# DCA-08-MR-009

# Head-on Collision of Metrolink Commuter Train No. 111 and UP Freight Train No. LOF65-12

# Chatsworth, CA

# September 12, 2008

# Track & Engineering Group Factual Report

# 18 pages, including cover

# NATIONAL TRANSPORTATION SAFETY BOARD

## OFFICE OF RAILROAD, PIPELINE &

## HAZARDOUS MATERIALS INVESTIGATIONS

## Washington, D.C. 20594

## DCA 08 MR 009

**HEAD ON COLLISION/DERAILMENT OF METROLINK TRAIN No. 111 & UNION PACIFIC TRAIN No. LOF65-12**

**On Metrolink's Ventura Subdivision**

**Chatsworth, California**

**September 12, 2008**

## TRACK & ENGINEERING GROUP FACTUAL REPORT

**Prepared by: R. A. Hipskind, Track & Engineering Group Chairman**

**Accident:**

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|---|---|
| NTSB Accident Number: | DCA 08 MR 009 |
| Date of Accident: | September 12, 2008 |
| Time of Accident: | 4:23 p.m. (PDT) |
| Type of Train: | Metrolink commuter train No.111 & UP freight train LOF65-12 |
| Railroad Owner: | Southern California Regional Rail Authority (Metrolink) |
| Train Operators: | Metrolink<br>Union Pacific |
| Crew Members Metrolink: | 1 Engineer, 1 Conductor |
| Crew Members UP: | 1 Engineer, 1 Conductor, 1 Brakeman |
| Location of Accident: | Chatsworth, California |

**Synopsis**:

On Friday, September 12, 2008, at approximately 4:23 p.m. pacific daylight time, westbound Metrolink passenger train No. 111 and eastbound Union Pacific freight train No. LOF65-12 collided head-on while operating in a 6 degree curve on Metrolink's Ventura Subdivision between Topanga and tunnel No. 28 near Chatsworth, California. The Metrolink train derailed its locomotive and lead passenger car, the UP train derailed two locomotives and 10 cars. As a result of the collision, the Metrolink locomotive was shoved about 50 feet into the lead passenger car. Emergency response agencies reported that 101 injured persons were transported to local hospitals. There were 25 fatalities.

Damage is estimated at $10.25 million[1]. Environmental conditions were daylight, clear skies, haze, calm winds and a temperature of 73 degrees F with visibility of four miles.

Parties to the investigation include Metrolink, Union Pacific (UP), Federal Railroad Administration (FRA), California Public Utilities Commission (CPUC), Brotherhood of Locomotive Engineers and Trainmen (BLET), United Transportation Union (UTU), Bombardier Transportation, Connex (operator of Metrolink trains), Mass Electric Construction Company, Los Angeles Police Department and Los Angeles Fire Department.

1 The damage estimate is as of the time of this report, late October 2008.

**The Accident:**

About 4:23 p.m. Pacific Daylight Time (PDT) [2], on September 12, 2008, westbound Metrolink train No. 111, consisting of a locomotive and three passenger cars collided with eastbound Union Pacific Railway Company (UP) train LOF65-12, the Leesdale local. The UP local consisted of two locomotives (UP 8485 in the lead, and UP 8491 trailing) with 17 cars, 7 loads and 10 empties and was about 1,164 feet long with 1,522 tons, including the locomotives. The Metrolink train was 313 feet in length. The accident occurred in Los Angeles County in the town of Chatsworth, California, which is approximately 30 miles northwest of downtown Los Angeles.

The head-on train accident occurred at about milepost 444.123[3], the point of collision (POC), which is located in the full body of a 6 degree curve west of Metrolink's closest signal control point (CP) at Topanga (hereafter CP Topanga will be referred to as Topanga). The westbound Metrolink train was routed and signaled to stop on the main track east of the westbound signal at Topanga, which is located east and clear of the No. 20 turnout that interlocks the single main track to the Chatsworth siding. The eastbound UP freight train, the Leesdale local, was routed from the single main track west of the No. 20 turnout into Topanga and over the reversed switch points and turnout rails of the No. 20 turnout onto the siding. However, the Metrolink train did not stop at the westbound signal for Topanga but proceeded through the reversed switch points and continued onto the single main track and collided with the UP train within the limits of the 6 degree curve west of Topanga. The POC, in the direction of the Metrolink train, is located 1,761 feet from the westbound signal at Topanga and 1,384 feet west of the point of switch and in the direction of the UP train about 650 feet east of MP 444.0 or the east portal of tunnel No. 28.

Metrolink designates the maximum authorized timetable speed on their single main track east of (prior to) Topanga as 70 mph and at a reduced speed between Topanga and tunnel No. 28 of 40 mph, which would be Federal Railroad Administration (FRA) Class 4 and 3, respectively. The 40 mph authorized speed is for a permanent speed restriction due to the curvature of the track.

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Metrolink estimated that the total annual gross tonnage, passenger and freight, is about 10.6 million gross tons. Metrolink operates, on average, about 20 Metrolink passenger trains and 12 Amtrak passenger trains and 9 UP freight trains daily on the Ventura Subdivision.

2 All times in this report is Pacific Daylight Time (PDT).

3 Milepost or MP references in this document should be considered assigned data locations. Please see Appendix A for specific measured footage distances between landmarks or other data points.

## Weather:

At about 3:51 PDT, the Van Nuys surface weather station, which is about 5.4 nautical miles east of Chatsworth, California, recorded that the environmental conditions were daylight, clear skies, haze, calm winds and a temperature of 73 degrees F with visibility of four miles.

## Details of the Investigation:

### Track Structure:

Post accident observations by investigators disclosed that the general construction of the main track proceeding Topanga consisted of 136 pound continuous welded rail (CWR)[4]. The rail is seated in 16 by 7 ¾ inch double shoulder tie plates that lay between the bottom surface of the rail and the top surface of timber crossties. The rail is fastened through the tie plates to standard timber crossties with four lag screws, two on the gage side and two on the field side. The track west of the Topanga switch is where the 6 degree curve begins and the type of crossties changes to concrete ties that are held in place by two elastic fasteners[5], one of the gage side and one on the field side of each rail.

The wooden crosstie sections of track averaged 24 ties per 39 feet. The concrete tie section averaged 19 ½ ties per 39 feet. The wooden crosstie section was predominantly box anchored (four rail anchors per crosstie, two rail anchors applied to each rail, a rail anchor on each side of a crosstie) with rail anchors applied to every crosstie. The CWR in the concrete tie sections is anchored on every tie with two elastic fasteners. Both areas of track are supported by a mixture of semi-angular granite ballast that filled the crosstie cribs[6]. The depth of the ballast was estimated at 20 to 22 inches. The ballast shoulders[7] measured 20 inches wide on tangent and 24 inches wide in the curve. Investigators did not observe any fouled ballast conditions.

At the point of collision (POC), Metrolink maintains a 6 degree curve with 4 ½ inches of elevation.

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4 CWR is rail that is welded in lengths over 400 feet, in this case, the rail in the vicinity of the accident is completely welded or without conventional joints.

5 The elastic fasteners observed in place serve as rail holding, rail anchoring and rail restraining devices.

6 The crosstie cribs are the ballast holding area in track between the lengths of the crossties.

7 Ballast shoulders refer to the amount of ballast extending from the ends of the crossties outward forming lateral restraint for the track.

The Topanga switch is constructed of CWR. The switch point area is completely welded (without rail joints) and the switch point area is constructed with Samson switch points and stock rails that are beveled for a protected fit of the switch point against the stock rail.

**Damages:**

The Metrolink estimated the total track and structures damages at $250,000. This figure included costs for the installation of 10 ½ track panels, where the collision occurred.

**Metrolink Train No. 111 West Movement:**

The National Transportation Safety Board (NTSB) Track Group's examination of Metrolink's track profile information disclosed that train No.111 west would have traversed the following portions of track from MP 445.5, the Chatsworth passenger station stop, through Topanga and the switch to the POC: [8]

- Metrolink train No. 111 west left Chatsworth Passenger Station at MP 445.50.
- The milepost designations in the westward direction of travel are descending.
- From MP 445.5 (Chatsworth Station) to about MP 444.8 the train travels on a 1.0% ascending grade.
- The track is straight (or tangent) from about MP 445.50 to about 444.39, where a 6 degree left-hand curve begins (left-hand in the direction of the Metrolink travel).
- The train traversed and crossed two public road crossings, Devonshire St. at about MP 445.20 and Chatsworth St. at about MP 444.69.
- The train passed the westbound signal at about MP 444.48 and shortly after passed through the #20 turnout (trailing move) at about MP 444.4.
- The train began to traverse a 6 degree, 00 minute left-hand curve about MP 444.39 and continued in that curve up to the POC.
- The train reached the POC at MP 444.123.

8 Although milepost references are enumerated here and in the next section for the UP train movement, please refer to Appendix A for the actual footage reference points for distances from the POC. The above milepost references were derived from a review of Metrolink's Ventura Subdivision track chart.

The Track Group's examination of Metrolink's track profile information disclosed that UP train No. LOF65-12 east would have traversed the following portions of track from tunnel No. 26 at milepost 442.60, eastward and through tunnels Nos. 27 and 28, exiting tunnel No. 28 into the curve and up to the POC: [9]

**UP LOF65-12 Train Movement:**

- UP LOF65-12 exited Tunnel #26 at about MP 442.60.
- The train passed the last eastbound signal prior to the collision at about MP 442.62.
- The milepost designations increase in the eastward direction of travel.
- The train traversed three curves between about MP 442.60 and about MP 444.00. A left-hand 6 degree, 00 minutes curve; left-hand 6 degree, 00 minutes curve, a right-hand 6 degree, 00 minutes curve.
- The train traveled on a descending grade between about MP 442.60 and about MP 444.00 which ranges from 0.76% to 1.00%.
- The train traveled through Tunnel #27 between about MP 442.90 and about MP 443.08.
- The train entered Tunnel #28 at MP 443.90 and exited the tunnel at about MP 444.00.
- The train entered a 6 degree right-hand curve (in the direction of travel).
- There is a natural mound of dirt on the right hand side of the track after the train exited the east portal of the tunnel.
- The train reached the POC at MP 444.123.

Note: Metrolink engineering department denotes their curves as right or left hand based upon the direction of movement through ascending mileposts not from the movement of a train based upon its direction. The right hand or left hand turnouts are based on the direction of possible travel facing the switch points.

9 Although milepost references are enumerated here and in the next section for the UP train movement, please refer to Appendix A for the actual footage reference points for distances from the POC. The above milepost references were derived from a review of Metrolink's Ventura Subdivision track chart.

In the above description of train movement, the trains traversed tangent track except for those portions defined otherwise. The two trains collided on curved track maintained with 4 ½ inches of superelevation near milepost 444.123 located on a single main track west of Topanga.

**Post Accident Inspection/Testing of Track:**

On September 13 & 14, 2008, members of the Track Group participated in inspection of the No. 20 turnout and measuring the track geometry conditions west of Topanga. Recorded track notes were developed from measurements taken at 15-foot, 6-inch incremental stations and using 62-foot chord mid-ordinates measurements. Investigators took measurements at a total of 25 stations. No station or measurements were taken on the west side of the POC due to the disturbed track conditions, track panel installation and surfacing repairs initiated after the collision.

The factual findings of the post-accident track measurements are as follows:

- The maximum measurement allowed for gage in Federal Railroad Administration (FRA) Track Safety Standards (TSS) Class 3 track is 57 3/4 inches. Track notes determined that the widest gage was 56 7/8 inches; 7/8 of an inch within the FRA maximum allowable limit.

- The maximum allowed deviation of alignment using a 62' chord in curved track for FRA Class 3 track may not be more than 1 ¾ inches. Track notes record that the greatest alignment deviation measurement for the undisturbed track was 5/16 of an inch from uniformity; 1 7/16 inches within the FRA maximum allowable limit.

- The maximum allowable difference in cross level between any two points less than 62 feet apart for FRA Class 3 track may not be more than 2 inches. Track notes recorded that the greatest crosslevel measurement deviation from designated elevation was 5/16 of an inch; 1 11/16 of an inch within the FRA maximum allowable limit.

- The average degree of curvature measured was 5 degrees, 58 minutes; the average elevation measured was 4 and 7/16 inches.

This is the last segment of track that the Metrolink train traveled over prior to the September 12, 2008, collision. There were no other geometry exceptions taken to the track conditions.

On September 14, 2008, investigators inspected the No. 20 turnout (a right hand switch) located at MP 444.4 on the main track that provides access to the Chatsworth siding, which begins at Topanga. During that inspection, the investigators observed contact marks on the field side of the turnout's left hand switch point about 31 feet from the end of the switch point. These marks extended for several feet along the switch point's length in a west direction toward the end of the switch point. Before the switch was disturbed or repaired, investigators noted the switch appeared to be in a reverse position; however the switch points were not up against either stock rail. Investigators observed the operating rod that controls the throw of the switch was severely bent. The right hand switch point's tip showed fresh signs of damage. The switch point was in the reverse position (lined against main track movement) at the time the Metrolink passenger train traversed through it.

**View of Topanga turnout looking east**

*Photo No. 1*


*As the above photograph shows, both switch points are "open" or not firmly against either stock rail. There is a chip out of the right hand switch point. The switch rods are bent.*

The track group investigators determined that the point of collision (POC) was at MP 444.123, which is about 650' from the east portal of tunnel No. 28 or milepost marker 444. The POC is about 6,939 feet from Chatsworth Station and about 1,761 feet from the westbound control signal at Topanga. (Note: See Appendix A for additional landmarks and reference point data.)

**Track Inspection Records:**

FRA regulations found in 49 Code of Federal Regulations (CFR) Part 213 requires that the carrier's track inspection records be prepared and signed on the day that a required inspection is made. Those track inspection records are required to reflect actual field conditions and any deviations from the FRA Track Safety Standards (TSS). The gross annual tonnage, the passenger operations and Metrolink's election to operate at FRA Class 3 and 4 speeds required Metrolink personnel to inspect the main track at least two times per calendar week. Metrolink officials stated that Metrolink typically attempts to inspect the main track at least three times per week.

On September 12, 2008, a Metrolink track inspector designated under 49CFR Part 213.7(b), last visually inspected the track in the collision area prior to the accident. The record of that inspection did not note any exceptions in the area of the collision.

As part of the Track Group's investigation, investigators inspected and reviewed Metrolink's track inspection records dating back to March 1, 2008, at Metrolink's division headquarters in Pomona, California. FRA did not note any exceptions for that inspection of Metrolink track inspection records and for the switch inspection records of the Topanga switch. FRA also reviewed Metrolink's list of qualified inspectors and persons designated to provide remedial actions on behalf of the railroad. FRA did not take any exceptions to the list of designated personnel.

An Associate Railroad Track Inspector for California Public Utilities Commission (CPUC) last inspected Metrolink's Ventura Subdivision on January 8, 2008. The inspection began at MP 424.6 and ended at MP 462.6. There were no FRA defective conditions or exceptions documented in the Chatsworth area.

FRA last ran their Automated Track Inspection Program vehicle, DOTX 220, on Metrolink's Ventura Subdivision on March 17, 2008. There was no FRA defective conditions or exceptions documented in the Chatsworth area.

**Track Geometry Car Data and Ultrasonic Rail Tests:**

Investigators reviewed and examined the two most recent Metrolink geometry car data, dated July 30, 2008 and December 12, 2007. Metrolink contracts its track geometry testing through Holland Track Testing Services, who tested, measured and recorded data. In the immediate area preceding the POC, the data does not list any geometry deficiencies

The last three ultrasonic tests to inspect rail for internal defects at the frequency required by 49CFR Part 213.231(a) were conducted by Sperry Rail Service on July 31, 2008; and by Herzog Rail Service on December 12, 2007, and October 17, 2007. The testing data did not denote any defective rails identified or requiring remedial action in the vicinity of the accident.

**Sight Distance Tests:**

On September 16, 2008, investigators conducted a sight distance test on the single main track in the 6 degree curve wherein an exemplar UP locomotive and Metrolink passenger train were positioned coupler–to-coupler at the POC. The equipment was moved away from each other in equal intervals of 60 feet until the engineer of each could not see the other piece of equipment. Those points were marked and measured. The UP locomotive was 300 feet west of the POC when the personnel aboard could no longer observe the Metrolink train. The Metrolink equipment moved east 247 feet where the personnel stated that they could no longer observe the UP locomotive. From those two points, investigators determined that the "line-of-sight" linear measurement was 539 feet (as measured from coupler-to-coupler[10] reference points).

**Sight Distance Diagram**

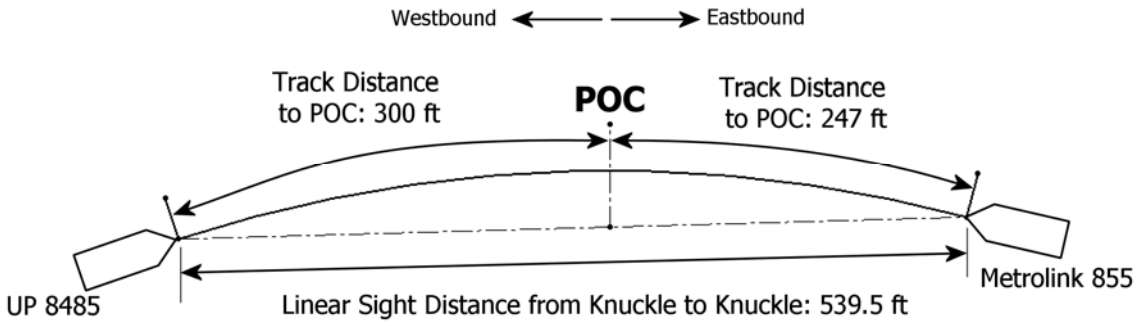



***Figure No. 1***

10 The coupler-to-coupler reference can also be referred to as "knuckle to knuckle".

On September 15, 2008, track and engineering personnel assisted investigators who conducted sight distance tests on the single main track from Chatsworth Station into the westbound control signal at Topanga to observe the display of that signal from a Metrolink locomotive, as well as, the switch points and other signal prior to Chatsworth station. The locomotive stopped where the locomotive engineer normally positions himself with a three car train at Chatsworth station. This location is about 7,064 feet from the POC and about 5,303 feet east of the westbound control signal for Topanga. The investigative group had the engineer move the train west and stop to identify the location where the westbound signal at Topanga could be clearly seen, which was 950 feet west of his stop location at Chatsworth station. This location is 4,353 feet east of the westbound signal at Topanga.

Investigators requested that the engineer determine his sight distance of the switch points at Topanga by backing a Metrolink consist eastbound until the engineer affirmed that he no longer could see the position of the switch points. This point was marked and measured from the point of switch and determined to be about 615 feet east of the switch points. Investigators conducted a sight distance test for the signal designated as signal 4451. The engineer's sight distance was determined by advancing a Metrolink consist westbound until the engineer affirmed that he had clear sight of signal 4451. This point was marked and measured from signal 4451 and determined to be about 1,360 feet east of that signal.

The westbound signal at control point (CP) Bernson, located at about MP 446.80, was also tested for the engineer's preview of the signal. The engineer's sight distance was determined by advancing a Metrolink consist westbound until the engineer affirmed that he had clear sight of the signal. This point was the grade crossing at Winnetka Avenue (MP 447.80). The signal is located 81 feet west of the centerline of the grade crossing at DeSoto Avenue (MP 446.80). The sight distance was determined to be about 5,353 feet east of the signal.

Investigators conducted a sight distance test for the intermediate signal designated as signal 4483, which is the approach signal to CP Bernson. The engineer's sight distance was determined by advancing a Metrolink consist westbound until the engineer affirmed that he had clear sight of signal 4483. This point was marked and measured from signal 4483 and determined to be about 1,832 feet east of the signal.

**Engineering Drawing:**

Metrolink engineering department personnel surveyed the collision site and produced an engineering drawing detailing the POC and other related locations relative to the accident investigation. The drawing includes the pertinent landmarks and sight distance tests data points. See Appendix A for a list of engineering station measurements associated with the POC and various landmarks and pertinent accident investigation data points. Appendix B shows a graphic of the POC detailing Metrolink train equipment lengths and immediate area.

Party to the Investigation - Acknowledgment Signatures

The undersigned designated *Party to the Investigation* representatives attest that the information contained in this report is a factually accurate representation of the information collected during the investigation, to the extent of their best knowledge and contribution in this investigation.

_____//s//_____ Date __10-27-08____
Richard A. Hipskind, NTSB

_____//s//_____ Date __10-28-08___
Michael Ridens, Metrolink

_____//s//_____ Date__10-28-08____
Wayne Mauthe, Metrolink

_____//s//_____ Date __10-28-08___
Lance Hawks, FRA

_____//s//_____ Date __10-27-08___
Matthew Dick, UP

_____//s//_____ Date __10-27-08___
Joseph Saavedra, Mass Electric

# Appendix A

Chatsworth NTSB Engineering Measurements - SCRRA Side
Note: All measurements made along north rail
Landmarks and measurements for the Metrolink Train travel

| Station | Landmark |
|---|---|
| **0+00** | Preliminary POC - Time stake M-0 and U-0 |
| **ML 0+60** | Time Stake M-1 |
| **ML 1+20** | Time Stake M-2 |
| **ML 1+35** | End repair track |
| **ML 1+43** | Join existing rail |
| **ML 1+80** | Time Stake M-3 |
| **ML 2+40** | Time Stake M-4 |
| **ML 2+47** | Metrolink Engineer's site distance point (Stake M-4 + 7 feet) |
| **ML 3+00** | Time Stake M-5 |
| **ML 3+45** | East End SCRRA commuter car - RAC point |
| **ML 3+60** | Time Stake M-6 |
| **ML 4+98** | West End Bridge 444.32 |
| **ML 5+37** | East End Bridge 444.32 |
| **ML 9+01** | Insulated joint – south rail |
| **ML 9+05** | Signal |
| **ML 9+08** | Insulated joint – north rail |
| **ML 9+40** | Curve 244 Spiral to Curve Point - 4 1/2 inches elevation |
| **ML 12+30** | Automatic Equipment Identification scanner |
| **ML 12+94** | End timber ties / begin concrete ties |
| **ML 12+97** | Curve 244 Tangent to Spiral Point |
| **ML 13+11** | Dragging Equipment Detector |
| **ML 13+84** | Point of Switch CP TOPANGA |
| **ML 14+12** | Flange / Switch point Contact - full solid contact |
| **ML 14+15** | Flange / Switch point Contact - initial solid contact |
| **ML 14+18** | Flange / Switch point Contact - initial trace contact |
| **ML 15+41** | Point of Frog CP TOPANGA |
| **ML 17+61** | Signal CP TOPANGA |
| **ML 19+99** | Westbound site distance point to switch point at CP TOPANGA |
| **ML 29+31** | West edge of panels - Chatsworth Rd. Crossing |
| **ML 29+91** | East edge of panels - Chatsworth Rd. Crossing |
| **ML 34+79** | Milepost Sign - MP445 |

| | |
|---|---|
| **ML 38+27** | 40P/40F westbound speed sign |
| **ML 42+73** | Crossing whistle sign - east and west bound, main track and siding |
| **ML 55+58** | West edge of panels - Devonshire Rd. Crossing |
| **ML 56+58** | East edge of panels - Devonshire Rd. Crossing |
| **ML 61+14** | Westbound site distance point to red aspect at CP TOPANGA |
| **ML 67+64** | West end of intertrack fence |
| **ML 68+66** | West end south platform - Chatsworth Station |
| **ML 68+85** | Crossing whistle sign - east and west bound, main track and siding |
| **ML 69+39** | West end north platform - Chatsworth Station |
| **ML 70+64** | Engineer's position stopped at Chatsworth with 3 car train |
| **ML 73+64** | East end north platform - Chatsworth Station |
| **ML 73+75** | East end south platform - Chatsworth Station |
| **ML 74+94** | East end of intertrack fence |
| **ML 82+12** | West edge of panels - Lassen Street Crossing |
| **ML 83+02** | East edge of panels – Lassen Street Crossing |
| **ML 83+41** | Insulated joint - main track south rail |
| **ML 83+44** | Insulated joint - siding track south rail |
| **ML 83+47** | Centerline of signal masts - main track and siding |
| **ML 83+49** | Insulated joint - main track north rail |
| **ML 83+51** | Insulated joint - siding track north rail |
| **ML 97+07** | Westbound site distance point to Signal 4451 |
| **ML 98+57** | Milepost sign - MP446 |
| **ML 99+18** | Begin survey 9/27/08 |
| **ML 119+21** | West end Bridge, 446.4 |
| **ML 120+09** | East end Bridge, 446.4 |
| **ML 125+02** | Crossing whistle sign - eastbound, main track and siding |
| **ML 133+04** | CP BERNSON – Eastbound Signals |
| **ML 137+65** | CP BERNSON - Point of switch |
| **ML 138+02** | West edge of panels - DeSoto Ave. Crossing |
| **ML 139+12** | East edge of panels - DeSoto Ave. Crossing |
| **ML 139+37** | CP BERNSON – Westbound signal |
| **ML 140+11** | West end - temporary platform |
| **ML 145+11** | East end - temporary platform |
| **ML 152+01** | Crossing whistle sign – westbound |
| **ML 153+00** | Milepost Sign - MP447 |

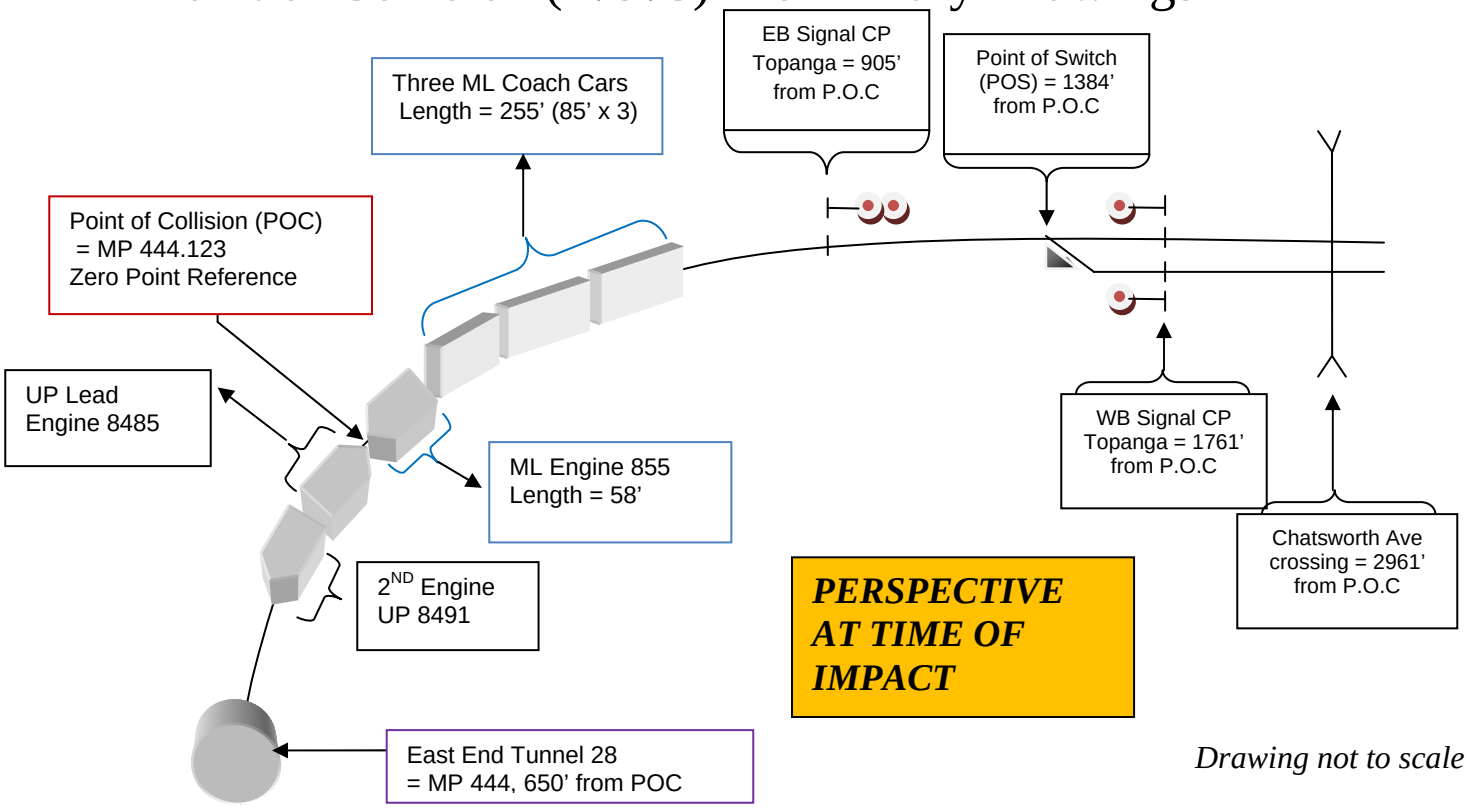
| | |
|---|---|
| **ML 156+82** | West Point of Switch - side track |
| **ML 165+21** | West edge of panels - Mason Ave. Crossing |
| **ML 166+22** | 70P/40F westbound speed sign (P=passenger; F=freight) |
| **ML 166+26** | East edge of panels – Mason Ave. Crossing |
| **ML 176+28** | Crossing whistle sign - east and west bound |
| **ML 184+95** | East Point of Switch - side track |
| **ML 192+35** | West edge of panels - Winnetka Ave. Crossing |
| **ML 192+90** | Westbound site distance point to CP BERNSON |
| **ML 193+45** | East edge of panels - Winnetka Ave. Crossing |
| **ML 206+21** | Crossing whistle sign – eastbound |
| **ML 206+62** | Crossing whistle sign – westbound |
| **ML 210+28** | Milepost Sign - MP448 |
| **ML 219+52** | West edge of panels - Corbin Ave. Crossing |
| **ML 220+62** | East edge of panels – Corbin Ave. Crossing |
| **ML 220+89** | Signal – 4484 westbound & 4483 eastbound |
| **ML 229+90** | Crossing whistle sign – westbound |
| **ML 233+55** | C/L Nordhoff Overpass |
| **ML 239+21** | Westbound site distance point to signal 4484 |
| **ML 240+49** | Crossing whistle sign – westbound |
| **ML 246+65** | West edge of panels - Tampa Ave. Crossing |
| **ML 247+86** | East edge of panels – Tampa Ave. Crossing |
| **ML 254+24** | Milepost Sign - MP449 |
| **ML 261+00** | Crossing whistle sign - westbound & plugged culvert |
| **ML 269+35** | West end Bridge |
| **ML 269+96** | East end Bridge |
| **ML 271+12** | West end platform - Northridge Station |
| **ML 273+21** | Engineer's position stopped at Northridge with 3 car train |
| **ML 276+24** | East end platform - Northridge Station |
| **ML 276+82** | West Point of Switch - Northridge storage track |
| **ML 279+18** | End Survey 9/27/08 |

Chatsworth NTSB Engineering Measurements - UPRR Side
Note: All measurements made along north rail
Landmarks and measurements for the UP train travel

| Station | Landmark |
|---|---|
| **0+00** | Preliminary POC – Time stake M-0 and U-0 |
| **UP 0+60** | Time Stake U-1 |
| **UP 1+20** | Time Stake U-2 |
| **UP 1+80** | Time Stake U-3 |
| **UP 2+40** | Time Stake U-4 |
| **UP 2+80** | Begin repair track - 136lb timber tie panels |
| **UP 3+00** | Time Stake U-5 and UP Engr's site distance point |
| **UP 3+60** | Time Stake U-6 |
| **UP 5+26** | End timber ties / begin concrete ties |
| **UP 5+72** | West end Curve 224 |
| **UP 6+50** | East Portal Tunnel 28 / Milepost Sign - MP444 |
| **UP 11+97** | West Portal Tunnel 28 |
| **UP 17+81** | Flange Lubricator |
| **UP 22+69** | East end Curve 223 / End concrete ties / begin timber ties |
| **UP 38+49** | End timber ties / begin concrete ties |
| **UP 38+69** | West end Curve 223 |
| **UP 47+39** | East end Curve 222 / End concrete ties / begin timber ties |
| **UP 55+33** | East Portal Tunnel 27 |
| **UP 58+81** | Milepost Sign - MP443 |
| **UP 60+13** | End timber ties / begin concrete ties |
| **UP 60+72** | West end Curve 222 |
| **UP 64+63** | West Portal Tunnel 27 |
| **UP 72+79** | End concrete ties / begin timber ties |
| **UP 73+09** | Flange Lubricator / east end Curve 221 |
| **UP 78+21** | Insulated joint - north rail |
| **UP 78+28** | Signal |
| **UP 78+35** | Insulated joint – south rail |
| **UP 78+39** | West end Curve 221 |
| **UP 80+23** | End timber ties / begin concrete ties |
| **UP 80+64** | East Portal Tunnel 26 |

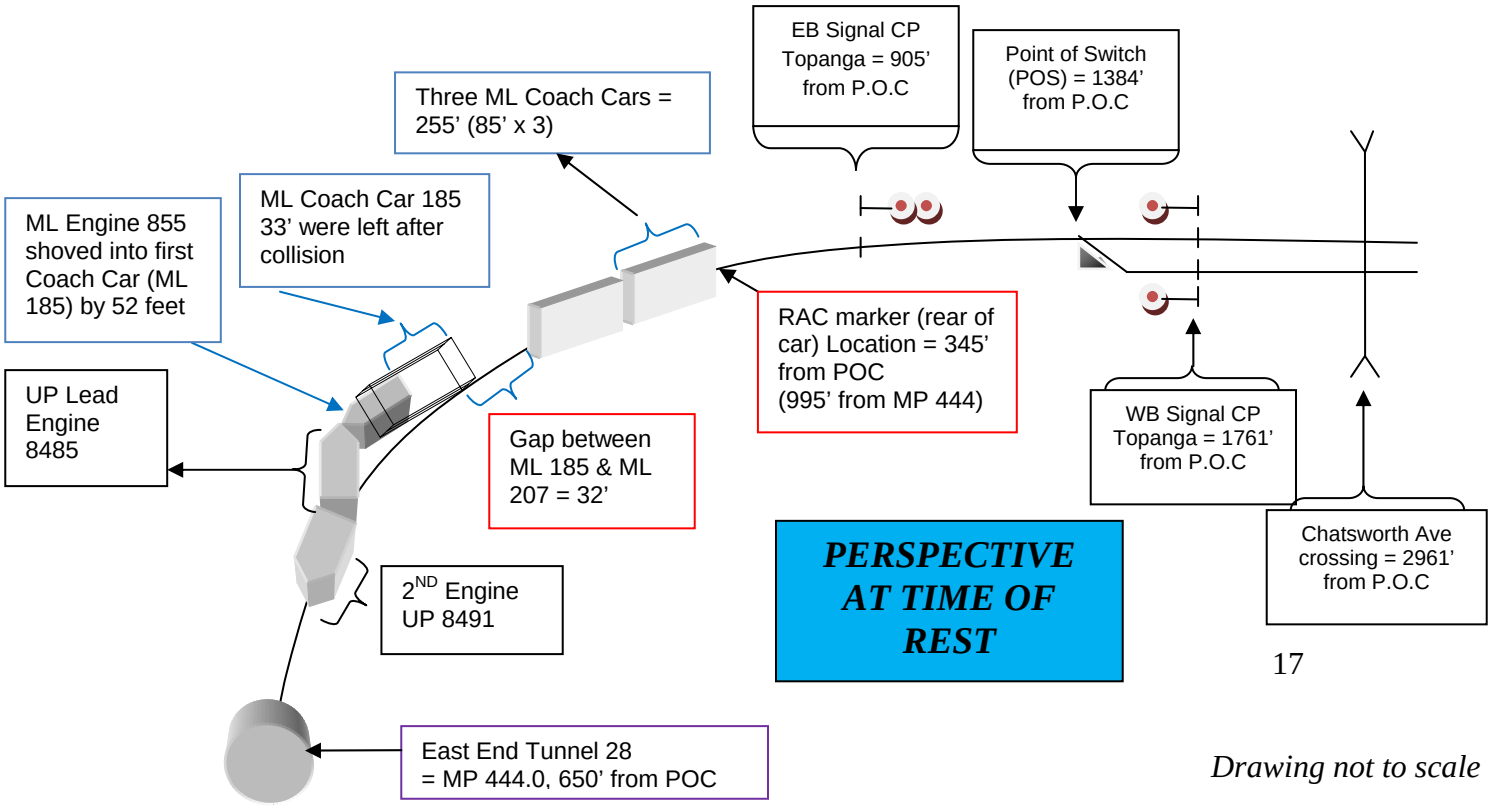
**Appendix B**

# Point of Collision (P.O.C) Preliminary Drawings




***PERSPECTIVE AT TIME OF IMPACT***

*Drawing not to scale*




***PERSPECTIVE AT TIME OF REST***



*Drawing not to scale*