

DANBURY BRANCH IMPROVEMENT PROGRAM TASK 6

STATE PROJECT 302-008



TRAIN SIMULATION REPORT FOR ALTERNATIVES

NOVEMBER 2010

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1.0 Executive Summary

This report presents the trip time calculations for each of the study alternatives:

- Alternative A: No build.
- Alternative B: Transportation System Management (TSM)
- Alternative C: South Norwalk to Danbury Improvements
- Alternative D: Extension from Danbury to New Milford
- Alternate E: Improvements from South Norwalk to Merritt 7/Wilton

Initial train simulations created a model of the existing train consist and track alignment to compare the runtimes against the MetroNorth Railroad (MNR) schedule. That effort is discussed in the Train Simulation Summary Report for Baseline Train Performance Model (November 2008).

The simulation includes end-to-end train runs that stop at each passenger station in both the outbound and inbound directions. The overall alignment is approximately 40 miles in each direction, is at-grade with a short tunnel section, and has twelve passenger stations. The alternatives involve two different consists: 1) the existing diesel locomotive with coaches; and 2) electric multiple units (EMUs) as presently used on the New Haven mainline.

The analysis was conducted using Railsim Version 7 software. Specifically, the module used for the analysis was the Train Performance Calculator (TPC).

2.0 Scope of Work

The work was authorized as part of the Danbury Branch Phase II Alternatives Analysis and Environmental Impact Statement (EIS). Task 6.4.1 was to create a train model and evaluate runtimes for a baseline run on the existing branch plus the extension from Danbury to New Milford. The findings of this model are described in the Baseline Train Performance Model Report.

The effort to calculate trip times for each of the alternatives responds to Task 6.4.2 of the original scope of work (December 2006) and item number four of the scope of extra work (December 2008).

The alternatives for which trip times are to be calculated are described in Section 3.

3.0 Alternative Descriptions and Criteria

3.1 Alternatives

The following is a description of the alternatives for which trip times are to be calculated. The descriptions are limited to the features that impact the trip time calculations.

Alternative A: No build

Operationally and physically, this alternative is the same as the existing conditions on the Danbury Branch plus routine maintenance and additional elements being progressed independent of this study. These elements include a new passenger station at Georgetown as part of a transit-oriented development (TOD) project and implementation of the Danbury Branch Signal System Project. The present maximum speed for passenger trains on the Branch is 50mph. The trip times would be the same as the present schedule times.

Alternative B: Transportation System Management (TSM)

This alternative is Alternative A with added shuttle trains in the AM and PM peak periods to provide reverse service. The trip times would be the same as the present schedule times.

Alternative C: South Norwalk to Danbury Improvements

This alternative includes track realignments for a maximum authorized speed of 60mph and electrification. The consist for this alternative will be six electric multiple units (EMUs). For additional comparison and analysis, a second trip time using the existing diesel consist rather than EMUs was also calculated for this alternative.

Alternative D: Extension from Danbury to New Milford

This alternative includes track replacement and realignments to allow 60mph operating speed and three new stations. Two calculations were made: 1) a diesel locomotive and six coaches (referred to as DD); and 2) six electric multiple units (referred to as DE).

Alternate E: Improvements from South Norwalk to Merritt 7/Wilton

This alternative, which was requested by the Connecticut Transportation Strategy Board, features partial electrification and limits the improvements described in Alternative C to the area between Wilton and South Norwalk. The consist for this alternative will be six electric multiple units south of Wilton and diesel hauled service between Danbury and Wilton.

3.2 Vehicle Criteria

The following vehicle information was supplied with the Railsim Model and was updated after discussions with MNR. *The updated information is shown in italics.* Train Performance Calculator (TPCs) have been run for the EMU/M2 using both vehicle weights, as described in Section 6.

3.2.1 Diesel Locomotive: MNR P 32 Diesel

Empty Weight	274,400 lbs
Initial / Maximum Acceleration	1.5 / 2.0 mphps
<i>Maximum Deceleration</i>	<i>2.8 mphps</i>

Frontal Area	145 square feet
Maximum Speed	80 mph/110 mph
Auxiliary Power	29 kW
Low/Normal Adhesion	6% / 15%
Tractive Effort	See Figure 1 ¹

3.2.2 Passenger Coach: MNR 6300

Empty weight	99,000 lbs
Length	85 feet
Passenger Weight ²	15,750 lbs
Vehicle Auxiliary Power	50 kW

3.2.3 Cab Car: MNR 6300

Empty weight	105,000 lbs
Length	85 feet
Frontal Area	133square feet
Passenger Weight	15,750 lbs
Vehicle Auxiliary Power	50 kW

3.2.4 Electric Multiple Unit (EMU) (M2/M4/M6)

M2, M4, and M6 are the designations of the EMUs presently in service on the New Haven Mainline and the New Canaan Branch. They operate in mixed consists and have very similar characteristics, including their power curves. The M2 was used as the basis of the trip time calculations.

Empty weight	70,000 lbs / 126,500 lbs
Length	85 feet
Frontal Area	136.5 square feet
Passenger Weight	15,750 lbs
Initial / Maximum Acceleration	2.5 / 3.0 mphps
Deceleration	3.8 mphps
Maximum Speed	80 mph / 100 mph
Auxiliary Power	40 kW
Low/Normal Adhesion	4% / 15%
Tractive Effort	See Figure 2

3.3 Station Stops and Dwell Times

There are nine passenger stations along the Danbury Branch. These stations are South Norwalk, Merritt 7, Wilton, Cannondale, Georgetown (planned), Branchville, Redding, Bethel, and

¹ Add 30 seconds to each station dwell time to approximate engine loading.

² Passenger weight assumes 105 passengers at 150 pounds each.

Danbury. Three stations – North Danbury, Brookfield, and New Milford – are included as initially proposed in this study. Subsequent to the TPCs, travel demand forecasts have been developed and the North Danbury Station has been dropped due to low forecasted demand.

Dwell time is the time a train is stopped at a station. It includes the time used to open the doors, discharge and load passengers, and then close the doors. MNR supplied dwell times for the existing diesel and coach consists.

4.0 TPC Program

4.1 Train Performance Calculator

The trip times were calculated using the Train Performance Calculator feature of the Railsim Version 7 software. Railsim is an analytical tool for use in modeling rail systems that is licensed by SYSTRA.

The Train Performance Calculator (TPC) simulates a single train on the rail alignment and is the first step in the analysis. Input data include detailed grade, curve, and speed restrictions, along with a suitable model of the vehicle (i.e., weight, performance limitations, and propulsion system characteristics).

In addition to the descriptions and criteria in Section 3, the following are other inputs and assumptions.

4.1.1 Grade Data

- The calculations assumed that the grades or vertical alignment of the existing railroad is retained.
 - For the New Haven Line and the Danbury Branch, data was collected from MNR Track Charts.
 - For the section north of Danbury, Phase I Report *Section 1.2.1: Overview of Existing Geometry* was used.

4.1.2 Curve Data

- Horizontal realignments have been prepared under Task 7 of the Study. The revised curvature allows 60mph maximum speed for passenger trains.

4.1.3 Platform Data

- Existing station platform length information was taken from MNR Track Charts. The planometrics maps were used to determine the platform starting locations.
- At Merritt 7 Station, the existing platform is low level. In Alternatives C through E, a high level platform is provided.
- Stations north of Danbury were assumed to be 400 feet in length.

4.1.4 Speed Data

- The existing and proposed speeds are shown in Figure 3 and Figure 4.

4.1.5 Tunnel Data

- The existing tunnel at MP 1.47 is assumed to be box type and 400 feet in length.

4.1.6 Additional Parameters

Additional parameters for the calculations were discussed and agreed to between CTDOT, MNR and URS at meetings held on April 21, 2008 and January 12, 2009. These parameters are as follows:

- Calculations were made for both normal and low adhesion track conditions.
- The coefficient for normal adhesion is 15% for all equipment.
- A low adhesion coefficient of 6% was used for diesel locomotive with coaches and 4% for EMU trains
- Tractive-effort curve (OEM curve) for P32AC-DM locomotive provided by MNR
- Tractive-effort curve from 2003 field tests for NHL EMU equipment provided by MNR on July 31, 2009. The trip time calculations used the M2 curve as it is essentially the same as for the M4s and M6s.
- Ignore “Calculated Curve Speed “ in the TPC Program
- Dwell times for each existing Danbury Branch station based on MNR input provided on January 1, 2009. Also add 30 seconds to the dwell times for locomotive acceleration. These times are for the existing consists that are diesel locomotive with end door coaches. For the mainline stations between South Norwalk and GCT, MNR uses 40 second dwell times for diesel trains and 20 seconds for EMU trains.

4.2 Train Performance Calculation

The program performs a discrete time simulation. The train position and speed are updated at very small time intervals during the course of the simulation.

Output from the train simulation includes time, distance, speed, and acceleration. This information is stored in a database for subsequent use by other program modules as required. The program also outputs other data including distance traveled, average speed, station-to-station run times, and energy consumption.

5.0 Results and Conclusions

5.1 TPC Results

Trip time results from each TPC are given in Table 1 through Table 13, and a summary of the trip times for the alternatives are shown in Table 15. The trip time for each alternative has been provided to the Connecticut Department of Transportation (CTDOT) for their use in preparing the travel demand forecasts for the Study.

The calculated trip time between Danbury and South Norwalk for Alternatives A & B is 1 hour 2 minutes. This includes the planned stop at Georgetown that accounts for about three minutes of the trip. Thus, an adjusted calculated time (59 minutes) compares fairly well to the existing train schedule (54 minutes), thus validating the TPC model. There is approximately 13 minutes of dwell time included in the calculated time, so the calculation can be considered to be conservative.

For Alternative C, the calculated trip times are about 57 minutes with diesel consists and 41 minutes with EMUs. This is a five-minute trip time reduction, which is attributable to the proposed track realignments, increased operating speed, and high level platform at Merritt 7. Electrification of the Branch and use of EMUs shows about an additional trip time reduction of 16 minutes.

For Alternative D, the calculated trip times between Danbury and New Milford are 33 minutes with diesel consists and 28 minutes with EMUs.

For all of the Build Alternatives (C-E), there is also a difference in the calculated trip times for the portion of the trip on the mainline between South Norwalk and Grand Central Terminal (GCT). For existing trains, the trip time is 54 minutes for diesel consists and 50 minutes for EMUs. These times include stops at Rowayton, Darien, and Noroton Heights on the mainline. If the Danbury Branch thru trains did not make these three mainline stops, the trip from Danbury to GCT would be reduced by another 10-11 minutes.

5.2 Conclusions

The calculations show that EMUs have shorter trip times than diesel locomotives with coaches. This can be attributed to better acceleration and deceleration, vehicles being propelled individually, and shorter dwell times due to better passenger access.

Overall, with all the improvements and changes, the trip time between Danbury and GCT could be reduced by up to 35 minutes, which represents a 30% reduction over existing travel times.

6.0 Errata

6.1 Revised M2 Vehicle Data

Subsequent to the development of the trip time summary and CTDOT beginning the travel demand forecasts, an error was found in the M2 vehicle data. The empty weight of the car is 126,500 lbs, not 77,000 lbs as was used in the TPCs as shown in Table 6 through Table 9. The corrected vehicle data is shown in italics in Section 3.2.

New TPCs using the corrected M2 Vehicle Data were run and are presented in Table 16 through Table 19. In each case, the difference in the trip time is less than 1 minute 21 seconds and about one minute on average. For an average trip time of 1 hour 15 minutes, the one minute difference is not significant, so the trip time summary has not been revised.

6.2 M8 Vehicle

During 2010, MNR has been testing new EMUs designated as M8. Vehicle data was not available at the time of the train performance calculations. However, it is expected that the operating characteristics of the M8 vehicles will be similar to those of the M2/4/6 cars. Power usage may be higher, and the upcoming “load flow analysis” will consider the M8s.

Table 1: Inbound Diesel, Existing Conditions
 15% Adhesion Coefficient

Station ID	Event State	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (Gallons/Hour)	Energy Consumption (Gallons)
New Milford	Departure	0:00:00	0:00:00	0			N.A.		0
Brookfield	Arrival	0:22:10	0:22:10	37488	19.22	25	0	119.71	17.46873
Brookfield	Departure	0:01:30	0:23:40	0	18		0	30.07	0.75247
North Danbury	Arrival	0:11:15	0:34:56	22704	22.92	25	0	119.73	7.8883
North Danbury	Departure	0:01:30	0:36:26	0	20.22		0	30.07	0.75247
Danbury	Arrival	0:19:57	0:56:23	17351	9.88	12.15	0	71.56	14.55447
Danbury	Departure	0:01:30	0:57:53	0	9.19		0	30.07	0.75247
Bethel	Arrival	0:06:07	1:04:00	12229	22.74	50	0	171.15	5.71412
Bethel	Departure	0:02:30	1:06:30	0	16.14		0	30.07	1.25356
Redding	Arrival	0:06:43	1:13:13	20465	34.59	50	0	171.17	8.98876
Redding	Departure	0:01:30	1:14:43	0	28.28		0	30.07	0.75247
Branchville	Arrival	0:08:43	1:23:26	23274	30.34	50	0	171.22	10.20087
Branchville	Departure	0:02:30	1:25:56	0	23.58		0	30.07	1.25356
Georgetown	Arrival	0:02:06	1:28:03	4297	23.18	44.44	0	170.26	2.92075
Georgetown	Departure	0:01:30	1:29:33	0	13.54		0	30.07	0.75247
Cannondale	Arrival	0:04:47	1:34:20	15725	37.31	50	0	171.19	4.55019
Cannondale	Departure	0:01:30	1:35:50	0	28.41		0	30.07	0.75247
Wilton	Arrival	0:03:14	1:39:04	8533	30.05	50	0	171.2	3.83948
Wilton	Departure	0:02:30	1:41:34	0	16.93		0	30.07	1.25356
Merritt 7	Arrival	0:05:31	1:47:05	19008	39.12	50	0	171.19	5.28032
Merritt 7	Departure	0:01:30	1:48:35	0	30.76		0	30.07	0.75247
South Norwalk	Arrival	0:11:30	2:00:05	21375	21.12	53.73	0	171.2	9.92937
Run Total (With Dwells)		2:00:05		202449	19.16	53.73	0	171.22	100.36333
Run Total (Without Dwells)		1:42:05		202449	22.54	53.73	N.A.	171.22	91.33536

Table 2: Inbound Diesel, 15% Adhesion
 Trip Time Calculation for Improved Track (60mph MAS)

Station ID	Event State	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (Gallons/Hour)	Energy Consumption (Gallons)
New Milford	Departure	0:00:00	0:00:00	0			N.A.		0
Brookfield	Arrival	0:13:45	0:13:45	37488	30.99	60	0	173.88	16.87706
Brookfield	Departure	0:01:30	0:15:15	0	27.94		0	30.07	0.75247
North Danbury	Arrival	0:06:22	0:21:37	22704	40.52	60	0	173.88	8.46484
North Danbury	Departure	0:01:30	0:23:07	0	32.8		0	30.07	0.75247
Danbury	Arrival	0:09:58	0:33:05	17351	19.78	58.6	0	172.84	11.94014
Danbury	Departure	0:01:30	0:34:35	0	17.19		0	30.07	0.75247
Bethel	Arrival	0:04:30	0:39:05	12229	30.92	60	0	173.9	6.02475
Bethel	Departure	0:02:30	0:41:35	0	19.87		0	30.07	1.25356
Redding	Arrival	0:05:58	0:47:32	20465	39.01	60.01	0	173.88	9.42403
Redding	Departure	0:01:30	0:49:02	0	31.17		0	30.07	0.75247
Branchville	Arrival	0:07:36	0:56:38	23274	34.81	60	0	173.89	9.91329
Branchville	Departure	0:02:30	0:59:08	0	26.19		0	30.07	1.25356
Georgetown	Arrival	0:02:06	1:01:15	4297	23.18	44.44	0	170.26	2.92075
Georgetown	Departure	0:01:30	1:02:45	0	13.54		0	30.07	0.75247
Cannondale	Arrival	0:04:26	1:07:10	15725	40.38	60	0	173.8	5.17579
Cannondale	Departure	0:01:30	1:08:40	0	30.16		0	30.07	0.75247
Wilton	Arrival	0:03:11	1:11:51	8533	30.46	57.64	0	172.03	4.50195
Wilton	Departure	0:02:30	1:14:21	0	17.06		0	30.07	1.25356
Merritt 7	Arrival	0:05:09	1:19:31	19008	41.89	60	0	173.82	6.12369
Merritt 7	Departure	0:01:30	1:21:01	0	32.45		0	30.07	0.75247
South Norwalk	Arrival	0:10:38	1:31:38	21375	22.84	50	0	171.2	9.01153
Run Total (With Dwells)		1:31:38		202449	25.1	60.01	0	173.9	99.40579
Run Total (Without Dwells)		1:13:39		202449	31.24	60.01	N.A.	173.9	90.37783

Table 3: Inbound Diesel, 6% Adhesion
 Trip Time Calculation for Improved Track (60mph MAS)

Station ID	Event State	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (Gallons/Hour)	Energy Consumption (Gallons)
New Milford	Departure	0:00:00	0:00:00	0			N.A.		0.00
Brookfield	Arrival	0:14:15	0:14:15	37488	29.9	60	0	169.33	17.00
Brookfield	Departure	0:01:30	0:15:45	0	27.05		0	30.07	0.75
North Danbury	Arrival	0:07:11	0:22:56	22704	35.92	60	0	168.96	8.65
North Danbury	Departure	0:01:30	0:24:26	0	29.72		0	30.07	0.75
Danbury	Arrival	0:10:29	0:34:54	17351	18.82	50.16	0	146.48	11.39
Danbury	Departure	0:01:30	0:36:24	0	16.46		0	30.07	0.75
Bethel	Arrival	0:04:46	0:41:11	12229	29.13	59.9	0	169.03	6.07
Bethel	Departure	0:02:30	0:43:41	0	19.11		0	30.07	1.25
Redding	Arrival	0:06:27	0:50:08	20465	36.03	60	0	169.34	9.49
Redding	Departure	0:01:30	0:51:38	0	29.23		0	30.07	0.75
Branchville	Arrival	0:09:42	1:01:20	23274	27.27	60	0	168.68	10.75
Branchville	Departure	0:02:30	1:03:50	0	21.68		0	30.07	1.25
Georgetown	Arrival	0:02:17	1:06:07	4297	21.35	39.09	0	120.8	2.57
Georgetown	Departure	0:01:30	1:07:37	0	12.9		0	30.07	0.75
Cannondale	Arrival	0:04:39	1:12:16	15725	38.5	60	0	168.86	5.11
Cannondale	Departure	0:01:30	1:13:46	0	29.1		0	30.07	0.75
Wilton	Arrival	0:03:25	1:17:11	8533	28.35	53.49	0	153.93	4.10
Wilton	Departure	0:02:30	1:19:41	0	16.38		0	30.07	1.25
Merritt 7	Arrival	0:05:28	1:25:09	19008	39.55	60	0	168.96	6.16
Merritt 7	Departure	0:01:30	1:26:39	0	31.03		0	30.07	0.75
South Norwalk	Arrival	0:10:48	1:37:27	21375	22.48	50	0	146.03	9.06
Run Total (With Dwells)		1:37:27		202449	23.61	60	0	169.34	99.38
Run Total (Without Dwells)		1:19:27		202449	28.96	60	N.A.	169.34	90.35

Table 4: Outbound Diesel, 15% Adhesion
 Trip Time Calculation for Improved Track (60mph MAS)

Station ID	Event State	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (Gallons/Hour)	Energy Consumption (Gallons)
South Norwalk	Departure	0:00:00	0:00:00	0			N.A.		0.00
Merritt 7	Arrival	0:10:13	0:10:13	20865	23.21	50	0	171.14	10.49
Merritt 7	Departure	0:01:30	0:11:43	0	20.24		0	30.07	0.75
Wilton	Arrival	0:05:40	0:17:23	19008	38.12	60	0	173.9	10.22
Wilton	Departure	0:02:30	0:19:53	0	26.45		0	30.07	1.25
Cannondale	Arrival	0:03:53	0:23:46	8563	25.09	52.46	0	171.11	6.31
Cannondale	Departure	0:01:30	0:25:16	0	18.09		0	30.07	0.75
Georgetown	Arrival	0:05:16	0:30:31	15755	34.04	60	0	173.88	9.78
Georgetown	Departure	0:01:30	0:32:01	0	26.48		0	30.07	0.75
Branchville	Arrival	0:02:46	0:34:47	4152	17.06	40.66	0	169.97	3.52
Branchville	Departure	0:02:30	0:37:17	0	8.96		0	30.07	1.25
Redding	Arrival	0:07:42	0:45:00	23189	34.2	60	0	173.81	12.52
Redding	Departure	0:01:30	0:46:30	0	28.63		0	30.07	0.75
Bethel	Arrival	0:05:42	0:52:12	20720	41.27	60	0	173.8	7.97
Bethel	Departure	0:02:30	0:54:42	0	28.7		0	30.07	1.25
Danbury	Arrival	0:04:29	0:59:11	12059	30.57	60	0	173.89	6.61
Danbury	Departure	0:01:30	1:00:41	0	22.9		0	30.07	0.75
North Danbury	Arrival	0:10:09	1:10:50	17496	19.59	60	0	173.8	8.05
North Danbury	Departure	0:01:30	1:12:20	0	17.07		0	30.07	0.75
Brookfield	Arrival	0:06:18	1:18:38	22704	40.91	60	0	173.89	9.86
Brookfield	Departure	0:01:30	1:20:08	0	33.05		0	30.07	0.75
New Milford	Arrival	0:13:38	1:33:46	37488	31.24	60	0	173.83	11.17
Run Total (With Dwells)		1:33:46		201999	24.48	60	0	173.9	105.52
Run Total (Without Dwells)		1:15:46		201999	30.29	60	N.A.	173.9	96.49

Table 5: Outbound Diesel, 6% Adhesion
 Trip Time Calculation for Improved Track (60mph MAS)

Station ID	Event State	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (Gallons/Hour)	Energy Consumption (Gallons)
South Norwalk	Departure	0:00:00	0:00:00	0			N.A.		0
Merritt 7	Arrival	0:10:29	0:10:29	20865	22.61	49.28	0	144.45	10.51144
Merritt 7	Departure	0:01:30	0:11:59	0	19.78		0	30.07	0.75247
Wilton	Arrival	0:06:49	0:18:48	19008	31.66	60	0	169	10.58853
Wilton	Departure	0:02:30	0:21:18	0	23.17		0	30.07	1.25356
Cannondale	Arrival	0:04:54	0:26:13	8563	19.83	40.96	0	125.11	5.95367
Cannondale	Departure	0:01:30	0:27:43	0	15.19		0	30.07	0.75247
Georgetown	Arrival	0:06:33	0:34:16	15755	27.33	52.95	0	152.97	9.69137
Georgetown	Departure	0:01:30	0:35:46	0	22.24		0	30.07	0.75247
Branchville	Arrival	0:03:18	0:39:04	4152	14.27	33.05	0	107.93	3.34001
Branchville	Departure	0:02:30	0:41:34	0	8.13		0	30.07	1.25356
Redding	Arrival	0:11:33	0:53:08	23189	22.8	60	0	168.92	14.23074
Redding	Departure	0:01:30	0:54:38	0	20.18		0	30.07	0.75247
Bethel	Arrival	0:06:00	1:00:38	20720	39.24	60	0	168.84	7.69972
Bethel	Departure	0:02:30	1:03:08	0	27.7		0	30.07	1.25356
Danbury	Arrival	0:04:52	1:07:59	12059	28.17	54.74	0	157.06	6.22475
Danbury	Departure	0:01:30	1:09:30	0	21.53		0	30.07	0.75247
North Danbury	Arrival	0:10:26	1:19:55	17496	19.07	60	0	168.86	8.02437
North Danbury	Departure	0:01:30	1:21:25	0	16.67		0	30.07	0.75247
Brookfield	Arrival	0:07:10	1:28:35	22704	36.03	60	0	168.98	10.09886
Brookfield	Departure	0:01:30	1:30:05	0	29.79		0	30.07	0.75247
New Milford	Arrival	0:13:54	1:43:59	37488	30.64	60	0	168.96	11.22221
Run Total (With Dwells)		1:43:59		201999	22.07	60	0	169	106.61364
Run Total (Without Dwells)		1:25:59		201999	26.7	60	N.A.	169	97.58568

Table 6: Inbound M2, 15% Adhesion
 Trip Time Calculation for Improved Track (60mph MAS)

Station ID	Event (State)	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (KW)	Energy Consumption (KWH)
New Milford	Departure	00:00.0	00:00.0	0			N.A.		0
Brookfield	Arrival	12:44.6	12:44.6	37488	33.43	60	0	4509.62	164.36428
Brookfield	Departure	01:00.0	13:44.6	0	31		0	240	4.00667
North Danbury	Arrival	04:46.7	18:31.3	22704	53.99	60	0	4509.85	79.39502
North Danbury	Departure	01:00.0	19:31.3	0	44.65		0	240	4.00667
Danbury	Arrival	08:46.2	28:17.5	17351	22.48	60	0	4510.24	110.93316
Danbury	Departure	01:00.0	29:17.5	0	20.18		0	240	4.00667
Bethel	Arrival	03:36.1	32:53.6	12229	38.58	60	0	4510.63	55.74009
Bethel	Departure	01:00.0	33:53.6	0	30.2		0	240	4.00667
Redding	Arrival	04:42.6	38:36.2	20465	49.38	60	0	4510.38	99.67801
Redding	Departure	01:00.0	39:36.2	0	40.73		0	240	4.00667
Branchville	Arrival	04:55.6	44:31.8	23274	53.68	60	0	4509.35	83.17924
Branchville	Departure	01:00.0	45:31.8	0	44.62		0	240	4.00667
Georgetown	Arrival	01:16.1	46:47.9	4297	38.5	60	0	4510.19	37.24442
Georgetown	Departure	01:00.0	47:47.9	0	21.53		0	240	4.00667
Cannondale	Arrival	03:26.6	51:14.5	15725	51.9	60	0	4510.28	48.79773
Cannondale	Departure	01:00.0	52:14.5	0	40.22		0	240	4.00667
Wilton	Arrival	02:16.6	54:31.1	8533	42.59	60	0	4511.26	41.34306
Wilton	Departure	01:00.0	55:31.1	0	29.59		0	240	4.00667
Merritt 7	Arrival	04:11.7	59:42.8	19008	51.49	60	0	4510.06	57.65389
Merritt 7	Departure	01:00.0	00:42.8	0	41.58		0	240	4.00667
South Norwalk	Arrival	09:57.7	10:40.5	21375	24.38	50	0	4511.57	80.26385
Run Total (With Dwells)		10:40.5		202449	32.55	60	0	4511.57	898.65943
Run Total (Without Dwells)		00:40.5		202449	37.92	60	N.A.	4511.57	858.59276

Table 7: Inbound M2, 4% Adhesion
 Trip Time Calculation for Improved Track (60mph MAS)

Station ID	Event (State)	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (KW)	Energy Consumption (KWH)
New Milford	Departure	0:00:00	12:00:00 AM	0			N.A.		0
Brookfield	Arrival	0:13:24	12:13:24 AM	37488	31.77	60	0	2597.62	162.00247
Brookfield	Departure	0:01:00	12:14:24 AM	0	29.57		0	240	4.00667
North Danbury	Arrival	0:05:58	12:20:22 AM	22704	43.29	60	0	2597.7	80.45248
North Danbury	Departure	0:01:00	12:21:22 AM	0	37.07		0	240	4.00667
Danbury	Arrival	0:09:39	12:31:01 AM	17351	20.43	60	0	2597.25	106.89224
Danbury	Departure	0:01:00	12:32:01 AM	0	18.51		0	240	4.00667
Bethel	Arrival	0:04:16	12:36:17 AM	12229	32.56	60	0	2596.38	55.00446
Bethel	Departure	0:01:00	12:37:17 AM	0	26.38		0	240	4.00667
Redding	Arrival	0:05:37	12:42:54 AM	20465	41.4	60	0	2596.8	89.35374
Redding	Departure	0:01:00	12:43:54 AM	0	35.15		0	240	4.00667
Branchville	Arrival	0:06:37	12:50:31 AM	23274	39.94	60	0	2595	87.30597
Branchville	Departure	0:01:00	12:51:32 AM	0	34.7		0	240	4.00667
Georgetown	Arrival	0:02:05	12:53:37 AM	4297	23.42	45.01	0	2006.88	26.18603
Georgetown	Departure	0:01:00	12:54:37 AM	0	15.83		0	240	4.00667
Cannondale	Arrival	0:04:22	12:58:58 AM	15725	40.95	60	0	2595.31	48.8661
Cannondale	Departure	0:01:00	12:59:58 AM	0	33.32		0	240	4.00667
Wilton	Arrival	0:03:06	1:03:04 AM	8533	31.28	60	0	2597.72	42.96172
Wilton	Departure	0:01:00	1:04:04 AM	0	23.65		0	240	4.00667
Merritt 7	Arrival	0:05:03	1:09:08 AM	19008	42.76	60	0	2597.38	58.57341
Merritt 7	Departure	0:01:00	1:10:08 AM	0	35.69		0	240	4.00667
South Norwalk	Arrival	0:10:30	1:20:37 AM	21375	23.14	50	0	2191	78.92035
Run Total (With Dwells)		1:20:37		202449	28.54	60	0	2597.72	876.58565
Run Total (Without Dwells)		1:10:37		202449	32.58	60	N.A.	2597.72	836.51898

Table 8: Outbound M2, 15% Adhesion
 Trip Time Calculation for Improved Track (60mph MAS)

Station ID	Event (State)	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (KW)	Energy Consumption (KWH)
South Norwalk	Departure	0:00:00	12:00:00 AM	0			N.A.		0
Merritt 7	Arrival	0:09:24	12:09:24 AM	20865	25.21	50	0	4499.68	94.93518
Merritt 7	Departure	0:01:00	12:10:24 AM	0	22.79		0	240	4.00667
Wilton	Arrival	0:04:11	12:14:36 AM	19008	51.57	60	0	4509.35	97.23135
Wilton	Departure	0:01:00	12:15:36 AM	0	41.63		0	240	4.00667
Cannondale	Arrival	0:02:17	12:17:53 AM	8563	42.49	60	0	4509.06	61.11177
Cannondale	Departure	0:01:00	12:18:53 AM	0	29.58		0	240	4.00667
Georgetown	Arrival	0:03:28	12:22:21 AM	15755	51.69	60	0	4509.68	92.01553
Georgetown	Departure	0:01:00	12:23:21 AM	0	40.11		0	240	4.00667
Branchville	Arrival	0:01:15	12:24:36 AM	4152	37.75	60	0	4509.84	41.32576
Branchville	Departure	0:01:00	12:25:36 AM	0	20.97		0	240	4.00667
Redding	Arrival	0:04:55	12:30:30 AM	23189	53.67	60	0	4508.5	112.14308
Redding	Departure	0:01:00	12:31:30 AM	0	44.59		0	240	4.00667
Bethel	Arrival	0:04:45	12:36:16 AM	20720	49.52	60	0	4512.04	87.586
Bethel	Departure	0:01:00	12:37:16 AM	0	40.91		0	240	4.00667
Danbury	Arrival	0:03:32	12:40:48 AM	12059	38.8	60	0	4509.93	62.23809
Danbury	Departure	0:01:00	12:41:48 AM	0	30.24		0	240	4.00667
North Danbury	Arrival	0:08:50	12:50:38 AM	17496	22.5	60	0	4510.92	70.30175
North Danbury	Departure	0:01:00	12:51:38 AM	0	20.22		0	240	4.00667
Brookfield	Arrival	0:04:47	12:56:24 AM	22704	53.99	60	0	4509.41	93.88983
Brookfield	Departure	0:01:00	12:57:24 AM	0	44.65		0	240	4.00667
New Milford	Arrival	0:12:46	1:10:11 AM	37488	33.35	60	0	4510.55	108.34859
Run Total (With Dwells)		1:10:11		201999	32.71	60	0	4512.04	961.19359
Run Total (Without Dwells)		1:00:11		201999	38.14	60	N.A.	4512.04	921.12692

Table 9: Outbound M2, 4% Adhesion
 Trip Time Calculation for Improved Track (60mph MAS)

Station ID	Event (State)	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (KW)	Energy Consumption (KWH)
South Norwalk	Departure	0:00:00	12:00:00 AM	0			N.A.		0
Merritt 7	Arrival	0:09:56	12:09:56 AM	20865	23.88	50	0	2201.88	93.1424
Merritt 7	Departure	0:01:00	12:10:56 AM	0	21.7		0	240	4.00667
Wilton	Arrival	0:05:11	12:16:06 AM	19008	41.74	60	0	2597.68	95.82729
Wilton	Departure	0:01:00	12:17:06 AM	0	34.98		0	240	4.00667
Cannondale	Arrival	0:03:17	12:20:24 AM	8563	29.56	58.74	0	2547.51	58.50719
Cannondale	Departure	0:01:00	12:21:24 AM	0	22.67		0	240	4.00667
Georgetown	Arrival	0:04:37	12:26:01 AM	15755	38.72	60	0	2596.91	89.35914
Georgetown	Departure	0:01:00	12:27:01 AM	0	31.84		0	240	4.00667
Branchville	Arrival	0:02:15	12:29:16 AM	4152	20.99	43.44	0	1944.82	29.32853
Branchville	Departure	0:01:00	12:30:16 AM	0	14.52		0	240	4.00667
Redding	Arrival	0:06:42	12:36:58 AM	23189	39.29	60	0	2597.01	114.43032
Redding	Departure	0:01:00	12:37:58 AM	0	34.19		0	240	4.00667
Bethel	Arrival	0:05:36	12:43:35 AM	20720	42	60	0	2583.76	77.42144
Bethel	Departure	0:01:00	12:44:35 AM	0	35.64		0	240	4.00667
Danbury	Arrival	0:04:16	12:48:51 AM	12059	32.09	60	0	2595.36	60.28148
Danbury	Departure	0:01:00	12:49:51 AM	0	26		0	240	4.00667
North Danbury	Arrival	0:09:43	12:59:34 AM	17496	20.46	60	0	2594.7	67.9461
North Danbury	Departure	0:01:00	1:00:34 AM	0	18.55		0	240	4.00667
Brookfield	Arrival	0:05:57	1:06:31 AM	22704	43.36	60	0	2596.67	95.43758
Brookfield	Departure	0:01:00	1:07:31 AM	0	37.12		0	240	4.00667
New Milford	Arrival	0:13:28	1:20:59 AM	37488	31.62	60	0	2596.18	108.08007
Run Total (With Dwells)		1:20:59		201999	28.34	60	0	2597.68	929.8282
Run Total (Without Dwells)		1:10:59		201999	32.33	60	N.A.	2597.68	889.76153

Table 10: Inbound Train #1833, Diesel
 Trip Time Calculation for Improved Track (60mph MAS)
 Trip Time Calculation for Mainline Portion of Trip (prepared by MNR)

Station ID	Event State	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (Gallons/Hour)	Energy Consumption (Gallons)
Start of Train Route	Departure	0:00:00	0:00:00	0			N.A.		0
EAST NORWALK	Pass	0:01:24	0:01:24	4109.31		56.69	N.A.		3.74518
SOUTH NORWALK	Arrival	0:01:42	0:03:06	6492	38.8	64.21	0	172.21	2.06719
SOUTH NORWALK	Departure	0:00:40	0:03:46	0	31.94		0	26.19	0.29178
ROWAYTON	Arrival	0:02:43	0:06:29	9467.39	39.6	61.76	0	172.19	6.20404
ROWAYTON	Departure	0:00:40	0:07:09	0	31.8		0	26.19	0.29178
DARIEN	Arrival	0:02:20	0:09:29	7899.36	38.58	60.63	0	172.18	5.23724
DARIEN	Departure	0:00:40	0:10:09	0	29.99		0	26.19	0.29178
NORTON HEIGHTS	Arrival	0:02:31	0:12:40	7903.94	35.59	59.03	0	172.2	5.66753
NORTON HEIGHTS	Departure	0:00:40	0:13:20	0	28.16		0	26.19	0.29178
STAMFORD	Arrival	0:03:56	0:17:16	16316.6	47.14	68.39	0	172.2	6.74378
STAMFORD	Departure	0:00:40	0:17:56	0	40.31		0	26.19	0.29178
HARRISON	Pass	0:11:31	0:29:28	56897.74		73.67	N.A.		24.50212
HARRISON	Pass	0:00:06	0:29:34	595.47		70	N.A.		0.21997
PELHAM	Pass	0:06:36	0:36:10	36995.58		90	N.A.		13.14291
HARLEM-125TH STREET	Arrival	0:11:33	0:47:42	58338.47	58.34	80	0	172.22	18.2451
HARLEM-125TH STREET	Departure	0:00:40	0:48:22	0	57.06		0	26.19	0.29178
GCT LEADS A-J	Pass	0:05:57	0:54:19	18585.97		60	N.A.		8.4989
GCT	Arrival	0:03:07	0:57:27	2707.96	26.67	10	0	172.18	1.5099
GCT	Departure	0:14:33	1:12:00	0	10.24		0	26.19	6.35503
End of Train Route	Pass	0:00:05	1:12:05	20.15		5.91	N.A.		0.09286
Run Total (With Dwells)		1:12:05		226329.9	35.68	90	N.A.	172.22	103.98239
Run Total (Without Dwells)		0:53:31		226329.9	48.05	90	N.A.	172.22	95.87671

Table 11: Inbound Train #1833, EMU
 Trip Time Calculation for Improved Track (60mph MAS)
 Trip Time Calculation for Mainline Portion of Trip (prepared by MNR)

Station ID	Event State	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (KW)	Energy Consumption (KWH)
Start of Train Route	Departure	0:00:00	0:00:00	0			N.A.		0
SOUTH NORWALK	Arrival	0:02:09	0:02:09	2402.46	12.74	27.97	0	3595.21	53.38754
SOUTH NORWALK	Departure	0:00:30	0:02:39	0	10.33		0	384	3.21067
ROWAYTON	Arrival	0:02:16	0:04:55	9381.51	46.9	70	0	4592.25	97.06895
ROWAYTON	Departure	0:00:20	0:05:15	0	40.9		0	384	2.144
DARIEN	Arrival	0:02:01	0:07:16	8083.17	45.51	70	0	4594.29	85.20944
DARIEN	Departure	0:00:20	0:07:36	0	39.06		0	384	2.144
NORTON HEIGHTS	Arrival	0:02:06	0:09:42	7871.66	42.66	70	0	4592.42	93.14458
NORTON HEIGHTS	Departure	0:00:20	0:10:02	0	36.81		0	384	2.144
STAMFORD	Arrival	0:03:40	0:13:42	16585.67	51.47	70	0	4593.55	95.80093
STAMFORD	Departure	0:00:20	0:14:02	0	47.18		0	384	2.144
HARRISON	Pass	0:10:36	0:24:38	57213.03		75	N.A.		357.36162
NEW ROCHELLE	Pass	0:04:12	0:28:50	29632.08		90	N.A.		120.44708
PELHAM	Pass	0:02:07	0:30:57	7361.63		70	N.A.		77.72369
HARLEM-125TH STREET	Arrival	0:11:58	0:42:55	58327.12	60	80	0	4593.48	236.31271
HARLEM-125TH STREET	Departure	0:00:30	0:43:25	0	58.98		0	384	3.21067
GCT LEADS A-J	Pass	0:05:43	0:49:08	18551.46		60	N.A.		141.8719
GCT Upper Track C	Pass	0:00:47	0:49:55	692.27		10	N.A.		5.51255
GCT	Arrival	0:02:22	0:52:17	2050.21	27.26	10	0	4593.15	16.75101
GCT	Departure	0:19:43	1:12:00	0	8.46		0	384	126.15467
End of Train Route	Pass	0:00:04	1:12:04	20.36		7.26	N.A.		1.5619
Run Total (With Dwells)		1:12:04		218172.6	34.4	90	N.A.	4594.29	1523.3059
Run Total (Without Dwells)		0:50:01		218172.6	49.56	90	N.A.	4594.29	1382.1539

Table 12: Outbound Train #1848, Diesel
 Trip Time Calculation for Improved Track (60mph MAS)
 Trip Time Calculation for Mainline Portion of Trip (prepared by MNR)

Station ID	Event State	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (Gallons/Hour)	Energy Consumption (Gallons)
GCT	Departure	0:00:00	0:00:00	0			N.A.		0
GCT Upper Track C	Pass	0:01:04	0:01:04	874.33		10	N.A.		1.02665
GCT LEADS A-J	Pass	0:00:53	0:01:56	770		10	N.A.		0.78621
HARLEM-125TH STREET	Arrival	0:06:22	0:08:18	19156.49	28.5	60	0	172.21	9.76499
HARLEM-125TH STREET	Departure	0:00:40	0:08:58	0	26.38		0	26.19	0.29178
PELHAM	Pass	0:12:26	0:21:23	57887.37		77.86	N.A.		22.14848
NEW ROCHELLE	Pass	0:02:05	0:23:28	7552.26		66.82	N.A.		2.45336
HARRISON	Pass	0:04:45	0:28:14	29812.92		86.97	N.A.		11.85392
STAMFORD	Arrival	0:11:19	0:39:32	57281.87	56.69	75	0	172.22	20.40155
STAMFORD	Departure	0:00:40	0:40:12	0	55.48		0	26.19	0.29178
NORTON HEIGHTS	Arrival	0:03:52	0:44:04	16588.6	48.77	70	0	172.16	9.1125
NORTON HEIGHTS	Departure	0:00:40	0:44:44	0	41.6		0	26.19	0.29178
DARIEN	Arrival	0:02:27	0:47:11	7881.95	36.58	62.9	0	172.21	5.35892
DARIEN	Departure	0:00:40	0:47:51	0	28.75		0	26.19	0.29178
ROWAYTON	Arrival	0:02:16	0:50:07	7732.26	38.68	62.36	0	172.18	5.04705
ROWAYTON	Departure	0:00:40	0:50:47	0	29.9		0	26.19	0.29178
SOUTH NORWALK	Arrival	0:03:23	0:54:10	9740.62	32.7	42	0	172.05	5.19873
SOUTH NORWALK	Departure	0:13:50	1:08:00	0	6.43		0	26.19	6.03706
End of Train Route	Pass	0:00:58	1:08:58	1536.7		27	N.A.		1.31603
Run Total (With Dwells)		1:08:58		216815.38	35.72	86.97	N.A.	172.22	101.96433
Run Total (Without Dwells)		0:51:49		216815.38	47.55	86.97	N.A.	172.22	94.4684

Table 13: Outbound Train #1848, EMU
 Trip Time Calculation for Improved Track (60mph MAS)
 Trip Time Calculation for Mainline Portion of Trip (prepared by MNR)

Station ID	Event State	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (KW)	Energy Consumption (KWH)
GCT	Departure	0:00:00	0:00:00	0			N.A.		0
GCT Upper Track C	Pass	0:01:03	0:01:03	875.56		10	N.A.		25.7987
GCT LEADS A-J	Pass	0:00:52	0:01:55	768.53		10	N.A.		21.40766
HARLEM-125TH STREET	Arrival	0:05:57	0:07:52	19156.73	30.04	60	0	4591.69	154.42661
HARLEM-125TH STREET	Departure	0:00:20	0:08:12	0	28.82		0	384	2.144
PELHAM	Pass	0:12:04	0:20:16	57882.94		80	N.A.		316.02764
NEW ROCHELLE	Pass	0:02:02	0:22:18	7558.99		70	N.A.		36.81835
HARRISON	Pass	0:04:19	0:26:37	29818.21		90	N.A.		165.1647
STAMFORD	Arrival	0:10:54	0:37:31	57274.28	59.11	75	0	4592.83	290.33102
STAMFORD	Departure	0:00:20	0:37:51	0	58.45		0	384	2.144
NORTON HEIGHTS	Arrival	0:03:36	0:41:27	16588.6	52.44	70	0	4593.98	135.78209
NORTON HEIGHTS	Departure	0:00:20	0:41:47	0	47.99		0	384	2.144
DARIEN	Arrival	0:02:04	0:43:51	7881.95	43.23	70	0	4591.87	83.9205
DARIEN	Departure	0:00:20	0:44:11	0	37.24		0	384	2.144
ROWAYTON	Arrival	0:01:57	0:46:09	7732.26	44.91	70	0	4592.09	80.152
ROWAYTON	Departure	0:00:20	0:46:29	0	38.37		0	384	2.144
SOUTH NORWALK	Arrival	0:03:15	0:49:43	9740.62	34.13	48.53	0	4592.23	64.40239
SOUTH NORWALK	Departure	0:00:30	0:50:13	0	29.57		0	384	3.21067
End of Train Route	Pass	0:00:54	0:51:08	1536.4		27	N.A.		17.84517
Run Total (With Dwells)		0:51:08		216815.07	48.19	90	N.A.	4593.98	1406.00752
Run Total (Without Dwells)		0:48:58		216815.07	50.32	90	N.A.	4593.98	1392.07685

Table 14: Dwell Times

Station	Diesel Dwell (seconds)	Engine Loading (seconds)	Total Diesel Dwell (seconds)	EMU (M2) Dwell (seconds)
Inbound Direction				
New Milford (Outbound Only)	0	30	30	0
Brookfield	60	30	90	60
North Danbury	60	30	90	60
Danbury	60	30	90	60
Bethel	120	30	150	60
Redding	60	30	90	60
Branchville	120	30	150	60
Georgetown	60	30	90	60
Cannondale	60	30	90	60
Wilton	120	30	150	60
Merrit 7 (high level platform)	60	30	90	60
South Norwalk (Inbound)	0	0	0	0
TOTAL DWELL	780	330	1110	600
Outbound Direction				
South Norwalk (Outbound)	0	30	30	0
Merrit 7 (high level platform)	60	30	90	60
Wilton	120	30	150	60
Cannondale	60	30	90	60
Georgetown	60	30	90	60
Branchville	120	30	150	60
Redding	60	30	90	60
Bethel	120	30	150	60
Danbury	60	30	90	60
North Danbury	60	30	90	60
Brookfield	60	30	90	60
New Milford (Inbound)	0	0	0	0
TOTAL DWELL	780	330	1110	600

Table 15: Inbound Trip Times for Alternatives
 Elapsed Time in Minutes at Departure from Station
 (Hrs:Min:Sec)

Station ID	Alternative A No Build and Alternative B TSM	Alternative C Norwalk to Danbury (Diesel)	Alternative C Norwalk to Danbury (EMU)	Alternative D Extension to New Milford (Diesel)	Alternative D Extension to New Milford (EMU)	Alternative D Extension to New Milford (EMU to Danbury/ Diesel to New Milford)	Alternative E Partial Electrification (EMU to Wilton/ Diesel to Danbury)
New Milford	n/a	n/a	n/a	0:00:00	0:00:00	0:00:00	n/a
Brookfield	n/a	n/a	n/a	0:15:15	0:13:45	0:15:15	n/a
North Danbury	n/a	n/a	n/a	0:23:07	0:19:32	0:23:07	n/a
Danbury	0:00:00	0:00:00	0:00:00	0:34:35	0:29:18	0:34:35	0:00:00
Bethel	0:08:37	0:07:00	0:04:36	0:41:35	0:33:54	0:39:11	0:08:37
Redding	0:16:50	0:14:28	0:10:18	0:49:03	0:39:36	0:44:53	0:16:50
Branchville	0:28:03	0:24:34	0:16:14	0:59:09	0:45:32	0:50:49	0:28:03
Georgetown	0:31:39	0:28:10	0:18:30	1:02:45	0:47:48	0:53:05	0:31:39
Cannondale	0:37:56	0:34:06	0:22:57	1:08:41	0:52:15	0:57:32	0:37:56
Wilton	0:43:40	0:39:47	0:26:14	1:14:22	0:55:32	1:00:49	0:44:10
Merritt 7	0:50:41	0:46:26	0:31:26	1:21:01	1:00:44	1:06:01	0:49:22
South Norwalk	1:03:41	0:58:34	0:42:24	1:33:09	1:11:42	1:16:59	1:00:20
Rowayton	1:07:04	1:01:57	0:45:00	1:36:32	1:14:18	1:19:35	1:02:56
Darien	1:10:04	1:04:57	0:47:21	1:39:32	1:16:39	1:21:56	1:05:17
Noroton Heights	1:13:15	1:08:08	0:49:47	1:42:43	1:19:05	1:24:22	1:07:43
Stamford	1:17:51	1:12:44	0:53:47	1:47:19	1:23:05	1:28:22	1:11:43
Harlem – 125th Street	1:48:17	1:43:10	1:23:10	2:17:45	1:52:28	1:57:45	1:41:06
Grand Central Terminal (Arrival)	1:57:21	1:52:14	1:32:03	2:26:49	2:01:21	2:06:38	1:49:59

Table 16: Inbound M2, 15% Adhesion (Revision 2)

Station ID	Event (State)	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (KW)	Energy Consumption (KWH)
New Milford	Departure	0:00:00	0	0			N.A.		0
Brookfield	Arrival	0:12:56	0.008987269	37488	32.92	60	0	4939.65	242.53303
Brookfield	Departure	0:01:00	0.009681713	0	30.56		0	384	6.41067
North Danbury	Arrival	0:04:53	0.013077546	22704	52.76	60	0	4965.07	116.22582
North Danbury	Departure	0:01:00	0.013771991	0	43.8		0	384	6.41067
Danbury	Arrival	0:08:56	0.019974537	17351	22.08	60	0	4969.63	175.52377
Danbury	Departure	0:01:00	0.020668981	0	19.85		0	384	6.41067
Bethel	Arrival	0:03:43	0.023244213	12229	37.47	60	0	4968.71	85.85722
Bethel	Departure	0:01:00	0.023938657	0	29.51		0	384	6.41067
Redding	Arrival	0:04:51	0.027305556	20465	47.97	60	0	4968.42	146.71286
Redding	Departure	0:01:00	0.028	0	39.76		0	384	6.41067
Branchville	Arrival	0:05:04	0.031517361	23274	52.22	60	0	4965.2	126.93109
Branchville	Departure	0:01:00	0.032211806	0	43.61		0	384	6.41067
Georgetown	Arrival	0:01:21	0.033146991	4297	36.26	60	0	4964.37	59.52629
Georgetown	Departure	0:01:00	0.033841435	0	20.81		0	384	6.41067
Cannondale	Arrival	0:03:31	0.036278935	15725	50.91	60	0	4966.05	74.01834
Cannondale	Departure	0:01:00	0.03697338	0	39.62		0	384	6.41067
Wilton	Arrival	0:02:21	0.038606481	8533	41.23	60	0	4966.68	65.52227
Wilton	Departure	0:01:00	0.039300926	0	28.93		0	384	6.41067
Merritt 7	Arrival	0:04:17	0.042271991	19008	50.49	60	0	4964.62	86.07335
Merritt 7	Departure	0:01:00	0.042966435	0	40.92		0	384	6.41067
South Norwalk	Arrival	0:10:01	0.049921296	21375	24.25	50	0	4968.08	127.69647
Run Total (With Dwells)		1:11:53		202449	32	60	0	4969.63	1370.72718
Run Total (Without Dwells)		1:01:53		202449	37.17	60	N.A.	4969.63	1306.62051

Table 17: Inbound M2, 4% Adhesion (Revision 2)

Station ID	Event (State)	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (KW)	Energy Consumption (KWH)
New Milford	Departure	0:00:00	0	0			N.A.		0
Brookfield	Arrival	0:13:29	0.009364583	37488	31.59	60	0	4363.16	239.49437
Brookfield	Departure	0:01:00	0.010059028	0	29.41		0	384	6.41067
North Danbury	Arrival	0:05:49	0.014100694	22704	44.33	60	0	4362.6	119.81246
North Danbury	Departure	0:01:00	0.014795139	0	37.83		0	384	6.41067
Danbury	Arrival	0:09:36	0.021458333	17351	20.55	60	0	4361.39	168.83797
Danbury	Departure	0:01:00	0.022152778	0	18.61		0	384	6.41067
Bethel	Arrival	0:04:17	0.025126157	12229	32.46	60	0	4362.08	85.24253
Bethel	Departure	0:01:00	0.025820602	0	26.31		0	384	6.41067
Redding	Arrival	0:05:33	0.029675926	20465	41.89	60	0	4361.93	136.4229
Redding	Departure	0:01:00	0.03037037	0	35.5		0	384	6.41067
Branchville	Arrival	0:06:23	0.034803241	23274	41.43	60	0	4363.66	134.44097
Branchville	Departure	0:01:00	0.035497685	0	35.82		0	384	6.41067
Georgetown	Arrival	0:02:01	0.036900463	4297	24.17	47.03	0	3692.92	44.00061
Georgetown	Departure	0:01:00	0.037594907	0	16.17		0	384	6.41067
Cannondale	Arrival	0:04:19	0.040591435	15725	41.41	60	0	4358.24	75.15003
Cannondale	Departure	0:01:00	0.04128588	0	33.62		0	384	6.41067
Wilton	Arrival	0:03:02	0.043393519	8533	31.95	60	0	4357.55	67.65745
Wilton	Departure	0:01:00	0.044087963	0	24.03		0	384	6.41067
Merritt 7	Arrival	0:04:59	0.047542824	19008	43.42	60	0	4362.07	87.84907
Merritt 7	Departure	0:01:00	0.048237269	0	36.15		0	384	6.41067
South Norwalk	Arrival	0:10:27	0.055493056	21375	23.25	50	0	3966.07	126.11317
Run Total (With Dwells)		1:19:55		202449	28.79	60	0	4363.66	1349.1282
Run Total (Without Dwells)		1:09:55		202449	32.91	60	N.A.	4363.66	1285.02154

Table 18: Outbound M2, 15% Adhesion (Revision 2)

Station ID	Event (State)	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (KW)	Energy Consumption (KWH)
South Norwalk	Departure	0:00:00	0:00:00	0			N.A.		0
Merritt 7	Arrival	0:09:34	0:09:34	20865	24.79	50	0	4960.02	152.1236
Merritt 7	Departure	0:01:00	0:10:34	0	22.44		0	384	6.41067
Wilton	Arrival	0:04:17	0:14:51	19008	50.49	60	0	4965.66	146.61242
Wilton	Departure	0:01:00	0:15:51	0	40.92		0	384	6.41067
Cannondale	Arrival	0:02:24	0:18:15	8563	40.52	60	0	4967.22	96.50262
Cannondale	Departure	0:01:00	0:19:15	0	28.61		0	384	6.41067
Georgetown	Arrival	0:03:36	0:22:50	15755	49.82	60	0	4967.13	139.08489
Georgetown	Departure	0:01:00	0:23:50	0	38.98		0	384	6.41067
Branchville	Arrival	0:01:22	0:25:12	4152	34.52	60	0	4967.96	67.33788
Branchville	Departure	0:01:00	0:26:12	0	19.94		0	384	6.41067
Redding	Arrival	0:05:03	0:31:16	23189	52.11	60	0	4965.75	167.84206
Redding	Departure	0:01:00	0:32:16	0	43.51		0	384	6.41067
Bethel	Arrival	0:04:52	0:37:08	20720	48.4	60	0	4968.35	129.72962
Bethel	Departure	0:01:00	0:38:08	0	40.15		0	384	6.41067
Danbury	Arrival	0:03:37	0:41:45	12059	37.84	60	0	4964.83	95.78222
Danbury	Departure	0:01:00	0:42:45	0	29.65		0	384	6.41067
North Danbury	Arrival	0:09:03	0:51:48	17496	21.97	60	0	4967.05	113.25776
North Danbury	Departure	0:01:00	0:52:48	0	19.78		0	384	6.41067
Brookfield	Arrival	0:04:53	0:57:41	22704	52.81	60	0	4965.76	137.27126
Brookfield	Departure	0:01:00	0:58:41	0	43.84		0	384	6.41067
New Milford	Arrival	0:12:51	1:11:32	37488	33.13	60	0	4966.19	159.12728
Run Total (With Dwells)		1:11:32		201999	32.09	60	0	4968.35	1468.77829
Run Total (Without Dwells)		1:01:32		201999	37.3	60	N.A.	4968.35	1404.67162

Table 19: Outbound M2, 4% Adhesion (Revision 2)

Station ID	Event (State)	Interval Time (Hrs:Min:Sec)	Elapsed Time (Hrs:Min:Sec)	Distance (Feet)	Average Speed (MPH)	Maximum Speed (MPH)	Makeup	Peak Power (KW)	Energy Consumption (KWH)
South Norwalk	Departure	0:00:00	12:00:00 AM	0			N.A.		0
Merritt 7	Arrival	0:10:00	12:10:00 AM	20865	23.7	50	0	3975.88	148.6991
Merritt 7	Departure	0:01:00	12:11:00 AM	0	21.54		0	384	6.41067
Wilton	Arrival	0:05:03	12:16:03 AM	19008	42.8	60	0	4362.12	144.36488
Wilton	Departure	0:01:00	12:17:03 AM	0	35.72		0	384	6.41067
Cannondale	Arrival	0:03:09	12:20:12 AM	8563	30.89	60	0	4362.81	94.27126
Cannondale	Departure	0:01:00	12:21:12 AM	0	23.45		0	384	6.41067
Georgetown	Arrival	0:04:26	12:25:38 AM	15755	40.38	60	0	4362.95	135.41993
Georgetown	Departure	0:01:00	12:26:38 AM	0	32.95		0	384	6.41067
Branchville	Arrival	0:02:09	12:28:47 AM	4152	22.01	45.11	0	3516.56	49.94686
Branchville	Departure	0:01:00	12:29:47 AM	0	15.01		0	384	6.41067
Redding	Arrival	0:06:23	12:36:09 AM	23189	41.31	60	0	4362.85	174.53846
Redding	Departure	0:01:00	12:37:09 AM	0	35.71		0	384	6.41067
Bethel	Arrival	0:05:32	12:42:41 AM	20720	42.55	60	0	4363.09	117.20103
Bethel	Departure	0:01:00	12:43:41 AM	0	36.04		0	384	6.41067
Danbury	Arrival	0:04:11	12:47:52 AM	12059	32.8	60	0	4363.83	93.09574
Danbury	Departure	0:01:00	12:48:52 AM	0	26.46		0	384	6.41067
North Danbury	Arrival	0:09:47	12:58:39 AM	17496	20.33	60	0	4358.94	110.66304
North Danbury	Departure	0:01:00	12:59:39 AM	0	18.44		0	384	6.41067
Brookfield	Arrival	0:05:49	1:05:28 AM	22704	44.38	60	0	4362.73	141.69114
Brookfield	Departure	0:01:00	1:06:28 AM	0	37.87		0	384	6.41067
New Milford	Arrival	0:13:24	1:19:52 AM	37488	31.79	60	0	4359.04	159.20605
Run Total (With Dwells)		1:19:52		201999	28.74	60	0	4363.83	1433.20416
Run Total (Without Dwells)		1:09:52		201999	32.86	60	N.A.	4363.83	1369.0975

Figure 1: Tractive Effort Curve, P32AC (DM)

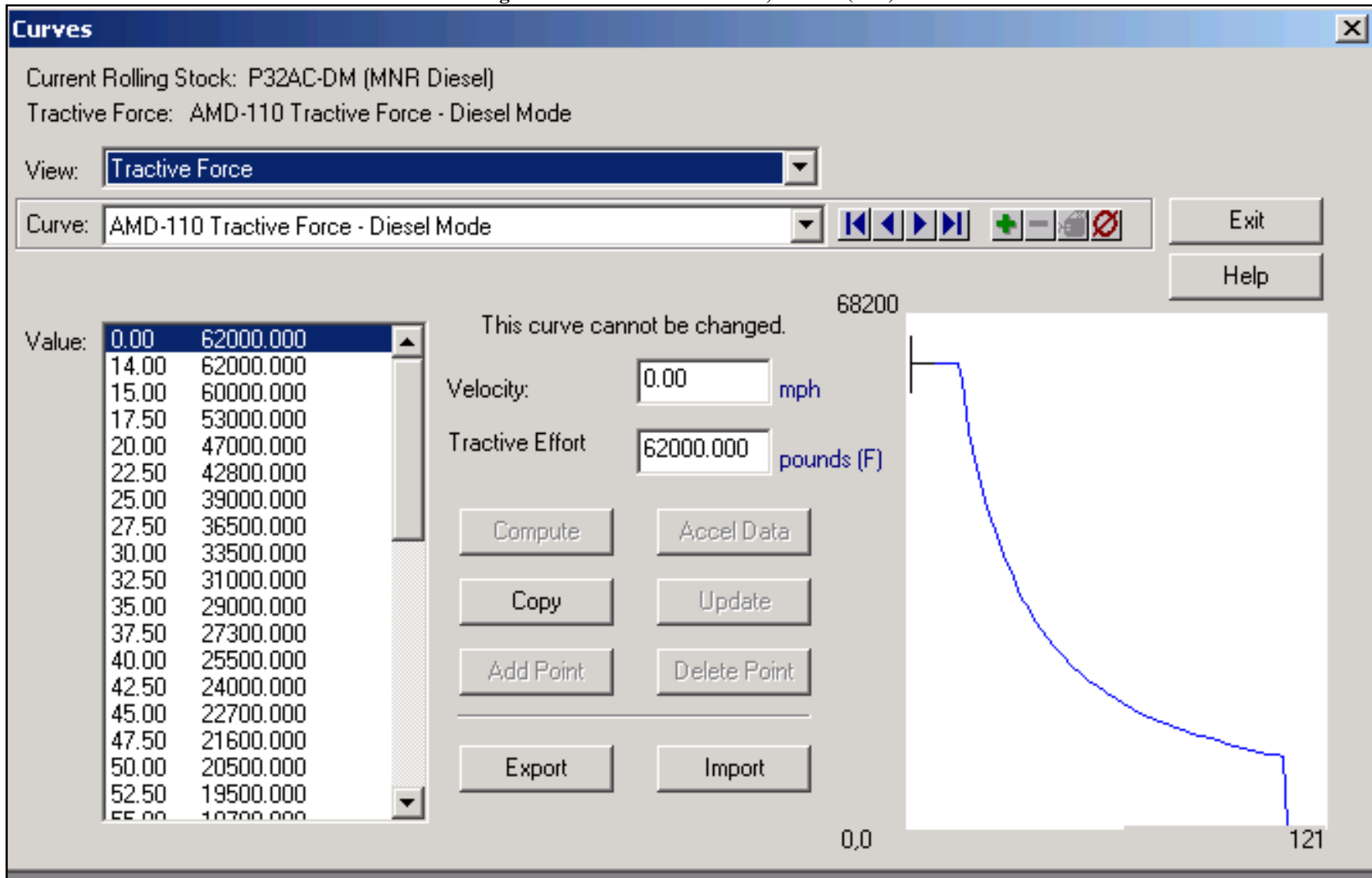


Figure 2: Tractive Effort Curve, NHL EMU (M2)

Velocity	TE
0.00	10000.00
1.00	11500.00
5.00	13800.00
7.00	14000.00
10.00	14200.00
15.00	13900.00
16.50	13200.00
19.00	12285.00
20.00	11520.00
20.25	11211.00
25.00	9956.00
30.00	9249.00
35.00	8450.00
40.00	7573.00
41.00	7057.00
43.00	6483.00
50.00	5565.00
55.00	5453.00
60.00	5065.00
65.00	4723.00
70.00	4269.00
75.00	3976.00
80.00	3878.00
84.20	3591.00
85.00	3500.00
90.00	2950.00
95.00	2300.00
100.00	1900.00

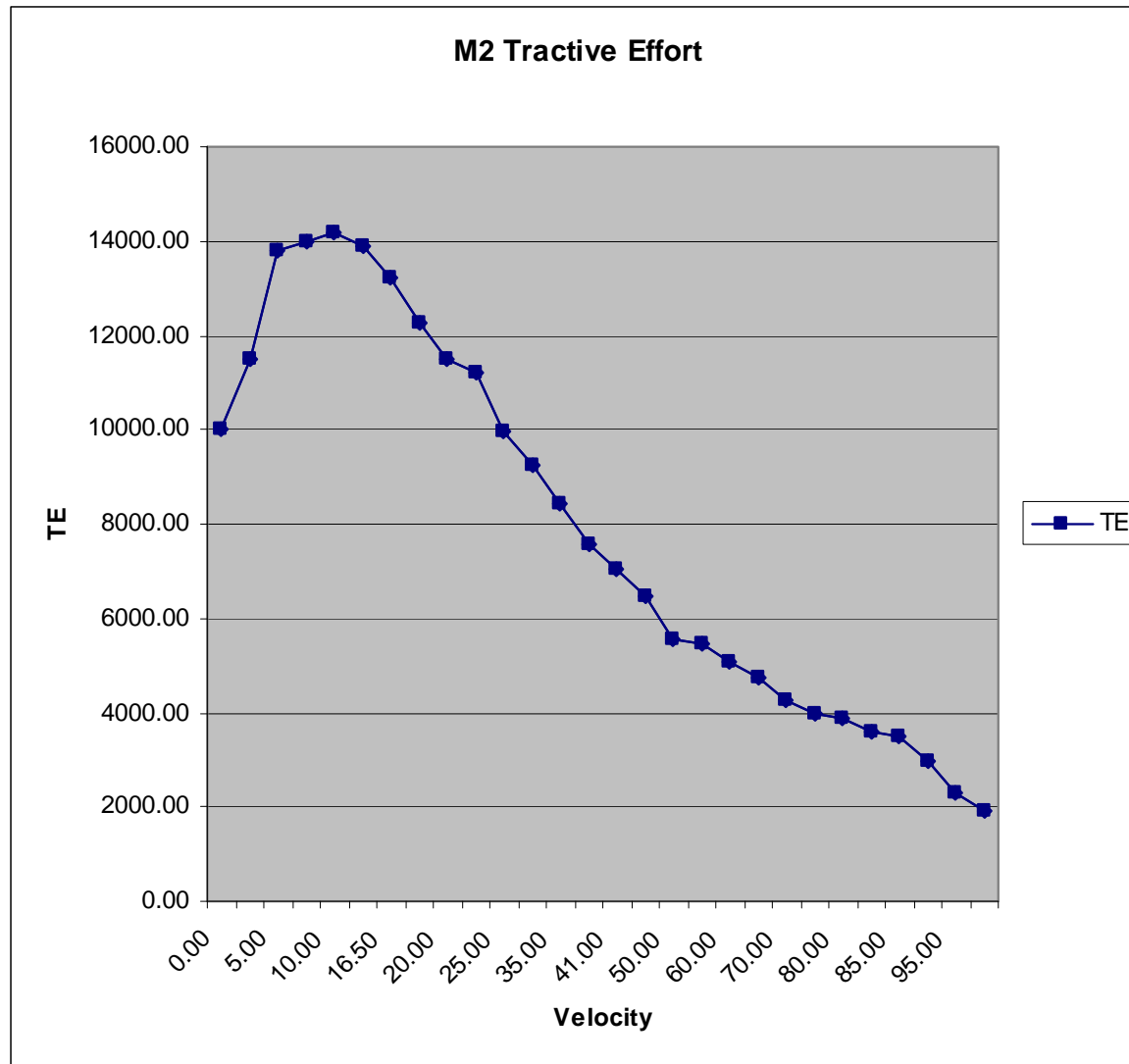


Figure 3: Passenger Train Speeds, South Norwalk to Danbury

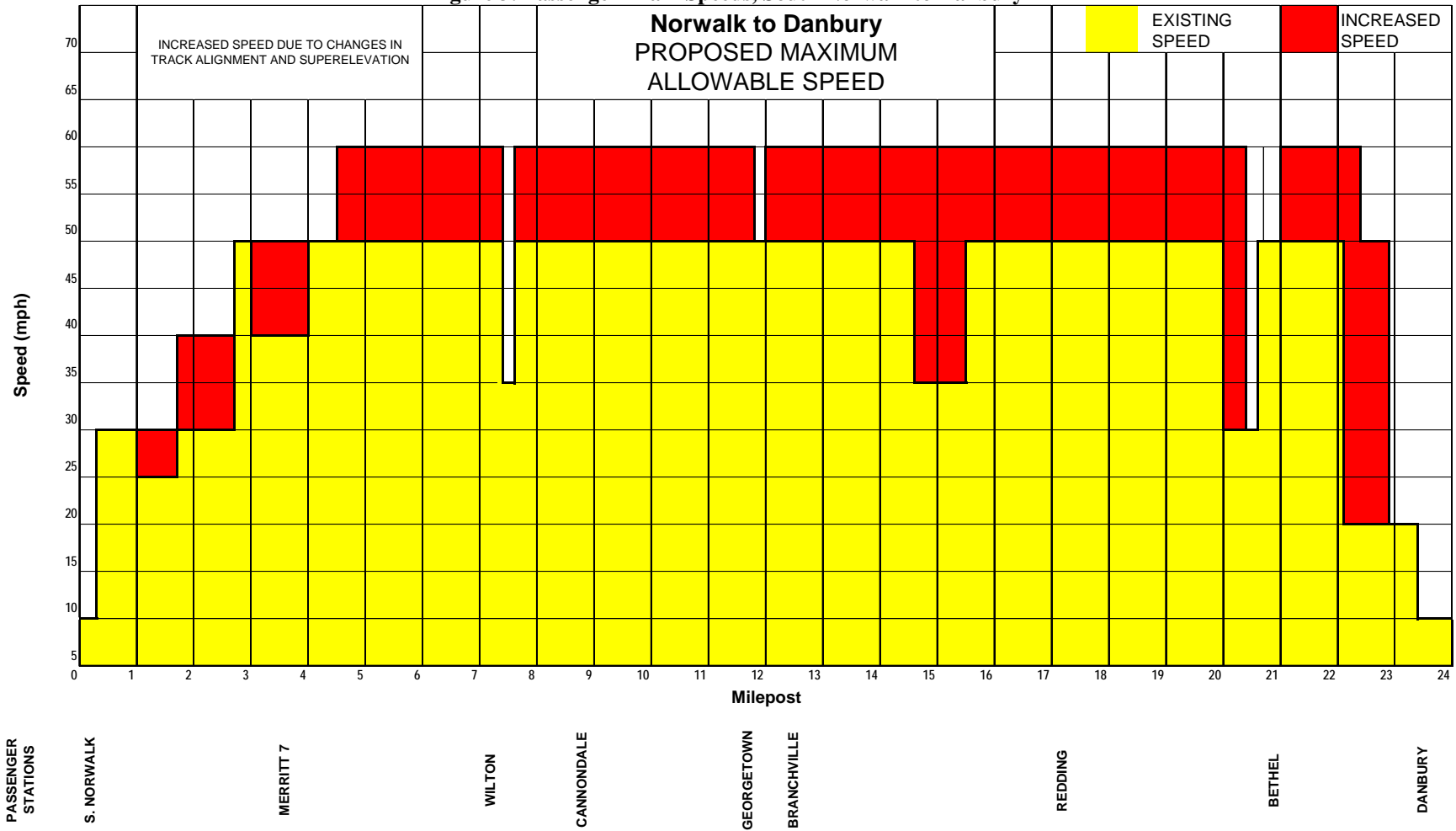


Figure 4: Passenger Train Speeds, Danbury to New Milford

