861
Fluid power valve and hose fitting mfg	1.407
Iron and steel mills	1.395
Electric power distribution	1.126
Cement manufacturing	0.998
Switchgear and switchboard apparatus mfg	0.995
Other communications equipment manufacturing	0.959
Prefabricated wood building manufacturing	0.957
Paint and coating manufacturing	0.765
Wood window and door manufacturing	0.761
Plumbing fixture fitting & trim mfg	0.736

Table 2

PPI Factors for Index PCUBHVY, 1986-2009

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1986						100	98.8	98.7	99.2	98.8	98.9	98.9	
1987	99.4	99.8	100	100.5	100.7	101.1	101.7	102.4	102.8	103.5	104.5	106.2	101.9
1988	107.5	107	106.7	107.3	107.5	107.9	108.4	108.5	108.7	109.7	111.3	112.7	108.6
1989	113.8	114	114.6	115.7	116.3	115.8	115.2	115.1	115.9	116.4	116.1	115.6	115.4
1990	116.5	115.8	116.4	116.7	117.1	116.5	116.5	118.1	119.7	121	120.8	119.7	117.9
1991	119.6	118.7	118	117.9	117.8	118.1	117.9	118	118.2	117.9	117.9	117.3	118.1
1992	117.1	117.7	117.9	118.2	118.4	118.8	118.8	118.9	119.1	118.9	118.9	118.8	118.5
1993	119.5	120.2	120.8	121	120.7	120.4	120.4	120.4	120.8	121.1	121.4	121.1	120.6
1994	121.8	122.3	122.7	122.7	123.2	124.1	124.6	125.3	125.8	125.7	126.9	127	124.3
1995	128.1	128.6	129	129.9	129.9	130.1	130.3	130.4	130.5	130.1	130.3	130.5	129.8
1996	130.6	130.4	131	132	133	133	132.3	132.4	132.9	132.9	133.3	133.6	132.3
1997	134	134.4	134.5	134.8	135.2	135	134.9	135	134.9	134.5	134.4	134	134.6
1998	133.6	133.3	133.3	133.7	133.8	133.6	133.9	133.5	133.4	133.1	132.6	131.9	133.3
1999	132.4	132.2	132.6	133.7	134.2	134.5	135.7	136.2	136.4	136.1	136.3	136.9	134.8
2000	137.8	139	140	139.5	139.3	140.5	140.3	139.8	140.8	140.6	140.4	139.7	139.8
2001	140.1	140.3	139.9	140.5	141.9	141.7	139.7	139.7	140.4	137.9	137.1	136.1	139.6
2002	136.3	136.2	136.7	137.4	137.3	**137.5**	137.6	137.8	138.1	138.1	137.6	137.4	137.3
2003	138	138.8	139.2	138.8	138.6	138.9	139.2	139.5	140.3	140.3	140.6	141	139.4
2004	143.3	145.3	148.4	151.3	153.8	153.9	155.5	157.9	159	161.5	161.2	159.9	154.2
2005	162.3	163.9	166.4	167.4	166.8	167.8	169.8	171.2	174.1	177.1	173.2	174	169.5
2006	176.3	175.8	177.8	181.5	184	186.4	187.7	188.6	184.4	182.9	182.7	183.5	182.6
2007	182.6	183.9	187.1	190.3	192.6	192.6	194.6	192.3	193.1	193.3	197.4	196.1	191.3
2008	197.9	199.7	205.3	210.1	216.9	222.5	227.3	224.7	225.3	216	206	198.7	212.5
2009	198.6	195.4	193.7	193.4	195	197.3	195.5	198.3	197.4	**196.8**	198.3(P)	198.6(P)	196.5(P)
2009	201.6 (P)												
P : Preliminary. All indexes are subject to revision four months after original publication.													

Cost Escalation from June 2002 through October 2009 = 196.8/137.5 = 1.431

Table 3
Inflation of MWRRI Unit Costs

All Costs in 1000's

				MWRRI PHASE 5 Unit Costs, 2002				MWRRI PHASE 7, Oct 2009		
				Total Unit Cost	Less 31% Soft Costs →	Pure Construction Cost	Escalation Factor = 1.43 →	Pure Construction Cost	Plus 31% Soft Costs →	Total Unit Cost
	Item No.	Description	Unit	Unit Cost		Unit Cost		Unit Cost		Unit Cost
Trackwork	1.1	HSR on Existing Roadbed	Mile	993		758		1,085		1,421
	1.2a	HSR on New Roadbed	Mile	1,059		808		1,157		1,516
	1.2b	HSR on New Roadbed & New Embankment	Mile	1,492		1,139		1,630		2,135
	1.2c	HSR on New Roadbed & New Embankment (Double Track)	Mile	2,674		2,041		2,922		3,827
	1.2d	HSR Double Track on 15' Retained Earth Fill[1]	Mile	N/A		N/A		15,463		20,256
	1.3	Timber & Surface w/ 33% Tie replacement	Mile	222		169		243		318
	1.4	Timber & Surface w/ 66% Tie Replacement	Mile	331		253		362		474
	1.5	Relay Track w/ 141# CWR	Mile	354		270		387		507
	1.6	Freight Siding	Mile	912		696		996		1,305
	1.65	Passenger Siding	Mile	1,376		1,050		1,503		1,969
	1.71	Fencing, 4 ft Woven Wire (both sides)	Mile	51		39		56		73
	1.72	Fencing, 6 ft Chain Link (both sides)	Mile	153		117		167		219
	1.73	Fencing, 10 ft Chain Link (both sides)	Mile	175		134		191		250
	1.74	Decorative Fencing (both sides)	Mile	394		301		430		564
	1.8	Drainage Improvements (cross country)	Mile	66		50		72		94
	1.9a	Land Acquisition Urban	Mile	327		250		357		468
	1.9b	Land Acquisition Rural	Mile	109		83		119		156
Curves	9.1	Elevate & Surface Curves	Mile	58		44		63		83
	9.2	Curvature Reduction	Mile	393		300		429		563
	9.3	Elastic Fasteners	Mile	82		63		90		117
Signals	8.1	Signals for Siding w/ High Speed Turnout	Each	1,268		968		1,385		1,815
	8.2	Install CTC System (Single Track)	Mile	183		140		200		262
	8.21	Install CTC System (Double Track)	Mile	300		229		328		429
	8.3	Install PTC System	Mile	197		150		215		282
	8.4	Electric Lock for Industry Turnout	Each	103		79		113		147
	8.5	Signals for Crossover	Each	700		534		765		1,002
	8.6	Signals for Turnout	Each	400		305		437		573
Turnouts	4.1a	#33 High Speed Turnout[1]	Each	N/A		N/A		621		813
	4.1	#24 High Speed Turnout	Each	450		344		492		644
	4.2	#20 Turnout Timber	Each	124		95		135		177
	4.3	#10 Turnout Timber	Each	69		53		75		99
	4.4	#20 Turnout Concrete	Each	249		190		272		356
	4.5	#10 Turnout Concrete	Each	118		90		129		169
	4.6	#33 Crossover	Each	1,136		867		1,241		1,626
	4.7	#20 Crossover	Each	710		542		776		1,016

Notes:

1. Item is new in Phase 7
2. Total Unit Costs include 31% in soft costs, including:
   - 7% Engineering
   - 15% Contingency
   - 3% Program Management of General Engineering Consultant
   - 4% for Construction Management and Inspection
   - 2% for Owner's Management Costs such as Alternatives Analysis or Environmental Studies
3. Pure Construction Costs Include Only Materials and Labor
4. 2009 costs escalated using the Producer Price Index *Material and Supply Inputs to Other Heavy Construction* (PCUBYVY)

Table 3

Inflation of MWRRI Unit Costs

All Costs in 1000's

	Item No.	Description	Unit	MWRRI PHASE 5 Unit Costs, 2002: Total Unit Cost	Less 31% Soft Costs →	Pure Construction Cost	Escalation Factor = 1.43 →	MWRRI PHASE 7, Oct 2009: Pure Construction Cost	Plus 31% Soft Costs →	Total Unit Cost
				Unit Cost		Unit Cost		Unit Cost		Unit Cost
Bridges-Under	5.1	Four Lane Urban Expressway	Each	4,835		3,691		5,283		6,920
	5.2	Four Lane Rural Expressway	Each	4,025		3,073		4,398		5,761
	5.3	Two Lane Highway	Each	3,054		2,331		3,337		4,371
	5.4	Rail	Each	3,054		2,331		3,337		4,371
	5.5	Minor river	Each	810		618		885		1,159
	5.6	Major River	Each	8,098		6,182		8,848		11,591
	5.65	Double Track High (50') Level Bridge	LF	14.0		9.3		13.3		20
	5.70	Rehab for 110	LF	14		11		15		20
	5.71	Convert open deck bridge to ballast deck (single track)	LF	4.7		3.6		5.1		6.7
	5.72	Convert open deck bridge to ballast deck (double track)	LF	9.4		7.1		10.2		13.4
	5.73	Single Track on Flyover/Elevated Structure	LF	6.0		4.6		6.6		8.6
	5.8	Single Track on Approach Embankment w/ Retaining Wall	LF	3.0		2.3		3.3		4.3
	5.9	Ballasted Concrete Deck Replacement Bridge	LF	2.1		1.6		2.3		3.0
	5.10	Land Bridges	LF	2.6		2.0		2.9		3.8
	5.11	Double Track on Flyover/Elevated Structure	LF	10.5		8.0		11.5		15.0
	47	Double Track on Approach Embankment w/ Retaining Wall	LF	5.5		4.2		6.0		7.9
Bridges-Over	6.1	Four Lane Urban Expressway	Each	2,087		1,593		2,280		2,987
	6.2	Four Lane Rural Expressway	Each	2,929		2,236		3,200		4,192
	6.3	Two Lane Highway	Each	1,903		1,453		2,079		2,724
	6.4	Rail	Each	6,110		4,664		6,676		8,745
Crossings	7.1	Private Closure	Each	83		63		91		119
	7.2	Four Quadrant Gates w/ Trapped Vehicle Detector	Each	492		376		538		704
	7.3	Four Quadrant Gates	Each	288		220		315		412
	7.31	Convert Dual Gates to Quad Gates	Each	150		115		164		215
	7.4a	Conventional Gates single mainline track	Each	166		127		181		238
	7.4b	Conventional Gates double mainline track	Each	205		156		224		293
	7.41	Convert Flashers Only to Dual Gate	Each	50		38		55		72
	7.5a	Single Gate with Median Barrier	Each	180		137		197		258
	7.5b	Convert Single Gate to Extended Arm	Each	15		11		16		21
	7.71	Precast Panels without Rdway Improvements	Each	80		61		87		115
	7.72	Precast Panels with Rdway Improvements	Each	150		115		164		215
	7.8	Michigan Type Grade Crossing Surface	Each	15.0		11.5		16		21
Station/Maintenance Facilities	2.1	Full Service - New	Each	1,000		763		1,093		1,431
	2.2	Full Service - Renovated	Each	500		382		546		716
	2.3	Terminal - New	Each	2,000		1,527		2,185		2,863
	2.4	Terminal - Renovated	Each	1,000		763		1,093		1,431
	2.5a	Maintenance Facility (non-electrified track/110 mph system)	Each	10,000		7,634		10,926		14,313
	2.6	Layover Facility	Each	6,536		4,989		7,141		9,355

1. Total Unit Costs include 31% in soft costs, including:
   - 7% Engineering
   - 15% Contingency
   - 3% Program Management of General Engineering Consultant
   - 4% for Construction Management and Inspection
   - 2% for Owner's Management Costs such as Alternatives Analysis or Environmental Studies
2. Pure Construction Costs Include Only Materials and Labor
3. 2009 costs escalated using the Producer Price Index *Material and Supply Inputs to Other Heavy Construction* (PCUBYVY)

Table 4

Inflation of Sample MWRRI Pay Items (Original SubUnit Prices and Quantities) using Multiple Inflation Factors

MWRRI Item No.	**Description**	**Unit**	**Reference**											**Unit Cost (Oct 2009)**
1.1	HSR on Existing Roadbed	Mile	MWRRI Phase 3B - Item 1.1											1,112,890
		Unit	*Inflation Index Used*	*Sub Unit*	*Sub Unit Qty*	*1993 Sub Unit Cost*	*1993 Sub Unit Total*	*1993-2002 Inflation Factor*	*2002 Sub Unit Cost*	*2002 Sub Unit Total*	*2002-2009 Inflation Factor*	*Oct 2009 Sub Unit Cost*	*Oct 2009 Sub Unit Total*	*Oct 2009 Sub Unit Total*
Materials	136# - CWR	mile	1	Track Mile	1.0	121200.00	121,200	0.95	135,449	135,449	1.79	242,481	242,481	242,481
	Mainline Wood Crossties (7" x 9" x 8'-6", New)	mile	4	Each	3200	27.35	87,520	1.34	37	117,294	1.25	46	146,325	146,325
	Tie Plates (13" DS , New)	mile	1	Each	6400	5.10	32,640	0.95	4.82	30,845	1.79	8.63	55,218	55,218
	Rail Anchors (115#, New)	mile	2	Each	6400	0.85	5,440	1.07	0.91	5,832	1.91	1.74	11,125	11,125
	Track Spikes (New)	mile	2	Each	25600	0.31	7,936	1.07	0.33	8,507	1.91	0.63	16,229	16,229
	Top Ballast - 12" Depth Under Tie Area, #4 Granite	mile	3	Ton	5196	15.00	77,933	1.35	20	104,898	1.70	34	178,578	178,578
Labor	Plant Welds	mile	5	Each	128	40.00	5,120	1.31	52	6,712	1.34	70	8,981	8,981
	Field Welds	mile	5	Each	18	400.00	7,200	1.31	524	9,439	1.34	702	12,630	12,630
	Roadbed Prep	mile	5	Foot	5280	3.00	15,840	1.31	3.93	20,766	1.34	5.26	27,785	27,785
	Place Subballast (6" x 25')	mile	5	CY	2811	10.00	28,111	1.31	13	36,854	1.34	18	49,310	49,310
	Drainage	mile	5	Track Mile	1.0	5000.00	5,000	1.31	6,555	6,555	1.34	8,771	8,771	8,771
	Track Labor	mile	5	Track Mile	1.0	85500.00	85,500	1.31	112,091	112,091	1.34	149,977	149,977	149,977
	Material Handling and Distribution (5% of Matl's Subtotal)	mile	-	LS	1.0	16633.44	16,633	1.00	20,141	20,141	1.00	32,498	32,498	32,498
	Track Labor Overhead (85% of Labor)	mile	-	LS	1.0	72965.70	72,966	1.00	95,658	95,658	1.00	127,990	127,990	127,990
	Equipment (30% of Track Labor)	mile	-	LS	1.0	25650.00	25,650	1.00	33,627	33,627	1.00	44,993	44,993	44,993
		Yearly SubTotal					*594,689*			*744,668*			*1,112,890*	*1,112,890*

MWRRI Item No.	**Description**	**Unit**	**Reference**											**Unit Cost (Oct 2009)**
1.2a	HSR on New Roadbed	Mile	MWRRI Phase 3B - Item 1.2											1,183,037
		Unit	*Inflation Index Used*	*Sub Unit*	*Sub Unit Qty*	*1993 Sub Unit Cost*	*1993 Sub Unit Total*	*1993-2002 Inflation Factor*	*2002 Sub Unit Cost*	*2002 Sub Unit Total*	*2002-2009 Inflation Factor*	*Oct 2009 Sub Unit Cost*	*Oct 2009 Sub Unit Total*	*Oct 2009 Sub Unit Total*
Materials	136# - CWR	mile	1	Track Mile	1.0	121200.00	121,200	0.95	135,449	135,449	1.79	242,481	242,481	242,481
	Mainline Wood Crossties (7" x 9" x 8'-6", New)	mile	4	Each	3200	27.35	87,520	1.34	37	117,294	1.25	46	146,325	146,325
	Tie Plates (13" DS , New)	mile	1	Each	6400	5.10	32,640	0.95	4.82	30,845	1.79	8.63	55,218	55,218
	Rail Anchors (136#, New)	mile	2	Each	6400	0.85	5,440	1.07	0.91	5,832	1.91	1.74	11,125	11,125
	Track Spikes (New)	mile	2	Each	25600	0.31	7,936	1.07	0.33	8,507	1.91	0.63	16,229	16,229
	Top Ballast - 12" Depth Under Tie Area, #4 Granite	mile	3	Ton	5196	15.00	77,933	1.35	20	104,898	1.70	34	178,578	178,578
Labor	Plant Welds	mile	5	Each	128	40.00	5,120	1.31	52	6,712	1.34	70	8,981	8,981
	Field Welds	mile	5	Each	18	400.00	7,200	1.31	524	9,439	1.34	702	12,630	12,630
	Roadbed Prep	mile	5	Foot	5280	3.00	15,840	1.31	3.93	20,766	1.34	5.26	27,785	27,785
	Site Clearing	mile	5	Acre	4.24	2800.00	11,879	1.31	3,671	15,573	1.34	4,912	20,837	20,837
	Place Subballast (6" x 25')	mile	5	CY	5622	10.00	56,222	1.31	13	73,707	1.34	18	98,620	98,620
	Drainage	mile	5	Track Mile	1.0	5000.00	5,000	1.31	6,555	6,555	1.34	8,771	8,771	8,771
	Track Labor	mile	5	Track Mile	1.0	85500.00	85,500	1.31	112,091	112,091	1.34	149,977	149,977	149,977
	Material Handling and Distribution (5% of Matl's Subtotal)	mile	-	LS	1.0	16633.44	16,633	1.00	20,141	20,141	1.00	32,498	32,498	32,498
	Track Labor Overhead (85% of Labor)	mile	-	LS	1.0	72965.70	72,966	1.00	95,658	95,658	1.00	127,990	127,990	127,990
	Equipment (30% of Track Labor)	mile	-	LS	1.0	25650.00	25,650	1.00	33,627	33,627	1.00	44,993	44,993	44,993
		Yearly SubTotal					*634,679*			*797,095*			*1,183,037*	*1,183,037*

Inflation Index No.

1	*Bureau of Labor Statistics, PPI Series Id: WPU101704 - Steel Mill Products*	*Item: Hot rolled bars, plates, and structural shapes*
2	*Bureau of Labor Statistics, PPI Series Id: PCU3312223312223*	*Product: Steel nails, staples, tacks, spikes, and brads*
3	*Bureau of Labor Statistics, PPI Series Id: PCU2123132123130*	*Product: Crushed and broken granite*
4	*Bureau of Labor Statistics, PPI Series Id: PCU3211143211141*	*Product: Wood poles, piles, and posts owned and treated by the same establishment*
5	*Engineering News Record Skilled Labor Index*	
6	*Bureau of Labor Statistics, PPI Series Id: PCUBCON*	*Product: Material and Supply Inputs to construction industries*
7	*Material and Supply inputs to other heavy construction*	

Table 4

Inflation of Sample MWRRI Pay Items (Original SubUnit Prices and Quantities) using Multiple Inflation Factors

MWRRI Item No.	Description	Unit	Reference											Unit Cost (Oct 2009)
1.2b	HSR on New Roadbed & New Embankment	Mile	MWRRI Phase 3B											1,659,927
		Unit	*Inflation Index Used*	*Sub Unit*	*Sub Unit Qty*	*1993 Sub Unit Cost*	*1993 Sub Unit Total*	*1993-2002 Inflation Factor*	*2002 Sub Unit Cost*	*2002 Sub Unit Total*	*2002-2009 Inflation Factor*	*Oct 2009 Sub Unit Cost*	*Oct 2009 Sub Unit Total*	*Oct 2009 Sub Unit Total*
Materials	136# - CWR	mile	1	Track Mile	1.0	121200.00	121,200	0.95	135,449	135,449	1.79	242,481	242,481	242,481
	Mainline Wood Crossties (7" x 9" x 8'-6", New)	mile	4	Each	3200	27.35	87,520	1.34	37	117,294	1.25	46	146,325	146,325
	Tie Plates (13" DS , New)	mile	1	Each	6400	5.10	32,640	0.95	4.82	30,845	1.79	8.63	55,218	55,218
	Rail Anchors (136#, New)	mile	2	Each	6400	0.85	5,440	1.07	0.91	5,832	1.91	1.74	11,125	11,125
	Track Spikes (New)	mile	2	Each	25600	0.31	7,936	1.07	0.33	8,507	1.91	0.63	16,229	16,229
	Top Ballast - 12" Depth Under Tie Area, #4 Granite	mile	3	Ton	5196	15.00	77,933	1.35	20	104,898	1.70	34	178,578	178,578
	Embankment Material[1]	mile	-	Mile										277,800
Labor	Plant Welds	mile	5	Each	128	40.00	5,120	1.31	52	6,712	1.34	70	8,981	8,981
	Field Welds	mile	5	Each	18	400.00	7,200	1.31	524	9,439	1.34	702	12,630	12,630
	Roadbed Prep	mile	5	Foot	5280	3.00	15,840	1.31	3.93	20,766	1.34	5.26	27,785	27,785
	Grading:Embankment[1]	mile	-	Mile										185,200
	Site Clearing	mile	5	Acre	4.24	2800.00	11,879	1.31	3,671	15,573	1.34	4,912	20,837	20,837
	Place Subballast (6" x 25')	mile	5	CY	5622	10.00	56,222	1.31	13	73,707	1.34	18	98,620	98,620
	Drainage	mile	5	Track Mile	1.0	5000.00	5,000	1.31	6,555	6,555	1.34	8,771	8,771	8,771
	Track Labor	mile	5	Track Mile	1.0	85500.00	85,500	1.31	112,091	112,091	1.34	149,977	149,977	149,977
	Material Handling and Distribution (5% of Matl's Subtotal)	mile	-	LS	1.0	16633.44	16,633	1.00	20,141	20,141	1.00	46,388	46,388	46,388
	Track Labor Overhead (85% of Labor)	mile	-	LS	1.0	72965.70	72,966	1.00	95,658	95,658	1.00	127,990	127,990	127,990
	Equipment (30% of Track Labor)	mile	-	LS	1.0	25650.00	25,650	1.00	33,627	33,627	1.00	44,993	44,993	44,993
		Yearly SubTotal					*634,679*			*797,095*			*1,196,927*	*1,659,927*

MWRRI Item No.	Description	Unit	Reference											Unit Cost (Oct 2009)
1.3	Timber & Surface w/ 33% Tie replacement	Mile	MWRRI Phase 3B - Item 1.3											170,457
		Unit	*Inflation Index Used*	*Sub Unit*	*Sub Unit Qty*	*1993 Sub Unit Cost*	*1993 Sub Unit Total*	*1993-2002 Inflation Factor*	*2002 Sub Unit Cost*	*2002 Sub Unit Total*	*2002-2009 Inflation Factor*	*Oct 2009 Sub Unit Cost*	*Oct 2009 Sub Unit Total*	*Oct 2009 Sub Unit Total*
Materials	Mainline Wood Crossties (7" x 9" x 8'-6", New)	mile	4	Each	1056	27.35	28,882	1.34	36.65	38,707	1.25	45.73	48,287	48,287
	Track Spikes (New)	mile	2	Each	8448	0.31	2,619	1.07	0.33	2,807	1.91	0.63	5,355	5,355
	Ballast	mile	3	Ton	1200	15.00	18,000	1.35	20.19	24,228	1.70	34.37	41,246	41,246
Labor	Track Labor	mile	5	Track Mile	1.0	18,750.00	18,750	1.31	24,581.25	24,581	1.34	32,889.71	32,890	32,890
	Material Handling and Distribution (5% of Matl's Subtotal)	mile	-	LS	1.0	2,475.02	2,475	1.00	3,287.13	3,287	0.00	4,744.42	4,744	4,744
	Track Labor Overhead (85% of Labor)	mile	-	LS	1.0	16,001.25	16,001	1.00	20,977.64	20,978	0.00	28,068.08	28,068	28,068
	Equipment (30% of Track Labor)	mile	-	LS	1.0	5,625.00	5,625	1.00	7,374.38	7,374	0.00	9,866.91	9,867	9,867
		Yearly SubTotal					*92,352*			*121,963*			*170,457*	*170,457*

MWRRI Item No.	Description	Unit	Reference											Unit Cost (Oct 2009)
1.4	Timber & Surface w/ 66% Tie Replacement	Mile	MWRRI Phase 3B - Item 1.4											297,607
		Unit	*Inflation Index Used*	*Sub Unit*	*Sub Unit Qty*	*1993 Sub Unit Cost*	*1993 Sub Unit Total*	*1993-2002 Inflation Factor*	*2002 Sub Unit Cost*	*2002 Sub Unit Total*	*2002-2009 Inflation Factor*	*Oct 2009 Sub Unit Cost*	*Oct 2009 Sub Unit Total*	*Oct 2009 Sub Unit Total*
Materials	Mainline Wood Crossties (7" x 9" x 8'-6", New)	mile	4	Each	2112	27.35	57,763	1.34	37	77,414	1.25	46	96,574	96,574
	Track Spikes (New)	mile	2	Each	16896	0.31	5,238	1.07	0.33	5,615	1.91	0.63	10,711	10,711
	Ballast	mile	3	Ton	1200	15.00	18,000	1.35	20	24,228	1.70	34	41,246	41,246
Labor	Track Labor	mile	5	Track Mile	1.0	37500.10	37,500	1.31	49,163	49,163	1.34	65,780	65,780	65,780
	Material Handling and Distribution (5% of Matl's Subtotal)	mile	-	Track Mile	1.0	4050.05	4,050	1.00	5,363	5,363	1.00	7,427	7,427	7,427
	Track Labor Overhead (85% of Labor)	mile	-	LS	1.0	32002.59	32,003	1.00	41,955	41,955	1.00	56,136	56,136	56,136
	Equipment (30% of Track Labor)	mile	-	LS	1.0	11250.03	11,250	1.00	14,749	14,749	1.00	19,734	19,734	19,734
		Yearly SubTotal					*165,804*			*218,487*			*297,607*	*297,607*

Note

1 Embankment Costs breakdown not provided in Phase 3B

Inflation Index No.

1	*Bureau of Labor Statistics, PPI Series Id: WPU101704 - Steel Mill Products*	*Item: Hot rolled bars, plates, and structural shapes*
2	*Bureau of Labor Statistics, PPI Series Id: PCU3312223312223*	*Product: Steel nails, staples, tacks, spikes, and brads*
3	*Bureau of Labor Statistics, PPI Series Id: PCU2123132123130*	*Product: Crushed and broken granite*
4	*Bureau of Labor Statistics, PPI Series Id: PCU3211143211141*	*Product: Wood poles, piles, and posts owned and treated by the same establishment*
5	*Engineering News Record Skilled Labor Index*	
6	*Bureau of Labor Statistics, PPI Series Id: PCUBCON*	*Product: Material and Supply Inputs to construction industries*
7	*Material and Supply inputs to other heavy construction*	

Table 4

Inflation of Sample MWRRI Pay Items (Original SubUnit Prices and Quantities) using Multiple Inflation Factors

MWRRI Item No.	**Description**	**Unit**	**Reference**											**Unit Cost (Oct 2009)**
1.5	Relay Track w/ 136# CWR	Mile	MWRRI Phase 3B - Item 1.5											517,350
		Unit	*Inflation Index Used*	*Sub Unit*	*Sub Unit Qty*	*1993 Sub Unit Cost*	*1993 Sub Unit Total*	*1993-2002 Inflation Factor*	*2002 Sub Unit Cost*	*2002 Sub Unit Total*	*2002-2009 Inflation Factor*	*Oct 2009 Sub Unit Cost*	*Oct 2009 Sub Unit Total*	*Oct 2009 Sub Unit Total*
Salvage Credit	Relay Quality Rail, Tie Plates, Joint Bars, Scrap	mile	1	Track Mile	1.0	(66,601.00)	(66,601)	0.95	(62,937.95)	(62,938)	1.79	(112,671.51)	(112,672)	(112,672)
	Labor to pick up existing jointed rail and OTM	mile	5	Track Mile	1.0	10,000.00	10,000	1.31	13,110.00	13,110	1.34	17,541.18	17,541	17,541
Materials	136# - CWR	mile	1	Track Mile	1.0	121,200.00	121,200	0.95	135,449	135,449	1.79	242,480.63	242,481	242,481
	Tie Plates (13" DS , New)	mile	1	Each	6400	5.10	32,640	0.95	4.82	30,845	1.79	8.63	55,218	55,218
	Rail Anchors (136#, New)	mile	2	Each	6400	0.85	5,440	1.07	0.91	5,832	1.91	1.74	11,125	11,125
	Track Spikes (New)	mile	2	Each	25600	0.31	7,936	1.07	0.33	8,507	1.91	0.63	16,229	16,229
Labor	Plant Welds	mile	5	Each	128	40.00	5,120	1.31	52.44	6,712	1.34	70.16	8,981	8,981
	Field Welds	mile	5	Each	18	400.00	7,200	1.31	524.40	9,439	1.34	701.65	12,630	12,630
	Track Labor	mile	5	Track Mile	1.0	37,500.00	37,500	1.31	49,162.50	49,163	1.34	65,779.43	65,779	65,779
	Material Handling and Distribution (5% of Matl's Subtotal)	mile	-	LS	1.0	8,360.80	8,361	1.00	6,540.24	6,540	1.00	11,496.09	11,496	11,496
	Track Labor Overhead (85% of Labor)	mile	-	LS	1.0	32,002.50	32,003	1.00	41,955.28	41,955	1.00	56,136.16	56,136	56,136
	Equipment (30% of Track Labor)	mile	-	LS	1.0	11,250.00	11,250	1.00	14,748.75	14,749	1.00	19,733.83	19,734	19,734
		Yearly SubTotal					*278,649*			*322,301*			*517,350*	*517,350*

MWRRI Item No.	**Description**	**Unit**	**Reference**											**Unit Cost (Oct 2009)**
1.6	Freight Siding	Mile	MWRRI Phase 3B - Item 1.6											995,107
		Unit	*Inflation Index Used*	*Sub Unit*	*Sub Unit Qty*	*1993 Sub Unit Cost*	*1993 Sub Unit Total*	*1993-2002 Inflation Factor*	*2002 Sub Unit Cost*	*2002 Sub Unit Total*	*2002-2009 Inflation Factor*	*Oct 2009 Sub Unit Cost*	*Oct 2009 Sub Unit Total*	*Oct 2009 Sub Unit Total*
Materials	Rail (Relay CWR)	mile	1	Track Mile	1.0	46,750.00	46,750	0.95	44,413	44,413	1.79	79,498	79,498	79,498
	Plant Welds	mile	5	Each	294	40.00	11,760	1.31	52	15,417	1.34	70	20,628	20,628
	13" DS Tie Plates	mile	1	Each	6400	2.50	16,000	0.95	2	15,120	1.79	4	27,068	27,068
	Rail Anchors (112# New)	mile	2	Each	6400	0.85	5,440	1.07	1	5,832	1.91	2	11,125	11,125
	Track Spikes	mile	2	Each	25600	0.31	7,936	1.07	0.33	8,507	1.91	1	16,229	16,229
	Mainline Crossties	mile	4	Each	3200	27.35	87,520	1.34	37	117,294	1.25	46	146,325	146,325
	Top Ballast	mile	3	Ton	5196	15.00	77,933	1.35	20	104,898	1.70	34	178,578	178,578
Labor	Track Labor	mile	5	Track Mile	1.0	85,500.00	85,500	1.31	112,091	112,091	1.34	149,977	149,977	149,977
	Field Welds	mile	5	Each	18	400.00	7,200	1.31	524	9,439	1.34	702	12,630	12,630
	Roadbed Preparation	mile	5	Foot	5280	3.00	15,840	1.31	4	20,766	1.34	5	27,785	27,785
	Subballast in Place	mile	5	CY	5622	10.00	56,224	1.31	13	73,653	1.34	18	98,695	98,695
	Site Clearing	mile	5	Acre	4.24	2800.00	11,879	1.31	3,671	15,573	1.34	4,912	20,837	20,837
	Drainage	mile	5	Track Mile	1	5000.00	5,000	1.31	6,550	6,550	1.34	8,777	8,777	8,777
	Material Handling and Distribution (5% of Matl's Subtotal)	mile	-	LS	1.0	12666.94	12,667	1.00	2,226	2,226	1.00	23,973	23,973	23,973
	Track Labor Overhead (85% of Labor)	mile	-	LS	1.0	72,965.70	72,966	1.00	95,658.03	95,658	1.00	127,990.45	127,990	127,990
	Equipment (30% of Track Labor)	mile	-	LS	1.0	25650.00	25,650	1.00	33,627	33,627	1.00	44,993	44,993	44,993
		Yearly SubTotal					*546,264*			*681,064*			*995,107*	*995,107*

Inflation Index No.

1	*Bureau of Labor Statistics, PPI Series Id: WPU101704 - Steel Mill Products*	*Item: Hot rolled bars, plates, and structural shapes*
2	*Bureau of Labor Statistics, PPI Series Id: PCU3312223312223*	*Product: Steel nails, staples, tacks, spikes, and brads*
3	*Bureau of Labor Statistics, PPI Series Id: PCU2123132123130*	*Product: Crushed and broken granite*
4	*Bureau of Labor Statistics, PPI Series Id: PCU3211143211141*	*Product: Wood poles, piles, and posts owned and treated by the same establishment*
5	*Engineering News Record Skilled Labor Index*	
6	*Bureau of Labor Statistics, PPI Series Id: PCUBCON*	*Product: Material and Supply Inputs to construction industries*
7	*Material and Supply inputs to other heavy construction*	

Table 4

Inflation of Sample MWRRI Pay Items (Original SubUnit Prices and Quantities) using Multiple Inflation Factors

MWRRI Item No.	**Description**	**Unit**	**Reference**											**Unit Cost (Oct 2009)**
4.1a	#33 High Speed Turnout1	Each	MWRRI Phase 3B - Item 4.1											619,731
		Unit	*Inflation Index Used*	*Sub Unit*	*Sub Unit Qty*	*1993 Sub Unit Cost*	*1993 Sub Unit Total*	*1993-2002 Inflation Factor*	*2002 Sub Unit Cost*	*2002 Sub Unit Total*	*2002-2009 Inflation Factor*	*Oct 2009 Sub Unit Cost*	*Oct 2009 Sub Unit Total*	*Oct 2009 Sub Unit Total*
Materials	Switch Package, OTM, Rail, Concrete Ties, Field Welds	Each	7	Each	1.0	250,000.00	250,000	1.14	285,025.00	285,025	1.44	409,181.89	409,182	409,182
	Ballast	Each	3	Ton	753	15.00	11,295	1.35	20.25	15,248	1.79	36.25	27,297	27,297
	Filter Fabric	Each	6	SY	850	2.00	1,700	1.14	2.28	1,940	1.37	3.12	2,648	2,648
Labor	Track Labor	Each	5	Track Mile	1.0	42,000.00	42,000	1.31	55,062.00	55,062	1.34	73,672.96	73,673	73,673
	Material Handling and Distribution (5% of Matl's)	Each	-	Track Mile	1.0	13,149.75	13,150	1.00	15,110.64	15,111	1.00	21,956.37	21,956	21,956
	Track Labor Overhead (85% of Labor)	Each	-	LS	1.0	35,842.80	35,843	1.00	46,989.91	46,990	1.00	62,872.50	62,873	62,873
	Equipment	Each	7	LS	1.0	23,706.00	23,706	1.14	16,518.60	16,519	1.44	22,101.89	22,102	22,102
		Yearly SubTotal					*377,694*			*435,894*			*619,731*	*619,731*

MWRRI Item No.	**Description**	**Unit**	**Reference**											**Unit Cost (Oct 2009)**
9.1	Elevate & Surface Curves	Mile	MWRRI Phase 3B - Item 9.1											62,675
		Unit	*Inflation Index Used*	*Sub Unit*	*Sub Unit Qty*	*1993 Sub Unit Cost*	*1993 Sub Unit Total*	*1993-2002 Inflation Factor*	*2002 Sub Unit Cost*	*2002 Sub Unit Total*	*2002-2009 Inflation Factor*	*Oct 2009 Sub Unit Cost*	*Oct 2009 Sub Unit Total*	*Oct 2009 Sub Unit Total*
Materials	Ballast	Mile	3	Ton	1200	15.00	18,000	1.35	20.25	24,300	1.79	36.25	43,502	43,502
Labor	Track Labor	Mile	5	Track Mile	1.0	4,500.00	4,500	1.31	5,899.50	5,900	1.34	7,893.53	7,894	7,894
	Material Handling and Distribution (5% of Matl's)	Mile	-	Track Mile	1.0	900.00	900	1.00	1,215.00	1,215	1.00	2,175.09	2,175	2,175
	Track Labor Overhead (85% of Labor)	Mile	-	LS	1.0	3,840.30	3,840	1.00	5,034.63	5,035	1.00	6,736.34	6,736	6,736
	Equipment (30% of Labor)	Mile	-	LS	1.0	1,350.00	1,350	1.00	1,769.85	1,770	1.00	2,368.06	2,368	2,368
		Yearly SubTotal					*28,590*			*38,219*			*62,675*	*62,675*

MWRRI Item No.	**Description**	**Unit**	**Reference**											**Unit Cost (Oct 2009)**
9.3	Elastic Fasteners	Mile	MWRRI Phase 3B - Item 9.3											146,440
		Unit	*Inflation Index Used*	*Sub Unit*	*Sub Unit Qty*	*1993 Sub Unit Cost*	*1993 Sub Unit Total*	*1993-2002 Inflation Factor*	*2002 Sub Unit Cost*	*2002 Sub Unit Total*	*2002-2009 Inflation Factor*	*Oct 2009 Sub Unit Cost*	*Oct 2009 Sub Unit Total*	*Oct 2009 Sub Unit Total*
Salvage Credit	Tie Plates (Relay)	mile	1	Each	6400	(2.50)	(16,000)	0.95	(2.36)	(15,120)	1.79	(4.23)	(27,068)	(27,068)
	Rail Anchors (Relay)	mile	2	Each	6400	(0.13)	(832)	1.07	(0.14)	(892)	1.91	(0.27)	(1,701)	(1,701)
Materials	Tie Plates	mile	1	Each	6400	5.73	36,672	1.07	6.14	39,312	1.91	11.72	74,992	74,992
	Lock Spikes	mile	2	Each	25600	0.60	15,360	0.95	0.57	14,515	1.79	1.02	25,985	25,985
	Elastic Hold Down Clip	mile	6	Each	12800	1.75	22,400	1.14	2.00	25,556	1.37	2.73	34,892	34,892
Labor	Track Labor	mile	5	Track Mile	1.0	1,000.00	1,000	1.31	1,311.00	1,311	1.34	1,754.12	1,754	1,754
	Material Handling and Distribution (5% of Matl's Subtotal)	mile	-	LS	1.0	3,721.60	3,722	1.00	3,969.19	3,969	1.00	6,793.46	6,793	6,793
	Track Labor Overhead (85% of Labor)	mile	-	LS	1.0	853.40	853	1.00	1,118.81	1,119	1.00	1,496.96	1,497	1,497
	Equipment (30% of Track Labor)	mile	-	LS	1.0	300.00	300	1.00	393.30	393	1.00	526.24	526	526
		Yearly SubTotal					*80,307*			*86,176*			*146,440*	*146,440*

Inflation Index No.

1	*Bureau of Labor Statistics, PPI Series Id: WPU101704 - Steel Mill Products*	*Item: Hot rolled bars, plates, and structural shapes*
2	*Bureau of Labor Statistics, PPI Series Id: PCU3312223312223*	*Product: Steel nails, staples, tacks, spikes, and brads*
3	*Bureau of Labor Statistics, PPI Series Id: PCU2123132123130*	*Product: Crushed and broken granite*
4	*Bureau of Labor Statistics, PPI Series Id: PCU3211143211141*	*Product: Wood poles, piles, and posts owned and treated by the same establishment*
5	*Engineering News Record Skilled Labor Index*	
6	*Bureau of Labor Statistics, PPI Series Id: PCUBCON*	*Product: Material and Supply Inputs to construction industries*
7	*Material and Supply inputs to other heavy construction*	

Table 5

Comparison of Unit Costs Using Two Different Inflation Methods - PPI Series *PCUBHVY* vs. Multiple PPI Indices

All Costs in 1000's, Oct 2009

			Using *PCUBHVY*	Using Multiple PPI Indices		
Item No.	**Description**	**Unit**	**Unit Cost**	**Unit Cost**	**Difference ($)**	**Difference (%)**
1.1	HSR on Existing Roadbed	Mile	1,085	1,113	28	2.6%
1.2a	HSR on New Roadbed	Mile	1,157	1,183	26	2.2%
1.2b	HSR on New Roadbed & New Embankment	Mile	1,630	1,660	30	1.8%
1.3	Timber & Surface w/ 33% Tie replacement	Mile	243	170	-72	-29.7%
1.4	Timber & Surface w/ 66% Tie Replacement	Mile	362	298	-64	-17.7%
1.5	Relay Track w/ 136# CWR	Mile	387	517	131	33.8%
1.6	Freight Siding	Mile	996	995	-1	-0.1%
4.1a	#33 High Speed Turnout	Each	621	620	-1	-0.1%
9.1	Elevate & Surface Curves	Mile	63	63	-1	-1.1%
9.3	Elastic Fasteners	Mile	90	146	57	63.5%
				Average	14.82	6.1%

Table 6

Unit Cost Comparison Using Updated Labor Overhead Rate

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All Costs in 1000's, Oct 2009

			Using Multiple PPI Indices and New Labor Overhead of 133%	Additional Unit Cost Increase Due to New Labor Overhead of 133%	% Increase Over PCUBHVY Cost
Item No.	**Description**	**Unit**	**Unit Cost**	**Unit Cost**	**Percentage**
1.1	HSR on Existing Roadbed	Mile	1,184	71	6.6%
1.2a	HSR on New Roadbed	Mile	1,255	71	6.2%
1.2b	HSR on New Roadbed & New Embankment	Mile	1,731	71	4.4%
1.3	Timber & Surface w/ 33% Tie replacement	Mile	186	16	6.5%
1.4	Timber & Surface w/ 66% Tie Replacement	Mile	329	31	8.7%
1.5	Relay Track w/ 136# CWR	Mile	549	31	8.1%
1.6	Freight Siding	Mile	1,067	71	7.2%
4.1a	#33 High Speed Turnout	Each	655	35	5.7%
9.1	Elevate & Surface Curves	Mile	66	4	5.9%
9.3	Elastic Fasteners	Mile	147	1	0.9%
				Average	5.9%

Table 7

Comparison of MWRRI Phase 7 Unit Costs vs. Costs of Similar Items in Other Projects

All Costs in 1000's

	Item No.	Description	Unit	MWRRI PHASE 7 Oct 2009 Unit Cost	Project 1 Sept 2009 Unit Cost	Project 2 Feb 2010 Unit Cost	Project 3 Aug 2009 Unit Cost	Project 4 Nov 2008 Unit Cost	*Difference in Unit Costs - Other Projects Average vs. MWRRI Phase 7 Cost*
Trackwork	1.2b	HSR on New Roadbed & New Embankment	Mile	1,630	1,802	-	-	-	*10.5%*
	1.71	Fencing, 4 ft Woven Wire (both sides)	Mile	56	63	-	-	-	*13.7%*
	1.72	Fencing, 6 ft Chain Link (both sides)	Mile	167	190	-	-	-	*13.7%*
	1.8	Drainage Improvements (cross country)	Mile	72	140	-	186	-	*126.1%*
Curves	4.1	#24 High Speed Turnout	Each	492	508	-	-	-	*3.4%*
	4.2	#20 Turnout Timber	Each	135	-	95	138	-	*-14.0%*
	4.4	#20 Turnout Concrete	Each	272	444	-	-	-	*63.1%*
	4.5	#10 Turnout Concrete	Each	129	177	-	-	-	*37.0%*
Crossings	7.4a	Conventional Gates single mainline track	Each	181	-	-	-	184	*1.4%*
	7.71	Precast Panels without Rdway Improvements	Each	87	62	-	-	125	*6.9%*

Table 8

Updated MWRRI Unit Costs

All Costs in 1000's

				MWRRI PHASE 7, Oct 2009				
				Pure Construction Cost	Adjustments For Increased Labor Overhead	Adjusted Pure Construction Cost	Plus 31% Soft Costs →	Total Unit Cost
	Item No.	Description	Unit	Unit Cost	Unit Cost	Unit Cost		Unit Cost
Trackwork	1.1	HSR on Existing Roadbed	Mile	1,085	71	1,156		1,514
	1.2a	HSR on New Roadbed	Mile	1,157	71	1,228		1,609
	1.2b	HSR on New Roadbed & New Embankment	Mile	1,630	71	1,701		2,229
	1.2c	HSR on New Roadbed & New Embankment (Double Track)	Mile	2,922	175	3,097		4,057
	1.2d	HSR Double Track on 15' Retained Earth Fill	Mile	15,463	928	16,391		21,472
	1.3	Timber & Surface w/ 33% Tie replacement	Mile	243	16	259		339
	1.4	Timber & Surface w/ 66% Tie Replacement	Mile	362	31	393		514
	1.5	Relay Track w/ 141# CWR	Mile	387	31	418		547
	1.6	Freight Siding	Mile	996	71	1,067		1,398
	1.65	Passenger Siding	Mile	1,503	90	1,594		2,088
	1.71	Fencing, 4 ft Woven Wire (both sides)	Mile	56		56		73
	1.72	Fencing, 6 ft Chain Link (both sides)	Mile	167		167		219
	1.73	Fencing, 10 ft Chain Link (both sides)	Mile	191		191		250
	1.74	Decorative Fencing (both sides)	Mile	430		430		564
	1.8	Drainage Improvements (cross country)	Mile	72		72		94
	1.9a	Land Acquisition Urban	Mile	357		357		468
	1.9b	Land Acquisition Rural	Mile	119		119		156
Curves	9.1	Elevate & Surface Curves	Mile	63	4	67		88
	9.2	Curvature Reduction	Mile	429	26	455		596
	9.3	Elastic Fasteners	Mile	90	1	91		119
Signals	8.1	Signals for Siding w/ High Speed Turnout	Each	1,385		1,385		1,815
	8.2	Install CTC System (Single Track)	Mile	200		200		262
	8.21	Install CTC System (Double Track)	Mile	328		328		429
	8.3	Install PTC System	Mile	215		215		282
	8.4	Electric Lock for Industry Turnout	Each	113		113		147
	8.5	Signals for Crossover	Each	765		765		1,002
	8.6	Signals for Turnout	Each	437		437		573
Turnouts	4.1a	#33 High Speed Turnout	Each	621	35	656		859
	4.1	#24 High Speed Turnout	Each	492	30	521		683
	4.2	#20 Turnout Timber	Each	135	8	144		188
	4.3	#10 Turnout Timber	Each	75	5	80		105
	4.4	#20 Turnout Concrete	Each	272	16	288		378
	4.5	#10 Turnout Concrete	Each	129	8	137		179
	4.6	#33 Crossover	Each	1,241	74	1,316		1,724
	4.7	#20 Crossover	Each	776	47	822		1,077

Notes:

1. Total Unit Costs include 31% in soft costs, including:
   - 7% Engineering
   - 15% Contingency
   - 3% Program Management of General Engineering Consultant
   - 4% for Construction Management and Inspection
   - 2% for Owner's Management Costs such as Alternatives Analysis or Environmental Studies
2. Pure Construction Costs Include Only Materials and Labor
3. 2009 costs escalated using the Producer Price Index *Material and Supply Inputs to Other Heavy Construction* (PCUBYVY)

Table 8

Updated MWRRI Unit Costs

All Costs in 1000's

				MWRRI PHASE 7, Oct 2009				
				Pure Construction Cost	Adjustments For Increased Labor Overhead	Adjusted Pure Construction Cost	Plus 31% Soft Costs →	Total Unit Cost
	Item No.	Description	Unit	Unit Cost	Unit Cost	Unit Cost		Unit Cost
Bridges-Under	5.1	Four Lane Urban Expressway	Each	5,283		5,283		6,920
	5.2	Four Lane Rural Expressway	Each	4,398		4,398		5,761
	5.3	Two Lane Highway	Each	3,337		3,337		4,371
	5.4	Rail	Each	3,337		3,337		4,371
	5.5	Minor river	Each	885		885		1,159
	5.6	Major River	Each	8,848		8,848		11,591
	5.65	Double Track High (50') Level Bridge	LF	13		13		17
	5.70	Rehab for 110	LF	15		15		20
	5.71	Convert open deck bridge to ballast deck (single track)	LF	5		5		7
	5.72	Convert open deck bridge to ballast deck (double track)	LF	10		10		13
	5.73	Single Track on Flyover/Elevated Structure	LF	7		7		9
	5.8	Single Track on Approach Embankment w/ Retaining Wall	LF	3		3		4
	5.9	Ballasted Concrete Deck Replacement Bridge	LF	2		2		3
	5.10	Land Bridges	LF	3		3		4
	5.11	Double Track on Flyover/Elevated Structure	LF	11		11		15
	47	Double Track on Approach Embankment w/ Retaining Wall	LF	6		6		8
Bridges-Over	6.1	Four Lane Urban Expressway	Each	2,280		2,280		2,987
	6.2	Four Lane Rural Expressway	Each	3,200		3,200		4,192
	6.3	Two Lane Highway	Each	2,079		2,079		2,724
	6.4	Rail	Each	6,676		6,676		8,745
Crossings	7.1	Private Closure	Each	91		91		119
	7.2	Four Quadrant Gates w/ Trapped Vehicle Detector	Each	538		538		704
	7.3	Four Quadrant Gates	Each	315		315		412
	7.31	Convert Dual Gates to Quad Gates	Each	164		164		215
	7.4a	Conventional Gates single mainline track	Each	181		181		238
	7.4b	Conventional Gates double mainline track	Each	224		224		293
	7.41	Convert Flashers Only to Dual Gate	Each	55		55		72
	7.5a	Single Gate with Median Barrier	Each	197		197		258
	7.5b	Convert Single Gate to Extended Arm	Each	16		16		21
	7.71	Precast Panels without Rdway Improvements	Each	87		87		115
	7.72	Precast Panels with Rdway Improvements	Each	164		164		215
	7.8	Michigan Type Grade Crossing Surface	Each	16		16		21
Station/Maintenance Facilities	2.1	Full Service - New	Each	1,093		1,093		1,431
	2.2	Full Service - Renovated	Each	546		546		716
	2.3	Terminal - New	Each	2,185		2,185		2,863
	2.4	Terminal - Renovated	Each	1,093		1,093		1,431
	2.5a	Maintenance Facility (non-electrified track/110 mph system)	Each	10,926		10,926		14,313
	2.6	Layover Facility	Each	7,141		7,141		9,355

1. Total Unit Costs include 31% in soft costs, including:
   - 7% Engineering
   - 15% Contingency
   - 3% Program Management of General Engineering Consultant
   - 4% for Construction Management and Inspection
   - 2% for Owner's Management Costs such as Alternatives Analysis or Environmental Studies
2. Pure Construction Costs Include Only Materials and Labor
3. 2009 costs escalated using the Producer Price Index *Material and Supply Inputs to Other Heavy Construction* (PCUBYVY)

Appendix B: Updated Unit Costs

Cost Estimating Methodology for High-Speed Rail on Shared Right-of-Way
Unit Costs

Updated 01/17/11

Item Number	Description	Unit	2010 Unit Cost	2010 Unit Cost (1000's)
2.0	Trackwork			
2.2	New Track Construction			
2.2.1	HSR on Existing Roadbed	MI	$ 1,122,920	$ 1,123
2.2.2	HSR on New Roadbed	MI	$ 1,380,000	$ 1,380
2.2.3	HSR on New Roadbed @ 30' offset from ex. Track centerline	MI	$ 1,550,000	$ 1,550
2.2.4	HSR on New Roadbed & New Embankment	MI	$ 1,687,208	$ 1,687
2.2.5	HSR on New Roadbed & New Embankment (Double Track)		$ 3,024,000	$ 3,024
2.2.6	HSR Double Track on 15' Retained Earth Fill (Cross Country)	MI	$ 15,971,602	$ 15,972
2.2.7	Freight Siding (3 mile)	EA	$ 4,288,000	$ 4,288
2.2.8	Passenger Siding (10 mile)	EA	$ 14,496,000	$ 14,496
2.3	Turnouts & Crossovers		$ -	
2.3.1	#33 High Speed Turnout	EA	$ 695,520	$ 696
2.3.2	#24 High Speed Turnout	EA	$ 508,876	$ 509
2.3.3	#20 Turnout Timber	EA	$ 183,000	$ 183
2.3.4	#15 Turnout - Timber	EA	$ 147,500	$ 148
2.3.5	#10 Turnout Timber	EA	$ 105,000	$ 105
2.3.6	16'6" Double Switch Point Derail	EA	$ 34,000	$ 34
2.3.7	#20 Turnout Concrete	EA	$ 281,578	$ 282
2.3.8	#15 Turnout - Concrete	EA	$ 155,000	$ 155
2.3.9	#10 Turnout Concrete	EA	$ 133,439	$ 133
2.3.10	#33 Crossover	EA	$ 1,284,630	$ 1,285
2.3.11	#20 Crossover	EA	$ 563,000	$ 563
2.4	Track Improvements		$ -	
2.4.1	Timber & Surface w/ 33% Tie replacement	MI	$ 251,046	$ 251
2.4.2	Timber & Surface w/ 66% Tie Replacement	MI	$ 374,307	$ 374
2.4.3	Replace Existing Rail w/ 136#/141# CWR	MI	$ 400,316	$ 400
2.4.4	Elevate & Surface Curves	MI	$ 65,589	$ 66
2.4.5	Curvature Reduction	MI	$ 444,419	$ 444
2.4.6	Elastic Rail Fasteners	MI	$ 92,729	$ 93
2.5	Site Work Related to HSR Track Construction		$ -	
2.5.1	Highway Barrier Type 6	LF	$ 1,275	$ 1
2.5.2	Highway Barrier Type 5	LF	$ 196	$ 0
2.5.3	Fencing, 4 ft Woven Wire (both sides)	MI	$ 57,673	$ 58
2.5.4	Fencing, 6 ft Chain Link (both sides)	MI	$ 173,018	$ 173
2.5.5	Fencing, 10 ft Chain Link (both sides)	MI	$ 197,896	$ 198
2.5.6	Decorative Fencing (both sides)	MI	$ 445,549	$ 446
2.5.7	Drainage Improvements (cross country)	MI	$ 74,635	$ 75
2.6	Land Acquisition		$ -	
2.6.1	Land Acquisition Rural	MI	$ 185,860	$ 186
2.6.2	Land Acquisition Urban	MI	$ 557,580	$ 558
3.0	Structures			
3.2	Bridges - Undergrade			
3.2.1	Four Lane Urban Expressway	EA	$ 5,467,593	$ 5,468
3.2.2	Four Lane Rural Expressway	EA	$ 4,551,616	$ 4,552
3.2.3	Two Lane Highway	EA	$ 5,453,574	$ 5,454
3.2.4	Rail	EA	$ 3,453,574	$ 3,454
3.2.5	Minor river	EA	$ 915,977	$ 916
3.2.6	Major River	EA	$ 9,157,512	$ 9,158
3.2.7	Double Track High (50') Level Bridge	LF	$ 13,735	$ 14
3.2.8	Ballasted Deck Replacement Bridge	LF	$ 3,200	$ 3
3.2.9	Rehab for Higher Passenger Speeds (90 - 110 mph)	LF	$ 1,580	$ 2
3.2.10	Convert open deck bridge to ballast deck (single track)	LF	$ 5,288	$ 5
3.2.11	Convert open deck bridge to ballast deck (double track)	LF	$ 10,575	$ 11
3.2.12	Single Track on Flyover/Elevated Structure	LF	$ 10,231	$ 10
3.2.13	Double Track on Flyover/Elevated Structure	LF	$ 17,904	$ 18
3.2.14	Land Bridges	LF	$ 2,963	$ 3
3.3	Bridges - Overhead			
3.3.1	Four Lane Urban Expressway	EA	$ 3,312,219	$ 3,312
3.3.2	Four Lane Rural Expressway	EA	$ 2,360,055	$ 2,360
3.3.3	Two Lane Highway	EA	$ 2,151,981	$ 2,152
3.3.4	Rail	EA	$ 6,909,410	$ 6,909
3.4	Other Structures			
3.4.1	Culvert Extension	MI	$ 58,000	$ 58

Cost Estimating Methodology for High-Speed Rail on Shared Right-of-Way
Unit Costs

Updated 01/17/11

Item Number	Description	Unit	2010 Unit Cost	2010 Unit Cost (1000's)
3.4.2	Single Track on Approach Embankment w/ Retaining Wall	LF	$ 5,115	$ 5
3.4.3	Double Track on Approach Embankment w/ Retaining Wall	LF	$ 9,378	$ 9
3.4.4	Two Bore Long Tunnel	route ft	$ 45,540	$ 46
3.4.5	Single Bore Short Tunnel	LF	$ 25,875	$ 26
Systems				
4.2.1	Install CTC System (Single Track)	MI	$ 206,943	$ 207
4.2.2	Install CTC System (Double Track)	MI	$ 339,251	$ 339
4.2.3	Install PTC System	MI	$ 176,985	$ 177
4.2.4	Electric Lock for Industry Turnout	EA	$ 116,476	$ 116
4.2.5	New Control Point (CP) - End of siding turnout, single track	EA	$ 650,000	$ 650
4.2.6	New Control Point (CP) - End of siding turnout & crossover, double track	EA	$ 1,296,000	$ 1,296
4.2.7	New Control Point (CP) - Universal Crossover	EA	$ 1,619,000	$ 1,619
4.2.8	Signal work to add Turnout to CP	EA	$ 452,335	$ 452
4.2.9	Signal work to add Crossover to CP	EA	$ 791,585	$ 792
4.2.10	Traffic Signal Preemption	EA	$ 75,000	$ 75
4.2.11	Traffic Signal Preemption and Intersection Signalization	EA	$ 300,000	$ 300
5.0	Crossings			
5.2.1	Crossing Closure	EA	$ 93,859	$ 94
5.2.2	Four Quadrant Gates	EA	$ 325,681	$ 326
5.2.3	Four Quadrant Gates w/ Trapped Vehicle Detector	EA	$ 556,371	$ 556
5.2.4	Convert Dual Gates to Quad Gates	EA	$ 169,625	$ 170
5.2.5	Conventional Gates single mainline track	EA	$ 187,719	$ 188
5.2.6	Conventional Gates double mainline track	EA	$ 231,821	$ 232
5.2.7	Convert Flashers Only to Dual Gate	EA	$ 56,542	$ 57
5.2.8	Dual Gate with Median Barrier	EA	$ 203,551	$ 204
5.2.9	Convert Dual Gate to Extended Arm	EA	$ 16,963	$ 17
5.2.10	Precast Panels without Rdway Improvements	EA	$ 90,467	$ 90
5.2.11	Precast Panels with Rdway Improvements	EA	$ 169,625	$ 170
Station/Maintenance Facilities				
	Full Service - New - Low Volume - 500 Surface Park	EA	$ 5,175,000	$ 5,175
	Full Service - Renovated - Low Volume- 500 Surface Park	EA	$ 4,140,000	$ 4,140
	Terminal - New - Low Volume - 500 Surface Park	EA	$ 7,762,500	$ 7,763
	Terminal - Renovated - Low Volume - 500 Surface Park	EA	$ 6,210,000	$ 6,210
	Full Service - New- High Volume - Dual Platform - 1000 Surface Park	EA	$ 10,350,000	$ 10,350
	Terminal - New- High Volume - Dual Platform - 1000 Surface Park	EA	$ 15,525,000	$ 15,525
	Maintenance Facility (non-electrified track)	EA	$ 82,800,000	$ 82,800
	Maintenance Facility (electrified track)	EA	$ 103,500,000	$ 103,500
	Layover Facility	LS	$ 10,350,000	$ 10,350
Allocations for Special Elements				
6.2.1	Yard - Category A - Placeholder	LS	$ 10,000,000	$ 10,000
6.2.2	Yard - Category B - Placeholder	LS	$ 30,700,000	$ 30,700
6.2.3	Yard - Category C - Placeholder	LS	$ 37,400,000	$ 37,400
6.2.4	Access to Signal/Switch Location	LS	$ 100,000	$ 100
6.2.5	Maintenance of Way Spur	LS	$ 1,000,000	$ 1,000
6.2.6	Rail-Rail Flyovers	LS	$ 40,000,000	$ 40,000
Contingency				
	Contingency - 30% of Construction Costs (G)		30%	
Professional Services and Environmental				
	Design Engineering		10%	
	Insurance and Bonding		0%	
	Program Management		4%	
	Construction Management & Inspection		6%	
	Engineering Services During Construction		2%	
	Integrated Testing and Commissioning		2%	
	Erosion Control and Water Quality Management		0%	

Appendix C: Estimating HSR Capital Costs in Yards, Terminals and Junctions in the MWRRI Route Network

Introduction

The objective of this memorandum is to define the methodology for estimating high-speed rail (HSR) capital costs in congested areas such as yards, terminals, and junctions, in the MWRRI route network. Categories have been established to be used to rapidly and effectively estimate the capital costs that would be incurred to extend HSR operations through these congested areas without the expense of performing extensive due diligence efforts in the earliest planning stages.

Background

As planning and route evaluation efforts for the MWRRI network progress, stations, yards and junctions are identified where significant amounts of freight train activity are occurring. Sometimes the rail freight traffic involves the switching of major industries which are the railroad's customers. Other times, the rail freight traffic may involve yard switch engines, local freight trains, and complete freight train movements in and out of towns, freight classification yards, junctions and/or railroad crew change points. In all of these cases, the freight railroads are using their tracks to serve their freight customers.
The significance of these locations to MWRRI planning is that, if not properly addressed in the planning stage, these locations can represent "bottlenecks" to the movement of HSR passenger trains.

Freight trains are often moving on time-sensitive operating schedules. Regular switching schedules are necessary to properly serve industrial customers' production requirements, or to be certain that the customers' freight cars make the required connecting trains. The on-time movement of complete freight trains is necessary so that these trains make their advertised schedules and connections with other freight trains, markets, guaranteed delivery times, "just-in-time" logistical requirements, vessel sailings, and other contractual requirements. Federal hours of service regulations limit how long railroad crews can work. The terms of railroad labor agreements may limit the ability of the railroads to "just think out of the box" and develop other plans to run the freight trains. Equipment cycles involving locomotives and train sets are established for the effective re-use of arriving resources (locomotives, cars and crews) for departing trains. Crew and equipment cycles using many of the same considerations and restrictions will be used by MWRRI for the planned utilization of its HSR train sets.

Many freight trains travel long distances with trips lasting several days. The trains must pass through congested cities at certain times to avoid causing delay to commuter train and intercity train operations. They must pass through track construction and maintenance projects at times when tracks and/or bridges are in service so as not to delay the train or the project work. Delays at one point on a route often result in the failure of the train to meet its operational requirements (connecting train, vessel sailing, industry production schedule, produce market availability time) since a freight train has little or no ability to make up time lost through delays along its route.

Both MWRRI and the freight railroads expect that their trains will run on schedule. Therefore, MWRRI planning must understand the freight requirements and ensure that sufficient additional capacity and operational flexibility are constructed to permit the operation of both MWRRI's HSR trains and the host railroads' freight trains. Included in these requirements is the need to provide sufficient infrastructure capacity to allow railroad maintenance activities to be performed while both freight and passenger train operations continue.

MWRRI planning must also recognize that certain types of freight trains move on irregular schedules based on customer loading schedules (e.g. coal trains, grain trains or extra trains that may be operated due to heavier than normal freight loadings). These trains may move at varying times of the day, night, or day of the week. Some, like grain trains, may be seasonal and can be especially heavy during harvest periods. The railroad must have the capacity and flexibility to handle these trains in addition to the scheduled freight and MWRRI passenger trains.

The alternative or assumption that freight traffic schedules will simply be re-organized and that temporal separation arrangements will be made restricting freight train operations for much of the day will, in many cases, not be realistic, viable or acceptable to the host railroads and their freight customers.

For these reasons, this methodology has been developed to propose a means of properly estimating the capital costs to enhance capacity at these potential freight "bottlenecks" in the early planning stages without the need for time-consuming detailed field planning. Such planning will still be needed, but can be deferred to later preliminary engineering phases of the project when the number of routes or alternatives has been reduced.

Methodology

The following three-step process is proposed to rapidly and effectively develop capital cost estimates for these "bottleneck" areas:

(1) Conduct a brief summary review of the yard, terminal or junction using available railroad track charts, timetables and maps, operating information and Internet imagery to determine the level of complexity of the yard or terminal segment and its operations, freight traffic levels and existing passenger train operations. Also consider the MWRRI proposed operating frequency and track speeds.

(2) After completing the review, compare the yard, terminal or junction with the menu of categories described below to determine which of the categories most closely represents the complexity of the location and its parameters.

(3) Utilize the estimating method assigned to the selected category for determining the capital costs required to conduct early planning and route evaluation analyses.

Parameters

In order to establish the categories for use in the cost estimating process, a group of six railroad yards and terminal areas on three railroads in Wisconsin and Minnesota were reviewed to understand both the physical layout of the railroad and how operations were conducted at each location. The six yard areas reviewed were: Portage, Winona and Red Wing (all CP), Altoona-Eau Claire and East St. Paul (both UP), and North Milwaukee-Wiscona (CP & WSOR). For all six locations, a desktop analysis was made.

Railroad track charts, timetables and maps, and Internet imagery and other information were used to assess the routes. This information included planned MWRRI speeds through the area, the general state of maintenance of the railroad, freight traffic volumes and whether or not Amtrak trains presently use the route. Operating problems that would likely occur with the introduction of MWRRI HSR service were anticipated so that a proposed operating solution could be developed and included in the capital cost estimate for the MWRRI corridor.

Considering these parameters, a proposed operating solution for each of the six yard or terminal areas was then developed that required the construction of additional physical capacity at or near the yard or terminal that was considered to be sufficient to meet the needs of both the freight railroad(s) and MWRRI. An itemized list of four types of capital costs (track, signals, bridges and grade crossings) from the MWRRI capital cost spreadsheets was then used to estimate the capital costs that would be incurred to resolve the "bottleneck." Costs to install a Positive Train Control system are not included in these estimates.

The sum of these four types of capital costs represents the cost to get MWRRI trains through the "bottleneck" area while maintaining satisfactory freight operations. All other costs to permit HSR operations through the yard area will be determined in the capital cost estimate for the complete route segment through the yard or terminal. Special costs applicable only to a particular yard and not related to the "bottleneck" itself (such as the need to rehabilitate two major bridges near Eau Claire or the need to replace one major overhead railroad bridge at Wiscona} were not included in the actual "bottleneck" costs. To make valid yard and terminal cost comparisons, these special costs would be assigned to the route segment.

All of the information described above has been summarized in Attachment A.

Categories

The detailed cost estimates for each of the six yard areas using the established MWRRI capital cost spreadsheets are described in Appendix B. A review of these cost estimates showed that for five of the six yards, the capital costs to resolve the "bottleneck" averaged approximately $30,700,000 for the four types of construction elements and approximately $47,300,000 when the 30% contingency and the 24% professional services and environmental percentages were included. The sixth yard area (North Milwaukee to Wiscona-MWRRI Segments 3 and 4) had much higher costs due to the number of grade separations requiring rehabilitation and the complexity of the freight track network serving yards and active industries. Therefore, to simplify initial planning and estimating, three categories have been established for estimating the capital costs necessary to enhance capacity in the "bottleneck" areas for route analysis purposes:

Category A: Smaller town sidings or yards and key junctions with a lower level of freight activity-Estimate the costs for these locations at $10,000,000.

Category B: Active Mainline Yards & Terminals as described in this Methodology-Estimate the capital costs for the "bottleneck area" at the average amount of

$30,700,000.

Category C: Major Terminal Areas-Prepare an individual preliminary capital cost estimate using the desktop analysis method (railroad track charts, maps, operating information and Internet imagery) to estimate capital costs. This is necessary to accurately identify the order of magnitude of capital costs associated with improving the complicated freight track network and/or rehabilitating or replacing many structures in a grade-separated urban environment. An example of this approach is the estimate prepared for North Milwaukee-Wiscona as described in Attachment A.

Attachment A: Cost Estimates for Yards, Terminals, and Junctions

As described previously, six yard and terminal areas were analyzed and capital costs were estimated to resolve “bottleneck” areas that would negatively impact MWRRI and freight railroad operations. For each of these six areas, the following information was developed:

- Current Situation
- Operating Parameters
- MWRRI Solution
- Capital Cost Estimate.

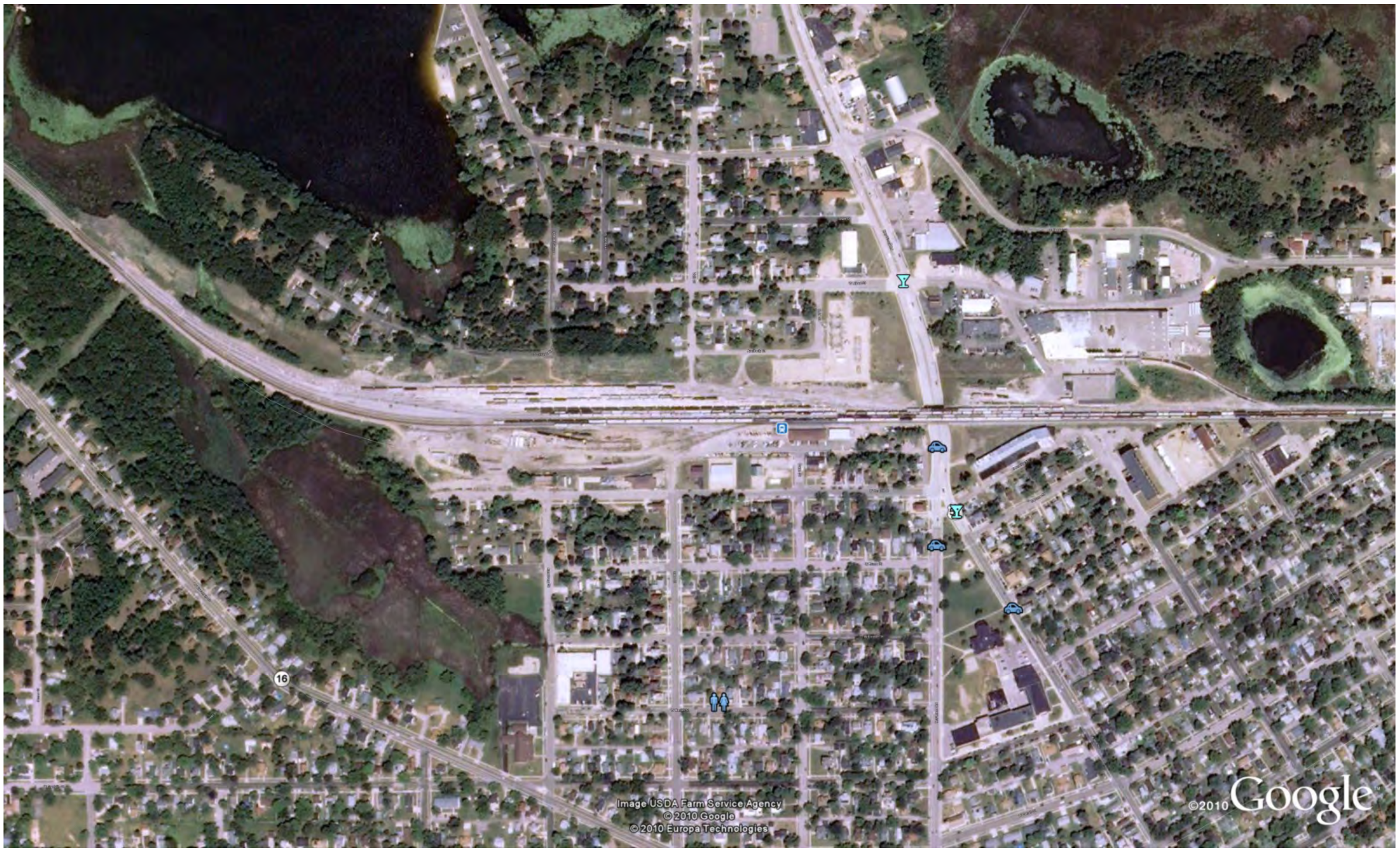
The information developed for each of these six “bottleneck” areas is described below.

Portage, WI (CP)

Current Situation:

- Junction between CP’s Milwaukee-St. Paul mainline and CP’s Madison & Portage (M&P) Subdivision (MWRRI Segments 8 and 11).
- Operational control is accomplished by Centralized Traffic Control (CTC) on the mainline, and Track Warrant Control (TWC) on the M&P Subdivision.
- Wisconsin Power & Light (WP&L) power generating station is located immediately south of Portage on the M&P Subdivision and is a destination for coal trains from Wyoming’s Powder River Basin.
- An active freight customer (Manley Brothers sand plant) is located on the east side of the M&P Subdivision opposite the WP&L power plant.
- Portage Amtrak station- Amtrak’s Empire Builder stops on the main track (currently at 12:27 PM in the eastward direction (Train No. 8) and 5:34 PM in the westward direction (Train No. 7).
- Freight trains queue at both ends of Portage (eastward trains at Portage East and westward trains at Portage West) to meet other trains arriving off the single track mainline from both directions (Milwaukee and La Crosse). Empty westward coal trains from WP&L also queue at Portage Jct. to wait for their opportunity to move west through Portage.

Figure 1 – Portage, WI



Operating Parameters:

- Maintain throughput capacity for CP mainline freight traffic and Amtrak trains while providing additional capacity for MWRRI trains to move to and from the M&P Subdivision between Portage and Madison.
- Amtrak and MWRRI trains would not meet each other between Portage Jct. and West Portage.
- Maintain existing holding capacity for CP freight trains meeting other trains between East Portage and West Portage.
- Maintain Amtrak platform station access for Amtrak and MWRRI trains, one train at a time between Portage Jct. and West Portage, to avoid the capital costs that would be incurred to relocate Portage Yard tracks, construct a second passenger platform and a fully accessible overhead pedestrian and baggage handling facility at the Portage station.
- Avoid or minimize delays related to arriving and departing WP&L coal trains.
- Minimize the effects on the business and residential areas that constrain the corridor between East Portage and West Portage by avoiding additional track construction between these two points.
- Avoid the high costs and potential environmental effects of constructing an additional HSR main track between Portage and West Portage on a high embankment within the Wisconsin River flood plain where unstable subsoil conditions exist.

MWRRI Solution:

- Add seven miles of second main track with signals and CTC between MP 0.0 and MP 7.0 on the M&P Subdivision to allow MWRRI trains to avoid WP&L coal train movements in this area.
- Construct one additional main track crossover at Portage Jct. to permit parallel movements to and from the proposed new second main track on the M&P Subdivision to permit coal trains and MWRRI trains to move simultaneously.
- Upgrade existing trackage and crossovers between Portage Jct. and West Portage to achieve and maintain optimum freight train speeds through Portage.
- Upgrade existing highway grade crossings between M&P MP 7.0 and Portage to HSR standards including trapped vehicle detection.
- Includes no major structure rehabilitation or replacement.

Capital Cost Estimate:

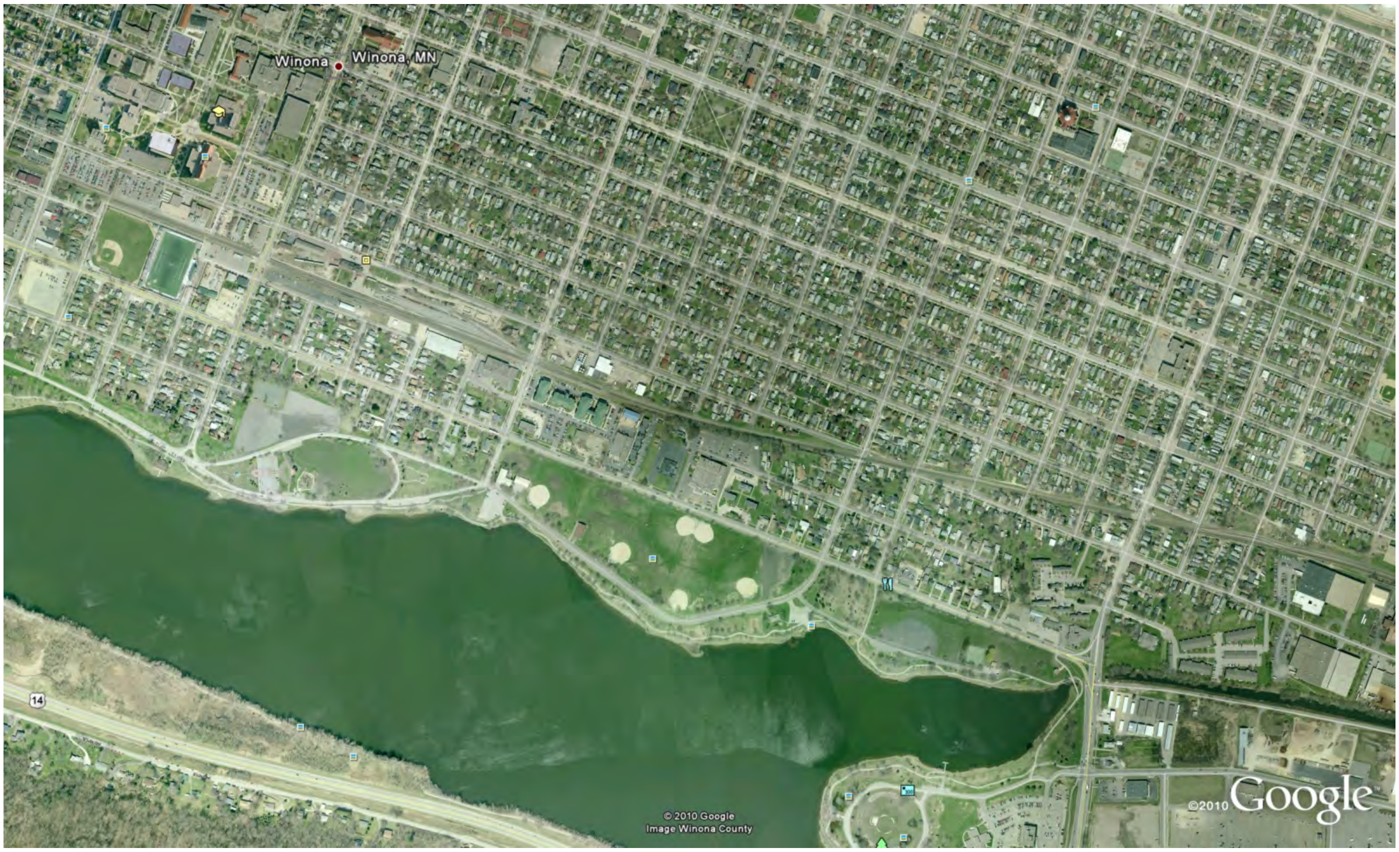
- $28,643,000 (Construction Elements Only).
- $46,173,000 (Total).

<u>Winona, MN (CP)</u>

Current Situation:

- Mississippi River port city on CP's Milwaukee-St. Paul mainline with active grain elevators and other industries in the port area between CP's main track and the river.
- Junction with CP's former Dakota, Minnesota & Eastern (DM&E) Railroad line to Rochester, Owatonna, Pierre, Rapid City and the Black Hills. (This route currently handles substantial grain, bentonite clay and other traffic originating in Wyoming, South Dakota and Minnesota destined to Winona and points east and south on CP. It was also the DM&E's route for some of the coal trains moving to and from DM&E's proposed Powder River Basin Expansion Project.
- Operational control is accomplished by CTC on the mainline and yard track rules on the sidings and port trackage.
- Winona Amtrak station-Amtrak's Empire Builder normally stops on the main track which uses the platform on the siding augmented by an arrangement of crossing panels to allow trains on the main track to detrain and board passengers and baggage. The existing Winona siding is between the main track and the station platform.
- Freight train movements to serve the port are concentrated near Tower CK and Minnesota City on the railroad west end of Winona.
- There is a high concentration of highway-rail grade crossings between the Winona depot (MP 308.2) and Tower CK (MP 310.1).

Figure 2 – Winona, MN



Operating Parameters:

- Maintain throughput capacity for CP mainline, port traffic and Amtrak trains.
- Increase main track capacity and flexibility to handle MWRRI trains.
- Minimize track construction activities between the Winona depot and Tower CK due to the number of grade crossings in this area. Consider rationalizing the number of highway and pedestrian grade crossings to minimize both accident exposure and construction costs. No specific reductions have been proposed. However, the costs of any crossing eliminations should be more than offset by the reduced overall cost to bring the remaining crossings up to HSR standards.
- Minimize construction activities between Tower CK and Minnesota City due to the amount of freight train activity and track connections in this area.
- Concentrate capacity enhancements railroad east of Winona depot where higher operating speeds can be achieved or maintained.
- No improvements to embankment protection have been included in this estimate.

MWRRI Solution:

- Upgrade existing CTC main track to HSR standards between CP Homer East and Tower CK.
- Upgrade second main track between CP Homer East and CP Homer West.

- Rehabilitate the twin two-span through plate girder bridges at MP 304.9 for HSR operation.
- Construct a segment of new HSR second main track CTC between CP Homer West and the east end of the Winona Siding at MP 305 including track shifts near MP 305.
- Replace the turnout at CP Homer West with universal crossovers in CTC territory.
- Upgrade the existing Winona Siding to a second HSR main track in CTC territory.
- Upgrade existing crossover and industry track turnouts and install electric locks on all hand throw switches between MP 305 and MP 309.
- Upgrade crossings to HSR standards including trapped vehicle detection.
- Replace crossing panels in existing siding at the Winona depot to allow the continued use of the existing main track to detrain and board passengers and baggage.
- Permit two HSR trains to meet each other on the enhanced trackage between MP 301.9 and MP 309.0 but only permit one train to come to platform at Winona depot at a time to avoid the need to construct accessible pedestrian and baggage handling facilities for both trains to come to platform simultaneously.

Capital Cost Estimate:

- $25,463,000 (Construction Elements Only).
- $41,047,000 (Total).

Red Wing, MN (CP)

Current Situation:

- Mississippi River port city on CP's Milwaukee-St. Paul mainline with active grain elevators and other industries on both sides of the main track.
- Major grain processing facility (ADM) is located adjacent to CP's main track with facilities on both sides of the main track. Switching activities occupy the main track between through train movements.
- Existing Red Wing siding and other available tracks in Red Wing are used for the storage and switching of grain traffic to serve ADM.
- Through freight trains stop on the main track to set out and pick up blocks of freight cars.
- Red Wing Amtrak station is located on the Red Wing siding and has a second platform to access the main track. The second platform is located between the siding and the main track.
- Operational control is accomplished by CTC on the main track and yard track rules on other tracks.
- An existing segment of two main track CTC is located west of Red Wing between CP Duke East (MP 372.7) and CP Duke West (MP 375.5).

Figure 3 – Red Wing, MN

Operating Parameters:

- Maintain throughput capacity for CP mainline freight trains and Amtrak trains.
- Maintain ability to provide local freight service to ADM plant and other customers.
- Assume that the portion of the existing siding railroad east of the Red Wing station would frequently be occupied by grain cars and industry switching activities as it is now. This track would, however be upgraded to permit HSR movements and higher speed freight train movements when the track was available.
- Increase track capacity to handle MWRRI trains.
- Upgrade grade crossings to HSR standards.
- No major structure upgrades or replacements are included in this segment.

MWRRI Solution:

- Upgrade the existing main track to HSR standards between MP 367.25 and MP 375.5.
- Upgrade the existing siding to HSR standards in CTC territory between MP 367.25 and MP 371.4.
- Upgrade the existing segment of second main track to HSR standards between MP 372.7 and MP 375.5
- Construct a new segment of second main track CTC to HSR standards between MP 371.4 and MP 372.7.

- Install high speed turnouts in CTC territory at MP 367.3 and MP 375.5.
- Install a new #20 CTC crossover at MP 371.4. Convert the existing #10 hand throw crossover to a new #20 power crossover in CTC territory at MP 371.4.
- Install new #33 power crossovers in CTC territory at MP 372.7 and MP 372.8.
- Relay existing rail with new 136# CWR in the existing Red Wing siding between MP 367.25 and MP 371.4.
- Install electric locks on all hand throw industry and yard track turnouts.
- Upgrade all grade crossings to HSR standards including trapped vehicle detection.
- Permit two HSR trains to meet each other on the enhanced trackage between MP 371.4 and MP 375.5 but only permit one train to come to platform at Red Wing depot at a time to avoid the need to construct accessible pedestrian and baggage handling facilities for both trains to come to platform simultaneously.

Capital Cost Estimate:

- $28,214,000 (Construction Elements Only)
- $45,480,000 (Total).

Eau Claire, WI (UP)

Current Situation:

- The area for this estimate extends from Altoona Jct. at MP 93.3 west through Altoona and Eau Claire to MP 85.0 west of Yukon Jct.
- Altoona Yard is located railroad east of Eau Claire and is a crew change point, freight car classification yard and terminal area for the Union Pacific Railroad (UP) between Chicago and the Twin Cities. Other terminals on this line are Milwaukee and Adams, WI.
- UP freight trains in both directions meet and queue at this location waiting for the arrival of trains arriving off the single track railroad in both directions. The trains may also wait for rested crews at this location.
- Operational control on the main track is accomplished by Track Warrant Control (TWC). Track warrants may be issued to trains either electronically or by radio. The railroad is equipped with an Automatic Block Signal (ABS) system, but not CTC. Yard Limit rules apply to the use of the main track in the Altoona-Eau Claire area.
- There are two major bridges (a single track bridge over the Eau Claire River and a double track bridge over the Chippewa River) in this segment. The cost to rehabilitate these two major structures has not been included in the "bottleneck" area capital cost estimate. It will be included in the line segment capital cost estimate in accordance with the methodology.
- Amtrak trains do not serve this community and do not use any portion of the mainline tracks, yard or terminal areas.
- The general maintenance condition of this freight-only railroad line is lower than that of the CP line through Portage and along the Mississippi River which handles higher speed Amtrak intercity passenger trains. Therefore, the costs to bring this terminal area up to HSR standards are higher than they might be if passenger trains currently used the line.

- There are no major active industries along the main track in the Altoona-Eau Claire yard segment.

Figure 4 – Eau Claire, WI

Operating Parameters:

- Maintain throughput capacity for UP mainline freight trains while providing additional capacity for MWRRI trains.
- Maintain existing holding capacity for arriving and departing UP freight trains at Altoona Yard. The locomotives of trains in both directions normally stop at the Altoona Yard office crossing located at MP 90.7 for easy crew access.
- An MWRRI passenger station facility would need to be located at Eau Claire. No capital costs for that station facility have been included in this estimate.
- Avoid the high cost of a second track over the Eau Claire River Bridge since this is only a single-track structure.

MWRRI Solution:

- Upgrade all existing main track, second main track and siding track with new 136# rail and 66% tie replacement. This includes the second track between Altoona Jct. and MP 89.6 west of Altoona Yard and the Altoona siding located west of the main track east of the Altoona yard office.

- Construct new second main track between the east switch at Yukon Jct. and MP 85.0 which includes the segment across the double track Chippewa River Bridge which currently has only one track across the bridge.
- Install CTC on the main track between MP 90.3 and MP 85.0, both segments of second main track and the Altoona siding.
- Install high speed HSR turnouts at MP 93.3, MP 89.6 and MP 85.0.
- Upgrade five existing turnouts to #20 powered turnouts in CTC territory to enhance the speed of arriving and departing freight trains.
- Install power crossovers in CTC territory at both end of Altoona yard to allow faster entry and exit from the yard and to permit additional flexibility for trains to overtake and/or meet each other at Altoona yard.
- Install electric locks for industry track switches.
- Replace the double track single span Forest Street Bridge (2-lane roadway under).
- Upgrade grade crossings to HSR standards including trapped vehicle detection.
- Permit two HSR trains to meet each other in available segments of two main track CTC territory, but only permit one train at a time to come to the platform at the Eau Claire station to avoid the need to construct accessible pedestrian and baggage handling facilities that would be required for both trains to come to platform simultaneously.

Capital Cost Estimate:

- $33,695,000 (Construction Elements Only).
- $54,316,000 (Total).
- Does not include rehabilitation of the Eau Claire River Bridge or the Chippewa River Bridge for HSR operations.

East St. Paul, MN (UP)

Current Situation:

- The area for this estimate extends from Hazel Park Jct. at MP 6.6 through East St. Paul to the BNSF connection at CP Westminster Street at UP MP 0.6 (for trains headed to St. Paul Union Depot) and at MP 0.0 (for trains headed to Minneapolis).
- The former C&NW East St. Paul Yard has been eliminated and most of the remaining tracks in this segment now serve active industries.
- This yard area is on the UP mainline between Chicago and St. Paul. Most UP freight trains from Chicago continue onto BNSF tracks and terminate in Minneapolis.
- Operational control on the single main track east of Hazel Park Jct. is accomplished by TWC. From Hazel Park Jct. to CP Westminster Street, the two main tracks may be used under the provisions of Yard Limit rules. An ABS system is also in effect between Eau Claire and CP Westminster Street.
- Amtrak trains do not serve this line, but they do use the BNSF through CP Westminster Street. There are no passenger stations in this yard segment and none are planned for MWRRI.

- The general maintenance of this freight-only railroad line is lower than that of the CP line through Portage and along the Mississippi River which handles higher speed Amtrak intercity passenger trains. Therefore, the costs to bring this terminal to HSR standards are higher than they might be if passenger trains currently used the line.
- There is a 4-mile long descending grade of at least 1.0% and increasing to 1.23% approaching CP Westminster Street in a westward direction on UP. A power derail is located on the UP main track on the St. Paul lead to the BNSF (MP 0.6) and on the UP main track on the Minneapolis lead to the BNSF (MP 0.0). The derails are controlled by the BNSF CP Westminster Street and were installed as protection against runaway cars and trains from the East St. Paul yard and industry tracks.
- Commuter trains are not currently planned for this UP route segment.

Figure 5 – East St. Paul, MN

Operating Parameters:

- Maintain throughput capacity for UP mainline freight trains and switch engines that serve local industries.
- Provide additional capacity and operational flexibility to accommodate MWRRI trains.
- No MWRRI, Amtrak or commuter station is planned for this segment.
- Update the power-operated derails located on UP main tracks that protect both approaches to

BNSF's CP Westminster Street.

- Upgrade trackage to HSR standards.
- Upgrade rail bridges over roadway and former rail right of way now used as a recreation corridor for HSR operation.
- Grade, curvature approaching CP Westminster Street and crossovers between MP 1.0 and MP 0.0 limit the speed of MWRRI trains at these locations.
- No other structure upgrades or replacements are included.

MWRRI Solution:

- Upgrade both main tracks between Hazel Park Jct. at MP 6.6 and CP Westminster Street to HSR standards including the replacement of 66% of the ties and the installation of new 136# CWR on both tracks.
- Install high speed turnout at Hazel Park Jct. MP 6.6.
- Install CTC on both main tracks between Hazel Park Jct. and CP Westminster Street.
- Replace all industry track turnouts on both main tracks.
- Install #20 universal power crossovers in CTC territory at MP 1.6 west of Payne Avenue overhead highway bridge.
- Replace all industry track switches with new turnouts and electric locks.
- Upgrade girder bridges over Johnson Parkway (MP 3.22) and over former GN Railway right-of-way at MP 1.84 (now converted to a recreation trail) for HSR operation.
- Upgrade grade crossings to HSR standards including trapped vehicle detection.

Capital Cost Estimate:

- $30,896,000 (Construction Elements Only).
- $49,804,000 (Total).

North Milwaukee, WI (CP/WSOR)

Current Situation:

- The segment of track between Grand Avenue Junction (on CP's Milwaukee-Watertown mainline), North Milwaukee and Wiscona has historically been a heavy manufacturing district with an elaborate track and yard network to support the rail customers. While several of the industries in the area have closed or ceased to use rail service, others are still active.
- One of the major industries is a large manufacturing plant that produces steel automobile frames. The industry is an active high-volume freight rail customer located between MP 91 and MP 92 on both sides of the right of way. A large fleet of empty rail cars is stored on many of the tracks near this industry and within the plant itself. These rail cars are held for prospective loading by the industry. The steel frames are shipped to automobile assembly plants at various locations.
- Several large industrial properties have been vacated. Some are being re-developed. The potential for increased rail freight traffic in this area exists.
- Glendale Yard, with track groups on both sides of the main track is located just south of North Milwaukee. Its purpose is to support the large industrial complex in this area.

- At North Milwaukee, Canco and Wiscona, there are several railroad junctions between the former lines of the Milwaukee Road and the Chicago & Northwestern Railroad which are now operated by CP, UP and Wisconsin Southern.
- There are no permanent highway-rail grade crossings between Grand Avenue Junction on the south and North Milwaukee on the north. The segment is totally grade-separated. However, in this same segment, there are a total of 10 roadway bridges over the track, and 6 roadway bridges under the track. All of these bridges are multiple track, multiple span bridges of varying size. Several accommodate highway intersections either immediately above or immediately below the tracks. Most of the rail bridges over the roadways require rehabilitation for HSR operation. No improvements have been planned for roadway bridges over the tracks.
- Between North Milwaukee and Wiscona, there are two highway-rail crossings at grade, no roadway bridges over the track and 3 rail bridges over roadways. The rail bridges over the roadways require rehabilitation for HSR operations.
- A multiple-span rail bridge over the Menominee River is located just north of Grand Avenue Junction. The river is channelized at this location. This was formerly a double track bridge. The east bridge has recently been replaced and is in use. The west bridge is in a deteriorated condition.
- A new multiple track ballast deck bridge over North Milwaukee Creek at North Milwaukee is of recent construction. The creek is channelized at this location.
- At Wiscona, a former C&NW (now UP) double track through riveted truss overhead rail bridge has been removed and the high embankment has been filled in effectively blocking the right-of-way and route between Wiscona and West Bend. The cost to remove the embankment and replace the structure has not been included in this estimate. In accordance with the methodology, these capital costs will be included with the line segment estimate. Approximately 0.75 miles of track have been removed at this location and vegetation has overgrown much of the area.
- No Amtrak passenger trains or commuter trains use this segment. However, Amtrak's Empire builder between Milwaukee and Portage passes through Grand Avenue Junction at the south end of this yard segment.
- Operational control of this segment is through Yard Limit rules and Track Warrant Control. There are no signal systems governing any of the main or yard tracks, except at Grand Avenue Junction (and those are part of the Milwaukee-Watertown segment).
- The main track in this segment appears to be maintained to FRA Class II standards with yard tracks maintained to FRA Class I or Class II standards. Major upgrading will be required to accommodate HSR operations.
- A large number of industry track turnouts, industrial lead switches, yard lead switches and crossovers as well as several junction switches are located in this segment and must be upgraded.
- The main tracks, industry leads and yard tracks are used as needed to make up freight trains, hold loaded and empty cars, classify freight cars and serve local industries. There is currently no provision to maintain a clear track through the corridor that could be used for HSR operations. A

main track does exist through the corridor that can be reconfigured and upgraded, along with adjacent yard tracks and industrial leads, to maintain the capacity to serve industries while permitting the passage of MWRRI HSR trains. This estimate details the requirements to do so.

- Because of the complexity of the track layout, the cost of bridge rehabilitation and the extensive use of all tracks for freight operations, an assumption has been made that only one HSR train will be accommodated between Grand Avenue Junction and Wiscona at any time. No capability to meet MWRRI trains will be provided in this segment at this time. Meets between opposing MWRRI trains must be planned to occur east of Grand Avenue Junction or north of Wiscona.

Figure 6 – North Milwaukee, WI

Operating Parameters:

- Maintain throughput capacity of the rail freight network in the segment.
- Maintain the capacity for the freight railroads to serve the existing and an expanded (renewed) freight rail customer base in the segment, including the use of the main tracks as necessary to accommodate the needed switching movements.
- Maintain the ability of freight railroads to interchange freight cars and freight trains with each other in this segment, if necessary.
- Upgrade main track, extend and/or upgrade certain industrial lead tracks, upgrade several yard tracks to replace main track capacity currently used for switching, replace all main track

turnouts and crossovers to permit HSR operation on the main track while accommodating the freight traffic needs on the other tracks.

- Install a CTC signal system to improve safety, track utilization, accommodate higher freight train operating speeds and to permit HSR operations.
- Rehabilitate or replace aging grade separation structures to HSR standards. Due to the configuration of many of the existing bridges, rehabilitation costs must consider that in most cases, adjoining spans must be disturbed to gain access to the spans to be rehabilitated for HSR operations. This will increase the unit cost for bridge work in this segment.
- Avoid the cost of installing a segment of second main track to accommodate meets between opposing MWRRI trains in this relatively short (8.2-mile) segment due to the exceptionally high infrastructure costs that would be associated with doing so.

MWRRI Solution:

- Reconstruct the entire main track segment with 66% tie replacement and replacement of existing rail with new 136# CWR between MP 88.3 and Wiscona.
- Construct one HSR main track between MP 92.0 and MP 93.0 near Wiscona to connect to the existing track to West Bend. (This same segment requires the replacement of an overhead rail bridge described above that is not included in this estimate.)
- Install CTC between Grand Avenue Junction and Wiscona.
- Extend the Miller Siding and install a main track crossover to permit switching the industry while HSR trains use the main track.
- Replace all industry track turnouts with #10 concrete turnouts and electric locks to improve safety.
- Replace 10 yard and industrial lead switches with #20 power turnouts in CTC territory to expedite freight operations and improve safety.
- Replace 5 existing hand throw crossovers with #10 crossovers in CTC territory to expedite freight operations.
- Rehabilitate 2.0 miles of yard tracks, including turnouts, with 66% tie replacement and new 136# CWR in Glendale Yard to accommodate additional freight train traffic when necessary to clear the main track for MWRRI HSR trains.
- Rehabilitate or replace 8 multiple track, multiple span rail bridges over roadways for HSR operations.
- Upgrade two highway-rail grade crossings to HSR standards including trapped vehicle detection.
- Require that meets between opposing MWRRI trains occur either east of Grand Avenue Junction or railroad west (north) of Wiscona.

Capital Cost Estimate:

- $37,427,000 (Construction Elements Only).
- $60,332,000 (Total).
- Does not include replacement of overhead rail bridge at Wiscona.

The conceptual capital cost estimates for each of the six yard and terminal “bottleneck” areas described above are included in Attachment B.

Attachment B: Conceptual Capital Cost Estimates for Yards, Terminals and Junctions

MWRRI: Milwaukee-Twin Cities Estimate

			Segment No.	Segments 8 & 11		Segments 21 & 24		Segment 24		Segments 18 & 23		Segment 23		Segments 3 & 4	
			From - To	Portage Yard		Winona Yard		Red Wing Yard		Eau Claire Yard		East St. Paul Yard		North Milwaukee Yard	
			Host Carrier	CP		CP		CP		UP		UP		CP/WSOR	
			Mileposts	7.0 to 180.4		301.9 to 309.0		367.2 to 375.5		93.3 to 85.0		6.6 to 0.6		88.3-95.5,92.0-93.0	
			Track Miles	10.4 miles		7.1 miles		8.3 miles		8.3 miles		6.0 miles		8.2 miles	
			Maximum Authorized Speed												
		Unit	2010 Unit Cost												
Trackwork															
1.1	HSR on Existing Roadbed	per mile	$ 1,123	1	$ 1,123	0.2	$ 225	1.3	$ 1,460		$ -		$ -	1.4	$ 1,572
1.2	HSR on New Roadbed	per mile	$ 1,198		$ -		$ -		$ -		$ -		$ -		$ -
1.3	HSR on New Roadbed & New Embankment	per mile	$ 1,687	7	$ 11,810		$ -		$ -		$ -		$ -		$ -
1.4	HSR on New Roadbed & New Embankment (Double Track)	per mile	$ 3,024		$ -		$ -		$ -		$ -		$ -		$ -
1.5	HSR Double Track on 15' Retained Earth Fill	per mile	$ 15,972		$ -		$ -		$ -		$ -		$ -		$ -
1.6	Timber & Surface w/ 33% Tie replacement	per mile	$ 251		$ -	10	$ 2,510	11.1	$ 2,787		$ -		$ -		$ -
1.7	Timber & Surface w/ 66% Tie Replacement	per mile	$ 374		$ -	4	$ 1,497	4.2	$ 1,572	12.7	$ 4,754	11	$ 4,117	9.2	$ 3,444
1.8	Relay Track w/ 136# CWR	per mile	$ 400		$ -		$ -	4.2	$ 1,681	12.7	$ 5,084	11	$ 4,403	9.2	$ 3,683
1.9	Freight Siding	per mile	$ 1,031		$ -		$ -		$ -		$ -		$ -		$ -
1.10	Passenger Siding	per mile	$ 1,556		$ -		$ -		$ -		$ -		$ -		$ -
1.11	Highway Barrier Type 6	lineal ft	$ 1		$ -		$ -		$ -		$ -		$ -		$ -
1.12	Highway Barrier Type 5	lineal ft	$ 0		$ -		$ -		$ -		$ -		$ -		$ -
1.13	Fencing, 4 ft Woven Wire (both sides)	per mile	$ 58		$ -		$ -		$ -		$ -		$ -		$ -
1.14	Fencing, 6 ft Chain Link (both sides)	per mile	$ 173		$ -		$ -		$ -		$ -		$ -		$ -
1.15	Fencing, 10 ft Chain Link (both sides)	per mile	$ 198		$ -		$ -		$ -		$ -		$ -		$ -
1.16	Decorative Fencing (both sides)	per mile	$ 446		$ -		$ -		$ -		$ -		$ -		$ -
1.17	Drainage Improvements (cross country)	per mile	$ 75		$ -		$ -		$ -		$ -		$ -		$ -
1.18	Land Acquisition Urban	per mile	$ -		$ -		$ -		$ -		$ -		$ -		$ -
1.19	Land Acquisition Rural	per mile	$ -		$ -		$ -		$ -		$ -		$ -		$ -
1.20	#33 High Speed Turnout	each	$ 696		$ -		$ -	2	$ 1,392	3	$ 2,088	1	$ 696		$ -
1.21	#24 High Speed Turnout	each	$ 509	1	$ 509	3	$ 1,527		$ -		$ -		$ -		$ -
1.22	#20 Turnout Timber	each	$ 183		$ -		$ -		$ -		$ -		$ -		$ -
1.23	#15 Turnout Timber	each	$ 148												
1.24	#10 Turnout Timber	each	$ 105		$ -		$ -		$ -		$ -		$ -		$ -
1.25	16'6" Double Switch Point Derail	each	$ 34		$ -		$ -		$ -		$ -		$ -		$ -
1.26	#20 Turnout Concrete	each	$ 282	3	$ 845		$ -		$ -	5	$ 1,408	1	$ 282	10	$ 2,816
1.27	#15 Turnout Concrete	each	$ 155												
1.28	#10 Turnout Concrete	each	$ 133	4	$ 534		$ -		$ -	2	$ 267	8	$ 1,068	19	$ 2,535
1.29	#33 Crossover	each	$ 1,285		$ -	1	$ 1,285	2	$ 2,569		$ -		$ -		$ -
1.30	#20 Crossover	each	$ 563	1	$ 563	1	$ 563	2	$ 1,126	2	$ 1,126	3	$ 1,689		$ -
1.31	Surface Curves and Adjust Superelevation	per mile	$ 66		$ -		$ -		$ -		$ -		$ -		$ -
1.32	Curvature Reduction	per mile	$ 444		$ -		$ -		$ -		$ -		$ -		$ -
1.33	Elastic Fasteners	per mile	$ 93		$ -		$ -		$ -		$ -		$ -		$ -
	Sub-total Trackwork (A)				$ 15,384		$ 7,607		$ 12,587		$ 14,726		$ 12,255		$ 14,050
Structures															
	Bridges-undergrade														
2.1	Four Lane Urban Expressway	each	$ 5,468		$ -		$ -		$ -		$ -		$ -		$ -
2.2	Four Lane Rural Expressway	each	$ 4,552		$ -		$ -		$ -		$ -		$ -		$ -
2.3	Two Lane Highway	each	$ 3,454		$ -		$ -		$ -	1	$ 3,454	2	$ 6,907		$ -
2.4	Rail	each	$ 3,454		$ -		$ -		$ -		$ -		$ -		$ -
2.5	Minor river	each	$ 916	2	$ 1,832		$ -		$ -		$ -		$ -		$ -
2.6	Major River	each	$ 9,158		$ -		$ -		$ -		$ -		$ -		$ -
2.7	Double Track High (50') Level Bridge	per LF	$ 14		$ -		$ -		$ -		$ -		$ -		$ -
2.8	Rehab for 110	per LF	$ 2	240	$ 379	420	$ 664		$ -		$ -		$ -	1750	$ 2,765
2.9	Convert open deck bridge to ballast deck (single track)	per LF	$ 5		$ -		$ -		$ -		$ -		$ -		$ -
2.10	Convert open deck bridge to ballast deck (double track)	per LF	$ 11		$ -		$ -		$ -		$ -		$ -		$ -
2.11	Single Track on Flyover/Elevated Structure	per LF	$ 10		$ -		$ -		$ -		$ -		$ -		$ -
2.12	Single Track on Approach Embankment w/ Retaining Wall	per LF	$ 5		$ -		$ -		$ -		$ -		$ -		$ -
2.13	Ballasted Deck Replacement Bridge	per LF	$ 3		$ -		$ -		$ -		$ -		$ -		$ -
2.14	Land Bridges	per LF	$ 3		$ -		$ -		$ -		$ -		$ -		$ -
2.15	Double Track on Flyover/Elevated Structure	per LF	$ 18		$ -		$ -		$ -		$ -		$ -		$ -
2.16	Double Track on Approach Embankment w/ Retaining Wall	per LF	$ 9		$ -		$ -		$ -		$ -		$ -		$ -
	Bridges-overhead				$ -		$ -		$ -		$ -		$ -		$ -
2.17	Four Lane Urban Expressway	each	$ 3,312		$ -		$ -		$ -		$ -		$ -		$ -
2.18	Four Lane Rural Expressway	each	$ 2,360		$ -		$ -		$ -		$ -		$ -		$ -
2.19	Two Lane Highway	each	$ 2,152		$ -		$ -		$ -		$ -		$ -		$ -
2.20	Rail	each	$ 6,909		$ -		$ -		$ -		$ -		$ -	1	$ 6,909
	Other Structures				$ -		$ -		$ -		$ -		$ -		$ -
2.21	Culvert Extensions	per mile	$ 58		$ -		$ -		$ -		$ -		$ -		$ -
2.22	Two Bore Long Tunnel	route ft	$ 45,540		$ -		$ -		$ -		$ -		$ -		$ -
2.23	Single Bore Short Tunnel	lineal ft	$ 25,875		$ -		$ -		$ -		$ -		$ -		$ -
	Sub-total Structures (B)				$ 2,211		$ 664		$ -		$ 3,454		$ 6,907		$ 9,674

Systems															
3.1	Install CTC System (Single Track)	per mile	$ 207	7	$ 1,449	4.2	$ 869	5.5	$ 1,138	3.9	$ 807		$ -	3.1	$ 642
3.2	Install CTC System (Double Track)	per mile	$ 339		$ -		$ -		$ -	4.8	$ 1,628	6.6	$ 2,239	5.1	$ 1,730
3.3	Install PTC System	per mile	$ 177		$ -		$ -		$ -		$ -		$ -		$ -
3.4	Electric Lock for Industry Turnout	each	$ 116	1	$ 116	7	$ 815	12	$ 1,398	3	$ 349	6	$ 699	12	$ 1,398
3.5	New Control Point (CP)	each	$ 1,434	1	$ 1,434	3	$ 4,302	6	$ 8,603	3	$ 4,302	1	$ 1,434		$ -
3.6	Signal work to add Crossover to CP	each	$ 792	1	$ 792	2	$ 1,583	2	$ 1,583	2	$ 1,583	3	$ 2,375	5	$ 3,958
3.7	Signal work to add Turnout to CP	each	$ 452	6	$ 2,714		$ -		$ -	8	$ 3,619	3	$ 1,357	10	$ 4,523
	Sub-total Systems (C)				$ 6,505		$ 7,569		$ 12,722		$ 12,288		$ 8,104		$ 12,251
Crossings															
4.1	Private Closure	each	$ 94	2	$ 188	6	$ 563		$ -		$ -		$ -		$ -
4.2	Four Quadrant Gates w/ Trapped Vehicle Detector	each	$ 556	6	$ 3,338	11	$ 6,120	4	$ 2,225	4	$ 2,225	5	$ 2,782	2	$ 1,113
4.3	Four Quadrant Gates	each	$ 326		$ -		$ -		$ -		$ -		$ -		$ -
4.4	Convert Dual Gates to Quad Gates	each	$ 170		$ -		$ -		$ -		$ -		$ -		$ -
4.5	Conventional Gates single mainline track	each	$ 188		$ -		$ -		$ -		$ -		$ -		$ -
4.6	Conventional Gates double mainline track	each	$ 232		$ -	2	$ 464		$ -	1	$ 232		$ -		$ -
4.7	Convert Flashers Only to Dual Gate	each	$ 57		$ -		$ -		$ -		$ -		$ -		$ -
4.8	Dual Gate with Median Barrier	each	$ 204		$ -		$ -		$ -		$ -		$ -		$ -
4.9	Convert Dual Gate to Extended Arm	each	$ 17		$ -		$ -		$ -		$ -		$ -		$ -
4.10	Precast Panels without Rdway Improvements	each	$ 90		$ -	3	$ 271		$ -	1	$ 90		$ -		$ -
4.11	Precast Panels with Rdway Improvements	each	$ 170	6	$ 1,018	13	$ 2,205	4	$ 679	4	$ 679	5	$ 848	2	$ 339
	Sub-total Crossings (D)				$ 4,544		$ 9,623		$ 2,904		$ 3,226		$ 3,630		$ 1,452
Station/Maintenance Facilities															
5.1	Full Service - New - Low Volume - 500 Surface Park	each	$ 5,175		$ -		$ -		$ -		$ -		$ -		$ -
5.2	Full Service - Renovated - Low Volume- 500 Surface Park	each	$ 4,140		$ -		$ -		$ -		$ -		$ -		$ -
5.3	Terminal - New - Low Volume - 500 Surface Park	each	$ 7,763		$ -		$ -		$ -		$ -		$ -		$ -
5.4	Terminal - Renovated - Low Volume - 500 Surface Park	each	$ 6,210		$ -		$ -		$ -		$ -		$ -		$ -
5.5	Full Service - New- High Volume - Dual Platform - 1000 Surface Park	each	$ 10,350		$ -		$ -		$ -		$ -		$ -		$ -
5.6	Terminal - New- High Volume - Dual Platform - 1000 Surface Park	each	$ 15,525		$ -		$ -		$ -		$ -		$ -		$ -
5.7	Maintenance Facility (non-electrified track)	each	$ 82,800		$ -		$ -		$ -		$ -		$ -		$ -
5.8	Layover Facility	lump sum	$ 10,350		$ -		$ -		$ -		$ -		$ -		$ -
	Sub-total Station/Maintenance Facilities (E)				$ -		$ -		$ -		$ -		$ -		$ -
Allocations for Special Elements															
6.1	Access to Signal/Switch Location	lump sum	$ 100		$ -		$ -		$ -		$ -		$ -		$ -
6.2	Access to Maintenance of Way Spur	lump sum	$ 1,000		$ -		$ -		$ -		$ -		$ -		$ -
6.3	Rail-Rail Flyovers	lump sum	$ 40,000		$ -		$ -		$ -		$ -		$ -		$ -
	Sub-Total Allocations for Special Elements (F)				$ -		$ -		$ -		$ -		$ -		$ -
	Sub-total Construction Elements (A+B+C+D+E+F)				$ 28,643		$ 25,463		$ 28,214		$ 33,695		$ 30,896		$ 37,427
Contingency															
	Design and Construction Contingency		30%		$ 8,593		$ 7,639		$ 8,464		$ 10,108		$ 9,269		$ 11,228
	Sub-total Construction Elements Including Contingency (G)				$ 37,236		$ 33,102		$ 36,678		$ 43,803		$ 40,164		$ 48,655
Professional Services and Environmental															
	Design Engineering														
	Insurance and Bonding														
	Program Management														
	Construction Management & Inspection														
	Engineering Services During Construction														
	Integrated Testing and Commissioning														
	Erosion Control and Water Quality Management														
	Sub-total Professional Services and Environmental (H)		24%		$ 8,937		$ 7,945		$ 8,803		$ 10,513		$ 9,639		$ 11,677
	Total Segment Cost (G)+(H)				$ 46,173		$ 41,047		$ 45,480		$ 54,316		$ 49,804		$ 60,332