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| Project Name: Ulster County Integrated Advance Train Detection and Arrival Prediction Implementation Plan | |

**Ulster County Transportation Council**
**Traffic Operations and Public Safety Committee (TOPS)**
**Ulster County, New York**


# Ulster County Integrated Advance Train Detection and Arrival Prediction Implementation Plan

## FINAL REPORT AND IMPLEMENTATION PLAN

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# Ulster County
## Contract No. UC-06-44
# Ulster County Integrated Advance Train Detection and Arrival Prediction Implementation Plan
# Final Report and Implementation Plan

# 0. Revision History

| Revision | Date | Comments |
|---|---|---|
| 1 | March 5, 2008 | Initial Draft Release |
| 2 | March 13, 2008 | Revised Release |
| 3 | April 18, 2008 | Final Release reflecting all review comments. |

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# 1. Introduction

## 1.1. Purpose

Ulster County Transportation Council, via its Traffic Operations and Public Safety Committee, has determined that a need exists for a system to provide advance warning to emergency responders of train traffic throughout the County. SYSTRA Engineering, Inc. was selected to conceptually design an appropriate system and to develop a plan for implementing that system.

The CSX West Shore Line (River Line) is one of the most intensively-used single track freight corridors in the U.S. It serves as the primary freight conduit between the South, New Jersey and New England points. The River Line connects major classification yards in New Jersey with Selkirk Yard, southwest of Albany, which handles the majority of freight entering New England. This freight crosses the Hudson River just east of Selkirk Yard, where traffic splits to the (east of) Hudson Line and the Boston & Albany route to Springfield, Worcester and Albany. Selkirk also serves as CSX's gateway to the "Water Level Route" serving Syracuse, Rochester, Buffalo and points west. While the River Line has no scheduled passenger service, it does serve freight trains of varying priorities, ranging from high-priority intermodal (container and trailer on flat car) trains to general merchandise trains and local switchers.

The River Line through Ulster County runs very close to the Hudson River at the northern and southern borders of the County. In the middle, the line swings inland, passing through the center of Kingston, owing to the many coves and inlets along the river. Kingston's CSX trackage serves a number of discrete functions in addition to through train movements. It includes an interlocked (signalized and remotely-controlled) passing siding over two miles in length, allowing trains in opposite directions to pass each other on what is otherwise a single track railroad. This siding is also used for higher priority trains to overtake lower priority trains in the same direction. Kingston's trackage also includes a local switching yard between the two

Figure 1-1. 2007 CSX System Map (Courtesy of CSX Corporation)

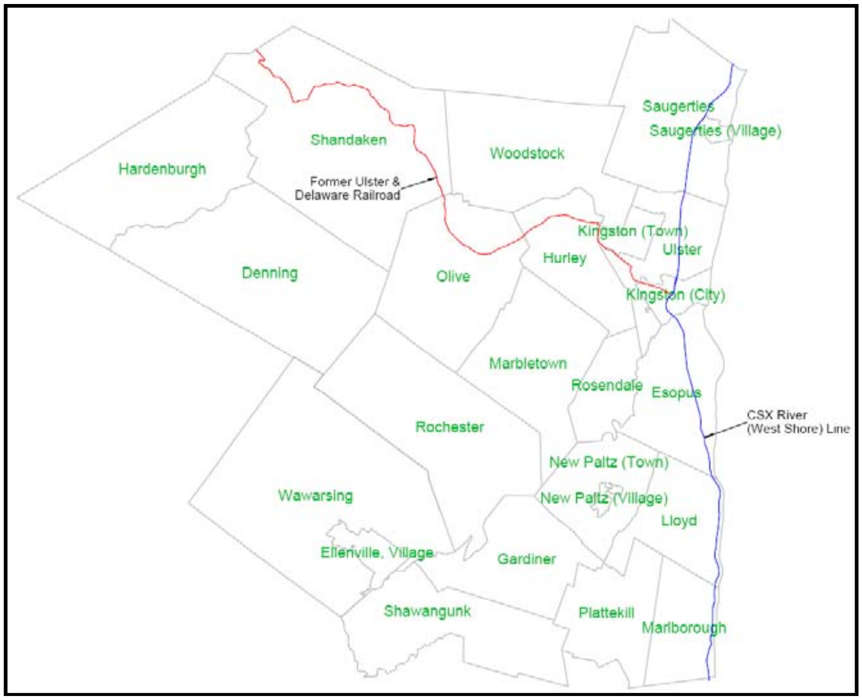


**Figure 1-2. Ulster County rail map showing the CSX River Line in blue and the former Ulster & Delaware Railroad in red. The former Ulster & Delaware segment from Kingston to Kingston Point is not shown.**

main tracks, with a long yard switching lead oriented northward that connects with both the passing track and main track. Finally, there are several industry spurs in Kingston, all located in the double track territory between the Flatbush Avenue and Boices Lane grade crossings.

River Line freight train operations are often congested as a result of intense train traffic and infrequently spaced passing sidings. Figure 1-2 shows the existing track layout in Ulster County and adjoining communities. With a typical average freight train speed of 30 to 40 MPH, and an average train length of just under 6,000 feet, this means that:

- From a rail operations perspective, a train waiting to leave Kingston could wait 30 or more minutes before an opposing direction freight train clears single track. If that opposing direction freight train has a speed restriction, an equipment problem or stops to set off/pick up a car at an industry siding, the waiting time will be even longer.
- From an emergency responder perspective, emergency vehicles without adequate advance warning that a train will be occupying the track at a grade crossing could be delayed by the critical minutes it would take to detour to an acceptable alternate route. If that opposing freight train has a speed restriction or an equipment problem, the delay could be increased beyond this already unacceptable level. Without an advance warning system, and with the volume of freight traffic through the area, it is also possible that yet another train could occupy a grade crossing at the selected alternate route, causing a second delay in the emergency response.

There are six closely-spaced crossings – Smith Avenue, Tenbroeck Avenue, Foxhall Avenue, Gage Street, Cemetery Crossing and Flatbush Avenue – in the “midtown” section of Kingston that are often occupied by stopped or moving CSX freight trains. This occupancy reflects:

- Through freight trains without “meets” (dispatcher-controlled passing of two trains in the same or opposite direction),
- Through freight trains slowing or stopping due to a “meet”,

- Yard switching activity, and
- Local industry set-offs/pick-ups.

As part of the project, a detailed understanding of how to dynamically predict train movement is required, including an overall contextual perspective that will allow an accurate and comprehensive prediction capability for which crossings will be occupied – and when – and which will communicate this information directly to emergency responders. At the same time, the future potential for communication of this information to public transit agencies and the public needs to be identified.

It is also critical to remain mindful of restrictions placed on the project, such as the caveat that CSX property cannot be utilized or impacted. Other considerations must be affordability, maintainability and expandability (to facilitate the potential of eventually making the system usable by public transit agencies and the general public).

## 1.2. Contractual Mechanism

The official name of the project is the "Ulster County Integrated Advance Train Detection and Arrival Prediction Implementation Plan." The work performed under this project was the subject of Ulster County RFP UC-06-44. SYSTRA provided a proposal dated September 25, 2006 in response to the RFP. Notice of Award was provided by the County on November 22, 2006 and the formal contract was executed on January 23, 2007.

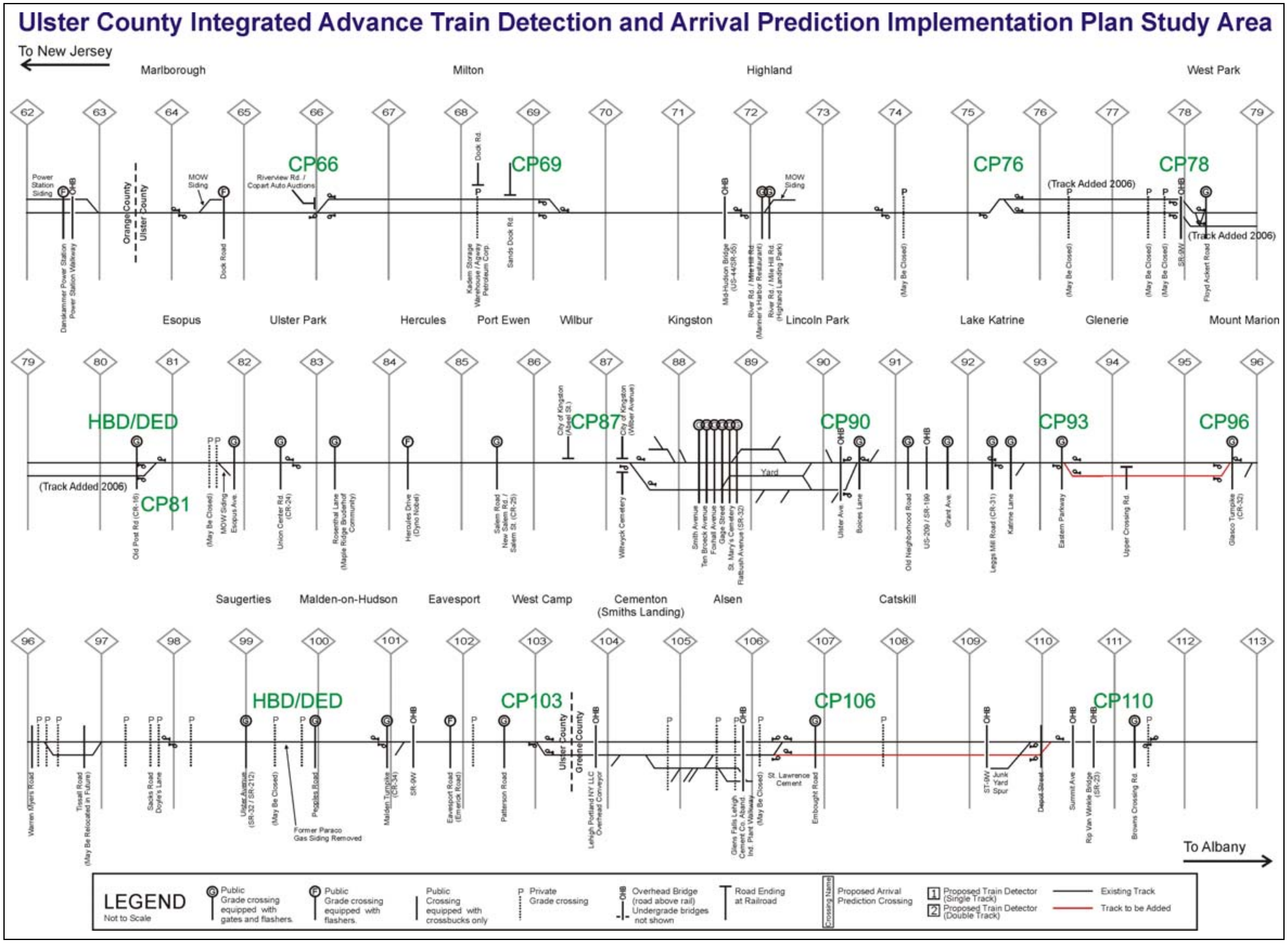


**Figure 1-3. The Project Study Area**

## 1.3. Next Steps

A companion report, the Existing Conditions and Advance Train Warning and Arrival Prediction System Requirements Draft Report, was issued in its final form on October 12, 2007. It details existing CSX operations and inventories all grade crossings on the River Line in Ulster County. It includes evaluation of the feasibility of installing wayside equipment as part of the project at public crossings in the Corridor.

A second companion report, the Ulster County Integrated Advance Train Detection and Arrival Prediction Implementation Plan Alternatives Analysis, was delivered to Ulster County in its final form on November 1, 2007. As part of this Task II work, the alternatives were presented to the Ulster County Transportation Council on November 16, 2007. This final project deliverable includes recommendations for phased Integrated Advance Train Detection/Arrival Prediction implementation, including recommended hardware and software functional specifications.

The next steps in the project are to ratify the recommended train detection technology (Doppler radar) and to ratify the recommended alternative (Alternative 6 – County-wide Deployment). After that, funding must be identified for the project, a Request for Proposal or Request for Bid document drafted, a Selection Committee organized and a vendor selected.

As an optional step, the County may wish to consider an interim test of the Doppler train detection technology at one location prior to awarding the overall project. The County may also wish to engage a construction management firm to oversee the installation, testing and deployment of the system, working on behalf of the County as the Project owner’s representative. Finally, the County must identify a responsible department that will serve as owner and maintainer of the system; candidates include Ulster County Emergency Management and Ulster County Information Technology.

As another optional step, the County may wish to consider “piggybacking” digital video camera with the Doppler radar sensors at selected or all crossings. This would require a broadband Internet connection at the sensor poles, which is not a requirement of the Doppler radar system itself (which uses the AT&T cell phone network for communication). Digital video camera feeds, similar to the existing Kingston Fire Department application at Foxhall Avenue, would support other types of railroad-related incident management in the County. It would not, by itself, provide for the predictive capabilities desired of the Integrated Advance Train Detection and Arrival Prediction Implementation Plan.

## 1.4. Acknowledgements

The authors of the report wish to thank the following Study participants for making time available for interviews, providing Study guidance and for reviewing draft versions of the Study’s products:

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- Charlie Schaller, UC Traffic Safety Board
- Art Snyder, Ulster County Emergency Communications
- Bill Tobin, UC Transportation Council
- Giselle Vagnini, NYSDOT
- Ed Voss, Wiltwyck Rural Cemetery
- Sylvia Wohlfahrt, UC Department of Information Services

# 2. Railroad Operations

As part of this task, the SYSTRA Team coordinated with the New York State Department of Transportation, the Ulster County Transportation Council, CSX and others to gather the available train and traffic data for the study area.

Using available CSX capital improvement information, the impact of CSX's planned capital improvements on the River Line (primarily in the form of additional passing sidings) on the dynamics of future Ulster County rail operations was evaluated. In addition, existing CSX train operations were quantified in terms of:

- Frequency,
- Average Speed, and
- Type (general merchandise, intermodal, maintenance of way, local, other).

## 2.1. Historical Overview

### *2.1.1. CSX River (West Shore) Line*

Today, the main railroad line running through Ulster County is known as the CSX River Line. Historically, it is most commonly known as the "West Shore". The West Shore Railroad was the final name of a railroad from Weehawken, New Jersey (across the Hudson River from New York City) north along the west shore of the river to Albany, New York and then west to Buffalo. It was organized as a competitor to Cornelius Vanderbilt's New York Central and Hudson River Railroad, (the "New York Central") but was soon taken over by that company.

The corporate roots of the West Shore date back to 1864. However, it was not until the North River Railway was incorporated April 3, 1880 to build a line north to Albany that the West Shore began to progress. (The Hudson River was also called the North River.) The North River Railway was consolidated with the Jersey City & Albany Railroad on May 5, 1881 to form the North River Railroad, forming a single planned line between Jersey City and Albany.

Rapid construction – relatively late for the 19$^{th}$ Century railroad boom – soon began along the west shore of the Hudson. At the south end, a new alignment was built along the east side of the New York, Susquehanna and Western Railway to North Bergen, where the alignment turned east into the Weehawken Tunnel under the New Jersey Palisades to Weehawken terminal, where convenient ferry connections to Manhattan (both 42$^{nd}$ Street and Cortlandt Street) were offered. This full line, known as the New York, West Shore and Buffalo Railroad, opened January 1, 1884, forming an immediate threat to the New York Central.

In 1881, the West Shore planned a link in a new cross-country line from New York to San Francisco, using the New York, Chicago and St. Louis Railway (Nickel Plate Road), Chicago, Milwaukee and St. Paul Railway, Northern Pacific Railroad and Oregon Navigation Company. However, the New York Central's William Henry Vanderbilt, who purchased the Nickel Plate in 1882, ended the cross-country plan by turning a potential West Shore partner into a hostile railroad. Fierce competition from the New York Central caused the New York, West Shore and Buffalo to then declare bankruptcy. The New York Central bought the New York, West Shore and Buffalo Railway on November 24, 1885 and reorganized the new acquisition as the West Shore Railroad on December 5 of that year, immediately leasing it for 475 years from January 1, 1886.

**Figure 2-1. A Saugerties building still shows the New York, West Shore & Buffalo Railroad Co. name, despite the railroad's corporate takeover more than 120 years ago.**

Kingston served as an important junction of multiple railroads in Ulster County until the 1970s. The first railroad to arrive in Kingston was the Ulster & Delaware, connecting Kingston Point, Kingston and points west in the Catskills. The next railroad to arrive in Kingston was the broad gauge (6 feet) Wallkill Valley, an affiliate of the Erie system. The last – but, ultimately, most important – was the West Shore Railroad. The West Shore quickly bought up the Wallkill Valley. About 1880, at the junction of the West Shore Railroad, Wallkill Valley Railroad and the Ulster & Delaware, Kingston Station, also known as "Union Station", was built by the West Shore Railroad.

Kingston Station, 2.8 miles west of Kingston Point, became a busy connection point between the West Shore and the Ulster & Delaware. The Ulster & Delaware went along the north side of the station while the Wallkill and West Shore ran in front (east) of it.

Passenger service on the West Shore always focused on Weehawken terminal, where the Manhattan connections were made via New York Central ferry. Commuter service consisted of express trains to West Haverstraw, Newburgh and Kingston, as well as local trains to Dumont. The southern portion of the line in New Jersey consisted of four mainline tracks to accommodate such a rich level of service. Prior to World War II, there were about 32 northbound trains daily, including four to Albany, four terminating at Newburgh, one terminating at Kingston and the remaining


**Figure 2-2. Former Kingston Station, which served the West Shore, Wallkill Valley and Ulster & Delaware Railroads.**

terminating in West Haverstraw/Dumont commuter territory. After the war, passenger traffic declined, with the number of northbound trains declining to 21 by 1955 and 17 by 1958.

Passenger service came to an end on the Ulster & Delaware in 1954 and on the New York Central's West Shore Line in 1959. The station had deteriorated so badly that it was torn down in the 1960s, despite an effort by Kingston citizens to save it.

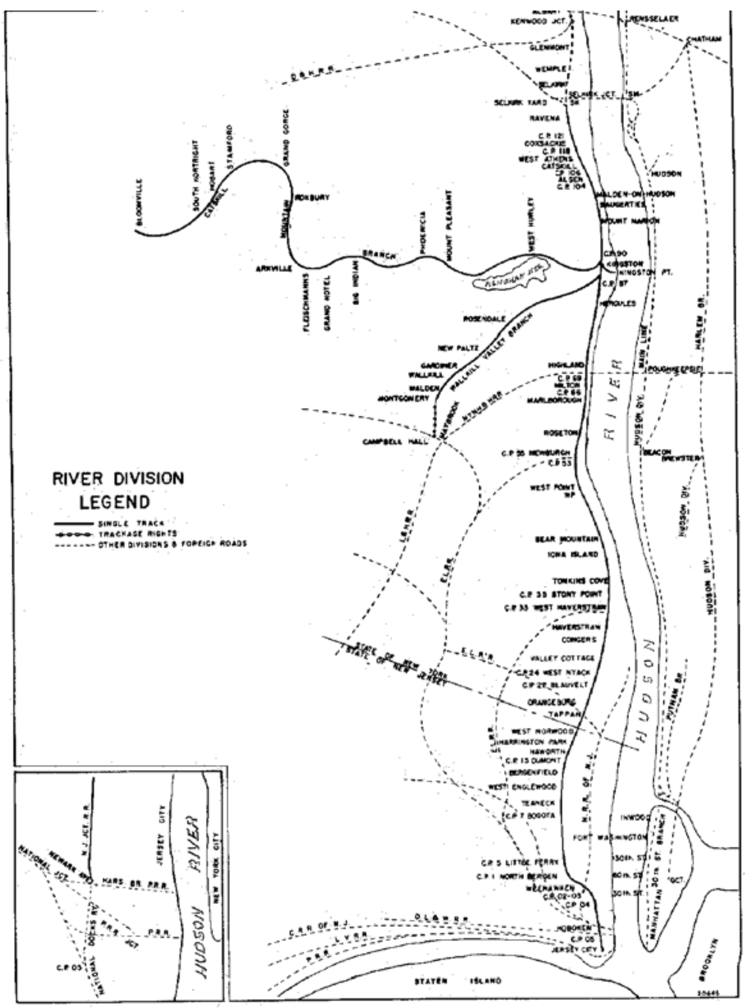


**Figure 2-3. New York Central Railroad Map of the River Division (Former West Shore)**

Under the New York Central, the West Shore saw a number of key freight connections built. The Hudson River Connecting Railroad was incorporated in 1913 and opened in 1924, providing a full bypass for the New York Central around Albany. This new route split from the West Shore southwest of Albany and ran southeast to cross the West Shore's Albany Branch at Selkirk onto the Alfred H. Smith Memorial Bridge. From there the line split, with one branch turning south to merge with the New York Central's Hudson Line at Stuyvesant on the east side of the river, and the other continuing east to a merge with the New York Central's Boston and Albany Railroad towards Boston.

Freight volumes continued to grow on the West Shore through Ulster County under the New York Central as a major freight classification yard was built at Selkirk in 1924 as part of the Albany bypass project. In 1966, the New York Central completely rebuilt the yard as a major computer-controlled east-west classification facility, with the new Alfred Perlman Yard opening in 1968. In that year, the New York Central merged with the Pennsylvania Railroad to form the Penn Central, in the wake of mounting passenger train losses (on lines other than the West Shore) and increased competition from trucks on interstate highways.

Penn Central continued to lose money, declaring bankruptcy in 1970. The advent of government-funded Amtrak to take over intercity passenger service in 1971 eliminated one source of losses, but did not return Penn Central to profitability. The bankrupt company threatened in mid-1973 to end all operations by the end of that year if it did not receive government aid. As a result, President Nixon signed the Regional Rail Reorganization Act of 1973 into law. The 3R Act, as it was called, provided interim funding to the bankrupt railroads and defined a new Consolidated Rail Corporation ("Conrail").

Under the 3R Act, the government was to create a Final System Plan to designate which lines should be included in the new Conrail. The plan, which included in the West Shore through Ulster County, was unveiled July 26, 1975, consisting of lines from Penn Central and six other bankrupt railroads. It was approved by Congress on November 9, and on February 5, 1976 President Ford signed the Railroad Revitalization and Regulatory Reform Act of 1976, which included this Final System Plan, into law.

Conrail operations began April 1, 1976. After shedding many unprofitable lines (including two in Ulster County), Conrail began turning a profit by 1981, the result of the Staggers Act freedoms and its own managerial improvements. The Northeast Rail Service Act of 1981 relieved Conrail of its requirement to provide commuter rail service on the Northeast Corridor, further improving its finances. Conrail offered its stock to the public in 1987 and its market valuation was established by investors as $1.9 billion at the time.

On June 23, 1997, CSX Transportation and Norfolk Southern filed a joint application with the Surface Transportation Board for authority to purchase, divide and operate the assets of Conrail. On June 6, 1998, the STB approved the CSX-Norfolk Southern application and set August 22, 1998, as the effective date of its decision. CSX acquired 42% of Conrail's assets (Norfolk Southern took title to the remaining 58%). As a result of the transaction, CSX's rail operations, through its new subsidiary New York Central Lines, grew to include some 3,800 miles of the Conrail system (predominantly the former New York Central Railroad, including the West Shore Line through Ulster County). CSX began operating the trains through Ulster County on June 1, 1999.

### *2.1.2. Other Railroads in Ulster County*

Other railroads in Ulster County included the Ulster & Delaware Railroad Company, the Wallkill Valley Railroad and the Central New England Railroad. While portions of the U&D are intact, the other two railroads have been abandoned in their entirety within the County.

The U&D was a small railroad established in 1866 and headquartered in Rondout, just east of downtown Kingston. Often advertising itself as "The Only All-Rail Route to the Catskill Mountains", the U&D ran from Kingston Point, on the Hudson River to Kingston and then through the heart of the Catskill Mountains to its western terminus at Oneonta.

The railroad's primary business was providing passenger service to popular tourist destinations. Many elegant hotels, some of which were sponsored or built by the railroad, provided significant passenger traffic. In 1913, more than 676,000 passengers rode the U&D to the Catskills. In the 1930s, after acquisition by the New York Central, special ski trains were operated from Weehawken direct to the Simpson Ski Slope in Woodland Valley by way of Kingston.

The line had many significant grades, some as steep as 4.4%. A train took almost four hours to travel from Kingston Point to Oneonta. As a result, passenger travel times were not competitive with modernizing highways and passenger service ended in 1954. Freight service continued through the Penn Central years, but in October 1976, after decades of declining revenues, the last freight train on the western segment of U&D rails operated. The Interstate Commerce Commission (ICC) permitted Penn Central to discontinue service in that year. In 1979, the U&D tracks were sold to Ulster County (MP 2.8 in Kingston to MP 41.4) with additional trackage beyond the County line sold to Delaware County. The trackage was never formally abandoned, despite the cessation of service.

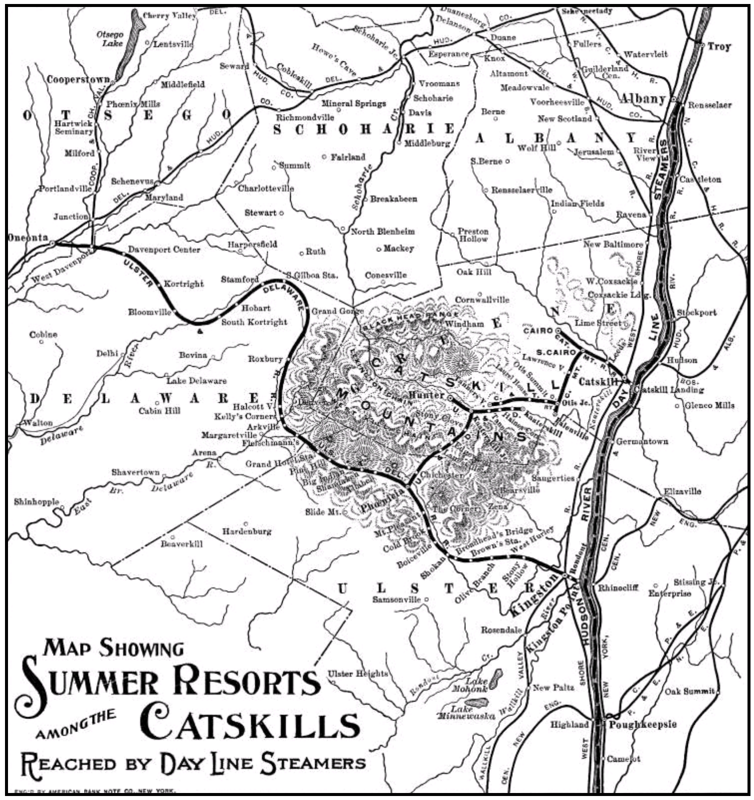


**Figure 2-4. Ulster & Delaware Railroad Company System Map showing rail connections in Kingston and ferry connections at Kingston Point.**

In 1983, the Catskill Mountain Railroad (CMRR) was chartered to operate a tourist passenger operation as well as freight service, negotiating a long-term lease with Ulster County. While freight service has not operated, the Catskill Mountain Railroad Scenic Train operates on a portion of the line disconnected from the national railroad network. The Scenic Train is the second stage of the implementation of CMRR's long-range plan for reopening the entire rail line to operation.

The CMRR operates a tourist train from Phoenicia, MP 27.5 to just north of Cold Brook (Boiceville), MP 22.1, which follows Esopus Creek. Phoenicia includes an historic 1900 railroad depot, home of the Empire State Railway Museum. The trackage near Boiceville includes a New York State Route 28 grade crossing, which became operational again in the Fall of 2004.

The tracks between Kingston and Cold Brook have been cleared for track car use, and are being upgraded for full train service from Kingston west towards Phoenicia. The Catskill Mountain Railroad is currently applying for funds to restore the line for tourist service to Ashokan, MP 16.2, as well as for freight service in Kingston. They are also working to restore a steam engine, former LS&I 23, owned by the Empire State Railway Museum, to eventually operate from Kingston to Phoenicia.

The portion of the line between Phoenicia, MP 27.9, and Highmount, MP 41.4, also leased by the Catskill Mountain Railroad, is isolated by three large washouts west of Phoenicia, and has not seen a train since service ceased in 1976. However, a 2.5 mile section of the line, between Giggle Hollow (MP 38.9) and Highmount, home to a scenic "double horseshoe curve", was cleared for track car use in 2006, by a joint team of members from the Trolley Museum of New York, Catskill Mountain Railroad and Ulster & Delaware Railroad Historical Society.

This year, the clearing is planned to be extended to the Route 28 crossing in Shandaken (MP 33.6), despite two paved-over crossings and a weak bridge abutment in Big Indian (MP 36.4). The remaining six mile segment between Shandaken and the washouts just west of Phoenicia are planned to be cleared in 2008.

Another portion of the U&D is still intact as part of the Trolley Museum of New York. Conrail operated this portion of the branch from Rondout (between Kingston and Kingston Point) to Kingston until 1979, when service ended. Starting at Kingston Point, which is designated as Milepost 0 of the line, the Trolley Museum operates the trackage in Kingston east of the CSX River Line, up to about Milepost 2.5. The line in this section is owned by the City of Kingston and leased to the Trolley Museum. The Trolley Museum is focused on the preservation of the use of trolleys, and to the restoration of the old Rondout Yard. The Rondout Engine House was rebuilt by the Museum in 1987.

**Figure 2-5. Former Ulster & Delaware trackage, now disconnected from the CSX River Line and out of service, in downtown Kingston.**

In addition to the U&D, the Wallkill Valley Railroad served Ulster County in a northeast/southwest alignment, terminating at Kingston. It was founded in 1866, and was constructed to the Erie Railroad's six-foot wide gauge, supporting interchange with the Erie but not with other standard gauge railroads. The railroad reached Kingston in the mid 1870s and was converted to standard gauge shortly thereafter.

The management of the Wallkill Valley learned that the West Shore Railroad was chartering a route between Albany and New Jersey, passing through Kingston. They responded by chartering an extension to the Wallkill Valley, vying for the same land already chartered for the West Shore. A protracted legal battle ensued. To resolve the issue, the West Shore purchased the line at a price of almost $1,000,000 in 1881. The Wallkill Valley Branch, never a popular route for freight or passengers, saw passenger service completely abandoned in 1937 by corporate successor New York Central. The last regular freight train operated on the Wallkill Valley as part of the Conrail network in 1977.

The railroad was torn up in 1983 and 1984. However, the corporate rights remain intact, along with most of the road bed. Today, the surviving corporate entity makes money by enforcing WVRR's original right-of-way and franchise, charging utility companies licensing fees to cross the property. Portions of the line in both Ulster and Orange Counties have been converted into a rail trail known as the Wallkill Valley Rail Trail.

The Central New England Railway, ultimately part of the New Haven Railroad's Maybrook Line, was also an important part of the Ulster County rail network. The line, now abandoned, traces its history to the Poughkeepsie Bridge Company, which was chartered in June 1871 to build a rail bridge across the Hudson. The first train crossed the bridge on December 29, 1888. The Hudson Connecting Railroad was chartered in 1887 to build southwest from the bridge to Maybrook and Campbell Hall, New York. Maybrook/Campbell Hall soon became a major junction point for many railroads transferring cars to the Maybrook Line and on to New England rail connections.

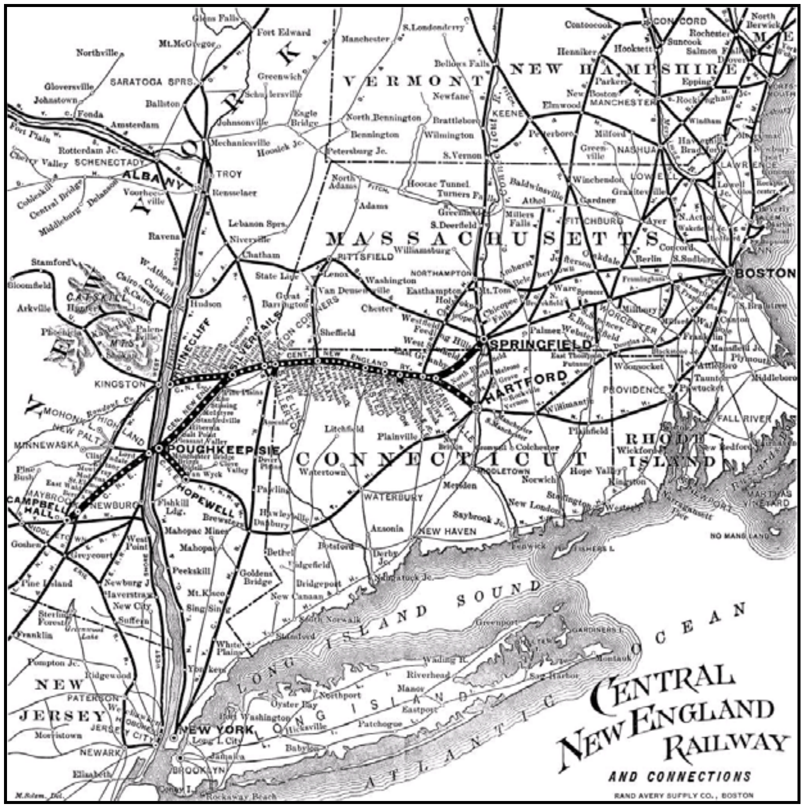


Figure 2-6. Map of the Central New England Railway from the late 19th Century.

In 1904, the New York, New Haven & Hartford Railroad acquired control of the line, but continued to operate it separately. On January 1, 1927 the Central New England was finally merged into the New York, New Haven & Hartford, ending its independent operation. At the time of the 1969 merger of the NYNH&H into Penn Central, all that was left of the Central New England was the westernmost section, from Maybrook over the Poughkeepsie Bridge and southeast along the Dutchess County Railroad to the former New York and New England Railroad. This so-called Maybrook Branch was operated until 1974, when the Poughkeepsie Bridge suffered fire damage and was abandoned, along with the Maybrook Branch itself. The closure of the Poughkeepsie Bridge route eliminated the southern-most rail freight crossing of the Hudson River, redirecting all rail freight traffic originating in the south and mid-Atlantic states and destined for New England to operate via Selkirk. This, of course, has significant implications for freight train volumes on the River Line through Kingston.

Of the four principal historical rail corridors in Ulster County, only the West Shore (River Line) and Ulster & Delaware have active train operations. And because the Ulster & Delaware train operations are infrequent and occur outside of the County's major transportation corridors, the Advance Train Warning and Arrival Prediction System need not address them. Therefore, the remainder of this report focuses on the West Shore (CSX River Line).

## 2.2. Train Frequencies

Early in the project, CSX indicated that train volumes on the River Line average between 30 and 35 trains per day. The railroad indicated that it would not make any specific operational data available to the project team.

However, prior to the initiation of this study, train frequency data was collected at the request of Ulster County by the NYSDOT Technical Services Division, based in Albany. A pole-mounted acoustic detector was used at the Route 32/212 (Ulster Avenue) grade crossing with CSX in Saugerties during the period January 10 through January 26, 2006. The first and last days of data collection were not complete 24-hour days, so they were excluded from daily train total counts (they were included in average train speed statistics).

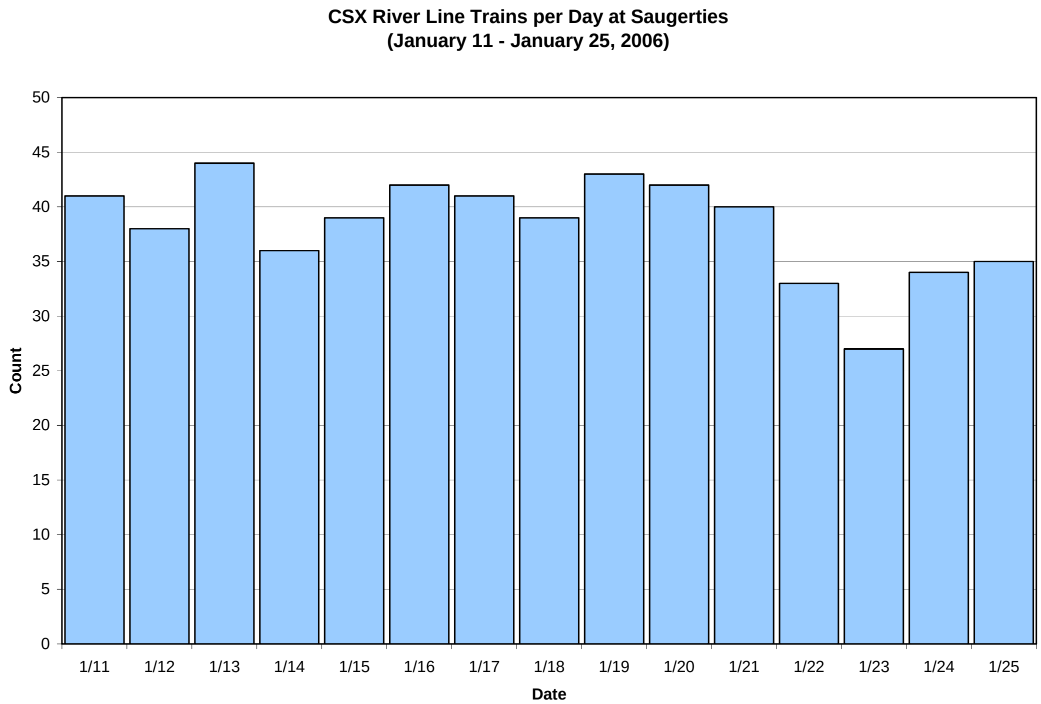


**Figure 2-7. NYSDOT-collected data showing train volumes at Saugerties.**

The Saugerties data collected by NYSDOT shows fairly consistent train volumes across the 15-day observation period, with daily train volumes ranging from 27 to 44 trains. It is likely that 2 to 4 of these "trains" are actually maintenance and inspection "hi-rail" (highway vehicles with deployable rail wheels) vehicles and not actual trains. A modest decline in daily train volume can be observed on January 23, 2006 (a Monday). Because local trains, which collect freight cars to make up trains, typically do not operate on weekends, Mondays tend to have fewer "road" freight trains than do other days. Interestingly, the previous Monday, January 16, 2006, saw more than 40 trains operating.

Overall, the Saugerties data appears to be consistent with CSX's statements of 30 to 35 daily trains, with the understanding that the Saugerties data includes 2 to 4 hi-rail vehicles. Train volumes are consistent across the length of the corridor in Ulster County, with only two weekday trains originating/terminating at Kingston Yard (see chart below). Virtually all trains traverse the corridor for its entire length through the County.

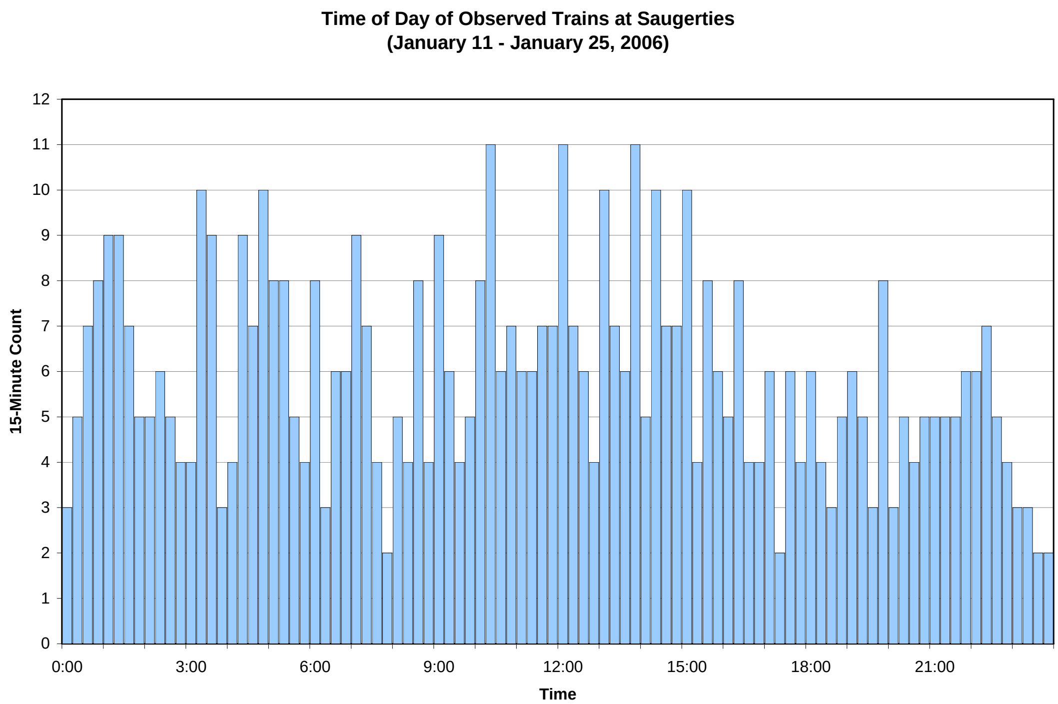


**Figure 2-8. Average train distributions.**

River Line trains are operated by CSX around the clock. Using the 15-day sample, distribution across each of the 96 15-minute time periods of the day was analyzed. Volumes appear highest from about 3:30 a.m. to 4:30 p.m. Some drop-off in train volume after 4:30 p.m., with a more notable drop-off after 11:00 p.m., was noted in the data. The afternoon period, coinciding with school children returning home on buses, by private vehicle or by foot, shows some of the highest 15-minute train counts observed during the 15 days of data collection.

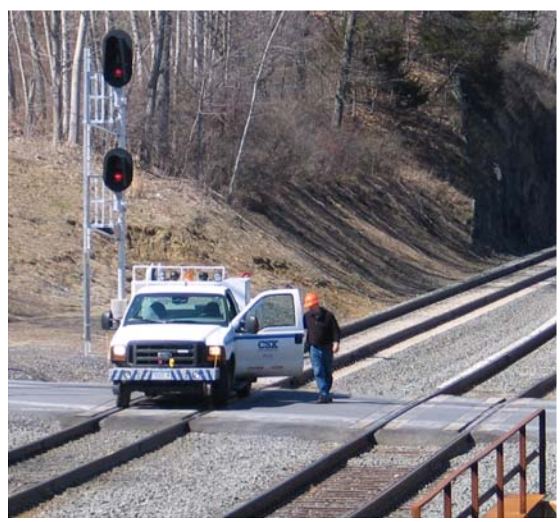

**Figure 2-9. In addition to train movements, the CSX River Line includes numerous "hi-rail" (highway vehicles with deployable rail wheels) vehicles for inspection and maintenance activities. This hi-rail vehicle is operating on the railroad at Old Post Road in Esopus.**

## 2.3. Train Characteristics

CSX trains on the River Line consist of intermodal (both double stack container and trailer on flat car), general merchandise freights and dedicated tri-level auto rack trains. In addition, local trains serving industries along the line plus dedicated trains of solid waste from New York City operate on a daily basis. In a *New York Times* article published on August 15, 2007, it was announced that garbage is now being shipped out of the Bronx entirely by rail instead of by trucks, part of a city plan to reduce the number of trucks traveling on the streets. According to Mayor Michael R. Bloomberg, the Bronx ships about 2,100 tons of garbage each day for disposal outside the city.


**Figure 2-11. Kingston Yard, located north of Flatbush Avenue and between the River Line main line (at left) and controlled siding (beyond the photo on the right).**

There are no regular mineral trains (coal, coke, iron ore or similar commodities) on the River Line, making its operating characteristics somewhat different than most other CSX lines.

The local trains are based out of Kingston Yard and service industries along the River Line. Local C712 works south of Kingston and Local C711 works north. Both locals generally work Monday through Friday.

**Figure 2-10. Although multiple freight train types operate on the Corridor, the most common type is the intermodal train. This "double stack" container train is passing Patterson Road in Saugerties on its way from California to Kearny, NJ.**

Destinations include Aluf Plastic on Glenshaw Street in Orangeburg, at MP 21.5. In addition, C712 serves Beckerle Lumber off Route 9W in Haverstraw; Xerox at MP 22, Bradley Parkway in Blauvelt; and Northeast Container in Bergenfield, NJ. After serving Northeast Container, the crew of Local Train C712 will generally "run around" the train in order to have the locomotive on the north end of the train for the return trip to Kingston Yard.

**Figure 2-12. CSX train consisting solely of tri-level auto racks passing Ulster Avenue grade crossing in Saugerties.**

## 2.4. CSX Operating Procedures

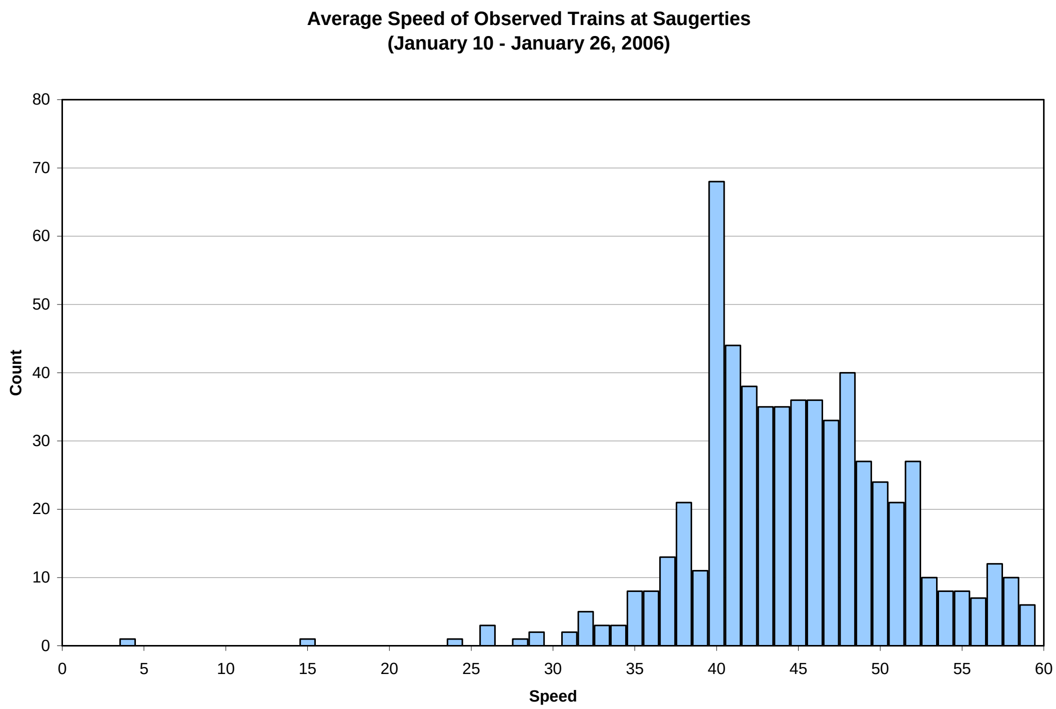


**Figure 2-13. Tabulation of Average Train Speeds at Saugerties.**

The NYSDOT acoustic device data collection included recording of train speed. As the graph of observed average speeds shows, most trains ranged from 40 to 55 MPH. The Saugerties location does not have notable civil speed constraints, nor is it near a yard or passing siding. Therefore, trains are able to operate close to their full performance, as evidenced by a number of trains with speeds approaching 60 MPH. CSX mineral trains, typically assigned the lowest horsepower/ton ratios on the railroad, typically operate in the 20 to 30 MPH range (and are limited to 40 MPH). The absence of mineral trains on the River Line can be noted in the average speed data.

**Figure 2-14. CSX general merchandise train crossing Boices Lane in Kingston.**

The CSX River Line is controlled from the former Conrail Dispatchers Office located at Selkirk, NY. All switches and associated interlocked signals are remote-controlled from this location, with no field operating personnel (other than train crews) stationed along the line itself. Because the line is primarily single track and is bounded by large yards on both ends (Selkirk Yard in Selkirk NY, Oak Island Yard in

Kearny, NJ), trains tend to be "fleeted" as a dispatching strategy. This means that two to four trains in one direction are dispatched close together, followed by a "fleet" of trains in the opposite direction.

When "meets" between opposing direction trains occur, they use the interlocked passing sidings along the line. These "interlockings", known as Control Points (CPs), are remotely-controlled from Selkirk and do not require that train crews throw switches by hand.

**Ulster County River Line Passing Sidings**

**CP66 to CP69 Milton**

**CP76 to CP78 to CP81 West Park/Esopus**

**CP87 to CP90 Kingston**

**CP103 to CP106 West Camp/Cementon**

Within Ulster County, there are four passing sidings in service, with the northernmost straddling the county line at West Camp/ Cementon. The CP numbers correspond to mileposts along the line, with MP 0 associated with the former Weehawken terminal, now abandoned (the numbers roughly correspond to the NYS Thruway mile marker system for reference). Three of the four sidings are about three miles long, with the capacity to accommodate two "nose to tail" trains of up to about 7000 feet in length. The fourth passing siding, shown in Figure 2-16, is a "super siding" constructed in 2006 by CSX. Totaling more than five miles in length from CP76 to CP81, the "super siding" has an intermediate universal (double crossover) interlocking at CP78. This allows the Selkirk Dispatcher to implement a number of complex dispatching maneuvers, such as having one same-direction train overtake ("loop around") another, while, at the same time pass an opposing-direction train. Each of the four "pockets" (track segments between CPs) at the "super siding" is sufficiently long to accommodate two typical length CSX trains.

Each of the County's four passing sidings has at least one grade crossing that could be blocked by a train waiting for an opposing direction train to pass. The least likely grade crossing impact is at the CP66-CP69 siding, where only the Agway Petroleum Products private crossing is affected (commercial activity at this location appears to be very low). This location is at the Kedem Winery Warehouse, but no activity associated with the winery appears to require crossing the tracks. The next lowest grade crossing impact is at the CP103-CP106 siding, located at the northern limits of Ulster County. A stopped train potentially affects up to four private crossings associated with St. Lawrence Cement. Only one of these crossings appears to be regularly-used and it's possible for CSX trains to pull clear or stop short (depending on direction) of this crossing.

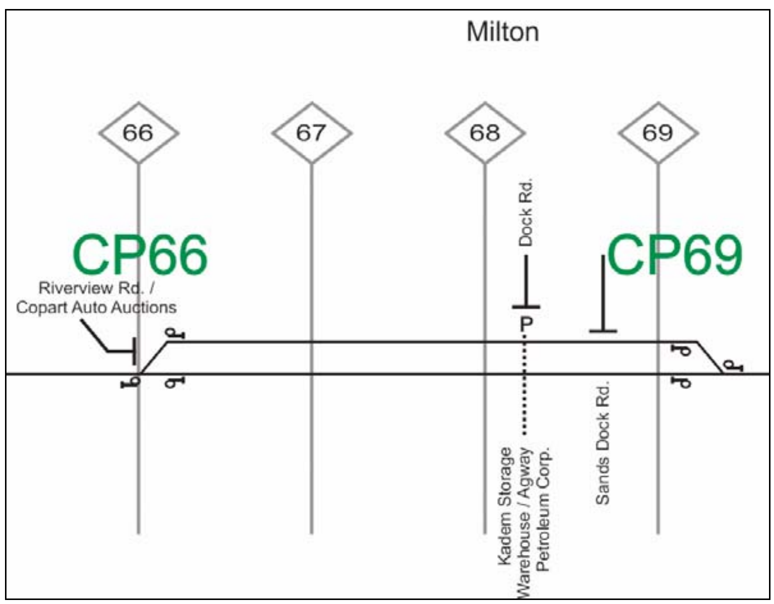


**Figure 2-15. Passing siding schematic from CP66 to CP 69 at Milton.**

**Figure 2-16. "Super siding" intermediate CP78 interlocking, looking north. Floyd Ackert Road grade crossing in West Park is shown.**

The new "super siding" has the potential for significant grade crossing blockages by trains at Floyd Ackert Road and Old Post Road (County Road 16) in West Park and Esopus, although their locations near CPs generally allow CSX trains to clear into the siding and, at the same time, pull clear/stop short of the potentially affected crossings. Three private crossings between CP76 and CP78 all appear to have been closed, either prior to the "super siding" construction or as part of it.

The new "super siding", known as the CSX West Park Siding, was designed in 2005 and constructed in 2006. At the south end, there is a #20 RH point of switch at MP 75.63 (Engineering Station 3993+00). At the north end, there is a #20 LH point of switch at MP 80.53 (Engineering Station 4252+10). In between, there is a #20 universal crossover mid siding, with the two switches between MP 77.90 (Engineering Stationing 4123+35) and MP 77.73 (Engineering Stationing 4123+75). There is a line swing (a "cut and throw") on the former single main south of the new south end interlocking to improve the approach alignment. From CP76 north to MP 77.7, CSX built the new track on the west and designated the new track as the main and the existing main as the siding. At MP 77.7, CSX did a "cut and throw" to build the new track east of the existing track, designating the new track as the siding and the existing track remaining designated as the main line.

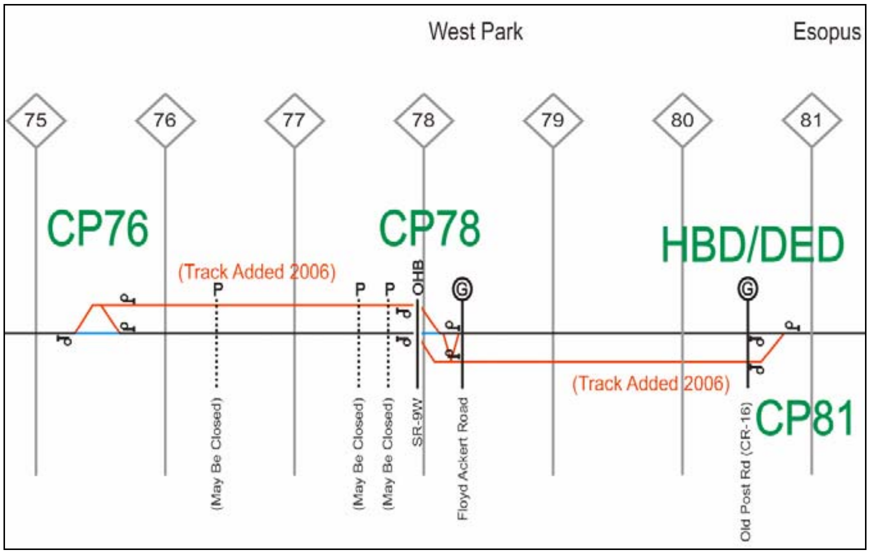


**Figure 2-17. Passing siding schematic from CP76 to CP81 at West Park.**

The most problematic passing siding on the River Line within Ulster County in terms of grade crossing impacts is the CP87 to CP90 passing siding in downtown Kingston. Unlike the other three sidings, the passing siding is not equipped with track circuits. This results in the CSX Engineer receiving a “Restricting” aspect at the entering CP, requiring operation into and out of the siding at a speed no faster than 10 MPH. In addition, the series of six downtown Kingston grade crossings are located near the midpoint of the siding, making it difficult for an engineer to pull clear/stop short while remaining within the siding. Finally, southbound trains that do stop short cannot see the signal at CP87, requiring radio communication with the busy River Line Dispatcher in Selkirk in order to know when to proceed across the six crossings, in expectation that the CP87 signal has cleared for a southbound move on to the single track mainline.

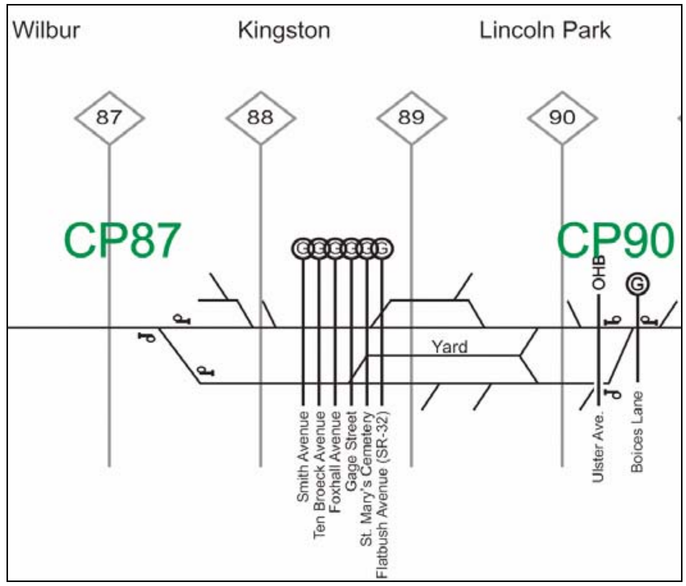


**Figure 2-18. Passing siding schematic from CP87 to CP90 at Kingston.**

**Train Travel Times Between Wiltwyck Cemetery and Boices Lane CP 90**
**(Observed September 19 and 20, 2007)**

| First Locomotive ID | Car Count | Dir. | Train Type | Arrival Time | | Travel Time | | Speed (mph) | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Wiltwyck Cemetery | Boices Lane CP 90 | h:mm:ss | seconds | | |
| CSX 7598 | 93 | N | COFC | 7:42:45 | 7:59:25 | 0:16:40 | 1000 | 10.80 | Held in Siding |
| CSX 5492 | 37 | S | GM | 8:07:38 | 8:03:58 | 0:03:40 | 220 | 49.09 | With TOFC, COFC |
| CSX 5391 | 77 | S | Auto Rack | 8:18:42 | 8:15:10 | 0:03:32 | 212 | 50.94 | |
| UP 4794 | 74 | N | COFC | 8:40:51 | 8:44:30 | 0:03:39 | 219 | 49.32 | |
| CSX 5011 | 43 | N | COFC | 9:05:15 | 9:09:40 | 0:04:25 | 265 | 40.75 | |
| CSX 5401 | 81 | N | TOFC | 9:46:53 | 9:50:30 | 0:03:37 | 217 | 49.77 | |
| CSX 8854 | 80 | N | Auto Rack | 10:49:22 | 10:54:15 | 0:04:53 | 293 | 36.86 | |
| CSX 7815 | 81 | N | GM | 11:37:30 | 11:50:20 | 0:12:50 | 770 | 14.03 | Held in Siding Train K681 With Tank Cars |
| CSX 8767 | 66 | S | GM | 11:49:20 | 11:45:30 | 0:03:50 | 230 | 46.96 | Mixed |
| CSX 124 | 81 | S | GM | 12:02:02 | 11:58:30 | 0:03:32 | 212 | 50.94 | Mixed |
| CSX 5213 | 38 | N | Garbage | 12:36:42 | 12:40:50 | 0:04:08 | 248 | 43.55 | |
| CSX 5277 | 60 | S | GM | 13:20:38 | 13:17:10 | 0:03:28 | 208 | 51.92 | Train Q349 |
| CSX 5313 | 118 | S | COFC | 14:19:34 | 14:15:50 | 0:03:44 | 224 | 48.21 | |
| CSX 2784 | 14 | N | GM | | 14:42:30 | n.a. | n.a. | n.a. | From Yard (CP 87 did not see this train) Mixed |
| CSX 5385 | 0 | S | Light Engines | 18:43:28 | 18:39:35 | 0:03:53 | 233 | 46.35 | Light Engines (no cars) |
| CSX 5420 | 43 | S | Garbage | 18:59:50 | 18:56:00 | 0:03:50 | 230 | 46.96 | |
| CSX 5466 | 94 | S | Garbage | 19:16:12 | 19:12:40 | 0:03:32 | 212 | 50.94 | |
| CSX 2529 | 0 | S | Light Engines | | 19:55:00 | n.a. | n.a. | n.a. | Routed Via Siding, Light Engines (no cars) |
| CSX 2 | 130 | N | GM | 19:47:12 | 19:57:00 | 0:09:48 | 588 | 18.37 | Via Main, slowed approaching CP 90, but did not stop |
| 222 | 123 | S | Containers | 20:44:33 | 20:41:02 | 0:03:31 | 211 | 51.18 | |
| 7318 | 46 | S | Containers | 21:32:18 | 21:28:42 | 0:03:36 | 216 | 50.00 | |
| 675 | 162 | S | Containers | 22:17:32 | 22:13:19 | 0:04:13 | 253 | 42.69 | |
| 5447 | 130 | N | Containers | 23:25:10 | 23:30:32 | 0:05:22 | 322 | 33.54 | |
| 8305 | 109 | N | GM | 1:01:48 | 1:06:16 | 0:04:28 | 268 | 40.30 | |
| 4766 | 86 | N | Intermodal | 2:53:59 | 2:57:54 | 0:03:55 | 235 | 45.96 | |
| 5478 | 174 | N | Containers | 3:52:13 | 3:57:33 | 0:05:20 | 320 | 33.75 | |
| 9030 | 101 | N | Tank Cars | 4:08:12 | 4:13:06 | 0:04:54 | 294 | 36.73 | |
| 5433 | 102 | N | Containers | 4:18:42 | 4:22:53 | 0:04:11 | 251 | 43.03 | |
| 605 | 119 | N | Containers | 5:21:12 | 5:25:57 | 0:04:45 | 285 | 37.89 | |
| 7353 | 110 | S | Containers | 5:30:42 | 5:06:28 | 0:24:14 | 1454 | 7.43 | Train stopped south of location; marker lights were visible in the distance. Marker disappeared around 5:23. |
| 158 | 77 | S | Tank Cars | 6:37:11 | 6:33:23 | 0:03:48 | 228 | 47.37 | |

**Figure 2-19. Field Observations of train traffic between Wiltwyck Cemetery and Boices Lane, September 19-20, 2007, and the calculated speeds (based on observed times at the two locations).**

To obtain a better understanding of CSX dispatching at the Kingston passing siding, SYSTRA collected train observation data at both CP87 (viewed from Kingston's Wiltwyck Cemetery) and at CP90 (viewed from shopping centers adjacent to Boices Lane) for a continuous 24-hour period from 7 a.m. on Wednesday, September 19, 2007 to Thursday, 7 a.m. on September 20, 2007. Freight traffic tends to build as the week progresses, so the observation period was chosen to obtain a snapshot of a relatively busy day on the CSX River Line.

The observations, shown in Figure 2-19, included some 31 trains, including two "light engine" movements, a local from Kingston Yard and 28 road freight trains. Of these road freight trains, 11 exceeded 100 cars in length. There were three "meets" at Kingston during the 24 hours – one between two General Merchandise trains, one between a General Merchandise train and a light engine movement and one between two Container on Flat Car trains. There were no overtakes (one higher priority train passes another in the same direction) observed at Kingston during the 24 hours.

Train speeds as high as 52 MPH were observed during the 24-hours, as shown in Figure 2-20. Predictably, trains that were held for meets in Kingston show low speeds.

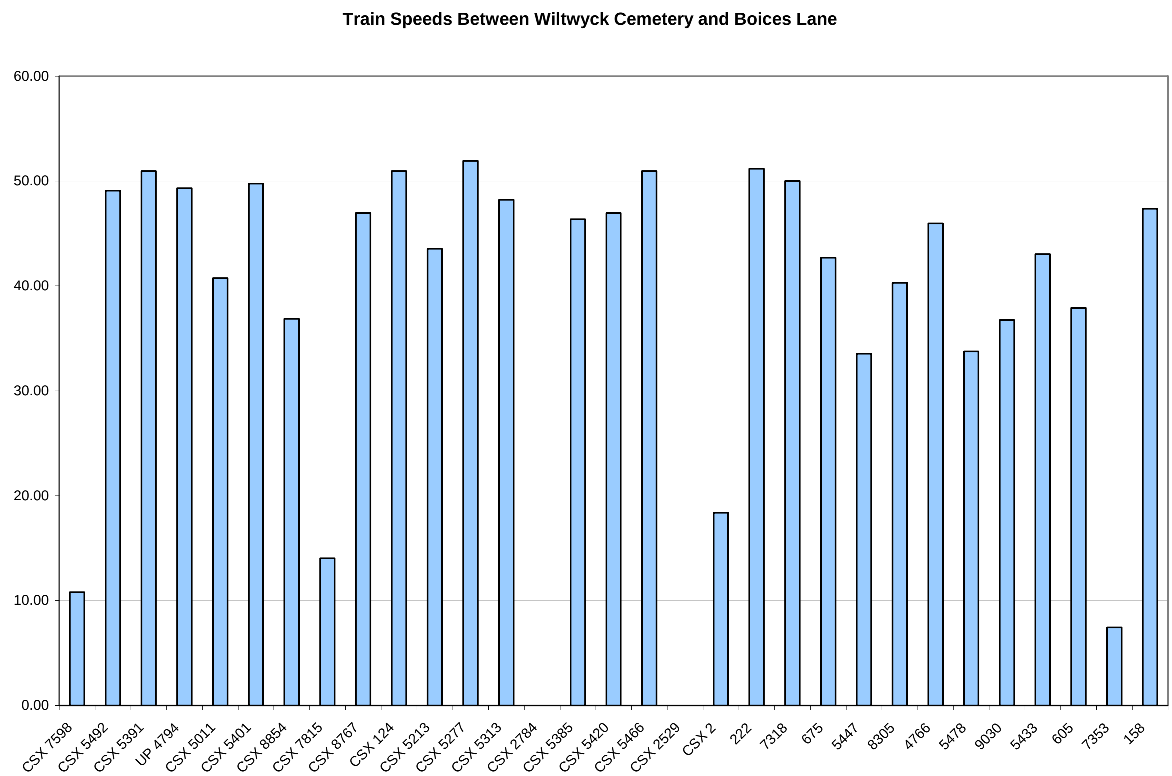


**Figure 2-20. Train speeds between Wiltwyck Cemetery and Boices Lane, calculated from September 19-20, 2007 field observations.**

There are several locations in the County where "dead end" access to residences is via an at-grade crossing of the CSX River Line. The CSX Emergency 1-800 number is prominently displayed on all crossings and is available to all emergency responders. In the event of a train blocking a crossing needed by emergency responders, the train crew would be radioed by the CSX River Line Dispatcher (who is informed of any 1-800 emergency requests) to "break" the train at the crossing.

**Figure 2-21. Passing siding at CP87.**

CSX indicated that this is not done routinely because the train crews know where all grade crossings are and, under normal circumstances, strive to avoid blocking any of them by stopped trains. Sometimes, unexpected events do occur and trains end up stopped on crossings. "Breaking" trains is not a practical solution to crossing blockage (except in emergencies) because it takes time for the Conductor to walk back to the proper location for the "break", time to recouple the train, time to recharge the brake line and time for the Conductor to rejoin the Engineer at the front of the train. The fact that there may be multiple closely-spaced crossings (occupied simultaneously by the train) complicates this issue and adds to the reluctance of a crew to “break” the train.

According to County Emergency Responders, crews are generally unwilling to “break” a train, unless mandated to do so by law enforcement personnel. In project interviews, Emergency Responders estimated that the typical train “break” requires between 10 and 20 minutes in order to allow passage of emergency equipment.

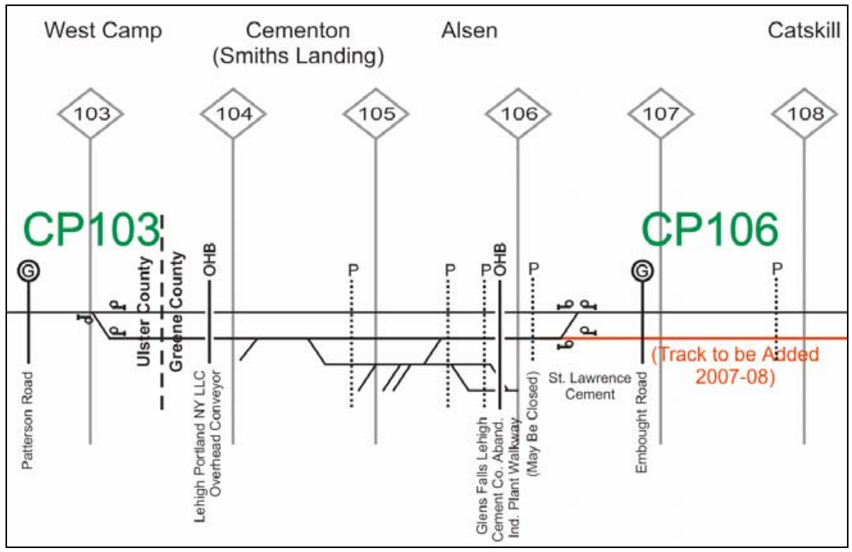


**Figure 2-22. Passing siding schematic from CP103 to CP106 at Cementon.**

## 2.5. Changes in Rail Operations Due to Capital Improvements

There are three NYSDOT-funded capital improvement projects planned by CSX on the River Line within Ulster County (or affecting infrastructure within the County) that will affect future rail operations. These include a signaling upgrade to the Kingston passing siding, a new passing siding at Mt. Marion and extension of the CP103-CP106 passing siding northward (with the double track actually added in Greene County) as shown in the right hand side of Figure 2-22.

Based on a review of the aerial photography for Catskill and Mt. Marion, the existing graded right of way of the former second track appears to be east of the existing track at both locations. So, it is highly probable that the new track will be on the east side. Based on discussions with NYSDOT in Spring, 2007, CSX has not yet performed preliminary engineering for the Catskill and Mt. Marion sidings. The approximate milepost limits of the Mt. Marion project are 93.3 to 95.7 and the approximate milepost limits for the extended Catskill siding are 106.3 to 110.1.

The Kingston project is limited to signal improvements without any associated track upgrades. At present, the controlled siding is not signalized and per CSX rule is operated at a maximum speed of 10 MPH. The project will signalize the controlled siding allowing for an increase in maximum authorized speed to 30 MPH. There are no track changes anticipated under this project at Kingston.

These three projects are 100% state funded, so they don't appear in the TIP.

On December 15, 2006, Governor George Pataki announced the funding of $60 million in statewide rail funding, including the three projects described above. He noted that New York has led the nation in railroad investment, providing approximately $359 million for rail capital projects since 1995. Investments have been focused on increasing rail access to New York City and Long Island, as well as expanding the capacity of New York’s Upstate railroads to ensure that future increases in rail freight can be absorbed by the industry, helping to reduce commercial vehicle traffic on State roadways.

The Rail Freight and Passenger Rail Assistance Program, administered by NYSDOT, is financed by the State’s five-year transportation capital program. The funds will be used for track and bridge improvements, grade crossing eliminations or upgrades, construction of inter-modal facilities, and the provision of passenger service subsidies.

The NYSDOT funding includes:

- $4.5 million to CSX Transportation, Inc. for track improvements and siding construction, in Catskill, Greene County (2007-2008),
- $1.7 million to CSX Transportation, Inc. for signal and track improvements in Kingston, Ulster County (2008-2009) and
- $4 million to CSX Transportation, Inc. for track improvements and siding construction in Mt. Marion and Saugerties, Ulster County (2008-2009).

The specific impacts to Ulster County as a result of CSX operational changes, once these three capital improvements are completed, is difficult to gauge. The River Line operates close to capacity on many days, so the additional/improved passing sidings are likely to result in increased train volumes. The speed improvement of the Kingston controlled siding between CP87 and CP90 from 10 MPH to 30 MPH is likely to increase the use of this siding, as the train running time penalty of "meeting" two trains there will be reduced after completion of the project in 2009.

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# 3. Grade Crossings

## 3.1. Locations

SYSTRA compiled a list of all known grade crossings on the River Line within Ulster County, using former Conrail Track Charts (current CSX Track Charts were not available) and the USDOT Federal Railroad Administration Grade Crossing Database. The two sources were extensively cross-referenced and supplemented by field visits to each crossing. Field notes are contained in Appendix A (contained in separate document). The data collection effort was extended into nearby Orange and Greene Counties so as to provide information on potential train sensor locations for the approaches to Ulster County.

The FRA Grade Crossing Database appears to contain records for every road crossing of the railroad, whether at grade, overgrade (bridge above railroad) or undergrade (bridge carrying railroad over road). Those records related to undergrade bridges were removed from consideration. Those records related to overgrade bridges were retaining because, while not applicable with respect to predicting train arrival times, these structures may serve as locations where train detection equipment can be installed.

During the field visits, the CSX emergency contact placards at each crossing were checked to verify that the FRA Grade Crossing Database's 7-character crossing ID was correct. Placards were found at all signalized grade crossings and some unsignalized ones.


**Figure 3-1. Most grade crossings in the Corridor – and all signalized ones – show the seven-character Association of American Railroads/Federal Railroad Administration crossing ID (lower left). The CSX milepost designation (lower right) is also shown, along with the CSX line designation for the River Line, which is "QR". This example is at Browns Crossing Road in Catskill.**

In many cases, there are differences in crossing names between the Conrail (now CSX) track charts, the USDOT Federal Railroad Administration database and locally-adopted crossing names. Table 3-1 shows all crossing names; the "Highway Name" and "Street Name" fields are from the USDOT FRA database. The "Field Inspection Name" will be used in subsequent phases of the project.

The AAR/FRA Grade Crossing database contains several errors that should be corrected (only NYSDOT and CSX can request changes, according to the FRA, which maintains the database). Grant Avenue crossing (Project ID #39) is a local road located in the Town of Ulster but fails to appear in the FRA Grade Crossing Inventory database. The Ulster County Planning Department reported that on October 18, 2005, it mailed to NYSDOT a completed US DOT Grade Crossing Inventory Form but, as of this date, the crossing continues to be omitted from the FRA database.

In addition, the municipality listed in the FRA database is often incorrect. In many cases, a hamlet or other informal geographic name is used, such as “Lake Katrine” or “Port Ewen”. These should be changed in the FRA database to reflect the correct municipal name. In addition, some municipalities are incorrect, such as Leggs Mill Rd., Katrine Lane and Eastern parkway being reported as located in City of Kingston (whereas, they are actually located in the Town of Ulster). These have been corrected in Table 3-1 in the report.

## Table 3-1. Ulster County Integrated Advance Train Detection and Arrival Prediction Implementation Plan Grade Crossings

(Revised June 15, 2007)

| LOCATION ID | AAR/FRA CROSSING ID | FIELD INSPECTION NAME | HIGHWAY NAME | STREET NAME | CSX TRACK CHART NAME | CSX MILE POST | PRIVATE? | SIGNALIZED? | COUNTY NAME | MUNICIPALITY |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 507120V | DANSKAMMER POWER STATION | TOWN RD | POWER PLANT | ROSETON (61.98) | 61.9 | No | Yes | ORANGE | CITY OF NEWBURGH |
| 2 | 507119B | DANSKAMMER POWER STATION | TOWN RD | POWER PLANT | CENTRAL HUDS | 62.5 | No | Yes | ORANGE | CITY OF NEWBURGH |
| 3 | 507117M | Unknown | | PRIVATE RD | Does Not Show | 63.8 | Yes | No | ULSTER | TOWN OF MARLBOROUGH (MARLBORO HAMLET) |
| 4 | 507118U | Unknown | DOCK RD | MAIN ST. | MAIN ST. | 64.7 | No | Yes | ULSTER | TOWN OF MARLBOROUGH (MARLBORO HAMLET) |
| 5 | 507116F | DOCK ROAD/OLD INDIAN TRAIL EXT. | TOWN RD | DOCK ROAD | DOCK ROAD (68.18) | 68.1 | No | Yes | ULSTER | TOWN OF MARLBOROUGH (MARLBORO HAMLET) |
| 6 | 507115Y | NOT A CROSSING | ST-293 | MID-HUDSON BRIDGE | ROUTE 44 (OHB 71.65) | 71.7 | No | N.A. | ULSTER | TOWN OF LLOYD (HIGHLAND) |
| 7 | 507114S | River Rd./Mile Hill Rd. | TOWN RD | NEW PALTZ TPK. | NEW PALTZ TP. (72.32) | 72.39 | No | Yes | ULSTER | TOWN OF LLOYD (HIGHLAND) |
| 8 | 507113K | River Rd./Mile Hill Rd. | HWY 725 | MAPLE AVENUE | NEW PALTZ TP. | 72.43 | No | Yes | ULSTER | TOWN OF LLOYD (HIGHLAND) |
| 9 | 507112D | Unknown | | PRIVATE RD | Does Not Show | 74.1 | Yes | No | ULSTER | TOWN OF LLOYD (HIGHLAND) |
| 10 | 918400H | Unknown | | PRIVATE ROAD | Does Not Show | 76.4 | Yes | No | ULSTER | TOWN OF ESOPUS |
| 11 | 507110P | Unknown | | PRIVATE ROAD | Does Not Show | 77.5 | Yes | No | ULSTER | TOWN OF ESOPUS |
| 12 | 507106A | Unknown | | PRIVATE ROAD | Private | 77.76 | Yes | No | ULSTER | TOWN OF ESOPUS |
| 13 | 507109V | NOT A CROSSING | ST-9W | ST-9W | ROUTE 9W (OHB 77.99) | 77.99 | No | N.A. | ULSTER | TOWN OF ESOPUS |
| 14 | 507108N | Unknown | | PRIVATE RD | Private (77.90) | 78 | Yes | No | ULSTER | TOWN OF ESOPUS |

## Table 3-1. Ulster County Integrated Advance Train Detection and Arrival Prediction Implementation Plan Grade Crossings

| LOCATION ID | (Revised June 15, 2007) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **AAR/FRA CROSSING ID** | **FIELD INSPECTION NAME** | **HIGHWAY NAME** | **STREET NAME** | **CSX TRACK CHART NAME** | **CSX MILE POST** | **PRIVATE?** | **SIGNALIZED?** | **COUNTY NAME** | **MUNICIPALITY** |
| 15 | 507107G | FLOYD ACKERT ROAD | TOWN RD | FLOYD ACKERT ROAD | FLOYD ACKERT | 78.3 | No | Yes | ULSTER | TOWN OF ESOPUS |
| 16 | 507105T | OLD POST RD (CR-16) | CR 16 | OLD POST RD. | ESOPUS ROAD | 80.49 | No | Yes | ULSTER | TOWN OF ESOPUS |
| 17 | 507103E | Unknown | | PRIVATE ROAD | Private | 81.65 | Yes | No | ULSTER | TOWN OF ESOPUS (ULSTER PARK) |
| 18 | 507104L | Unknown | | PRIVATE ROAD | Private | 81.75 | Yes | No | ULSTER | TOWN OF ESOPUS (ULSTER PARK) |
| 19 | 507102X | ESOPUS AVE. | L | UNION CENTER ROAD | ESOPUS RD | 81.9 | No | Yes | ULSTER | TOWN OF ESOPUS |
| 20 | 507101R | UNION CENTER RD. (CR-24) | L | ROSENTHAL LANE | EDDYVILLE RD | 82.5 | No | Yes | ULSTER | TOWN OF ESOPUS |
| 21 | 507100J | ROSENTHAL LANE (MAPLE RIDGE BRUDERHOF COMMUNITY) | TOWN RD | ROSENTHAL | VAN KEUREN L | 83.2 | No | Yes | ULSTER | TOWN OF ESOPUS (ULSTER PARK) |
| 22 | 507099S | HERCULES DRIVE (DYNO NOBEL) | | DYNO NOBEL | HERCULES POW | 84.29 | No | Yes | ULSTER | TOWN OF ESOPUS (ULSTER PARK) |
| 23 | 918401P | Unknown | | CEMETERY | Does Not Show | 85.1 | Yes | No | ULSTER | CITY OF KINGSTON |
| 24 | 507098K | SALEM RD/NEW SALEM RD./SALEM ST. (CR-25) | L | NEW SALEM ST. | SALEM ST | 85.5 | No | Yes | ULSTER | TOWN OF ESOPUS (PORT EWEN) |
| 25 | 507097D | NOT A CROSSING | | ABELL ST. | Does Not Show | 86.6 | No | N.A. | ULSTER | CITY OF KINGSTON (PORT EWEN) |
| 26 | 507096W | NOT A CROSSING | | DEWITT ST. | Does Not Show | 86.64 | No | N.A. | ULSTER | CITY OF KINGSTON |
| 27 | 507095P | NOT A CROSSING | L | W. O'REILEY ST. | OREILLY ST (UGB 87.06) | 87.13 | No | N.A. | ULSTER | CITY OF KINGSTON |
| 28 | 507094H | NOT A CROSSING | ST-28 | BROADWAY ST. | BROADWAY (UGB 88.05) | 88.1 | No | N.A. | ULSTER | CITY OF KINGSTON |

## Table 3-1. Ulster County Integrated Advance Train Detection and Arrival Prediction Implementation Plan Grade Crossings

| LOCATION ID | (Revised June 15, 2007) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AAR/FRA CROSSING ID | FIELD INSPECTION NAME | HIGHWAY NAME | STREET NAME | CSX TRACK CHART NAME | CSX MILE POST | PRIVATE? | SIGNALIZED? | COUNTY NAME | MUNICIPALITY |
| 29 | 507093B | SMITH AVE. | L | SMITH AVE. | SMITH AVE. | 88.3 | No | Yes | ULSTER | CITY OF KINGSTON |
| 30 | 507092U | TENBROECK AVE. | L | TEN BROECK AVE. | TENBROECK AV. | 88.4 | No | Yes | ULSTER | CITY OF KINGSTON |
| 31 | 507091M | FOXHALL AVENUE | L | FOXHALL RD | FOXHALL AVE | 88.5 | No | Yes | ULSTER | CITY OF KINGSTON |
| 32 | 507090F | GAGE ST | L | GAGE ST | GAGE ST. | 88.6 | No | Yes | ULSTER | CITY OF KINGSTON |
| 33 | 507089L | ST. MARY'S CEMETERY | | CEMETERY XING. | CEMETERY XIN | 88.7 | No | Yes | ULSTER | CITY OF KINGSTON |
| 34 | 507088E | FLATBUSH AVE. (SR-32) | ST-32 | FLATBUSH AVE. | FLATBUSH AVE. | 88.8 | No | Yes | ULSTER | CITY OF KINGSTON |
| 35 | 507087X | NOT A CROSSING | L | ULSTER AVE MALL | US RT 9W (OHB 90.25) | 90.25 | No | N.A. | ULSTER | TOWN OF ULSTER |
| 36 | 507086R | BOICES LANE | L | BOICES LANE | BOICES LANE | 90.5 | No | Yes | ULSTER | TOWN OF ULSTER (LAKE KATRINE) |
| 37 | 507085J | OLD NEIGHBORHOOD LANE | L | OLDNEIGHBORHOOD R | NEIGHBORHOOD | 91.2 | No | Yes | ULSTER | TOWN OF ULSTER (LAKE KATRINE) |
| 38 | 507084C | NOT A CROSSING | US-209 | US 209 | ROUTE 209 (OHB 91.34) | 91.4 | No | N.A. | ULSTER | TOWN OF ULSTER |
| 39 | 914899A | GRANT AVENUE | Unknown | Unknown | IBM XING | 91.86 | No | Yes | ULSTER | TOWN OF ULSTER |
| 40 | 842689J | LEGGS MILL RD. (CR-31) | C-32 | LEGGS MILL RD. | LEGGS MILL RD. | 92.34 | No | Yes | ULSTER | TOWN OF ULSTER |
| 41 | 842688C | KATRINE LANE | L | KATRINE LANE | KATRINE LANE | 92.6 | No | Yes | ULSTER | TOWN OF ULSTER |
| 42 | 842687V | EASTERN PARKWAY | L | EASTERN PKWY | EASTERN PKWY | 93.32 | No | Yes | ULSTER | TOWN OF ULSTER |
| 43 | 842686N | GLASCO TURNPIKE (CR-32) | C-32 | GLASCO TPK. | GLASCO TPK. | 95.71 | No | Yes | ULSTER | TOWN OF SAUGERTIES |
| 44 | 842685G | WARREN MYERS RD. | | | WARRE MEYERS | 95.97 | Yes | No | ULSTER | TOWN OF SAUGERTIES |
| 45 | 842684A | Unknown | | PRIVATE RD | Private | 96.17 | Yes | No | ULSTER | TOWN OF SAUGERTIES (MOUNT MARION) |

## Table 3-1. Ulster County Integrated Advance Train Detection and Arrival Prediction Implementation Plan Grade Crossings

| LOCATION ID | (Revised June 15, 2007) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AAR/FRA CROSSING ID | FIELD INSPECTION NAME | HIGHWAY NAME | STREET NAME | CSX TRACK CHART NAME | CSX MILE POST | PRIVATE? | SIGNALIZED? | COUNTY NAME | MUNICIPALITY |
| 46 | 842683T | Unknown | | PRIVATE RD | Private | 96.25 | Yes | No | ULSTER | TOWN OF SAUGERTIES (MOUNT MARION) |
| 47 | 842682L | Unknown | | PRIVATE RD | Private | 96.45 | Yes | No | ULSTER | TOWN OF SAUGERTIES (MOUNT MARION) |
| 48 | 842681E | TISSALL RD. | | TISSAL ROAD | TISSAL RD | 96.76 | Yes *(See Report Text)* | No | ULSTER | TOWN OF SAUGERTIES |
| 49 | 918456C | Unknown | | PRIVATE ROAD | Private (97.32) | 97.4 | Yes | No | ULSTER | TOWN OF SAUGERTIES |
| 50 | 842680X | SACKS ROAD | | SACKS ROAD | Private | 97.7 | Yes | No | ULSTER | TOWN OF SAUGERTIES |
| 51 | 842679D | DOYLE’S LANE | | DOYLE'S LANE | Private | 97.8 | Yes | No | ULSTER | TOWN OF SAUGERTIES |
| 52 | 842678W | Unknown | | PRIVATE RD | Private | 98.2 | Yes | No | ULSTER | TOWN OF SAUGERTIES |
| 53 | 842677P | ULSTER AVE (SR-32/SR-212) | SR #32 | ULSTER AVE. | ULSTER AVE. (98.98) | 99 | No | Yes | ULSTER | TOWN OF SAUGERTIES |
| 54 | 842676H | Unknown | | | Private | 99.45 | Yes | No | ULSTER | TOWN OF SAUGERTIES |
| 55 | 842675B | Unknown | | PRIVATE ROAD | Private | 99.76 | Yes | No | ULSTER | TOWN OF SAUGERTIES |
| 56 | 842674U | PEOPLES RD | L | PEOPLES RD. | PEOPLES RD. | 99.97 | No | Yes | ULSTER | TOWN OF SAUGERTIES |
| 57 | 842673M | MALDEN TURNPIKE (CR-34) | CR #34 | MALDEN TPK. | MALDEN TPK. | 100.96 | No | Yes | ULSTER | TOWN OF SAUGERTIES |
| 58 | 842672F | NOT A CROSSING | ST-9W | | ROUTE 9W (OHB 101.34) | 101.32 | No | N.A. | ULSTER | TOWN OF SAUGERTIES |
| 59 | 842671Y | Unknown | TOWN RD | EMERICK ROAD | EAVESPORT RD | 101.87 | No | Yes | ULSTER | TOWN OF SAUGERTIES |
| 60 | 842670S | Unknown | | PRIVATE ROAD | Does Not Show | 102.12 | Yes | No | ULSTER | TOWN OF SAUGERTIES |
| 61 | 842669X | PATTERSON RD. | TOWN RD | PATTERSON RD. | PATTERSON RD. | 102.66 | No | Yes | ULSTER | TOWN OF SAUGERTIES |

## Table 3-1. Ulster County Integrated Advance Train Detection and Arrival Prediction Implementation Plan Grade Crossings

| LOCATION ID | (Revised June 15, 2007) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **AAR/FRA CROSSING ID** | **FIELD INSPECTION NAME** | **HIGHWAY NAME** | **STREET NAME** | **CSX TRACK CHART NAME** | **CSX MILE POST** | **PRIVATE?** | **SIGNALIZED?** | **COUNTY NAME** | **MUNICIPALITY** |
| 62 | 842668R | NOT A CROSSING | ST-9W | 9W SR | ROUTE 9W (UGB 103.24) | 103.2 | No | N.A. | ULSTER | TOWN OF SAUGERTIES |
| 63 | 842667J | Unknown | TOWN RD | OVERBAUGH LANE EX | OVERBAUGH LA | 103.92 | No | No | GREENE | TOWN OF CATSKILL (CEMENTON) |
| 64 | 842665V | NOT A CROSSING | ST-9W | ST-9W | Does Not Show (Maybe Adjacent to CSX) | 104.01 | No | Yes | GREENE | TOWN OF CATSKILL (CEMENTON) |
| 65 | 842664N | Unknown | LOCAL R | OVERBAUGH LA. | OVERBAUGH LA | 104.12 | No | No | GREENE | TOWN OF CATSKILL (CEMENTON) |
| 66 | 842663G | NOT A CROSSING | ST-9W | 9W SR | ROUTE 9W (UGB 104.50) | 104.52 | No | N.A. | GREENE | TOWN OF CATSKILL (CEMENTON) |
| 67 | 842662A | Unknown | | PRIVATE RD | Private | 104.84 | Yes | No | GREENE | TOWN OF CATSKILL (CEMENTON) |
| 68 | 842661T | Unknown | | PRIVATE RD | Private | 105.62 | Yes | Yes | GREENE | TOWN OF CATSKILL (CEMENTON) |
| 69 | 842660L | Unknown | | PRIVATE RD | Unknown (Not Shown as Private) | 105.8 | Yes | No | GREENE | TOWN OF CATSKILL (CEMENTON) |
| 70 | 842659S | Unknown | | PEDESTRIAN | Does Not Show | 105.9 | No | No | GREENE | TOWN OF CATSKILL (CEMENTON) |
| 71 | 842658K | Unknown | | PRIVATE RD | Does Not Show | 106.08 | Yes | No | GREENE | TOWN OF CATSKILL (CEMENTON) |
| 72 | 842657D | EMBOUGHT ROAD | TOWN RD | EMBOUGHT RD | EMBOUGH RD | 106.85 | No | Yes | GREENE | TOWN OF CATSKILL |
| 73 | 842654H | Unknown | | PRIVATE RD. | Private | 108.47 | Yes | No | GREENE | TOWN OF CATSKILL |
| 74 | 842653B | NOT A CROSSING | | W. BRIDGE ST. | ROUTE 9W (OHB 109.30) | 109.3 | No | N.A. | GREENE | TOWN OF CATSKILL |

## Table 3-1. Ulster County Integrated Advance Train Detection and Arrival Prediction Implementation Plan Grade Crossings

| LOCATION ID | (Revised June 15, 2007) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AAR/FRA CROSSING ID | FIELD INSPECTION NAME | HIGHWAY NAME | STREET NAME | CSX TRACK CHART NAME | CSX MILE POST | PRIVATE? | SIGNALIZED? | COUNTY NAME | MUNICIPALITY |
| 75 | 842652U | NOT A CROSSING | | KATERSKILL RD. | CAUTERSKILL AVE (OHB 109.42) | 109.42 | No | N.A. | GREENE | TOWN OF CATSKILL |
| 76 | 842651M | Unknown | | DEPOT ST. | DEPOT STREET | 109.97 | No | No | GREENE | TOWN OF CATSKILL |

## 3.2. Crossing Warning System Types

Signalized crossings on the CSX River Line are generally equipped with gates, flashers and a warning gong (bell). A few crossings are equipped only with flashers, or only with flashers and gong. The Dock Road crossing at MP 68.18 is unsignalized, except that it includes a non-standard crossing bell that sounds when a train is approaching. There are no gates or flashers. This crossing is a paved driveway serving the Kedem Storage Warehouse and the Agway Petroleum Corp.


**Figure 3-2. Railroad crossing "cross bucks" and stop sign at Depot Street crossing in Catskill.**

Unsignalized crossings are marked only with railroad crossbucks or, in some cases, with no signage of any sort. Railroad crossbucks are sometimes accompanied by a stop sign, such as the installation at Depot Street crossing in Catskill.

Tissall Road in Saugerties is the only crossing listed in the FRA database that is public but unsignalized. However, according to the Ulster County Planning Department, the Tissall Road crossing is actually private, despite the road being designated as a public road. Table 3-1 has been modified to show this crossing as being private – not public. Efforts are underway to improve and relocate this crossing with the work included in the draft 2008-2012 TIP. When that occurs, the road and crossing will both be public.

Signalized crossings may be equipped with "fixed" start locations, or "variable" Constant Warning Time (CWT) circuitry. CWT crossing systems include motion detectors that will cause the gates to rise if a train has stopped between the outer-most crossing approach location and the crossing itself. "Fixed" start locations are based on the maximum authorized approach speed of all train types and, therefore, result in longer gate down times than do CWT systems. Circuitry information for the Ulster County crossings was not made available by CSX.

**Figure 3-3. Crossing equipped with gates, flashers and gong at Esopus Avenue. The former two-track alignment of the River Line is evident in this photo.**

## 3.3. Grade Crossing Cell Phone Coverage and Utility Availability

**Figure 3-4. Crossing equipped only with flashers and gong (bell above the crossbucks) at the Danskammer Power Station in Newburgh, Orange County.**

The SYSTRA Team performed a comprehensive survey of cell phone signal strength at all grade crossings on the River Line within Ulster County, as well as at crossings in adjoining Greene and Orange Counties. This information is needed to understand whether train location information could be transmitted from a wayside device using cell phone signals. Signal strength is defined as the magnitude of the signal being received, measured, or predicted, at a reference point that is a significant distance from the transmitting antenna. Typically, this is measured as signal electric field strength of voltage per length or signal power received by a reference antenna. Very low-power uses such as cell phones are most often expressed in dB-microvolts per meter (dBμV/m) or in decibels above a reference level of one milliwatt (e.g. -80 dBm).

The SYSTRA Team used the dBm measurement in assessing cell phone signal strength at the crossings. In the dBm measurement system, higher figures (smaller magnitude negative numbers) mean stronger signals. An exceptionally strong cell phone signal is usually between -55 and -65. Acceptably strong cell phone signals range between -65 and -80. Figures in the -90s are mediocre, though still viable for data and voice communications. Most cell phones revert to “No Signal” at about -105 or -106 dBm.

It should be noted that even in high reception areas, basements and the interiors of large buildings often have poor reception. Weak signal strength can also be caused by destructive interference of the signals from local towers in urban areas, or by the construction materials used in some buildings causing rapid attenuation of signal strength. Large buildings such as warehouses, hospitals and factories often have no useable signal further than a few feet from the outside walls. Rather than relying on generalized coverage maps, SYSTRA used a spectrum analyzer to measure actual signal strength at each potential train detection location.

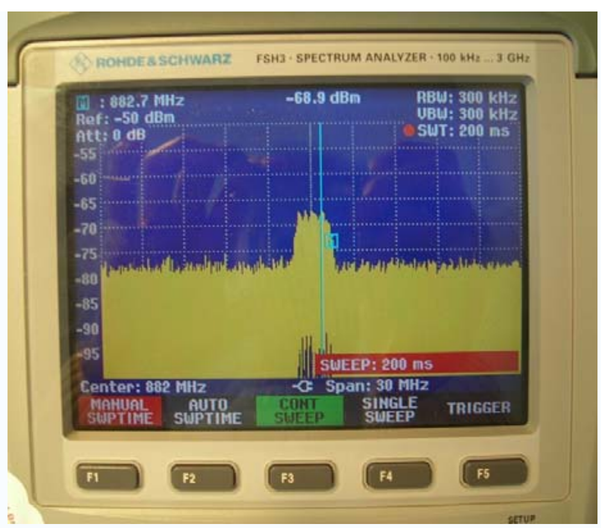


**Figure 3-5. Typical cell phone signal strength reading, showing -68.9 dBm value.**

Cell phones in the U.S. operate at around 800MHz and PCS phones at 1900MHz: these frequencies are classified as UHF and low energy microwaves respectively. This has led to the rapid growth in the home cellular repeater market. The more advanced models now typically include an external directional antenna and an amplifier (usually operating at 55db gain) which is generally enough to turn a very weak signal into a clear one over the local area.

Table 3-2 shows the measured cell phone signal strengths. They range from a high of -72.1 dBm and a low of -77.1 dBm. All measured locations, therefore, appear to have adequate cell phone signal strength for the purpose of communicating train location information to a central location.

### Table 3-2. Grade Crossing Cell Phone Coverage and Power Availability

| LOCATION ID | FIELD INSPECTION NAME | PRIVATE? | CELL PHONE COVERAGE READING (DBM) | POWER AVAILABILITY | LOCATION OF EXISTING CROSSING ENCL. | FEASIBLE LOCATION FOR NEW 8' x 8' HOUSE | NOTES |
|---|---|---|---|---|---|---|---|
| 1 | DANSKAMMER POWER STATION | No | -73.3 | None | None | SE | Site is a Power Station |
| 2 | DANSKAMMER POWER STATION | No | -72.5 | None | None | SW | Site is a Power Station Lots of Overhead Crossings |
| 4 | Unknown | No | -74.5 | 13897 NYT 24 | None | NW | Boat Storage Yard |
| 5 | DOCK ROAD/OLD INDIAN TRAIL EXT. | No | -75.5 | 19884N | None | NW | No Signals (RR Crossing) but there is a non-standard crossing bell that sounds. Paved driveway Kedem Storage Warehouse Agway Petroleum Corp. Near River QR 68.12 |
| 7 | River Rd./Mile Hill Rd. | No | -72.1 | 17611 | SW | SW | Mariner's Harbor Restaurant Town - Lloyd |
| 8 | River Rd./Mile Hill Rd. | No | -72.2 | 17601N | NE | SE | Town - Lloyd |
| 14 | Unknown | Yes | -75.5 | None | None | NE | Crossing has been removed |
| 15 | FLOYD ACKERT ROAD | No | -74.1 | 182973 | None | NE | |
| 16 | OLD POST RD (CR-16) | No | -73.3 | 78402 | NE | NE | |
| 17 | Unknown | Yes | -75.1 | None | None | SE | Former Old Farm Road No Longer a Crossing |
| 18 | Unknown | Yes | -73.2 | None | None | NE | Farm Road |
| 19 | ESOPUS AVE. | No | -72.8 | None | SE | SE | |
| 20 | UNION CENTER RD. (CR-24) | No | -71.9 | 5270K | None | NE | |
| 21 | ROSENTHAL LANE (MAPLE RIDGE BRUDERHOF COMMUNITY) | No | -72.2 | 77698 | NE | NE | |
| 22 | HERCULES DRIVE (DYNO NOBEL) | No | -73.2 | None | NE | SW | "DYNO-NOBEL" Site |
| 24 | SALEM RD/NEW SALEM RD./SALEM ST. (CR-25) | No | -74.6 | 17070K | NE | SE | Town - Esopus |
| 29 | SMITH AVE. | No | -77.1 | 1881 | None | NW | |
| 30 | TENBROECK AVE. | No | -75.9 | 1946 K NYT 100 | SW | SE | |
| 31 | FOXHALL AVENUE | No | -76.2 | None | NE | NE | |
| 32 | GAGE ST | No | -76.5 | 69918 K | NE | NE | |

## Table 3-2. Grade Crossing Cell Phone Coverage and Power Availability

| LOCATION ID | FIELD INSPECTION NAME | PRIVATE? | CELL PHONE COVERAGE READING (DBM) | POWER AVAILABILITY | LOCATION OF EXISTING CROSSING ENCL. | FEASIBLE LOCATION FOR NEW 8' x 8' HOUSE | NOTES |
|---|---|---|---|---|---|---|---|
| 33 | ST. MARY'S CEMETERY | No | -76.4 | 107249 | None | NW | |
| 34 | FLATBUSH AVE. (SR-32) | No | -74.2 | 893 K NYT 13 | NE | NE | |
| 36 | BOICES LANE | No | -75.6 | 103630 12-3 | None | NW | |
| 37 | OLD NEIGHBORHOOD LANE | No | -75 | K 3439 | NE | NW | |
| 39 | GRANT AVENUE | Unknown | -76.1 | 102807 | SE | SW | Divided Road<br>Mile Post 91.86 |
| 40 | LEGGS MILL RD. (CR-31) | No | -75.1 | 118727 NYT 2 | NE | NW | |
| 41 | KATRINE LANE | No | -76.2 | 102736 | NE | SE | |
| 42 | EASTERN PARKWAY | No | -75.1 | 158045 | NE | NW/NE | |
| 43 | GLASCO TURNPIKE (CR-32) | No | -76.2 | 163908 | NE | SE | |
| 44 | WARREN MYERS RD. | Yes | -76 | 62631 | None | NW | |
| 45 | Unknown | Yes | -75.5 | 62625 | None | NW | |
| 46 | Unknown | Yes | -75.5 | 62623 | None | NW | |
| 47 | Unknown | Yes | -75.2 | 62623 | None | SW | QR 96.45 |
| 48 | TISSALL RD. | No | -76 | 52609 | SE | NE | NorthEast Solite Plant |
| 49 | Unknown | Yes | -74.9 | 166898 | None | NE | Unpaved Drive<br>No Crossing I.D. Signs at Site |
| 50 | SACKS ROAD | Yes | -75.1 | None | None | NE | QR 97.70 |
| 51 | DOYLE'S LANE | Yes | -73.6 | 144489 | None | NE | QR 97.80 |
| 52 | Unknown | Yes | -73.5 | None | None | SE | QR 98.20 |
| 53 | ULSTER AVE (SR-32/SR-212) | No | -74.4 | 138182 | NE | SE | |
| 54 | Unknown | Yes | -75.8 | None | None | SE | Dirt Path<br>Not Really a Crossing |
| 55 | Unknown | Yes | -75.4 | None | None | NE | Narrow Paved Driveway |
| 56 | PEOPLES RD | No | -74.5 | 166859 | SE | SW | |
| 57 | MALDEN TURNPIKE (CR-34) | No | -74.2 | 16562 K | SW | SW | |
| 59 | Unknown | No | -75.1 | 166743 | NE | SW | |
| 60 | Unknown | Yes | -75.9 | None | None | NE | Dirt/Gravel Driveway<br>Private Drive |
| 61 | PATTERSON RD. | No | -75 | 16463 | NE | SE | Patterson Rd is Fairly Narrow |
| 64 | NOT A CROSSING | No | -75.1 | None | None | No | No Longer a Crossing<br>Vehicles Cannot Cross Here |
| 66 | NOT A CROSSING | No | -75.4 | 181044 | NW | NW | No Access Fenced In Area<br>Cement Plant<br>6 Lines of Track<br>QR 104.84 |
| 67 | Unknown | Yes | -75.3 | 38183 K | SE | NW | St Lawrence Cement Plant<br>4 Sets of Train Tracks |
| 68 | Unknown | Yes | -75.5 | None | None | NE | Cement Plant Entrance |
| 69 | Unknown | Yes | -75.3 | None | None | No | |

## Table 3-2. Grade Crossing Cell Phone Coverage and Power Availability

| LOCATION ID | FIELD INSPECTION NAME | PRIVATE? | CELL PHONE COVERAGE READING (DBM) | POWER AVAILABILITY | LOCATION OF EXISTING CROSSING ENCL. | FEASIBLE LOCATION FOR NEW 8' x 8' HOUSE | NOTES |
|---|---|---|---|---|---|---|---|
| 71 | Unknown | Yes | -74.7 | 173499 | NE | NE | |
| 72 | EMBOUGHT ROAD | No | -75.1 | 26032 K | None | NE | |
| 73 | Unknown | Yes | -74.9 | None | None | No | Junk Yard QR 108.05 |
| 76 | Unknown | No | -73.3 | None | None | SE | A couple dozen tractor-trailers parked here |

The SYSTRA Team also recorded apparent power availability at all of the grade crossing sites, as shown in Table 3-2. Commercial power viability is mixed. Subsequent to this data collection effort, the feasibility of solar power for train detection equipment was investigated and confirmed. Therefore, power availability need not be a criterion for determining where train detection equipment should be located. The SYSTRA Team also identified the most feasible quadrant (NE, NW, SE or SW) at each crossing for the location of an equipment enclosure, provisionally sized as 8 feet by 8 feet. In some cases, no feasible location exists and the column in Table 3-2 is shown as “No”.

Table 3-3 shows the cell phone signal strength and power availability for the six overgrade bridges within the study area (including adjoining areas of Orange and Greene Counties). All six bridges crossing over the tracks have adequate cell phone coverage; none have apparent power sources very close by.

## Table 3-3. Overhead Bridge Cell Phone Coverage and Power Availability

| LOCATION ID | FIELD INSPECTION NAME | PRIVATE? | CELL PHONE COVERAGE READING (DBM) | POWER AVAILABILITY | LOCATION OF EXISTING CROSSING ENCL. | FEASIBLE LOCATION FOR NEW 8' x 8' HOUSE | NOTES |
|---|---|---|---|---|---|---|---|
| 6 | Mid-Hudson Bridge | No | -74.8 | None | None | No | Mid-Hudson Bridge Town - Lloyd |
| 13 | Rte 9W | No | -75.4 | None | None | No | Rte 9W Crosses Over Tracks |
| 35 | Ulster Ave. Bridge | No | -75.3 | None | None | No | Ulster Ave. Bridge Crosses Over Tracks |
| 38 | RTE 209 | No | -75.9 | None | None | No | RTE 209 Crosses Over Tracks |
| 58 | Route 9W | No | -74.7 | None | None | No | Route 9W Bridge Crosses Over Track |
| 74 | W. Bridge St. | No | -75.6 | None | None | No | W. Bridge St. Crosses Over Tracks |

## 3.4. Vehicular Traffic Counts

In order to provide some prioritization of train detection deployment at crossings, available traffic count data (Annualized Average Daily Traffic) was collected from NYSDOT, Ulster County and local municipalities. NYSDOT assisted the project at the request of Ulster County in performing counts at selected crossings.

It can be assumed that the use of crossings by Emergency Responders approximates the overall vehicular usage. Only a small percentage of the overall crossing inventory has available AADT data. They range from 56 vehicles at Patterson Road in Saugerties to 6112 vehicles at Routes 32/212 (Ulster Avenue), also in Saugerties.

### Table 3-4. Grade Crossing Vehicular Traffic Counts

| Crossing | Municipality | Agency Performing Count | Date of Count | Annualized Average Daily Traffic |
|---|---|---|---|---|
| River Rd./Mile Hill Rd. (North) | Highland Landing (Town of Lloyd) | Town of Lloyd Engineer | 2007 | 600-1000 (Estimated, Summer Months) |
| River Rd./Mile Hill Rd. (South) | Highland Landing (Town of Lloyd) | Town of Lloyd Engineer | 2007 | 600-1000 (Estimated, Summer Months) |
| Old Post Road | Town of Esopus | Ulster County DPW Engineer's Office | 10/30/1995 | 354 |
| Swartekill Road (Old Post Road) | Town of Esopus | NYSDOT | 05/21/2007 | 371 |
| Union Center Road | Town of Esopus | Ulster County DPW Engineer's Office | 11/13/1995 | 817 |
| New Salem Road | Town of Esopus | NYSDOT | 05/21/2007 | 1340 |
| Foxhall Avenue | City of Kingston | NYSDOT | 05/21/2007 | 3356 |
| Tenbroeck Avenue (Between Albany and Foxhall Avenues) | City of Kingston | Ulster County Transportation Council (Lochner Engineering) | 2007 | 1561 |
| Flatbush Avenue | City of Kingston | NYSDOT | 05/21/2007 | 3147 |
| Leggs Mills Road | Town of Ulster | Ulster County DPW Engineer's Office | 11/29/1993 | 5490 |
| Ulster Avenue (Routes 32/212) | Town of Saugerties | NYSDOT | 05/21/2007 | 6112 |
| Glasco Turnpike | Town of Saugerties | Ulster County DPW Engineer's Office | 06/08/1994 | 3244 |
| Malden Turnpike | Town of Saugerties | Ulster County DPW Engineer's Office | 05/09/1994 | 1457 |
| Patterson Road | Town of Saugerties | Ulster County Traffic Safety | 09/06 to 09/13/2006 | 56 |

# 4. Emergency Response

As part of the Emergency Responder Stakeholders Meeting, representatives from the City of Kingston Fire Department, Ulster County Sheriff's Department, Ulster County Emergency Management, New York State Police Department and other local/municipal police/fire departments were invited to a meeting. The meeting agenda included discussion of the minimum warning time requirements by grade crossing location to maximize responders' ability to adjust response routes.

Emergency Responders in Ulster County include police, fire and ambulance services. Each of these broad classes of responder has many sub-types, depending on the location within the County. The City of Kingston has the only full-time professional Fire Department; all other jurisdictions have volunteer fire departments (though they may have some paid professionals on staff).

**Ulster County Emergency Responders**

**50 fire departments,**

**20 ambulance services (volunteer, commercial and municipal), and**

**18 police departments.**

At the meeting, the phenomenon of "self-dispatching" motorists was presented as an issue which can impede response times in the County. When motorists see a grade crossing in Kingston (or in some other municipalities) blocked, they will immediately change course to use a different crossing (or the grade-separated Broadway underpass in Kingston). This can complicate emergency response efforts because of the volume of traffic competing for limited crossing capacity and because the act of turning around can block traffic.

Emergency Responders described at the Stakeholders Meeting how incidents are handled on dead-end streets that are temporarily inaccessible due to passing/stopped trains. Train crews are asked to split or otherwise move the train, a process which can take 10 to 20 minutes. Crews are generally unwilling to do this, unless forced to do so by law enforcement personnel.

## 4.1. Police

Ulster County's law enforcement includes overlapping coverages of municipal/town officers, County sheriffs and State troopers. Municipal/town officers will not cross town lines unless specifically requested to do so by another department. The County sheriff and New York State troopers generally do not respond to calls in the City of Kingston. New York State troopers are based out of several reporting stations within the County; the barracks on State Route 209 serve as Zone Headquarters for the County.

Ulster County Sherriff's Department cruisers are equipped with GPS transponders, allowing Emergency Management personnel the opportunity to see their locations on a screen. Some town police departments in the County are also equipped with GPS transponders, with more being added. New York State troopers' cars will also be so equipped in the near future.

As part of the Emergency Responders meeting, the relationship with the CSX Police Department was discussed. While there are few CSX police officers, they do have police powers and can make arrests of individuals on CSX property. In the past, County police departments could not take direct action when crimes occurred on CSX property; this has now changed with the municipal, County and State officers now able to make arrests on CSX property.

## 4.2. Fire

There are some 50 Fire Departments within the County. Volunteer fire departments typically receive emergency calls via pager. Protocols differ by jurisdiction but, typically, some responders travel directly to the incident while others respond to the firehouse in order to drive apparatus to the incident.

According to the Emergency Responders, the specific route taken to an incident is at the discretion of the apparatus operator in all cases. In numerous cases, operators are familiar with bypass routes, both to avoid blocked crossings and to avoid automobile congestion that results from blocked crossings.

The City of Kingston recently installed real-time video camera at Foxhall Avenue for use in emergency responses by the Kingston Fire Department. Real-time information from the camera has been helpful in determining whether a freight train is in downtown Kingston, thereby allowing the responders to use the shortest path (via at-grade railroad crossings) or grade-separated Broadway in responding to an incident. In cases where a train shows up after the fire truck has left the station, the apparatus operator will receive a radio call from the firehouse when the video camera at the Foxhall Avenue crossing reveals that it is occupied by a train.

**Figure 4-1. Esopus Fire Department, located just east of the Old Post Road grade crossing in Esopus.**

The camera took about 6 months to install, due to various system compatibility issues. It transmits images via the Internet and is accessible only to legitimate users via password protection. The camera relies on a communications network that also supports multiple crime prevention cameras installed in Kingston that are monitored by the Kingston Police Department.

During interviews, Emergency Responders in the County recounted experiences interacting with CSX Dispatchers, located at Selkirk, NY. In the case of emergency equipment (notably fire hoses) across tracks, CSX response has been good. In the case of requesting temporary train speed restrictions due to an incident close to the tracks, CSX response has been mixed.

## 4.3. Ambulance


**Figure 4-2. Commercial ambulance service in Kingston, one of several service providers in Ulster County.**

There are some 20 ambulance services in the County, including volunteer, commercial and municipal services. Volunteer and municipal services have specific coverage areas and are generally the first to be called by the Ulster County 911 Center; when a volunteer or municipal ambulance is unavailable for a response, one of several private County ambulance services is called. In many cases, a commercial ambulance service is simultaneously dispatched with a local volunteer squad to provide Advanced Life Support (ALS) patient care. These services generally have contracts in place to provide coverage in the event that the primary coverage is unavailable. In some portions of the County, including the City of Kingston and the Town of Ulster, all coverage is provided by commercial ambulance services.

## 4.4. Ulster County 911 Center

SYSTRA visited the Ulster County 911 Center to understand its functionality and how the Advance Train Detection System might integrate with existing information systems. For the year 2005, the Center handled 65,126 incidents, according to its Computer Aided Dispatch (CAD) database. For 2006, the number of incidents declined slightly to 63,749. Each call in CAD requires some action, either a radio dispatch or turning the call over to another agency (typically, the City of Kingston) via a local seven-digit phone call. These numbers do not include multiple 911 calls related to the same incident or administrative calls received on the 911 Center's non-emergency business lines.

### *4.4.1. Ulster County 911 Center Systems*

Incoming calls come via Verizon, the local phone provider in Ulster County. Call sources include "land line" phones, Voice over Internet Protocol (VOIP) phones and cell phones of multiple providers. A database at the 911 Center allows the caller's location to be shown graphically on a GIS-type map of the County. The map is maintained using the ArcGIS software developed by ESRI and the database consists of a *.SHP file that had been maintained by MSAG Data Consultants, based in Virginia. Late in 2006, MSAG's contract was not renewed and database maintenance is in the process of being turned in-house to the Ulster County Information Technology's GIS Group.

At present, the GIS database is updated manually (from computer to computer). The 911 Center plans to move to a Spatial Database Engine (SDE) source in the near future, allowing seamless deployment to all 911 Center computers at the same time.

The 911 Center uses CAD software from New World Systems (**http://www.newworldsys.com**) based in Michigan. The CAD software does not have a direct GIS component. The CAD software is licensed on a per-user basis. The 911 Center also uses EAGLE address-matching software from MSAG Data Consultants (**http://www.msag.com**). There is a 50-seat license for the EAGLE software, exceeding the County's immediate needs. This software integrates with the CAD software.

Virtually all incoming calls result in a successful Caller ID by the EAGLE software and a display on the screen. This applies to land line and most VOIP phones. For cell phones, the cell provider passes latitude/longitude data, which varies in accuracy. The Verizon data is precise to within a few hundred feet. Some other provides are accurate to only within a mile.

The Center has a Virtual Private Network (VPN), allowing secure access from remote locations. The Center's servers are AS400's.

### *4.4.2. Ulster County 911 Center Facility*

The Ulster County 911 Center's facility is fairly cramped at present. There is no conference room and it is difficult for a supervisor to have an overview of the entire operation. The facility is limited to 2400 square feet at present. A recent space-planning effort identified the need for about 4500 square feet but there are no present plans or funds for implementation.

The location of the facility has political ramifications. It is critical that the facility be viewed as being in "neutral territory" and not aligned with any particular law enforcement or fire service agency in the County.

There is a limited-capacity back-up facility located at the State Police Barracks in Highland, NY. It has two workstations with the CAD software but no EAGLE GIS/address-matching software.

**Figure 4-3. The Ulster County 911 Center in Kingston.**

Most County police departments and officers have access to the CAD data in their cruiser. Some departments in the County are equipped with the AIRLINK Automatic Vehicle Location (AVL) hardware and software, for which the County has a County-wide license. This system is being phased out in favor of new TrackStar software. The AVL system shows 911 Center personnel the location of all County Sheriff cars, some New York State Police cruisers and some local police department cruisers. It is highly desirable that all police cruisers in the County be equipped with AVL.

There are no ambulance or fire vehicles in the County equipped with AVL, though this would be very desirable.

The Ulster County Emergency Management Center is equipped with a back-up generator, Uninterruptible Power Supply (UPS) and multiple redundant communications systems.

The Ulster County 911 Center has constant challenges with evolving telephone technology. Land line 911 mapping using caller ID and address matching is excellent. However, cell phone response is based on the location of the tower receiving the call; many calls to towers east of the Hudson are actually made by Ulster County residents/visitors and need to be transferred from a different 911 center back to Ulster County. Voice Over Internet Protocol (VOIP) phones pose another problem, especially those that are nomadic (as opposed to static).

### 4.4.3. Ulster County 911 Center Dispatching

The 911 Center provides dispatch for all local law enforcement agencies outside of the City of Kingston. City of Kingston residents are encouraged to call 911 – not seven digit numbers – and 911 Center personnel quickly transfer these calls to the appropriate department within the City (after recording some basic information). It also coordinates with multi-jurisdiction agencies, including:

- Ulster County Sheriff's Department
- New York State Police
- New York City Department of Environmental Protection Police.

Normally, local law enforcement agencies will not cross jurisdictional boundaries. However, upon request of another local agency, they can be requested to do so.

Figure 4-4. Ulster County 911 Center workstations.

Most local law enforcement agency communication is via the 911 Center's common police radio frequency which is broadcast from multiple antenna sites within the County. In 1997, the County negotiated an agreement with Sprint to construct a 150 foot tower on which the County could locate emergency dispatch radio equipment. The tower is County-owned. Later, NEXTEL offered to add 40 feet to the tower. The tower provides a platform for microwave transmission to remote antenna sites within the County. There is a 150-foot County-owned tower in Ellenville. There is a Verizon Wireless tower with collocated County radio equipment at Sam's Point that provides coverage as far north as Esopus. And there is a tower at the Belleayre Ski Area, which is connected to the rest of the County radio network via phone lines and not via microwave. Microwave is preferred for reliability and clarity.

The 911 Center rarely has any communication with the NYSDOT Region 8 Traffic Management Center in Hawthorne, NY (refer to Section 0).

### *4.4.4. Ulster County 911 Center Staffing*

The personnel at the 911 Center undergo a 3 to 6 month on-the-job training program before taking calls. They are trained to provide basic medical assistance over the phone.

The Center has eight workstations and is staffed 24/7. Not all workstations are staffed at all times. There are some part-time personnel who can be brought in should there be a large incident requiring extra personnel.

The 911 Center tries to stay abreast of all road closures, as they affect emergency dispatch. The City of Kingston, which receives calls passed from the 911 Center and handles its own dispatching, typically does not provide notice. Other jurisdictions, including municipalities, the County and the State, typically provide at least one week of advance notice in the event of a planned closure.

In discussions with the County Emergency Responders, the lack of advance warning from CSX regarding road closures (sometimes multiple adjacent road closures) for grade crossing surface improvements was discussed. Typically, Ulster County Emergency Management likes to have two weeks of advance notice regarding planned closures, so that all emergency responders can be notified. In the case of a recent CSX project, only one day of notice was provided.

### *4.4.5. Ulster County 911 Center CSX Coordination*

In discussions with Ulster County 911 Center personnel, it was learned that CSX Dispatchers at Selkirk, NY are generally cooperative in supporting track closures when fire hoses or apparatus are blocking tracks. When there is an incident next to the ROW that does not require track closure, they are less consistent with respect to applying temporary speed restrictions for passing trains. Emergency responders and 911 Center personnel are familiar with the CSX 800 number for grade crossing incidents. The crossing ID's are clearly marked and these are used as geographic reference when communicating with CSX (railroad mileposts are not).

The 911 Center does not have any knowledge of CSX train locations. The protocol when an emergency responder encounters a grade crossing blocked by a train is to wait, rather than to try to "guess" which other crossings may (or may not) be open.

## 4.5. Required Advance Train Detection and Arrival Prediction System Functionality

### *4.5.1. Geographic Coverage*

Ideally, every crossing (public or private) in the County would be covered by the Advance Train Detection and Arrival Prediction System. In a somewhat less ambitious work scope, only public (nor private) crossings would be covered. In a still lower cost solution, coverage would focus on the "core" congested crossings from Esopus through Kingston to Saugerties.

### *4.5.2. Advance Warning Time*

In discussions with County Emergency Responders, it was agreed that a minimum advance warning time of 5 minutes is needed within the City of Kingston and a minimum of 10 minutes is needed elsewhere in the County. Ideally, these advance warning times would be twice as long. This represents the duration of the advance notification that a train is approaching a crossing and that the gates are about to be activated.

The most pressing need for the Advance Train Detection and Arrival Prediction System is at the Ulster County 911 Center, followed by the City of Kingston Fire Department and City of Kingston Police Department. Some emergency responders within the County are equipped with mobile data terminals, which could be used as a display mechanism for the Advanced Grade Crossing warnings.

County Emergency Responders understand that they must always obey warning devices and never drive around gate arms that are in the down position or pass grade crossing flashers that are flashing. Since the proposed Advance Train Detection and Arrival Prediction System will not be connected to the railroad signal system, the emergency dispatcher will not know exactly what the trains are doing at all times. The emergency dispatcher will advise the emergency responders to use an alternate highway-rail grade crossing, which the System has predicted is clear of trains (and approaching trains).

NYSDOT has expressed concern that, should a train reverse direction and activate a warning devices for the alternate highway-rail grade crossing, the responding emergency team would arrive at the alternate highway-rail grade crossing to find that is not passable. NYSDOT expressed concern that the responding emergency team could attempt to go around the gates because they were notified by the emergency dispatcher that the alternate highway-rail grade crossing is not occupied (or has been cleared). They may also incorrectly assume that the warning devices are not working properly. Strict guidelines and an associated training program for emergency responders must be established to prevent such highway-rail crossing gate/flasher violations.

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# 5. Traffic Management

SYSTRA visited the NYSDOT Region 8 Traffic Management Center (TMC) in Hawthorne, NY. The purpose of the visit was to understand the current capabilities, responsibilities and functionality of the Region 8 TMC, which covers Ulster and six other New York counties north of the Bronx. With the Integrated Advance Train Detection/Arrival Prediction System having the possibility of an Intelligent Transportation Systems (ITS) component, it is likely that the Region 8 TMC would serve as the gateway for any data generated by the Train Detection/Arrival Prediction System.

## 5.1. Transportation Management Center (TMC) Overview

The Region 8 TMC is located at 200 Bradhurst Avenue in Hawthorne, NY. The facility is located in a purpose-built building completed in 2004 and comprising about 100,000 square feet. In addition to the NYSDOT TMC facility, the same building houses a regional office of the State Police. It also includes offices for a New York State Thruway representative and a “field” office for the NYSDOT Region 8 Director, whose principal work location is Poughkeepsie.

The building is owned and maintained by New York State Office of Government Services (OGS). The user agencies and organizations effectively pay rent to OGS.

The facility has a large lobby designed for press briefings and other major events. With the Indian Point Nuclear Plant within Region 8, rapid dissemination of information to the media in the event of an emergency is an important capability.

## 5.2. Transportation Management Center (TMC) Personnel

The TMC is managed by a State Police co-manager and a NYSDOT co-manager. On the “floor”, there are typically three to four personnel during daytime shifts, plus a manager. Overnight, the staffing drops to two, unless there is a storm or major incident occurring. In that case, extra personnel are called in.

## 5.3. Transportation Management Center (TMC) Field Data Acquisition and VMS Equipment

The TMC currently has somewhat limited field data acquisition equipment, with most equipment having been installed as part of localized major construction projects. About 25 CCTV video cameras feed the TMC, with all CCTVs having pan-tilt-zoom capability. However, the TMC only has primary control of seven of the CCTVs at present. Other operating agencies, such as the NYS Thruway Authority, have primary control of the remaining cameras.

TMC controls about 25 permanent Variable Message Signs (VMS) and about 25 quasi-permanent VMS. Communication with the quasi-permanent VMS is via Verizon analog cell modems; Verizon is discontinuing support for this and effectively forcing an upgrade to digital cell modems. Communication with the permanent VMS is via a T1 Line frame relay network, again supplied by

Verizon. VMS are located at the three major Hudson River crossings within Region 8 – The Mid-Hudson Bridge, the Newburgh Bridge and the Tappan Zee Bridge. The VMS do not have any "watchdog" devices to indicate if their CPU's have failed, their power supply has failed or similar issues.

VMS are controlled sign-by-sign; there is no possibility of a global message (such as an "Amber Alert"). The software supporting each VMS has a list of predefined context-sensitive messages, plus the possibility of a user-specified message. NYSDOT personnel at the TMC have built libraries of standard messages, based on actual operating experience, to drive each VMS.

TMC also utilizes permanently-mounted acoustic detectors to determine lane volumes, speeds and percent occupancy. There is also the possibility of using TRANSMIT data, which is based on the E-Z Pass transponder reads to provide not only volume/speed/occupancy data for road segments but origin-destination data as well. Integrating field information from TRANSMIT segments and from "point source" acoustic detectors requires sophisticated software applications. TRANSMIT data is viewable through the Region 8 TMC's TRANSCOM Regional Architecture workstation.

NYSDOT is embarking on a series of major Route 17 projects this summer. The extent to which the project includes ITS components is not known at present. NYSDOT indicated that there will be a "Corridor Manager" to coordinate five related Route 17 projects, an improvement over previous management structures.

**Figure 5-1. Operating theatre of the Region 8 TMC**
***(Photo courtesy of NYSDOT)***

There is no overlap in data acquisition coverage with the Region 11 TMC that controls New York City (located in Long Island City, NY), making coordination across the Bronx/Westchester Line difficult. Future ITS efforts will be better coordinated across regions to ensure that overlaps in data are provided.

It was noted that the Long Island, New York City and Region 8 TMC's all evolved under their respective NYSDOT Regions, with little or no uniformity in terms of systems architecture, functionality, software applications, computer hardware or operating systems. Looking to the future, NYSDOT is working to standardize future deployments.

In terms of planned lane outages and other projects, road work is displayed on three websites: www.TravelInfoNY.com, www.HudsonValleyTraveler.com and www.Trips123.com. The TMC uses this information to plan signage displays. NYSDOT Region 8 does not currently produce a weekly bulletin of road projects but plans to in the near future.  The NYS Thruway Authority currently produces a weekly bulletin of road projects within its jurisdiction.

## 5.4. Transportation Management Center (TMC) Facilities and Equipment

The TMC computers are running the Microsoft XP Professional operating system.  There are 12 principal work stations on the "floor" plus numerous supporting work stations for managers and system maintainers.  Above the main "floor" is a soundproof conference room, known as the "war room" where authorities can meet and confer in the event of a major incident.

Potentially the most useful display in the TMC shows "Key Corridors" and user-controlled, color-coded threshold speeds (for example, 0 to 35 MPH in red, 36 to 50 MPH in yellow, 51 MPH and above in green).  This capability is limited to so-called "Key Corridors" in Region 8, consisting of interstates and parkways and NY17 (only the portion that is Future I-86). Although the NYS Thruway is a separate entity not under the control of NYSDOT, real time data from the Thruway within Region 8 is included at the TMC.

**Figure 5-2.  Hudson Valley Transportation Management Center facility in Hawthorne, NY.**

A near-term future goal of the TMC is to be able to support pre-scripted playbooks.  If, for example, an accident takes out a northbound lane of I-684 between two exits, the TMC operator would enter this information and be prompted to launch a script that would automatically update all applicable VMS with information about an accident ahead (without necessarily including any alternative route information).  If there were multiple concurrent incidents, the operator would need to continue to make VMS updates interactively, as scripting would be infeasible for all of the multiple incident permutations. At present, this must be done individually for each VMS, using different software applications depending on the generation/manufacturer of the VMS.

A long-term future goal of the TMC in terms of traffic speeds calls for the overview display system to send the operator an alarm when the current speed differs significantly from the historical information.  The system would subsequently suggest a response plan based on the location, time-of-day, date and other factors.

A long-term future goal of the TMC is to be able to support pre-scripted playbooks that will suggest alternative routes to motorists.  In order to do this, the alternative route must be known to be free-flowing (requiring substantially more data acquisition equipment than is in service at present) and it must be known that there is sufficient capacity.  Based on the Long Island TMC experience (which dates back to the mid-1980's), it is likely to be 15 to 20 years before the Region 8 TMC has this capability.

## 5.5. TMC Related Systems

The TMC supports the following publicly-available web sites with real time or near real time information:

- **www.travelinfony.com**
- **www.trips123.com**
- **www.hudsonvalleytraveler.com**

The first is a statewide system fed by the Condition Acquisition Reporting System (CARS). The second is a New York metro region system fed by TRANSCOM, which is based in Jersey City, NJ. The third is a system fed directly by the Region 8 TMC. When an incident occurs, TMC personnel must enter it in all three systems. It was noted that the data requirements and structures are slightly different for each system. For example, the TRANSCOM system does not address incidents on roadway shoulders, whereas the other two systems do.

The TMC will also support the New York State 511 traveler information system, which is scheduled for a "soft" rollout in the New York metro area in June, 2008 and then a full rollout within this coverage area in November, 2008. (the ITS World Congress to be held in New York City during that month is a significant schedule goal). The statewide 511 rollout would be subsequent to the November 2008 New York metro rollout.

**Figure 5-3. Cell phone 911 Center supervisor at the Region 8 TMC**
***(Photo courtesy of NYSDOT)***

The TMC also hosts the Westchester County cell phone 911 call center, which answers about 30,000 calls per month. The call center is staffed by New York State Police civilian dispatchers. Westchester land line 911 calls are handled in a different facility, although some may be handled at the TMC. TMC systems allow the Computer Aided Dispatch incident log generated as a result of a 911 call, with personal and confidential information redacted, to be transferred to TMC personnel for informing their traffic management decision-making.

## 5.6. TMC Use of Advance Train Detection/Arrival Prediction Data:

With only two VMS in Ulster County (on corridors that do not have railroad grade crossing interference), there is no possibility of immediate application of Ulster County Advance Train Detection/Arrival Prediction data at the Region 8 TMC. However, over the next decade or two, such data may have applicability as two-lane State roads and County roads are added to the TMC. It is likely that such data will be communicated via a secure Internet connection and that Extensible Markup Language (XML) schema can be developed to communicate this information, consistent with the Region 8 ITS architecture.

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# 6. Technology Alternatives

SYSTRA evaluated eight technology alternatives for detecting trains on the West Shore Line. Of these eight technologies, five were fatally-flawed in the first round of evaluation. Three technologies were included on a short list. Subsequent detailed evaluation of these three technologies led to the recommendation of the use of Doppler Radar Speed Sensors for the train detection technology deployed in Ulster County.

The "long list" of train detection alternatives included:

1. Railroad track circuits,
2. Railroad Audio Frequency Overlay (AFO) circuits,
3. Grade crossing traffic signal preemption contact interfaces,
4. Inductive loop train presence detectors,
5. Light beam train presence detectors,
6. Acoustic sensors,
7. Microwave motion detectors, and
8. Doppler radar speed sensors.

The first two long list alternatives were deemed fatally-flawed because they require use of CSX facilities. The third long list alternative, while having precedence as the means to interface CSX grade crossing circuitry with traffic signal preemption (to clear crossings of cars queued at a nearby intersection when a train is approaching) was dropped after CSX indicated that it would not cooperate with such an interface throughout the County (the only existing such interface is at Boices Lane in the Town of Ulster). In addition, the third long list alternative would not provide train detection coverage at non-crossing locations, an issue because the southern portion of the River Line within the County has virtually no at-grade crossings.

Inductive loop train presence detectors, which use the inductive properties of large steel objects (such as locomotives and freight cars) to indicate train presence, were fatally flawed because they cannot distinguish direction or speed. In addition, given the need to locate the equipment within the road crossing right-of-way to avoid private property impacts, such detectors may be susceptible to false "reads" when large highway vehicles pass.

Light beam train presence detectors, using a light source on one side of the track and receiver on the other side, suffer from many of the same shortcomings as inductive loops. They cannot measure speed or train direction. They are susceptible to false "reads" due to CSX work crews, trespassers and even animals on the tracks.

The final short list of train detection technologies – acoustic sensors, microwave motion detectors, and Doppler radar speed sensors – is shown in Table 6-1. The strengths and weaknesses of each of the short list train detection technologies are detailed in the following sections.

**Table 6-1. Short List of Train Detection Technologies**

| **Manufacturer** | **SmarTek Systems** | **MS Sedco** | **SpeedInfo** |
|---|---|---|---|
| **Type of Device** | **Acoustic Sensor** | **Micro Wave Motion Detector** | **Doppler Radar Speed Sensor** |
| **Device Model #** | **SAS-1** | **TC26-B** | **DVSS-100** |
| Train motion detection | Yes | Yes | Yes |
| Train speed detection and output | Yes | No | Yes |
| Train travel direction detection and output | No | No | Yes |
| Train length detection and output | No | No | Yes |
| Data communication device for near-real-time central processing | Yes | No | Yes |
| Data center for processing and control center mimic display | No | No | Yes |
| Power demands for detection device and data communications | 60W solar panel per device | 1.8 W power demand per device | 10W solar panel per device |
| Ability to differentiate environment noise and disturbance | Poor | Poor | Very Good |
| Ability to identify CSX hi-rail vehicles | None | None | Very Good |
| Capital cost | $3500-4000 per device | $810 per sensor | $5000 per device including two years' service |
| On-going operational cost | User pays own telecom charges; User maintains the equipment | User maintains the equipment | Vendor maintains all equipment ($1200 per year or $3600 for four years; per device) |
| Further information | www.smarteksys.com | www.mssedco.com | www.speedinfo.com |

## 6.1. Acoustic Sensor

Acoustic sensors are commonly used in traffic volume surveys and other vehicle tallying applications. Acoustic sensors are the only type of non-invasive (off the CSX right of way) potential train detection technology that has actually been tested on the CSX River Line. Prior to the initiation of this study, train frequency data was collected at the request of the Ulster County Planning Department by the NYSDOT Technical Services Division, based in Albany. A pole-mounted acoustic detector was used at the Route 32/212 (Ulster Avenue) grade crossing with CSX in Saugerties during the period January 10 through January 26, 2006. It was found to effectively detect the presence of a train and to record its approximate velocity.

The most promising manufacturer of acoustic sensors for vehicle detection is SmarTek Systems. The detector is attractive in its ability to detect train velocity and the company's support of a data communication device that can provide real-time or near-real-time communication with a central location.

**Figure 6-1: SmarTek Systems – Acoustic Sensor – SAS-1**

The model SAS-1 from SmarTek Systems provides vehicle detection, and per vehicle speed information. The device features a standard RS-232 serial port for communications.

**Figure 6-2: SmarTek Systems SAS-1 Acoustic Sensor showing proximity to highway traffic.**

The device is designed for all-weather vehicle detection and supports solar power inputs. The sensor is "addressable" meaning that it can have a unique ID to support data from multiple sensors feeding a single wayside equipment enclosure. The device supports software upgrades without having to remove the sensor from its installed position.

The weaknesses of the acoustic sensor in terms of the proposed Ulster County train detection application are that it does not support train travel direction or train length outputs. In addition, the acoustic detector is susceptible to ambient noise and potential confusion of high horsepower diesel trucks with a similar "sound profile" of a CSX diesel locomotive. Power requirements are higher than the other two short-listed technologies, requiring a 60 watt capacity solar panel (versus 10 watts or less for the other two technologies).

## 6.2. Microwave Motion Detector

The microwave motion detector technology is similar to the detection technology used on security lights in residential and business applications. While readily available and capable of detecting trains from a location off of the CSX right-of-way, the technology is not capable of determining train length, speed or direction.

**Figure 6-3: MS Sedco – Microwave Motion Detector – TC26-B**

The model TC26-B from MS Sedco appears to be the most promising technology in this category, based on SYSTRA's review. Based on microwave technology, the TC26-B is not affected by temperature, humidity, color or background noise variations. The vehicle detection range is estimated to be 200 feet for automobiles and 350 feet for large trucks, well in excess of the Ulster County requirements.

However, the microwave motion detector is susceptible to false train detections from passing CSX track workers, trespassers or animals.

## 6.3. Doppler Radar Speed Sensor

SYSTRA also evaluated Doppler radar-based speed sensors. One manufacturer of such systems is SpeedInfo. The technology offers great promise for train detection in that it can detect the presence of a train, velocity, direction and train length. The device includes near-real-time communications output, with processing by a data center maintained by the manufacturer. The data center can consolidate the messages from the field and then relay them to a processing computer in Ulster County via an Internet connection. The operational cost for this is $1200 per year or $3600 for four years, per sensor.

**Figure 6-4: SpeedInfo Doppler Radar Speed Sensor DVSS-100 and supporting solar panel**

The SpeedInfo sensors are readily configurable to be powered solely by solar panels. Power draw is about 10 watts per device. Capital cost is approximately $5000 per sensor which includes two years of service in case of any operational problem.

SpeedInfo's real-time traffic data service includes three elements: the company's solar-powered radar sensors, wireless communications via the AT&T Wireless network and data customization and dissemination through the company's proprietary hardware and software.

**Figure 6-5: Pole mounting arrangement of SpeedInfo Doppler Radar Speed Sensor DVSS-100**

### *6.3.1. Solar Powered Doppler Sensors*

At the core of SpeedInfo's data service is the DVSS-100 Doppler radar speed sensor which measures the speed of vehicles. The DVSS-100 sensor is fully self-contained and because it is solar powered requires no wiring or electricians to install it.

### *6.3.2. Wireless Communication with Speed Sensor*

SpeedInfo's speed sensors measure vehicle speed at programmable rates. For example, the default rate is every 30 seconds during daylight hours with the average speed transmitted once per minute over the AT&T Wireless network. Because sensors are typically mounted 8 to 20 feet above the ground, data transmission is highly reliable.

### *6.3.3. Data Customization and Dissemination*

The final component of SpeedInfo's traffic data service is the company's network server and software technology that customizes and disseminates traffic data to end users, such as Ulster County. SpeedInfo can customize the data each end user receives. The company guarantees performance and data availability levels.

## 6.4. Alternative Technology Recommendation

Based on the evaluation of alternative technologies, SYSTRA recommends that the Doppler radar-based train detection technology be applied to the Advanced Train Detection project. The capabilities of this technology provide the most comprehensive set of train performance attribute data feeds with good manufacturer support and reasonable capital cost.

The Kingston Fire Department has expressed a desire to have digital video feeds from the Doppler radar-based detection locations. This would be similar to the feed provided to the Fire Department by the video camera mounted on the County Records Management Bldg. The Fire Department dispatcher can see if the Foxhall crossing is blocked when dispatching fire department apparatus. While the Doppler radar units do not transmit video nor require a broadband Internet connection for transmission of the information they record, there would be potential synergies between Doppler radar and digital video feeds in terms of mounting locations and hardware. While the digital video feeds would not have predictive capabilities, they would allow County 911 Dispatchers and other emergency responders to actually see what is happening at a crossing during a public safety event.

Figure 6-6 and Figure 6-7 display potential installation configurations within public road rights-of-way in one-track and two-track territory. In order to provide conservative construction cost and equipment procurement estimates, it is assumed that a sensor is required for each active track. Additional discussion and demonstration with a potential vendor of sensor equipment will be required in order to determine whether one sensor or two is required in multiple track territory.

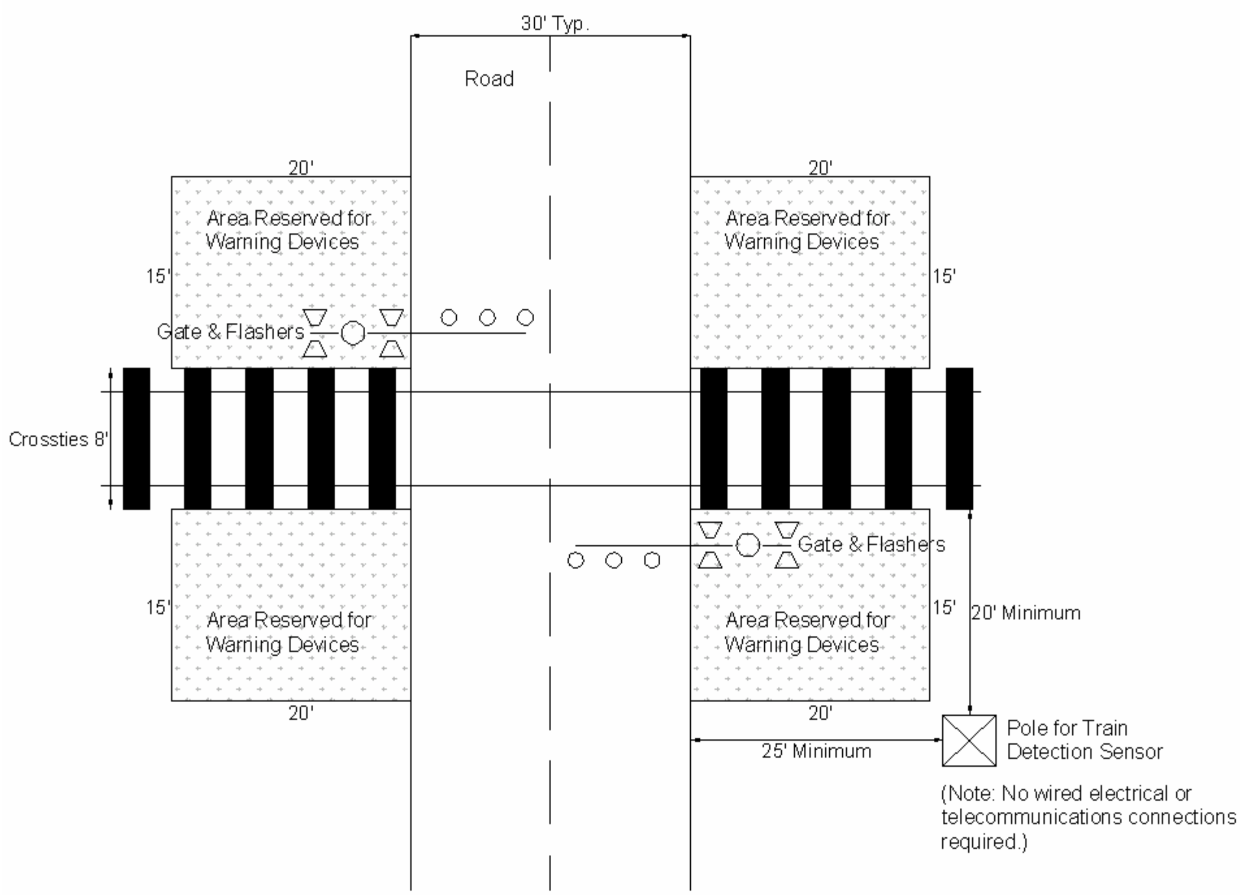


**Figure 6-6: Potential Installation Configuration for Doppler Technology in Single-Track Territory.**

The pole that the proposed Doppler radar-based train detector will be mounted on cannot interfere with the visibility of warning devices at highway-rail grade crossings. In addition, the present location of warning devices may change in the future to allow for more clearance distance, especially at highway-rail grade crossings where the existing devices do not meet the minimum clearance distance or a highway project changes the configuration of the existing highway. To address these concerns, the proposed pole's clearance distance is a minimum of 25 feet from the pavement edge and 20 feet from the edge of the road crossties. This will ensure ample spacing for visibility by motorists, cyclists and pedestrians of existing and relocated warning devices. The NYSDOT Office of Modal Safety and Security (Rail Safety Bureau) has indicated that it reserves the right to review and approve/disapprove all proposed work within the vicinity of a highway-rail grade crossing. This includes the envelope around the highway-rail grade crossing reserved for crossing warning devices, approximately 15 feet from the rail, and 20 feet from the edge of pavement.

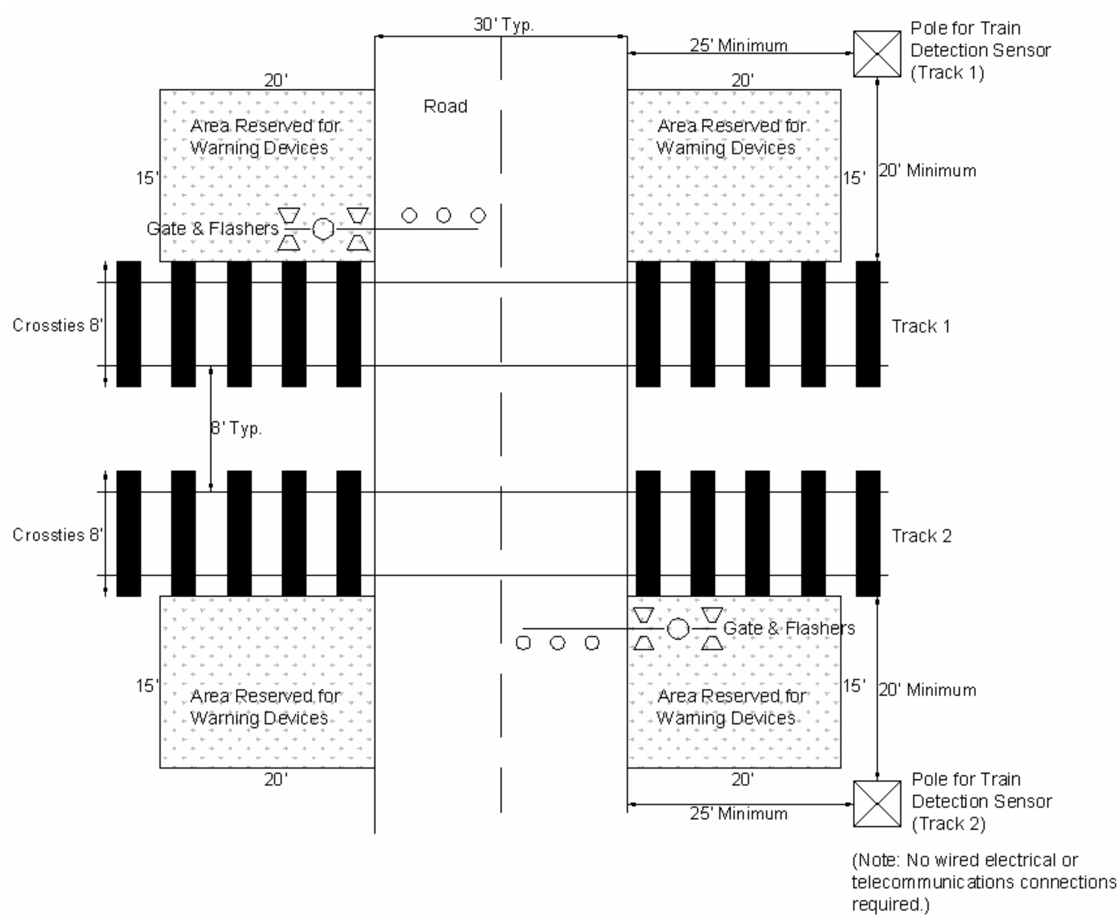


**Figure 6-7: Potential Installation Configuration for Doppler Technology in Double-Track Territory.**

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# 7. Ulster County Coverage Area Alternatives

With one train detection technology clearly superior to the others, SYSTRA worked to develop six alternatives for the Advance Train Detection Project. These alternatives focus on deployment alternatives, rather than technology alternatives. In addition to the six deployment alternatives listed below, Ulster County may wish to consider a demonstration project for a single crossing in the County to ensure that the recommended technology is reliable and well-supported by the manufacturer. The six deployment alternatives recommended for consideration by SYSTRA are as follows:

- Alternative 1 – City of Kingston Focus,
- Alternative 2 – Town of Saugerties Focus,
- Alternative 3 – Town of Esopus Focus,
- Alternative 4 – City of Kingston and Town of Saugerties Combined Focus,
- Alternative 5 – Town of Esopus and City of Kingston Combined Focus, and
- Alternative 6 – County-wide Deployment.

Figure 7-1 through Figure 7-6 (beginning on page 67) detail the recommended train sensor locations for each of the six alternatives. The crossing names for which train arrival prediction is feasible are shown boxed in these graphics. Train sensors are used to detect approaching trains, of course, but also present at grade crossings to determine actual train passage times at crossings. This information is used to predict arrival times at downstream crossings but also to provide feedback to the Train Arrival Prediction software so that it can properly recalibrate itself for following train movement predictions.

Note that each of the alternatives has at least one "sub-alternative" with respect to the recommended locations for train sensors. For example, Alternative 1 (Kingston Focus) has three sub-alternatives in the Town of Esopus where a train detector should be located for detection of northbound trains approaching Kingston. The two-track crossing at Old Post Road, the single track crossing at Esopus Avenue and the single track crossing at Union Center Road are all possibilities. The Task 1 report indicated that all three of these locations have excellent cellular phone service so there are no distinctions amongst the sub-alternatives with respect to communications reliability. Should Alternative 1 be selected by the County for implementation, a choice will need to be made amongst the sub-alternatives with respect to:

- Constructability,
- Proper exposure for solar panels,
- Community impacts, and
- Roadway right-of-way width and its effect on safety for the traveling public and security of the sensor.

Because sensors may be required for each track, single track locations are preferred over multiple track locations where sub-alternatives are considered.

## Table 7-1. Ulster County Publicly-Owned Parcels Adjacent to CSX River Line

| Owner | Section Number | Block Number | Parcel Number | Acreage | Address | City or Town | Notes |
|---|---|---|---|---|---|---|---|
| City Of NY OWSL | 056.025 | 0004 | 039.000 | 2.06 | 71 SMITH AVE | KINGSTON | Includes Lot 51 & Part 43 |
| City Of NY OWSL | 056.025 | 0004 | 048.110 | 1.41 | 91 SMITH AVE | KINGSTON | Formally Lots 42.2 & 48 |
| City Of Kingston | 056.025 | 0005 | 020.000 | 1.17 | 17 VALLEY ST | KINGSTON | |
| City Of Kingston | 056.049 | 0003 | 008.100 | 1.47 | 472-530 ABEEL ST | KINGSTON | Includes 780' Waterfront |
| City Of Kingston | 056.033 | 0002 | 025.100 | 2.96 | 426 WILBUR AVE | KINGSTON | Land Fr Lot 24.1 Added |
| Town Of Esopus | 056.020 | 0001 | 007.000 | 4.86 | 324 MOUNTAIN VIEW AVE | ESOPUS | Highway Garage |
| Town Of Esopus | 056.019 | 0003 | 003.000 | 1.68 | 139 STATION RD | ESOPUS | The Hutts |
| Town Of Esopus | 071.004 | 0004 | 028.200 | 34.38 | 70 WEST SHORE CT | ESOPUS | Town Of Esopus Landfill |
| Town of Marlborough | 103.003 | 0002 | 071.000 | 0.60 | OLD INDIAN TRL | MARLBOROUGH | Railroad |
| American Land Preservation | 103.003 | 0003 | 028.120 | 10.46 | RIVER VISTA DR | MARLBOROUGH | |
| Ulster Fire District #5 | 048.058 | 0006 | 005.000 | 3.53 | 830 ULSTER AVE | ULSTER | |
| Ulster Acquisition I LLC | 039.082 | 0001 | 030.420 | 14.65 | 701 GRANT AVE | ULSTER | Bldg 963 |
| Town of Ulster | 048.066 | 0002 | 014.200 | 0.07 | ULSTER AVE | ULSTER | Water Dept |
| Ulster County Ind Dev Agy | 048.066 | 0002 | 020.600 | 4.60 | 36 KIEFFER LN | ULSTER | |

In each alternative, at least one required location for a train detector could not be satisfied using the previously-completed inventory of overgrade (above the railroad tracks) bridges and public grade crossings. In Alternative 1, train detectors are needed at the north and south limits of the Kingston passing siding (CP87 to CP90). While the north limits can be accommodated with a train detector at the Boices Lane grade crossing in the Town of Esopus, the south limits pose a much greater challenge for siting a detector. The Ulster County Planning Department and County GIS Group provided SYSTRA with a list of publicly-owned land parcels adjacent to the CSX right-of-way. A review of this information indicates that the properties at 472-530 Abeel Street and at 426 Wilbur Avenue offer promise for detecting trains at CP87. In addition, the privately-owned cemetery parcel at CP87 (Wiltwyck Cemetery) is a possible location for a train detector. These three locations are listed as sub-alternatives in Alternative 1.

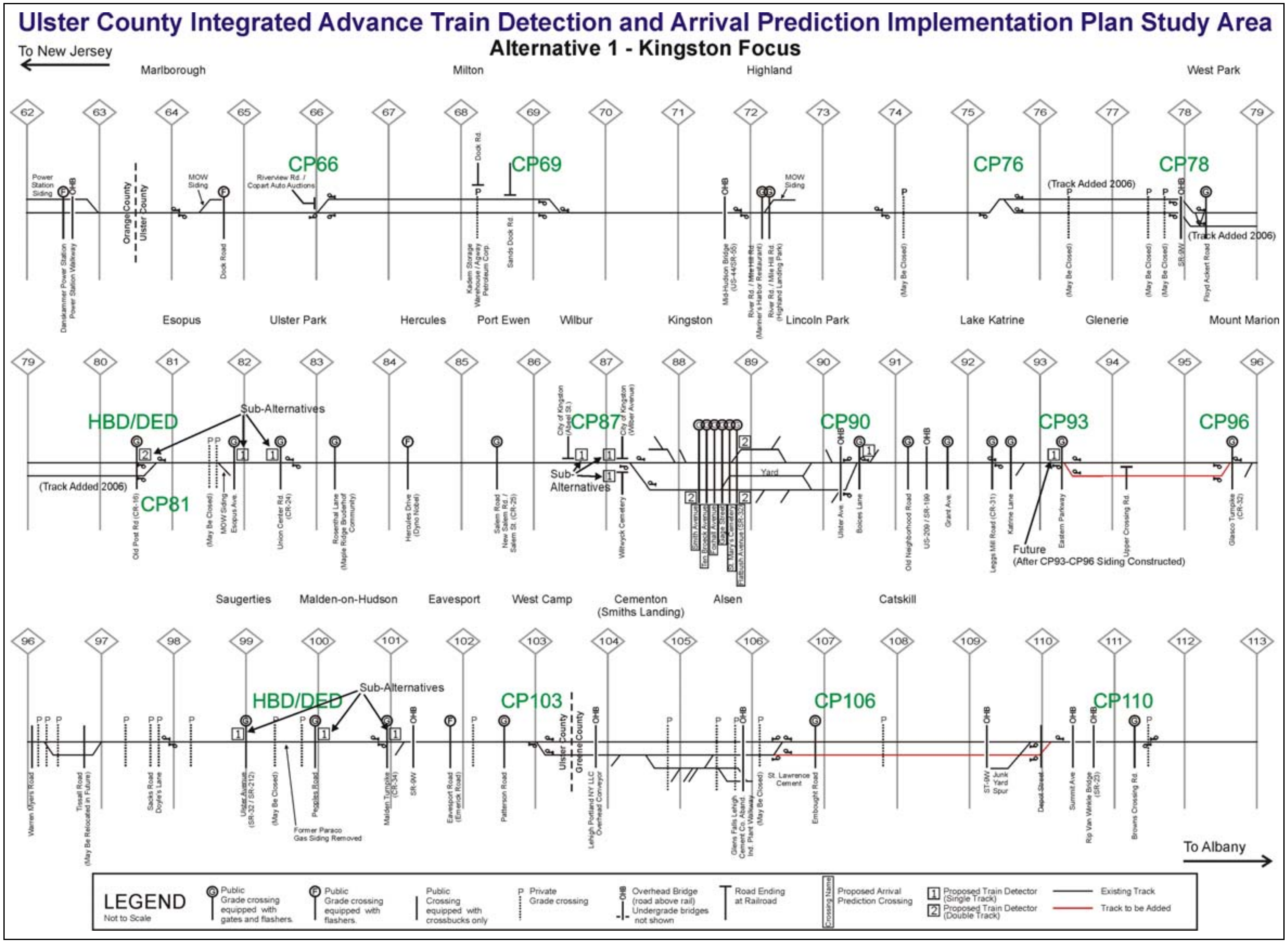


**Figure 7-1. Alternative 1 Applied to the Project Study Area**

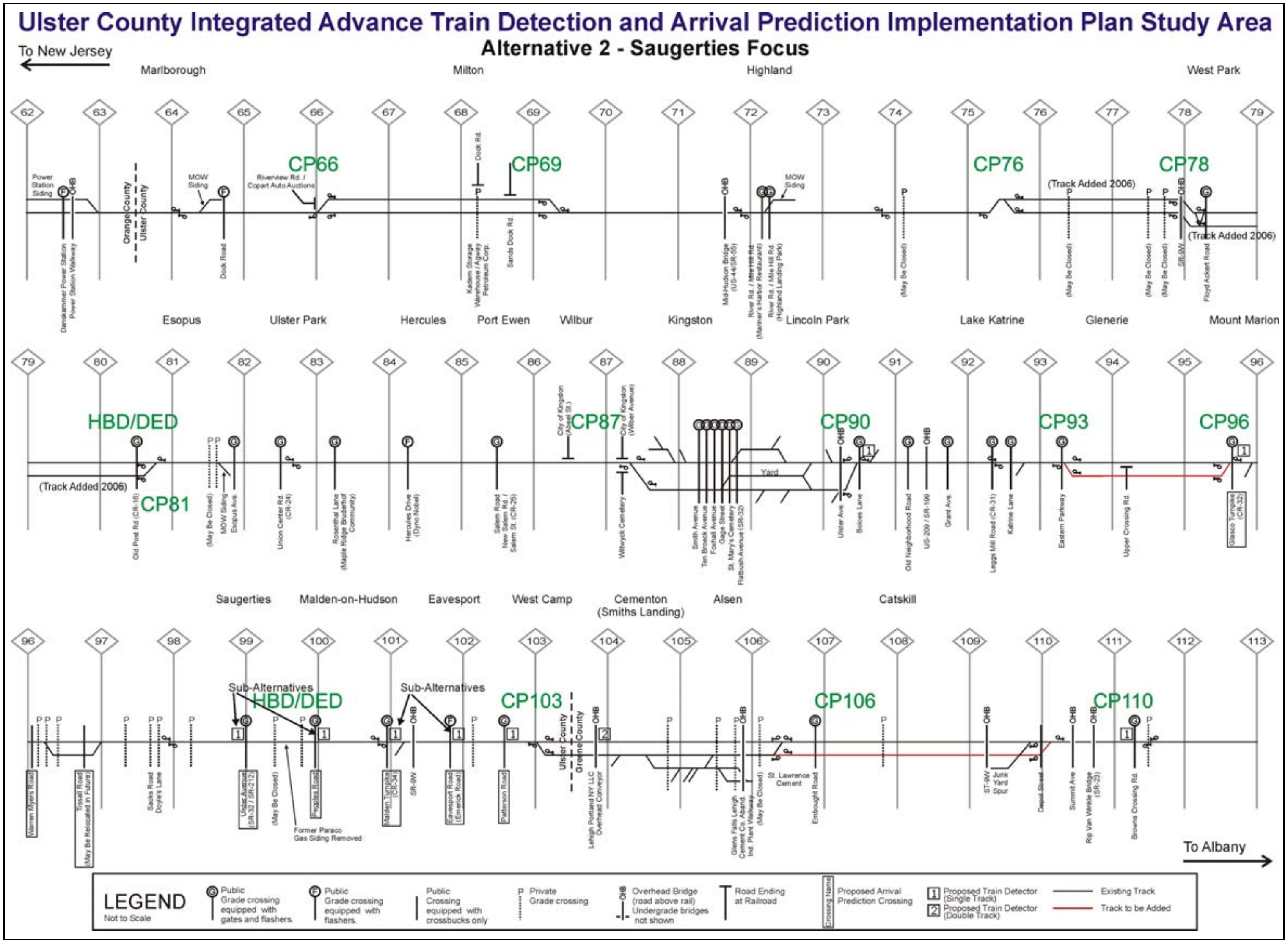


**Figure 7-2. Alternative 2 Applied to the Project Study Area**

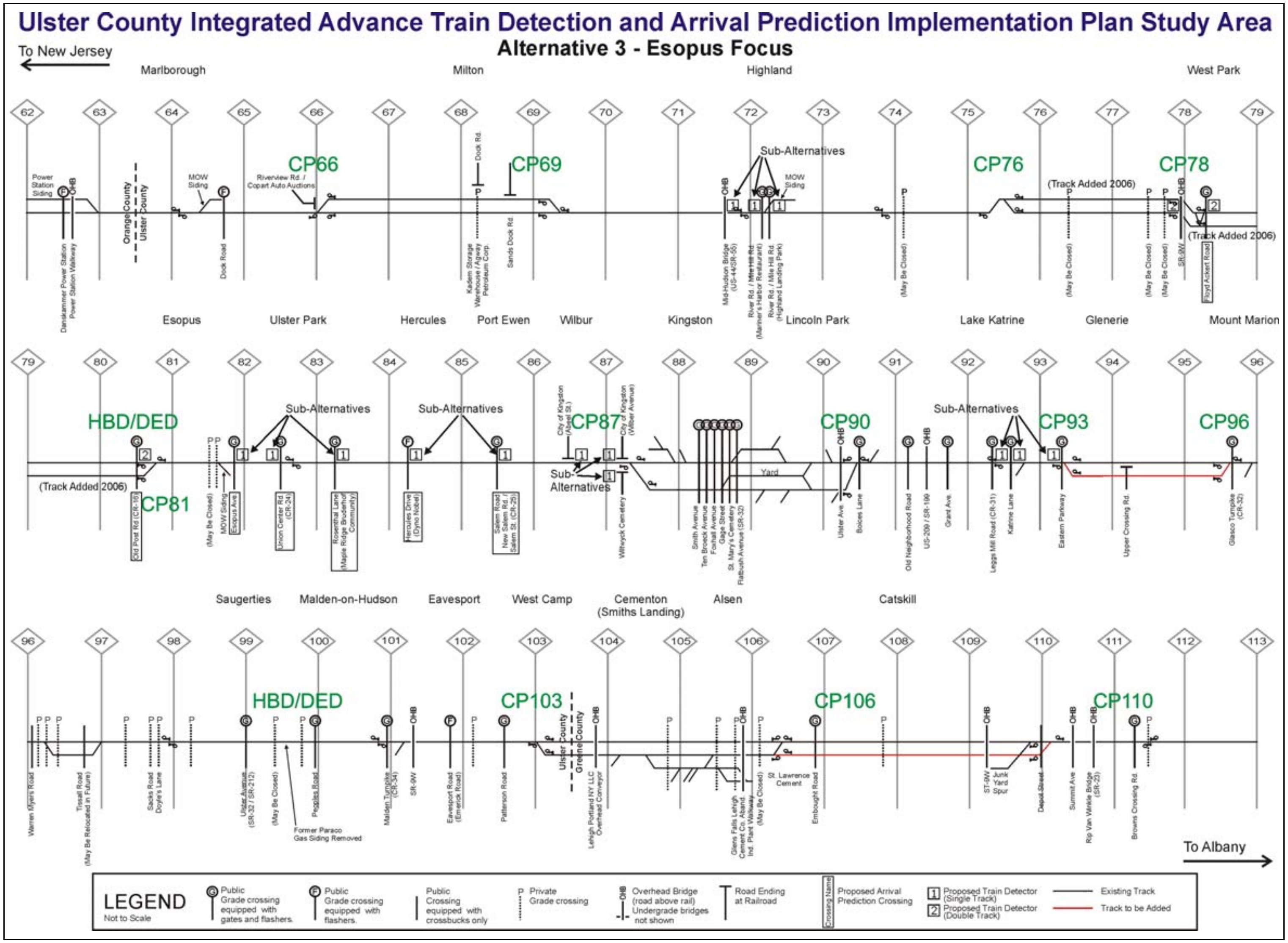


Figure 7-3. Alternative 3 Applied to the Project Study Area

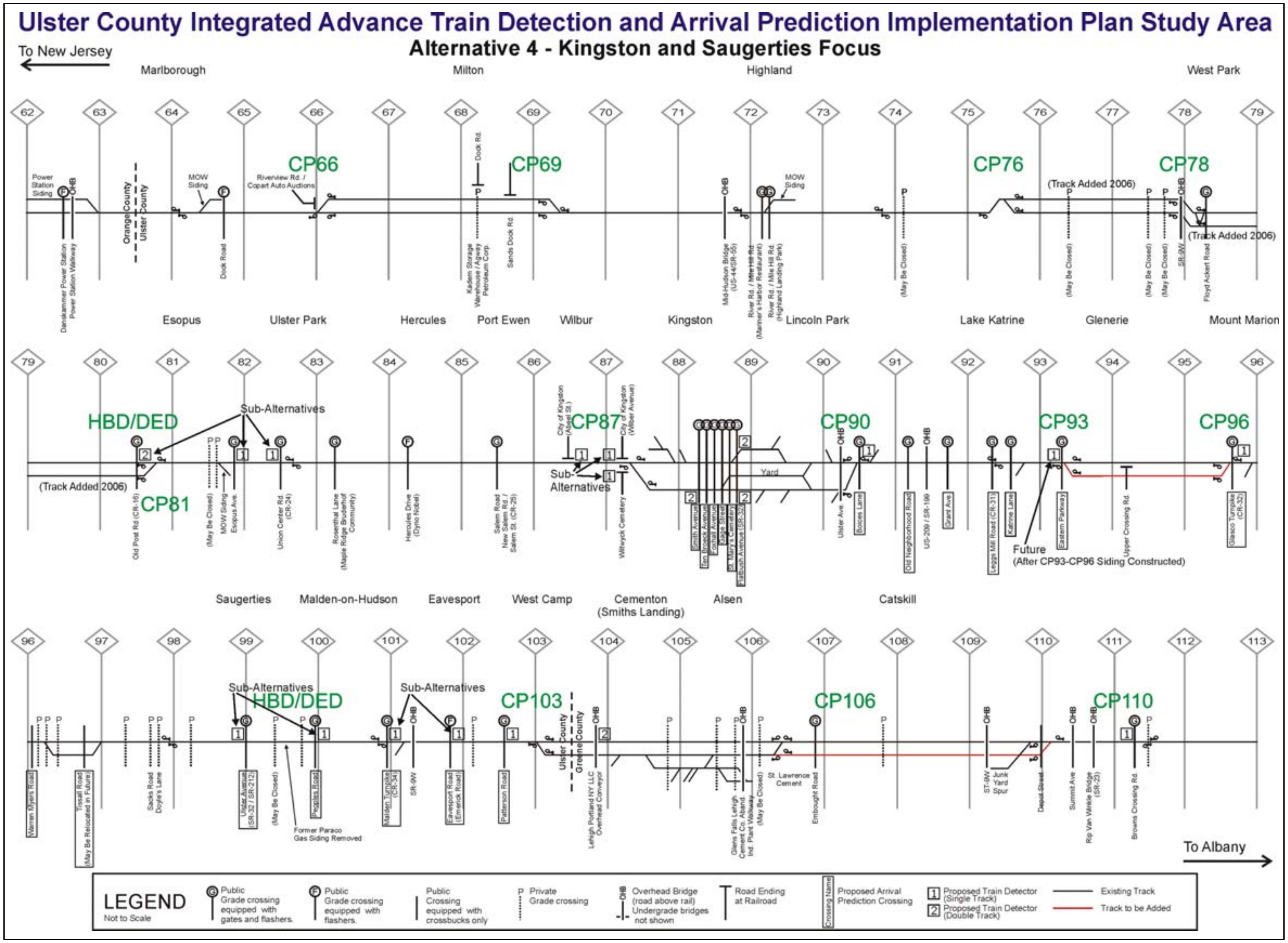


**Figure 7-4. Alternative 4 Applied to the Project Study Area**

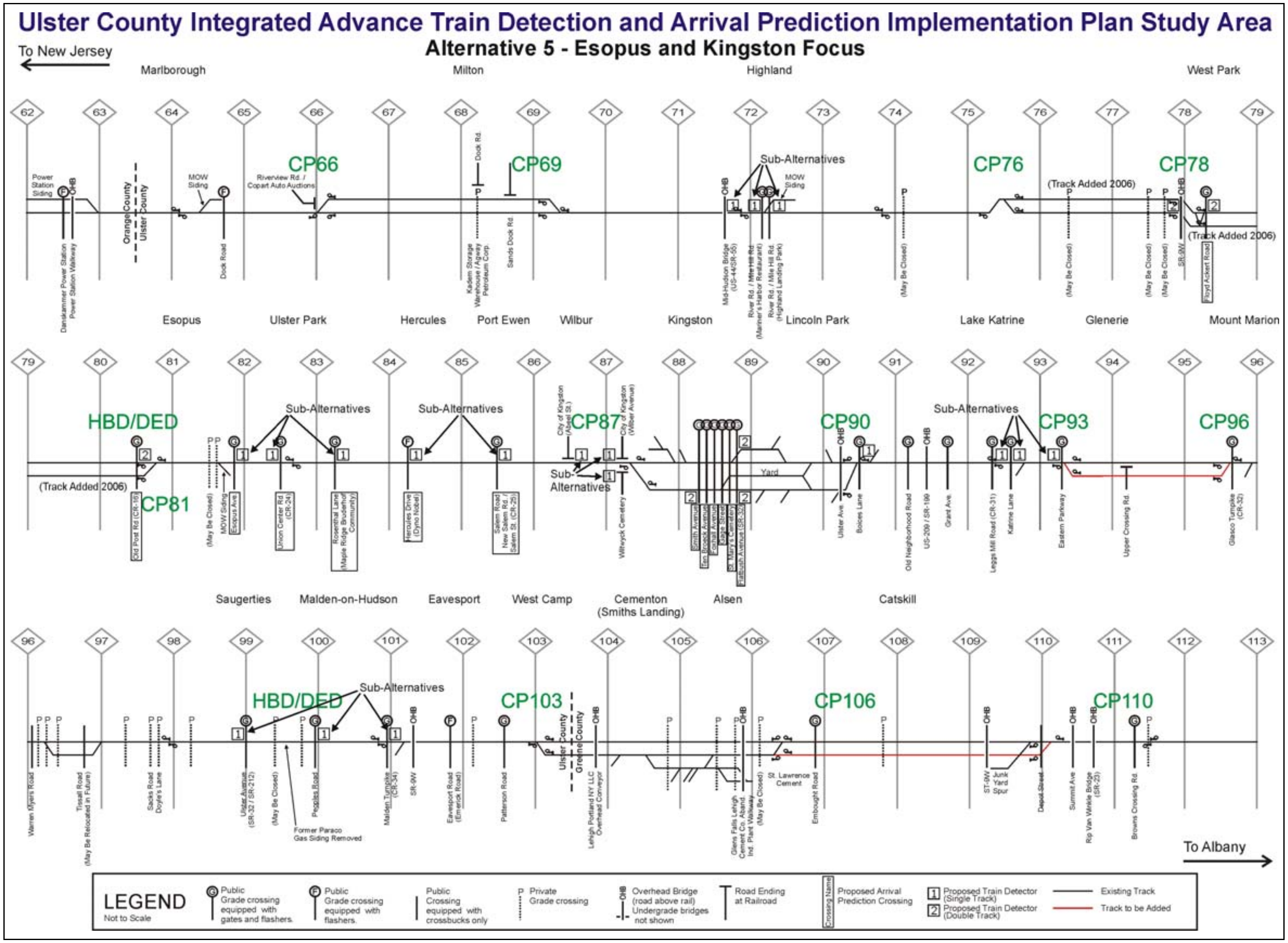


**Figure 7-5. Alternative 5 Applied to the Project Study Area**

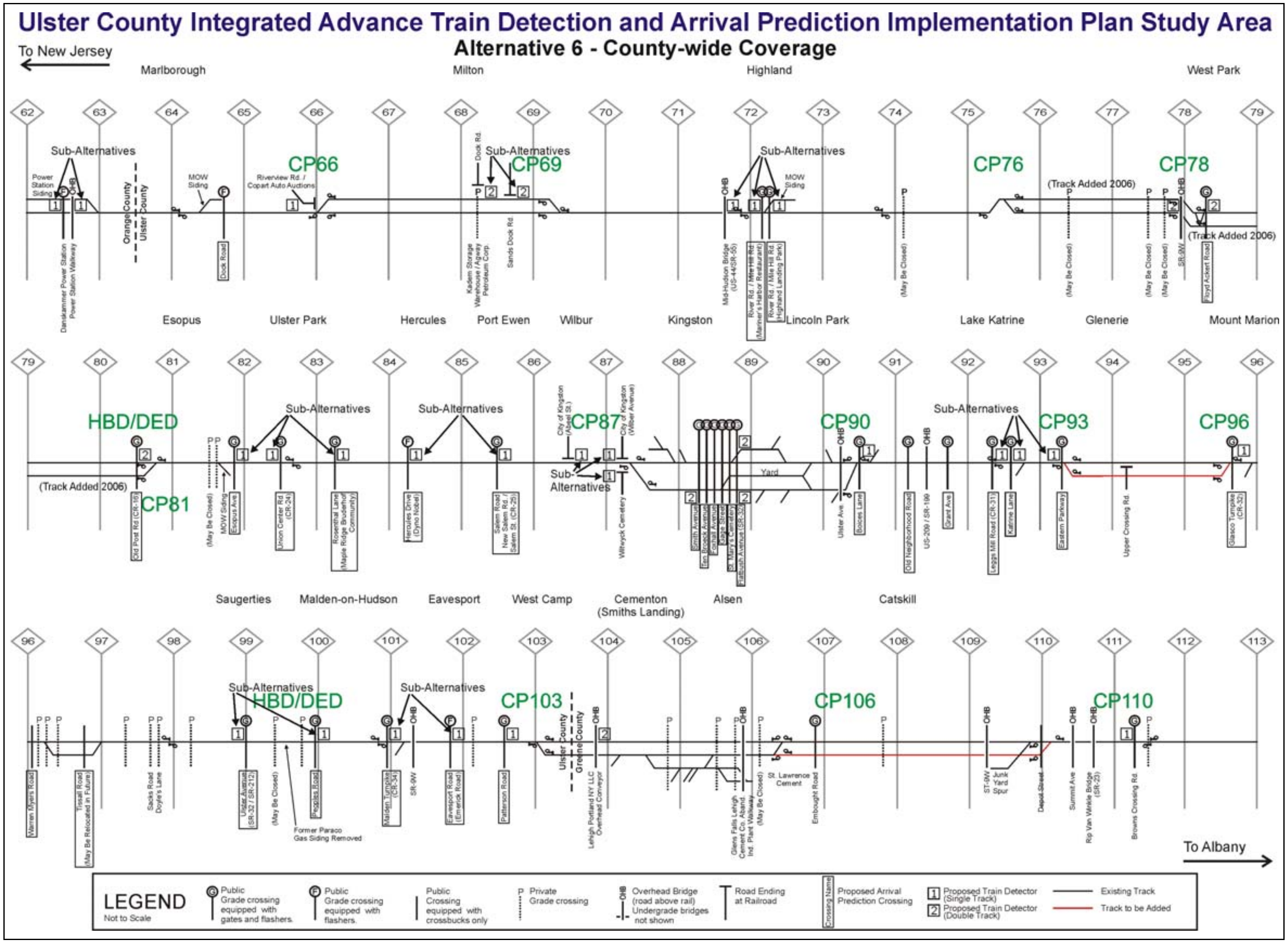


**Figure 7-6. Alternative 6 Applied to the Project Study Area**

In Alternative 1, train detector locations are included at Flatbush Avenue and at Smith Avenue for software "feedback" calibration purposes and to detect trains that may be holding on one of the tracks while a CSX train in the opposite direction passes. Alternative 1 also includes one future train detector location at Eastern Parkway, needed after the proposed NYSDOT-funded passing siding between CP93 and CP96 is constructed. In total, 11 to 12 train detector locations (depending on the sub-alternative choice within the Town of Esopus) are required in Alternative 1, as summarized in the table below.

## Table 7-2. Proposed Train Sensor Locations by Alternative

| Alternative | | | |
|---|---|---|---|
| | **1 (Kingston Focus)** | Min | 11 |
| | | Max | 12 |
| | **2 (Saugerties Focus)** | Min | 8 |
| | | Max | 8 |
| | **3 (Esopus Focus)** | Min | 11 |
| | | Max | 11 |
| | **4 (Kingston and Saugerties Focus)** | Min | 17 |
| | | Max | 18 |
| | **5 (Esopus and Kingston Focus)** | Min | 19 |
| | | Max | 19 |
| | **6 (County-wide Coverage)** | Min | 29 |
| | | Max | 29 |

Alternative 2 provides a focus on the Town of Saugerties and eight public grade crossings spread over a seven mile segment of the CSX River Line in the northeastern portion of the County. To provide good predictive capabilities, eight detectors are required – five in Ulster County and three in Greene County. The three locations in Greene County are needed to provide sufficient advance warning times (10 minutes being the minimum required advanced warning time according to the Task 1 report) for southbound CSX trains approaching Ulster County.

Alternative 3 provides a focus on the Town of Esopus and seven public grade crossings spread over as many miles. A total of 11 sensor locations are recommended for the Esopus-focused alternative. All are located at overgrade bridge or grade crossing locations, except for the recommended sensor at CP 87 in Kingston (to detect southbound trains converging from main and siding tracks to the single track towards Esopus). As with Alternative 1, one of the two publicly-owned abutting properties or Wiltwyck Cemetery is needed as a sensor location at CP 87.

## Table 7-3. Coverage Matrix

| **Crossing Name** | **Alternative** | | | | | |
|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** |
| Dock Road | None | None | None | None | None | Fair |
| River Rd./Mile Hill Rd. (Mariner's Harbour Restaurant) | None | None | None | None | None | Fair |
| River Rd./Mile Hill Rd. (Highland Landing Park) | None | None | None | None | None | Fair |
| Floyd Ackert Road | None | None | Good | None | Good | Good |

## Table 7-3. Coverage Matrix

| Crossing Name | Alternative | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Old Post Rd (CR-16) | None | None | Good | None | Good | Good |
| Esopus Ave. | None | None | Good | None | Good | Good |
| Union Center Rd. (CR-24) | None | None | Good | None | Good | Good |
| Rosenthal Lane (Maple Ridge Bruderhof Community) | None | None | Good | None | Good | Good |
| Hercules Drive (Dyno Nobel) | None | None | Good | None | Good | Good |
| Salem Road/New Salem Rd./Salem St. (CR-25) | None | None | Good | None | Good | Good |
| Smith Avenue | Good | None | None | Good | Good | Good |
| Tenbroeck Avenue | Good | None | None | Good | Good | Good |
| Foxhall Avenue | Good | None | None | Good | Good | Good |
| Gage Street | Good | None | None | Good | Good | Good |
| St. Mary's Cemetery | Good | None | None | Good | Good | Good |
| Flatbush Avenue (SR-32) | Good | None | None | Good | Good | Good |
| Boices Lane | None | None | None | Good | None | Good |
| Old Neighborhood Lane | None | None | None | Good | None | Good |
| Grant Ave. | None | None | None | Good | None | Good |
| Leggs Mill Road (CR-31) | None | None | None | Good | None | Good |
| Katrine Lane | None | None | None | Good | None | Good |
| Eastern Parkway | None | None | None | Good | None | Good |
| Glasco Turnpike (CR-32) | None | Good | None | Very Good | None | Very Good |
| Warren Myers Rd. | None | Good | None | Very Good | None | Very Good |
| Tissall Rd. | None | Good | None | Very Good | None | Very Good |
| Ulster Avenue (SR-32/SR-212) | None | Very Good | None | Very Good | None | Very Good |
| Peoples Road | None | Very Good | None | Very Good | None | Very Good |
| Malden Turnpike (CR-34) | None | Good | None | Good | None | Good |
| Eavesport Road (Emerick Road) | None | Good | None | Good | None | Good |
| Patterson Road | None | Good | None | Good | None | Good |
| Total Score | 12 | 18 | 14 | 45 | 26 | 62 |

Alternatives 4 and 5 combine Kingston/Saugerties and Kingston/Esopus, respectively. Alternative 4 reduces the total number of sensors by two when comparing it with the total of Alternatives 1 and 2. This is because of overlap in the Boices Lane area. Similarly, Alternative 5 reduces the total number of sensors by three or four (depending on which sub-alternatives are selected) when comparing it with the total of Alternatives 1 and 3.

Alternative 6 provides maximum County coverage from border to border on the CSX River Line. It includes some 29 detector locations, including one in Orange County and three in Greene County. Even with a detector in Orange County, it will be difficult to provide a full 10 minute advance warning for northbound trains approaching Dock Road in Marlborough.

Table 7-3 summarizes the estimated predictive accuracy at each public County crossing for each of the six alternatives. A rating of “Very Good” means that an accurate (90 percent of the time) train arrival prediction ten or more minutes in advance of the train’s arrival at the crossing is assured. A rating of “Good” means that an accurate (90 percent of the time) train arrival prediction five or more minutes in advance of the train’s arrival at the crossing is assured. A rating of “Fair” means that trains in one direction or in certain circumstances (such as leaving a passing siding after meeting a train in the opposite direction or being overtaken by a train in the same direction) may not be predicted until shortly before they pass the subject crossing.

Using a rating system where “Very Good” earns three points, “Good” earns two points, “Fair” earns one point and “None” earns zero points, Alternative 6 (County-wide coverage) scores the highest benefit with 62 points. Only the three public crossings at the south end of the CSX River Line in Marlborough earn “Fair” ratings in that alternative; all other crossings have predictive accuracy ratings of “Good” or “Very Good”. The next highest scoring alternative is Alternative 4 (Kingston and Saugerties Focus) with 45 points. This Alternative covers all public crossings in the County, except for the ten crossings within the County that are south of Esopus.

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# 8. Capital Cost

SYSTRA developed estimated capital costs for each of the six alternatives, presented in the following section. They are based on the $5000 per SpeedInfo Doppler radar sensor (which includes the appropriately-sized solar panel). Installation equipment, including concrete footing, aluminum pole, cap, base, bolts, miscellaneous hardware and protective posts/stanchions, is estimated to cost $8000 per sensor. Labor for pole foundation excavation and setting of the pole is estimated to cost $4000 per sensor. Finally, installation of the sensor itself, including calibration and proper setting of the associated solar panel, is estimated to cost $5000 per sensor.

The capital cost estimates were based on the conservative assumption that sensors in multiple track territory (Flatbush Avenue in Kingston and Old Post Road in Esopus, for example) would cover only one track. In other words, two sensors are assumed to be required at these locations, complete with their own footings, poles, solar panels and mounting hardware. At these locations, it may be possible to use only one sensor, or two sensors on one pole, yielding capital cost savings when compared with the numbers below.

The capital cost estimates include a project management cost of 15% of the entire project cost. This item is to cover the cost of Ulster County personnel, as well as the possible retention of a local construction management firm to provide quality assurance of the field installation work. A 20% contingency is included in all estimates.

The single largest cost item is the development of the Train Arrival Prediction software. Since no Commercial Off-the-Shelf (COTS) application is known to exist, this software will need to be developed for the project. The software will need to process the train location data, determine direction and speed, evaluate the possibility that the train will stop at a passing siding to be passed by another train in the same or opposite direction, and predict the train arrival time at the crossing start location (gates down/flashers on) with as much advanced warning as possible. Chapter 5 presents some of the required software logic which will be detailed in greater detail in the upcoming Task 3 Implementation Plan for the project.

Each alternative was estimated to have a software application design, development, testing and deployment cost of $250,000, except for Alternative 2 (Saugerties Focus). Because Saugerties lies entirely within single track territory, the software application for this alternative would be considerably less complex. As such, the cost was estimated at $150,000. It should be noted that, should Alternative 2 be chosen for implementation, additional software cost would need to be budgeted if the County subsequently upgraded to any of the other alternatives' coverage areas.

## 8.1. Capital Cost Estimates

### Table 8-1. Summary of Capital Cost by Alternative

| Alternative | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Coverage | Kingston Focus | Saugerties Focus | Esopus Focus | Kingston and Saugerties Focus | Esopus and Kingston Focus | County-wide Coverage |
| Sensors | 12 | 8 | 11 | 18 | 19 | 29 |
| Sensor Capital Cost | $60,000 | $40,000 | $55,000 | $90,000 | $95,000 | $145,000 |
| Field Mounting Equipment | $96,000 | $64,000 | $88,000 | $144,000 | $152,000 | $232,000 |
| Pole Foundations and Setting Labor | $48,000 | $32,000 | $44,000 | $72,000 | $76,000 | $116,000 |
| Field Mounting Labor | $60,000 | $40,000 | $55,000 | $90,000 | $95,000 | $145,000 |
| Communications/Web-Based Data Server Charges for First Year | $14,400 | $9,600 | $13,200 | $21,600 | $22,800 | $34,800 |
| Computer Web-Based Servers | $12,000 | $12,000 | $12,000 | $12,000 | $12,000 | $12,000 |
| Terminals/Workstations | $6,000 | $6,000 | $6,000 | $6,000 | $6,000 | $6,000 |
| Software Development/Testing/Acceptance | $250,000 | $150,000 | $250,000 | $250,000 | $250,000 | $250,000 |
| Training and Documentation | $60,000 | $60,000 | $60,000 | $60,000 | $60,000 | $60,000 |
| Sub-Total Hardware and Software | $606,400 | $413,600 | $583,200 | $745,600 | $768,800 | $1,000,800 |
| Project Management (15%) | $90,960 | $62,040 | $87,480 | $111,840 | $115,320 | $150,120 |
| Total Project Cost | $697,360 | $475,640 | $670,680 | $857,440 | $884,120 | $1,150,920 |
| Contingency (20%) | $139,472 | $95,128 | $134,136 | $171,488 | $176,824 | $230,184 |
| Total Project Cost with Contingency | $836,832 | $570,768 | $804,816 | $1,028,928 | $1,060,944 | $1,381,104 |

Estimated capital costs range from $571,000 for Alternative 2 (Saugerties Focus) to $1,381,000 for Alternative 6 (County-wide coverage). These include project management and contingency.

## 8.2. Annual Operating Cost

Annual operating costs for the six alternatives are shown below. The SpeedInfo annual charges are $1200 per device, though discounts are available should Ulster County enter into a multi-year support contract. It was assumed that the computer servers would be replaced every four years and the terminals/workstations every three years. Software maintenance in the form of supporting updated operating systems and minor functional enhancements was estimated as 20% of the initial software development cost. A small on-going training budget for new users is included, as is a 20% contingency and a 15% project management allocation. The project management time would be allocated to an Ulster County employee in the Information Technology or Planning Departments.

### Table 8-2. Summary of Operating Cost by Alternative

| Alternative | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Coverage | Kingston Focus | Saugerties Focus | Esopus Focus | Kingston and Saugerties Focus | Esopus and Kingston Focus | County-wide Coverage |
| Sensors | 12 | 8 | 11 | 18 | 19 | 29 |
| Sensor Operating Cost | $14,400 | $9,600 | $13,200 | $21,600 | $22,800 | $34,800 |
| Computer Servers | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 | $3,000 |
| Terminals/Workstations | $2,000 | $2,000 | $2,000 | $2,000 | $2,000 | $2,000 |
| Software Maintenance | $50,000 | $30,000 | $50,000 | $50,000 | $50,000 | $50,000 |
| Training | $10,000 | $10,000 | $10,000 | $10,000 | $10,000 | $10,000 |
| Sub-Total Hardware and Software | $79,400 | $54,600 | $78,200 | $86,600 | $87,800 | $99,800 |
| Project Management (15%) | $11,910 | $8,190 | $11,730 | $12,990 | $13,170 | $14,970 |
| Total Project Operating Cost | $91,310 | $62,790 | $89,930 | $99,590 | $100,970 | $114,770 |
| Contingency (20%) | $18,262 | $12,558 | $17,986 | $19,918 | $20,194 | $22,954 |
| Total Project Operating Cost with Contingency | $109,572 | $75,348 | $107,916 | $119,508 | $121,164 | $137,724 |

Estimated annual maintenance costs for the project range from $75,000 for Alternative 2 (Saugerties) to $138,000 for Alternative 6 (County wide).

## 8.3. Capital Cost/Benefit Score Ratios

### Table 8-3. Summary of Cost/Benefit Count by Alternative

| Alternative | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Coverage | Kingston Focus | Saugerties Focus | Esopus Focus | Kingston and Saugerties Focus | Esopus and Kingston Focus | County-wide Coverage |
| Sensors | 12 | 8 | 11 | 18 | 19 | 29 |
| Total Project Cost with Contingency | $836,832 | $570,768 | $804,816 | $1,028,928 | $1,060,944 | $1,381,104 |
| Benefit Count | 12 | 18 | 14 | 45 | 26 | 62 |
| Cost/Benefit Count Ratio | 69736 | 31709 | 57487 | 22865 | 40806 | 22276 |

Quantifying the benefits of the Train Arrival Prediction System is difficult. The system will improve response time to police, fire and ambulance incidents. In the future, the system could be expanded to inform County public transit providers and even school bus operators of crossings that are blocked or about to be blocked for little incremental cost. However, assigning dollar values to these benefits is not possible, especially because the primary benefit is one of improved County safety – not efficiency.

To assess the relative strengths and weaknesses of the six alternatives, a summary of Cost/Benefit Count by Alternative was developed. This divides the estimated capital cost by the benefit count, which is a quantification of which public grade crossings in the County are covered by the alternative and how robust the predictive nature of the system will be at each of those crossings. Not surprisingly, the most expensive alternative (Alternative 6 – County-wide coverage) scores the best, (lowest Cost/Benefit Count Ratio) revealing the strong per-crossing cost efficiencies of a larger project. Interestingly, Alternative 4 (Kingston and Saugerties Focus) scores second best, despite the fact that this alternative has a somewhat lower capital cost than Alternative 5.

# 9. Functional Requirements

As was noted in the previous chapter, the custom-written software for the Ulster County Integrated Advance Train Detection and Arrival Prediction System represents the single largest cost of the project. The estimated cost of the software reflects the projected complexity of logic that can handle the great variety of CSX operating scenarios on the River Line.

Table 9-1 below details "basic" operating scenarios on the River Line, including single train operation, multiple train operation involving two trains "meeting" (passing in the same or opposite directions) and complex multiple train operation involving three trains. There are 48 site-specific operating scenarios within the County that must be addressed within these three broad categories. Of course, there may be additional CSX trains on-line within the County at any given time, but a properly-designed parametric software application that successfully predicts train arrival times for the 48 site-specific operating scenarios will be able to handle the more complex scenarios as well.

**Table 9-1. Summary of Scenario Alternatives**

| Scenario | Direction | Type | Routing | Meet/Overtake Location(s) | No. of Trains |
|---|---|---|---|---|---|
| 1 | N | Single | NA | NA | 1 |
| 2 | S | Single | NA | NA | 1 |
| 3 | N | Single | NA | NA | 1 |
| 4 | S | Single | NA | NA | 1 |
| 5 | N | Single | NA | NA | 1 |
| 6 | S | Single | NA | NA | 1 |
| 7 | Both | Meet | RH | CP66/69 | 2 |
| 8 | N | Single | NA | NA | 1 |
| 9 | S | Single | NA | NA | 1 |
| 10 | Both | Meet | LH | CP66/69 | 2 |
| 11 | Both | Meet | RH | CP87/90 | 2 |
| 12 | Both | Meet | LH | CP87/90 | 2 |
| 13 | Both | Meet | RH | CP93/96 | 2 |
| 14 | Both | Meet | LH | CP93/96 | 2 |
| 15 | Both | Meet | RH | CP103/106 | 2 |
| 16 | Both | Meet | LH | CP103/106 | 2 |
| 17 | Both | Meet | RH | CP103/110 | 2 |
| 18 | Both | Meet | LH | CP103/110 | 2 |
| 19 | Both | Meet | RH | CP106/110 | 2 |
| 20 | Both | Meet | LH | CP106/110 | 2 |
| 21 | Both | Meet | RH | CP76/78 | 2 |
| 22 | Both | Meet | LH | CP76/78 | 2 |
| 23 | Both | Meet | RH | CP76/81 | 2 |
| 24 | Both | Meet | LH | CP76/81 | 2 |
| 25 | Both | Meet | RH | CP78/81 | 2 |
| 26 | Both | Meet | LH | CP78/81 | 2 |
| 27 | N | Overtake | NA | CP66/69 | 2 |

## Table 9-1. Summary of Scenario Alternatives

| Scenario | Direction | Type | Routing | Meet/Overtake Location(s) | No. of Trains |
|---|---|---|---|---|---|
| 28 | N | Overtake | NA | CP76/78 | 2 |
| 29 | N | Overtake | NA | CP78/81 | 2 |
| 30 | N | Overtake | NA | CP76/81 | 2 |
| 31 | N | Overtake | NA | CP87/90 | 2 |
| 32 | N | Overtake | NA | CP93/96 | 2 |
| 33 | N | Overtake | NA | CP103/106 | 2 |
| 34 | N | Overtake | NA | CP106/110 | 2 |
| 35 | N | Overtake | NA | CP103/110 | 2 |
| 36 | S | Overtake | NA | CP106/110 | 2 |
| 37 | S | Overtake | NA | CP103/106 | 2 |
| 38 | S | Overtake | NA | CP103/110 | 2 |
| 39 | S | Overtake | NA | CP93/96 | 2 |
| 40 | S | Overtake | NA | CP87/90 | 2 |
| 41 | S | Overtake | NA | CP78/81 | 2 |
| 42 | S | Overtake | NA | CP76/78 | 2 |
| 43 | S | Overtake | NA | CP76/81 | 2 |
| 44 | S | Overtake | NA | CP66/69 | 2 |
| 45 | Both | Meet & Overtake | RH | CP76/78, CP76/81 | 3 |
| 46 | Both | Meet & Overtake | RH | CP78/81, CP76/81 | 3 |
| 47 | Both | Meet & Overtake | RH | CP103/106,CP103/110 | 3 |
| 48 | Both | Meet & Overtake | RH | CP106/110, CP103/110 | 3 |

The recommended system hardware architecture is shown in Figure 9-1. It identifies those hardware components that exist and those that need to be acquired to support the Advance Train Detection and Arrival Prediction System. Communications with other systems are via the System's web server, with potential links to the Hudson Valley Transportation Management Center in Hawthorne, NY, Ulster County public transit providers and Ulster County emergency responders above and beyond the initial deployment at the Ulster County 911 Center. These connections would use broadband Internet communications already in place.

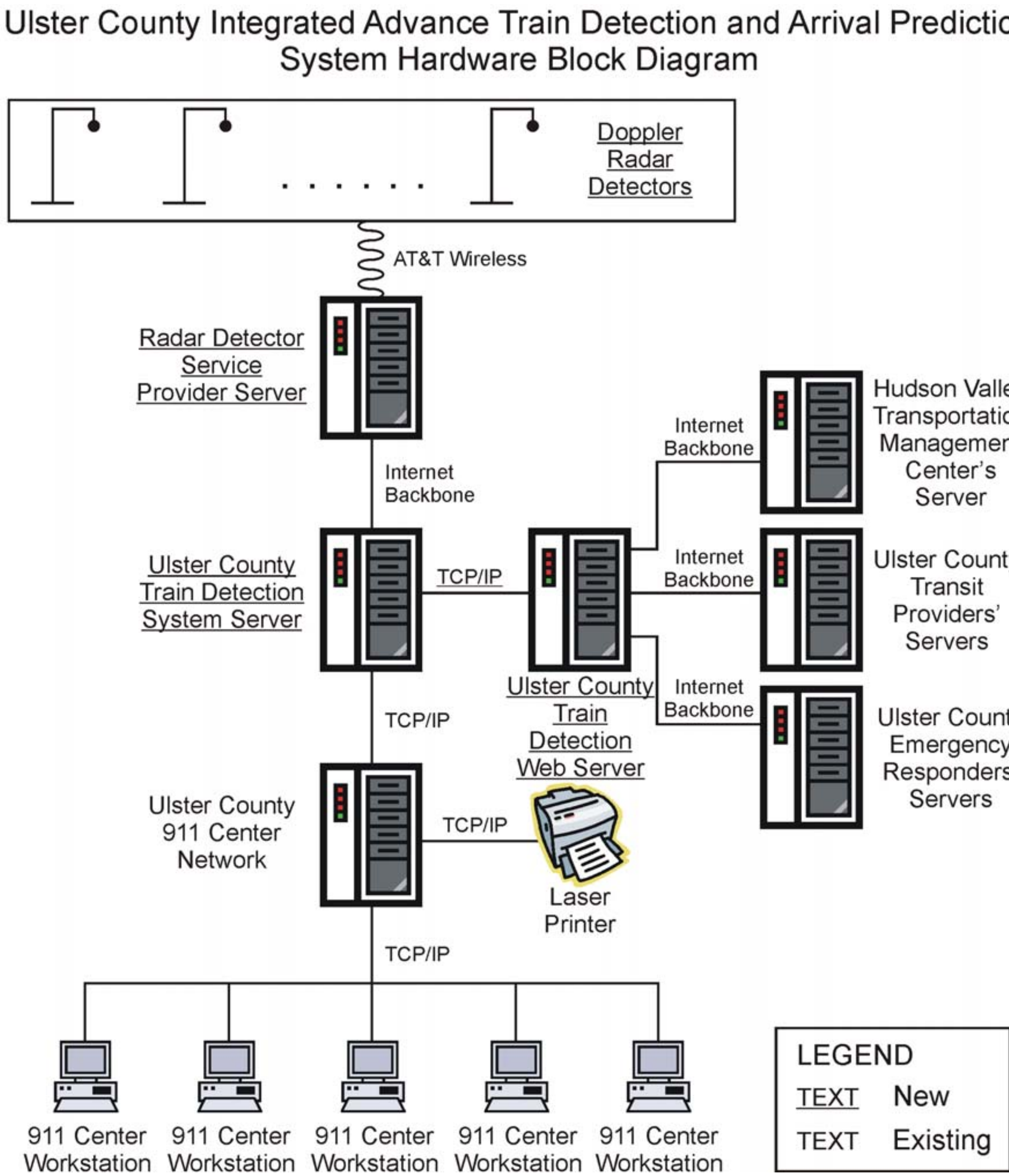


**Figure 9-1. Recommended System Hardware Architecture**

The recommended system software architecture is shown in Figure 9-2. It shows eight independent software processes ("threads") that communicate with each other using an internal messaging system. The Train Detection Process is responsible for interpreting messages received from the Doppler Radar service provider and performing required message correction or deletion when out-of-range or incorrect syntax messages are received. The Infrastructure Database Process would load the database definitions of the grade crossings locations, the track topology, the train detection locations and train maximum authorized speed information (including any temporary speed restrictions established by the system administrator). These two processes would feed the Real Time Monitor Process that would associate the Doppler Radar service provider data with specific sites along the railroad. This, in turn, would be passed to Train Arrival Prediction Process, which would compute the actual train arrival estimates at each crossing. These predictions would be output to a log file (the Events Log Process) for later diagnostic analysis, if desired, and also to the Emergency Responder Display Process. This process would generate the graphical and tabular displays shown as examples in Figure 9-4 through Figure 9-6. It would also provide for interface to the Hudson Valley TMC via the ITS Interface Process, which would use message structures such as Extensible Markup Language (XML) to communicate updates in ITS-compatible message structures. This same ITS Interface Process could be used to interface with other systems, such as on-demand public transit provider dispatch centers.

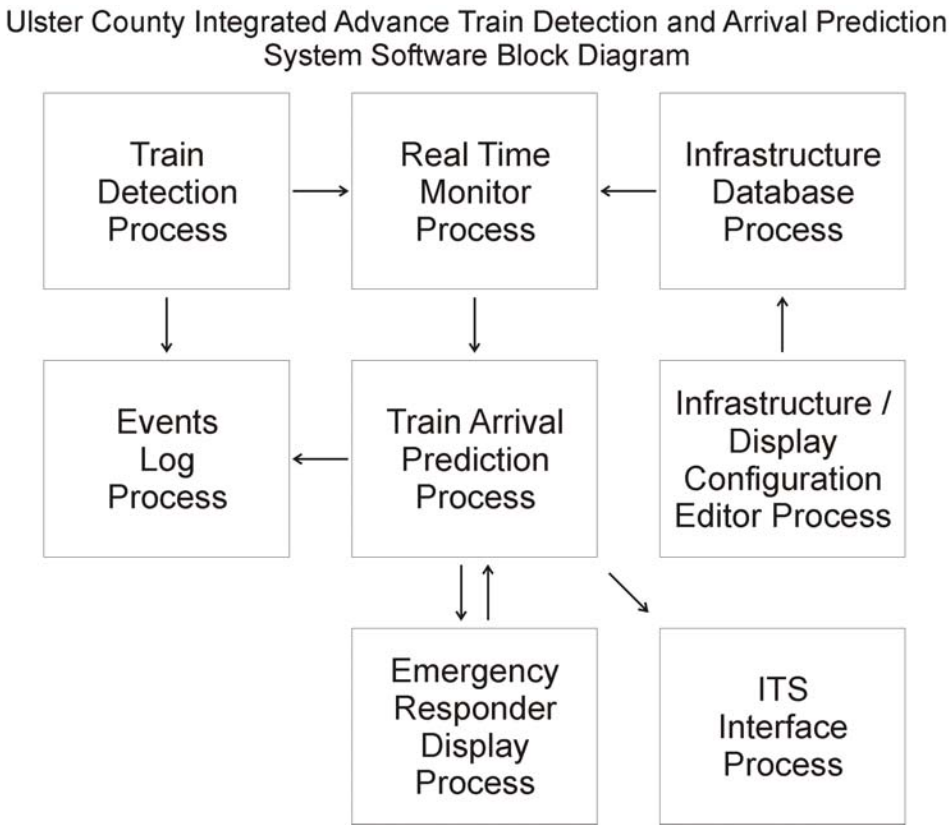


**Figure 9-2. Recommended System Software Architecture**

Based on inputs from Ulster County Emergency Management, SYSTRA developed several prototype software screens for the system. These include both graphical and tabular displays. The Emergency Responder Display Process would allow a virtually unlimited number of concurrent displays (subject to screen resolution, computer memory and CPU power constraints) showing different areas of the County in different displays. For example, one window could show a County graphical overview, one window could show a zoomed-in view of one community and a third window could show a tabular display that could be scrolled to show the entire County grade crossing inventory.

Ulster County Advance Train Detection and Arrival Prediction System [View: System Tabular]

File Edit View Options Window Help

| ID | Crossing | Status | Estimated Time to Block | Estimated Time to Clear | Municipality | AAR/CSX ID | CSX Milepost |
|---|---|---|---|---|---|---|---|
| 29 | SMITH AVE. | Clear | | | CITY OF KINGSTON | 507093B | 88.3 |
| 30 | TENBROECK AVE. | Blocked | | 0:00:10 | CITY OF KINGSTON | 507092U | 88.4 |
| 31 | FOXHALL AVENUE | Blocked | | 0:00:16 | CITY OF KINGSTON | 507091M | 88.5 |
| 32 | GAGE ST | Blocked | | 0:00:22 | CITY OF KINGSTON | 507090F | 88.6 |
| 33 | ST. MARY'S CEMETERY | Blocked | | 0:00:27 | CITY OF KINGSTON | 507089L | 88.7 |
| 34 | FLATBUSH AVE. (SR-32) | Blocked | | 0:00:32 | CITY OF KINGSTON | 507088E | 88.8 |
| 36 | BOICES LANE | Train Approaching | 0:01:47 | 0:03:53 | TOWN OF ULSTER (LAKE KATRINE) | 507086R | 90.5 |
| 37 | OLD NEIGHBORHOOD LANE | Train Approaching | 0:02:43 | 0:04:58 | TOWN OF ULSTER (LAKE KATRINE) | 507085J | 91.2 |
| 39 | GRANT AVENUE | Train Approaching | 0:03:32 | 0:06:12 | TOWN OF ULSTER | 914899A | 91.86 |
| 40 | LEGGS MILL RD. (CR-31) | Train Approaching | 0:04:18 | 0:06:57 | TOWN OF ULSTER | 842689J | 92.34 |
| 41 | KATRINE LANE | Train Approaching | 0:04:28 | 0:07:07 | TOWN OF ULSTER | 842688C | 92.6 |
| 42 | EASTERN PARKWAY | Train Approaching | 0:05:32 | 0:08:11 | TOWN OF ULSTER | 842687V | 93.32 |
| 43 | GLASCO TURNPIKE | Clear | | | TOWN OF SAUGERTIES | 842686N | 95.71 |
| 44 | WARREN MYERS RD. | Clear | | | TOWN OF SAUGERTIES | 842685G | 95.97 |

For Help, press F1 | Time Format: Time Until Event | Warning Threshold: 00:10:00 | Current Time: 10:22:23

**Figure 9-3. Typical System Software Screen Showing Tabular Display and "Time to Go" Information.**

Ulster County Advance Train Detection and Arrival Prediction System [View: System Tabular]

File Edit View Options Window Help

| ID | Crossing | Status | Estimated Time to Block | Estimated Time to Clear | Municipality | AAR/CSX ID | CSX Milepost |
|---|---|---|---|---|---|---|---|
| 29 | SMITH AVE. | Clear | | | CITY OF KINGSTON | 507093B | 88.3 |
| 30 | TENBROECK AVE. | Blocked | | 10:22:33 | CITY OF KINGSTON | 507092U | 88.4 |
| 31 | FOXHALL AVENUE | Blocked | | 10:22:39 | CITY OF KINGSTON | 507091M | 88.5 |
| 32 | GAGE ST | Blocked | | 10:22:45 | CITY OF KINGSTON | 507090F | 88.6 |
| 33 | ST. MARY'S CEMETERY | Blocked | | 10:22:50 | CITY OF KINGSTON | 507089L | 88.7 |
| 34 | FLATBUSH AVE. (SR-32) | Blocked | | 10:22:55 | CITY OF KINGSTON | 507088E | 88.8 |
| 36 | BOICES LANE | Train Approaching | 10:24:10 | 10:26:16 | TOWN OF ULSTER (LAKE KATRINE) | 507086R | 90.5 |
| 37 | OLD NEIGHBORHOOD LANE | Train Approaching | 10:25:06 | 10:27:21 | TOWN OF ULSTER (LAKE KATRINE) | 507085J | 91.2 |
| 39 | GRANT AVENUE | Train Approaching | 10:25:55 | 10:28:35 | TOWN OF ULSTER | 914899A | 91.86 |
| 40 | LEGGS MILL RD. (CR-31) | Train Approaching | 10:26:41 | 10:29:20 | TOWN OF ULSTER | 842689J | 92.34 |
| 41 | KATRINE LANE | Train Approaching | 10:26:51 | 10:29:30 | TOWN OF ULSTER | 842688C | 92.6 |
| 42 | EASTERN PARKWAY | Train Approaching | 10:27:55 | 10:30:34 | TOWN OF ULSTER | 842687V | 93.32 |
| 43 | GLASCO TURNPIKE | Clear | | | TOWN OF SAUGERTIES | 842686N | 95.71 |
| 44 | WARREN MYERS RD. | Clear | | | TOWN OF SAUGERTIES | 842685G | 95.97 |

For Help, press F1 | Time Format: Predicted Times | Warning Threshold: 00:10:00 | Current Time: 10:22:23

**Figure 9-4. Typical Software Screen Showing Tabular Display and "Wall Clock Time" Information.**

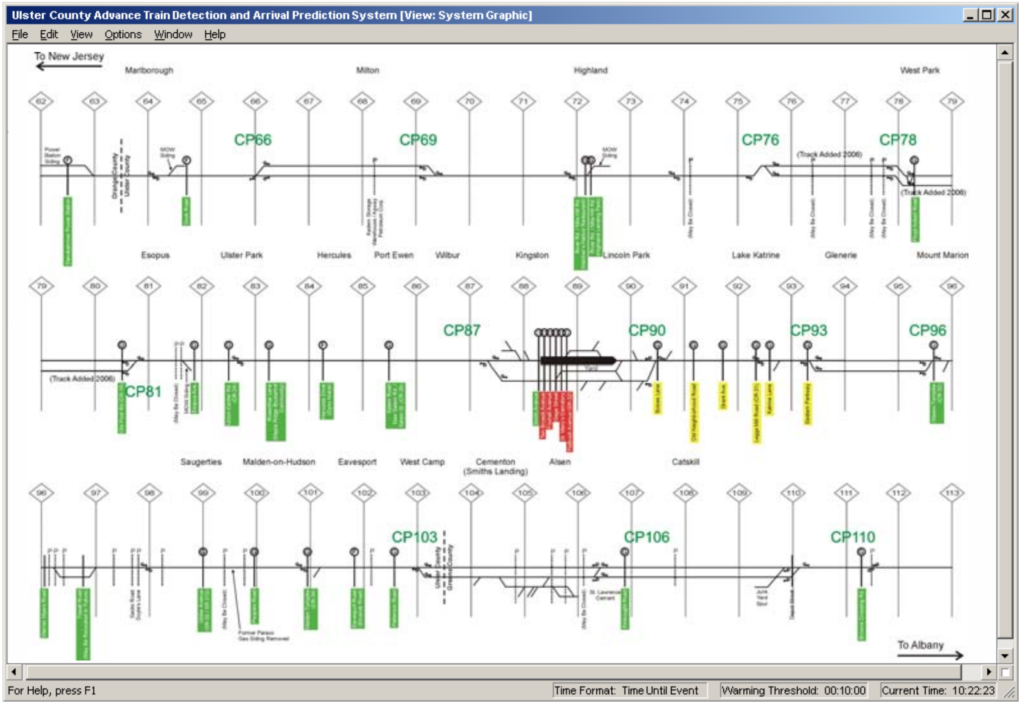


**Figure 9-5. Typical Software Screen Showing Graphical System Overview with Color-Coded Grade Crossing Predictive Status**

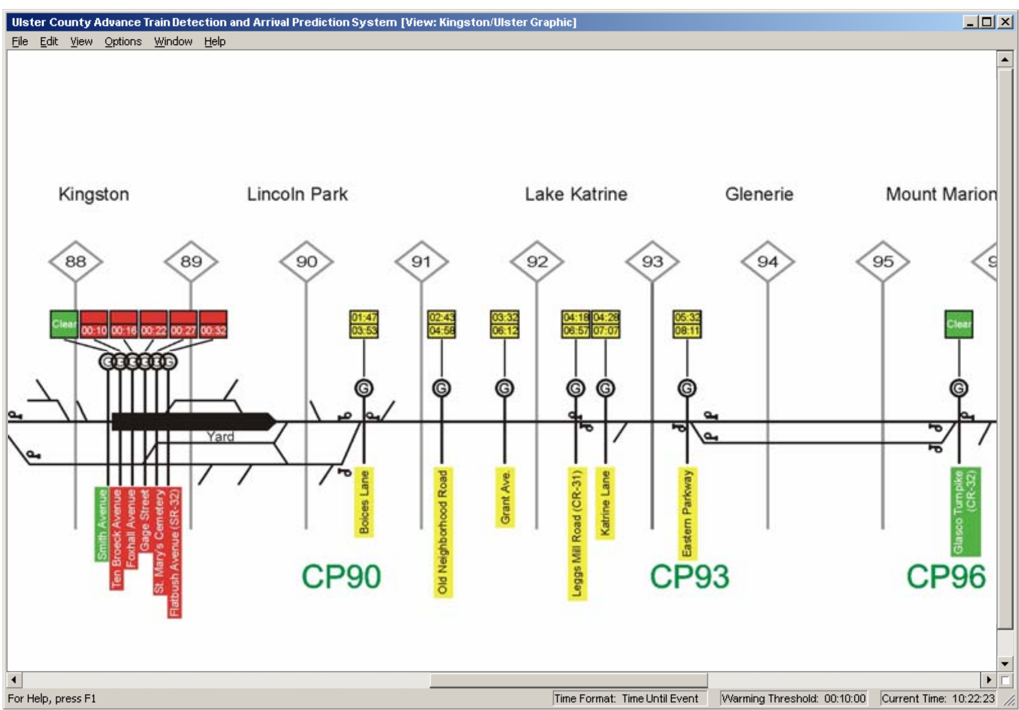


**Figure 9-6. Typical Software Screen Showing Graphical System Zoom with Color-Coded Grade Crossing Predictive Status and "Time to Go" Predictive Information in Text Boxes**

Throughout the system, standard colors would be used to show grade crossing status. Green indicates that the crossing is not occupied by a train or about to be occupied within the advance train arrival prediction window (a user variable with a default value of 10 minutes). Yellow indicates that a crossing is predicted to be occupied (or gates/flashers about to be initiated) within the train arrival prediction window. Red indicates that the crossing is currently occupied. Additional colors may be needed to show crossings where train arrival times cannot be reliably predicted because of lack of system deployment and because of hardware/communications failures.

Figure 9-6 shows a black rectangular train symbol; it is important to recognize that the symbol is approximation only. The “tail” of the train would be shown halfway between the last crossing predicted to be unoccupied and the last crossing predicted to be occupied in the direction of travel. The “nose” of the train would be shown halfway between the last crossing predicted to be occupied and the first crossing ahead of the train predicted to be unoccupied in the direction of travel.

A means will be required for Dispatchers to manually indicate crossings are clear (based on a radio communication from an emergency responder, for example) where a train detection device is malfunctioning or where detector coverage does not precisely correspond with a given crossing.

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# 10. Implementation Plan

Consistent with the direction received from the Ulster County Transportation Council on November 16, 2007, Alternative 6 is recommended for implementation. The UCTC meeting included Council staff, representatives of SYSTRA and sub-consultant Dewkett Engineering, New York State DOT Rail Programs, New York State Thruway Authority, the Town of Saugerties, the Town of Ulster, the County Fire Coordinator, the County Department of Public Works and the Ulster County 911 Center.

The following implementation plan is recommended:

1. Ratify the recommended train detection technology (Doppler radar)

2. Ratify the recommended alternative (Alternative 6 – County-wide Deployment).

3. Identify construction funding for the project.

4A. Research the legal issues associated with locating poles and other train detection equipment on public road crossings of the CSX right-of-way.

4B. Concurrently, negotiate with private landowners for permission to construct poles for train detection equipment at the few key County locations that do not offer ready access to the CSX right-of-way from public road crossings or parallel roads.

5. Draft the required Request for Proposal or Request for Bid document in consultation with the Ulster County Purchasing Department,

6. Identify a responsible department that will serve as owner and maintainer of the system (candidates include Ulster County Emergency Management and Ulster County Information Technology).

7. Organize a Selection Committee to select a vendor/system integrator,

8. Select the vendor/system integrator and negotiate contract,

9. Manage the construction of the project’s hardware,

10. Manage and test the project’s software implementation,

11. Train the system’s initial users and associated emergency responders at the County 911 Center,

12. Train the system’s hardware and software maintainers, and

13. Identify funding for the system’s recurring maintenance.

With respect to Step 11 of the Implementation Plan, training must encompass both emergency dispatchers (starting with the initial users at the Ulster County 911 Center) and emergency responders. Of course, County emergency responders understand that they must always obey warning devices and never drive around gate arms that are in the down position or pass grade crossing flashers that are flashing. Since the proposed Advance Train Detection and Arrival Prediction System will not be connected to the railroad signal system, the emergency dispatcher will not know exactly what the trains are doing at all times. The emergency dispatcher will advise the emergency responders to use an alternate highway-rail grade crossing, which the System has predicted is clear of trains (and approaching trains).

NYSDOT has expressed concern that, should a train reverse direction and activate a warning devices for the alternate highway-rail grade crossing, the responding emergency team would arrive at the alternate highway-rail grade crossing to find that is not passable. NYSDOT expressed concern that the responding emergency team could attempt to go around the gates because they were notified by the emergency dispatcher that the alternate highway-rail grade crossing is not occupied (or has been cleared). The training program for emergency responders will identify the predicted accuracy of the system and note that unusual railroad operating conditions could result in the scenario described above. The training program will reinforce the present strict guidelines designed to prevent such highway-rail crossing gate/flasher violations.

## 10.1. Project Schedule

The proposed schedule for project implementation is shown in Figure 10-1.

## Ulster County Integrated Advance Train Detection and Arrival Prediction Implementation Plan – Recommended Implementation Schedule

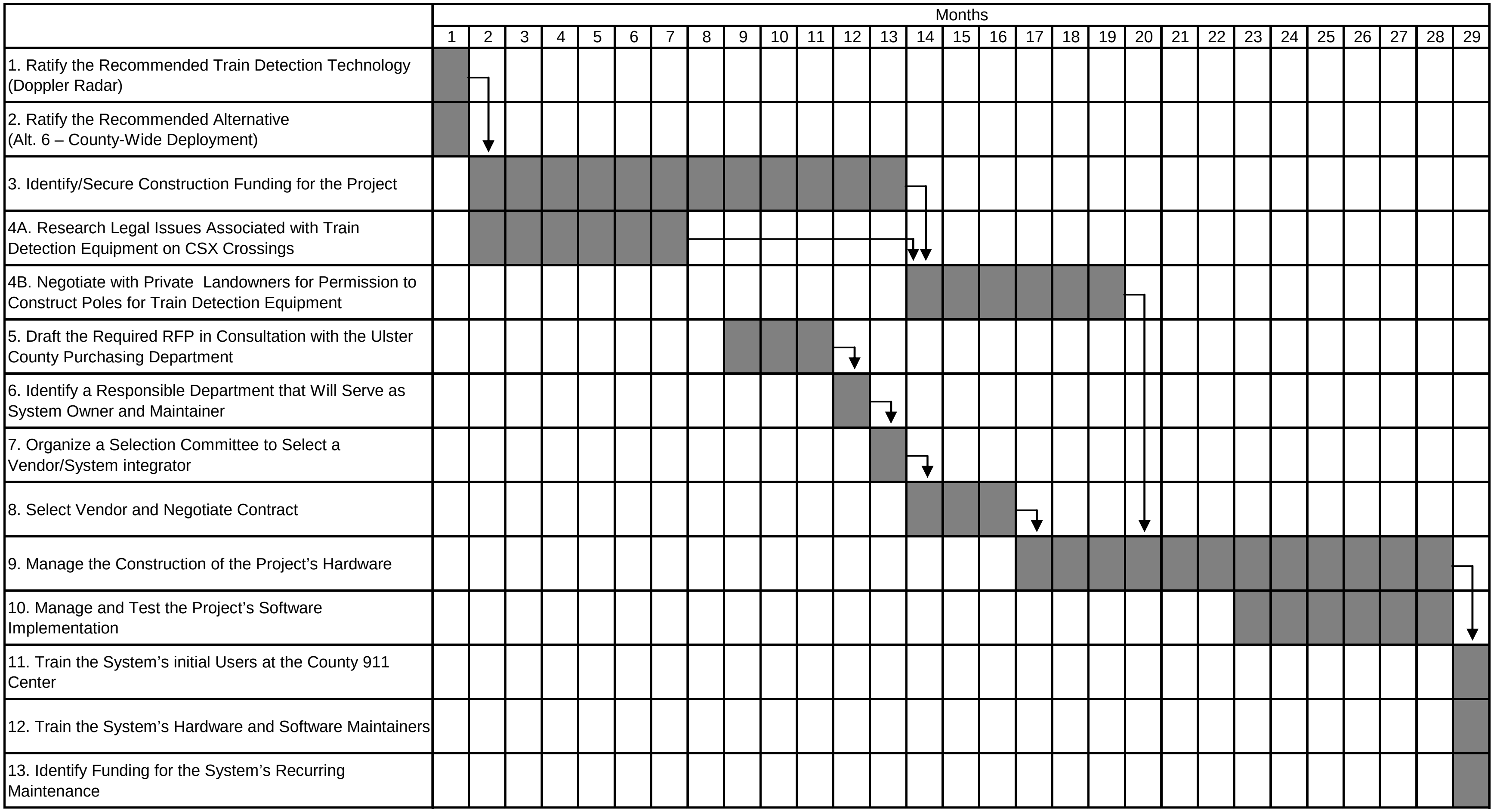


**Figure 10-1. Typical Software Screen Showing Graphical System Zoom with Color-Coded Grade Crossing Predictive Status and "Time to Go" Predictive Information in Text Boxes**

## 10.2. Project Funding

Potential funding for the project may be available from the New York State Department of Transportation's Rail Freight Bureau (NYSDOT), from the Federal Railroad Administration (FRA) and from the New York State Energy Research and Development Authority (NYSERDA).

NYSDOT funding sources include the New York State Rail Freight and Passenger Rail Assistance Program, which is financed by the State's five-year transportation capital program. The funds can be used for track and bridge improvements, grade crossing eliminations or upgrades, construction of inter-modal facilities, and the provision of passenger service subsidies. NYSDOT funding is presumably available for a project such as the Integrated Advance Train Detection and Arrival Prediction Implementation Plan in that it serves as a lower-cost alternative to grade crossing elimination.

Potential FRA funding stems from those authorized in Title 23 United States Code (23 U.S.C.) Section 130 (which are called "Section 130 funds"), and from periodic Transportation Bills, such as the "Transportation Equity Act for the 21st Century" ("TEA-21") and its successor, the "Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users" or "SAFETEA-LU". SAFETEA-LU was signed into law on August 10, 2005 and discussions have been on-going in Congress regarding successor legislation. These programs allocate money to the States specifically for eliminating hazards at public highway-railroad grade crossings (Federal highway funds cannot be spent on safety improvements at private rail crossings). The FHWA also administers the distribution of Section 130 funds.

The amount of federal grade crossing improvement funding available has remained relatively unchanged, typically varying from $140 million to $155 million per year. The Section 130 funds for grade-crossing safety improvements are available at a 90 percent Federal share, with the remaining 10 percent to be paid by State and/or local authorities and/or the railroad. The Federal share may amount to 100 percent for the following projects: signing; pavement markings; active warning devices; the elimination of hazards; and crossing closures. The decision on whether to allow 100 percent Federal funding rests with the individual States.

At least half of a State's Section 130 funds must be used for installing what FHWA has defined as protective devices: the installation of standard signs and pavement markings; the installation or replacement of active warning devices; upgrading active warning devices, including track circuit improvements and interconnections with highway traffic signals; crossing illumination; crossing surface improvements; and general site improvements. The remaining funds may be spent on additional protective devices, or on other safety improvements including sight-distance improvements, crossing closures or consolidations, or roadway bridges over the railroad tracks.

Since the beginning of the Section 130 Program in 1974, approximately $3.8 billion has been obligated for grade-crossing improvements. Discussions with NYSDOT and the FRA are warranted to determine if the Integrated Advance Train Detection and Arrival Prediction System is eligible for Section 130 or other federal grade crossing improvement funds.

NYSERDA offered up to $4 million in funding for projects that support the development, demonstration and commercialization of innovative transportation products, systems and services in

New York State in 2007. It advertises the availability of funding through periodic "Program Opportunity Notices". Additional selection rounds and awards are expected in September, 2008. Selection is made through competitive proposal and it appears that the Integrated Advance Train Detection and Arrival Prediction System is eligible for such funding.

It is not anticipated that CSX will offer any funding for the Integrated Advance Train Detection and Arrival Prediction System.

## 10.3. Optional Steps

As an optional step, the County may wish to consider an interim test of the Doppler train detection technology at one location prior to awarding the overall project. The County may also wish to engage a construction management firm to oversee the installation, testing and deployment of the system, working on behalf of the Project.

As another optional step, the County may wish to consider "piggybacking" digital video camera with the Doppler radar sensors at selected or all crossings. This would require a broadband Internet connection at the sensor poles, which is not a requirement of the Doppler radar system itself (which uses the AT&T cell phone network for communication). Digital video camera feeds, similar to the existing Kingston Fire Department application at Foxhall Avenue, would support other types of railroad-related incident management in the County. It would not, by itself, provide for the predictive capabilities desired in the Integrated Advance Train Detection and Arrival Prediction Implementation Plan. Cost of "piggybacked" digital video equipment and the necessary broadband communication network are not included in the project's capital cost estimates.

# 11. Conclusions and Recommendations

The Doppler radar-based train detection technology is recommended for application to the Advanced Train Detection and Arrival Prediction Project. The capabilities of this technology provide the most comprehensive set of train performance attribute data feeds with good manufacturer support and reasonable capital cost. The built-in wireless communications devices and "data warehouse" services bundled with the hardware are an attractive feature. The integrated solar panel power supply also makes the Doppler radar-based train detection technology straight-forward to implement within Ulster County.

Estimated capital costs range from $571,000 for Alternative 2 (Saugerties Focus) to $1,381,000 for Alternative 6 (County-wide coverage). These include project management and contingency. The capital cost estimates are based on the conservative assumption that two sensors are required at multiple track locations, complete with their own footings, poles, solar panels and mounting hardware. At these locations, it may be possible to use only one sensor, or two sensors on one pole, yielding capital cost savings when compared with the numbers below.

The single largest cost item is the development of the Train Arrival Prediction software. Since no Commercial Off-the-Shelf (COTS) application is known to exist, this software will need to be developed for the project. The software will process the train location data, determine direction and speed, evaluate the possibility that the train will stop at a passing siding to be passed by another train in the same or opposite direction, and predict the train arrival time at the crossing start location (gates down/flashers on) with as much advanced warning as possible.

Each alternative was estimated to have a software application design, development, testing and deployment cost of $250,000, except for Alternative 2 (Saugerties Focus). Because Saugerties lies entirely within single track territory, the software application for this alternative would be somewhat simpler to develop. As such, the cost was estimated at $150,000. It should be noted that, should Alternative 2 be chosen for implementation, additional software cost would need to be budgeted if the County subsequently upgraded to any of the other alternatives' coverage areas.

Estimated annual maintenance costs for the project range from $75,000 for Alternative 2 (Saugerties) to $138,000 for Alternative 6 (County wide).

A summary of Cost/Benefit Count by Alternative was developed to assess the relative strengths and weaknesses of the six alternatives. This divides the estimated capital cost by the benefit count, which is a tally of which public grade crossings in the County are covered by the alternative and how robust (reliable, accurate and with a minimum of 10 minutes of advance warning) the system will predict train arrivals at the covered crossings. Alternative 6, which provides for County-wide coverage, has the lowest Cost/Benefit Count ratio. It is on this basis that Alternative 6 is recommended for implementation.

An initial test of the Doppler radar detector technology at a multiple track location (Flatbush Avenue in Kingston or Old Post Road in Esopus) is recommend before the project proceeds to full implementation. This will confirm the feasibility of using this technology for train detection and will resolve whether one sensor or two is needed in multiple track territory.