

TASK 10

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# CAPITAL COSTS TECHNICAL MEMO

PREPARED BY: QUANDEL CONSULTANTS, LLC

NOVEMBER 4, 2016



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SMITHGROUP JJR . AECOM . BERGMANN ASSOCIATES . QUANDEL CONSULTANTS

**NORTH** ↑  
**SOUTH** ↓  
COMMUTER RAIL

# North-South Commuter Rail Feasibility Study

## Task 10: Capital Costs Technical Memo

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# 1. INTRODUCTION AND SCOPE OF WORK

## 1.1 Introduction

The North-South Commuter Rail Project, (WALLY), is a proposed 27-mile long commuter rail operation on existing tracks that would provide service between Ann Arbor and Howell, with intermediate stops along the way. It has been embraced by a number of local public and private organizations in Washtenaw and Livingston counties as a way to expand commuting options in a rapidly growing part of southeast Michigan along the US-23 corridor. The Ann Arbor Area Transportation Authority (AAATA) has taken on the role as the “designated authority” for studying and developing the concept.

This report is one of the deliverables in a feasibility study which will determine in detail the costs of the project and the estimated number of future riders. It will also define the organization needed to build and operate the service, and the prospects for establishing a funding source for the service. It will help drive the community’s decision about moving forward with the project.

## 1.2 Scope of Work

Quandel Consultants is serving as sub-consultant to SmithGroupJJR (SGJJR), the project prime consultant to implement the following workscope as defined in the contract documents:

### *Task 10-Estimate/Refine Capital Costs*

*Review and refine project capital costs by and between proposed station locations. Cost worksheets, originally prepared by R.L. Banks, have been maintained and updated by TheRide staff, with help from MDOT. The consultant shall review the cost estimates for accuracy and completeness and make any changes that are necessary. Cost estimates have been developed for the following categories (details attached in Appendices)*

- a) Stations and station sites*
- b) Track work and grade crossings*
- c) Signals / Positive Train Control (if required)*
- d) Grade crossing signals / protection*
- e) Interlockers / Connections*

*As part of this task, the consultant shall develop preliminary cost estimates for other specific infrastructure elements, including:*

- Ann Pere – this is where the MDOT tracks cross over CSX tracks, just south of Howell. The consultant shall evaluate the potential for conflicts at this crossing, and devise procedures for minimizing delay of commuter rail traffic, in consultation with the railroads. Costs associated with needed upgrades should be estimated. The consultant shall draft an agreement between the two railroads that governs the use of the crossing.*

- *Layover facilities – proposed locations for layover facilities have been identified. Concept plans for the layover facilities have been developed and cost-estimated. The consultant will review the proposed layover locations and will verify that they will support the proposed operating plan. The consultant will confirm existing concepts and cost estimates or create new concepts and cost estimates for layover facilities.*
  - *Daytime*
  - *Overnight / weekend*
- *Bridges – no assessments of existing bridge conditions have been conducted by TheRide/MDOT nor have any cost estimates have been made for any deficiencies associated with bridges. The consultant shall examine existing bridge assessments and develop costs to perform any upgrades needed to ensure safe reliable passenger service (see detail below).*
- *Property acquisition – the consultant shall describe all property that would need to be acquired for the project, either by purchase or by lease, and provide estimates of the costs of such property*
  - *Rolling stock acquisition*
  - *Railcars – a fleet of railcars, suitable for passenger service, is available from the Michigan Department of Transportation. The feasibility study should assume that these railcars will be made available at no cost to the service operator for the first three years of service (Note: This assumption was later revised to include costs for leasing the passenger rolling stock. A line item is included in Task 11: Operating Costs.)*
- *Locomotives – locomotives will need to be leased for this service and those costs should be estimated.*
- *Buses for connecting service – TheRide has devised routes to serve the Plymouth Road station, and has estimated the capital and operating expense for those routes. The consultant shall evaluate and confirm those requirements and costs*
- *Maintenance and inspection fleet – Any requirements to purchase right-of-way maintenance equipment should be spelled out and estimated. However, if it is assumed that maintenance will be purchased as a service, then those costs should be included in the operating cost estimates*

*A construction timeline shall be developed as part of this task, indicating major project milestones and indicating the cumulative construction costs at each milestone.*

Bergmann Associates is serving as sub-consultant to SmithGroupJJR (SGJJR), the project prime consultant to implement the following work scope as defined in the contract documents:

*The project team will develop capital costs and a construction timeline as described above. An important element of this effort is the assessment of existing bridges to identify deficiencies and potential costs associated with upgrades.*

*This scope is based on the understanding that the structures along the Great Lakes Central RR line (approximately 19) and the structures along the Watco RR line (5) have already been inspected and load rated.*

*Bergmann will review the existing bridge inspection reports information and provide a brief summary of each structure including any repair needs and associated costs. This task includes:*

- Review of existing inspection reports for each bridge on the line.*
- Bridge inspection is NOT included as part of this task. It is assumed that inspection reports will be provided for each bridge by MDOT and Watco.*
- Develop a brief report outlining the location, condition, repair needs, and load rating for each structure.*
- A bridge management program is NOT included as part of this task. It assumed that MDOT and Watco have prepared bridge management programs to meet the requirements of the FRA.*

*In order to show that these bridges have the safe load carrying capacity for the passenger service proposed along the line, Bergmann Associates will assess the existing load ratings on file for each bridge. An equivalent Cooper Train loading chart will be developed for the anticipated car/engine proposed for the project and compared to the existing ratings to determine if the bridges can safely carry the proposed passenger service equipment at the desired speed.*

- Equivalent Cooper Train Loading charts will be provided for the anticipated car/engine proposed for the project.*
- Bridge load rating is NOT included as part of this task. It is assumed that all bridge load ratings will be provided by MDOT and Watco.*
- Existing load ratings on file will be reviewed, summarized, and compared with the equivalent load charts for the anticipated car/engine proposed for the Wally project.*
- If the existing bridge ratings are not sufficient and repairs are necessary, repair recommendations and modifications to the ratings for the proposed repair can be performed as an amendment to this proposal.*

*We understand that one structure over the Huron River located southeast of Lakeland, MI has a slow order on certain train movements due to the load carrying capacity of the structure. We have included time in our proposal for a high level study to assess options for improving this bridge which include:*

- Visit site (1) to evaluate site conditions and constraints for preparing the high level cost estimate.*
- Review existing inspection and load rating information to be provided by MDOT.*
- Estimate total replacement costs for the bridge.*
- Estimate rehabilitation costs to bring the bridge up to required loading with no slow orders.*
- No drawings or in-depth analysis will be performed as part of this work at this time.*
- No geotechnical or survey information will be performed as part of the high level study.*
- Prepare a brief memorandum with the summary of these high level findings.*

*No inspection time is assumed as part of this task but it can be performed with additional hours and expenses if desired.*

- Deliverable(s):*
1. *Submit draft estimate of Capital Costs*
  2. *Review meeting and submit final estimate of Capital Costs*

*Amendment 1 adds the following scope:*

*Additional Rail Option for Analysis: Whitmore Lake/Barton Drive/Ann Arbor*

- *Diesel-electric locomotives with coaches*
- *One to two train sets operating with a reverse commute to provide four trips to Ann Arbor in the AM/four trips to Whitmore Lake in the PM*

*Prepare Capital Cost Estimate. Update Technical Memo for Task 10: Capital Cost Estimate.*

*Note: Following review of existing reports, all bridges appear to be adequate for carrying passenger trains without strengthening repairs. Consequently, development of Cooper Train loading charts is not required.*

## 2. DESCRIPTION OF SERVICE PLAN OPTIONS

### 2.1 Service Limits and Railroad Ownership

The North-South commuter rail service is proposed to operate over an approximately 27-mile route between Howell and Ann Arbor, Michigan. Most of the route is owned by the Michigan Department of Transportation (MDOT) which contracts with Great Lakes Central railroad (GLC) for operations and maintenance. The southern section of the route, beginning near Barton Road north of Ann Arbor, is owned and operated by the Ann Arbor Railroad (AARR). Discussions are underway to lease the southern section of the route to GLC so that the proposed new service would be operated over a single carrier's track. Although the service is proposed to operate over a distance of approximately 27 miles, the actual amount of track and right-of-way needed for the project would be approximately 30.1miles.

### 2.2 Service Plan Options

Five service options have been evaluated and are described briefly as follows:

#### **Option 1: Full Service Option**

- 6 stations: Howell, Genoa Township, Hamburg, Whitmore Lake, Barton Drive and Downtown Ann Arbor
- Four train sets to Ann Arbor in the AM; four trains sets return to Howell in the PM
- Dedicated bus service at Barton Drive
- Mid-day layover facility in Ann Arbor area
- Overnight/maintenance facility in Howell area
- CSX coordination required at the Annpere Interlocking
- New freight interchange at Ellsworth Rd
- 60 mph max speed
- Gates at all public crossings
- Positive Train Control



### **Option 2: Full Service without Barton Drive Station**

- 5 stations: Howell, Genoa Township, Hamburg, Whitmore Lake and Downtown Ann Arbor
- Four train sets to Ann Arbor in the AM; four trains sets return to Howell in the PM
- Dedicated bus service in Ann Arbor
- Mid-day layover facility in Ann Arbor area
- Overnight/maintenance facility in Howell area
- CSX coordination required at the Annpere Interlocking
- New freight interchange at Ellsworth Rd
- 60 mph max speed
- Gates at all public crossings
- Positive Train Control

### **Option 3: Starter Service with Howell/Whitmore Lake/Ann Arbor Stations**

- 3 stations: Howell, Whitmore Lake and Downtown Ann Arbor
- Four train sets to Ann Arbor in the AM; four trains sets return to Howell in the PM
- Dedicated bus service in Ann Arbor
- Mid-day layover facility in Ann Arbor area
- Overnight/maintenance facility in Howell area
- CSX coordination required at the Annpere Interlocking
- New freight interchange at Ellsworth Rd
- 60 mph max speed
- Gates at all public crossings
- Positive Train Control

#### **Option 4A: Minimum Operable Configuration (MOC) with PTC**

- 2 Stations: Whitmore Lake and Barton Drive
- Shuttle service with a single train set (and one spare set), 14 trains per day
- Dedicated bus service at Barton Drive
- Parking and layover/maintenance facility in Whitmore Lake
- 40 mph max speed
- As Warranted Grade Crossing Gates
- Positive Train Control (PTC)

#### **Option 4B: Minimum Operable Configuration (MOC) without PTC**

- 2 Stations: Whitmore Lake and Barton Drive
- Shuttle service with a single train set (and one spare set), 12 trains per day
- Dedicated bus service at Barton Drive
- Parking and layover/maintenance facility in Whitmore Lake
- 40 mph max speed
- As Warranted Grade Crossing Gates
- Centralized Traffic Control (CTC)

#### **Option 5A: Shuttle Service (one train set) with Whitmore Lake/Barton Drive/Ann Arbor Stations**

- 3 stations: Whitmore Lake, Barton Drive and Downtown Ann Arbor
- One train set, making four peak direction trips to Ann Arbor in the AM and four peak direction trips to Whitmore Lake in the PM. The accomplishment of this objective with a single train set requires three reverse commutes in the AM and three reverse commutes in the PM. Due to the round trip travel time, peak direction starts occur at roughly one hour intervals, which may not be optimal for capturing commuter market share.
- Weekday operation only
- Dedicated bus service at Barton Drive

- Mid-day layover track/minimal facility in Ann Arbor
- Overnight/layover track/minimal facility in Whitmore Lake
- Periodic offsite maintenance at Owosso or another existing facility
- New freight interchange at Ellsworth Rd
- 60 mph max speed
- Gates at all public crossings
- Positive Train Control

**Option 5B: Shuttle Service (two train sets) with Whitmore Lake/Barton Drive/Ann Arbor Stations**

- 3 stations: Whitmore Lake, Barton Drive and Downtown Ann Arbor
- Two train sets, making four peak direction trips to Ann Arbor in the AM and four peak direction trips to Whitmore Lake in the PM. The accomplishment of this objective with two train sets requires two reverse commutes in the AM and two reverse commutes in the PM. Peak direction starts are implemented at roughly 35 minute intervals.
- Weekday operation only
- Dedicated bus service at Barton Drive
- Mid-day layover track/minimal facility in Ann Arbor
- Overnight/layover track/minimal facility in Whitmore Lake
- Periodic offsite maintenance at Owosso or another existing facility
- New freight interchange at Ellsworth Rd
- 60 mph max speed
- Gates at all public crossings
- Positive Train Control

There has been interest expressed in a new passenger station at the location where the Ann Arbor Railroad crosses over the Michigan Central Line adjacent to North Main Street. The complications associated with a station in this location are noted in Task 7: Prospective Station Locations. The service plan options are defined more fully in Task 8: Service Plans for Evaluation.

## 3. CAPITAL COST ESTIMATES

### 3.1 Infrastructure Requirements and Capital Cost Estimates

Based on the requirements of the respective service plans, Quandel Consultants has identified the necessary infrastructure improvements and prepared an estimate of the capital costs for the development and construction of each option. The capital cost estimates for each option are as follows:

- Option 1: Full Service Option: \$122.3 million
- Option 2: Full Service without Barton Drive Station: \$121.0 million
- Option 3: Starter Service: \$118.4 million
- Option 4A: Minimum Operable Configuration (MOC) with PTC: \$28.9 million
- Option 4B: Minimum Operable Configuration (MOC) without PTC: \$21.9 million
- Option 5A: Shuttle Service (one train set): \$61.3 million
- Option 5B: Shuttle Service (two train sets): \$65.2 million

### 3.2 High and Low Cost Estimates

The capital cost estimate values presented above are based on a set of infrastructure improvements that Quandel Consultants has defined as necessary to provide reliable commuter service, recognizing the condition of the existing track and signal infrastructure, the age and condition of the proposed commuter rail coaches and locomotives, weather conditions in central Michigan, the present regulatory environment and the public's expectations. These values are defined in our spreadsheets as the "High Estimate."

It may prove possible to minimize the initial capital cost by reducing the scope and extent of the infrastructure improvements. We have identified three elements where such reductions may be possible, depending upon decisions made by the owner, State of Michigan and Federal Railroad Administration. Specifically:

- The owner may elect to reduce the functionality of the proposed maintenance facility, performing certain functions at an off-site facility owned by others.
- The owner and the State may petition the Federal Railroad Administration (FRA) for a waiver or exemption from regulations requiring the implementation of Positive Train Control. The FRA is solely responsible for determining whether or not to grant an exemption or waiver.
- In compliance with Michigan's Railroad Code of 1993, the selection of devices to be installed at a highway-railroad grade crossing will be evaluated by a diagnostic study team comprised of knowledgeable individuals representing the MDOT, the roadway authorities with jurisdiction, the operating railroads, and other relevant affected parties. Diagnostic study teams perform a review of conditions at existing or proposed highway-railroad crossings and provide input to assist the

Department with its determination concerning safety needs at each crossing. The team may determine that a lesser degree of grade crossing warning system improvements is warranted.

Quandel Consultants has quantified possible reductions to the recommended infrastructure improvements to develop a “Low Cost estimate” for each of the options. The low cost values are as follows:

- Option 1: Full Service Option: \$85.5 million
- Option 2: Full Service without Barton Drive Station: \$84.3 million
- Option 3: Starter Service: \$81.6 million
- Option 4A: Minimum Operable Configuration (MOC) with PTC: \$28.0 million
- Option 4B: Minimum Operable Configuration (MOC) without PTC: \$21.0 million

Low cost estimates have not been developed for the Shuttle Service options, (5A and 5B) as there the opportunity for large reductions in cost is anticipated to be quite limited, as is demonstrated in the Option 4A and 4B analyses.

### 3.3 Capital Cost Spreadsheets

Capital cost spreadsheets are provided as Appendix I to this document. The spreadsheets employ a tabular format that provides detailed quantities and unit costs and summarizes the costs of improvements by categories that enable the utilization of (Federal Transit Administration (FTA) Standard Cost Category worksheets. The cost elements include descriptive titles that are intended to clearly define the scope of the proposed improvement to the stakeholders.

Some general notes are as follows:

- Unit prices are in 2015 dollars.
- Trackwork for the corridor segments subject to commuter service is based on an inspection of the track with the objective of raising conditions to a state of good repair suitable for passenger service. In addition, elements such as bridge deck replacement are included in the scope, as such activities are likely to result in track outages lasting multiple days.
- Positive Train Control (PTC) pricing strategy. Costs for all options are based on the construction of a Centralized Traffic Control (CTC) system with a PTC overlay. The overlay including back office server, wayside interface unit functionality and vitality is priced at 82% of the signal system hardware based on our analysis of the costs provided by GE Transportation for Michigan DOT’s high speed rail program on the former Michigan Central line. GE is providing a new PTC signal system to enable Amtrak to operate passenger service under the federal mandate defined in 49CFR236. The contract provides detailed unit prices, which have been employed to develop the unit prices employed in our North-South estimates.
- All options are configured to protect commuter service territory from freight operations with remotely controlled split point derails, as this functionality will be required by the FRA for any operation without PTC and will be required by the Ann Arbor Railroad for any option which seeks to use property owned by AARR.

- Options which employ PTC must equip all passenger equipment locomotives and cab cars with On Board PTC equipment. Any freight locomotives which operate in the territory must be similarly equipped. The cost estimates provide funding to equip 2 GLC freight locomotives for the Full Service, Starter Service and Shuttle Service options, as only GLC will operate freight trains in passenger service territory when the interchange point is moved to Ellsworth. The MOC PTC Option provides funds to equip 2 GLC locomotives and 2 AARR locomotives, as both freight railroads will operate through passenger service territory to interchange at Osmer.
- The costs for stations and parking in the Full Service and Starter Service options are simple allocations as concept plans have not been developed. The AA-Washington St estimate is based on the previous report prepared by SGJJR.
- Right of Way costs are based on Zillow values for local undeveloped property, except in the case of the Whitmore Lake site, which is based on the per acre asking price of the specific property.
- Commuter rail locomotives and passenger coaches will be leased. The lease costs are addressed in the annual operating costs.
- All options include a connecting bus service with a fleet of 6 new buses. The options with a Barton Rd Station have bus service from Barton Rd. Those without have service from Washington St. The capital costs include the procurement of new equipment.
- Allocations for Special Elements are identical for each option, although it is reasonable to anticipate that the costs for implementing special elements for the Full Service and Starter Service territory may be greater than that of the MOC and Shuttle service territories, simply due to length and complexity of the system.
- Professional Services and Environmental use identical percentages, although some elements of the MOC implementation could proceed with a lesser, expedited design effort.
- Columns are provided to identify the possible cost reductions for the Low Estimate.

## 4. EQUIPMENT MAINTENANCE AND LAYOVER FACILITIES

Under the Full Service and Starter Service options, the locomotives, gallery coaches and gallery cab control cars will be maintained at the Howell Maintenance Facility, which is also the overnight layover facility for the service. The Howell facility is proposed to be located on a site west of the GLC main track between the East Grand River Road grade separation (highway under) at MP 72.79 and the CSXT crossing at the Ann Pere Interlocking at MP 72.10. The Midday Layover Facility will be located on the site of the Ann Arbor Railroad's Ferry Yard, south of the Hoover Street grade crossing at MP 44.64, and north of State Street grade crossing at MP 43.96 on the west side of the AA main track (in the segment now under discussion and proposed to be leased to MDOT). Design criteria for the maintenance and layover facilities are provided as Appendix II. Concept design plans are provided as Appendix III.

Under the Minimum Operable Configuration and Shuttle Service options, overnight storage, minor maintenance and daily inspections will be performed at the Whitmore Lake site adjacent to the passenger station. Under the Minimum Operable Configuration Options the Whitmore Lake facility will also provide midday storage, while under the Shuttle Service Options trains will be stored at an abbreviated Ann Arbor layover facility during the midday. Periodic inspections and other maintenance activities will be performed at an off-site location. For the purposes of estimating operating costs, the site is presumed to be GLC's Owosso facility.

## 5. ELLSWORTH INTERCHANGE

Two of the most important actions being taken to optimize the corridor's characteristics are discussions about the possibility of a lease arrangement for the southern end of the N-S commuter rail corridor and the potential for relocation of the freight interchange between GLC and AARR to Ellsworth, south of State Street crossing in Ann Arbor. These two critical changes will have important positive effects for the project:

- One railroad (GLC) would have complete operational control of the entire N-S commuter rail corridor. This is a critical element in train operations efficiency, signals, communications and the installation of Positive Train Control which is mandated for the new service.
- AARR freight trains would no longer enter the N-S commuter rail corridor. This eliminates the risk factors associated with commuter territory for AARR. It also relocates the point where freight trains will interchange traffic, occupying the main track and sidings to do so, with the resultant potential for delay to commuter trains. The new interchange point would be south of the south end of the N-S commuter rail territory on AARR trackage at Ellsworth instead of on GLC trackage at Osmer siding where it is today.

Quandel Consultants has developed a concept plan for the new interchange, which is presented as Appendix IV.



## 6. BRIDGE ASSESSMENT

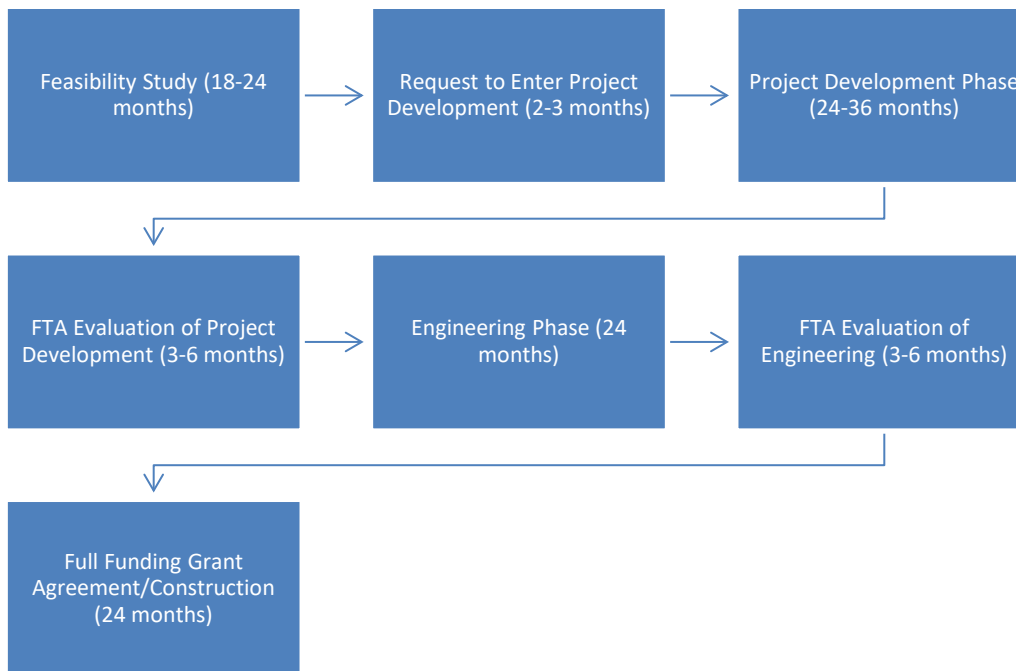
Bergmann Associates reviewed available bridge data and proposed passenger train speeds to report that based on the information we have received, we do not anticipate any speed restrictions for the passenger trains due to the load carrying capacity of the existing bridges. All the bridges appear to be adequate for carrying passenger trains without any strengthening repairs. This assumes the recommended repairs noted in the 2008 load rating report of the Ann Arbor Railroad line were made. As of 2015, we believe there were still some repairs that needed to be made.

That said, it may be worth considering a contingency budget to account for any deterioration that may occur between now and the time when the commuter trains are in operation. Assuming \$25,000 per bridge, times 12 bridges on the line would give a contingency budget of \$300,000, which seems reasonable. Since the need for future repairs is an unknown, the contingency budget could be adjusted up or down as desired.

Quandel Consultants note: The capital cost estimates for each option contain a contingency line item calculated at 20% of the value of the defined construction cost elements. The value ranges from a high of \$10.7 million for Option 1 to a low of \$2.7 million for Option 4B. These values are sufficient to address the possible bridge work identified in the Bergmann analysis.

## 7. CONSTRUCTION TIMELINE

Since it is expected that the N-S project will seek funding under the Federal Transit Administration’s New Starts program, the construction timeline of the project depends almost entirely on the amount of time it will take for work to be completed on the project to meet FTA requirements for Project Development, Engineering and Full Funding Grant Agreement phases. The process and general timeline are defined as follows:



The project stakeholders have been studying the feasibility of North-South commuter rail service for a number of years. Anticipating that the feasibility study phase will conclude with the current study in Spring 2017, and assuming that the identified project sponsors can advance the program rapidly with the minimum durations shown above, we can develop a construction timeline with major project milestones and cumulative construction costs. An example is provided for Option 1: Full Service in Appendix V.

## **STAY INFORMED AND GET INVOLVED!**

We would like to hear from you. Stay up-to-date on the latest news and developments, and engage with us through the website.

[www.NSRAILSTUDY.com](http://www.NSRAILSTUDY.com)

If your community or business group would like to learn more, a representative from the project team can present to your organization.

email:

[TellUs@TheRide.org](mailto:TellUs@TheRide.org)

Phone:

734.973.6500

# **APPENDIX I: CAPITAL COST SPREADSHEETS**

**APPENDIX I: CAPITAL COST SPREADSHEETS**

North-South Commuter Rail		Host Carrier	Ellsworth to State St Freight Only	Passenger Service Limits				Systemwide	J/R/Quandt Cost Total High Estimate	J/R/Quandt Cost Total Low Estimate	Delta	Potential Cost Reduction
Option 1: Full Service High and Low Estimates				Ann Arbor RR	Ann Arbor RR	Great Lakes Central RR	Great Lakes Central RR					
1/18/2016		Mileposts From - To	41.75-44.0	44.0-47.5	47.5-57.6	57.6-74.0						
		Route Miles	2.25 miles	3.5 miles	10.1 miles	16.4 miles						
		Maximum Authorized Speed		15 MPH (44.0-45.4) 30 MPH (45.4-47.19) 60MPH (47.19-47.5)	60 MPH	60 MPH						
Cost Element		Unit	Unit Cost	Quantity	Quantity	Quantity	Quantity					
<b>Trackwork</b>												
Add Rail Spikes	EA	\$	2	7083	14287	27618		\$	97,897	\$	97,897	
Eliminate Joint (Inspect, Chop, and Weld)	ME	\$	118,518	3	10.2	16.4		\$	3,555,558	\$	3,555,558	
Replace Switch Timbers	EA	\$	250		4			\$	1,000	\$	1,000	
Replace Turnout Switch Point	EA	\$	3,500		2			\$	7,000	\$	7,000	
Install Reel Block	EA	\$	1,000		2			\$	2,000	\$	2,000	
Replace Frog	EA	\$	15,000		4	2		\$	90,000	\$	90,000	
Replace Rail with 115 CWR	LFT	\$	70	18480		2000		\$	1,433,600	\$	1,433,600	
Remove Turnout (Pocket Track)	EA	\$	4,000			1		\$	4,000	\$	4,000	
Construct Track Ballasted (at grade)	TF	\$	310	21,477				\$	6,657,817	\$	6,657,817	
Install #10 Turnout - Timber	EA	\$	93,302	4	1	2		\$	559,812	\$	559,812	
Install Split Point Detail	EA	\$	60,000			6	6	\$	780,000	\$	780,000	
Install 50% Tie Replacement	ME	\$	444,000	95	3.5			\$	1,554,000	\$	1,554,000	
Surface Algae and Ballast	ME	\$	100,000	3.5				\$	350,000	\$	350,000	
Install New Guardrail on Washington St. Bridge, MP 45.48	FT	\$	40	80				\$	3,200	\$	3,200	
Install New Guardrail and Redeck Timbers on Haven St. Bridge, MP 45.55	FT	\$	100	95				\$	9,500	\$	9,500	
Install New Guardrail and Redeck Timbers on Miller Ave., MP 45.69	FT	\$	100	75				\$	7,500	\$	7,500	
Install New Guardrail and Redeck Timbers on Felch St, MP 45.89	FT	\$	100	85				\$	8,500	\$	8,500	
Rebuild Ballast at Private Crossing at MP 45.5	FTF	\$	50			100		\$	5,000	\$	5,000	
Rebuild and Improve Drainage at Crooked Lake Rd MP 69.40	FTF	\$	900			40		\$	36,000	\$	36,000	
Rebuild and Improve Drainage at Chilton Rd MP 69.99	FTF	\$	900			40		\$	36,000	\$	36,000	
Rebuild and Improve Drainage at Private Crossing MP 65.5	FTF	\$	900			20		\$	18,000	\$	18,000	
<b>Sub-total Trackwork (A)</b>								<b>\$</b>	<b>15,216,492</b>	<b>\$</b>	<b>15,216,492</b>	
<b>Systems</b>												
Install Electric Lock for Industry Turnout	EA	\$	120,000	1	7	5		\$	1,560,000	\$	1,560,000	
Install New Control Point (CP) for Temporal Separation with split point detail with bungalow, switch machine, home and remote signals	EA	\$	700,000	1	2	2		\$	2,100,000	\$	2,100,000	
Install Crossing Diamond	EA	\$	1,280,000	1				\$	1,280,000	\$	1,280,000	
Install Derail Control Point	EA	\$	790,000	1		1		\$	1,480,000	\$	1,480,000	
Install Intermediate	EA	\$	280,000	2	5	9		\$	4,480,000	\$	4,480,000	
Install Locomotive On-Road Systems (Passenger and Freight)	EA	\$	100,000			12		\$	1,200,000	\$	1,200,000	
<b>Sub-total Hardware</b>								<b>\$</b>	<b>12,020,000</b>	<b>\$</b>	<b>12,020,000</b>	
System Integration-Communications, Back office, dispatch, PTPCD, PTPSP	EA		82%					\$	9,834,545	\$	9,834,545	
<b>Sub-total Systems-Hardware</b>								<b>\$</b>	<b>21,854,545</b>	<b>\$</b>	<b>21,854,545</b>	
									<b>\$</b>	<b>10,820,000</b>	<b>\$</b>	<b>11,034,545</b>
											Eliminate PTC component.	
<b>Crossings</b>												
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Liberty Street, MP 45.4	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Summit Street, MP 46.09	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Wright Street, MP 46.57	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Longbow Street, MP 46.6	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Portage Trail, MP 46.65	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Bowen Street, MP 46.71	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Traver Street, MP 46.74	EA	\$	166,000	1				\$	166,000	\$	83,000	
Install Grade Crossing Start Modification at Barton Road, MP 47.19	EA	\$	90,000					\$	-	\$	-	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Barton Street, MP 47.39	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Traver Street, MP 48.29	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Pontiac Trail, MP 49.73	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Warren Road, MP 50.02	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Low Road, MP 50.90	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Northfield Church Road, MP 51.90	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at N. Territorial Road, MP 53.39	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at 5 Mile Road, MP 53.93	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Main Street, MP 55.35	EA	\$	166,000	1				\$	166,000	\$	83,000	
Install Grade Crossing Start Modification at 8 Mile, MP 57.56	EA	\$	50,000					\$	-	\$	-	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Hall Road, MP 58.75	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Strawberry Lake Road, MP 59.02	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Hamburg Road, MP 59.45	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Merrill Road, MP 60.53	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Pletts Drive, MP 61.62	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Private-Trail Hamburg Township, MP 61.7	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Girard Road, MP 61.84	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Kross Road, MP 62.23	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at M-36, MP 62.52	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Swarthout Road, MP 63	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Bishop Lake Road, MP 65.36	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Chilton Road, MP 65.99	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Coon Lake Road, MP 67.73	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Crooked Lake Road, MP 69.40	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Beck Road, MP 71.00	EA	\$	166,000	1				\$	166,000	\$	83,000	
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Barnard Street, MP 73.68	EA	\$	166,000	1				\$	166,000	\$	83,000	
<b>Sub-total Crossings (C)</b>								<b>\$</b>	<b>5,312,000</b>	<b>\$</b>	<b>2,656,000</b>	
											Allowance for MDOT Diagnostic Review Reductions	
<b>ROW</b>												
Procure Howell Overnight Maintenance and Layover Facility Site	ACRE	\$	20,000			12		\$	240,000	\$	240,000	
Procure Ann Arbor - Washington/Liberty Station Site	ACRE	\$	100,000	1				\$	100,000	\$	100,000	
Procure Ann Arbor-Barton Station Site	ACRE	\$	20,000	1				\$	20,000	\$	20,000	
Procure Whitmore Lake Station Site	ACRE	\$	140,000			4		\$	560,000	\$	560,000	
Procure Hamburg Station Site	ACRE	\$	20,000			4		\$	80,000	\$	80,000	
Procure Genoa Township Station Site	ACRE	\$	20,000	4				\$	80,000	\$	80,000	
Procure Howell Station Site	ACRE	\$	20,000			4		\$	80,000	\$	80,000	
<b>Sub-total ROW (D)</b>								<b>\$</b>	<b>1,180,000</b>	<b>\$</b>	<b>1,180,000</b>	
<b>Stations/Parking</b>												
Construct Ann Arbor - Washington/Liberty Station	EA	\$	1,000,000	1				\$	1,000,000	\$	1,000,000	
Construct Ann Arbor-Barton Station	EA	\$	750,000	1				\$	750,000	\$	750,000	
Construct Whitmore Lake Station	EA	\$	750,000			1		\$	750,000	\$	750,000	
Construct Hamburg Station	EA	\$	750,000			1		\$	750,000	\$	750,000	
Construct Genoa Township Station	EA	\$	750,000			1		\$	750,000	\$	750,000	
Construct Howell Station	EA	\$	750,000			1		\$	750,000	\$	750,000	
<b>Sub-total Stations/Parking (E)</b>								<b>\$</b>	<b>4,750,000</b>	<b>\$</b>	<b>4,750,000</b>	
<b>Vehicles</b>												
Procure Locomotives	EA	\$	-					\$	-	\$	-	
Procure Cars (Coaches and Cab Cars)	EA	\$	123,400			1		\$	1,234,000	\$	1,234,000	
Procure Hybrid Bus (new)	EA	\$	665,000			6		\$	3,990,000	\$	3,990,000	
Procure Agency Automobiles	EA	\$	25,000			10		\$	250,000	\$	250,000	
<b>Sub-total Vehicles</b>								<b>\$</b>	<b>4,240,000</b>	<b>\$</b>	<b>4,240,000</b>	
<b>Maintenance Facilities</b>												
Construct Ann Arbor Barton Station and Layover MOC	EA	\$	385,000					\$	385,000	\$	385,000	
Construct B Mile Station and Layover MOC	EA	\$	2,679,142					\$	2,679,142	\$	2,679,142	
Construct Ann Arbor Midway Layover Facility	EA	\$	1,967,464			1		\$	6,967,464	\$	6,967,464	
Construct Howell Overnight Layover Facility	EA	\$	16,596,324			1		\$	16,596,324	\$	16,596,324	
<b>Sub-total Maintenance Facilities (F)</b>								<b>\$</b>	<b>23,567,928</b>	<b>\$</b>	<b>14,225,942</b>	
											9,337,846	
											Reduced Maintenance Facility functionality	
<b>Allocations for Special Elements</b>												
Development of ADA Compliance Waiver Request 49 CFR 37.42	LS	\$	13,600			1		\$	13,600	\$	13,600	
Development of Instructions to Operating Rules, Timetables, and Timetable Special Instructions 49 CFR 217.7(a)	LS	\$	23,400			1		\$	23,400	\$	23,400	
Development of Operational Tests and Inspection Program 49 CFR 217.7(d)	LS	\$	14,200			1		\$	14,200	\$	14,200	
Development of Training Program on Operating Rules 49 CFR 217.9(d)	LS	\$	14,200			1		\$	14,200	\$	14,200	
Develop Emergency Procedures Plan and Train Employee 49 CFR 103 and 203	LS	\$	14,200			1		\$	14,200	\$	14,200	
Modify Conductor Certification Program 49 CFR 242.103	LS	\$	7,100			1		\$	7,100	\$		



North-South Commuter Rail				Ellsworth to State St Freight Only		Passenger Service Limits			Systemwide	JIR/Quandel Cost Total-High Estimate	JIR/Quandel Cost Total-Low Estimate	Delta	Potential Cost Reduction
Option 3: Starter Service High and Low Estimates				Host Carrier	Ann Arbor RR	Ann Arbor RR	Great Lakes Central RR	Great Lakes Central RR					
1/13/2016				Mileposts From - To	41.75-44.0	44.0-47.5	47.5-57.6	57.6-74.0					
				Route Miles	2.25 miles	3.5 miles	10.1 miles	16.4 miles					
				Maximum Authorized Speed		45.4- 30 MPH (45.4-47.19) 60MPH	60 MPH	60 MPH					
Cost Element				Unit	Unit Cost	Quantity	Quantity	Quantity					
<b>Trackwork</b>													
	Add Rail Spikes	EA	\$	2		7083	14297	27618		\$	97,997	\$	97,997
	Eliminate Joint (Inspect, Crop, and Weld)	MI	\$	118,519		3.5	10.1	16.4		\$	3,555,556	\$	3,555,556
	Replace Switch Timbers	EA	\$	250			4			\$	1,000	\$	1,000
	Replace Turnout Switch Point	EA	\$	3,500			2			\$	7,000	\$	7,000
	Install Wheel Block	EA	\$	1,000			2			\$	2,000	\$	2,000
	Replace Ffse	EA	\$	15,000			4	2		\$	90,000	\$	90,000
	Replace Rail with 115 CWR	LFT	\$	70		18,480		2000		\$	1,333,600	\$	1,333,600
	Remove Turnouts (Pocket Track)	EA	\$	4,000			1			\$	4,000	\$	4,000
	Construct Track - Ballasted (at-grade)	TF	\$	310		21,477				\$	6,657,827	\$	6,657,827
	Install R10 Turnout - Timber	EA	\$	93,302		4				\$	373,208	\$	373,208
	Install Split Point Derailed	EA	\$	60,000			1	6	6	\$	780,000	\$	780,000
	Install 50% Tie Replacement	MI	\$	444,000		3.5				\$	1,554,000	\$	1,554,000
	Surface Align and Ballast	MI	\$	100,000		3.5				\$	350,000	\$	350,000
	Install New Guardrail on Washington St. Bridge, MP 45.48	FT	\$	40		80				\$	3,200	\$	3,200
	Install New Guardrail and Redeck Timbers on Huron St. Bridge, MP 45.55	FT	\$	100		95				\$	9,500	\$	9,500
	Install New Guardrail and Redeck Timbers on Miller Ave., MP 45.69	FT	\$	100		75				\$	7,500	\$	7,500
	Install New Guardrail and Redeck Timbers on Felch St., MP 45.89	FT	\$	100		85				\$	8,500	\$	8,500
	Rebuild Ballast at Private Grade Crossing at MP 55.55	TFT	\$	50			100			\$	5,000	\$	5,000
	Rebuild and Improve Drainage at Crooked Lake Rd MP 69.40	TFT	\$	900				40		\$	36,000	\$	36,000
	Rebuild and Improve Drainage at Chilson Rd MP 65.99	TFT	\$	900				40		\$	36,000	\$	36,000
	Rebuild and Improve Drainage at Private Crossing MP 65.5	TFT	\$	900				20		\$	18,000	\$	18,000
	<b>Sub-total Trackwork (A)</b>									\$	<b>15,216,492</b>	\$	<b>15,216,492</b>
<b>Systems</b>													
	Install Electric Lock for Industry Turnout	EA	\$	120,000		1	7	5		\$	1,560,000	\$	1,560,000
	Install New Control Point (CPI) for Temporal Separation with split point derailed with bungalow, switch machine, home and remote	EA	\$	200,000		1	2			\$	2,100,000	\$	2,100,000
	Install Crossing Diamond	EA	\$	1,280,000				1		\$	1,280,000	\$	1,280,000
	Install Derailed Control Point	EA	\$	700,000		1		1		\$	1,400,000	\$	1,400,000
	Install Intermediate	EA	\$	280,000		2	5	9		\$	4,480,000	\$	4,480,000
	Install Locomotive On-Board Systems (Passenger and Freight)	EA	\$	100,000					12	\$	1,200,000	\$	1,200,000
	<b>Sub-total Hardware</b>									\$	<b>12,020,000</b>	\$	<b>12,020,000</b>
	Systems Integration: Communications, Back office, dispatch, PTCOP, PTCSP	EA		82%						\$	9,834,545		
	<b>Sub-total Systems +Hardware</b>									\$	<b>21,854,545</b>	\$	<b>21,854,545</b>
										\$		\$	11,034,545
													Eliminate PTC components
<b>Crossings</b>													
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Liberty Street, MP 45.4	EA	\$	166,000		1				\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Summit Street, MP 46.09	EA	\$	166,000		1				\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Wright Street, MP 46.57	EA	\$	166,000		1				\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Longhorn Street, MP 46.6	EA	\$	166,000		1				\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Pontiac Trail, MP 46.64	EA	\$	166,000		1				\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Bowen Street, MP 46.71	EA	\$	166,000		1				\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Traver Street, MP 46.74	EA	\$	166,000		1				\$	166,000	\$	83,000
	Install Grade Crossing Start Modification at Barton Road, MP 47.19	EA	\$	166,000						\$		\$	
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Barton Street, MP 47.19	EA	\$	166,000		1				\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Traver Street, MP 48.19	EA	\$	166,000			1			\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Pontiac Trail, MP 49.71	EA	\$	166,000			1			\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Warren Road, MP 50.02	EA	\$	166,000			1			\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Toy Road, MP 50.90	EA	\$	166,000			1			\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Northfield Church Road, MP 51.90	EA	\$	166,000			1			\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at N. Territorial Road, MP 53.19	EA	\$	166,000			1			\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at 5 Mile Road, MP 53.91	EA	\$	166,000			1			\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Main Street, MP 56.35	EA	\$	166,000			1			\$	166,000	\$	83,000
	Install Grade Crossing Start Modification at 8 Mile, MP 57.56	EA	\$	50,000						\$	-	\$	-
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Hall Road, MP 58.75	EA	\$	166,000				1		\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Strawberry Lake Road, MP 59.02	EA	\$	166,000				1		\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Hamburg Road, MP 59.45	EA	\$	166,000				1		\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Merrill Road, MP 60.53	EA	\$	166,000				1		\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Pettys Drive, MP 61.52	EA	\$	166,000				1		\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Private-Trail Hamburg Township MP 61.7	EA	\$	166,000				1		\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Grand Road, MP 61.84	EA	\$	166,000				1		\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Kress Road, MP 62.23	EA	\$	166,000				1		\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at M-36, MP 62.52	EA	\$	166,000				1		\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Sutherland Road, MP 64.3	EA	\$	166,000				1		\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Bishop Lake Road, MP 65.36	EA	\$	166,000				1		\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Chilson Road, MP 65.99	EA	\$	166,000				1		\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Coon Lake Road, MP 67.73	EA	\$	166,000				1		\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Crooked Lake Road, MP 69.40	EA	\$	166,000				1		\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Beck Road, MP 71.02	EA	\$	166,000				1		\$	166,000	\$	83,000
	Replace Existing Warning System with New Gates, Flashers, and Bungalow at Barnard Street, MP 73.68	EA	\$	166,000				1		\$	166,000	\$	83,000
	<b>Sub-total Crossings (C)</b>									\$	<b>5,312,000</b>	\$	<b>2,656,000</b>
										\$		\$	2,656,000
													Allowance for MDOT Diagnostic Review
<b>ROW</b>													
	Procure Howell Overnight Maintenance and Layover Facility Site	ACRE	\$	20,000				12		\$	240,000	\$	240,000
	Procure Ann Arbor- Washington/Liberty Station Site	ACRE	\$	100,000			1			\$	100,000	\$	100,000
	Procure Ann Arbor-Barton Station Site	ACRE	\$	20,000						\$		\$	
	Procure Whitmore Lake Station Site	ACRE	\$	145,000				4		\$	580,000	\$	580,000
	Procure Hamburg Station Site	ACRE	\$	20,000						\$		\$	
	Procure Genoa Township Station Site	ACRE	\$	20,000						\$		\$	
	Procure Howell Station Site	ACRE	\$	20,000				4		\$	80,000	\$	80,000
	<b>Sub-total ROW (D)</b>									\$	<b>1,000,000</b>	\$	<b>1,000,000</b>
<b>Stations/Parking</b>													
	Construct Ann Arbor- Washington/Liberty Station	EA	\$	1,000,000			1			\$	1,000,000	\$	1,000,000
	Construct Ann Arbor-Barton Station	EA	\$	750,000						\$		\$	
	Construct Whitmore Lake Station	EA	\$	750,000				1		\$	750,000	\$	750,000
	Construct Hamburg Station	EA	\$	750,000						\$		\$	
	Construct Genoa Township Station	EA	\$	750,000						\$		\$	
	Construct Howell Station	EA	\$	750,000				1		\$	750,000	\$	750,000
	<b>Sub-total Stations/Parking (E)</b>									\$	<b>2,500,000</b>	\$	<b>2,500,000</b>
<b>Vehicles</b>													
	Procure Locomotives	EA	\$	-						\$	-	\$	-
	Procure Cars (Coaches and Cab Cars)	EA	\$	-						\$	-	\$	-
	Procure Hybrid Bus (Inra)	EA	\$	665,000				6		\$	3,990,000	\$	3,990,000
	Procure Agency Automobiles	EA	\$	25,000				10		\$	250,000	\$	250,000
	<b>Sub-total Vehicles</b>									\$	<b>4,240,000</b>	\$	<b>4,240,000</b>
<b>Maintenance Facilities</b>													
	Construct Ann Arbor Barton Station and Layover MOC	EA	\$	385,000						\$		\$	
	Construct 8 Mile Station and Layover MOC	EA	\$	2,679,142						\$		\$	
	Construct Ann Arbor Midway Layover Facility	EA	\$	6,967,464		1				\$	6,967,464	\$	6,967,464
	Construct Howell Overnight Layover Facility	EA	\$	16,596,324					1	\$	16,596,324	\$	7,258,478
	<b>Sub-total Maintenance Facilities (F)</b>									\$	<b>23,563,788</b>	\$	<b>14,225,942</b>
										\$		\$	9,337,846
													Reduced Maintenance Facility functionality
<b>Allocations for Special Elements</b>													
	Development of ADA Compliance Waiver Request 49 CFR 37.42	LS	\$	13,600				1		\$	13,600	\$	13,600
	Development of Modifications to Operating Rules, Timetables, and Timetable Special Instructions 49 CFR 217.7(a)	LS	\$	28,400				1		\$	28,400	\$	28,400
	Development of Operational Tests and Inspection Program 49 CFR 217.7(b)	LS	\$	14,200				1		\$	14,200	\$	14,200
	Development of Training Program on Operating Rules 49 CFR 217.9(b)	LS	\$	14,200				1		\$	14,200	\$	14,200
	Develop Emergency Preparedness Plan and train employees 49 CFR 101 and 201	LS	\$	14,200				1		\$	14,200	\$	14,200
	Modify Conductor Certification Program 49 CFR 242.103	LS	\$	7,100				1		\$	7,100	\$	7,100
	Prepare System Safety Program and Collision Hazard Analysis 49 CFR 270 (proposed rule)	LS	\$	19,600				1		\$	19,600	\$	19,600
	Develop and implement Training and Trial Running Program	LS	\$	74,400				1		\$	74,400	\$	74,400
	Advertising of Service in the Media and Development of Website	LS	\$	17,100				1		\$	17,100	\$	17,100
	Development and Printing of Schedules and User Information	LS	\$	24,200				1		\$	24,200	\$	24,200
	Procure and Train Fare Collection System including Hardware and Software	LS	\$	128,400				1		\$	128,400	\$	128,400
	Develop and Implement Local Grade Crossing Safety Advertising Program	LS	\$	23,100				1		\$	23,100	\$	23,100
	Prepare PTCOP	LS											

North-South Commuter Rail				Barton Road Station to Whitmore Lake Station Site #1	Barton Layover/Station Track	8 Mile Layover/Station Track									
Option 4A: Minimum Operable Configuration (MOC) w/ PTC High and Low Estimates				Host Carrier	Great Lakes Central RR	Great Lakes Central RR	Great Lakes Central RR								
1/13/2016				Mileposts From - To	47.5-57.6			Systemwide	JJR/Quandel Cost Total-High Estimate	JJR/Quandel Cost Total-Low Estimate	Delta	Potential Cost Reduction			
				Route Miles	10.1 miles										
				Maximum Authorized Speed	40 MPH										
Cost Element				Unit	Unit Cost	Quantity	Quantity	Quantity							
<b>Trackwork</b>															
Add Rail Spikes	EA	\$	2	14297					\$	28,593	\$	28,593			
Eliminate Joint (Inspect, Crop, and Weld)	MI	\$	118,519						\$	-	\$	-			
Replace Switch Timbers	EA	\$	250	4					\$	1,000	\$	1,000			
Replace Turnout Switch Point	EA	\$	3,500	2					\$	7,000	\$	7,000			
Install Heel Block	EA	\$	1,000	2					\$	2,000	\$	2,000			
Replace Frog	EA	\$	15,000	4					\$	60,000	\$	60,000			
Replace Rail with 115 CWR	LFT	\$	70						\$	-	\$	-			
Remove Turnouts (Pocket Track)	EA	\$	4,000						\$	-	\$	-			
Construct Track: Ballasted (at-grade)	TF	\$	310		450	1013			\$	453,530	\$	453,530			
Install #10 Turnout - Timber	EA	\$	93,302	1		1			\$	186,604	\$	186,604			
Install Split Point Derrail	EA	\$	60,000	7		1	1		\$	540,000	\$	540,000			
Install 50% Tie Replacement	MI	\$	444,000						\$	-	\$	-			
Surface Align and Ballast	MI	\$	100,000						\$	-	\$	-			
Install New Guardrail on Washington St. Bridge, MP 45.48	FT	\$	40						\$	-	\$	-			
Install New Guardrail and Redeck Timbers on Huron St. Bridge, MP 45.55	FT	\$	100						\$	-	\$	-			
Install New Guardrail and Redeck Timbers on Miller Ave., MP 45.69	FT	\$	100						\$	-	\$	-			
Install New Guardrail and Redeck Timbers on Felch St. MP 45.89	FT	\$	100						\$	-	\$	-			
Rebuild Ballast at Private Grade Crossing at MP 55.55	TFT	\$	50						\$	-	\$	-			
Rebuild and Improve Drainage at Crooked Lake Rd MP 69.40	TFT	\$	900						\$	-	\$	-			
Rebuild and Improve Drainage at Chilson Rd MP 65.99	TFT	\$	900						\$	-	\$	-			
Rebuild and Improve Drainage at Private Crossing MP 65.5	TFT	\$	900						\$	-	\$	-			
									\$	-	\$	-			
									\$	-	\$	-			
<b>Sub-total Trackwork (A)</b>									\$	<b>1,278,727</b>	\$	<b>1,278,727</b>			
<b>Systems</b>															
Install Electric Lock for Industry Turnout	EA	\$	120,000	7	1	1			\$	1,080,000	\$	1,080,000			
Install New Control Point (CP) for Temporal Separation with split point derailed with bungalow, switch machine, home and remote signals	EA	\$	700,000	2					\$	1,400,000	\$	1,400,000			
Install Crossing Diamond	EA	\$	1,280,000						\$	-	\$	-			
Install Derailed Control Point	EA	\$	700,000						\$	-	\$	-			
Install Intermediate	EA	\$	280,000	4					\$	1,120,000	\$	1,120,000			
Install Locomotive On-Board Systems (Passenger and Freight)	EA	\$	100,000					8	\$	800,000	\$	800,000			
<b>Sub-total Hardware</b>									\$	<b>4,400,000</b>	\$	<b>4,400,000</b>			
Systems Integration: Communications, Back office, dispatch, PTCIP, PTCSP	EA		82%						\$	3,600,000	\$	3,600,000			
<b>Sub-total Systems +Hardware</b>									\$	<b>8,000,000</b>	\$	<b>8,000,000</b>			
<b>Crossings</b>															
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Liberty Street, MP 45.4	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Summit Street, MP 46.09	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Wright Street, MP 46.57	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Longshore Street, MP 46.6	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Pontiac Trail, MP 46.64	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Bowen Street, MP 46.71	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Traver Street, MP 46.74	EA	\$	166,000						\$	-	\$	-			
Install Grade Crossing Start Modification at Barton Road, MP 47.19	EA	\$	50,000	1					\$	50,000	\$	50,000			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Barton Street, MP 47.19	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Traver Street, MP 48.39	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Pontiac Trail, MP 49.71	EA	\$	166,000	1					\$	166,000	\$	83,000			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Warren Road, MP 50.02	EA	\$	166,000	1					\$	166,000	\$	83,000			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Joy Road, MP 50.90	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Northfield Church Road, MP 51.90	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at N. Territorial Road, MP 53.19	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at 5 Mile Road, MP 53.91	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Main Street, MP 56.35	EA	\$	166,000	1					\$	166,000	\$	83,000			
Install Grade Crossing Start Modification at 8 Mile, MP 57.56	EA	\$	50,000	1					\$	50,000	\$	50,000			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Hall Road, MP 58.75	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Strawberry Lake Road, MP 59.02	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Hamburg Road, MP 59.45	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Merrill Road, MP 60.53	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Petys Drive, MP 61.52	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Private-Trail Hamburg Township MP 61.7	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Girard Road, MP 61.84	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Kress Road, MP 62.23	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at M-36, MP 62.52	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Swarthout Road, MP 64.3	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Bishop Lake Road, MP 65.36	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Chilson Road, MP 65.99	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Coon Lake Road, MP 67.73	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Crooked Lake Road, MP 69.40	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Beck Road, MP 71.02	EA	\$	166,000						\$	-	\$	-			
Replace Existing Warning System with New Gates, Flashers, and Bungalow at Barnard Street, MP 73.68	EA	\$	166,000						\$	-	\$	-			
<b>Sub-total Crossings (C)</b>									\$	<b>598,000</b>	\$	<b>349,000</b>	\$	<b>249,000</b>	Allowance for MDOT Diagnostic Review Reductions
<b>ROW</b>															
Procure Howell Overnight Maintenance and Layover Facility Site	ACRE	\$	20,000						\$	-	\$	-			
Procure Ann Arbor- Washington/Liberty Station Site	ACRE	\$	100,000						\$	-	\$	-			
Procure Ann Arbor-Barton Station Site	ACRE	\$	20,000			1			\$	20,000	\$	20,000			
Procure Whitmore Lake Station Site	ACRE	\$	145,000					4	\$	580,000	\$	580,000			
Procure Hamburg Station Site	ACRE	\$	20,000						\$	-	\$	-			
Procure Genoa Township Station Site	ACRE	\$	20,000						\$	-	\$	-			
Procure Howell Station Site	ACRE	\$	20,000						\$	-	\$	-			
<b>Sub-total ROW (D)</b>									\$	<b>600,000</b>	\$	<b>600,000</b>			
<b>Stations/Parking</b>															
Construct Ann Arbor- Washington/Liberty Station	EA	\$	1,000,000						\$	-	\$	-			
Construct Ann Arbor-Barton Station	EA	\$	750,000						\$	-	\$	-			
Construct Whitmore Lake Station	EA	\$	750,000						\$	-	\$	-			
Construct Hamburg Station	EA	\$	750,000						\$	-	\$	-			
Construct Genoa Township Station	EA	\$	750,000						\$	-	\$	-			
Construct Howell Station	EA	\$	750,000						\$	-	\$	-			
<b>Sub-total Stations/Parking (E)</b>									\$	-	\$	-			
<b>Vehicles</b>															
Procure Locomotives	EA	\$	-						\$	-	\$	-			
Procure Cars (Coaches and Cab Cars)	EA	\$	-						\$	-	\$	-			
Procure Hybrid Bus (new)	EA	\$	665,000					6	\$	3,990,000	\$	3,990,000			
Procure Agency Automobiles	EA	\$	25,000					6	\$	150,000	\$	150,000			
<b>Sub-total Vehicles</b>									\$	<b>4,140,000</b>	\$	<b>4,140,000</b>			
<b>Maintenance Facilities</b>															
Construct Ann Arbor Barton Station and Layover MOC	EA	\$	385,000			1			\$	385,000	\$	385,000			
Construct 8 Mile Station and Layover MOC	EA	\$	2,679,142					1	\$	2,679,142	\$	2,341,900	Eliminate train shed		
Construct Ann Arbor Midday Layover Facility	EA	\$	6,967,464						\$	-	\$	-			
Construct Howell Overnight Layover Facility	EA	\$	16,596,324						\$	-	\$	-			
<b>Sub-total Maintenance Facilities (F)</b>									\$	<b>3,064,142</b>	\$	<b>2,726,900</b>	\$	<b>337,242</b>	Reduced Maintenance Facility functionality
<b>Allocations for Special Elements</b>															
Development of ADA Compliance Waiver Request 49 CFR 37.42	LS	\$	13,600					1	\$	13,600	\$	13,600			
Development of Modifications to Operating Rules, Timetables, and Timetable Special Instructions 49 CFR 217.7(a)	LS	\$	28,400					1	\$	28,400	\$	28,400			
Development of Operational Tests and Inspection Program 49 CFR 217.7©	LS	\$	14,200					1	\$	14,200	\$	14,200			
Development of Training Program on Operating Rules 49 CFR 217.9©	LS	\$	14,200					1	\$	14,200	\$	14,200			
Develop Emergency Preparedness Plan and train employees 49 CFR 101 and 201	LS	\$	14,200					1	\$	14,200	\$	14,200			
Modify Conductor Certification Program 49 CFR 242.103	LS	\$	7,100					1	\$	7,100	\$	7,100			
Prepare System Safety Program and Collision Hazard Analysis 49 CFR 270 (proposed rule)	LS	\$	19,600					1	\$	19,600	\$	19,600			
Develop and implement Training and Trial Running Program	LS	\$	74,400					1	\$	74,400	\$	74,400			
Advertising of Service in the Media and Development of Website	LS	\$	17,100					1	\$	17,100	\$	17,100			
Development and Printing of Schedules and User Information	LS	\$	24,200					1	\$	24,200	\$	24,200			
Procure and Train Fare Collection System including Hardware and Software	LS	\$	128,400					1	\$	128,400	\$	128,400			
Develop and Implement Local Grade Crossing Safety Advertising Program	LS	\$	23,100					1	\$	23,100	\$	23,100			
Prepare PTCIP	LS	\$	102,000					1	\$	102,000	\$	102,000			
<b>Sub-Total Allocations for Special Elements (E)</b>									\$	<b>480,500</b>	\$	<b>480,500</b>			
<b>Sub-total Construction Elements (A+B+C+D+E+F)</b>															









AA Midday Layover						
WL-BD-AA						
9/29/2016						
Minimal facility on west side of main track, south of Hoover St with single side track, turnouts on each end, security cameras, wayside air and power, sufficient length to store entire fleet: 3-loco, 3-coach, 3-cab: 1000 ft with access road. Signal is included in main line signal costs.			<b>Quandel Unit Costs (2014)</b>	<b>Quantity</b>	<b>JJR/Quandel Cost Total</b>	
	<b>Unit</b>					
#10 Turnout - Timber	EA	\$ 93,302		2		186,604
#8 Ballasted Turnouts in Yard	EA	\$ 70,519		0		-
Yard Track on New Roadbed	TFT	\$ 158		1000		158,000
TrainWasher	LS	\$ 3,000,000		0		-
Parking Lot - 3" asphalt on 8" gravel base, earthwork, drainage, lighting	EA	\$ 3,000		0		-
Security Fence + Gate - 12' fence w/graffiti wrap	LF	\$ 100		1600		160,000
10' Wide Access Roadway	CF	\$ 2		9,167		18,333
15'x30' Crew Building	SF	\$ 120		0		-
CCTV System	L SUM	\$ 50,000		1		50,000
Electrical	VEHICLE	\$ -		0		-
Wayside Air and Power	LSUM	\$ 170,000		1		170,000
						50% of 21 vehicle fleet for full service
<b>TOTAL COST AA LAYOVER FACILITY</b>						<b>\$ 742,937</b>
Whitmore Lake Overnight Layover						
WL-BD-AA						
10/14/2016						
Modest facility on east side of main track, south of 8 Mile Rd with single side track, turnouts on each end, security cameras, wayside air and power, sufficient length to store entire fleet: 3-loco, 3-coach, 3-cab: 800 ft with access road. Signal is included in main line signal costs. Pole barn building to provide shelter for inspections and light maintenance. Small pole barn facility for infrastructure stores and small building for staff assembly and reporting.			<b>Quandel Unit Costs (2014)</b>	<b>Quantity</b>	<b>JJR/Quandel Cost Total</b>	
	<b>Unit</b>					
#10 Turnout - Timber	EA	\$ 93,302		2		186,604
#8 Ballasted Turnouts in Yard	EA	\$ 70,519		0		-
Yard Track on New Roadbed	TFT	\$ 158		1000		158,000
Parking Lot - 600 cars, 3" asphalt on 8" gravel base, earthwork, drainage,	EA	\$ 3,000		600	\$	1,800,000
Security Fence + Gate - 12' fence w/graffiti wrap	LF	\$ 100		1524	\$	152,400
Mobile Office - 32'x8' with utility hook-ups (Means)	EA	\$ 22,000		1	\$	22,000
Storage Shed - 24'x20' pole barn	SF	\$ 50		480	\$	24,000
Wayside Air and Power	LSUM	\$ 170,000		1		170,000
15'x30' Crew Building	SF	\$ 120		450		54,000
CCTV System	L SUM	\$ 50,000		1		50,000
Train Shed 275X40 Including Utilities	EA	\$ 337,242		1	\$	337,242
<b>TOTAL COST WHITMORE LAKE OVERNIGHT FACILITY</b>						<b>\$ 2,609,642</b>

AA Midday Layover						
AA Midday Layover		Quandel Unit Costs (2014)	AA Midday Layover	JJR/Quandel Cost Total		
Full Service						
6/18/2015						
	Unit		Quantity			
#10 Turnout - Timber	EA	\$ 93,302	2	186,604		
#8 Ballasted Turnouts in Yard	EA	\$ 70,519	4	282,076		
Yard Track on New Roadbed	TFT	\$ 158	5648	892,384		
TrainWasher	LS	\$ 3,000,000	1	3,000,000		
Parking Lot - 3" asphalt on 8" gravel base, earthwork, drainage, lighting	EA	\$ 3,000	30	90,000		
Security Fence + Gate - 12' fence w/graffiti wrap	LF	\$ 100	3803	380,300		
10' Wide Access Roadway	CF	\$ 2	19,360	42,979		
15'x30' Crew Building	SF	\$ 120	450	54,000		
CCTV System	L SUM	\$ 50,000	1	50,000		
Electrical	VEHICLE	\$ 82,456	20	1,649,121		
Wayside Air and Power	LSUM	\$ 340,000	1	340,000		
<b>TOTAL COST AA LAYOVER FACILITY</b>				<b>\$ 6,967,464</b>		

Minimum Operating Configuration Alternative (Layover Facility and Station Combined)

				High Cost	Low Cost	
Station/Maintenance Facilities						
Survey, Borings and Engineering	LS	\$	80,000	1	\$ 80,000	\$ 80,000
Mobilization	LS	\$	10,000	1	\$ 10,000	\$ 10,000
Site Preparation/Demolition	LS	\$	15,000	1	\$ 15,000	\$ 15,000
Parking Lot - 600 cars, 3" asphalt on 8" gravel base, earthwork, drainage, lighting	EA	\$	3,000	600	\$ 1,800,000	\$ 1,800,000
Platform - 12' wide x 250' long, wood	SF	\$	50	3000	\$ 150,000	\$ 150,000
Canopy - 100' x 14'	SF	\$	20	1400	\$ 28,000	\$ 28,000
Signage	LS	\$	10,000	1	\$ 10,000	\$ 10,000
Security Fence + Gate - 12' fence w/graffiti wrap	LF	\$	100	1524	\$ 152,400	\$ 152,400
Lift	EA	\$	8,000	1	\$ 8,000	\$ 8,000
Lift Shelter	EA	\$	2,500	1	\$ 2,500	\$ 2,500
Mobile Office - 32'x8' with utility hook-ups (Means)	EA	\$	22,000	1	\$ 22,000	\$ 22,000
Storage Shed - 24'x20' pole barn	SF	\$	50	480	\$ 24,000	\$ 24,000
Permitting + Construction Management	EA	\$	40,000	1	\$ 40,000	\$ 40,000
Barton Rd Bus Transfer roadway modifications	LS	\$	64,000		\$ -	\$ -
Barton Rd 480 volt Standby Power	EA	\$	25,000		\$ -	\$ -
Train Shed 275X40 Including Utilities	EA	\$	337,242	1	\$ 337,242	\$ - Eliminate train shed
<b>Sub-total Station/Maintenance Facilities (D)</b>					<b>\$ 2,679,142</b>	<b>\$ 2,341,900</b>

North-South Commuter Rail Line		Overnight Layover			
Howell Overnight Layover		GLC			
6/18/2015		Quandel Unit Costs (2014)		JJR/Quandel Cost Total-High Estimate	
		JJR/Quandel Cost Total-Low Estimate			
	Unit		Quantity		
#10 Turnout - Timber	EA	\$ 93,302	2	\$ 186,604	\$ 186,604
#8 Ballasted Turnouts in Yard	EA	\$ 70,519	7	\$ 493,633	\$ 493,633
Yard Track on New Roadbed	TFT	\$ 158	6349	\$ 1,003,142	\$ 1,003,142
Wheel Changer Cost	EA	\$ 400,000	1	\$ 400,000	\$ 400,000
10' Wide Access Roadway	CF	\$ 2	17307	\$ 38,422	\$ 38,422
24' Wide Access Roadway	CF	\$ 2	69545	\$ 154,389	\$ 154,389
General Construction	SF	\$ 31	27120	\$ 834,360	\$ 166,872
Sitework	SF	\$ 24	27120	\$ 657,848	\$ 657,848
Concrete Work	SF	\$ 45	27120	\$ 1,228,023	\$ 300,000
Masonry	SF	\$ 21	27120	\$ 570,223	\$ 114,045
Steel	SF	\$ 139	27120	\$ 3,759,761	\$ 751,952
Carpentry	SF	\$ 1	27120	\$ 23,570	\$ 4,714
Insulation, Roofing, Waterproofing	SF	\$ 22	27120	\$ 595,857	\$ 119,171
Doors, Windows, Openings	SF	\$ 22	27120	\$ 583,635	\$ 116,727
Painting & Coatings	SF	\$ 9	27120	\$ 241,586	\$ 48,317
Specialties	SF	\$ 4	27120	\$ 103,829	\$ 20,766
Equipment	SF	\$ 12	27120	\$ 336,766	\$ 67,353
Furniture & Accessories	SF	\$ 9	27120	\$ 246,136	\$ 49,227
Safety & Fire Protection	SF	\$ 9	27120	\$ 244,702	\$ 48,940
Conveying Equipment	SF	\$ 34	27120	\$ 922,266	
Plumbing & HVAC	SF	\$ 48	27120	\$ 1,303,671	\$ 260,734
Electrical	VEHICLE	\$ 82,456	25	\$ 2,061,401	\$ 1,649,121
Parking Lot - 3" asphalt on 8" gravel base, earthwork, drainage, lighting	EA	\$ 3,000	30	\$ 90,000	\$ 90,000
Security Fence + Gate - 12' fence w/graffiti wrap	LF	\$ 100	5165	\$ 516,500	\$ 516,500
<b>Total Segment Cost (E)+(F)</b>				<b>\$ 16,596,324</b>	<b>\$ 7,258,478</b>

## **APPENDIX II: DESIGN CRITERIA: FACILITIES**



# Appendix II: Design Criteria for Maintenance and Layover Facilities

## Operational Assumptions

North-South Commuter Rail trains will be stored overnight at the Howell Maintenance Facility. They will operate from Howell to Ann Arbor in the morning peak period. They will lay over at the Ann Arbor Layover facility during the day and return to Howell in the late afternoon peak period.

The commuter train fleet consists of five train sets, each with a locomotive, 3 gallery coaches and a gallery cab control car. Four train sets will be used in daily service while a fifth is in maintenance or available as an operational spare. Train sets will be rotated to equalize utilization and balance maintenance requirements. All trains will have the locomotive on the north end of the train facing north, then three gallery coaches, then a gallery cab control car on the south end of the train with the cab facing south. Trains will be operated from the cab control car in the southbound direction and from the locomotive in the northbound direction. Train will be operated in push-pull service with a crew of one locomotive engineer and one conductor.

Initially, commuter rail service will be operated during peak periods only on Monday through Friday with no weekend or holiday service anticipated. In later years, changing ridership demands may result in revisions to the service plan.

## Functional Requirements

The functional requirements of the Howell Maintenance & Storage Facility and the Ann Arbor Layover Facility are described below.

### Howell Maintenance & Storage Facility

The Howell Maintenance and Storage Facility is expected to be located south of the Howell commuter rail station between the E. Grand River Ave. grade crossing and the CSX Ann Pere Interlocking on the west side of the existing Great Lakes Central Railroad main track. The function of this facility is to provide light maintenance and repairs, daily inspection, servicing, locomotive fueling, cleaning, and overnight storage for each of the 5 trainsets. Certain periodic inspections, major component replacement, heavy maintenance and repairs and wheel truing will all be performed at an off-site location. The facility will be the primary reporting location for train crews and commuter rail equipment maintenance personnel.

### Ann Arbor Layover Facility

The Ann Arbor Layover Facility is expected to be located south of the Ann Arbor commuter rail station between the Hoover St. grade crossing and E. Stadium Blvd on the west side of the Ann Arbor Railroad main track. The function of this layover facility is to provide midday storage, exterior train washing, and interior cleaning of rail cars. An office/service building for employees will be located on site. The layover facility must accommodate the storage of 4 trainsets during the day after their arrival in Ann Arbor and before their evening departure to Howell.

## **Design and Construction Requirements**

### Track Design:

Storage tracks and yard leads shall be ballasted construction using 115 pound rail, 8'6" treated timber ties at 19" spacing, with 8 inches of hard rock ballast meeting AREMA specification for yard and shop track areas under the ties with additional ballast between the ties filled level to the top of the ties. The sub-ballast section must be constructed of approved material, at least 6 inches deep and meeting compaction requirements. Rail may be either new or used and may be either bolted or continuous welded rail. Rail must be inspected and tested for external and internal defects before installation. Track must be constructed to AREMA standards for yard and shop tracks and must, at a minimum meet Federal Railroad Administration Standards for Class 2 track.

Main track turnouts will be #10 turnouts. For both facilities, the north end turnout will be power-operated within a centralized traffic control point. A power-operated derail to protect the main track will also be included in each control point. The south end of the each facility will be a #10 hand-throw turnout equipped with an electric lock and a locked hand-throw derail. The south entrance to each facility is the alternate entrance for use in case the north or main entrance is not available for service.

Storage/shop track turnouts will be #8 hand-throw turnouts with switch stands capable of being locked to facilitate the use of blue signal protection for workers as required by the FRA. Hand-throw derails, also capable of being locked must be located at each end of each storage track designed to derail equipment moving toward the storage/shop track. These also are to facilitate the use of blue signal protection for workers.

Lead (or ladder) tracks connect the mainline to the storage tracks. Lead tracks should be level or sloped away from the main track with a maximum grade of 0.5 percent. Storage tracks used for commuter trains shall have a turnout on each end, enabling access to the main track from either end of the facility.

Tracks used for the storage of a spare locomotive, spare cab control car or locomotive fuel tank cars may be single-end or stub tracks with the turnout on the north end and with a bumping post on the south end. Storage tracks shall be tangent and level. The centerline to centerline spacing of storage tracks shall be at least 19 ft. in order to allow access between stored trains for maintenance and cleaning. Shop tracks are both inside and outside of shop buildings where inspection, maintenance, testing, repair, and servicing are performed. Shop tracks shall be constructed on timber ties embedded in concrete.

### Signal Design:

The north entrance to each facility shall be located within a new Centralized Traffic Control (CTC) control point operated by the railroad's train dispatcher. Access to the main track and use of the main track turnout is only permitted with the authority of the railroad's control operator (train dispatcher). All storage and shop tracks shall be located within a fenced area and all movements inside the secured area will be made under the direction of the designated shop or facility supervisor.

## **Howell Maintenance and Overnight Storage**

The Howell Maintenance and Overnight Storage Facility shall include an employee welfare building, a shop building, and train layover/storage tracks.

Additional Elements and Details:

- Fuel delivery site for access by fuel trucks with spill protection
- Locomotive fuel storage tank(s) with fuel pump and filter system and control valves, meters, etc.
- Fuel spill protection trays spotted at the locomotive resting points on the storage tracks and acceptable method of cleaning/disposal of waste material
- Toilet Dumping System- toilet servicing capability (either fixed plant or service truck)
- Sanding Station (fixed plant or bag sand)
- Electrical Substation including switchgear and distribution and to shop and train storage tracks
- 480 volts three phase 60 Hz ground-mounted head end power sources for train air HVAC, lighting and other train electrical systems
- 140 PSI Compressed air system with drier for shop locations and connections for trains on storage tracks
- Access roadway to buildings, parking areas and storage tracks (for waste dump and coach cleaning)
- Employee parking
- Parking lot striping and signage
- Employee walkway system- 10 ft. platforms between tracks. These platforms adjacent to servicing tracks allow access for golf cart type service vehicles and foot access for inspection and maintenance of brakes, doors, wheels, couplers, and interior train cleaning, etc.
- Adequate number of servicing tracks and track lengths for storage of 5 trainsets, each consisting of one locomotive, three coaches and one cab control car.
- Track drainage system connected to the storm sewer system
- Potable and non-potable water hydrants with antifreeze protection
- Lockable yard switches and/or derails for blue flag protection
- 24-hour illuminated path and safety lighting
- Yard PA system
- Security system with exterior fencing along the perimeter of the facility
- 2 track shop building for inspection pit, train inspection, light maintenance and repairs capable of accommodating two entire train sets inside shop building with doors on either end closed. Shop building also contains:
  - Inventory storage area inside (a storage room) for parts and materials. Storage facilities contain cleaning supplies, maintenance equipment, and replacement parts such as air hoses, air filters, light bulbs, etc.
  - Surface inspection and maintenance track
  - Transfer table and wheel set storage
  - Space for future wheel lathe for truing car wheel
  - Mechanical department offices and room for the maintenance and materials inventory records.
  - Transportation employee locker rooms, lockers, rest rooms, showers, lunch room.

- Mechanical employee locker rooms, lockers, rest rooms, showers, lunch room.
- Communications room/computer terminal area for transportation crews
- Training room
- Unloading dock for the storehouse area and room for a fork lift and other shop machinery
- Outside materials storage

## **Ann Arbor Midday Layover Facility**

The Ann Arbor Midday Layover Facility shall include an employee welfare building, maintenance equipment storage building, car wash, and storage/servicing tracks.

Additional elements and details:

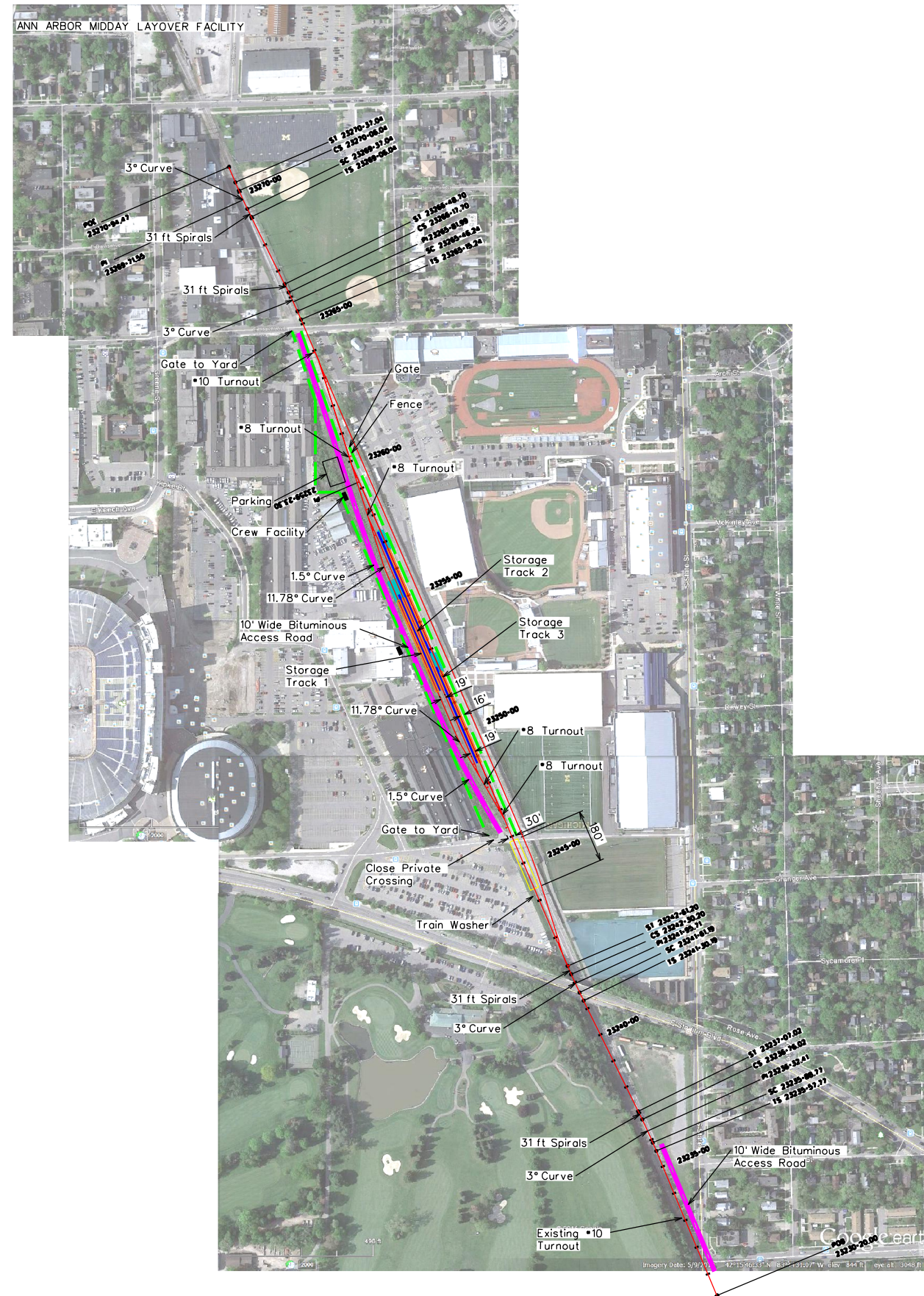
- Electrical Substation including switchgear and distribution to trains
- 480 volts three phase 60 Hz ground-mounted head end power sources for train air HVAC, lighting and other train electrical systems
- 140 PSI Compressed air system with drier and connections to trains on storage tracks
- Access roadways to buildings and parking for management personnel
- Parking lot striping and signage
- Employee walkway system- 8 ft. platforms between tracks. These platforms adjacent to servicing tracks allow access for golf cart type service vehicles and foot access for inspection and cleaning access.
- Adequate number of servicing tracks and track lengths for storage of 4 trainsets, each consisting of one locomotive, three coaches and one cab control car.
- Track drainage system connected to the storm sewer system
- Fuel spill protection trays spotted at the locomotive resting points on the track
- Potable and non-potable water hydrants with antifreeze protection
- Lockable yard switches and/or derails for blue flag protection
- 24-hour illuminated path and safety lighting
- Crew Facility that contains:
  - Inventory storage area inside (a storage room) for parts and materials. Storage facilities contain cleaning supplies, maintenance equipment, and replacement parts such as air hoses, air filters, light bulbs, etc.
  - Mechanical department offices and room for the maintenance and materials inventory records.
  - Mechanical employee locker rooms, lockers, rest rooms, showers, lunch room.
  - Transportation employee locker rooms, lockers, rest rooms, showers, lunch room.
  - Communications room/computer terminal area for transportation crews
  - Training room
- Train Washer Building (pull-through building to wash train sets on arrival)

Security system with exterior fencing and two access gates along the perimeter of the facility

# **APPENDIX III: MAINTENANCE AND LAYOVER FACILITY DESIGN PLANS**

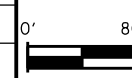
NOTES:

- 1) 4 trainsets fit in yard:  
1 Trainset on Storage Track 1,  
1 Trainset on Storage Track 2,  
2 Trainsets on Storage Track 3
- 2) \*10 Turnout Leads into Yard from North  
(Distance from POS to POF= 77.4')
- 3) \*8 Turnouts in yard  
(Distance from POS to POF=68')
- 4) Total Acreage Required= 3.8 Acres
- 5) Quantities of Track Elements:  
-1 No. 10 Turnouts Leading into Yard from north end  
-4 No. 8 Turnouts in Yard  
-600' Storage Track 1  
-850' Storage Track 2  
-1195' Storage Track 3  
-Total New Track including S curvature= 5648'



REV	DATE	BY	APP.	DESCRIPTION

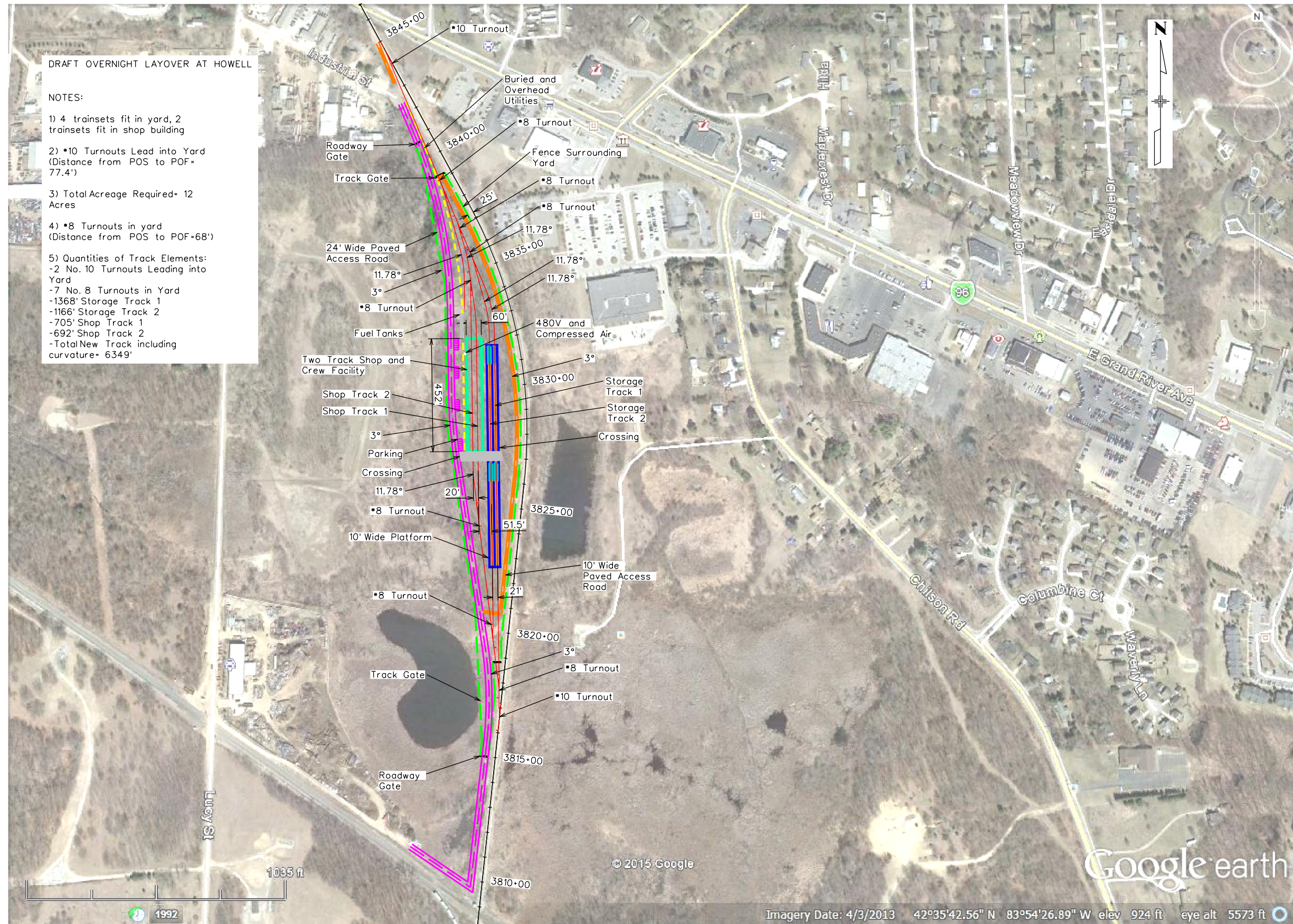
DESIGNED: KRM  
 DRAWN: KRM  
 CHECKED: WRM  
 APPROVED: WRM  
 DATE: 06/12/2015



Existing Track	Proposed 9' Platform
Proposed New Track	Proposed Locomotive
Proposed Fence	Proposed Coach
Proposed 10' Access Road	Proposed Trainwasher

## NORTH-SOUTH COMMUTER RAIL, MIDDAY LAYOVER FACILITY AT STADIUM

PROJECT ID Quandel1404
DRAWING NO.
SCALE:
SHEET NO.



**DRAFT OVERNIGHT LAYOVER AT HOWELL**

**NOTES:**

- 1) 4 trainsets fit in yard, 2 trainsets fit in shop building
- 2) \*10 Turnouts Lead into Yard (Distance from POS to POF= 77.4')
- 3) Total Acreage Required- 12 Acres
- 4) \*8 Turnouts in yard (Distance from POS to POF=68')
- 5) Quantities of Track Elements:  
 -2 No. 10 Turnouts Leading into Yard  
 -7 No. 8 Turnouts in Yard  
 -1368' Storage Track 1  
 -1166' Storage Track 2  
 -705' Shop Track 1  
 -692' Shop Track 2  
 -Total New Track including curvature= 6349'



REV	DATE	BY	APP.	DESCRIPTION

DESIGNED: KRM  
 DRAWN: KRM  
 CHECKED: WRM  
 APPROVED: WRM  
 DATE: 06/03/2015



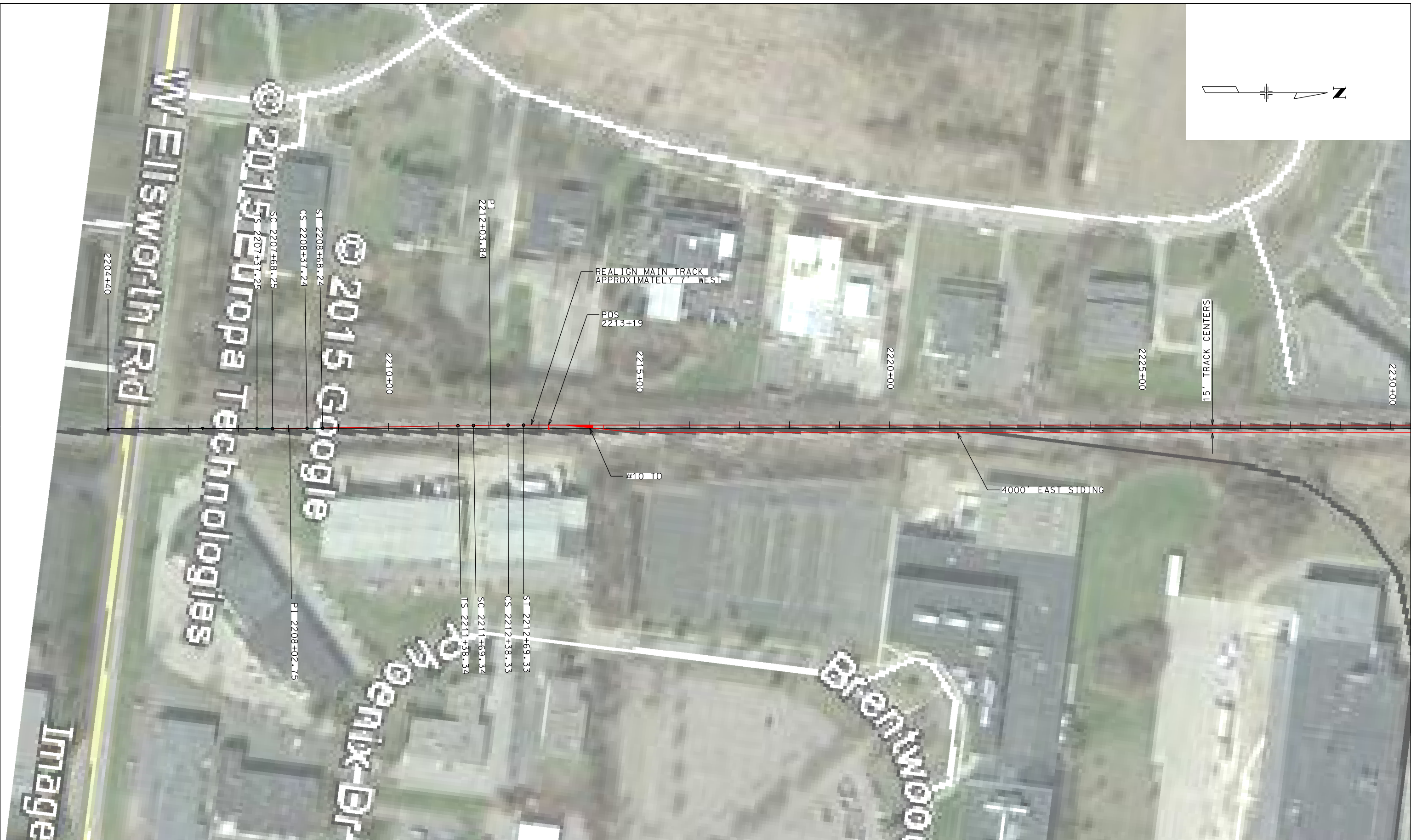
- Existing Track
- Proposed New Track
- Fence Line
- Utilities
- Proposed 24' Access Road
- Proposed 9' Platform
- Proposed Locomotive
- Proposed Coach
- Proposed Shop Building
- Proposed 10' Access Road

## NORTH-SOUTH COMMUTER RAIL, OVERNIGHT MAINTENANCE AND STORAGE FACILITY AT HOWELL

PROJECT ID: Ouandel1404  
 DRAWING NO.:  
 SCALE:  
 SHEET NO.:

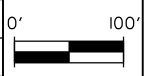
## **APPENDIX IV: ELLSWORTH INTERCHANGE PLANS**





REV	DATE	BY	APP.	DESCRIPTION

DESIGNED: KRM  
 DRAWN: KRM  
 CHECKED: WRM  
 APPROVED: WRM  
 DATE: 06/16/2015



Existing Track  
 Proposed New Track

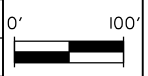
### NORTH-SOUTH COMMUTER RAIL, ELLSWORTH INTERCHANGE

PROJECT ID: Quandel1404  
 DRAWING NO.:  
 SCALE:  
 SHEET NO. 1 OF 5



REV	DATE	BY	APP.	DESCRIPTION

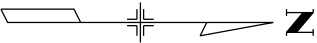
DESIGNED: KRM  
 DRAWN: KRM  
 CHECKED: WRM  
 APPROVED: WRM  
 DATE: 06/16/2015



Existing Track  
 Proposed New Track

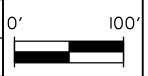
**NORTH-SOUTH COMMUTER RAIL,  
 ELLSWORTH INTERCHANGE**

PROJECT ID: Quandel1404  
 DRAWING NO.:  
 SCALE:  
 SHEET NO. 2 OF 5



REV	DATE	BY	APP.	DESCRIPTION

DESIGNED: KRM  
 DRAWN: KRM  
 CHECKED: WRM  
 APPROVED: WRM  
 DATE: 06/16/2015



— Existing Track  
 — Proposed New Track

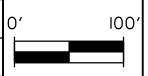
**NORTH-SOUTH COMMUTER RAIL,  
ELLSWORTH INTERCHANGE**

PROJECT ID: Quandel1404  
 DRAWING NO.:  
 SCALE:  
 SHEET NO. 3 OF 5



REV	DATE	BY	APP.	DESCRIPTION

DESIGNED: KRM  
 DRAWN: KRM  
 CHECKED: WRM  
 APPROVED: WRM  
 DATE: 06/16/2015



Existing Track  
 Proposed New Track

### NORTH-SOUTH COMMUTER RAIL, ELLSWORTH INTERCHANGE

PROJECT ID: Quandel1404  
 DRAWING NO.:  
 SCALE:  
 SHEET NO. 4 OF 5



REV	DATE	BY	APP.	DESCRIPTION

DESIGNED: KRM  
 DRAWN: KRM  
 CHECKED: WRM  
 APPROVED: WRM  
 DATE: 06/16/2015



Existing Track  
 Proposed New Track

**NORTH-SOUTH COMMUTER RAIL,  
 ELLSWORTH INTERCHANGE**

PROJECT ID: Quandel1404  
 DRAWING NO.:  
 SCALE:  
 SHEET NO. 5 OF 5

# **APPENDIX V: PROJECT TIMELINE: OPTION 1: FULL SERVICE**







