TASK 08

SERVICE PLANS FOR EVALUATION TECHNICAL MEMO

PREPARED BY: QUANDEL CONSULTANTS, LLC

NOVEMBER 4, 2016

TheRide MDOT Michigan Department of Transportation

SMITHGROUP JJR AECOM . BERGMANN ASSOCIATES . QUANDEL CONSULTANTS

NORTH SOUTH COMMUTER RAIL

North South Commuter Rail
Feasibility Study

Task 8: Service Plans for Evaluation
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 work scope as defined in the contract documents:

> *Task 8 – Draft Service Plans for Evaluation*
>
> *At least four service plans should be created for evaluation. For each service plan concept, provide estimates of basic annual operating costs and revenues. If any phase of a service plan would qualify as a "demonstration" project or "proof-of-concept" trial operation, that phase should be identified accordingly. Preliminary Service Plan Options include:*
>
> *a. "Minimum Operation Configuration" – this alternative represents a minimum level of service for a single train shuttling between a northern terminal at 8 Mile/US-23 and a southern terminal at Barton/Plymouth. The minimum operating configuration is more fully described In Appendices*
>
> *b. Howell – Ann Arbor (North): Service runs from Howell to Barton/Plymouth Road on the north side of Ann Arbor*
>
> *c. Howell - Ann Arbor (Downtown): Service runs from Howell to Barton/Plymouth Road and then onward to downtown Ann Arbor and possible UM Athletic Campus (Stadium) location(s). (Options A, B and C would be limited service options, that is, weekday service only, with trains operating during peak hours.)*
>
> *d. "Full Service Option" – This service plan would provide all day service and include Saturday and Sunday trains*

Service plans for rail shall pay explicit and detailed attention to how passenger fares are to be collected, with particular attention to methods that do not involve on-board personnel. The assessment shall include commentary on the enforceability of 'proof-of-payment' systems using citations and fines as an enforcement mechanism, paying particular attention to MI laws that may or may not allow such mechanisms, and to the practices of similar operations elsewhere in the US.

As needed, the consultant should perform capacity analyses of service plans. These analyses must take into account existing and reasonably foreseeable freight operations. The capacity analyses should be performed using string-line diagrams as opposed to computer simulations, unless the use of simulations is approved in advance by the client.

The project team will develop draft service plans as described above. The consultant shall perform a field inspection of the corridor and prepare an inspection report. The draft service plan shall include schedules, track schematics depicting existing conditions and proposed improvements, including station locations, layover facilities, signal modifications and track improvements for each alternative.

Deliverable(s):
1. *Submit draft Service Plans for Evaluation.*
2. *Review meeting, refine and resubmit Service Plans.*

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 and four trips to Whitmore Lake in the PM*
- *Prepare service plan including description of service, TPC, stringline, schedule, track schematic and fare revenue estimate. Update Technical Memo for Task 8 Service Plans*

2. DESCRIPTION OF SERVICE PLAN OPTIONS

2.1 Service Limits and Railroad Ownership

The North-South (N-S) commuter rail service is proposed to operate over an approximatly 27-mile route between Howell and Ann Arbor, Michigan. Most of the route is owned by 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. 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 30.1 miles.

2.2 Service Plan Options

Five service options have been developed and approved by AAATA and MDOT staff. Each is described briefly as follows:

Option 1: Full Service Option

- 6 stations: Howell, Genoa Township, Hamburg, Whitmore Lake, Barton Dr. and Downtown Ann Arbor
- Four train sets to Ann Arbor in the AM; four trains sets return to Howell in the PM
- Weekday operation only
- 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
- Weekday operation only
- 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
- Weekday operation only
- 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
- Weekday operation only
- 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
- Weekday operation only
- 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

2.3 Service Plan Development Methodology

The project team staff, including representatives of SmithGroupJJR, MDOT, Great Lakes Central Railroad, Ann Arbor Railroad and Quandel Consultants inspected the railroad between Morgan Rd in Ann Arbor MP 40.7 and Armond Rd MP 75.86 in Howell.

- February 25, 2015 Station Site Inspection
- March 16, 2015 Great Lakes Central Property Inspection
- May 11, 2015 Ann Arbor Railroad Property Inspection
- June 5, 2015 Facility Site Alternatives inspection

The inspection reports are provided as a separate file.

Following the inspections, Quandel Consultants evaluated the track geometry to define feasible track speeds based on track curvature, superelevation, permissible unbalance and spiral length in accord with American Railway Engineering and Maintenance of Way Association (AREMA) recommended practice. (In some cases, the existing superelevation must be reduced to meet AREMA spiral lengths to avoid costly track realignment.) Quandel Consultants employed Berkley Simulation Software's Rail Traffic Controller (RTC) program to establish travel times, schedules and stringline graphs for each of the Service Options. The schedules were also provided to AECOM, the project ridership consultant, to develop estimates of ridership for each option.

Based on the service plan requirements, Quandel developed capital cost estimates for each option, addressing trackwork, signal, grade crossing warning systems, right of way, stations and parking, vehicles, maintenance and layover facilities, special elements, contingency and professional services. Specific improvements were illustrated in track schematics depicting existing and proposed conditions. Annual operating and maintenance costs were developed using a detailed methodology considering transportation department, equipment maintenance, infrastructure maintenance and administration.

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. Capital cost estimates for each option are presented in the Task 10 Technical Memo, while operating and maintenance costs are presented in the Task 11 Technical Memo.

3. SERVICE PLAN PARAMETERS

3.1 Option 1: Full Service Option

The full service option serving six stations in the corridor is anticipated to incur a capital cost of $122.3 million and an annual operating expense of $13.2 million (2015 dollars). The nominal travel time between terminal stations is 51 minutes. Excluding the costs of connecting bus service, the annual operating cost per revenue train mile is $207. Travel time computations, curve parameters, schedules, stringlines and track schematics are presented in Appendix I.

Five new connecting bus routes were introduced to connect the North-South Barton Drive Station to the surrounding Ann Arbor area (Options 1, 4, 5A and 5B). The connecting bus services are based on bus service specifications provided by AAATA. Connector buses are modeled to depart from Barton Drive Station four minutes after the arrival of a North-South train. Descriptions of the added bus routes, including the bus stops along the routes, are documented in the table below.

North-South Bus Connectors at Barton Drive Station (Options 1, 4, 5A and 5B)

Route	Route Description & Route Bus Stops
Route 1	**Plymouth to Maiden Lane, to E. Medical Center Dr. to Observatory to Ann to Zina Pitcher Place, to Catherine to Glen**
STOPS	· E. Medical Center Dr. @ Taubman · E. Medical Center Dr. @ CMHC · Ann @ Simpson Memorial Institute · Zina Pitcher @ Ann (Kresge)
Route 2	**Plymouth to Broadway to Beakes, to Fifth Ave. to Huron to Fletcher to N. University**
STOPS	· Fifth Ave. @ Detroit (Kerrytown) · Huron @ Fifth (downtown) · Huron @ State · Fletcher @ Washington (Rackham) · CC Little Bldg (main UM bus stop)
Route 3	**Plymouth to Broadway to Beakes to Fifth Ave. to William to State**
STOPS	· Broadway @ Swift (Lowertown) · Fifth Ave. @ Ann (City Hall) · Fifth Ave. @ William (Blake Transit Center) · William @ Thompson · State @ North University (Diag)
Route 4	· **Plymouth to Maiden Lane to Fuller to Glen to Huron to Fletcher to North University**
STOPS	· Maiden Lane @ Nielsen Ct. · Glen @ Catherine · Fletcher @ Washington (Rackham) · CC Little Bldg (main UM bus stop)
Route 5	**Plymouth to Murfin to Bonisteel to Beal to VA to Beal to Hayward, to** · **Hubbard to Huron Pkwy (assumes bus can go eastbound on Plymouth from station stop**
STOPS	· Murfin @ Hayward · Bonisteel @ Murfin · Bonisteel @ Beal · VA Medical Center · Beal @ Hayward

Source: AAATA

3.2 Option 2: Full Service without Barton Drive Station

An alternative service option serving five stations in the corridor (eliminating the Barton Drive station) is anticipated to incur a capital cost of $121.0 million and an annual operating expense of $13.1 million (2015 dollars). The nominal travel time between terminal stations is 48 minutes. Excluding the costs of connecting bus service, the annual operating cost per revenue train mile is $206. Travel time computations, curve parameters, schedules and stringlines are presented in Appendix II. As the track schematic is virtually identical to that of Option 1 (without the Barton Drive station), track schematics are not provided. Instead of connecting bus service at Barton Drive Station (as in Options 1, 4, 5A and 5B), new connecting bus service at Ann Arbor Station, provided by AAATA, was added. These routes connect Ann Arbor Station to the UM Central Campus, UM Medical Center, and UM North Campus. This connecting bus service shown in the following table is also applicable for the "Starter" service (Option 3), described in the next section.

North-South Bus Connectors at Ann Arbor Station (Options 2 and 3)

Route	Route Description & Route Bus Stops
Route UMMC1	**Ann Arbor Station to U-M Central Campus & Medical Center Route**
	· First & Liberty (Downtown Rail Station) · Blake Transit Center · Central Campus Transit · Center Mott Hospital · Taubman Center · Cancer Center
Route UMMC2	**Ann Arbor Station to U-M Medical Center & Central Campus Route**
	· First & Liberty (Downtown Rail Station) · Huron & Fourth Ave · Cancer Center · Taubman Center · Mott Hospital · Central Campus Transit Center
Route UM North	**Ann Arbor Station to U-M North Campus Route**
	· First & Liberty (Downtown Rail Station) · Pierpoint Commons · First & Liberty (Downtown Rail Station)

Source: AAATA

3.3 Option 3: Starter Service with Howell-Whitmore Lake-Ann Arbor Stations

An alternative service option serving just three stations in the corridor, is anticipated to incur a capital cost of $118.4 million and an annual operating expense of $12.9 million (2015 dollars). The nominal travel time between terminal stations is 44 minutes. Excluding the costs of connecting bus service, the annual operating cost per revenue train mile is $203. Travel time computations, curve parameters, schedules and stringlines are presented in Appendix III. As the track schematic is virtually identical to that of Option 1 (without the Genoa, Hamburg and Barton Drive stations), track schematics are not provided.

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

An alternative service option, intended as a low initial cost startup system, serving just two stations (Whitmore Lake and Barton Drive) and operating in a shuttle mode, is anticipated to incur a capital cost of $28.94 million and an annual operating expense of $5.8 million (2015 dollars). The nominal travel time between terminal stations is 18 minutes. Excluding the costs of connecting bus service, the annual operating cost per revenue train mile is $133. Schedules, travel time computations and track schematics are presented in Appendix IV.

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

Anticipating that the FRA may grant either an Exemption or Waiver of the current regulations requiring Positive Train Control (PTC), an alternative MOC service option has been developed. As the FRA standard exemption is limited to a maximum of 12 trains per day, the schedule must be modified slightly to eliminate one round trip. This option would employ a conventional Centralized Traffic Control (CTC) system without the PTC functionality. In all other respects, it is identical to Option 4A and is expected to incur a capital cost of $21.9 million and an annual operating expense of $5.7 million (2015 dollars). The nominal travel time between terminal stations remains 18 minutes. Excluding the costs of connecting bus service, the annual operating cost per revenue train mile is $152. Due to its similarity to Option 4A, schedules, travel time computations and track schematics are not provided.

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

This initial service option serving three stations in the corridor is anticipated to incur a capital cost of $61.3 million and an annual operating expense of $6.6 million (2015 dollars). The nominal travel time between terminal stations is 21 minutes. Excluding the costs of connecting bus service, the annual operating cost per revenue train mile is $133. Travel time computations, schedules, stringlines and track schematics are presented in Appendix V.

Capital and operating costs have been developed assuming that the system will employ a modern signal system with wayside signals and Centralized Traffic Control (CTC) to provide remote operation of switches and derails, along with a Positive Train Control (PTC) system, which provides additional safety features. The FRA requires that new passenger rail systems employ PTC unless granted a waiver or an exclusion. A possibility exists that the FRA would allow the service to operate without PTC which would provide a significant capital cost savings and a modest operating cost savings.

Schedules, travel time computations and track schematics are presented in Appendix V.

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

This initial service option serving three stations in the corridor is anticipated to incur a capital cost of $65.2 million and an annual operating expense of $7.0 million (2015 dollars). The nominal travel time between terminal stations is 21 minutes in the peak direction and 26 minutes in the off peak direction. (The off peak direction train must take the siding at Osmer and wait briefly to allow the peak direction train to proceed unimpeded.) Excluding the costs of connecting bus service, the annual operating cost per revenue train mile is $165. Travel time computations, schedules, stringlines and track schematics are presented in Appendix VI.

As is the case with Option 5A, capital and operating costs have been developed assuming that the system will employ a modern signal system with wayside signals and Centralized Traffic Control (CTC) to provide remote operation of switches and derails, along with a Positive Train Control (PTC) system, which provides additional safety features. The Federal Railroad Administration (FRA) requires that new passenger rail systems employ PTC unless granted a waiver or an exclusion. A possibility exists that the FRA would allow the service to operate without PTC which would provide a significant capital cost savings and a modest operating cost savings.

Schedules and travel time computations and track schematics are presented in Appendix VI. The track schematic presented for Appendix 5A applies. Notes in the schematic identify the differences.

4. REVENUE ESTIMATES

Quandel Consultants developed an estimate of annual revenues for each option, employing daily ridership estimates prepared by AECOM (Task 6). The data is annualized employing a 262 day period. As AECOM did not provide station to station volumes for each option, Quandel employed a number of simplifying assumptions to define rational revenue values. Ridership and revenue values for each option are as follows:

- Option 1: 1840 trips per day, 482,000 annual trips, $1.148 M annual revenue
- Option 2: 1076 trips per day, 282,000 annual trips, $.610 M annual revenue
- Option 3: 1058 trips per day, 277,000 annual trips, $.580 M annual revenue
- Option 4: 748 trips per day, 196,000 annual trips, $.385 M annual revenue
- Option 5A: 1350 trips per day, 353,000 annual trips, $.669 M annual revenue
- Option 5B: 1676 trips per day, 439,000 annual trips, $.811 M annual revenue

The computations and assumptions for the revenue estimates are presented in Appendix V.

5. FARE COLLECTION TECHNOLOGY

The original scope of work identifies “Proof of Payment” fare collection technology as a possible strategy for the AAATA or the commuter rail operator to employ for the new commuter rail system. Proof of payment technologies have been used throughout the United States, primarily for light rail transit, DMU type commuter rail systems and bus rapid transit systems. Such systems generally employ street level platform boarding areas which are not conducive to establishing paid areas with turnstiles or gates to prevent access by un-ticketed passengers. The proof of payment strategy requires passengers to buy a ticket in advance and validate it shortly before riding the system. In order to minimize costs, the transit agencies generally perform random, rather than regular fare inspections. Platform mounted vending and validating machines are required for dispensing and validating the tickets. The cost of procuring and installing the machines and ongoing servicing and maintenance can be relatively large compared to the revenue obtained.

Recently, The Rapid (transit agency in Grand Rapids, MI), implemented a proof of payment system on its new Silver Line BRT system. The agency takes fare evasion seriously and imposes significant fines of $65.00 to $250.00 on offenders. The implementation of this policy makes moot any concerns that the North-South project sponsors may have regarding the enforceability of fare evasion fines in Michigan.

Most conventional commuter rail systems operating locomotive hauled coaches require that passengers purchase fares in advance at station ticket windows or on-line, and display monthly passes, multiple ride or single ride tickets for inspection by the conductor walking through the train. As a conductor is always aboard the train to ensure the safety of passengers while boarding and in the event of emergencies, no significant labor savings is likely to be obtained by employing the proof of payment technology.

In recent years, transit agencies have been implementing new fare collection technologies that employ smart phone and internet technologies to minimize the costs of hardware, enable fare integration across multiple modes, minimize fare evasion and eliminate the costs of obsolescence due to rapidly evolving communications technologies. Metra and CTA in Chicago have recently adopted a cellular telephone and magnetic stripe based fare collection technology that shows great promise for use in regional fare collection applications. Quandel Consultants recommends that AAATA monitor the Chicago rollout and consider adopting a similar technology, rather than investing in the infrastructure required by a proof of payment fare collection system. The Metra cellular application requires the rider to activate a stored ticket on his cell phone for inspection by the conductor. In just a 3-month period, Metra has observed rapid adoption of the technology by the riding public.

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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

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

Phone:

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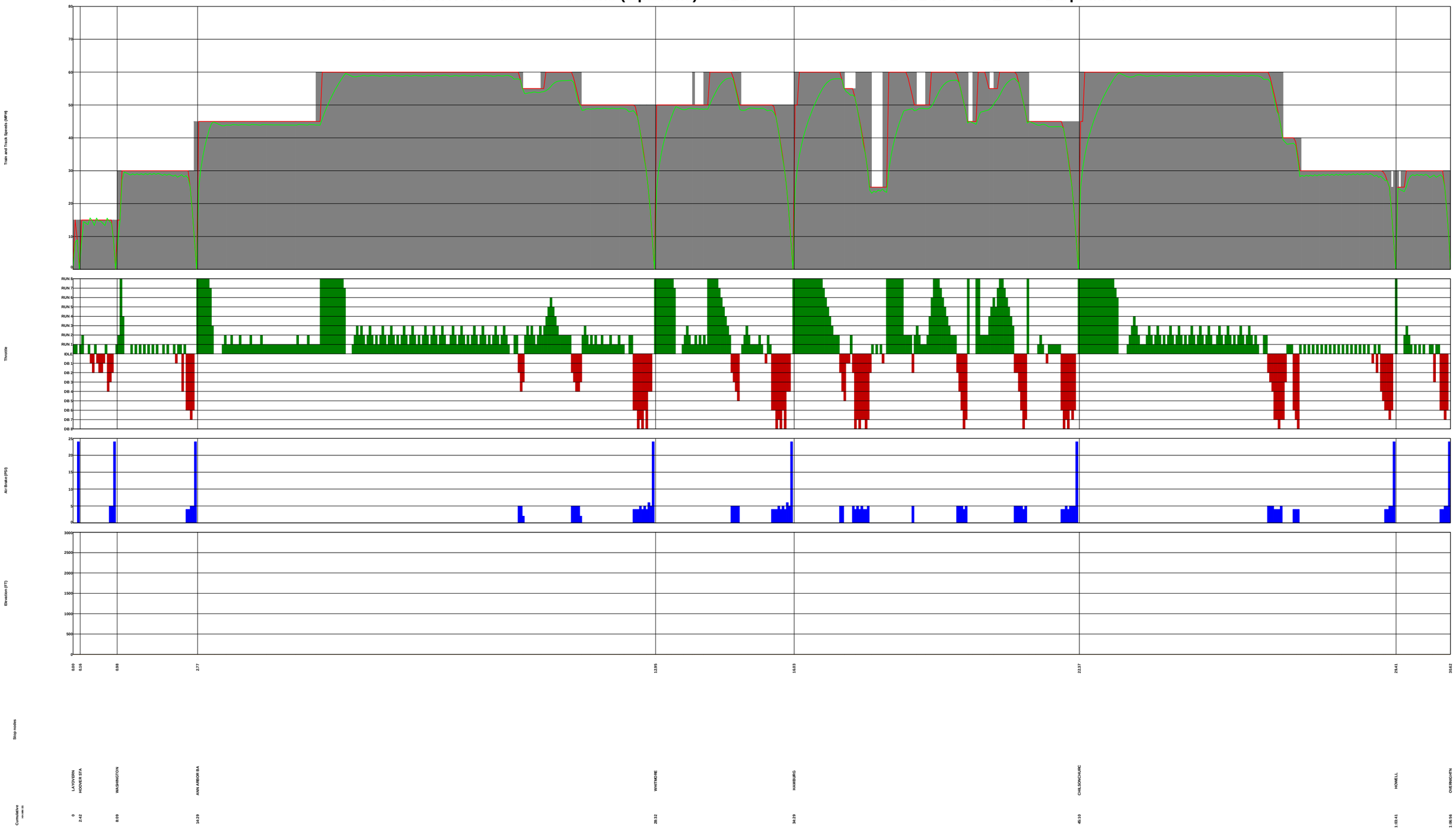
APPENDIX I: OPTION 1 FULL SERVICE OPTION: SERVICE PLAN PARAMETERS

Prepared by Quandel Consultants, LLC for SmithGroupJJR, Inc.
October 14, 2016

North-South Commuter Rail

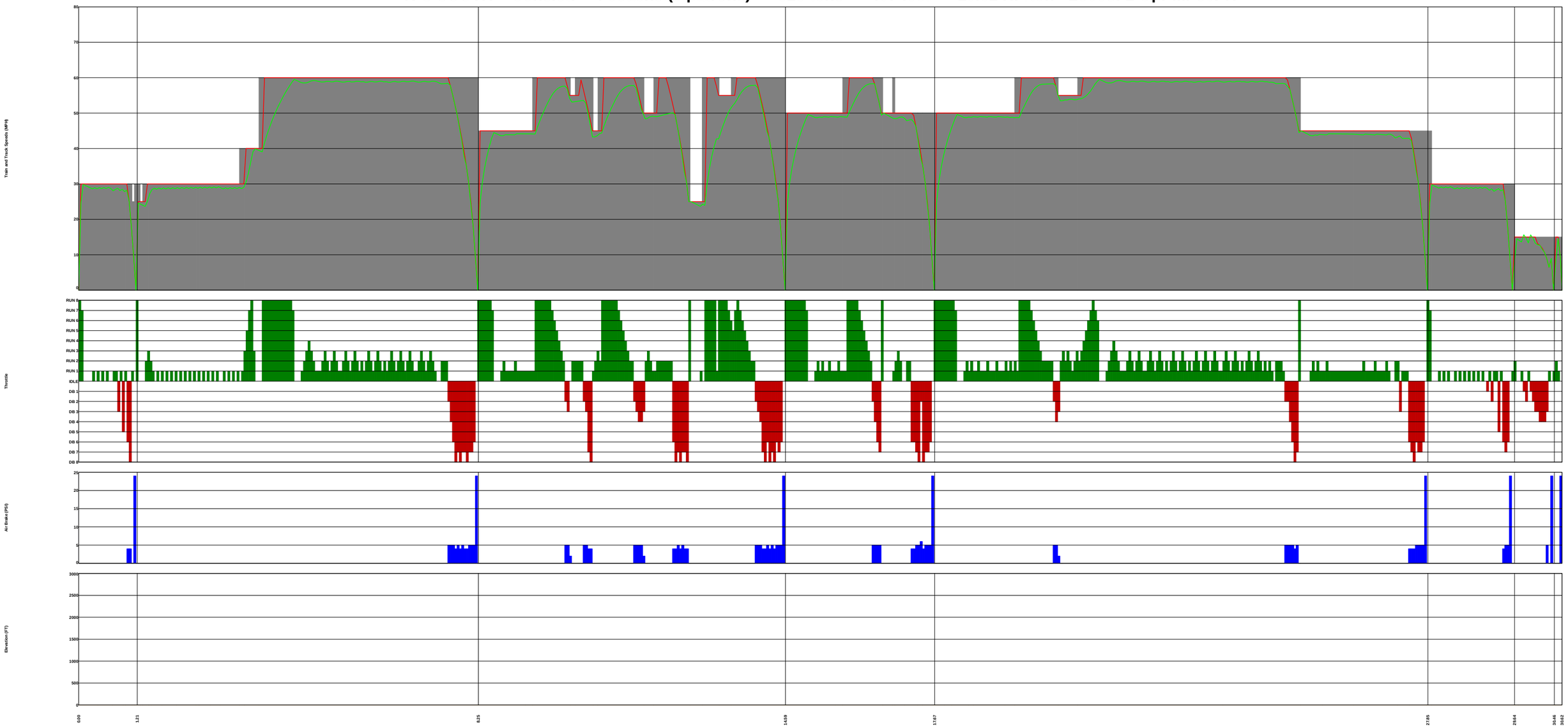
N-S NORTH Consist: 4 coachs (0 patrons) 323 tons 407 feet 10.61 HP/ton Locos: 1 Opr MP36PH



Case: NorthSouthDegraded RTC run: 17 August 2015 10:00:18 User: Siddhartha Kotikalapudi of Quandel Consultants, LLC

North-South Commuter Rail

N-S SOUTH Consist: 4 coachs (0 patrons) 323 tons 407 feet 10.61 HP/ton Locos: 1 Opr MP36PH



Stop nodes

Cumulative mm:ss

OVERINGHTN	HOWELL	CHELSONCHURC	HAMBURG	WHITMORE	ANN ARBOR BA	WASHINGTON	HOOVER STA
0	10:51	23:07	33:45	39:46	53:51	59:26	1:05:25
							LAYOVERN
							1:06:47

Case: NorthSouthDegraded RTC run: 17 August 2015 10:01:49 User: Siddhartha Kotikalapudi of Quandel Consultants, LLC

Quandel Consultants, LLC
17-Aug-15

North-South Commuter Rail
Degraded Curve and Speed Analysis

Curve	Existing Conditions									Proposed Conditions						
	Milepost		Degree of Curve				Radius (ft.)	Superelevation E(a)	Spiral Length Ls (ft.)	Design Speed Limits		New Superelevation $E(a)_{new}$	Unbalance E(u)	Unbalance E(u)	Spiral Length due to Lateral Acceleration Ls (min) (ft.)	Spiral Length due to Roll Ls (min) (ft.)
	Start MP	End MP	D	M	S	Degree in Decimal				Passenger	Freight	Proposed	Passenger	Freight		
Ann Arbor																
AA-1	44.70	44.75	1	12	0	1.20	4774.74			15	10	0.50	-0.31	-0.42	-6	31
AA-2	45.10	45.15	1	10	0	1.17	4911.15			15	10	0.50	-0.32	-0.42	-6	31
AA-3	45.40	45.60	3	0	0	3.00	1910.08			30	30	0.50	1.39	1.39	51	31
AA-4	45.70	46.00	1	30	0	1.50	3819.83			30	30	0.50	0.45	0.45	17	31
AA-5	46.20	46.40	4	0	0	4.89	1172.05			30	30	0.50	2.58	-0.16	-6	31
AA-6	46.45	46.55	2	15	0	2.25	2546.64			30	30	0.50	0.92	0.92	34	31
AA-7	46.56	46.75	5	0	0	5.00	1146.28			30	30	0.50	2.65	2.65	97	31
Great Lakes Central																
1	47.30	47.65	1	0	0	1.00	5729.65	1.00	73.00	45	40	1.00	0.42	0.12	23.0	62
2	47.90	48.80	1	30	0	1.50	3819.83	1.00	73.00	45	40	1.00	1.13	0.68	62.0	62
3	49.45	49.90	1	30	0	1.50	3819.83	1.00	73.00	45	40	1.00	1.13	0.68	62.0	62
4	54.50	54.90	2	30	0	2.50	2292.01	3.25	216.00	55	40	3.25	2.04	-0.45	138.0	201.5
5	55.80	56.00	3	10	0	3.17	1809.57	4.75	216.00	50	40	3.25	2.29	0.30	140.0	201.5
6	56.65	56.75	3	10	0	3.17	1809.57	4.75	216.00	50	40	3.25	2.29	0.30	140.0	201.5
7	57.10	57.25	2	5	0	2.08	2750.35	2.50	216.00	50	40	2.50	1.15	-0.17	70.0	155
8	57.70	57.80	3	0	0	3.00	1910.08	3.75	205.00	50	40	3.25	2.00	0.11	122.0	201.5
9	58.07	58.27	3	0	0	3.00	1910.08	4.50	216.00	50	40	3.25	2.00	0.11	122.0	201.5
10	58.32	58.52	3	0	0	3.00	1910.08	4.50	216.00	50	40	3.25	2.00	0.11	122.0	201.5
11	59.35	59.50	3	0	0	3.00	1910.08	4.50	216.00	50	40	3.25	2.00	0.11	122.0	201.5
12	60.70	60.90	1	0	0	1.00	5729.65	1.00	216.00	60	40	1.00	1.52	0.12	112.0	62
13	61.65	61.90	2	30	0	2.50	2292.01	3.25	216.00	55	40	3.25	2.04	-0.45	138.0	201.5
14	62.25	62.50	6	0	0	6.00	955.37	2.75	91.00	25	25	1.25	1.38	1.38	42.0	77.5
15	63.25	63.45	3	0	0	3.00	1910.08	4.50	216.00	50	40	3.25	2.00	0.11	122.0	201.5
16	63.60	64.05	2	20	0	2.33	2455.70	4.00	216.00	60	40	3.25	2.63	-0.64	193.0	201.5
17	64.40	64.50	3	50	0	3.83	1494.95	4.25	187.00	45	40	3.25	2.18	1.04	120.0	201.5
18	64.87	64.97	2	56	0	2.93	1953.48	4.25	216.00	55	40	3.25	2.96	0.04	199.0	201.5
19	65.35	65.40	2	14	0	2.23	2565.65	2.50	216.00	60	40	2.75	2.88	-0.25	211.0	170.5
20	65.75	65.90	4	0	0	4.00	1432.69	4.50	187.00	45	40	3.00	2.67	1.48	147.0	186
21	66.25	66.35	2	0	0	2.00	2864.93	2.25	216.00	45	40	2.25	0.59	-0.01	33.0	139.5
22	66.60	66.70	1	55	0	1.92	2989.48	2.00	216.00	45	40	2.00	0.72	0.15	40.0	124
23	67.20	67.55	2	0	0	2.00	2864.93	2.25	216.00	60	40	2.25	2.79	-0.01	205.0	139.5
24	67.88	68.43	1	12	0	1.20	4774.74	1.50	216.00	60	40	1.50	1.52	-0.16	112.0	93
25	71.40	71.70	2	0	0	2.00	2864.93	0.75	73.00	40	40	0.75	1.49	1.49	73.0	46.5
26	72.40	72.65	3	0	0	3.00	1910.08	1.00	73.00	30	35	1.00	0.89	1.57	33.0	62
27	73.10	73.40	3	0	0	3.00	1910.08	1.00	73.00	30	20	1.00	0.89	-0.16	33.0	62
28	73.62	73.67	3	47	0	3.78	1514.70	1.00	73.00	30	20	1.00	1.38	0.06	51.0	62
29	73.80	73.85	6	15	0	6.25	917.19	1.75	73.00	25	20	1.00	1.73	0.75	53.0	62

NOTES

1. Eu max is 3.0 in for Budd Bilevel Coaches

2. Max speed set at 60 mph

3. New Spiral Length= Existing Spiral Length

4. Existing AARR curve, superelevation, and spiral lengths are unknown. We assume that spirals and superelevation can be adjusted to meet proposed conditions as part of the proposed surfacing work

KEY

Minor adjustments to curve, superelevation, and spiral lengths required

Large adjustments to curve, superelevation, and spiral lengths required

8/17/2015

North-South Commuter Rail
Degraded Curve and Speed Analysis

NORTHBOUND-DEGRADED SPEED

Station	*Milepost*	*Dwell (hr:min:s)*	*Cummulative Time*	*Time Between Stations*	*Time Between Stations with Pad*
AA Midday Layover	44.40	0:00:00	0:00:00	0:00:00	0:00:00
Hoover Station	44.66	0:01:30	0:02:42	0:02:42	0:02:53
Ann Arbor Washington	45.48	0:01:30	0:08:09	0:05:27	0:05:50
Ann Arbor Barton	47.27	0:01:30	0:14:29	0:06:20	0:06:47
Whitmore Station Site	57.45	0:01:30	0:28:32	0:14:03	0:15:02
Hamburg-Merrill Road	60.53	0:01:30	0:34:29	0:05:57	0:06:22
Genoa-Chilson Hills Church	66.87	0:01:30	0:45:10	0:10:41	0:11:26
Howell	73.91	0:08:00	1:03:41	0:18:31	0:19:49
Overnight Layover	72.7	0:00:00	1:06:56	0:03:15	0:03:29
				Total Time	1:11:37

PROPOSED TRAINSET 1

Northbound (PM)

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:sec)*	*Departure Time (hr:min:sec)*
AA Midday Layover	44.4		0:00:00	16:21:17
Hoover Station	44.66	16:22:40	0:01:30	16:24:10
Ann Arbor Washington	45.48	16:28:30	0:01:30	16:30:00
Ann Arbor Barton	47.27	16:35:17	0:01:30	16:36:47
Whitmore Station Site	57.45	16:50:19	0:01:30	16:51:49
Hamburg-Merrill Road	60.53	16:56:41	0:01:30	16:58:11
Genoa-Chilson Hills Church	66.87	17:08:06	0:01:30	17:09:36
Howell	73.91	17:21:25	0:08:00	17:29:25
Overnight Layover	72.7	17:32:54	0:00:00	

PROPOSED TRAINSET 2

Northbound (PM)

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
AA Midday Layover	44.4		0:00:00	16:51:17
Hoover Station	44.66	16:52:40	0:01:30	16:54:10
Ann Arbor Washington	45.48	16:58:30	0:01:30	17:00:00
Ann Arbor Barton	47.27	17:05:17	0:01:30	17:06:47
Whitmore Station Site	57.45	17:20:19	0:01:30	17:21:49
Hamburg-Merrill Road	60.53	17:26:41	0:01:30	17:28:11
Genoa-Chilson Hills Church	66.87	17:38:06	0:01:30	17:39:36
Howell	73.91	17:51:25	0:08:00	17:59:25
Overnight Layover	72.7	18:02:54	0:00:00	

PROPOSED TRAINSET 3

Northbound (PM)

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
AA Midday Layover	44.4		0:00:00	17:21:17
Hoover Station	44.66	17:22:40	0:01:30	17:24:10
Ann Arbor Washington	45.48	17:28:30	0:01:30	17:30:00
Ann Arbor Barton	47.27	17:35:17	0:01:30	17:36:47
Whitmore Station Site	57.45	17:50:19	0:01:30	17:51:49
Hamburg-Merrill Road	60.53	17:56:41	0:01:30	17:58:11
Genoa-Chilson Hills Church	66.87	18:08:06	0:01:30	18:09:36
Howell	73.91	18:21:25	0:08:00	18:29:25
Overnight Layover	72.7	18:32:54	0:00:00	

PROPOSED TRAINSET 4

Northbound (PM)

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
AA Midday Layover	44.4		0:00:00	17:51:17
Hoover Station	44.66	17:52:40	0:01:30	17:54:10
Ann Arbor Washington	45.48	17:58:30	0:01:30	18:00:00
Ann Arbor Barton	47.27	18:05:17	0:01:30	18:06:47
Whitmore Station Site	57.45	18:20:19	0:01:30	18:21:49
Hamburg-Merrill Road	60.53	18:26:41	0:01:30	18:28:11
Genoa-Chilson Hills Church	66.87	18:38:06	0:01:30	18:39:36
Howell	73.91	18:51:25	0:08:00	18:59:25
Overnight Layover	72.7	19:02:54	0:00:00	

NOTES

1 A schedule pad of 7% of the TPC run time including intermediately station dwells is added to each station to station segment

2 The trainset dwells 8 minutes at Howell Station to detrain passengers and change ends.

8/17/2015

North-South Commuter Rail
Degraded Curve and Speed Analysis

SOUTHBOUND-DEGRADED SPEED

Station	*Milepost*	*Dwell (hr:min:s)*	*Cummulative Time*	*Time Between Stations*	*Time Between Stations with Pad*
Overnight Layover	72.7	0:00:00	0:00:00	0:00:00	0:00:00
Howell	73.91	0:08:00	0:10:51	0:10:51	0:11:37
Genoa-Chilson Hills Church	66.87	0:01:30	0:23:07	0:12:16	0:13:08
Hamburg-Merrill Road	60.53	0:01:30	0:33:45	0:10:38	0:11:23
Whitmore Station Site	57.45	0:01:30	0:39:46	0:06:01	0:06:26
Ann Arbor Barton	47.27	0:01:30	0:53:51	0:14:05	0:15:04
Ann Arbor Washington	45.48	0:01:30	0:59:26	0:05:35	0:05:58
Hoover Station	44.66	0:01:30	1:05:25	0:05:59	0:06:24
AA Midday Layover	44.4	0:00:00	1:06:47	0:01:22	0:01:28
				Total Time	1:11:27

PROPOSED TRAINSET 1

Southbound (AM

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
Overnight Layover	72.7		0:00:00	5:48:23
Howell	73.91	5:52:00	0:08:00	6:00:00
Genoa-Chilson Hills Church	66.87	6:11:38	0:01:30	6:13:08
Hamburg-Merrill Road	60.53	6:23:00	0:01:30	6:24:30
Whitmore Station Site	57.45	6:29:26	0:01:30	6:30:56
Ann Arbor Barton	47.27	6:44:31	0:01:30	6:46:01
Ann Arbor Washington	45.48	6:50:29	0:01:30	6:51:59
Hoover Station	44.66	6:56:53	0:01:30	6:58:23
AA Midday Layover	44.4	6:59:51	0:00:00	

PROPOSED TRAINSET 2

Southbound (AM

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
Overnight Layover	72.7		0:00:00	6:18:23
Howell	73.91	6:22:00	0:08:00	6:30:00
Genoa-Chilson Hills Church	66.87	6:41:38	0:01:30	6:43:08
Hamburg-Merrill Road	60.53	6:53:00	0:01:30	6:54:30
Whitmore Station Site	57.45	6:59:26	0:01:30	7:00:56
Ann Arbor Barton	47.27	7:14:31	0:01:30	7:16:01
Ann Arbor Washington	45.48	7:20:29	0:01:30	7:21:59
Hoover Station	44.66	7:26:53	0:01:30	7:28:23
AA Midday Layover	44.4	7:29:51	0:00:00	

PROPOSED TRAINSET 3

Southbound (AM

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
Overnight Layover	72.7		0:00:00	6:48:23
Howell	73.91	6:52:00	0:08:00	7:00:00
Genoa-Chilson Hills Church	66.87	7:11:38	0:01:30	7:13:08
Hamburg-Merrill Road	60.53	7:23:00	0:01:30	7:24:30
Whitmore Station Site	57.45	7:29:26	0:01:30	7:30:56
Ann Arbor Barton	47.27	7:44:31	0:01:30	7:46:01
Ann Arbor Washington	45.48	7:50:29	0:01:30	7:51:59
Hoover Station	44.66	7:56:53	0:01:30	7:58:23
AA Midday Layover	44.4	7:59:51	0:00:00	

PROPOSED TRAINSET 4

Southbound (AM

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
Overnight Layover	72.7		0:00:00	7:18:23
Howell	73.91	7:22:00	0:08:00	7:30:00
Genoa-Chilson Hills Church	66.87	7:41:38	0:01:30	7:43:08
Hamburg-Merrill Road	60.53	7:53:00	0:01:30	7:54:30
Whitmore Station Site	57.45	7:59:26	0:01:30	8:00:56
Ann Arbor Barton	47.27	8:14:31	0:01:30	8:16:01
Ann Arbor Washington	45.48	8:20:29	0:01:30	8:21:59
Hoover Station	44.66	8:26:53	0:01:30	8:28:23
AA Midday Layover	44.4	8:29:51	0:00:00	

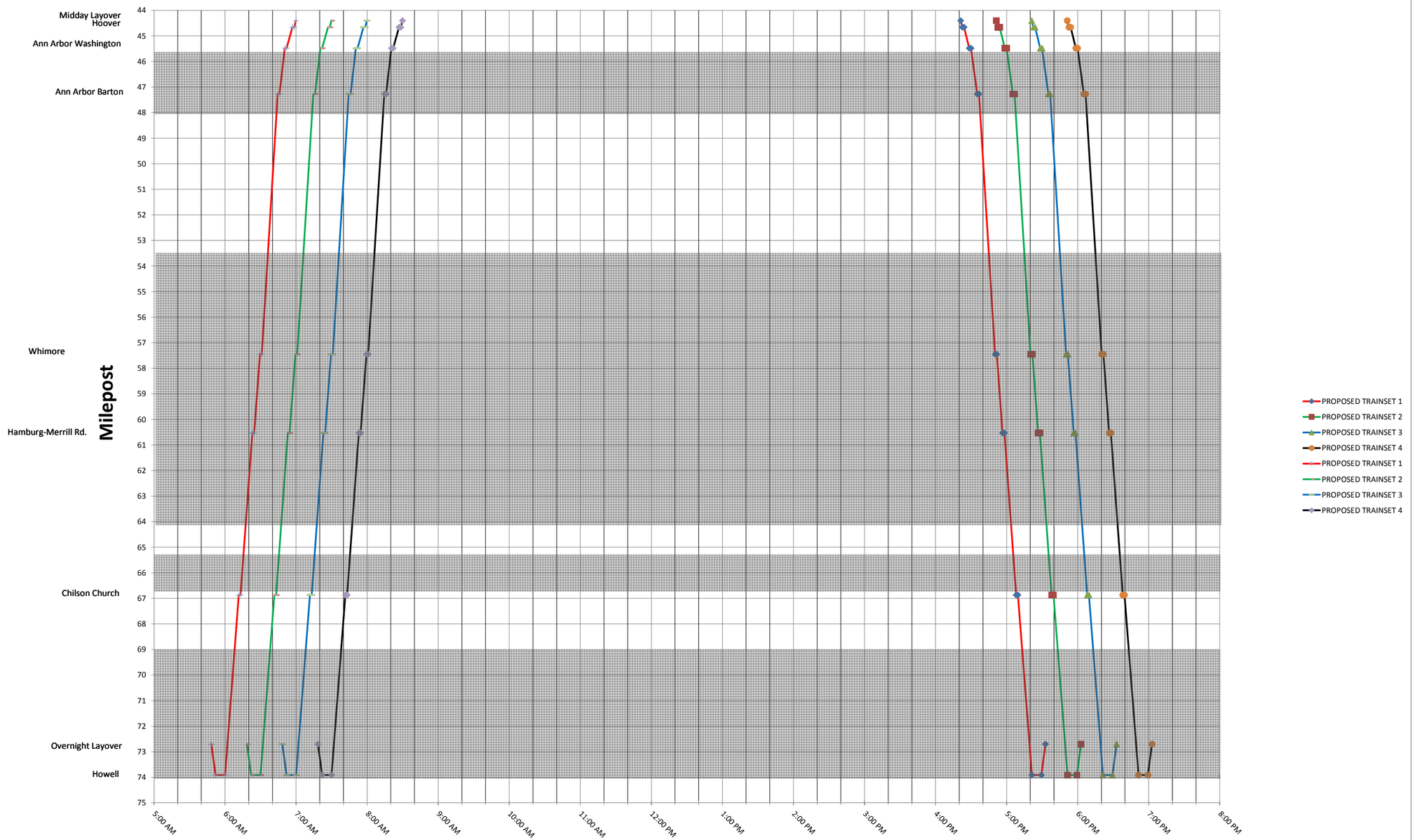
NOTES

1 A schedule pad of 7% of the TPC run time including intermediately station dwells is added to each station to station segmen

2 The trainset dwells 8 minutes at Howell Station to change ends and board departing passengers.

8/17/15

North-South Commuter Rail
Degraded Curve and Speed Analysis



NORTH-SOUTH COMMUTER RAIL

PROPOSED INFRASTRUCTURE IMPROVEMENTS

LEGEND

EXISTING TRACK

PROPOSED NEW TRACK

REMOVE/REPLACE TRACK

EXISTING TURNOUT

PROPOSED TURNOUT

AT GRADE CROSSING

RAILROAD BRIDGE OVER WATERWAY

ROAD UNDERPASS

ROAD OVERPASS

TRACK SHIFT

6°15' CURVE LENGTH AND DEGREE

ABBREVIATIONS

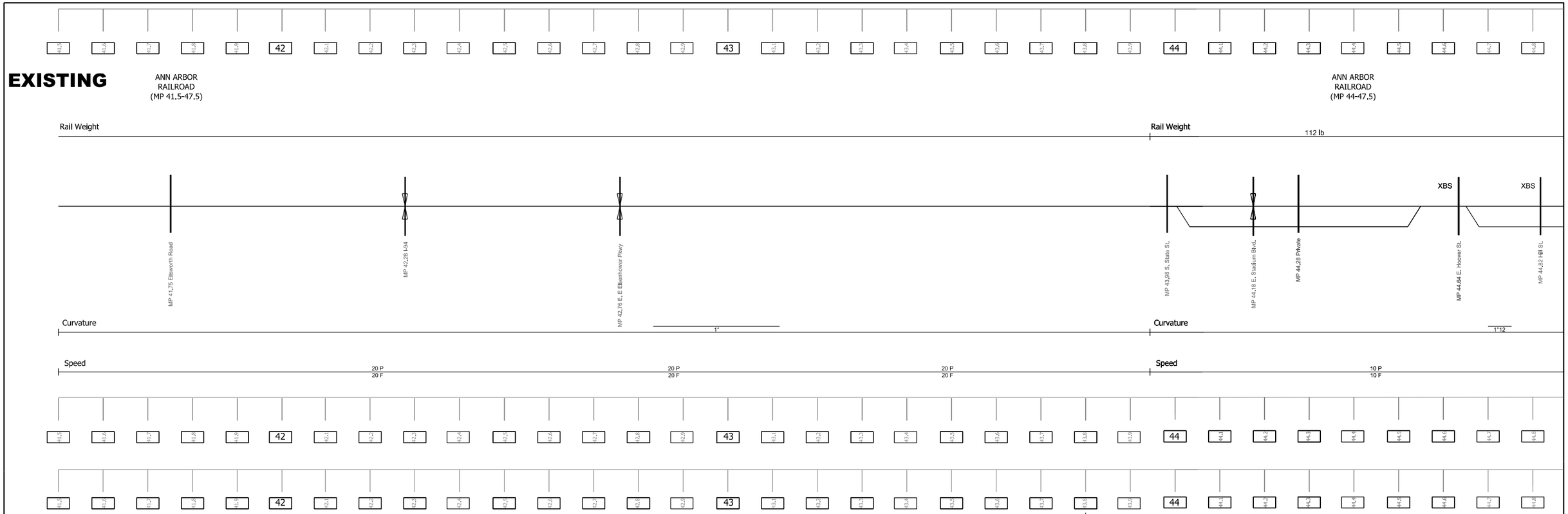
HTTO	HAND THROW TURNOUT
POTO	POWER OPERATED TURNOUT
MP	MILEPOST
CTC	CENTRALIZED TRAFFIC CONTROL
PTC	POSITIVE TRAIN CONTROL
CTC	CONTINUOUS WELDED RAIL
ATR	ABOVE TOP OF RAIL
IN	INCHES
P	PASSENGER
F	FREIGHT
TFT	TRACK FEET
LB	POUND
EL	ELECTRIC LOCK
D	DERAIL

CROSSING ABBREVIATIONS

X	EXISTING RAILROAD CROSSING SIGN
B	EXISTING BELL
S	EXISTING SIGNAL
C	EXISTING CANTILEVER SIGNAL
G	EXISTING GATES
X	PROPOSED RAILROAD CROSSING SIGN
B	PROPOSED BELL
S	PROPOSED SIGNAL
C	PROPOSED CANTILEVER SIGNAL
G	PROPOSED GATES

August 10, 2015

EXISTING



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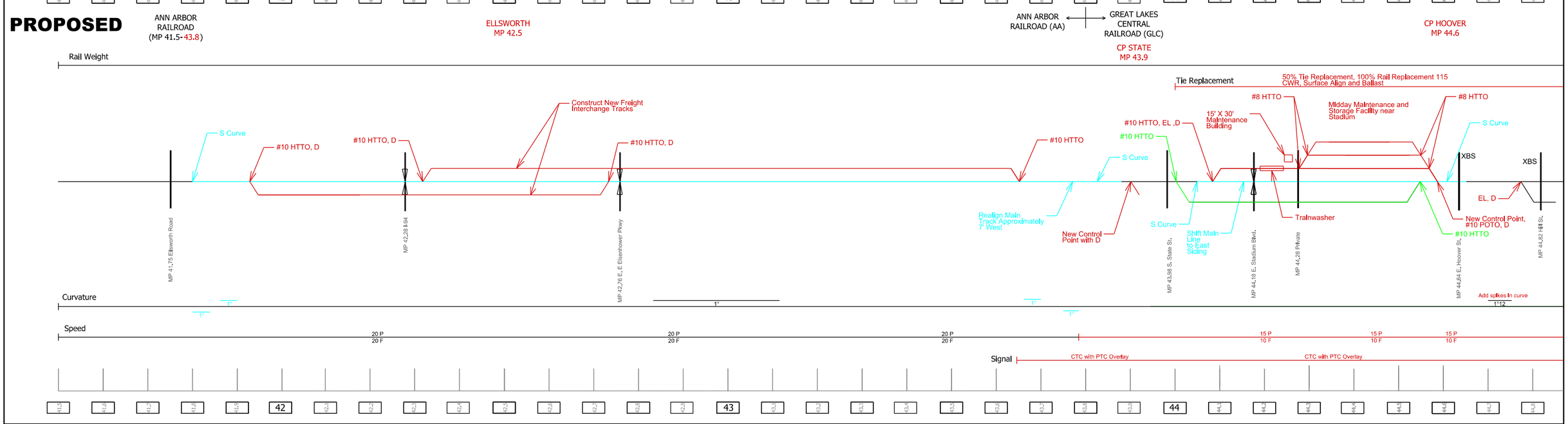

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1	Rev	KRM		08/10/2015

DESIGNED:	KRM
DRAWN:	KRM
CHECKED:	WRO
APPROVED:	WRM
DATE:	08/10/2015

QUANDEL CONSULTANTS
Quandel Consultants, LLC
161 N. Clark St.
Suite 2060
Chicago, IL 60601

NORTH-SOUTH COMMUTER RAIL, FULL SERVICE- DEGRADED SPEEDS EXISTING AND PROPOSED TRACK SCHEMATICS

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DRAWING NO.	
SCALE:	NTS
SHEET NO.	1 OF 10

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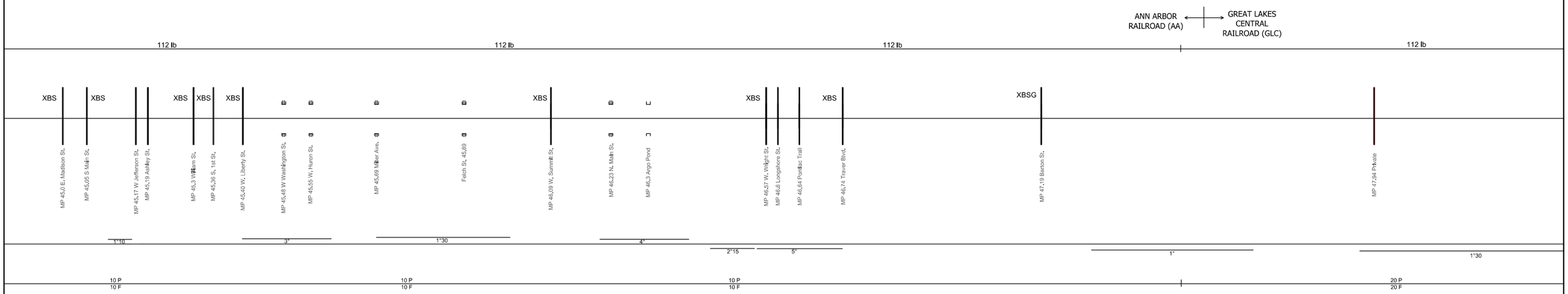
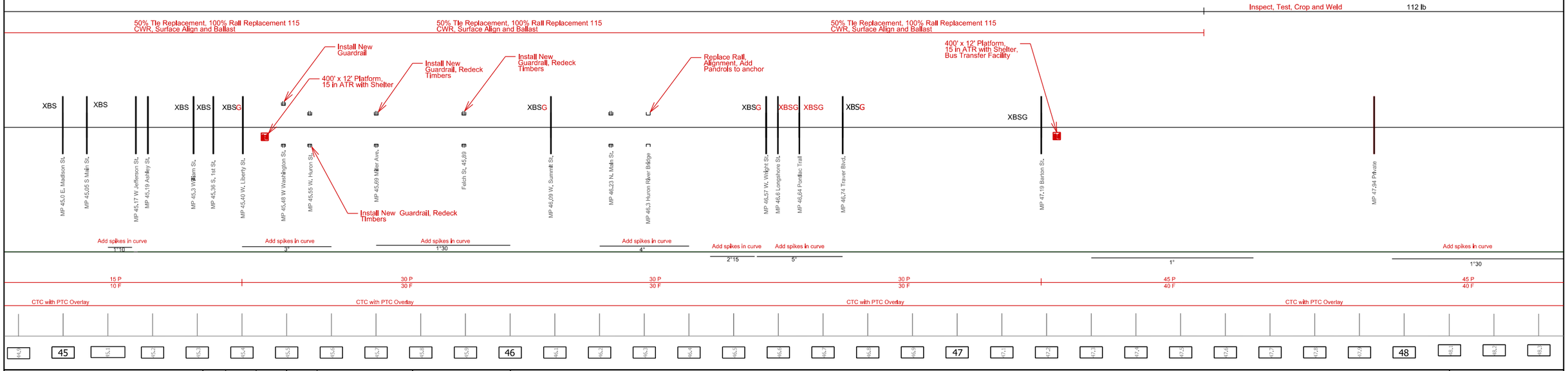


PROPOSED

Ann Arbor-
Washington/Liberty
Station
MP 45.48

Ann Arbor- Barton
Station
MP 47.27



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DATE:	08/10/2015

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Chicago, IL 60601

NORTH-SOUTH COMMUTER RAIL, FULL SERVICE- DEGRADED SPEEDS EXISTING AND PROPOSED TRACK SCHEMATICS

PROJECT ID	Quandel1404
DRAWING NO.	
SCALE:	NTS
SHEET NO.	2 OF 10

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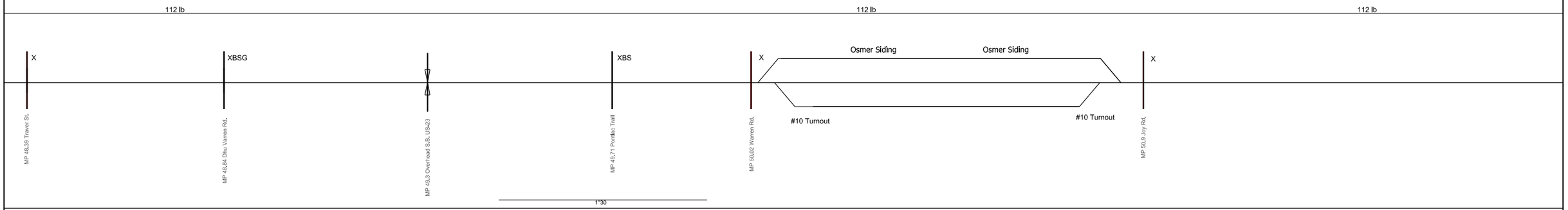

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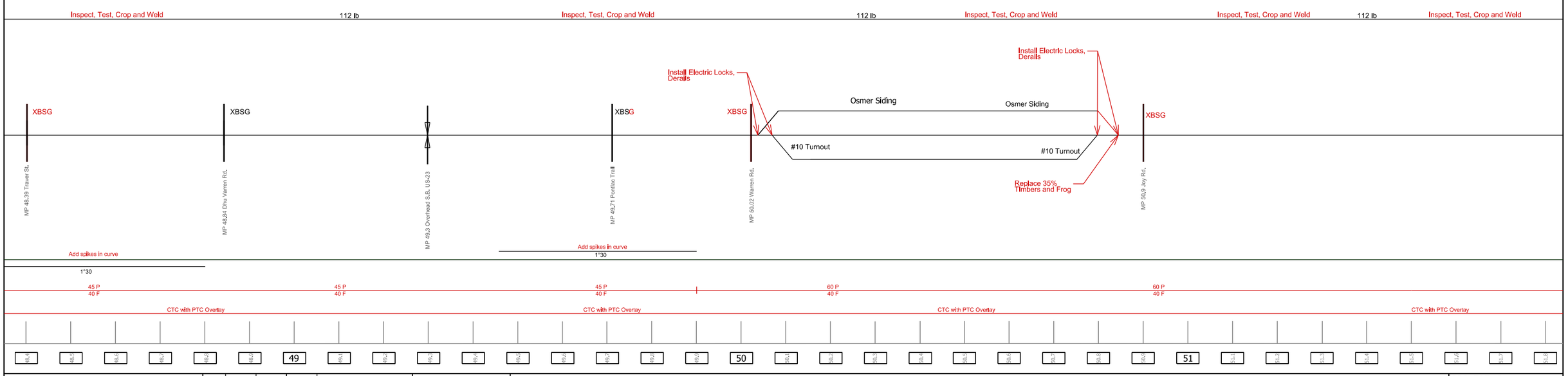

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NORTH-SOUTH COMMUTER RAIL, FULL SERVICE- DEGRADED SPEEDS EXISTING AND PROPOSED TRACK SCHEMATICS

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DRAWING NO.	
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SHEET NO.	3 OF 10

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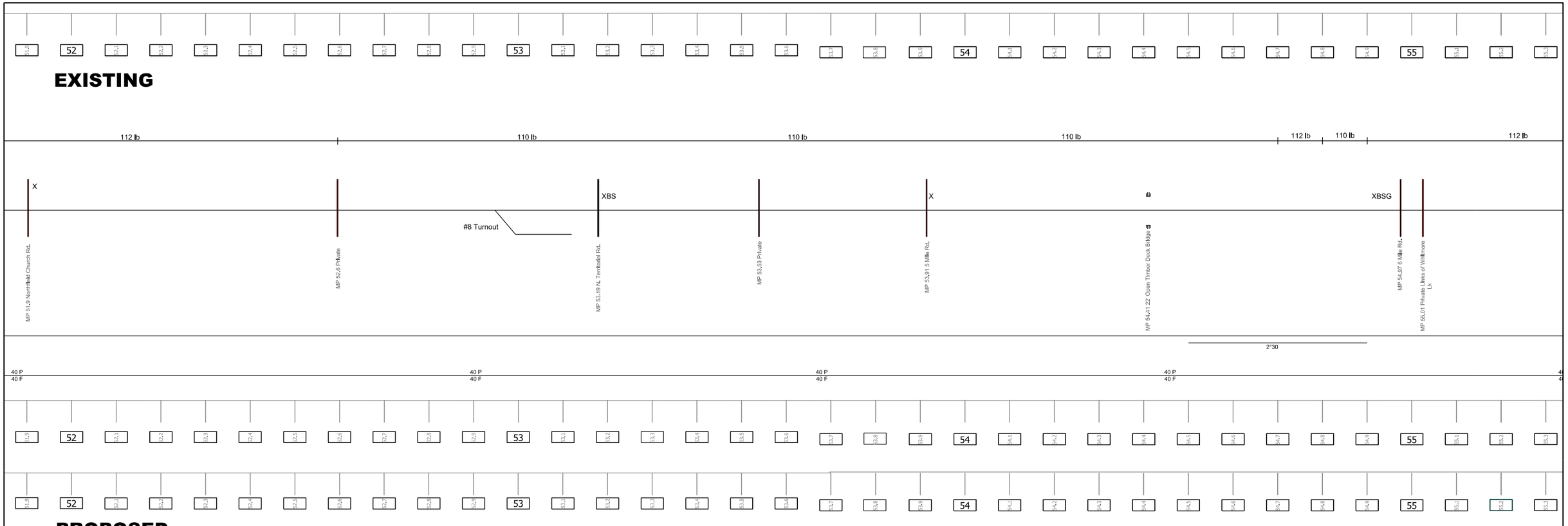

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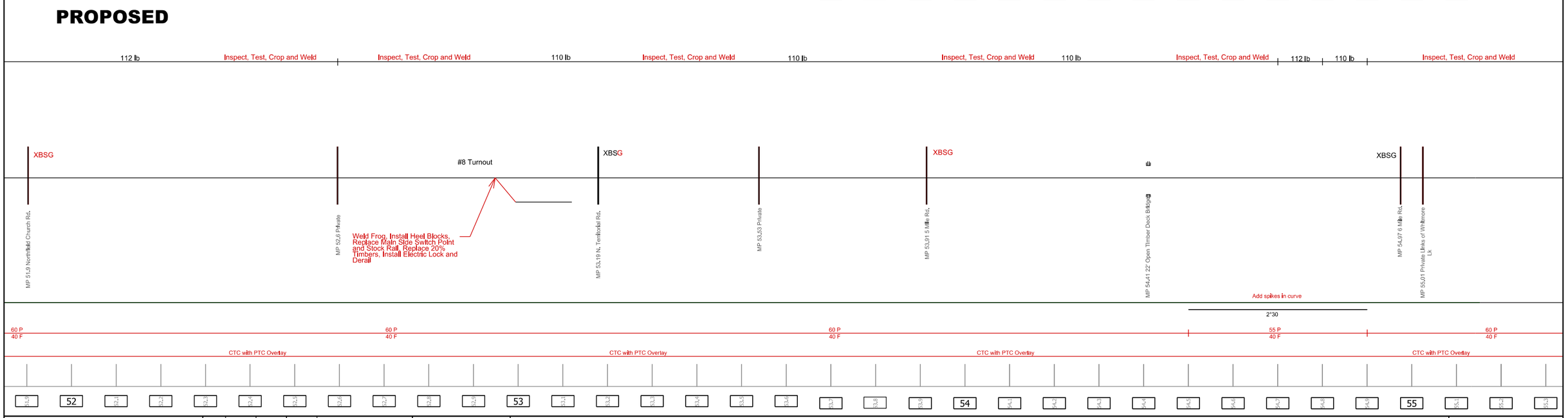

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NORTH-SOUTH COMMUTER RAIL, FULL SERVICE- DEGRADED SPEEDS EXISTING AND PROPOSED TRACK SCHEMATICS

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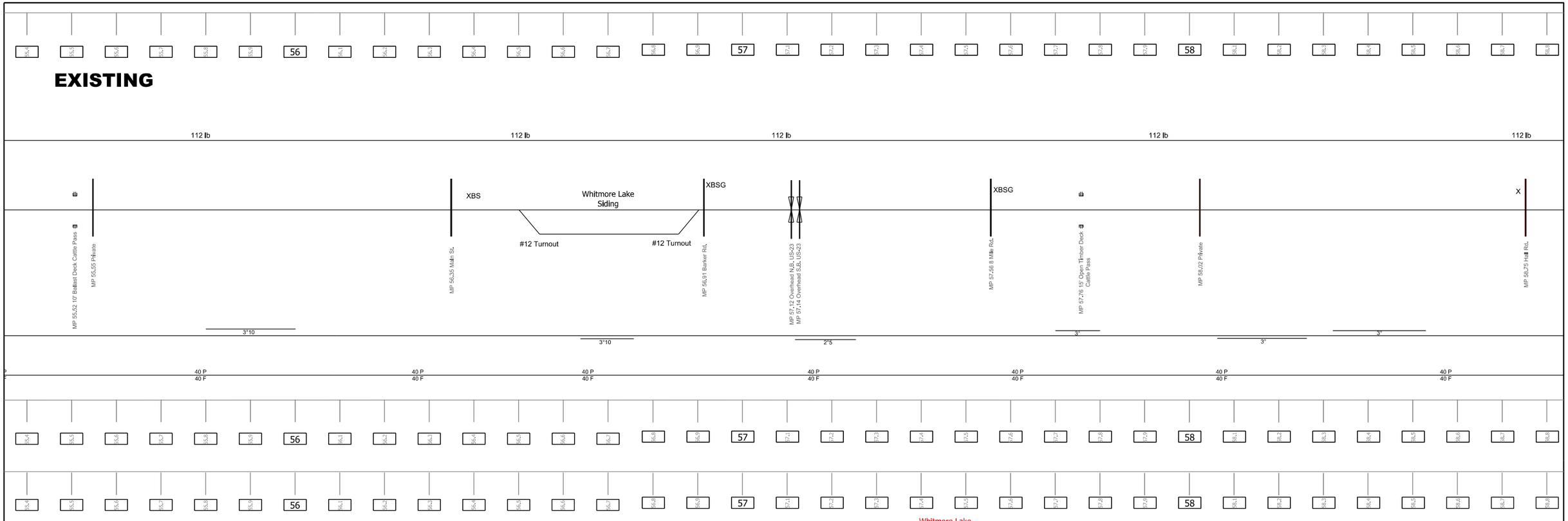

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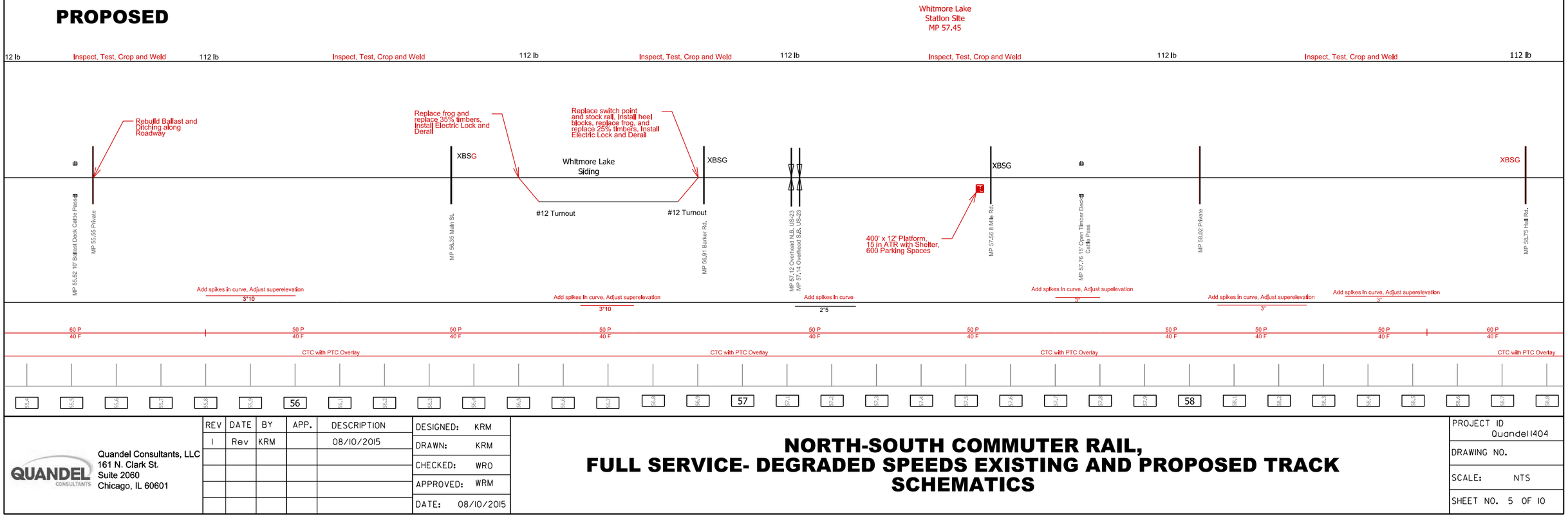

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NORTH-SOUTH COMMUTER RAIL, FULL SERVICE- DEGRADED SPEEDS EXISTING AND PROPOSED TRACK SCHEMATICS

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DRAWING NO.	
SCALE:	NTS
SHEET NO.	5 OF 10

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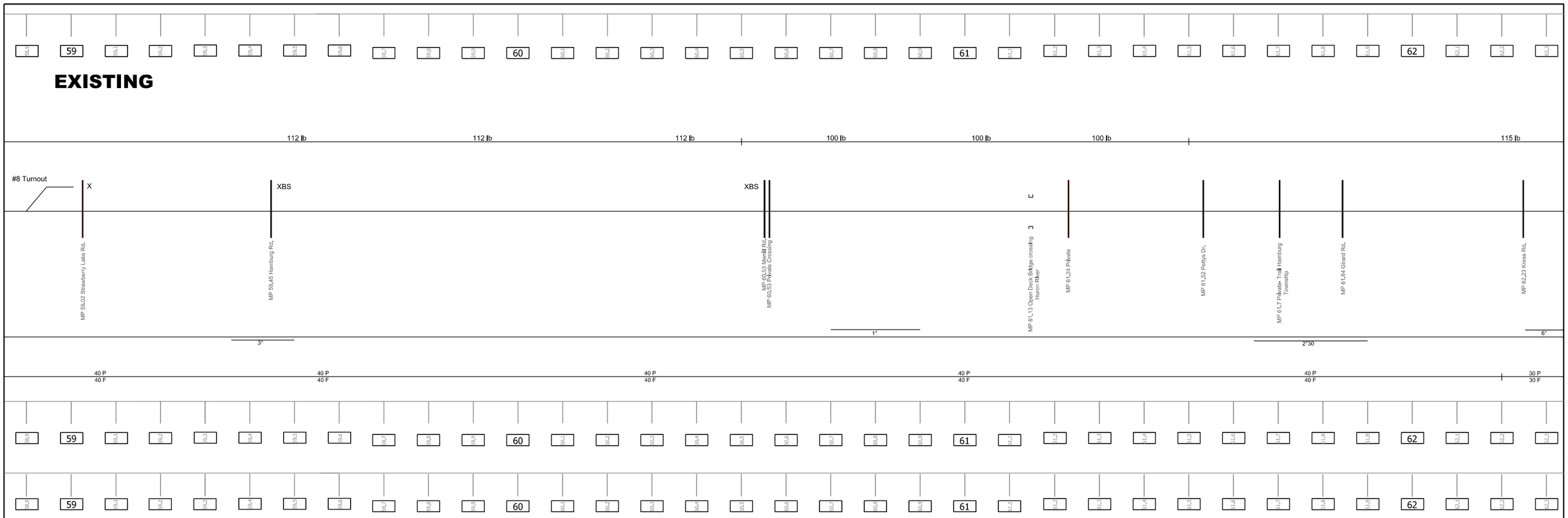

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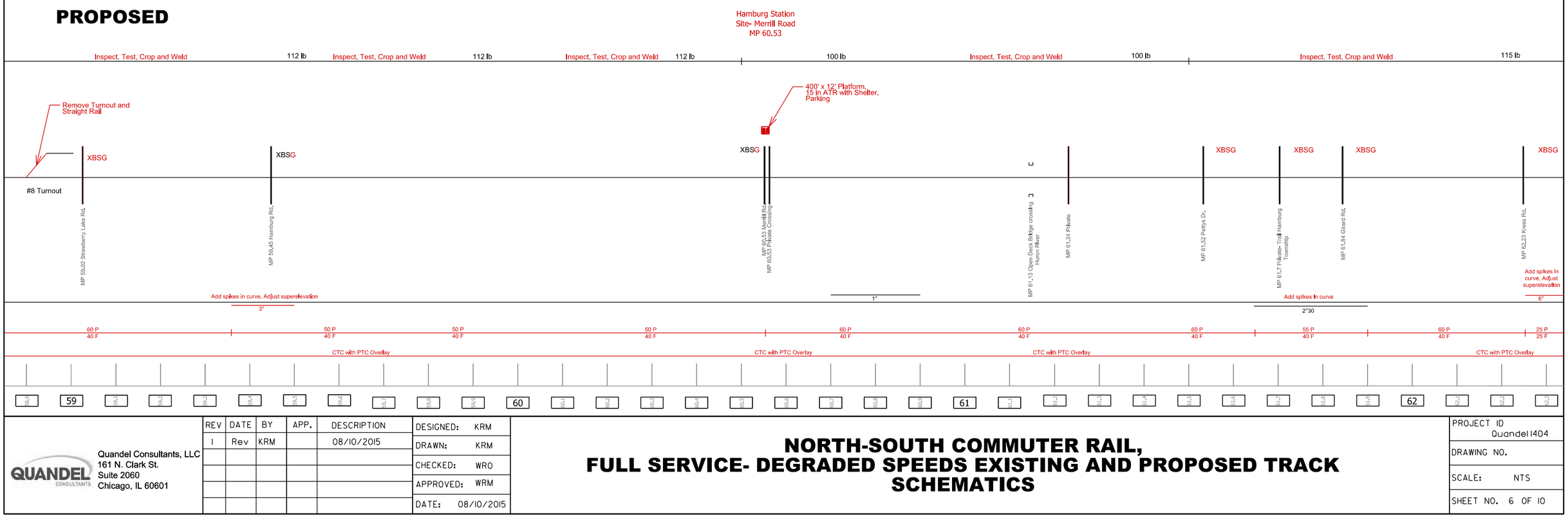

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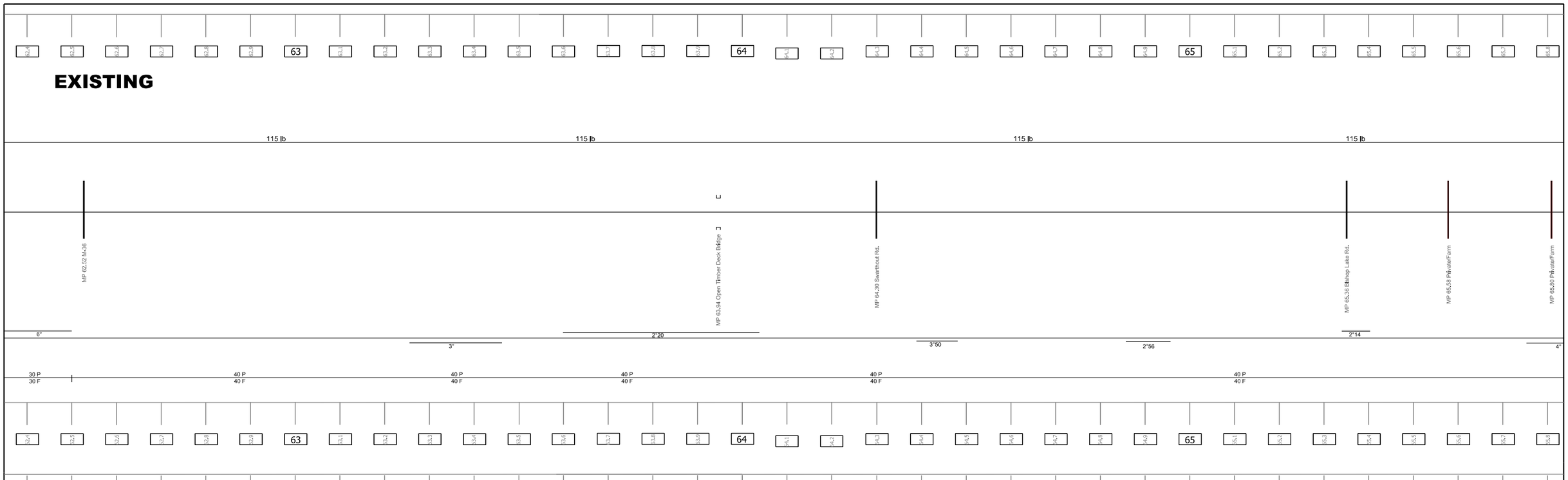
DATE:	08/10/2015

NORTH-SOUTH COMMUTER RAIL, FULL SERVICE- DEGRADED SPEEDS EXISTING AND PROPOSED TRACK SCHEMATICS

PROJECT ID	Quandel1404
DRAWING NO.	
SCALE:	NTS
SHEET NO.	6 OF 10

EXISTING



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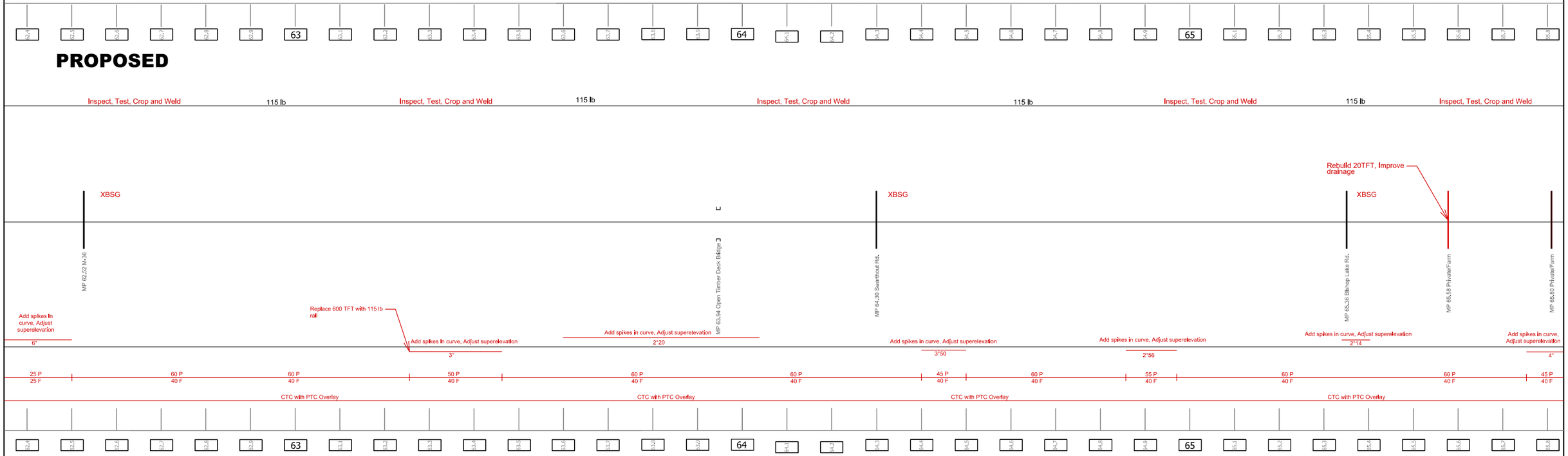

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1	Rev	KRM		08/10/2015

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APPROVED:	WRM
DATE:	08/10/2015

NORTH-SOUTH COMMUTER RAIL, FULL SERVICE- DEGRADED SPEEDS EXISTING AND PROPOSED TRACK SCHEMATICS

PROJECT ID	Quandel1404
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SCALE:	NTS
SHEET NO.	7 OF 10

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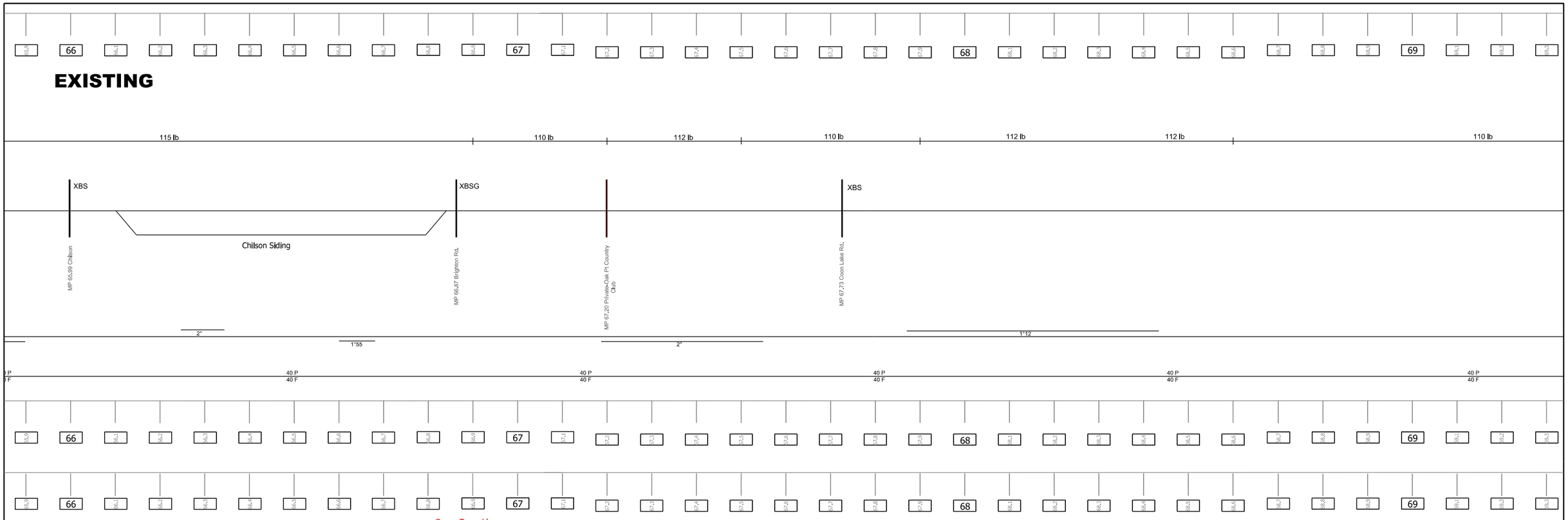
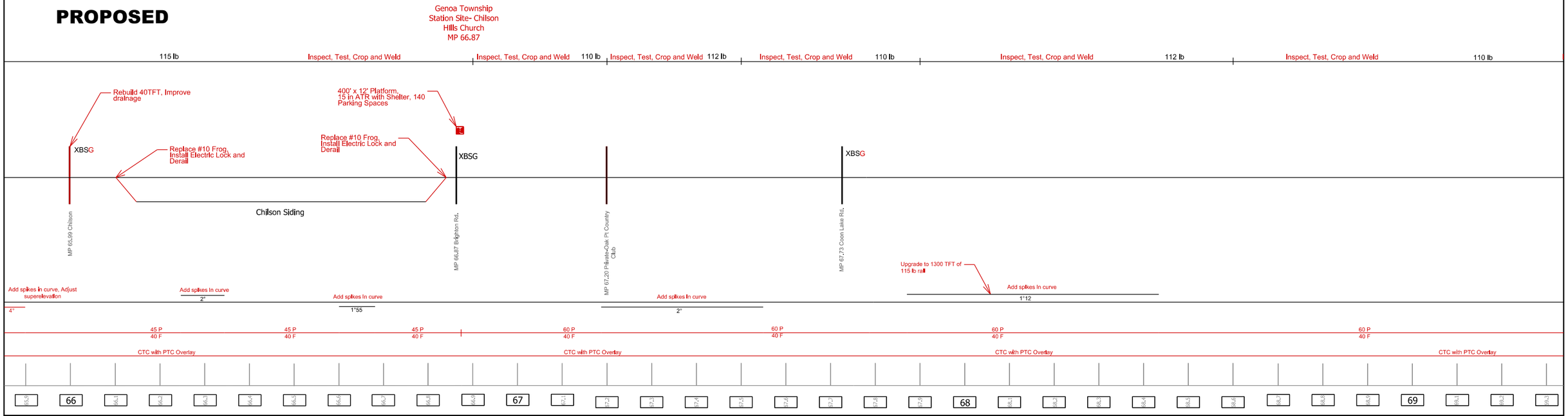


PROPOSED

Genoa Township
Station Site- Chilson
Hills Church
MP 66.87



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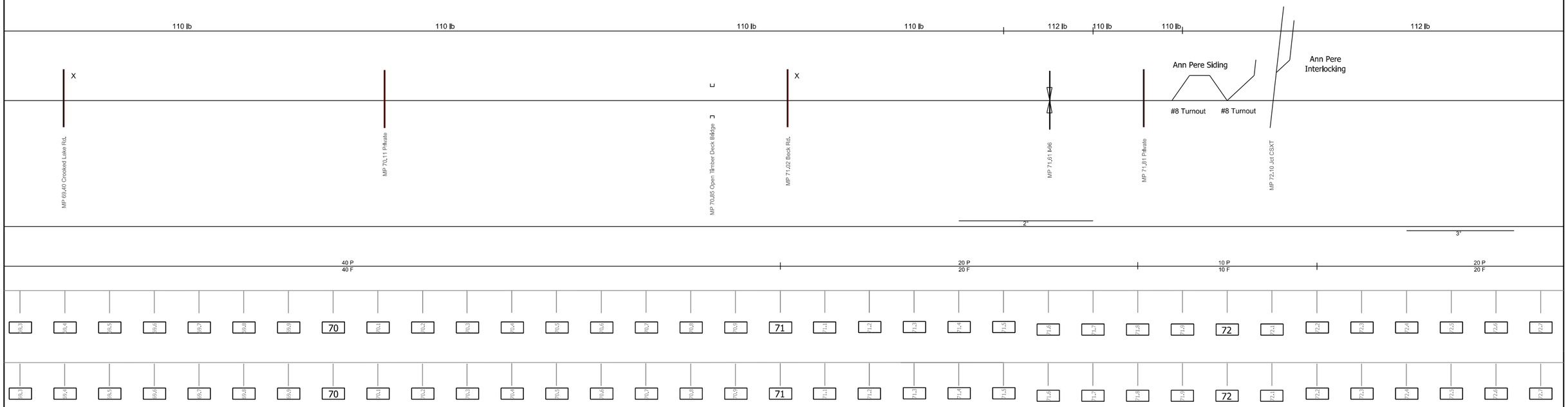
CHECKED:	WRO
APPROVED:	WRM
DATE:	08/10/2015

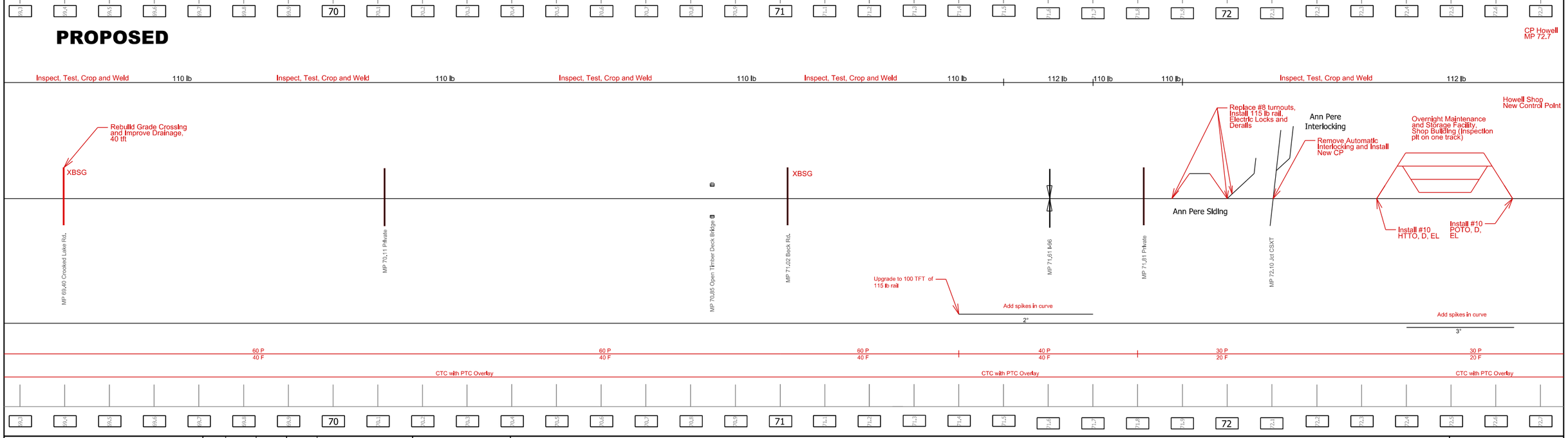
NORTH-SOUTH COMMUTER RAIL, FULL SERVICE- DEGRADED SPEEDS EXISTING AND PROPOSED TRACK SCHEMATICS

PROJECT ID	Quandel1404
DRAWING NO.	
SCALE:	NTS
SHEET NO.	8 OF 10

EXISTING



PROPOSED



Quandel Consultants, LLC
161 N. Clark St.
Suite 2060
Chicago, IL 60601

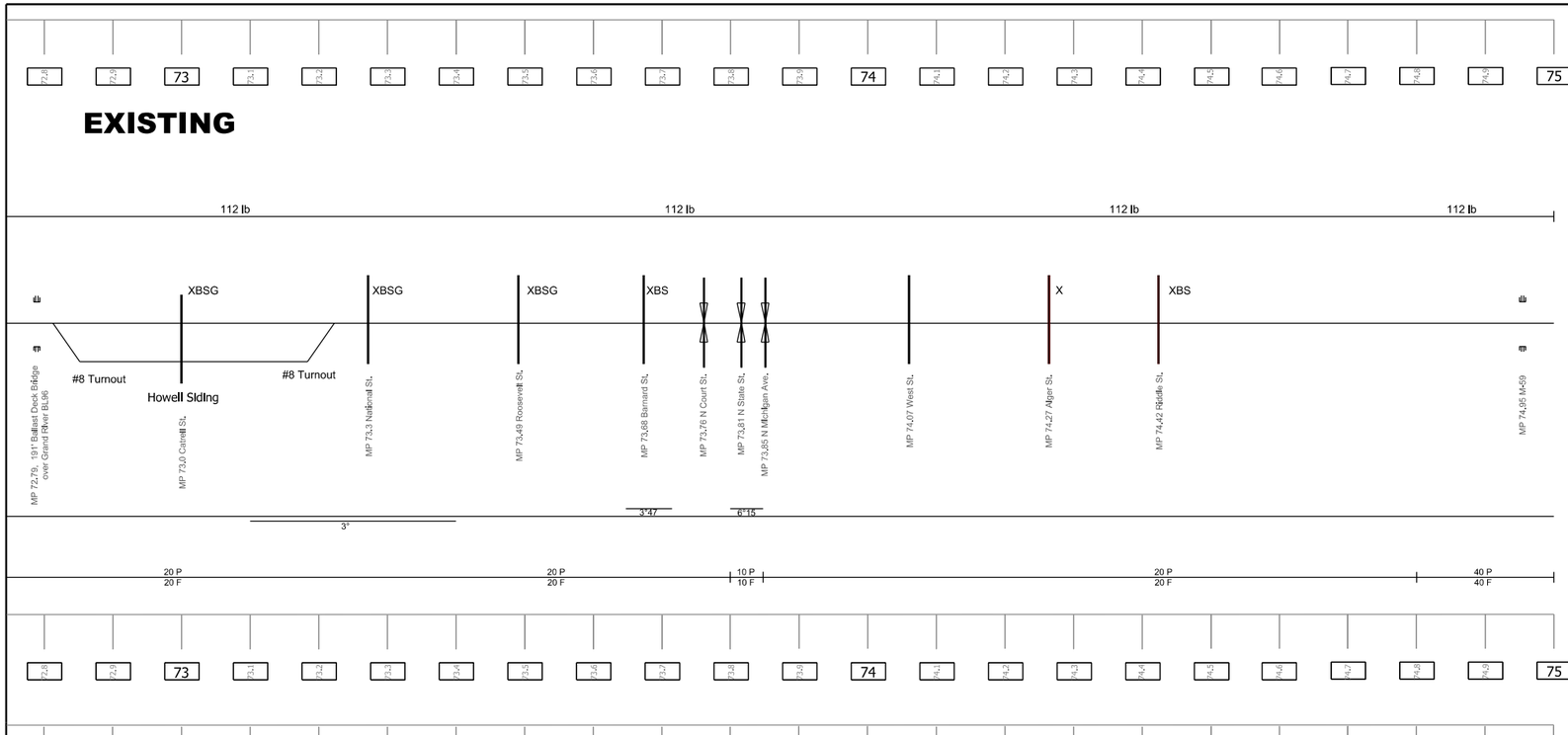
REV	DATE	BY	APP.	DESCRIPTION
1	Rev	KRM		08/10/2015

DESIGNED:	KRM
DRAWN:	KRM
CHECKED:	WRO
APPROVED:	WRM
DATE:	08/10/2015

NORTH-SOUTH COMMUTER RAIL, FULL SERVICE- DEGRADED SPEEDS EXISTING AND PROPOSED TRACK SCHEMATICS

PROJECT ID	Quandel1404
DRAWING NO.	
SCALE:	NTS
SHEET NO.	9 OF 10

EXISTING



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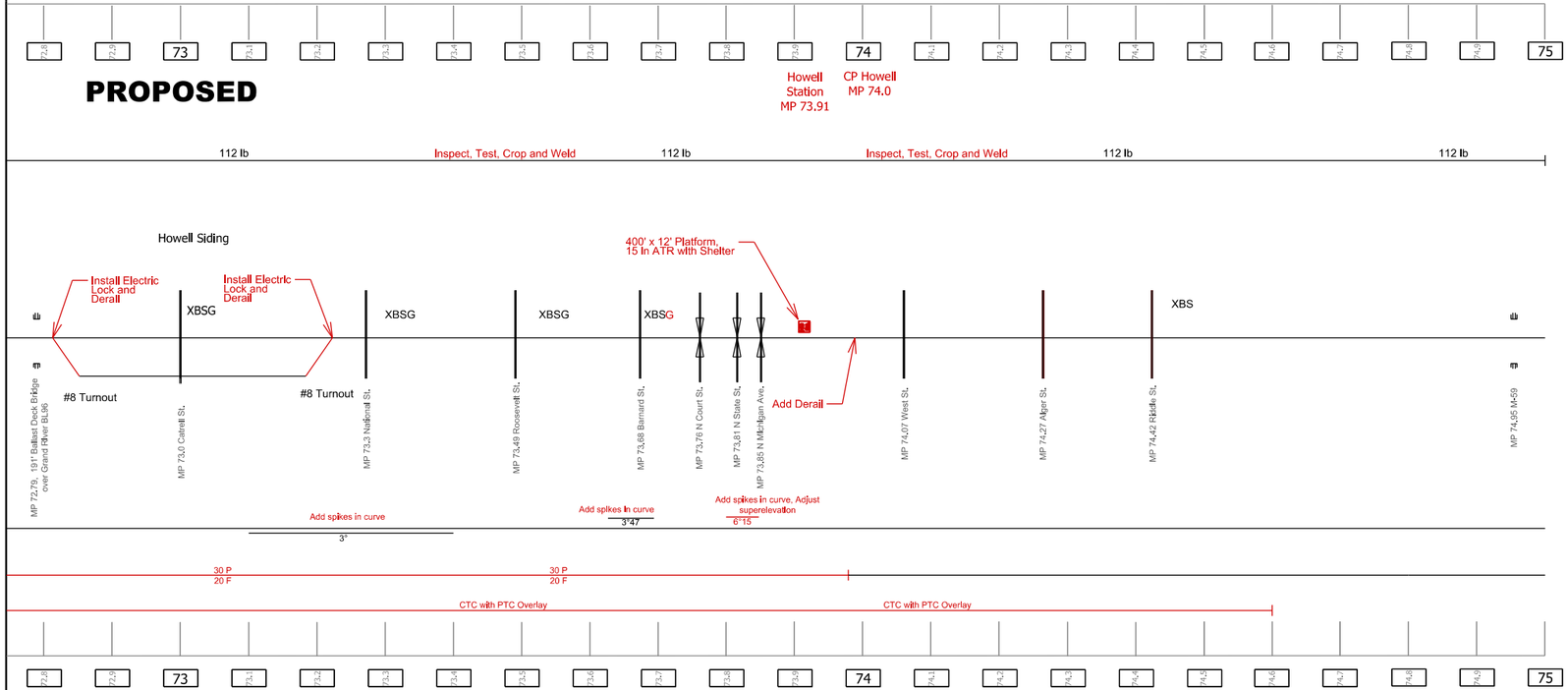


Quandel Consultants, LLC
161 N. Clark St.
Suite 2060
Chicago, IL 60601

REV	DATE	BY	APP.	DESCRIPTION
1	Rev	KRM		08/10/2015

DESIGNED:	KRM
DRAWN:	KRM
CHECKED:	WRO
APPROVED:	WRM
DATE:	08/10/2015

NORTH-SOUTH COMMUTER RAIL, FULL SERVICE- DEGRADED SPEEDS EXISTING AND PROPOSED TRACK SCHEMATICS

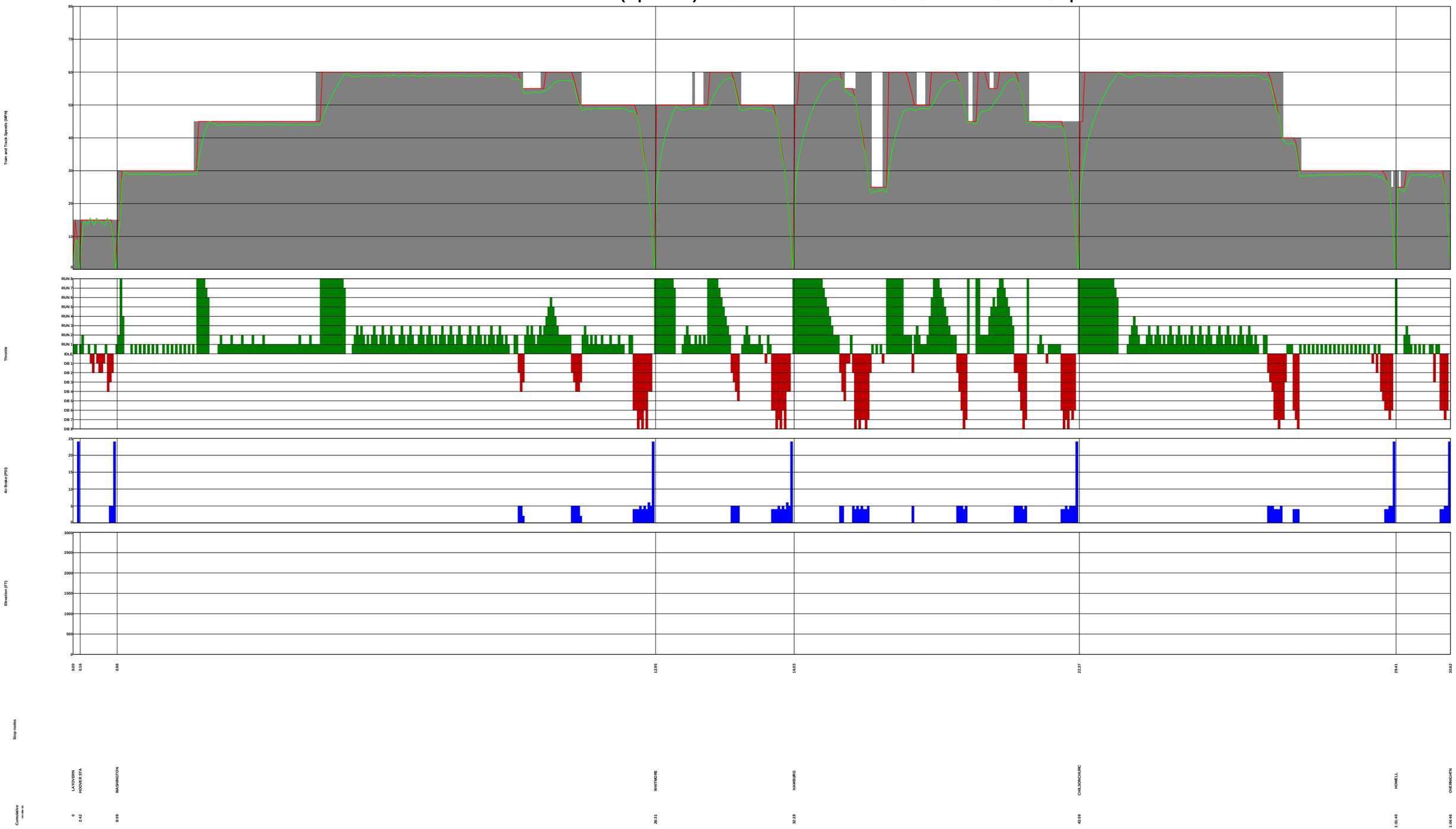
PROJECT ID	Quandel1404
DRAWING NO.	
SCALE:	NTS
SHEET NO.	10 OF 10

APPENDIX II: OPTION 2 FULL SERVICE WITHOUT BARTON DRIVE STATION: SERVICE PLAN PARAMETERS

Prepared by Quandel Consultants, LLC for SmithGroupJJR, Inc.
October 14, 2016

North-South Commuter Rail

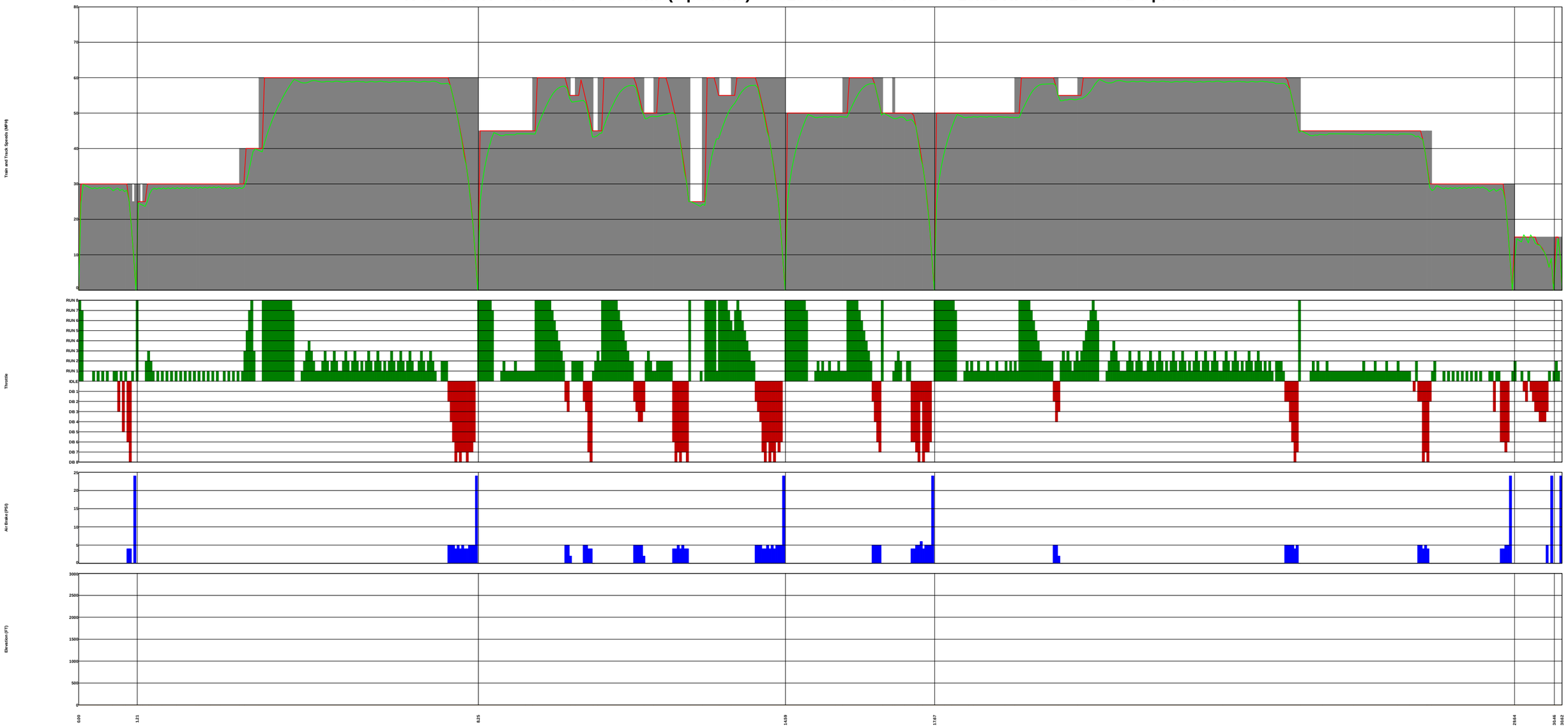
N-S NORTH Consist: 4 coachs (0 patrons) 323 tons 407 feet 10.61 HP/ton Locos: 1 Opr MP36PH



Case: EliminateBarton RTC run: 17 August 2015 11:18:03 User: Siddhartha Kotikalapudi of Quandel Consultants, LLC

North-South Commuter Rail

N-S SOUTH Consist: 4 coachs (0 patrons) 323 tons 407 feet 10.61 HP/ton Locos: 1 Opr MP36PH



Case: EliminateBarton RTC run: 17 August 2015 11:18:21 User: Siddhartha Kotikalapudi of Quandel Consultants, LLC

Quandel Consultants, LLC
17-Aug-15

North-South Commuter Rail
Degraded Curve and Speed Analysis

Curve	Existing Conditions									Proposed Conditions						
	Milepost		Degree of Curve				Radius (ft.)	Superelevation E(a)	Spiral Length Ls (ft.)	Design Speed Limits		New Superelevation $E(a)_{new}$	Unbalance E(u)	Unbalance E(u)	Spiral Length due to Lateral Acceleration Ls (min) (ft.)	Spiral Length due to Roll Ls (min) (ft.)
	Start MP	End MP	D	M	S	Degree in Decimal				Passenger	Freight	Proposed	Passenger	Freight		
Ann Arbor																
AA-1	44.70	44.75	1	12	0	1.20	4774.74			15	10	0.50	-0.31	-0.42	-6	31
AA-2	45.10	45.15	1	10	0	1.17	4911.15			15	10	0.50	-0.32	-0.42	-6	31
AA-3	45.40	45.60	3	0	0	3.00	1910.08			30	30	0.50	1.39	1.39	51	31
AA-4	45.70	46.00	1	30	0	1.50	3819.83			30	30	0.50	0.45	0.45	17	31
AA-5	46.20	46.40	4	0	0	4.89	1172.05			30	30	0.50	2.58	-0.16	-6	31
AA-6	46.45	46.55	2	15	0	2.25	2546.64			30	30	0.50	0.92	0.92	34	31
AA-7	46.56	46.75	5	0	0	5.00	1146.28			30	30	0.50	2.65	2.65	97	31
Great Lakes Central																
1	47.30	47.65	1	0	0	1.00	5729.65	1.00	73.00	45	40	1.00	0.42	0.12	23.0	62
2	47.90	48.80	1	30	0	1.50	3819.83	1.00	73.00	45	40	1.00	1.13	0.68	62.0	62
3	49.45	49.90	1	30	0	1.50	3819.83	1.00	73.00	45	40	1.00	1.13	0.68	62.0	62
4	54.50	54.90	2	30	0	2.50	2292.01	3.25	216.00	55	40	3.25	2.04	-0.45	138.0	201.5
5	55.80	56.00	3	10	0	3.17	1809.57	4.75	216.00	50	40	3.25	2.29	0.30	140.0	201.5
6	56.65	56.75	3	10	0	3.17	1809.57	4.75	216.00	50	40	3.25	2.29	0.30	140.0	201.5
7	57.10	57.25	2	5	0	2.08	2750.35	2.50	216.00	50	40	2.50	1.15	-0.17	70.0	155
8	57.70	57.80	3	0	0	3.00	1910.08	3.75	205.00	50	40	3.25	2.00	0.11	122.0	201.5
9	58.07	58.27	3	0	0	3.00	1910.08	4.50	216.00	50	40	3.25	2.00	0.11	122.0	201.5
10	58.32	58.52	3	0	0	3.00	1910.08	4.50	216.00	50	40	3.25	2.00	0.11	122.0	201.5
11	59.35	59.50	3	0	0	3.00	1910.08	4.50	216.00	50	40	3.25	2.00	0.11	122.0	201.5
12	60.70	60.90	1	0	0	1.00	5729.65	1.00	216.00	60	40	1.00	1.52	0.12	112.0	62
13	61.65	61.90	2	30	0	2.50	2292.01	3.25	216.00	55	40	3.25	2.04	-0.45	138.0	201.5
14	62.25	62.50	6	0	0	6.00	955.37	2.75	91.00	25	25	1.25	1.38	1.38	42.0	77.5
15	63.25	63.45	3	0	0	3.00	1910.08	4.50	216.00	50	40	3.25	2.00	0.11	122.0	201.5
16	63.60	64.05	2	20	0	2.33	2455.70	4.00	216.00	60	40	3.25	2.63	-0.64	193.0	201.5
17	64.40	64.50	3	50	0	3.83	1494.95	4.25	187.00	45	40	3.25	2.18	1.04	120.0	201.5
18	64.87	64.97	2	56	0	2.93	1953.48	4.25	216.00	55	40	3.25	2.96	0.04	199.0	201.5
19	65.35	65.40	2	14	0	2.23	2565.65	2.50	216.00	60	40	2.75	2.88	-0.25	211.0	170.5
20	65.75	65.90	4	0	0	4.00	1432.69	4.50	187.00	45	40	3.00	2.67	1.48	147.0	186
21	66.25	66.35	2	0	0	2.00	2864.93	2.25	216.00	45	40	2.25	0.59	-0.01	33.0	139.5
22	66.60	66.70	1	55	0	1.92	2989.48	2.00	216.00	45	40	2.00	0.72	0.15	40.0	124
23	67.20	67.55	2	0	0	2.00	2864.93	2.25	216.00	60	40	2.25	2.79	-0.01	205.0	139.5
24	67.88	68.43	1	12	0	1.20	4774.74	1.50	216.00	60	40	1.50	1.52	-0.16	112.0	93
25	71.40	71.70	2	0	0	2.00	2864.93	0.75	73.00	40	40	0.75	1.49	1.49	73.0	46.5
26	72.40	72.65	3	0	0	3.00	1910.08	1.00	73.00	30	35	1.00	0.89	1.57	33.0	62
27	73.10	73.40	3	0	0	3.00	1910.08	1.00	73.00	30	20	1.00	0.89	-0.16	33.0	62
28	73.62	73.67	3	47	0	3.78	1514.70	1.00	73.00	30	20	1.00	1.38	0.06	51.0	62
29	73.80	73.85	6	15	0	6.25	917.19	1.75	73.00	25	20	1.00	1.73	0.75	53.0	62

NOTES

1. Eu max is 3.0 in for Budd Bilevel Coaches

2. Max speed set at 60 mph

3. New Spiral Length= Existing Spiral Length

4. Existing AARR curve, superelevation, and spiral lengths are unknown. We assume that spirals and superelevation can be adjusted to meet proposed conditions as part of the proposed surfacing work

KEY

Minor adjustments to curve, superelevation, and spiral lengths required

Large adjustments to curve, superelevation, and spiral lengths required

8/17/2015

North-South Commuter Rail
Degraded Curve and Speed Analysis
Case 1- Eliminate Barton

NORTHBOUND-DEGRADED SPEED

Station	*Milepost*	*Dwell (hr:min:s)*	*Cummulative Time*	*Time Between Stations*	*Time Between Stations with Pad*
AA Midday Layover	44.40	0:00:00	0:00:00	0:00:00	0:00:00
Hoover Station	44.66	0:01:30	0:02:42	0:02:42	0:02:53
Ann Arbor Washington	45.48	0:01:30	0:08:09	0:05:27	0:05:50
Whitmore Station Site	57.45	0:01:30	0:26:31	0:18:22	0:19:39
Hamburg-Merrill Road	60.53	0:01:30	0:32:28	0:05:57	0:06:22
Genoa-Chilson Hills Church	66.87	0:01:30	0:43:09	0:10:41	0:11:26
Howell	73.91	0:08:00	1:01:40	0:18:31	0:19:49
Overnight Layover	72.7	0:00:00	1:04:46	0:03:06	0:03:19
				Total Time	1:09:18

PROPOSED TRAINSET 1

Northbound (PM

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:sec)*	*Departure Time (hr:min:sec)*
AA Midday Layover	44.4		0:00:00	16:21:17
Hoover Station	44.66	16:22:40	0:01:30	16:24:10
Ann Arbor Washington	45.48	16:28:30	0:01:30	16:30:00
Whitmore Station Site	57.45	16:48:09	0:01:30	16:49:39
Hamburg-Merrill Road	60.53	16:54:31	0:01:30	16:56:01
Genoa-Chilson Hills Church	66.87	17:05:57	0:01:30	17:07:27
Howell	73.91	17:19:16	0:08:00	17:27:16
Overnight Layover	72.7	17:30:35	0:00:00	

PROPOSED TRAINSET 2

Northbound (PM

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
AA Midday Layover	44.4		0:00:00	16:51:17
Hoover Station	44.66	16:52:40	0:01:30	16:54:10
Ann Arbor Washington	45.48	16:58:30	0:01:30	17:00:00
Whitmore Station Site	57.45	17:18:09	0:01:30	17:19:39
Hamburg-Merrill Road	60.53	17:24:31	0:01:30	17:26:01
Genoa-Chilson Hills Church	66.87	17:35:57	0:01:30	17:37:27
Howell	73.91	17:49:16	0:08:00	17:57:16
Overnight Layover	72.7	18:00:35	0:00:00	

PROPOSED TRAINSET 3

Northbound (PM

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
AA Midday Layover	44.4		0:00:00	17:21:17
Hoover Station	44.66	17:22:40	0:01:30	17:24:10
Ann Arbor Washington	45.48	17:28:30	0:01:30	17:30:00
Whitmore Station Site	57.45	17:48:09	0:01:30	17:49:39
Hamburg-Merrill Road	60.53	17:54:31	0:01:30	17:56:01
Genoa-Chilson Hills Church	66.87	18:05:57	0:01:30	18:07:27
Howell	73.91	18:19:16	0:08:00	18:27:16
Overnight Layover	72.7	18:30:35	0:00:00	

PROPOSED TRAINSET 4

Northbound (PM

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
AA Midday Layover	44.4		0:00:00	17:51:17
Hoover Station	44.66	17:52:40	0:01:30	17:54:10
Ann Arbor Washington	45.48	17:58:30	0:01:30	18:00:00
Whitmore Station Site	57.45	18:18:09	0:01:30	18:19:39
Hamburg-Merrill Road	60.53	18:24:31	0:01:30	18:26:01
Genoa-Chilson Hills Church	66.87	18:35:57	0:01:30	18:37:27
Howell	73.91	18:49:16	0:08:00	18:57:16
Overnight Layover	72.7	19:00:35	0:00:00	

NOTES

1 A schedule pad of 7% of the TPC run time including intermediately station dwells is added to each station to station segment

2 The trainset dwells 8 minutes at Howell Station to detrain passengers and change ends.

8/17/2015

North-South Commuter Rail
Degraded Curve and Speed Analysis
Case 1- Eliminate Barton

SOUTHBOUND-DEGRADED SPEED

Station	*Milepost*	*Dwell (hr:min:s)*	*Cummulative Time*	*Time Between Stations*	*Time Between Stations with Pad*
Overnight Layover	72.7	0:00:00	0:00:00	0:00:00	0:00:00
Howell	73.91	0:08:00	0:10:51	0:10:51	0:11:37
Genoa-Chilson Hills Church	66.87	0:01:30	0:23:07	0:12:16	0:13:08
Hamburg-Merrill Road	60.53	0:01:30	0:33:45	0:10:38	0:11:23
Whitmore Station Site	57.45	0:01:30	0:39:46	0:06:01	0:06:26
Ann Arbor Washington	45.48	0:01:30	0:57:20	0:17:34	0:18:48
Hoover Station	44.66	0:01:30	1:03:18	0:05:58	0:06:23
AA Midday Layover	44.4	0:00:00	1:04:41	0:01:23	0:01:29

Total Time 1:09:13

PROPOSED TRAINSET 1

Southbound (AM)

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
Overnight Layover	72.7		0:00:00	5:48:23
Howell	73.91	5:52:00	0:08:00	6:00:00
Genoa-Chilson Hills Church	66.87	6:11:38	0:01:30	6:13:08
Hamburg-Merrill Road	60.53	6:23:00	0:01:30	6:24:30
Whitmore Station Site	57.45	6:29:26	0:01:30	6:30:56
Ann Arbor Washington	45.48	6:48:14	0:01:30	6:49:44
Hoover Station	44.66	6:54:37	0:01:30	6:56:07
AA Midday Layover	44.4	6:57:36	0:00:00	

PROPOSED TRAINSET 2

Southbound (AM)

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
Overnight Layover	72.7		0:00:00	6:18:23
Howell	73.91	6:22:00	0:08:00	6:30:00
Genoa-Chilson Hills Church	66.87	6:41:38	0:01:30	6:43:08
Hamburg-Merrill Road	60.53	6:53:00	0:01:30	6:54:30
Whitmore Station Site	57.45	6:59:26	0:01:30	7:00:56
Ann Arbor Washington	45.48	7:18:14	0:01:30	7:19:44
Hoover Station	44.66	7:24:37	0:01:30	7:26:07
AA Midday Layover	44.4	7:27:36	0:00:00	

PROPOSED TRAINSET 3

Southbound (AM)

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
Overnight Layover	72.7		0:00:00	6:48:23
Howell	73.91	6:52:00	0:08:00	7:00:00
Genoa-Chilson Hills Church	66.87	7:11:38	0:01:30	7:13:08
Hamburg-Merrill Road	60.53	7:23:00	0:01:30	7:24:30
Whitmore Station Site	57.45	7:29:26	0:01:30	7:30:56
Ann Arbor Washington	45.48	7:48:14	0:01:30	7:49:44
Hoover Station	44.66	7:54:37	0:01:30	7:56:07
AA Midday Layover	44.4	7:57:36	0:00:00	

PROPOSED TRAINSET 4

Southbound (AM)

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
Overnight Layover	72.7		0:00:00	7:18:23
Howell	73.91	7:22:00	0:08:00	7:30:00
Genoa-Chilson Hills Church	66.87	7:41:38	0:01:30	7:43:08
Hamburg-Merrill Road	60.53	7:53:00	0:01:30	7:54:30
Whitmore Station Site	57.45	7:59:26	0:01:30	8:00:56
Ann Arbor Washington	45.48	8:18:14	0:01:30	8:19:44
Hoover Station	44.66	8:24:37	0:01:30	8:26:07
AA Midday Layover	44.4	8:27:36	0:00:00	

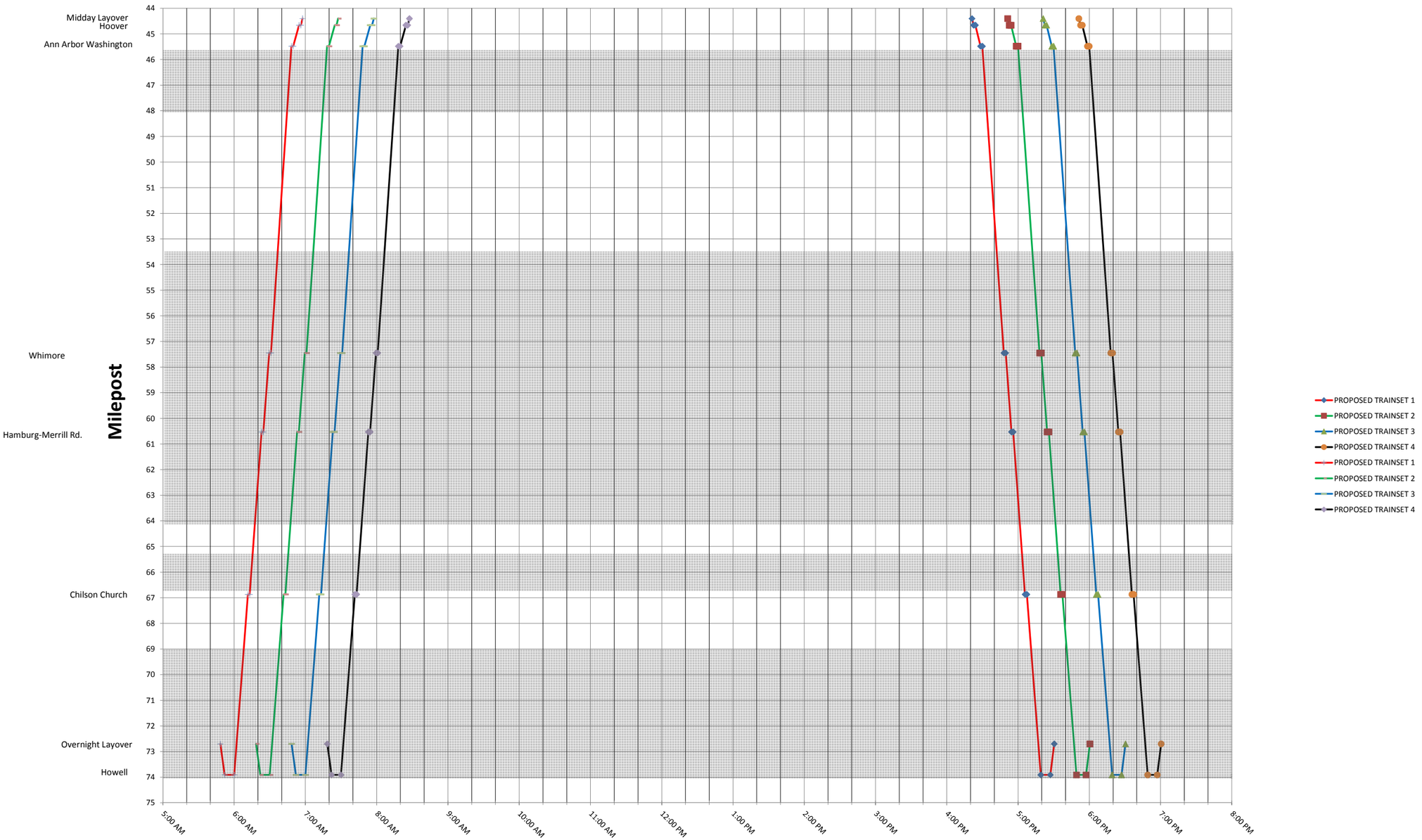
NOTES

1 A schedule pad of 7% of the TPC run time including intermediately station dwells is added to each station to station segment

2 The trainset dwells 8 minutes at Howell Station to change ends and board departing passengers.

8/17/15

North-South Commuter Rail
Degraded Curve and Speed Analysis

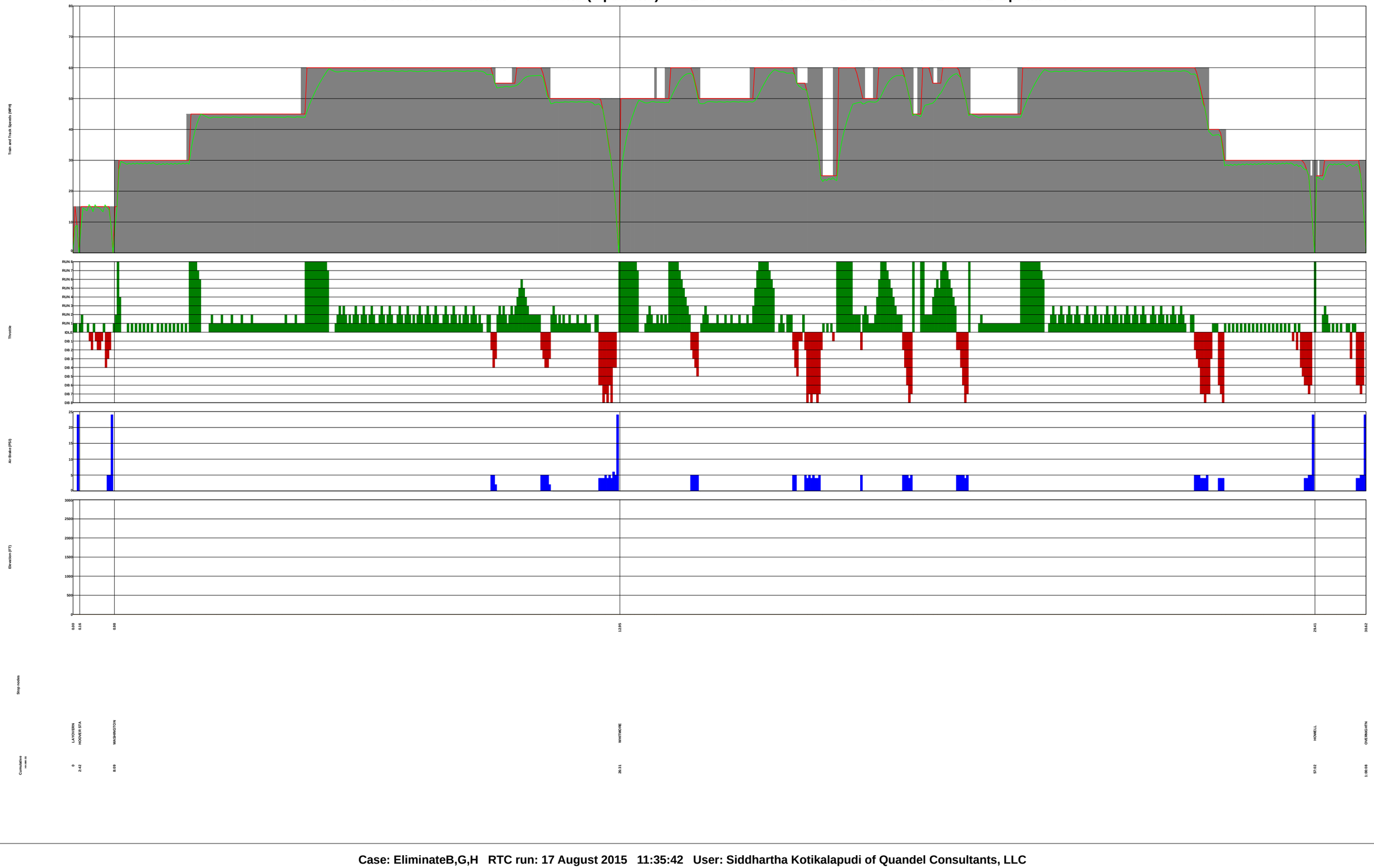


APPENDIX III: OPTION 3 STARTER SERVICE HOWELL-WHITMORE LAKE-ANN ARBOR: SERVICE PLAN PARAMETERS

Prepared by Quandel Consultants, LLC for SmithGroupJJR, Inc.
October 14, 2016

North-South Commuter Rail

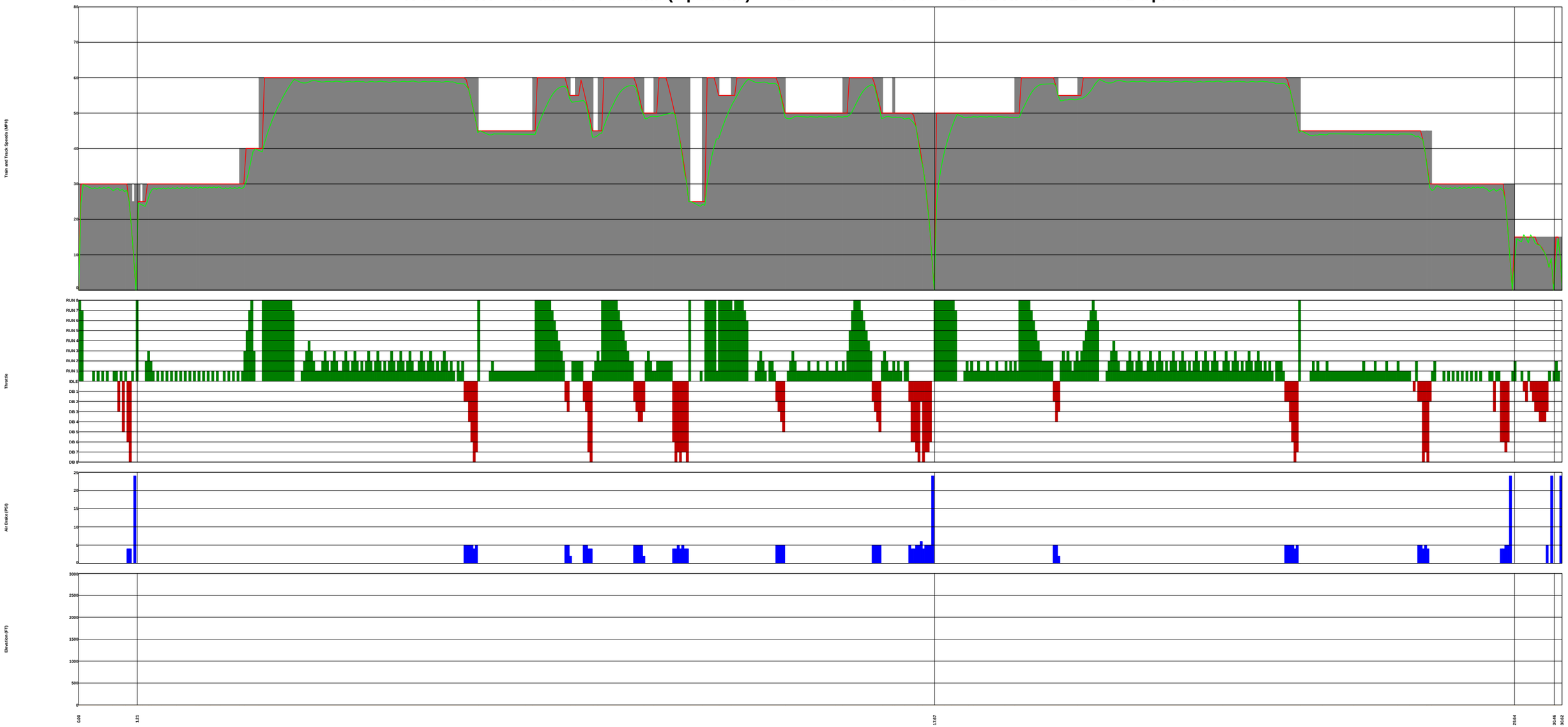
N-S NORTH Consist: 4 coachs (0 patrons) 323 tons 407 feet 10.61 HP/ton Locos: 1 Opr MP36PH



Case: EliminateB,G,H RTC run: 17 August 2015 11:35:42 User: Siddhartha Kotikalapudi of Quandel Consultants, LLC

North-South Commuter Rail

N-S SOUTH Consist: 4 coachs (0 patrons) 323 tons 407 feet 10.61 HP/ton Locos: 1 Opr MP36PH



Stop nodes

Cumulative mm:ss	
0	OVERNGHTN
10:51	HOWELL
35:00	WHITMORE
52:34	WASHINGTON
59:32	HOOVER STA
59:54	LAYOVERN

Case: EliminateB,G,H RTC run: 17 August 2015 11:35:57 User: Siddhartha Kotikalapudi of Quandel Consultants, LLC

Quandel Consultants, LLC
17-Aug-15

North-South Commuter Rail
Degraded Curve and Speed Analysis

Curve	Existing Conditions									Proposed Conditions						
	Milepost		Degree of Curve				Radius (ft.)	Superelevation E(a)	Spiral Length Ls (ft.)	Design Speed Limits		New Superelevation $E(a)_{new}$	Unbalance E(u)	Unbalance E(u)	Spiral Length due to Lateral Acceleration Ls (min) (ft.)	Spiral Length due to Roll Ls (min) (ft.)
	Start MP	End MP	D	M	S	Degree in Decimal				Passenger	Freight	Proposed	Passenger	Freight		
Ann Arbor																
AA-1	44.70	44.75	1	12	0	1.20	4774.74			15	10	0.50	-0.31	-0.42	-6	31
AA-2	45.10	45.15	1	10	0	1.17	4911.15			15	10	0.50	-0.32	-0.42	-6	31
AA-3	45.40	45.60	3	0	0	3.00	1910.08			30	30	0.50	1.39	1.39	51	31
AA-4	45.70	46.00	1	30	0	1.50	3819.83			30	30	0.50	0.45	0.45	17	31
AA-5	46.20	46.40	4	0	0	4.89	1172.05			30	30	0.50	2.58	-0.16	-6	31
AA-6	46.45	46.55	2	15	0	2.25	2546.64			30	30	0.50	0.92	0.92	34	31
AA-7	46.56	46.75	5	0	0	5.00	1146.28			30	30	0.50	2.65	2.65	97	31
Great Lakes Central																
1	47.30	47.65	1	0	0	1.00	5729.65	1.00	73.00	45	40	1.00	0.42	0.12	23.0	62
2	47.90	48.80	1	30	0	1.50	3819.83	1.00	73.00	45	40	1.00	1.13	0.68	62.0	62
3	49.45	49.90	1	30	0	1.50	3819.83	1.00	73.00	45	40	1.00	1.13	0.68	62.0	62
4	54.50	54.90	2	30	0	2.50	2292.01	3.25	216.00	55	40	3.25	2.04	-0.45	138.0	201.5
5	55.80	56.00	3	10	0	3.17	1809.57	4.75	216.00	50	40	3.25	2.29	0.30	140.0	201.5
6	56.65	56.75	3	10	0	3.17	1809.57	4.75	216.00	50	40	3.25	2.29	0.30	140.0	201.5
7	57.10	57.25	2	5	0	2.08	2750.35	2.50	216.00	50	40	2.50	1.15	-0.17	70.0	155
8	57.70	57.80	3	0	0	3.00	1910.08	3.75	205.00	50	40	3.25	2.00	0.11	122.0	201.5
9	58.07	58.27	3	0	0	3.00	1910.08	4.50	216.00	50	40	3.25	2.00	0.11	122.0	201.5
10	58.32	58.52	3	0	0	3.00	1910.08	4.50	216.00	50	40	3.25	2.00	0.11	122.0	201.5
11	59.35	59.50	3	0	0	3.00	1910.08	4.50	216.00	50	40	3.25	2.00	0.11	122.0	201.5
12	60.70	60.90	1	0	0	1.00	5729.65	1.00	216.00	60	40	1.00	1.52	0.12	112.0	62
13	61.65	61.90	2	30	0	2.50	2292.01	3.25	216.00	55	40	3.25	2.04	-0.45	138.0	201.5
14	62.25	62.50	6	0	0	6.00	955.37	2.75	91.00	25	25	1.25	1.38	1.38	42.0	77.5
15	63.25	63.45	3	0	0	3.00	1910.08	4.50	216.00	50	40	3.25	2.00	0.11	122.0	201.5
16	63.60	64.05	2	20	0	2.33	2455.70	4.00	216.00	60	40	3.25	2.63	-0.64	193.0	201.5
17	64.40	64.50	3	50	0	3.83	1494.95	4.25	187.00	45	40	3.25	2.18	1.04	120.0	201.5
18	64.87	64.97	2	56	0	2.93	1953.48	4.25	216.00	55	40	3.25	2.96	0.04	199.0	201.5
19	65.35	65.40	2	14	0	2.23	2565.65	2.50	216.00	60	40	2.75	2.88	-0.25	211.0	170.5
20	65.75	65.90	4	0	0	4.00	1432.69	4.50	187.00	45	40	3.00	2.67	1.48	147.0	186
21	66.25	66.35	2	0	0	2.00	2864.93	2.25	216.00	45	40	2.25	0.59	-0.01	33.0	139.5
22	66.60	66.70	1	55	0	1.92	2989.48	2.00	216.00	45	40	2.00	0.72	0.15	40.0	124
23	67.20	67.55	2	0	0	2.00	2864.93	2.25	216.00	60	40	2.25	2.79	-0.01	205.0	139.5
24	67.88	68.43	1	12	0	1.20	4774.74	1.50	216.00	60	40	1.50	1.52	-0.16	112.0	93
25	71.40	71.70	2	0	0	2.00	2864.93	0.75	73.00	40	40	0.75	1.49	1.49	73.0	46.5
26	72.40	72.65	3	0	0	3.00	1910.08	1.00	73.00	30	35	1.00	0.89	1.57	33.0	62
27	73.10	73.40	3	0	0	3.00	1910.08	1.00	73.00	30	20	1.00	0.89	-0.16	33.0	62
28	73.62	73.67	3	47	0	3.78	1514.70	1.00	73.00	30	20	1.00	1.38	0.06	51.0	62
29	73.80	73.85	6	15	0	6.25	917.19	1.75	73.00	25	20	1.00	1.73	0.75	53.0	62

NOTES

1. Eu max is 3.0 in for Budd Bilevel Coaches

2. Max speed set at 60 mph

3. New Spiral Length= Existing Spiral Length

4. Existing AARR curve, superelevation, and spiral lengths are unknown. We assume that spirals and superelevation can be adjusted to meet proposed conditions as part of the proposed surfacing work

KEY

Minor adjustments to curve, superelevation, and spiral lengths required

Large adjustments to curve, superelevation, and spiral lengths required

8/17/2015

North-South Commuter Rail
Degraded Curve and Speed Analysis
Eliminate Barton, Genoa, Hamburg

NORTHBOUND-DEGRADED SPEED

Station	*Milepost*	*Dwell (hr:min:s)*	*Cummulative Time*	*Time Between Stations*	*Time Between Stations with Pad*
AA Midday Layover	44.40	0:00:00	0:00:00	0:00:00	0:00:00
Hoover Station	44.66	0:01:30	0:02:42	0:02:42	0:02:53
Ann Arbor Washington	45.48	0:01:30	0:08:09	0:05:27	0:05:50
Whitmore Station Site	57.45	0:01:30	0:26:31	0:18:22	0:19:39
Howell	73.91	0:08:00	0:57:02	0:30:31	0:32:39
Overnight Layover	72.7	0:00:00	1:00:08	0:03:06	0:03:19
				Total Time	1:04:21

PROPOSED TRAINSET 1

Northbound (PM)

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:sec)*	*Departure Time (hr:min:sec)*
AA Midday Layover	44.4		0:00:00	16:21:17
Hoover Station	44.66	16:22:40	0:01:30	16:24:10
Ann Arbor Washington	45.48	16:28:30	0:01:30	16:30:00
Whitmore Station Site	57.45	16:48:09	0:01:30	16:49:39
Howell	73.91	17:14:18	0:08:00	17:22:18
Overnight Layover	72.7	17:25:37	0:00:00	

PROPOSED TRAINSET 2

Northbound (PM)

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
AA Midday Layover	44.4		0:00:00	16:51:17
Hoover Station	44.66	16:52:40	0:01:30	16:54:10
Ann Arbor Washington	45.48	16:58:30	0:01:30	17:00:00
Whitmore Station Site	57.45	17:18:09	0:01:30	17:19:39
Howell	73.91	17:44:18	0:08:00	17:52:18
Overnight Layover	72.7	17:55:37	0:00:00	

PROPOSED TRAINSET 3

Northbound (PM)

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
AA Midday Layover	44.4		0:00:00	17:21:17
Hoover Station	44.66	17:22:40	0:01:30	17:24:10
Ann Arbor Washington	45.48	17:28:30	0:01:30	17:30:00
Whitmore Station Site	57.45	17:48:09	0:01:30	17:49:39
Howell	73.91	18:14:18	0:08:00	18:22:18
Overnight Layover	72.7	18:25:37	0:00:00	

PROPOSED TRAINSET 4

Northbound (PM)

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
AA Midday Layover	44.4		0:00:00	17:51:17
Hoover Station	44.66	17:52:40	0:01:30	17:54:10
Ann Arbor Washington	45.48	17:58:30	0:01:30	18:00:00
Whitmore Station Site	57.45	18:18:09	0:01:30	18:19:39
Howell	73.91	18:44:18	0:08:00	18:52:18
Overnight Layover	72.7	18:55:37	0:00:00	

NOTES

1 A schedule pad of 7% of the TPC run time including intermediately station dwells is added to each station to station segment

2 The trainset dwells 8 minutes at Howell Station to detrain passengers and change ends.

8/17/2015

North-South Commuter Rail
Degraded Curve and Speed Analysis
Eliminate Barton, Genoa, and Hamburg

SOUTHBOUND-DEGRADED SPEED

Station	*Milepost*	*Dwell (hr:min:s)*	*Cummulative Time*	*Time Between Stations*	*Time Between Stations with Pad*
Overnight Layover	72.7	0:00:00	0:00:00	0:00:00	0:00:00
Howell	73.91	0:08:00	0:10:51	0:10:51	0:11:37
Whitmore Station Site	57.45	0:01:30	0:35:00	0:24:09	0:25:50
Ann Arbor Washington	45.48	0:01:30	0:52:34	0:17:34	0:18:48
Hoover Station	44.66	0:01:30	0:58:32	0:05:58	0:06:23
AA Midday Layover	44.4	0:00:00	0:59:54	0:01:22	0:01:28

Total Time 1:04:06

PROPOSED TRAINSET 1

Southbound (AM)

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
Overnight Layover	72.7		0:00:00	5:48:23
Howell	73.91	5:52:00	0:08:00	6:00:00
Whitmore Station Site	57.45	6:24:20	0:01:30	6:25:50
Ann Arbor Washington	45.48	6:43:08	0:01:30	6:44:38
Hoover Station	44.66	6:49:31	0:01:30	6:51:01
AA Midday Layover	44.4	6:52:29	0:00:00	

PROPOSED TRAINSET 2

Southbound (AM)

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
Overnight Layover	72.7		0:00:00	6:18:23
Howell	73.91	6:22:00	0:08:00	6:30:00
Whitmore Station Site	57.45	6:54:20	0:01:30	6:55:50
Ann Arbor Washington	45.48	7:13:08	0:01:30	7:14:38
Hoover Station	44.66	7:19:31	0:01:30	7:21:01
AA Midday Layover	44.4	7:22:29	0:00:00	

PROPOSED TRAINSET 3

Southbound (AM)

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
Overnight Layover	72.7		0:00:00	6:48:23
Howell	73.91	6:52:00	0:08:00	7:00:00
Whitmore Station Site	57.45	7:24:20	0:01:30	7:25:50
Ann Arbor Washington	45.48	7:43:08	0:01:30	7:44:38
Hoover Station	44.66	7:49:31	0:01:30	7:51:01
AA Midday Layover	44.4	7:52:29	0:00:00	

PROPOSED TRAINSET 4

Southbound (AM)

Station	*Milepost (mi)*	*Arrival (hr:min:sec)*	*Dwell (hr:min:s)*	*Departure Time (hr:min:sec)*
Overnight Layover	72.7		0:00:00	7:18:23
Howell	73.91	7:22:00	0:08:00	7:30:00
Whitmore Station Site	57.45	7:54:20	0:01:30	7:55:50
Ann Arbor Washington	45.48	8:13:08	0:01:30	8:14:38
Hoover Station	44.66	8:19:31	0:01:30	8:21:01
AA Midday Layover	44.4	8:22:29	0:00:00	

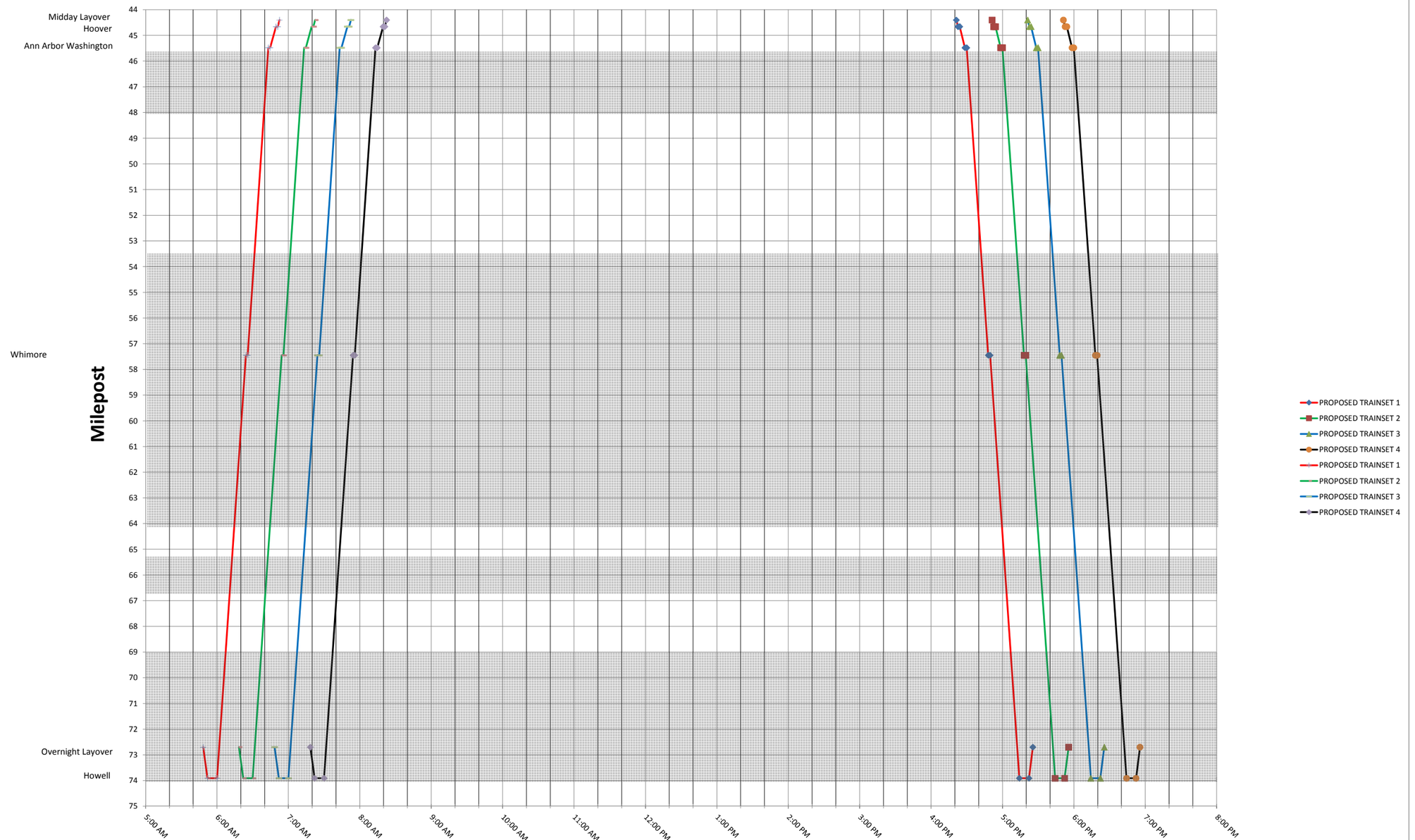
NOTES

1 A schedule pad of 7% of the TPC run time including intermediately station dwells is added to each station to station segment

2 The trainset dwells 8 minutes at Howell Station to change ends and board departing passengers.

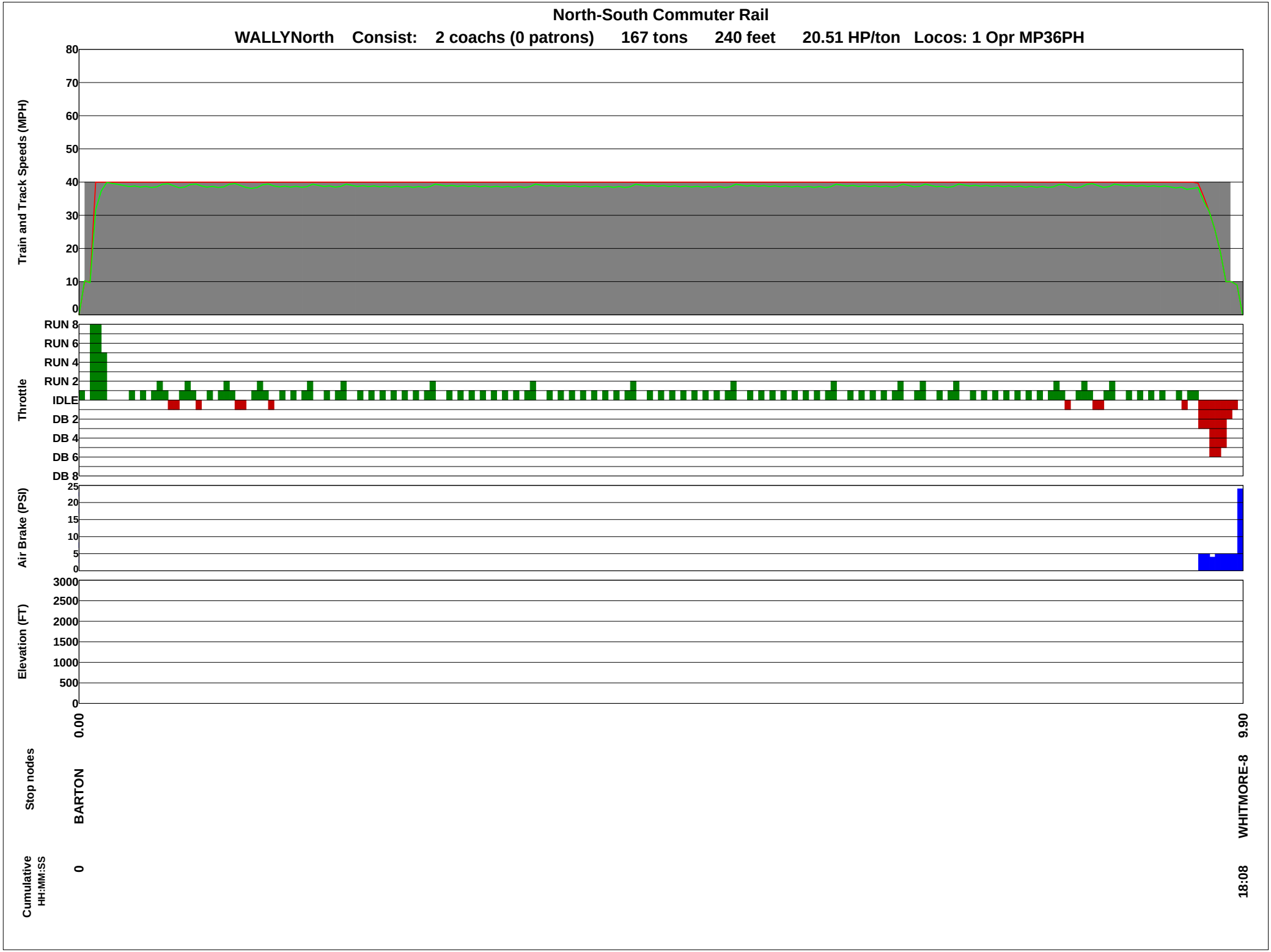
8/17/15

North-South Commuter Rail
Degraded Curve and Speed Analysis

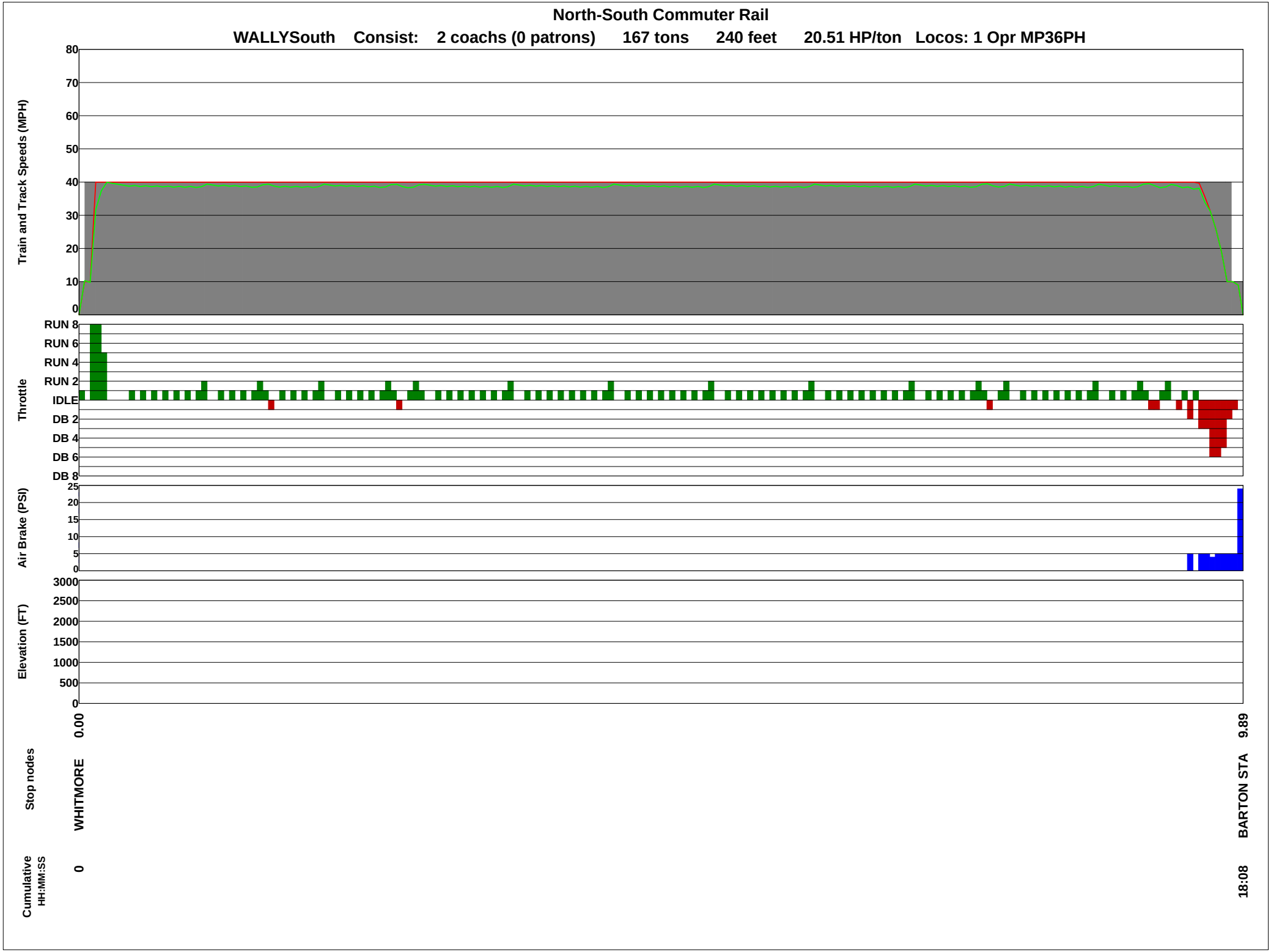


APPENDIX IV: OPTION 4A MINIMUM OPERABLE CONFIGURATION (MOC) WITH PTC: SERVICE PLAN PARAMETERS

Prepared by Quandel Consultants, LLC for SmithGroupJJR, Inc.
October 14, 2016



Case: WALLY TPC_40SofBarton RTC run: 20 March 2015 14:14:52 User: Charles Hoppesch of Quandel Consultants, LLC



Case: WALLY TPC_40SofBarton RTC run: 20 March 2015 14:14:17 User: Charles Hoppesch of Quandel Consultants, LLC

North-South Commuter Rail
MOC Schedule
07/13/15

Southbound Morning Departures & Arrivals

Station	Train 1	Train 3	Train 5	Train 7
8 Mile	05:30	06:16	07:07	07:53
Barton	05:48	06:34	07:25	08:11
AA Layover	5 min	5 min	5 min	See Note 1

Northbound Morning Departures & Arrivals

Station	Train 2	Train 4	Train 6
Barton	05:53	06:39	07:30
8 Mile	06:11	06:57	07:48
8M Layover	5 min	10 min	5 min

Note 1: Train 7 lays over at Barton Road station and becomes Afternoon Train 8.

Northbound Afternoon Departures & Arrivals

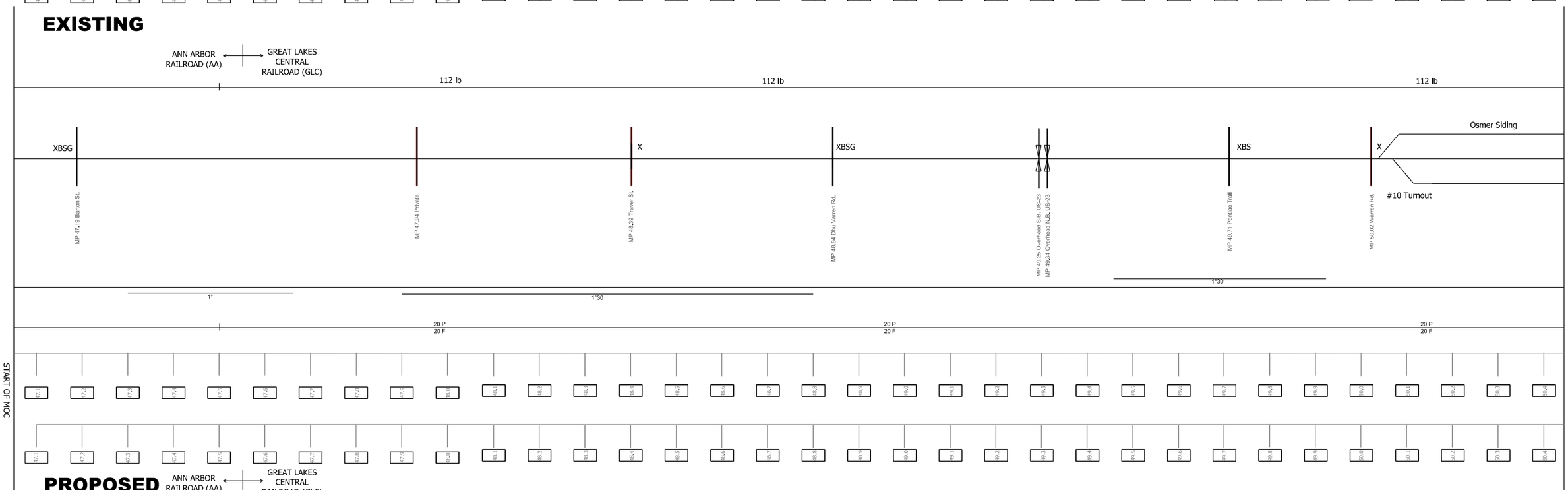
Station	Train 8	Train 10	Train 12	Train 14
Barton	15:30	16:16	17:07	17:53
8-Mile	15:48	16:34	17.25	18:11
8M Layover	5 min	5 min	5 min	See Note 2

Southbound Afternoon Departures & Arrivals

Station	Train 9	Train 11	Train 13
8 Mile	15:53	16:39	17:30
Barton	16:11	16:57	17:48
AA Layover	5 min	10 min	5 min

Train 14 goes to 8-Mile layover facility at the conclusion of the operating day.

EXISTING



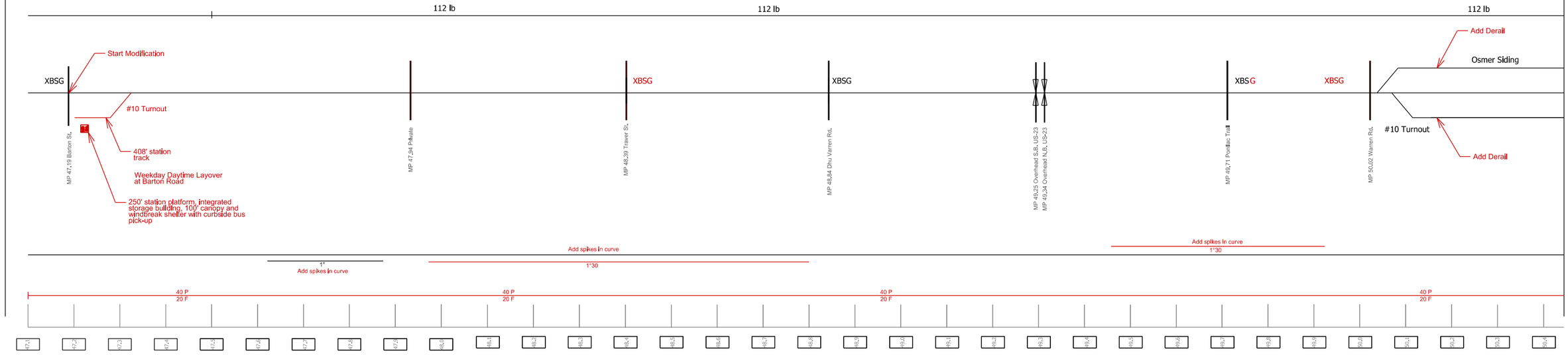
START OF MOC

MATCHLINE A- MP 50.45

PROPOSED

ANN ARBOR RAILROAD (AA) ⟷ GREAT LAKES CENTRAL RAILROAD (GLC)

Ann Arbor- Barton Station MP 47.24



QUANDEL

REV	DATE	BY	APP.	DESCRIPTION

DESIGNED: KRM
DRAWN: KRM
CHECKED: WRM
APPROVED: WRM
DATE: 04/13/2015

50′
0′

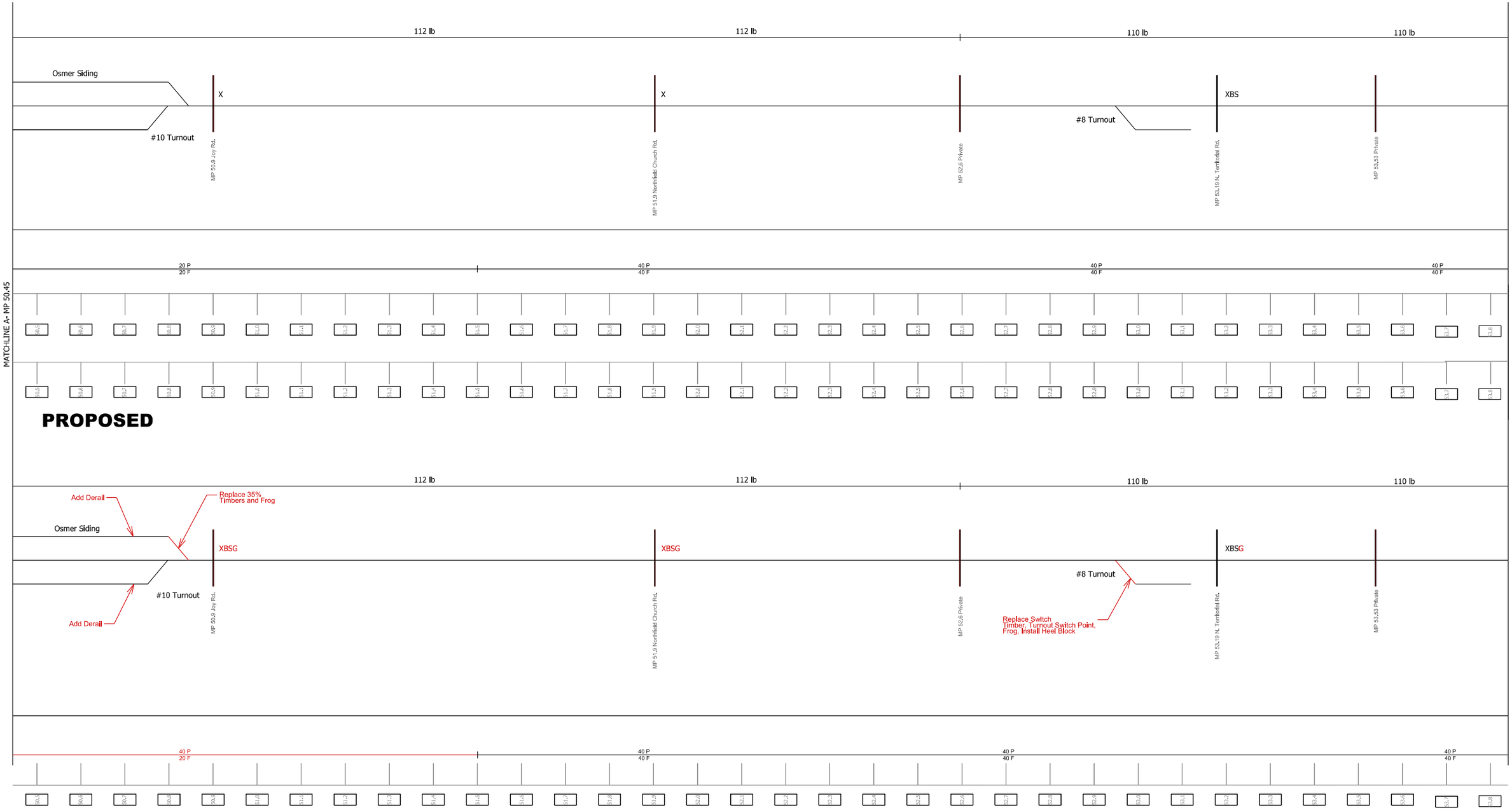
Existing Track
Proposed New Track
Existing Turnout
Proposed Turnout
At Grade Road Crossing
Railroad Bridge Over Waterway
Road Underpass
Road Overpass
6°15′ Curve Length and Degree

X	Existing Railroad Crossing Sign	X	Proposed Railroad Crossing Sign
B	Existing Bell	B	Proposed Bell
S	Existing Signal	S	Proposed Signal
C	Existing Cantilever Signal	C	Proposed Cantilever Signal
G	Existing Gates	G	Proposed Gates

NORTH-SOUTH COMMUTER RAIL MINIMUM OPERABLE CONFIGURATION EXISTING AND PROPOSED TRACK SCHEMATICS

PROJECT ID Quandel1404
DRAWING NO.
SCALE:
SHEET NO. 1 OF 4

EXISTING



PROPOSED

REV	DATE	BY	APP.	DESCRIPTION

DESIGNED: KRM
DRAWN: KRM
CHECKED: WRM
APPROVED: WRM
DATE: 04/13/2015

50′
0′

Existing Track
Proposed New Track
Existing Turnout
Proposed Turnout
At Grade Road Crossing
Railroad Bridge Over Waterway
Road Underpass
Road Overpass
6°15′ Curve Length and Degree

	Existing	Proposed
X	Railroad Crossing Sign	Railroad Crossing Sign
B	Bell	Bell
S	Signal	Signal
C	Cantilever Signal	Cantilever Signal
G	Gates	Gates

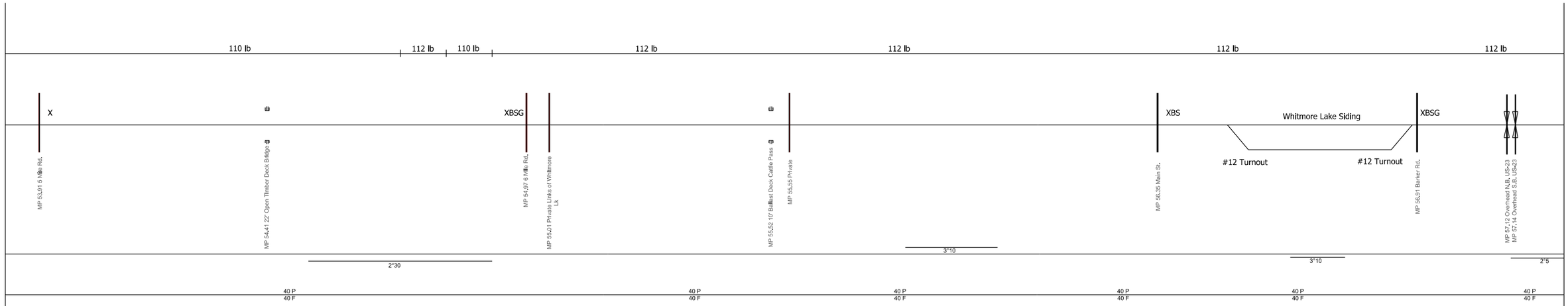
NORTH-SOUTH COMMUTER RAIL MINIMUM OPERABLE CONFIGURATION EXISTING AND PROPOSED TRACK SCHEMATICS

PROJECT ID Quandel1404
DRAWING NO.
SCALE:
SHEET NO. 2 OF 4

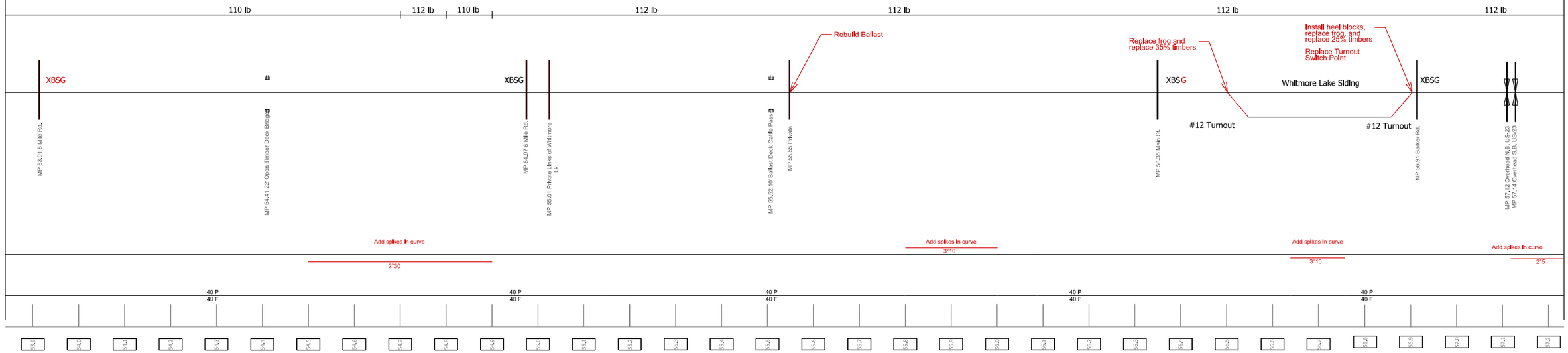
MATCHLINE B- MP 53.85

MATCHLINE C- MP 57.25

EXISTING



PROPOSED



REV	DATE	BY	APP.	DESCRIPTION

DESIGNED: KRM
DRAWN: KRM
CHECKED: WRM
APPROVED: WRM
DATE: 04/13/2015

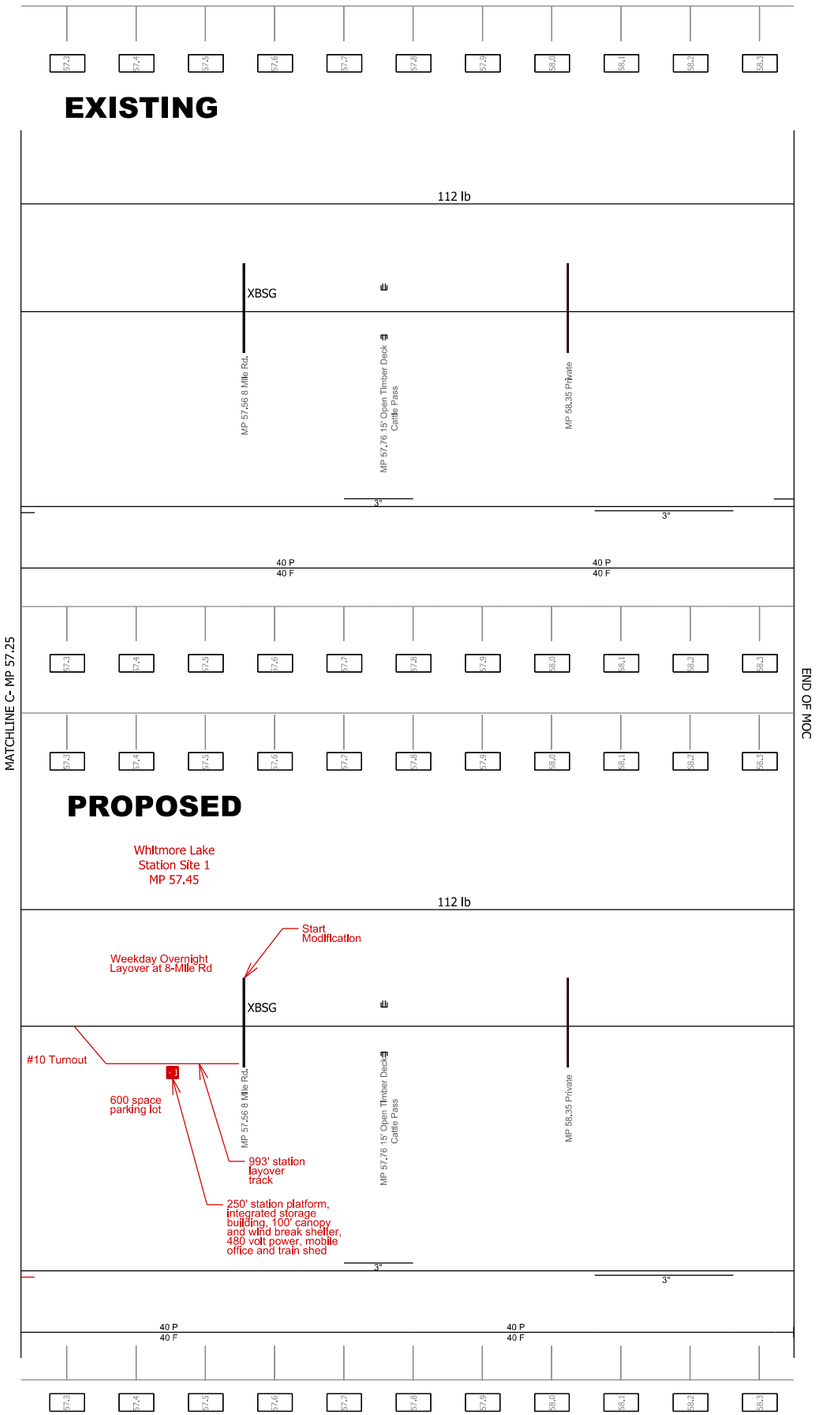
50′
0′

Existing Track
Proposed New Track
Existing Turnout
Proposed Turnout
At Grade Road Crossing
Railroad Bridge Over Waterway
Road Underpass
Road Overpass
6°15′ Curve Length and Degree

X	Existing Railroad Crossing Sign	X	Proposed Railroad Crossing Sign
B	Existing Bell	B	Proposed Bell
S	Existing Signal	S	Proposed Signal
C	Existing Cantilever Signal	C	Proposed Cantilever Signal
G	Existing Gates	G	Proposed Gates

NORTH-SOUTH COMMUTER RAIL MINIMUM OPERABLE CONFIGURATION EXISTING AND PROPOSED TRACK SCHEMATICS

PROJECT ID Quandel1404
DRAWING NO.
SCALE:
SHEET NO. 3 OF 4



QUANDEL

REV	DATE	BY	APP.	DESCRIPTION

DESIGNED: KRM
DRAWN: KRM
CHECKED: WRM
APPROVED: WRM
DATE: 04/13/2015

50′
0′

Existing Track
Proposed New Track
Existing Turnout
Proposed Turnout
At Grade Road Crossing
Railroad Bridge Over Waterway
Road Underpass
Road Overpass
6°15′ Curve Length and Degree

X	Existing Railroad Crossing Sign	X	Proposed Railroad Crossing Sign
B	Existing Bell	B	Proposed Bell
S	Existing Signal	S	Proposed Signal
C	Existing Cantilever Signal	C	Proposed Cantilever Signal
G	Existing Gates	G	Proposed Gates

NORTH-SOUTH COMMUTER RAIL MINIMUM OPERABLE CONFIGURATION EXISTING AND PROPOSED TRACK SCHEMATICS

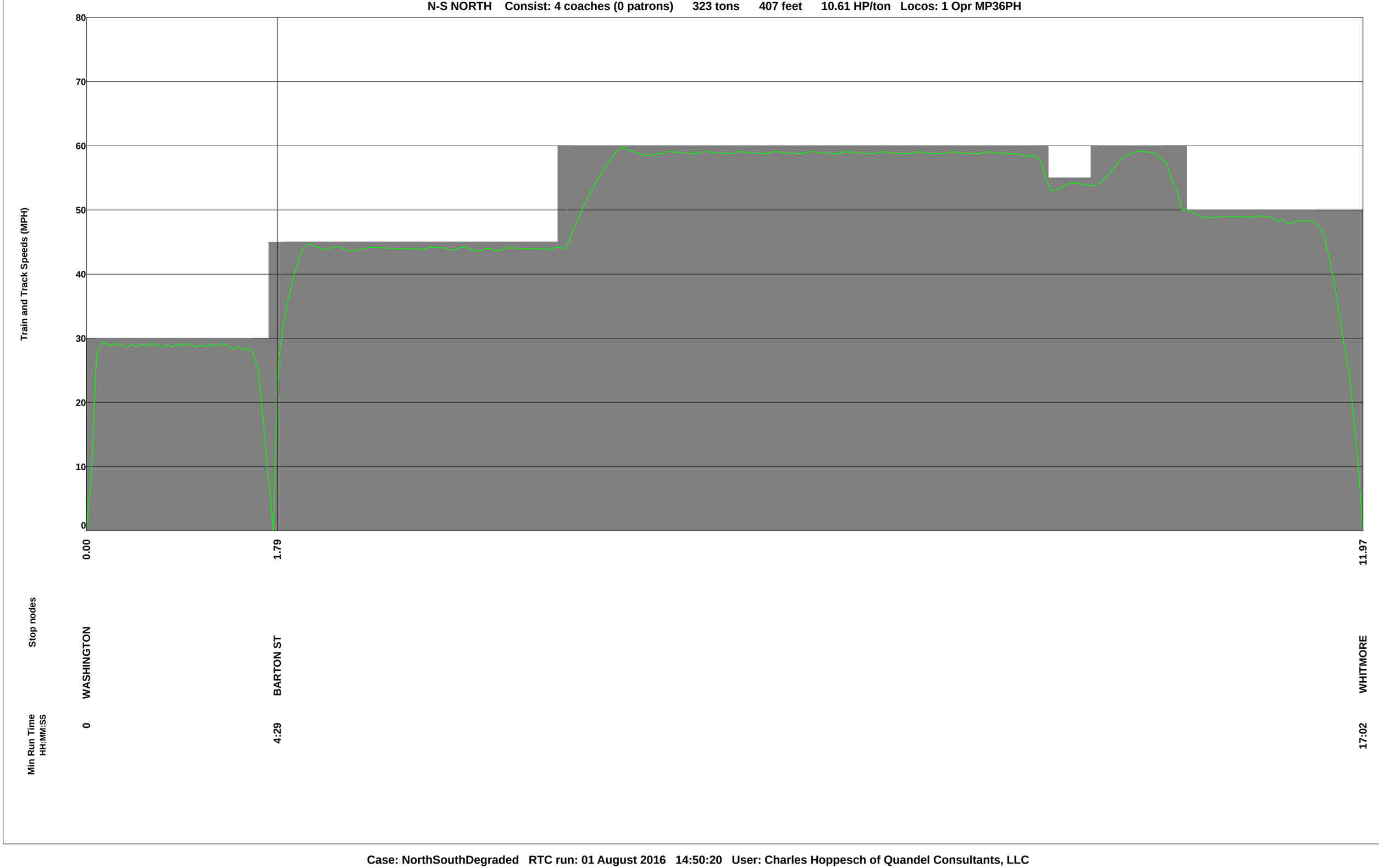
PROJECT ID Quandel1404
DRAWING NO.
SCALE:
SHEET NO. 4 OF 4

APPENDIX V: OPTIONS 5A AND 5B SHUTTLE SERVICE: WHITMORE LAKE/BARTON DRIVE/ANN ARBOR: SERVICE PLAN PARAMETERS

Prepared by Quandel Consultants, LLC for SmithGroupJJR, Inc.
October 14, 2016

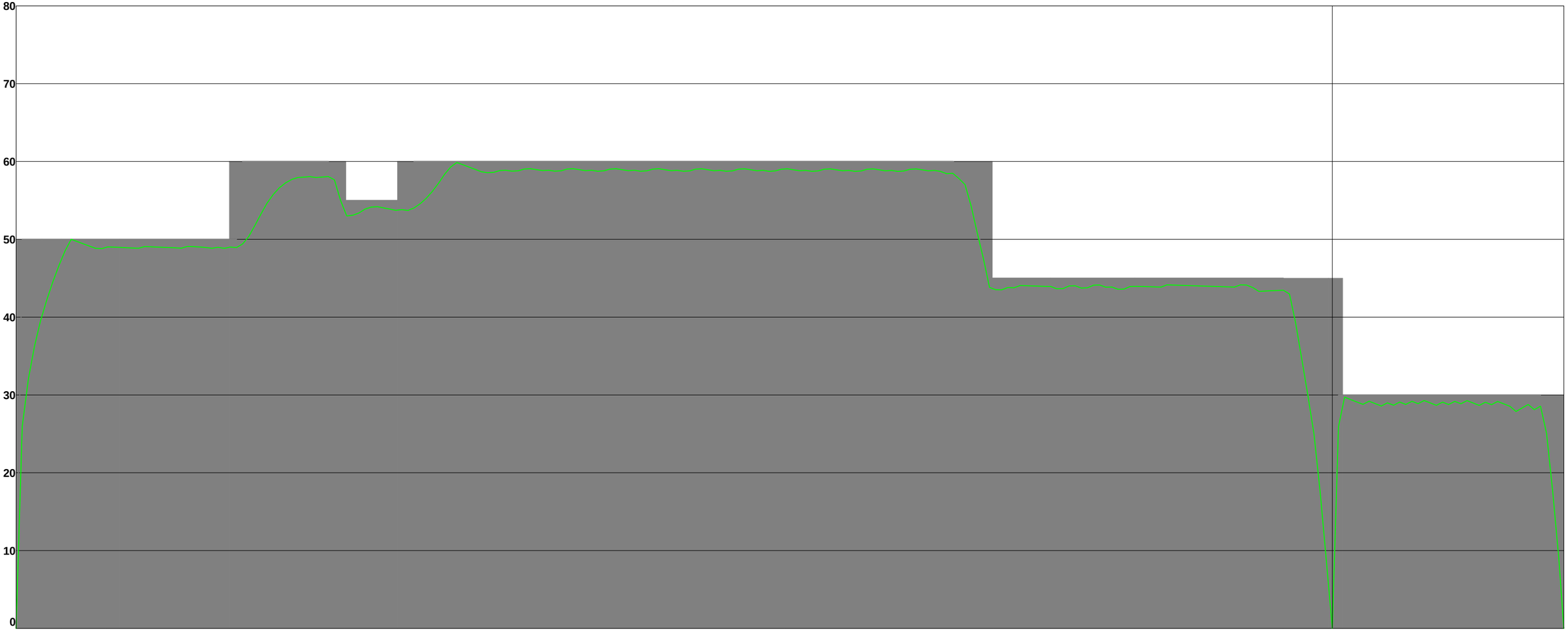
North-South Commuter Rail

N-S NORTH Consist: 4 coaches (0 patrons) 323 tons 407 feet 10.61 HP/ton Locos: 1 Opr MP36PH



North-South Commuter Rail

N-S SOUTH Consist: 4 coaches (0 patrons) 323 tons 407 feet 10.61 HP/ton Locos: 1 Opr MP36PH



Stop nodes	WHITMORE	BARTON ST	WASHINGTON
Min Run Time HH:MM:SS	0	12:28	16:34
	0.00	10.18	11.97

One Train Set														
PM Northbound				AM Northbound			*Stations*	AM Southbound				*PM Southbound*		
1016	***1014***	***1012***	***1010***	***1006***	***1004***	***1002***		***1001***	***1003***	***1005***	***1007***	***1011***	***1013***	***1015***
19:14:00	18:13:00	17:07:00	16:06:00	8:20:00	7:14:00	6:13:00	**Whitmore Lake Station**	5:22:00	6:23:00	7:29:00	8:30:00	16:16:00	17:17:00	18:23:00
19:00:00	17:59:00	16:53:00	15:52:00	8:06:00	7:00:00	5:59:00	**Ann Arbor Barton Drive**	5:37:00	6:38:00	7:44:00	8:45:00	16:31:00	17:32:00	18:38:00
18:53:00	17:52:00	16:46:00	15:45:00	7:59:00	6:53:00	5:52:00	**Ann Arbor Washington St**	5:42:00	6:43:00	7:49:00	8:50:00	16:36:00	17:37:00	18:43:00
0:21:00	0:21:00	0:21:00	0:21:00	0:21:00	0:21:00	0:21:00	***Totals***	0:20:00	0:20:00	0:20:00	0:20:00	0:20:00	0:20:00	0:20:00

Turnaround Time ***0:10:00*** ***0:15:00*** ***Single train bathroom break***

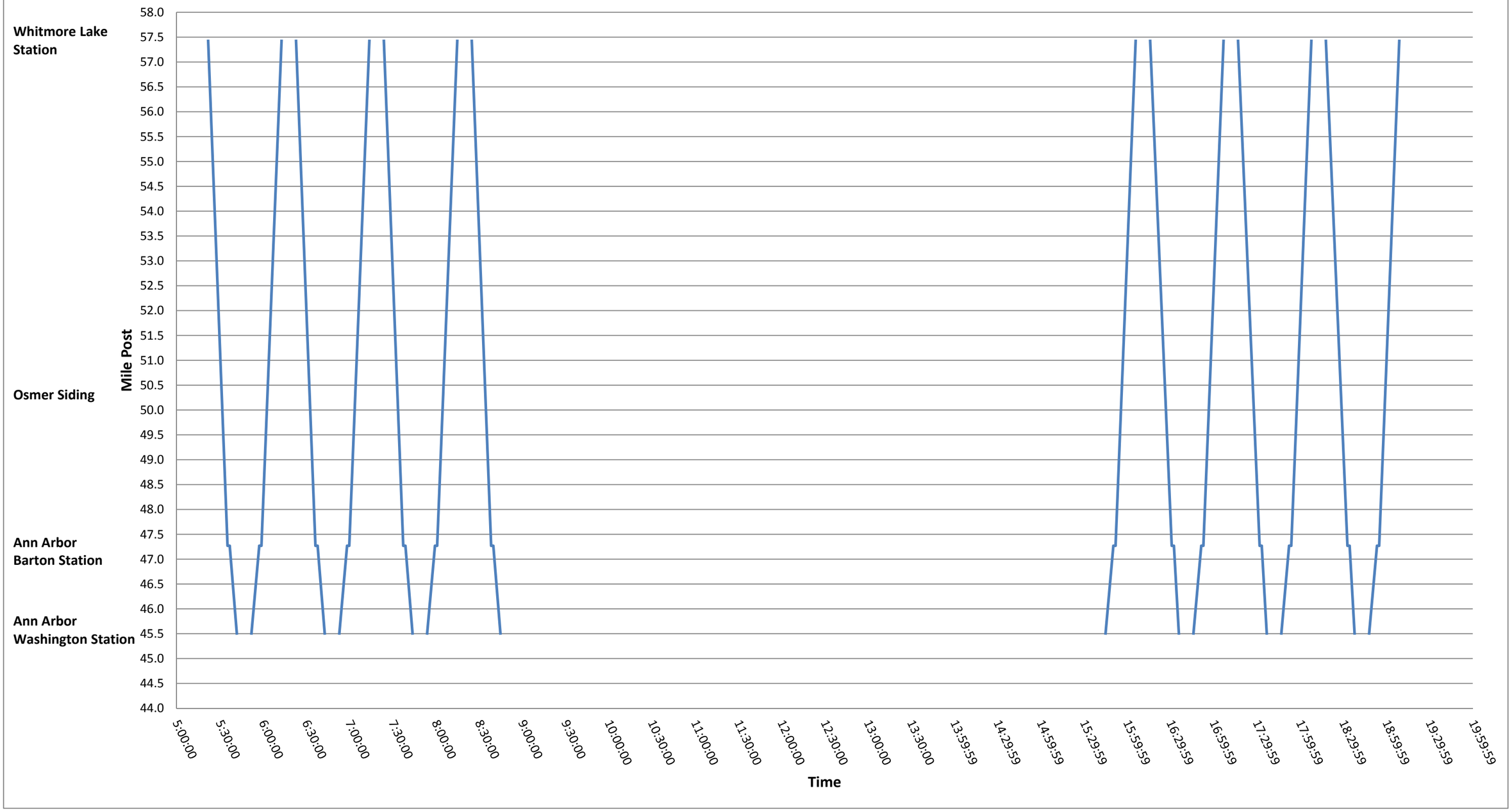
Meet1013 ***Meet 1011*** ***Meet 1005*** ***Meet 1003*** ***Meet 1002*** ***Meet 1004*** ***Meet 1012*** ***Meet1014***

Two Train Sets														
PM Northbound				AM Northbound			*Stations*	AM Southbound				*PM Southbound*		
1016	***1014***	***1012***	***1010***	***1006***	***1004***	***1002***		***1001***	***1003***	***1005***	***1007***	***1011***	***1013***	***1015***
18:32:00	17:57:00	17:21:00	16:51:00		8:01:00	7:26:00	**Whitmore Lake Station**	6:30:00	7:05:00	7:39:00	8:15:00	17:01:00	17:36:00	
18:21:55	*17:46:55*	*17:10:55*	*16:40:55*		*7:45:55*	*7:10:55*	**Osmore Siding**	*6:38:34*	*7:13:34*	*7:47:34*	*8:23:34*	*17:09:34*	*17:44:34*	
18:18:00	17:43:00	17:07:00	16:37:00		7:42:00	7:07:00	**Ann Arbor Baton Drive**	6:45:00	7:20:00	7:54:00	8:30:00	17:21:00	17:56:00	
18:11:00	17:36:00	17:00:00	16:30:00		7:35:00	7:00:00	**Ann Arbor Washington St**	6:50:00	7:25:00	7:59:00	8:35:00	17:26:00	18:01:00	
0:21:00	0:21:00	0:21:00	0:21:00	0:00:00	0:26:00	0:26:00	***Totals***	0:20:00	0:20:00	0:20:00	0:20:00	0:25:00	0:25:00	0:00:00
1	***2***	***1***	***2***		***2***	***1***	***Train Set***	***1***	***2***	***1***	***2***	***2***	***1***	

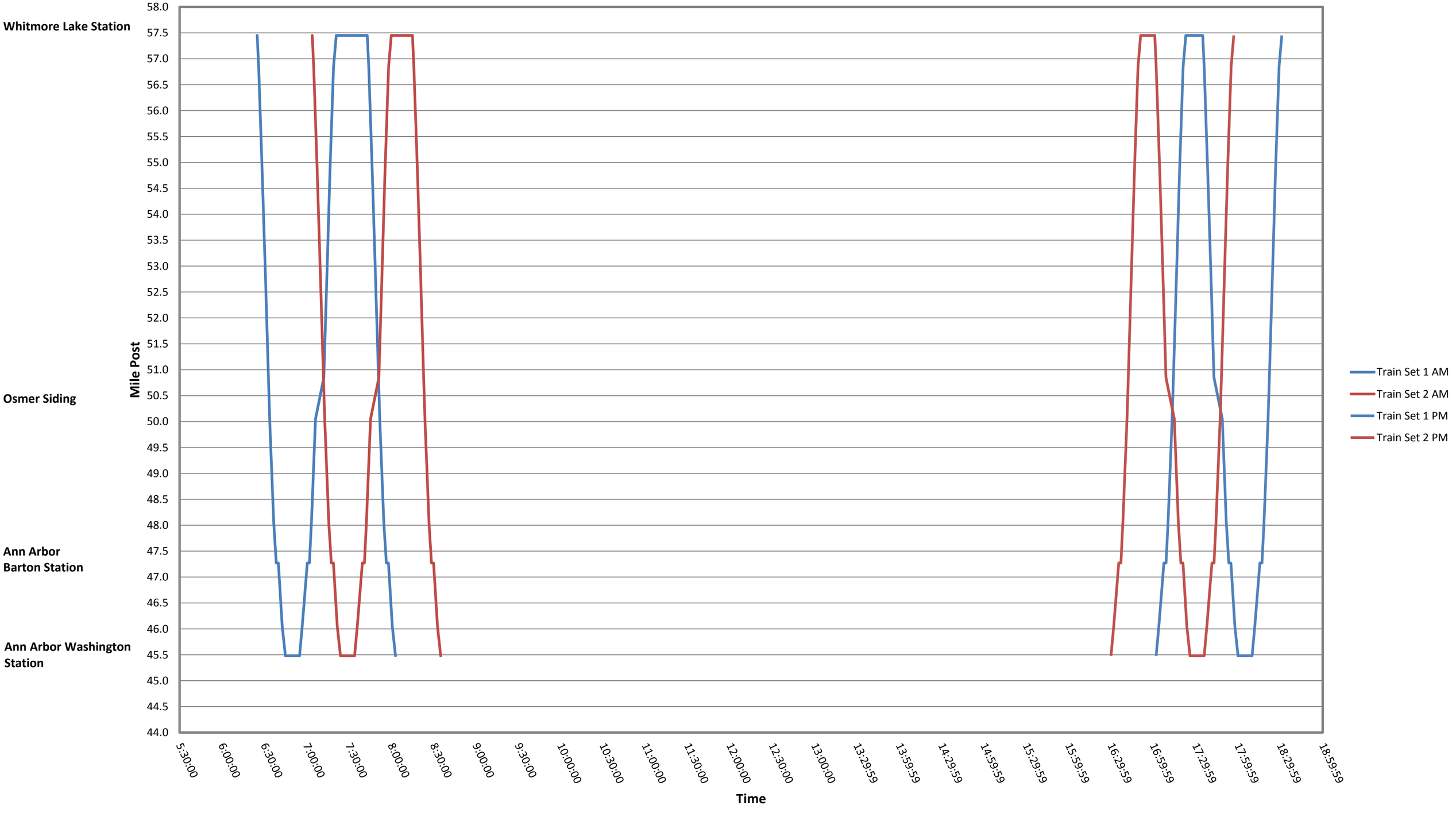
Turnaround Time ***0:10:00***

Meet Penalty ***0:05:00***

North-South Commuter Rail
Degraded Curve and Speed Analysis
Schedule Stringline with One Trainset



North-South Commuter Rail
Degraded Curve and Speed Analysis
Schedule Stringline with Two Trainsets



NORTH-SOUTH COMMUTER RAIL

PROPOSED INFRASTRUCTURE IMPROVEMENTS

LEGEND

- EXISTING TRACK
- FUTURE TRACK
- PROPOSED NEW TRACK
- REMOVE/REPLACE TRACK
- EXISTING TURNOUT
- PROPOSED TURNOUT
- AT GRADE CROSSING
- RAILROAD BRIDGE OVER WATERWAY
- ROAD UNDERPASS
- ROAD OVERPASS
- TRACK SHIFT
- 6°15' CURVE LENGTH AND DEGREE
- PROPOSED INTERMEDIATE SIGNAL

ABBREVIATIONS

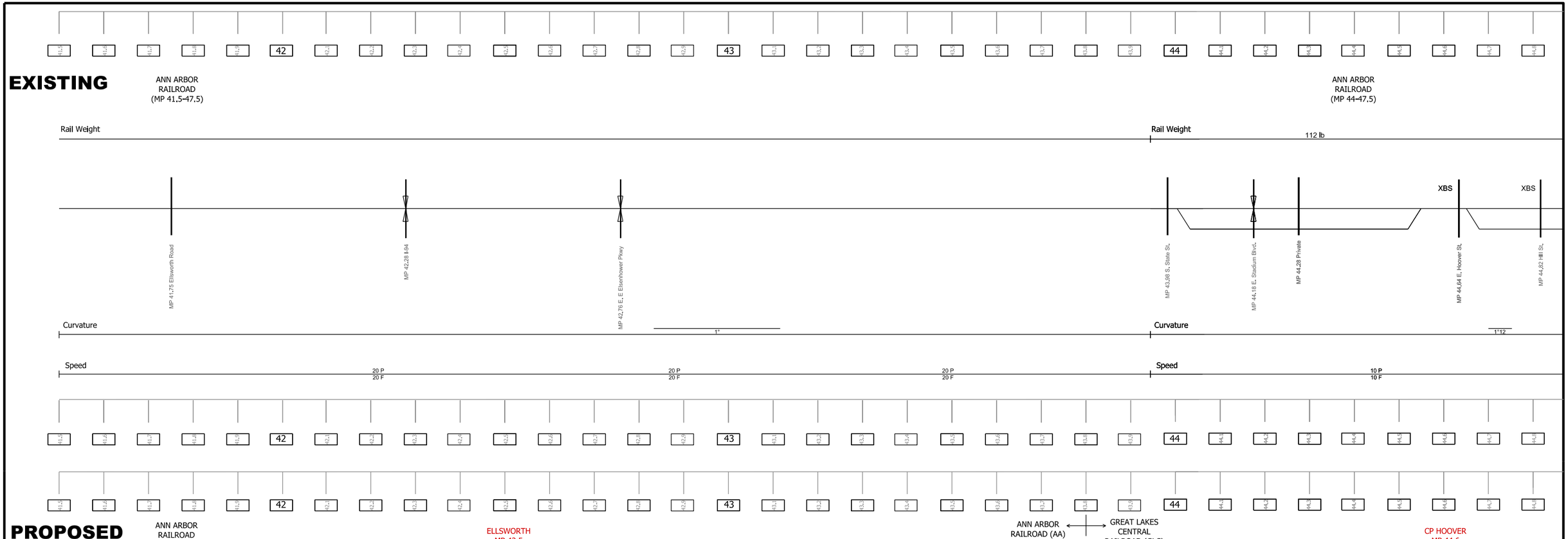
HTTO	HAND THROW TURNOUT
POTO	POWER OPERATED TURNOUT
MP	MILEPOST
CTC	CENTRALIZED TRAFFIC CONTROL
PTC	POSITIVE TRAIN CONTROL
CTC	CONTINUOUS WELDED RAIL
ATR	ABOVE TOP OF RAIL
IN	INCHES
P	PASSENGER
F	FREIGHT
TFT	TRACK FEET
LB	POUND
EL	ELECTRIC LOCK
D	DERAIL

CROSSING ABBREVIATIONS

X	EXISTING RAILROAD CROSSING SIGN
B	EXISTING BELL
S	EXISTING SIGNAL
C	EXISTING CANTILEVER SIGNAL
G	EXISTING GATES
X	PROPOSED RAILROAD CROSSING SIGN
B	PROPOSED BELL
S	PROPOSED SIGNAL
C	PROPOSED CANTILEVER SIGNAL
G	PROPOSED GATES

October 14,2016

EXISTING



PROPOSED

Quandel Consultants, LLC
161 N. Clark St.
Suite 2060
Chicago, IL 60601

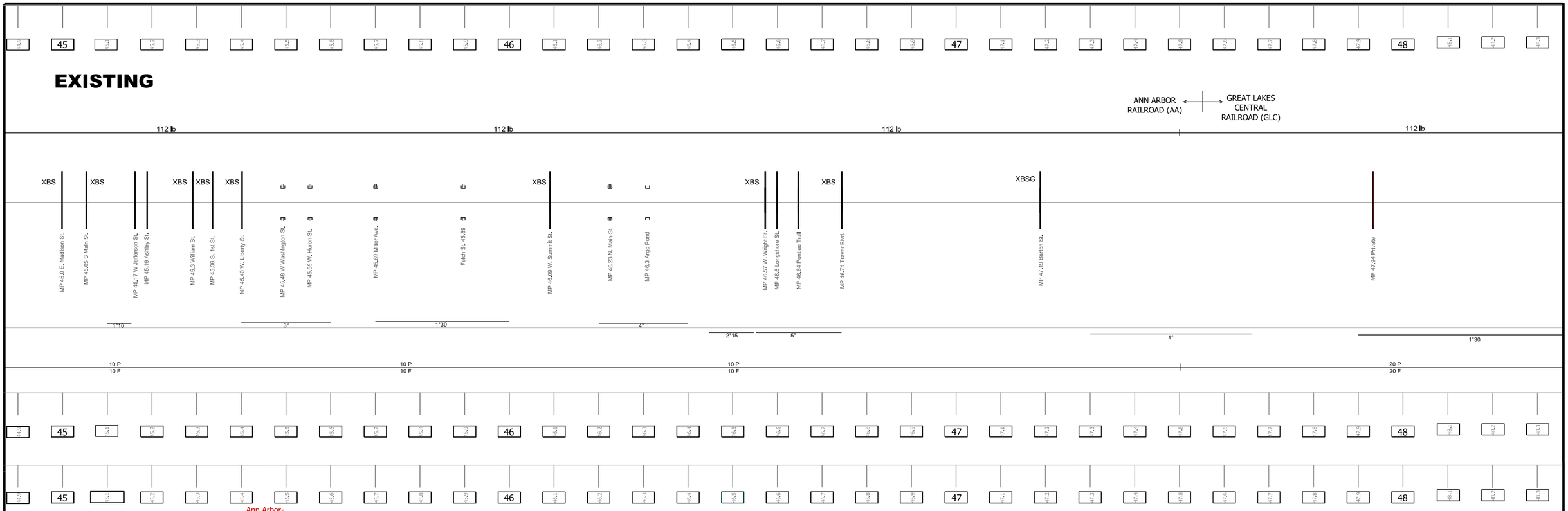
REV	DATE	BY	APP.	DESCRIPTION
0	Rev			

DESIGNED:	KRM
DRAWN:	SP
CHECKED:	WRO
APPROVED:	WRM
DATE:	10/14/2016

NORTH-SOUTH COMMUTER RAIL, OPTION 5 WL-BD-AA EXISTING AND PROPOSED TRACK SCHEMATICS

PROJECT ID	Quandel 1404
DRAWING NO.	
SCALE:	NTS
SHEET NO.	1 OF 5

EXISTING



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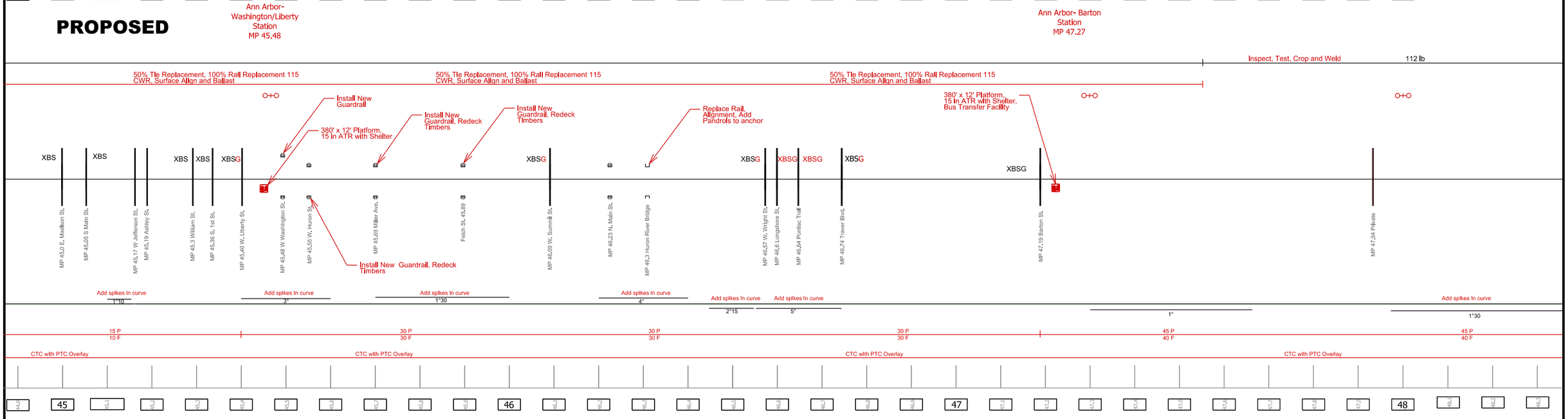


Quandel Consultants, LLC
161 N. Clark St.
Suite 2060
Chicago, IL 60601

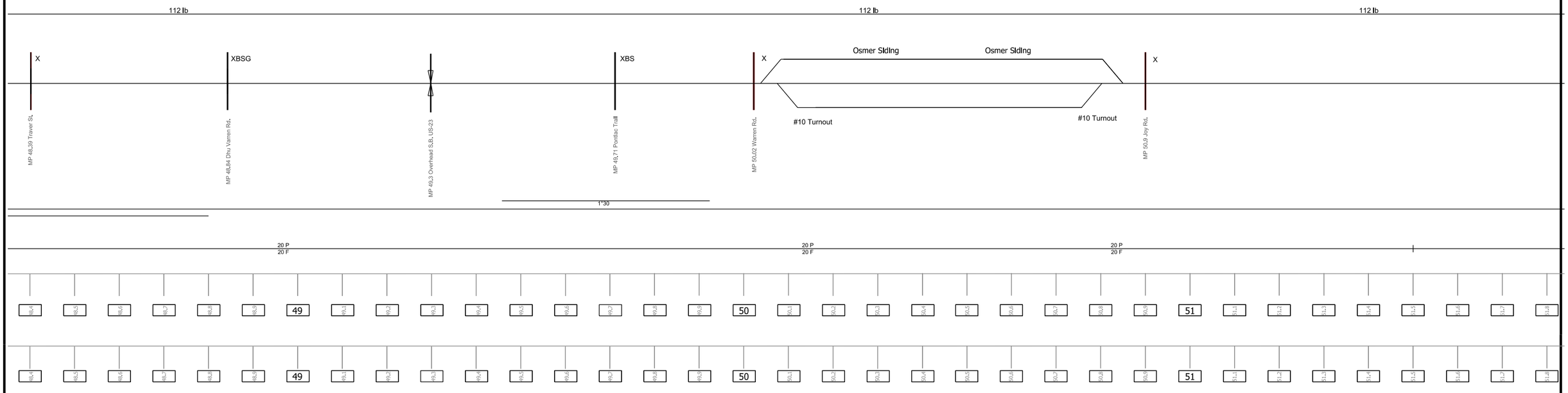
REV	DATE	BY	APP.	DESCRIPTION
0	Rev			

DESIGNED:	KRM
DRAWN:	SP
CHECKED:	WRO
APPROVED:	WRM
DATE:	10/14/2016

NORTH-SOUTH COMMUTER RAIL, OPTION 5 WL-BD-AA EXISTING AND PROPOSED TRACK SCHEMATICS

PROJECT ID	Quandel 1404
DRAWING NO.	
SCALE:	NTS
SHEET NO.	2 OF 5

EXISTING



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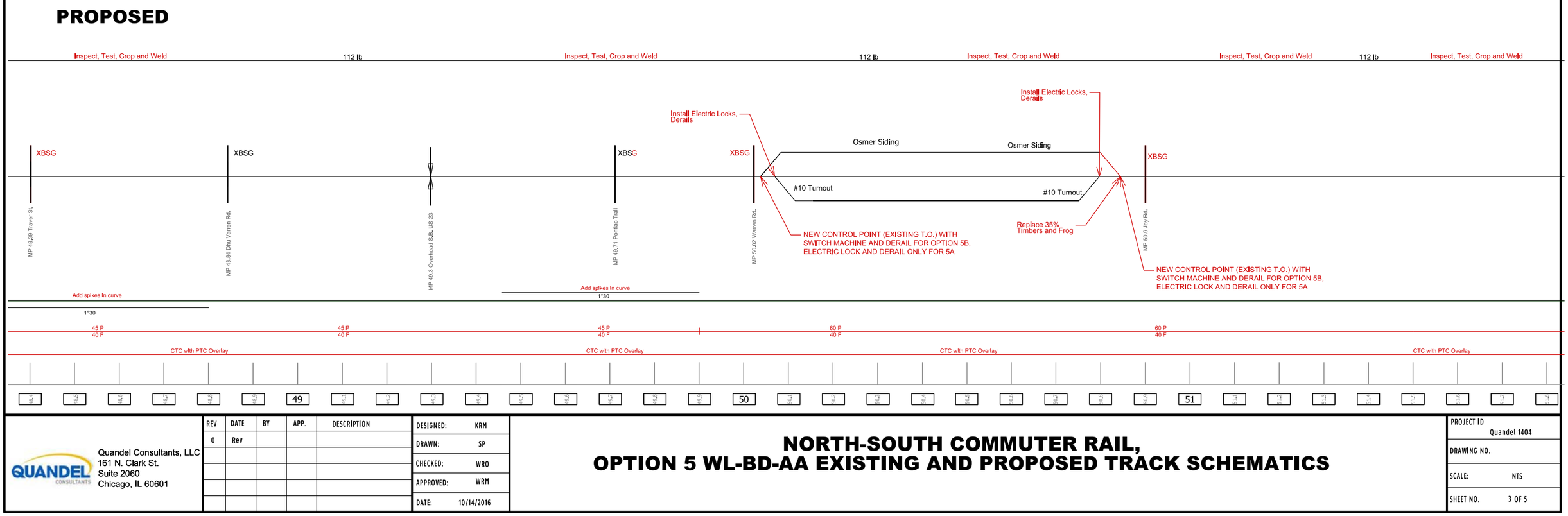

Quandel Consultants, LLC
161 N. Clark St.
Suite 2060
Chicago, IL 60601

REV	DATE	BY	APP.	DESCRIPTION
0	Rev			

DESIGNED:	KRM
DRAWN:	SP
CHECKED:	WRO
APPROVED:	WRM
DATE:	10/14/2016

NORTH-SOUTH COMMUTER RAIL, OPTION 5 WL-BD-AA EXISTING AND PROPOSED TRACK SCHEMATICS

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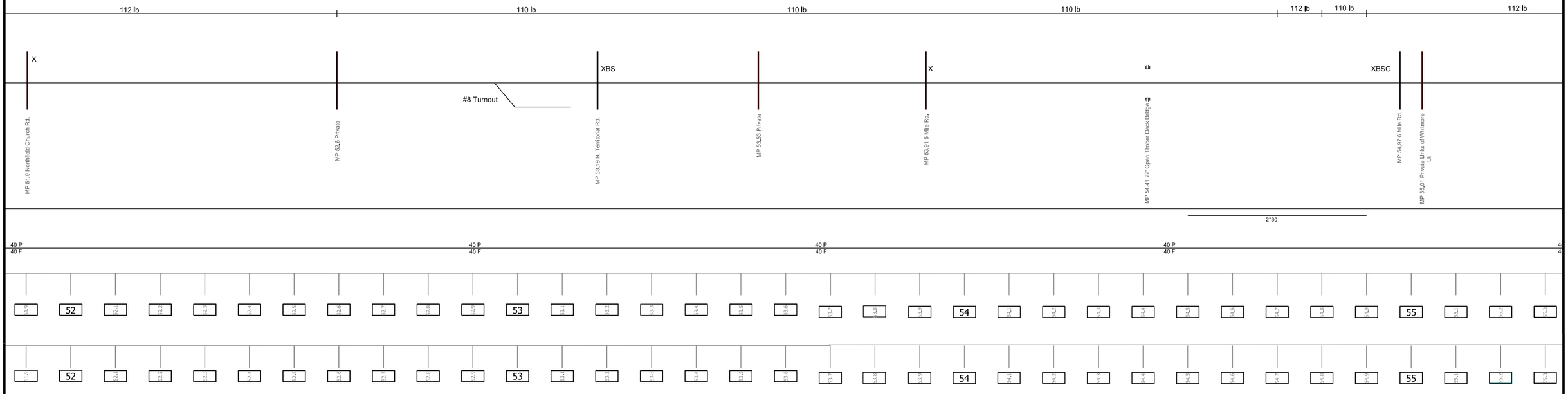
DRAWING NO.	
SCALE:	NTS
SHEET NO.	3 OF 5

EXISTING



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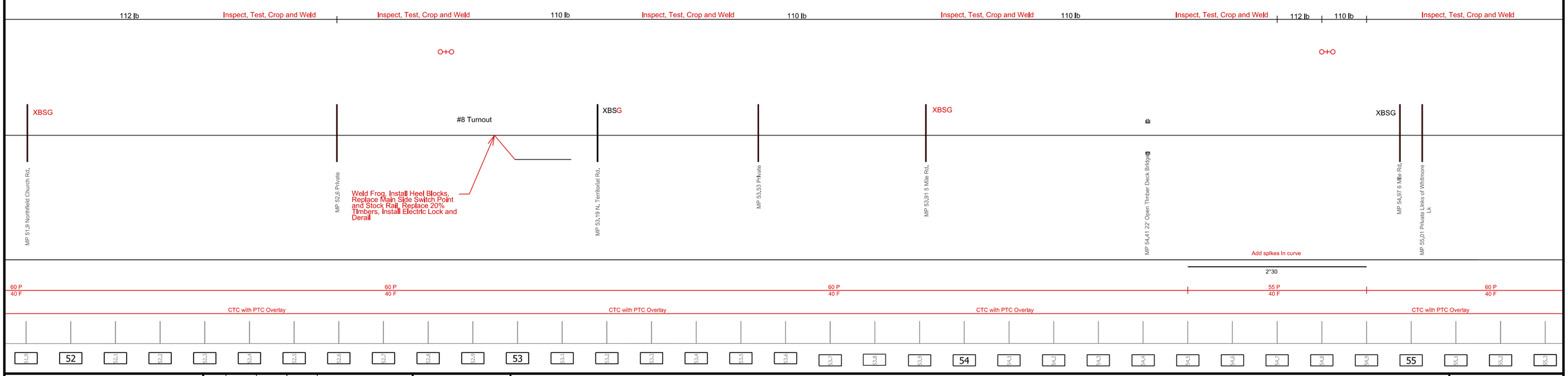


Quandel Consultants, LLC
161 N. Clark St.
Suite 2060
Chicago, IL 60601

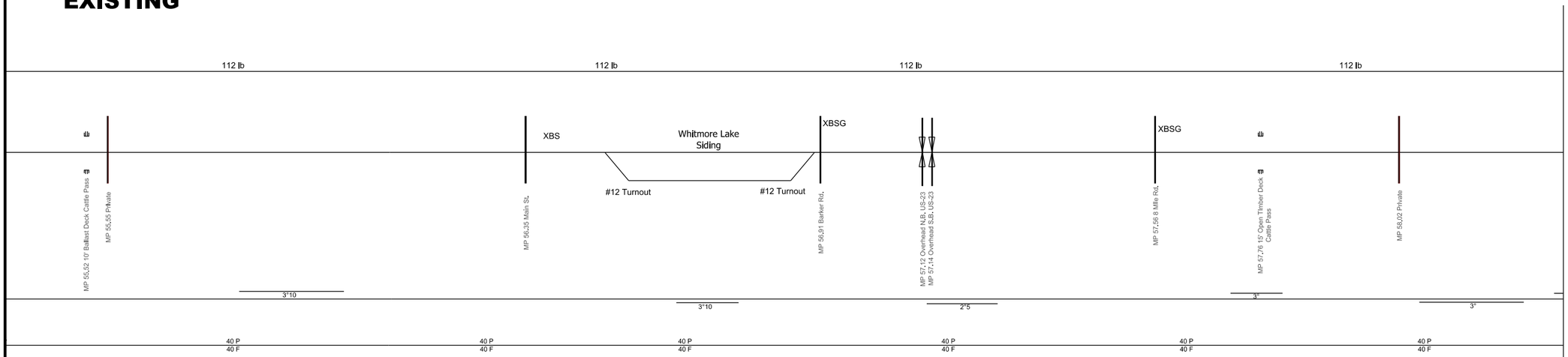
REV	DATE	BY	APP.	DESCRIPTION
0	Rev			

DESIGNED:	KRM
DRAWN:	SP
CHECKED:	WRO
APPROVED:	WRM
DATE:	10/14/2016

NORTH-SOUTH COMMUTER RAIL, OPTION 5 WL-BD-AA EXISTING AND PROPOSED TRACK SCHEMATICS

PROJECT ID	Quandel 1404
DRAWING NO.	
SCALE:	NTS
SHEET NO.	4 OF 5

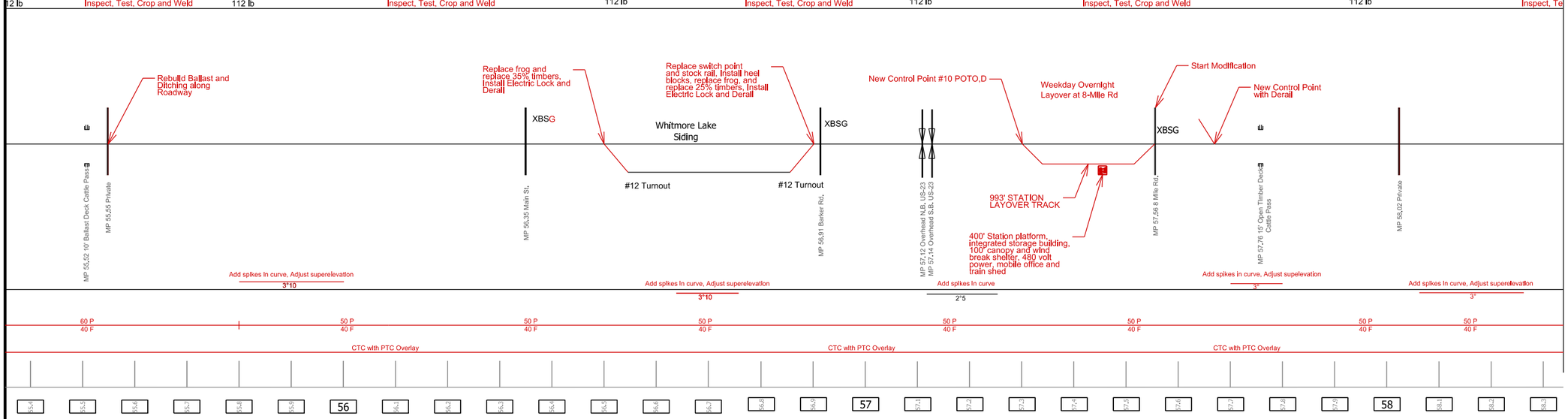
EXISTING



END OF MOC

PROPOSED

Whitmore Lake Station Site MP 57.45



Quandel Consultants, LLC
161 N. Clark St.
Suite 2060
Chicago, IL 60601

REV	DATE	BY	APP.	DESCRIPTION
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DESIGNED:	KRM
DRAWN:	SP
CHECKED:	WRO
APPROVED:	WRM
DATE:	10/14/2016

NORTH-SOUTH COMMUTER RAIL, OPTION 5 WL-BD-AA EXISTING AND PROPOSED TRACK SCHEMATICS

PROJECT ID	Quandel 1404
DRAWING NO.	
SCALE:	NTS
SHEET NO.	5 OF 5

APPENDIX VI REVENUE COMPUTATIONS

Prepared by Quandel Consultants, LLC for SmithGroupJJR, Inc.
October 14, 2016

Option 1 Full Service

Average Weekday Revenue

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor- Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	**TOTAL**
Ann Arbor-Washington (MP 45.48)	$ -	$ 315.02	$ 700.73	$ 361.85	$ 168.56	$ 361.76	$ 1,907.91
Ann Arbor-Barton (MP 47.27)	$ 315.02	$ -	$ 409.09	$ 181.07	$ 87.48	$ 193.60	$ 1,186.26
Whitmore Lake (MP 57.45)	$ 700.73	$ 409.09	$ -	$ -	$ -	$ -	$ 1,109.82
Hamburg (MP 60.53)	$ 361.85	$ 181.07	$ -	$ -	$ -	$ -	$ 542.92
Genoa (MP 66.87)	$ 168.56	$ 87.48	$ -	$ -	$ -	$ -	$ 256.04
Howell (MP 73.91)	$ 361.76	$ 193.60	$ -	$ -	$ -	$ -	$ 555.36
TOTAL	$ 1,907.91	$ 1,186.26	$ 1,109.82	$ 542.92	$ 256.04	$ 555.36	$ 5,558.32

$ 5,558.32 per day

262 days per year

$ 1,456,279.11 annual revenue (Not used for this study)

NOTE: Boardings and alightings at AA-Stadium are assigned to AA-Washington

Metthod 2-Using Metra Rates

Annual Revenue- 1 Way

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor- Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	**TOTAL**
Ann Arbor-Washington (MP 45.48)	$ -	$ 14,608.51	$ 32,495.43	$ 16,780.43	$ 7,816.97	$ 16,776.26	$ 88,477.60
Ann Arbor-Barton (MP 47.27)	$ 14,608.51	$ -	$ 18,971.32	$ 8,397.14	$ 4,056.59	$ 8,978.05	$ 55,011.61
Whitmore Lake (MP 57.45)	$ 32,495.43	$ 18,971.32	$ -	$ -	$ -	$ -	$ 51,466.75
Hamburg (MP 60.53)	$ 16,780.43	$ 8,397.14	$ -	$ -	$ -	$ -	$ 25,177.57
Genoa (MP 66.87)	$ 7,816.97	$ 4,056.59	$ -	$ -	$ -	$ -	$ 11,873.56
Howell (MP 73.91)	$ 16,776.26	$ 8,978.05	$ -	$ -	$ -	$ -	$ 25,754.31
TOTAL	$ 88,477.60	$ 55,011.61	$ 51,466.75	$ 25,177.57	$ 11,873.56	$ 25,754.31	$ 257,761.40

Annual Revenue for 1 way tickets was calculated by multiplying the annual number of 1 way trips by the 1 way ticket prices

Annual Revenue- 10 Ride

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor- Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	**TOTAL**
Ann Arbor-Washington (MP 45.48)	$ -	$ 12,999.10	$ 28,915.43	$ 14,931.74	$ 6,955.78	$ 14,928.03	$ 78,730.07
Ann Arbor-Barton (MP 47.27)	$ 12,999.10	$ -	$ 16,881.26	$ 7,472.03	$ 3,609.68	$ 7,988.94	$ 48,951.01
Whitmore Lake (MP 57.45)	$ 28,915.43	$ 16,881.26	$ -	$ -	$ -	$ -	$ 45,796.69
Hamburg (MP 60.53)	$ 14,931.74	$ 7,472.03	$ -	$ -	$ -	$ -	$ 22,403.77
Genoa (MP 66.87)	$ 6,955.78	$ 3,609.68	$ -	$ -	$ -	$ -	$ 10,565.46
Howell (MP 73.91)	$ 14,928.03	$ 7,988.94	$ -	$ -	$ -	$ -	$ 22,916.97
TOTAL	$ 78,730.07	$ 48,951.01	$ 45,796.69	$ 22,403.77	$ 10,565.46	$ 22,916.97	$ 229,363.96

Annual Revenue for 10 ride tickets was calculated by multiplying the annual number of 10 ride trips by the 10 ride ticket prices per trip

Annual Revenue- Monthly

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor- Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	**TOTAL**
Ann Arbor-Washington (MP 45.48)	$ -	$ 37,437.41	$ 83,276.43	$ 43,003.40	$ 20,032.64	$ 42,992.72	$ 226,742.60
Ann Arbor-Barton (MP 47.27)	$ 37,437.41	$ -	$ 48,618.03	$ 21,519.46	$ 10,395.87	$ 23,008.15	$ 140,978.91
Whitmore Lake (MP 57.45)	$ 83,276.43	$ 48,618.03	$ -	$ -	$ -	$ -	$ 131,894.46
Hamburg (MP 60.53)	$ 43,003.40	$ 21,519.46	$ -	$ -	$ -	$ -	$ 64,522.86
Genoa (MP 66.87)	$ 20,032.64	$ 10,395.87	$ -	$ -	$ -	$ -	$ 30,428.51
Howell (MP 73.91)	$ 42,992.72	$ 23,008.15	$ -	$ -	$ -	$ -	$ 66,000.86
TOTAL	$ 226,742.60	$ 140,978.91	$ 131,894.46	$ 64,522.86	$ 30,428.51	$ 66,000.86	$ 660,568.20

Annual Revenue for monthly tickets was calculated by multiplying the annual number of monthly trips by the monthly ticket prices per trip

(See Option 5A for full description of methodology)

Total Annual Revenue	$ 1,147,693.57

Option 2: Full Service w/o Barton

Average Weekday Revenue

Station	Ann Arbor-Washington (MP 45.48)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	**TOTAL**
Ann Arbor-Washington (MP 45.48)	$ -	$ 1,152.50	$ 161.00	$ 58.50	$ 108.00	$ 1,480.00
Whitmore Lake (MP 57.45)	$ 1,152.50	$ -	$ -	$ -	$ -	$ 1,152.50
Hamburg (MP 60.53)	$ 161.00	$ -	$ -	$ -	$ -	$ 161.00
Genoa (MP 66.87)	$ 58.50	$ -	$ -	$ -	$ -	$ 58.50
Howell (MP 73.91)	$ 108.00	$ -	$ -	$ -	$ -	$ 108.00
TOTAL	$ 1,480.00	$ 1,152.50	$ 161.00	$ 58.50	$ 108.00	$ 2,960.00

$ 2,960.00 per day

262 days per year

$ 775,520.00 annual revenue (not used for this study)

NOTE: Boardings and alightings at AA-Stadium are assigned to AA-Washington

Metthod 2-Using Metra Rates

Annual Revenue- 1 Way

Station	Ann Arbor-Washington (MP 45.48)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	**TOTAL**
Ann Arbor-Washington (MP 45.48)	$ -	$ 53,446.04	$ 7,466.21	$ 2,712.88	$ 5,008.39	$ 68,633.52
Whitmore Lake (MP 57.45)	$ 53,446.04	$ -	$ -	$ -	$ -	$ 53,446.04
Hamburg (MP 60.53)	$ 7,466.21	$ -	$ -	$ -	$ -	$ 7,466.21
Genoa (MP 66.87)	$ 2,712.88	$ -	$ -	$ -	$ -	$ 2,712.88
Howell (MP 73.91)	$ 5,008.39	$ -	$ -	$ -	$ -	$ 5,008.39
TOTAL	$ 68,633.52	$ 53,446.04	$ 7,466.21	$ 2,712.88	$ 5,008.39	$ 137,267.04

Annual Revenue- 10 Ride

Station	Ann Arbor-Washington (MP 45.48)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	**TOTAL**
Ann Arbor-Washington (MP 45.48)	$ -	$ 47,557.91	$ 6,643.67	$ 2,414.00	$ 4,456.62	$ 61,072.20
Whitmore Lake (MP 57.45)	$ 47,557.91	$ -	$ -	$ -	$ -	$ 47,557.91
Hamburg (MP 60.53)	$ 6,643.67	$ -	$ -	$ -	$ -	$ 6,643.67
Genoa (MP 66.87)	$ 2,414.00	$ -	$ -	$ -	$ -	$ 2,414.00
Howell (MP 73.91)	$ 4,456.62	$ -	$ -	$ -	$ -	$ 4,456.62
TOTAL	$ 61,072.20	$ 47,557.91	$ 6,643.67	$ 2,414.00	$ 4,456.62	$ 122,144.40

Annual Revenue- Monthly

Station	Ann Arbor-Washington (MP 45.48)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	**TOTAL**
Ann Arbor-Washington (MP 45.48)	$ -	$ 136,966.79	$ 19,133.76	$ 6,952.33	$ 12,835.07	$ 175,887.94
Whitmore Lake (MP 57.45)	$ 136,966.79	$ -	$ -	$ -	$ -	$ 136,966.79
Hamburg (MP 60.53)	$ 19,133.76	$ -	$ -	$ -	$ -	$ 19,133.76
Genoa (MP 66.87)	$ 6,952.33	$ -	$ -	$ -	$ -	$ 6,952.33
Howell (MP 73.91)	$ 12,835.07	$ -	$ -	$ -	$ -	$ 12,835.07
TOTAL	$ 175,887.94	$ 136,966.79	$ 19,133.76	$ 6,952.33	$ 12,835.07	$ 351,775.87

(See Option 5A for full description of methodology)

Total Annual Revenue	$ 611,187.31

Option 3: Starter Service

Average Weekday Revenue

Station	Ann Arbor-Washington (MP 45.48)	Whitmore Lake (MP 57.45)	Howell (MP 73.91)	**TOTAL**
Ann Arbor-Washington (MP 45.48)	$ -	$ 1,265.00	$ 138.00	$ 1,403.00
Whitmore Lake (MP 57.45)	$ 1,265.00	$ -	$ -	$ 1,265.00
Howell (MP 73.91)	$ 138.00	$ -	$ -	$ 138.00
TOTAL	$ 1,403.00	$ 1,265.00	$ 138.00	$ 2,806.00

$ 2,806.00 per day

262 days per year

$ 735,172.00 annual revenue

(not used for this study)

NOTE: Boardings and alightings at AA-Stadium are assigned to AA-Washington

Metthod 2-Using Metra Rates

Annual Revenue- 1 Way

Station	Ann Arbor-Washington (MP 45.48)	Whitmore Lake (MP 57.45)	Howell (MP 73.91)	**TOTAL**
Ann Arbor-Washington (MP 45.48)	$ -	$ 58,663.11	$ 6,399.61	$ 65,062.72
Whitmore Lake (MP 57.45)	$ 58,663.11	$ -	$ -	$ 58,663.11
Howell (MP 73.91)	$ 6,399.61	$ -	$ -	$ 6,399.61
TOTAL	$ 65,062.72	$ 58,663.11	$ 6,399.61	$ 130,125.44

Annual Revenue- 10 Ride

Station	Ann Arbor-Washington (MP 45.48)	Whitmore Lake (MP 57.45)	Howell (MP 73.91)	**TOTAL**
Ann Arbor-Washington (MP 45.48)	$ -	$ 52,200.23	$ 5,694.57	$ 57,894.80
Whitmore Lake (MP 57.45)	$ 52,200.23	$ -	$ -	$ 52,200.23
Howell (MP 73.91)	$ 5,694.57	$ -	$ -	$ 5,694.57
TOTAL	$ 57,894.80	$ 52,200.23	$ 5,694.57	$ 115,789.59

Annual Revenue- Monthly

Station	Ann Arbor-Washington (MP 45.48)	Whitmore Lake (MP 57.45)	Howell (MP 73.91)	**TOTAL**
Ann Arbor-Washington (MP 45.48)	$ -	$ 150,336.65	$ 16,400.36	$ 166,737.01
Whitmore Lake (MP 57.45)	$ 150,336.65	$ -	$ -	$ 150,336.65
Howell (MP 73.91)	$ 16,400.36	$ -	$ -	$ 16,400.36
TOTAL	$ 166,737.01	$ 150,336.65	$ 16,400.36	$ 333,474.02

(See Option 5A for full description of methodology)

Total Annual Revenue	$ 579,389.05

Option 4: MOC

Average Weekday Revenue

Station	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	**TOTAL**
Ann Arbor-Barton (MP 47.27)	$ -	$ 935.00	$ 935.00
Whitmore Lake (MP 57.45)	$ 935.00	$ -	$ 935.00
TOTAL	$ 935.00	$ 935.00	$ 1,870.00

$ 1,870.00 per day

262 days per year

$ 489,940.00 annual revenue

(not used for this study)

NOTE: Boardings and alightings at AA-Stadium are assigned to AA-V

Metthod 2-Using Metra Rates

Annual Revenue- 1 Way

Station	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	**TOTAL**
Ann Arbor-Barton (MP 47.27)	$ -	$ 43,359.69	$ 43,359.69
Whitmore Lake (MP 57.45)	$ 43,359.69	$ -	$ 43,359.69
TOTAL	$ 43,359.69	$ 43,359.69	$ 86,719.38

Annual Revenue- 10 Ride

Station	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	**TOTAL**
Ann Arbor-Barton (MP 47.27)	$ -	$ 38,582.78	$ 38,582.78
Whitmore Lake (MP 57.45)	$ 38,582.78	$ -	$ 38,582.78
TOTAL	$ 38,582.78	$ 38,582.78	$ 77,165.55

Annual Revenue- Monthly

Station	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	**TOTAL**
Ann Arbor-Barton (MP 47.27)	$ -	$ 111,118.39	$ 111,118.39
Whitmore Lake (MP 57.45)	$ 111,118.39	$ -	$ 111,118.39
TOTAL	$ 111,118.39	$ 111,118.39	$ 222,236.78

(See Option 5A for full description of methodology)

Total Annual Revenue $ 386,121.71

Option 5A: WL-BD-AA
Estimate of Annual Revenue Year 2015

Analysis of Fare Policy for Midwest Commuter Rail Systems

Music City Star									
Station	Distance (mi)	Cummulative Mileage	1 Ride	1 Ride $/Mile	10 Ride	10 Ride $/Mile	Monthly	Monthly $/Mile
Riverfront		0	N/A		N/A		N/A	
Donelson	7.21	7.21	$ 2.00	$ 0.28	$ 17.25	$ 0.25	$ 67.25	$ 0.23
Hermitage	4.08	11.29	$ 4.50	$ 0.40	$ 40.00	$ 0.35	$ 150.25	$ 0.33
Mt. Juliet	5.5	16.75	$ 4.75	$ 0.28	$ 43.00	$ 0.26	$ 158.50	$ 0.24
Martha	6.23	23.02	$ 5.00	$ 0.22	$ 45.25	$ 0.20	$ 168.00	$ 0.18
Lebanon	8.19	31.21	$ 5.25	$ 0.17	$ 47.25	$ 0.15	$ 176.50	$ 0.14
Total Miles	31.21	31.21						

Northstar Commuter Rail								
Station	Milepost	Difference	Cummulative Mileage	1 Ride Rush hour	1 Ride Rush hour $/Mile	1 ride weekend	1 Ride Weekend $/Mile
Target Field	11.1		0	$ 3.00	-	$ 2.50	
Fridley	16.1	4.8	4.8	$ 3.00	$ 0.63	$ 2.50	$ 0.52
Coon Rapids	25.1	9	13.8	$ 3.00	$ 0.22	$ 3.00	$ 0.22
Anoka	27.1	2	15.8	$ 3.00	$ 0.19	$ 3.00	$ 0.19
Ramsey	29.1	2	18	$ 3.50	$ 0.19	$ 3.50	$ 0.19
Elk River	36.7	7.6	25.4	$ 4.50	$ 0.18	$ 4.00	$ 0.16
Big Lake	47	10.3	35.7	$ 6.00	$ 0.17	$ 5.25	$ 0.15
Total Miles	35.7		35.7				

Metra UP West							
Zone 5 Miles Between Zones	1 Ride	1 Ride $/Mile	10 Ride	10 Ride $/Mile	Monthly	Monthly $/Mile	
A (0-5)	$ 3.25	$ 0.65	$ 29.25	$ 0.59	$ 92.75	$ 0.46	
B (5-10)	$ 3.50	$ 0.35	$ 31.50	$ 0.32	$ 99.75	$ 0.25	
C (10-15)	$ 4.75	$ 0.32	$ 42.75	$ 0.29	$ 135.50	$ 0.23	
D (15-20)	$ 5.50	$ 0.28	$ 49.50	$ 0.25	$ 156.75	$ 0.26	
E (20-25)	$ 6.00	$ 0.24	$ 54.00	$ 0.22	$ 171.00	$ 0.17	
F (25-30)	$ 6.50	$ 0.22	$ 58.50	$ 0.20	$ 185.25	$ 0.15	
H (30-35)	$ 7.50	$ 0.21	$ 67.50	$ 0.19	$ 213.75	$ 0.15	
I (35-40)	$ 8.25	$ 0.21	$ 74.25	$ 0.19	$ 235.25	$ 0.15	

Metra Revenue Statistics as Reported on Metra Website 2014										
Ticket Type	Tickets	Trips	Revenues							
Monthly	8.3%	64.8%	60.7%							
Ten Ride	9.4%	17.5%	23.0%							
One Way	72.2%	15.2%	14.0%							
Weekend	9.8%	4.5%	2.3%							
One Way		17.7%								
	Note minor adjustment: One way trips computed as sum of weekend and oneway trips.									
Fares									System Listed in Timetable	
Zone	Monthly	Ten Ride	One-Way	Monthly Fare/One-Way Fare	Savings for Ten Ride Calculate d	Savings for Monthly Calculated		Ten Ride	Monthly	
A	$ 92.75	$ 29.25	$ 3.25	28.54	10%	-715%		Save 10%	Save over 30%	
B	$ 99.75	$ 31.50	$ 3.50	28.50	10%	-714%				
C	$ 135.50	$ 42.75	$ 4.75	28.53	10%	-715%				
D	$ 156.75	$ 49.50	$ 5.50	28.50	10%	-714%				
E	$ 171.00	$ 54.00	$ 6.00	28.50	10%	-714%				
F	$ 185.25	$ 58.50	$ 6.50	28.50	10%	-714%				
G	$ 199.50	$ 63.00	$ 7.00	28.50	10%	-714%				
H	$ 213.75	$ 67.50	$ 7.50	28.50	10%	-714%				
I	$ 235.25	$ 74.25	$ 8.25	28.52	10%	-715%				
J	$ 249.50	$ 78.75	$ 8.75	28.51	10%	-715%				
K	$ 263.75	$ 83.25	$ 9.25	28.51	10%	-715%				
M	$ 292.25	$ 92.25	$ 10.25	28.51	10%	-715%				
	Assumed Average Number of 1 Way Trips/month taken by a user of a monthly pass			40						

Fare Policy Assumptions for North-South Commuter Rail

Ridership taken from AECOM Station-Station pairs
Weekday Service Only
262 days per year
One-way, 10 ride and monthly tickets
One-way: $ 0.20 per mi, round up to nearest $0.50, $2.00 minimum fare
10 Ride 10% discount on one-way fares
Monthly: 30% discount on one-way fares, assuming
40 average number of one-way rides per monthly
Employ Metra fare distribution: One-Way/10 Ride/Monthly: 17.7%/17.5%/64.8%

Option 5A: WL-BD-AA 2015 Weekday Trips Station to Station

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	TOTAL
Ann Arbor-Washington (MP 45.48)		126	289				415
Ann Arbor-Barton (MP 47.27)	126		258				384
Whitmore Lake (MP 57.45)	289	258					547
Hamburg (MP 60.53)							0
Genoa (MP 66.87)							0
Howell (MP 73.91)							0
TOTAL	415	384	547	0	0	0	1346

2015 Annual Trips Station to Station

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	TOTAL
Ann Arbor-Washington (MP 45.48)		0	33012	75718	0	0	0 108730
Ann Arbor-Barton (MP 47.27)	33012		0	67596	0	0	0 100608
Whitmore Lake (MP 57.45)	75718	67596		0	0	0	0 143314
Hamburg (MP 60.53)	0	0	0		0	0	0 0
Genoa (MP 66.87)	0	0	0	0		0	0 0
Howell (MP 73.91)	0	0	0	0	0		0 0
TOTAL	108730	100608	143314	0	0	0	352652

The Average Annual Trips were calculated by multiplying the total number days in a year (262 days) by the Average Weekday Trips

2015 AnnualWeekday Trips-One Ride

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	TOTAL
Ann Arbor-Washington (MP 45.48)	0	5843	13402	0	0	0	19245
Ann Arbor-Barton (MP 47.27)	5843	0	11964	0	0	0	17808
Whitmore Lake (MP 57.45)	13402	11964	0	0	0	0	25367
Hamburg (MP 60.53)	0	0	0	0	0	0	0
Genoa (MP 66.87)	0	0	0	0	0	0	0
Howell (MP 73.91)	0	0	0	0	0	0	0
TOTAL	19245	17808	25367	0	0	0	62419

The Annual Weekday One Ride Trips were calculated by multiplying the Average Annual Trips by the percentage of Annual One Ride Trips from Metra Statistics (17.7%)

2015 Annual Weekday Trips-Ten Ride

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	TOTAL
Ann Arbor-Washington (MP 45.48)	0	5777	13251	0	0	0	19028
Ann Arbor-Barton (MP 47.27)	5777	0	11829	0	0	0	17606
Whitmore Lake (MP 57.45)	13251	11829	0	0	0	0	25080
Hamburg (MP 60.53)	0	0	0	0	0	0	0
Genoa (MP 66.87)	0	0	0	0	0	0	0
Howell (MP 73.91)	0	0	0	0	0	0	0
TOTAL	19028	17606	25080	0	0	0	61714

The Annual Weekday One Ride Trips were calculated by multiplying the Average Annual Trips by the percentage of Annual TenRide Trips from Metra Statistics (17.5%)

2015 Annual Weekday Trips-Monthly

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	TOTAL
Ann Arbor-Washington (MP 45.48)	0	21392	49065	0	0	0	70457
Ann Arbor-Barton (MP 47.27)	21392	0	43802	0	0	0	65194
Whitmore Lake (MP 57.45)	49065	43802	0	0	0	0	92867
Hamburg (MP 60.53)	0	0	0	0	0	0	0
Genoa (MP 66.87)	0	0	0	0	0	0	0
Howell (MP 73.91)	0	0	0	0	0	0	0
TOTAL	70457	65194	92867	0	0	0	228518

The Annual Weekday One Ride Trips were calculated by multiplying the Average Annual Trips by the percentage of Annual Monthly Trips from Metra Statistics (64.8%)

Station	Milepost
Ann Arbor Washington	45.48
Ann Arbor-Barton	47.27
Whitmore Lake	57.45
Hamburg	60.53
Genoa	66.87
Howell	73.91

Raw Station to Station Fares One Way

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor- Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)
Ann Arbor-Washington (MP 45.48)		$ 0.36	$ 2.39	$ 3.01	$ 4.28	$ 5.69
Ann Arbor-Barton (MP 47.27)	$ 0.36		$ 2.04	$ 2.65	$ 3.92	$ 5.33
Whitmore Lake (MP 57.45)	$ 2.39	$ 2.04		$ 0.62	$ 1.88	$ 3.29
Hamburg (MP 60.53)	$ 3.01	$ 2.65	$ 0.62		$ 1.27	$ 2.68
Genoa (MP 66.87)	$ 4.28	$ 3.92	$ 1.88	$ 1.27		$ 1.41
Howell (MP 73.91)	$ 5.69	$ 5.33	$ 3.29	$ 2.68	$ 1.41	

Raw Station to Station Fares were calculated by multiplying the distance between stations by $.20 per mile

Station to Station Fares Rounded-One Way

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)
Ann Arbor-Washington (MP 45.48)	$ -	$ 2.00	$ 2.50	$ 3.50	$ 4.50	$ 6.00
Ann Arbor-Barton (MP 47.27)	$ 2.00	$ -	$ 2.50	$ 3.00	$ 4.00	$ 5.50
Whitmore Lake (MP 57.45)	$ 2.50	$ 2.50	$ -	$ 2.00	$ 2.00	$ 3.50
Hamburg (MP 60.53)	$ 3.50	$ 3.00	$ 2.00	$ -	$ 2.00	$ 3.00
Genoa (MP 66.87)	$ 4.50	$ 4.00	$ 2.00	$ 2.00	$ -	$ 2.00
Howell (MP 73.91)	$ 6.00	$ 5.50	$ 3.50	$ 3.00	$ 2.00	$ -

One-way Station to Station fares were established by rounding up raw fares to the nearest $0.50 and making the minimum fare $02.00

Station to Station Fares Rounded-Ten Ride

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor- Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)
Ann Arbor-Washington (MP 45.48)	$ -	$ 18.00	$ 22.50	$ 31.50	$ 40.50	$ 54.00
Ann Arbor-Barton (MP 47.27)	$ 18.00	$ -	$ 22.50	$ 27.00	$ 36.00	$ 49.50
Whitmore Lake (MP 57.45)	$ 22.50	$ 22.50	$ -	$ 18.00	$ 18.00	$ 31.50
Hamburg (MP 60.53)	$ 31.50	$ 27.00	$ 18.00	$ -	$ 18.00	$ 27.00
Genoa (MP 66.87)	$ 40.50	$ 36.00	$ 18.00	$ 18.00	$ -	$ 18.00
Howell (MP 73.91)	$ 54.00	$ 49.50	$ 31.50	$ 27.00	$ 18.00	$ -

Station to Station Fares for 10 Rides were calculated by ensuring a 10% savings so 10% less than buying 10 One ways

Station to Station Fares-Rounded Monthly

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)
Ann Arbor-Washington (MP 45.48)	$ -	$ 56.00	$ 70.00	$ 98.00	$ 126.00	$ 168.00
Ann Arbor-Barton (MP 47.27)	$ 56.00	$ -	$ 70.00	$ 84.00	$ 112.00	$ 154.00
Whitmore Lake (MP 57.45)	$ 70.00	$ 70.00	$ -	$ 56.00	$ 56.00	$ 98.00
Hamburg (MP 60.53)	$ 98.00	$ 84.00	$ 56.00	$ -	$ 56.00	$ 84.00
Genoa (MP 66.87)	$ 126.00	$ 112.00	$ 56.00	$ 56.00	$ -	$ 56.00
Howell (MP 73.91)	$ 168.00	$ 154.00	$ 98.00	$ 84.00	$ 56.00	$ -

Station to Station Fares for Monthly Rides were calculated by ensuring a 30% savings per month, which agrees with the Metra data, so 30% less than buying 40 One ways (2 per day with 20 days per month)

Annual Revenue-One Way

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)
Ann Arbor-Washington (MP 45.48)	$ -	$ 11,686	$ 33,505	$ -	$ -	$ -
Ann Arbor-Barton (MP 47.27)	$ 11,686	$ -	$ 29,911	$ -	$ -	$ -
Whitmore Lake (MP 57.45)	$ 33,505	$ 29,911	$ -	$ -	$ -	$ -
Hamburg (MP 60.53)	$ -	$ -	$ -	$ -	$ -	$ -
Genoa (MP 66.87)	$ -	$ -	$ -	$ -	$ -	$ -
Howell (MP 73.91)	$ -	$ -	$ -	$ -	$ -	$ -
Totals	$ 45,191	$ 41,597	$ 63,416	$ -	$ -	$ -
Total One-Way Fare Revenue						$ 150,205

Value is calculated by multiplying the annual one-way ticket trips by the one-way fare

Annual Revenue-10 Ride

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor- Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)
Ann Arbor-Washington (MP 45.48)	$ -	$ 10,399	$ 29,814	$ -	$ -	$ -
Ann Arbor-Barton (MP 47.27)	$ 10,399	$ -	$ 26,616	$ -	$ -	$ -
Whitmore Lake (MP 57.45)	$ 29,814	$ 26,616	$ -	$ -	$ -	$ -
Hamburg (MP 60.53)	$ -	$ -	$ -	$ -	$ -	$ -
Genoa (MP 66.87)	$ -	$ -	$ -	$ -	$ -	$ -
Howell (MP 73.91)	$ -	$ -	$ -	$ -	$ -	$ -
Totals	$ 40,213	$ 37,015	$ 56,430	$ -	$ -	$ -
Total 10 Ride Fare Revenue						$ 133,657

Value is calculated by multiplying the annual 10 ride ticket trips by the cost of the discounted 10 Ride fare

Annual Revenue-30 Ride

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)
Ann Arbor-Washington (MP 45.48)	$ -	$ 29,948	$ 85,864	$ -	$ -	$ -
Ann Arbor-Barton (MP 47.27)	$ 29,948	$ -	$ 76,654	$ -	$ -	$ -
Whitmore Lake (MP 57.45)	$ 85,864	$ 76,654	$ -	$ -	$ -	$ -
Hamburg (MP 60.53)	$ -	$ -	$ -	$ -	$ -	$ -
Genoa (MP 66.87)	$ -	$ -	$ -	$ -	$ -	$ -
Howell (MP 73.91)	$ -	$ -	$ -	$ -	$ -	$ -
Totals	$ 115,813	$ 106,602	$ 162,518	$ -	$ -	$ -
Total Monthly Fare Revenue						$ 384,933

Value is calculated by multiplying the annual Monthly ticket trips by the cost of the discounted Monthly fare

2015 Annual Revenue

One-Way	$ 150,205
10 Ride	$ 133,657
Monthly	$ 384,933
Total	**$ 668,796**

2040 Annual Revenue

AECOM estimates that the daily ridership will increase from 1,346 to 1,956 or approximately 45%. Calculations show that that while the increase is not uniformly distributed among the station pairs, a simple 45% addition to the 2015 revenue estimate is sufficiently accurate.

1.45 **$ 969,754**

Option 5B: WL-BD-AA
Estimate of Annual Revenue Year 2015

Analysis of Fare Policy for Midwest Commuter Rail Systems

Music City Star									
Station	Distance (mi)	Cummulative Mileage	1 Ride	1 Ride $/Mile	10 Ride	10 Ride $/Mile	Monthly	Monthly $/Mile
Riverfront		0	N/A		N/A		N/A	
Donelson	7.21	7.21	$ 2.00	$ 0.28	$ 17.75	$ 0.25	$ 67.25	$ 0.23
Hermitage	4.08	11.29	$ 4.50	$ 0.40	$ 40.00	$ 0.35	$ 150.25	$ 0.33
Mt. Juliet	5.5	16.79	$ 4.75	$ 0.28	$ 43.00	$ 0.26	$ 158.50	$ 0.24
Martha	6.23	23.02	$ 5.00	$ 0.22	$ 45.25	$ 0.20	$ 168.00	$ 0.18
Lebanon	8.19	31.21	$ 5.25	$ 0.17	$ 47.25	$ 0.15	$ 176.50	$ 0.14
Total Miles	31.21	31.21						

Northstar Commuter Rail								
Station	Milepost	Difference	Cummulative Mileage	1 Ride Rush hour	Rush hour $/Mile	1 ride weekend	1 Ride Weekend $/Mile
Target Field	11.3		0	$ 3.00		$ 2.50	
Fridley	16.1	4.8	4.8	$ 3.00	$ 0.63	$ 2.50	$ 0.52
Coon Rapids	25.1	9	13.8	$ 3.00	$ 0.22	$ 3.00	$ 0.22
Anoka	27.1	2	15.8	$ 3.00	$ 0.19	$ 3.00	$ 0.19
Ramsey	29.1	2.2	18	$ 3.50	$ 0.19	$ 3.50	$ 0.19
Elk River	36.7	7.4	25.4	$ 4.50	$ 0.18	$ 4.00	$ 0.16
Big Lake	47	10.3	35.7	$ 6.00	$ 0.17	$ 5.25	$ 0.15
Total Miles	35.7		35.7				

Metra UP West							
Zone 5 Miles Between Zones	1 Ride	1 Ride $/Mile	10 Ride	10 Ride $/Mile	Monthly	Monthly $/Mile
A (0-5)	$ 3.25	$ 0.65	$ 29.25	$ 0.59	$ 92.75	$ 0.46
B (5-10)	$ 3.50	$ 0.35	$ 31.50	$ 0.32	$ 99.75	$ 0.25
C (10-15)	$ 4.75	$ 0.32	$ 42.75	$ 0.29	$ 135.50	$ 0.23
D (15-20)	$ 5.50	$ 0.28	$ 49.50	$ 0.25	$ 156.75	$ 0.26
E (20-25)	$ 6.00	$ 0.24	$ 54.00	$ 0.22	$ 171.00	$ 0.17
F (25-30)	$ 6.50	$ 0.22	$ 58.50	$ 0.20	$ 185.25	$ 0.15
H (30-35)	$ 7.50	$ 0.21	$ 67.50	$ 0.19	$ 213.75	$ 0.15
I (35-40)	$ 8.25	$ 0.21	$ 74.25	$ 0.19	$ 235.25	$ 0.15

Metra Revenue Statistics as Reported on Metra Website 2014

Ticket Type	Tickets	Trips	Revenues
Monthly	8.3%	64.8%	60.7%
Ten Ride	9.6%	17.5%	23.0%
One Way	72.3%	13.2%	14.0%
Weekend	9.8%	4.5%	2.3%
One Way		17.7%	

Note minor adjustment: One way trips computed as sum of weekend and oneway trips.

Fares								Savings Listed in Timetable	
Zone	Monthly	Ten-Ride	One-Way	Monthly Fare/One-Way Fare	Savings for Ten Ride Calculated	Savings for Monthly Calculated		Ten Ride	Monthly
A	$ 92.75	$ 29.25	$ 3.25	28.54	10%	-715%		Save 10%	Save over 30%
B	$ 99.75	$ 31.50	$ 3.50	28.50	10%	-714%			
C	$ 135.50	$ 42.75	$ 4.75	28.53	10%	-715%			
D	$ 156.75	$ 49.50	$ 5.50	28.50	10%	-714%			
E	$ 171.00	$ 54.00	$ 6.00	28.50	10%	-714%			
F	$ 185.25	$ 58.50	$ 6.50	28.50	10%	-714%			
G	$ 199.50	$ 63.00	$ 7.00	28.50	10%	-714%			
H	$ 213.75	$ 67.50	$ 7.50	28.50	10%	-714%			
I	$ 235.25	$ 74.25	$ 8.25	28.52	10%	-715%			
J	$ 249.50	$ 78.75	$ 8.75	28.51	10%	-715%			
K	$ 263.79	$ 83.25	$ 9.26	28.51	10%	-714%			
M	$ 292.25	$ 92.25	$ 10.25	28.51	10%	-715%			

Assumed Average Number of 1 Way Trips/month taken by a user of a 40

Fare Policy Assumptions for North-South Commuter Rail

Ridership taken from AECOM Station-Station pairs
Weekday Service Only
262 days per year
One-way, 10 ride and monthly tickets
One-way: $ 0.20 per mi, round up to nearest $0.50, $2.00 minimum fare
10 Ride 10% discount on one-way fares
Monthly: 30% discount on one-way fares, assuming
40 average number of one-way rides per monthly
Employ Metra fare distribution: One-Way/10 Ride/Monthly: 17.7%/17.5%/64.8%

Option 5B: WL-BD-AA 2015 Weekday Trips Station to Station

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	TOTAL
Ann Arbor-Washington (MP 45.48)		263	387				650
Ann Arbor-Barton (MP 47.27)	263		188				451
Whitmore Lake (MP 57.45)	387	188					575
Hamburg (MP 60.53)							0
Genoa (MP 66.87)							0
Howell (MP 73.91)							0
TOTAL	650	451	575	0	0	0	1676

2015 Annual Trips Station to Station

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor- Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	TOTAL
Ann Arbor-Washington (MP 45.48)	0	68906	101394	0	0	0	170300
Ann Arbor-Barton (MP 47.27)	68906	0	49256	0	0	0	118162
Whitmore Lake (MP 57.45)	101394	49256	0	0	0	0	150650
Hamburg (MP 60.53)	0	0	0	0	0	0	0
Genoa (MP 66.87)	0	0	0	0	0	0	0
Howell (MP 73.91)	0	0	0	0	0	0	0
TOTAL	170300	118162	150650	0	0	0	439112

The Average Annual Trips were calculated by multiplying the total number days in a year (262 days) by the Average Weekday Trips

2015 AnnualWeekday Trips-One Ride

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	TOTAL
Ann Arbor-Washington (MP 45.48)	0	12196	17947	0	0	0	30143
Ann Arbor-Barton (MP 47.27)	12196	0	8718	0	0	0	20915
Whitmore Lake (MP 57.45)	17947	8718	0	0	0	0	26665
Hamburg (MP 60.53)	0	0	0	0	0	0	0
Genoa (MP 66.87)	0	0	0	0	0	0	0
Howell (MP 73.91)	0	0	0	0	0	0	0
TOTAL	30143	20915	26665	0	0	0	77723

The Annual Weekday One Ride Trips were calculated by multiplying the Average Annual Trips by the percentage of Annual One Ride Trips from Metra Statistics (17.7%)

2015 Annual Weekday Trips-Ten Ride

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor- Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	TOTAL
Ann Arbor-Washington (MP 45.48)	0	12059	17744	0	0	0	29803
Ann Arbor-Barton (MP 47.27)	12059	0	8620	0	0	0	20678
Whitmore Lake (MP 57.45)	17744	8620	0	0	0	0	26364
Hamburg (MP 60.53)	0	0	0	0	0	0	0
Genoa (MP 66.87)	0	0	0	0	0	0	0
Howell (MP 73.91)	0	0	0	0	0	0	0
TOTAL	29803	20678	26364	0	0	0	76845

The Annual Weekday One Ride Trips were calculated by multiplying the Average Annual Trips by the percentage of Annual TenRide Trips from Metra Statistics (17.5%)

2015 Annual Weekday Trips-Monthly

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)	TOTAL
Ann Arbor-Washington (MP 45.48)	0	44651	65703	0	0	0	110354
Ann Arbor-Barton (MP 47.27)	44651	0	31918	0	0	0	76569
Whitmore Lake (MP 57.45)	65703	31918	0	0	0	0	97621
Hamburg (MP 60.53)	0	0	0	0	0	0	0
Genoa (MP 66.87)	0	0	0	0	0	0	0
Howell (MP 73.91)	0	0	0	0	0	0	0
TOTAL	110354	76569	97621	0	0	0	284545

The Annual Weekday One Ride Trips were calculated by multiplying the Average Annual Trips by the percentage of Annual Monthly Trips from Metra Statistics (64.8%)

Station	Milepost
Ann Arbor Washington	45.48
Ann Arbor-Barton	47.27
Whitmore Lake	57.45
Hamburg	60.53
Genoa	66.87
Howell	73.91

Raw Station to Station Fares One Way

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor- Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)
Ann Arbor-Washington (MP 45.48)		$ 0.36	$ 2.39	$ 3.01	$ 4.28	$ 5.69
Ann Arbor-Barton (MP 47.27)	$ 0.36		$ 2.04	$ 2.65	$ 3.92	$ 5.33
Whitmore Lake (MP 57.45)	$ 2.39	$ 2.04		$ 0.62	$ 1.88	$ 3.29
Hamburg (MP 60.53)	$ 3.01	$ 2.65	$ 0.62		$ 1.27	$ 2.68
Genoa (MP 66.87)	$ 4.28	$ 3.92	$ 1.88	$ 1.27		$ 1.41
Howell (MP 73.91)	$ 5.69	$ 5.33	$ 3.29	$ 2.68	$ 1.41	

Raw Station to Station Fares were calculated by multiplying the distance between stations by $.20 per mile

Station to Station Fares Rounded-One Way

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)
Ann Arbor-Washington (MP 45.48)	$ -	$ 2.00	$ 2.50	$ 3.50	$ 4.50	$ 6.00
Ann Arbor-Barton (MP 47.27)	$ 2.00	$ -	$ 2.50	$ 3.00	$ 4.00	$ 5.50
Whitmore Lake (MP 57.45)	$ 2.50	$ 2.50	$ -	$ 2.00	$ 2.00	$ 3.50
Hamburg (MP 60.53)	$ 3.50	$ 3.00	$ 2.00	$ -	$ 2.00	$ 3.00
Genoa (MP 66.87)	$ 4.50	$ 4.00	$ 2.00	$ 2.00	$ -	$ 2.00
Howell (MP 73.91)	$ 6.00	$ 5.50	$ 3.50	$ 3.00	$ 2.00	$ -

Station to Station Fares Rounded-Ten Ride

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor- Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)
Ann Arbor-Washington (MP 45.48)	$ -	$ 18.00	$ 22.50	$ 31.50	$ 40.50	$ 54.00
Ann Arbor-Barton (MP 47.27)	$ 18.00	$ -	$ 22.50	$ 27.00	$ 36.00	$ 49.50
Whitmore Lake (MP 57.45)	$ 22.50	$ 22.50	$ -	$ 18.00	$ 18.00	$ 31.50
Hamburg (MP 60.53)	$ 31.50	$ 27.00	$ 18.00	$ -	$ 18.00	$ 27.00
Genoa (MP 66.87)	$ 40.50	$ 36.00	$ 18.00	$ 18.00	$ -	$ 18.00
Howell (MP 73.91)	$ 54.00	$ 49.50	$ 31.50	$ 27.00	$ 18.00	$ -

Station to Station Fares-Rounded Monthly

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)
Ann Arbor-Washington (MP 45.48)	$ -	$ 56.00	$ 70.00	$ 98.00	$ 126.00	$ 168.00
Ann Arbor-Barton (MP 47.27)	$ 56.00	$ -	$ 70.00	$ 84.00	$ 112.00	$ 154.00
Whitmore Lake (MP 57.45)	$ 70.00	$ 70.00	$ -	$ 56.00	$ 56.00	$ 98.00
Hamburg (MP 60.53)	$ 98.00	$ 84.00	$ 56.00	$ -	$ 56.00	$ 84.00
Genoa (MP 66.87)	$ 126.00	$ 112.00	$ 56.00	$ 56.00	$ -	$ 56.00
Howell (MP 73.91)	$ 168.00	$ 154.00	$ 98.00	$ 84.00	$ 56.00	$ -

One-way Station to Station fares were established by rounding up raw fares to the nearest $0.50 and making the minimum fare $02.00

Station to Station Fares for 10 Rides were calculated by ensuring a 10% savings so 10% less than buying 10 One ways

Station to Station Fares for Monthly Rides were calculated by ensuring a 30% savings per month, which agrees with the Metra data, so 30% less than buying 40 One ways (2 per day with 20 days per month)

Annual Revenue-One Way

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)
Ann Arbor-Washington (MP 45.48)	$ -	$ 24,393	$ 44,867	$ -	$ -	$ -
Ann Arbor-Barton (MP 47.27)	$ 24,393	$ -	$ 21,796	$ -	$ -	$ -
Whitmore Lake (MP 57.45)	$ 44,867	$ 21,796	$ -	$ -	$ -	$ -
Hamburg (MP 60.53)	$ -	$ -	$ -	$ -	$ -	$ -
Genoa (MP 66.87)	$ -	$ -	$ -	$ -	$ -	$ -
Howell (MP 73.91)	$ -	$ -	$ -	$ -	$ -	$ -
Totals	$ 69,260	$ 46,189	$ 66,663	$ -	$ -	$ -
Total One-Way Fare Revenue						$ 182,111

Annual Revenue-10 Ride

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor- Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)
Ann Arbor-Washington (MP 45.48)	$ -	$ 21,705	$ 39,924	$ -	$ -	$ -
Ann Arbor-Barton (MP 47.27)	$ 21,705	$ -	$ 19,395	$ -	$ -	$ -
Whitmore Lake (MP 57.45)	$ 39,924	$ 19,395	$ -	$ -	$ -	$ -
Hamburg (MP 60.53)	$ -	$ -	$ -	$ -	$ -	$ -
Genoa (MP 66.87)	$ -	$ -	$ -	$ -	$ -	$ -
Howell (MP 73.91)	$ -	$ -	$ -	$ -	$ -	$ -
Totals	$ 61,629	$ 41,100	$ 59,318	$ -	$ -	$ -
Total 10 Ride Fare Revenue						$ 162,048

Annual Revenue-10 Ride

Station	Ann Arbor-Washington (MP 45.48)	Ann Arbor-Barton (MP 47.27)	Whitmore Lake (MP 57.45)	Hamburg (MP 60.53)	Genoa (MP 66.87)	Howell (MP 73.91)
Ann Arbor-Washington (MP 45.48)	$ -	$ 62,512	$ 114,981	$ -	$ -	$ -
Ann Arbor-Barton (MP 47.27)	$ 62,512	$ -	$ 55,856	$ -	$ -	$ -
Whitmore Lake (MP 57.45)	$ 114,981	$ 55,856	$ -	$ -	$ -	$ -
Hamburg (MP 60.53)	$ -	$ -	$ -	$ -	$ -	$ -
Genoa (MP 66.87)	$ -	$ -	$ -	$ -	$ -	$ -
Howell (MP 73.91)	$ -	$ -	$ -	$ -	$ -	$ -
Totals	$ 177,492	$ 118,368	$ 170,837	$ -	$ -	$ -
Total Monthly Fare Revenue						$ 466,697

Value is calculated by multiplying the annual one-way ticket trips by the one-way fare

Value is calculated by multiplying the annual 10 ride ticket trips by the cost of the discounted 10 Ride fare

Value is calculated by multiplying the annual Monthly ticket trips by the cost of the discounted Monthly fare

2015 Annual Revenue

One-Way	$ 182,111
10 Ride	$ 162,048
Monthly	$ 466,697
Total	**$ 810,856**

2040 Annual Revenue

AECOM estimates that the daily ridership will increase from 1,676 to 2,420 or approximately 44%. Calculations show that that while the increase is not uniformly distributed among the station pairs, a simple 44% addition to the 2015 revenue estimate is sufficiently accurate.

1.44 **$ 1,167,632**