TAPPAN ZEE BRIDGE/I-287
ENVIRONMENTAL REVIEW

New York State Department of Transportation
New York State Thruway Authority
Metropolitan Transportation Authority/Metro-North Railroad

EIS Methodology Report

Tappan Zee Bridge/I-287 Corridor
Draft Environmental Impact Statement

September 15, 2010

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LIST OF ACRONYMS AND ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
APE	Area of Potential Effect
ARC	Access to the Region's Core
ASTM	American Society for Testing Materials
ATR	Automatic Traffic Recorder
BA	Biological Assessment
BPM	Best Practice Model
BRT	Bus Rapid Transit
BTU	British Thermal Unit
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CRT	Commuter Rail Transit
CWA	Clean Water Act
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dBA	A-weighted Decibel
DEIS	Draft Environmental Impact Statement
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EJ	Environmental Justice
EO	Executive Order
EPM	Environmental Procedures Manual (NYSDOT)
ESA	Endangered Species Act
ESB	Environmental Science Bureau (NYSDOT)
ETC	Estimated Time of Completion
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GCT	Grand Central Terminal
GIS	Geographic Information System
HOT	High-Occupancy Toll
HOV	High-Occupancy Vehicle

LIST OF ACRONYMS AND ABBREVIATIONS (con't)

Ldn	Day-Night Sound Level
Leq (1)	Hourly Equivalent Sound Level
LOS	Level of Service
LRTP	Long Range Transportation Plan
MTA	Metropolitan Transportation Authority
MOA	Memorandum of Agreement
MPO	Metropolitan Planning Organization
MSAT	Mobile Source Air Toxic
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_x	Oxides of Nitrogen
NPS	National Park Service
NRE	National Register-Eligible Resource
NRL	National Register-Listed Resource
NY	New York
NYCDEP	New York City Department of Environmental Protection
NYMTC	New York Metropolitan Transportation Council
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOS	New York State Department of State
NYSDOT	New York State Department of Transportation
NYSHPO	New York State Historic Preservation Office
NYSM	New York State Museum
NYSTA	New York State Thruway Authority
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter with Diameters up to 2.5 µm
PM_{10}	Particulate Matter with Diameters up to 10 µm
ROW	Right-of-way
Rte	Route
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SAV	Submerged Aquatic Vegetation
SEQRA	State Environmental Quality Review Act
TAZ	Traffic Analysis Zones
TDM	Transportation Demand Management
TIP	Transportation Improvement Program
TNM	Traffic Noise Model

LIST OF ACRONYMS AND ABBREVIATIONS (con't)

TOD	Transit-Oriented Development
TSM	Travel System Management
USACE	US Army Corps of Engineers
USBEA	US Bureau of Economic Analysis
USCG	US Coast Guard
USDOT	US Department of Transportation
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service
VIA	Visual Impacts Assessment
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compound

1 Introduction

The Project Sponsors - New York State Department of Transportation (NYSDOT), the New York State Thruway Authority (NYSTA), and Metro-North Railroad (an agency of the Metropolitan Transportation Authority [MTA]) – in cooperation with the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) – are preparing an Environmental Impact Statement (EIS) for the Tappan Zee Bridge/I-287 Corridor Project in Rockland and Westchester Counties, New York (NY).

The 30-mile corridor includes the 15-mile portion of Rockland County from Suffern to Nyack on the Hudson River, the 3-mile river crossing, and the 12-mile section of Westchester County from Tarrytown on the Hudson River to Port Chester on Long Island Sound. The corridor passes through the communities within the towns of Ramapo, Clarkstown, Orangetown, Greenburgh, White Plains, Harrison, and Rye. Figure 1-1 shows the I-287 Corridor.

This document presents the methodologies that will be used to assess the impacts of the project, the results of which will be presented in the EIS. The *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)* Section 6002 requires early coordination regarding the impact assessment methodologies that will be used during the preparation of the EIS. This document has been prepared to support collaboration with participating agencies regarding the technical approaches and the level of detail required in the analysis of each alternative for the project.

The methodologies will be developed to support decision-making relative to highway, bridge and transit elements. The proposed methodologies will provide the level of detail necessary to enable participating agencies, reviewing agencies, decision-makers, and the public to understand the range of environmental consequences and trade-offs among the alternatives under consideration. Approval of this report by FHWA and FTA does not necessarily constitute approval of what is ultimately included for environmental documentation in the project's Environmental Impact Statement.

1.1 Tiering

In accordance with the Revised Notice of Intent, issued February 14, 2008, the EIS will be completed using a tiered process to facilitate decision-making. The proposed methodologies described in this document support decisions both on broad overall corridor issues in a Tier 1 transit analysis of general alignment and mode choice while simultaneously assessing the site specific impacts, costs, and mitigation measures in a Tier 2 bridge and highway analysis. The methodologies also support the concurrent development of both the Tier 1 and Tier 2 analyses to maximize the efficiencies and potential for multi-modal solutions as well as the comprehensive consideration of the full range of potential impacts to the human and natural environment.

The Tier 1 transit analysis will provide the basis for a corridor level decision on transit mode(s), alignment(s), and logical termini within the corridor and a sufficient detail of impact assessment and preliminary engineering to allow the selected Tier 2 highway and bridge elements to proceed to final design and construction.

Figure 1-1 Tappan Zee Bridge / I-287 Corridor

The Project Sponsors will prepare the EIS based on the level of design development of the bridge, highway, and transit elements of the project as shown in Table 1-1. Future Tier 2 Transit Environmental Documentation will be initiated after the Tier 1 Transit/Tier 2 Highway-Bridge-Transit Accommodation Record of Decision (ROD) and during the bridge and highway design phase, after a decision has been made to advance the Bus Rapid Transit (BRT) and Commuter Rail Transit (CRT) modes in either a single or sequenced environmental process. Appropriate analysis years for that process will be set based on the projected advancement dates of BRT and CRT modes.

1.2 Analysis Years

The analysis years for which the Tier 1 transit analysis and the Tier 2 bridge and highway analysis will be conducted are:

- 2010 (existing conditions). This will be based on running the calibrated Best Practice Model (BPM) and Paramics models for 2010 to develop ridership and traffic; data gathered from the literature (e.g., air pollutant levels, fish data); and data collected during the sampling programs for the project (e.g., noise, sediment quality, water quality).
- 2017 (estimated time of completion (ETC)) with highway and bridge improvements but without transit.
- 2047 (ETC +30) with highway and bridge improvements but without transit
- 2047 (ETC+30) with highway and bridge improvements plus bus rapid transit (BRT) and commuter rail transit (CRT).

Using 2017 (without transit) and 2047 (with transit) allows for the analysis of staging of the project. This analysis can be refined in the Tier 2 transit environmental documentation, as appropriate. Using 2047 (without transit) allows for a comparison of future conditions in the corridor with and without transit, thus determining the differential impacts of implementing transit. This 2047 analysis without transit would also serve as a “worse case analysis” of potential conditions during any intermediate years between 2017 and 2047 without transit improvements.

Table 1-1

Analysis of Tier 1 and 2 Project Elements

Tier 1 Project Elements	Tier 2 Project Elements
Transit alignments (not in the I-287 right-of-way), including: ▪ Piermont Line. ▪ CRT Hudson Line Connector. ▪ BRT alignments in Westchester County. These alignments will be developed to a planning level with the presentation of rights-of-way, profiles, and selected cross sections, as appropriate.	**Bridge** – Hudson River and Rockland and Westchester County landings. Preliminary engineering design will be provided for the replacement bridge structure, foundations, and approaches as per NYSDOT standard procedures.
Stations – station locations will be developed conceptually (e.g., a typical station size can be used with the range of parking identified from Best Practice Model (BPM) runs and traffic data from the BPM runs can be used with the Paramics traffic model to apply additional traffic to road links in the vicinity of major stations and to perform air quality screening as per the NYSDOT Environmental Procedures Manual (EPM)). Other Tier 1 transit components (e.g., substations, vent structures) will be addressed to the extent possible based on their level of design development, but most of these items would be deferred to the Tier 2 Transit Environmental Documentation.	**Highway** – I-287 in Rockland County. The highway will be designed to include highway features such as improved interchanges and climbing lanes, as well as the transit alignment accommodations.
Transit operations – BRT and CRT operations will be identified based on the service plans developed for the project. The operations will then be analyzed using appropriate modeling techniques. For example, the CRT service plan shows the number and type of rail operations. Thus, the noise levels from rail operations can then be predicted using the procedures presented in the FTA noise guidance manual.	**Transit alignment accommodations** – within the I-287 Corridor in Rockland County. The highway will be designed to accommodate the necessary BRT and CRT alignments within I-287.

1.3 Organization of the EIS Methodology Report

For each technical topic to be addressed in the EIS, the material covered in this DEIS Methodology report is generally organized as follows:

- **Regulatory and Permitting Requirements** – The EIS to be prepared will address subject matters under various federal statutes, including the Endangered Species Act (ESA), National Historic Preservation Act (NHPA), Clean Air Act (CAA), and Clean Water Act (CWA), among others, for which permits will be sought, and Executive Orders (such as those regarding environmental justice and wetlands). Furthermore, the EIS will conform to requirements of the New York State Environmental Quality Review Act (SEQRA) and will present analysis and information required by other applicable state environmental laws and regulations.

- **Affected Environment** – Many of the studies of existing conditions are largely completed at this time and will be described, including the study areas defined for each area of analysis. Additional information accumulated as part of the scoping process has been considered and incorporated into the project's overall geographic information system (GIS) database.

- **Environmental Consequences** – The environmental methodologies presented herein are based on (1) the findings of the preliminary environmental analysis; (2) baseline conditions information gathered throughout the course of the project; (3) consultations with local, state, and federal agencies; and (4) comments from the public. Impacts will be addressed for both operation and construction of the project. Each technical chapter includes a discussion of the analysis of operational impacts. Construction impacts for all topics are addressed in Chapter 24. The impact analysis also address direct, indirect (secondary), and cumulative impacts. The manner in which indirect and cumulative impacts will be addressed is discussed in Chapter 25.

- **Mitigation Measures** – Section 1.1 above reviewed the tiering of the proposed project's DEIS process. Under this approach, some details regarding transit options will not be known at this stage in the planning process. The potential impacts of those transit options and the possible measures to mitigate potential significant adverse impacts will be discussed qualitatively in this DEIS and analyzed in more detail in the Future Tier 2 Transit Environmental Documentation. For proposed highway improvements and other project elements being analyzed at a Tier 2 level in this DEIS, mitigation measures will be developed to a traditional level in the DEIS and FEIS, and mitigation commitments will be made in the ROD.

Overall, the organization of this Methodology Report, including the specific chapter order and structure, reflects the projected structure to be followed in the preparation of the DEIS itself.

2 Description of Alternatives

The DEIS analysis will include a range of reasonable alternatives, as described below. The DEIS will include detailed engineering, environmental analysis and the results of continued public input, leading to the recommendation of a locally preferred alternative for the project. Based on the results of the *Transit Mode Selection Report* (May 2009) and the *Alternatives Analysis for Rehabilitation and Replacement of the Tappan Zee Bridge* Report (March 2009), the No Build Alternative (Alternative A) and four Build Alternatives (Alternatives B through E) will be evaluated in the DEIS:

- *The Alternatives Analysis for Rehabilitation and Replacement of the Tappan Zee Bridge Report* (March 2009) recommended that only single- and dual-level bridge replacements be studied in the DEIS.

- The *Transit Mode Selection Report* (May 2009) recommended that full-corridor BRT from Suffern to Port Chester and CRT from Suffern to Manhattan (Grand Central Terminal) via a new connection to MNR's Hudson Line be studied in the DEIS.

The Build alternatives are being further refined prior to the start of detailed impact analyses though a series of detailed screening analyses of potential transit alignments and bridge options and the specific highway improvements and future transit accommodations to be included in them. This process involves the same type of detailed comparisons of options against criteria that reflect the project's goals and objectives and input received during extensive public outreach meetings dealing with these options. The results of these efforts will be summarized in the EIS and presented in detail in the *Bridge Options Development Report*, the *Transit Alignment Options Report*, and the *Highway Improvements and Transit Accommodations Report.* Where the Build alternatives primarily differ is in the particular character of the BRT service and infrastructure in Rockland and Westchester Counties. Basically, BRT service could be provided in shared use HOV/HOT lanes or a busway in Rockland County and in a busway or bus lanes in Westchester County.

2.1 Common Elements of the DEIS Build Alternatives

2.1.1 Bridge Component

Each alternative will include a single- or dual-level replacement bridge that accommodates BRT and CRT in addition to the highway lanes to handle vehicular traffic (see Figure 2-1). All bridge configurations will feature two CRT tracks and the same number and width of lanes, busways or BRT/HOV/HOT lanes, shoulders, and bicycle/pedestrian facilities. These single- and dual-level replacement bridge options will be refined further to optimize the location of the highway lanes and transit modes on the structure(s), with one single-level and one dual-level bridge option analyzed in the DEIS.

Possible
Single-Level Bridge

Possible
Dual-Level Bridge

Figure 2-1 DEIS Bridge Options

2.1.2 CRT in Rockland County

The CRT service included in all alternatives would begin in Suffern, connect to the Port Jervis Line and continue across Rockland County to a direct connection with the Hudson Line in Tarrytown. Rail service would then continue from Tarrytown providing a one-seat ride to the ultimate GCT destination.

2.1.3 Roadway Components and TSM Measures

A reconstructed highway to accommodate the recommended transit solution would be built. Other features to be studied include interchange reconfiguration and climbing lanes, and HOV/HOT lanes in Rockland County (incorporating BRT) under several alternatives. East of Exit 9 (Tarrytown) in Westchester County, there are no proposed highway improvements that are not related to transit.

Potential TDM/TSM measures include ramp metering, congestion pricing and ITS measures.

2.2 DEIS Alternatives

2.2.1 Alternative A – No Build

Consistent with NEPA requirements, a No Build Alternative (Figure 2-2) will be analyzed in the DEIS. Under this alternative, the bridge and highway would be maintained sufficiently to avoid severe deterioration and operational and safety deficiencies. Projects include any planned transportation improvements, including on-going highway improvements in Westchester County, others in the Long Range Transportation Plan (LRTP) for the region, and projects separately identified by the project team.

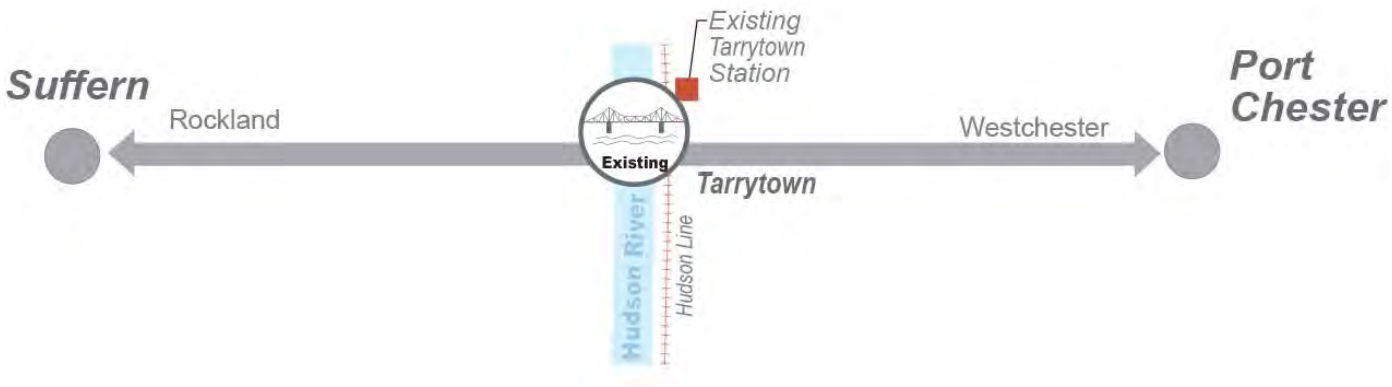

Figure 2-2 Alternative A – No Build

2.2.2 Alternative B – Full-Corridor Busway and Rockland CRT

Alternative B (Figure 2-3) would provide BRT service between Suffern and Port Chester by implementing BRT in Rockland and Westchester Counties in a busway, as well as CRT service in Rockland County. The alignment provides a BRT trunk route, primarily along I-287, that is intended to operate like a rail system. The trunk would extend from Suffern to Port Chester, connecting the NJTransit Suffern Station to the Port Chester New Haven Line Station.

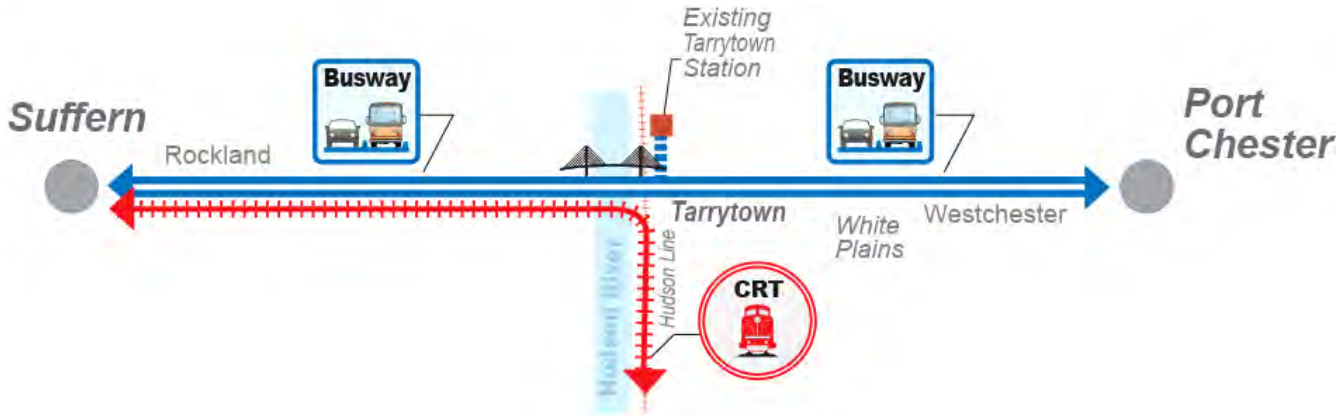

Figure 2-3 Alternative B – Full-Corridor Busway and Rockland CRT

2.2.3 Alternative C – Busway/Bus Lanes and Rockland CRT

Alternative C (Figure 2-4) would provide BRT service between Suffern and Port Chester by means of BRT in a Rockland County busway and BRT in Westchester County in bus lanes, as well as provide CRT service in Rockland County.

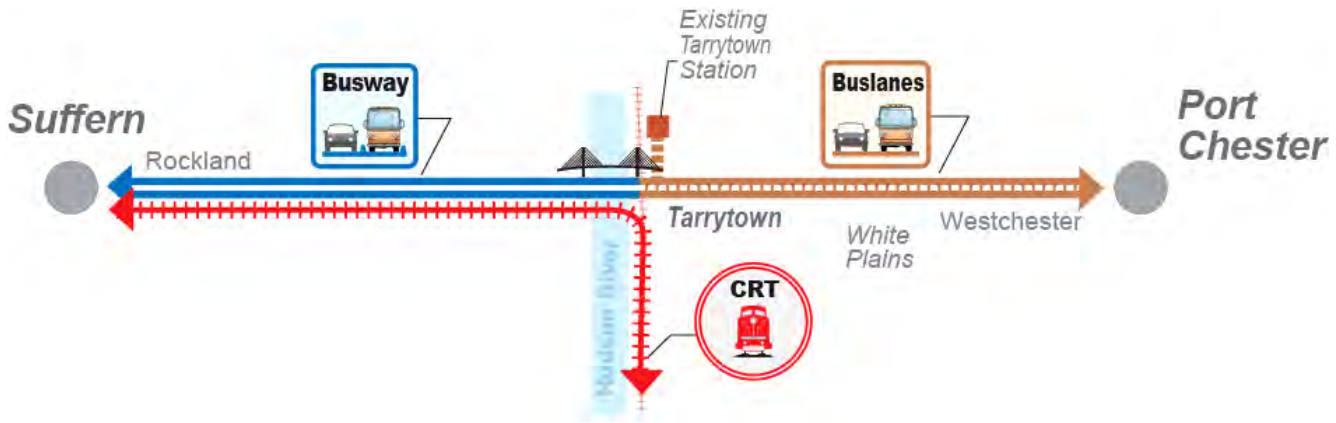

Figure 2-4 Alternative C – Busway/Bus Lanes and Rockland CRT

2.2.4 Alternative D – HOV/HOT/Busway and Rockland CRT

Alternative D (Figure 2-5) would provide BRT service between Suffern and Port Chester by means of BRT in Rockland County in HOV/HOT lanes (which would combine buses with carpools and (under HOT lane options) cars that pay a toll for the lane's use) and BRT in Westchester County in a busway, and provide CRT service in Rockland County.

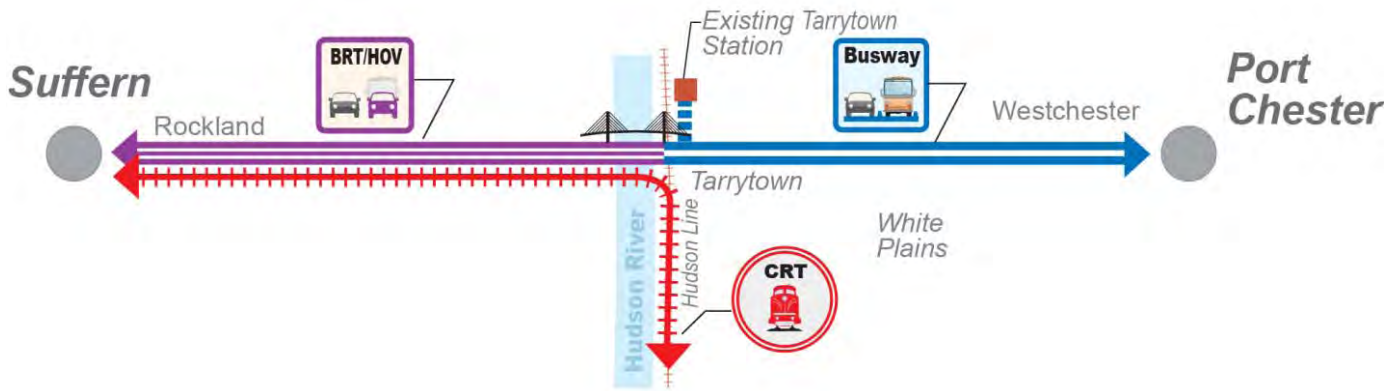

Figure 2-5 Alternative D – HOV/HOT/Busway and Rockland CRT

2.2.5 Alternative E – HOV/HOT/Bus Lanes and Rockland CRT

Alternative E (Figure 2-6) would provide BRT service between Suffern and Port Chester by means of BRT in Rockland County in HOV/HOT lanes (as under Alternative D) and BRT in Westchester County in bus lanes, and provide CRT service in Rockland County.

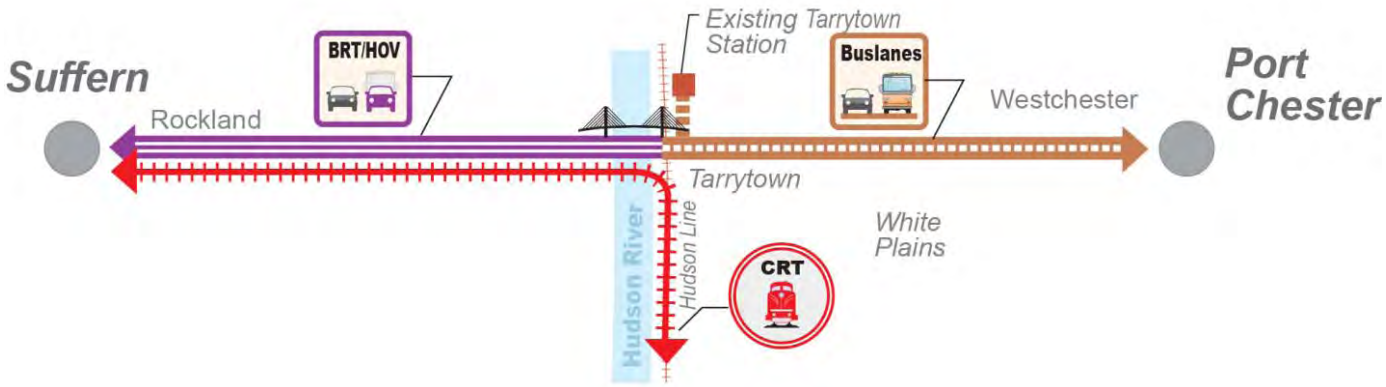

Figure 2-6 Alternative E – HOV/HOT/Bus Lanes and Rockland CRT

2.3 DEIS Alternative Components and Impact Analyses

Table 2-1 provides a brief summary of the key elements included in the proposed project's four build alternatives, either related to their construction or long-term operation and presence in the corridor. These components will be the focus of the bulk of the analyses in the DEIS. The listing of potential impacts associated with various project elements does not mean that these elements are expected to have significant impacts in each area, but rather than those elements will require a substantial amount of analyses in the areas noted.

The individual chapters in this Methodology Report provide further information about those project elements expected to require detailed analyses and the ways in which those analyses will be done. The EIS itself will detail the design, construction and operation of the highway, transit and non-motorized modes in the corridor in each of the project alternatives, and provide extensive information on how the impact analyses were performed and the results of those studies.

Table 2-1

Project Components and Key Impact Areas

Major Activities or Elements		Likely Key Impact Analysis Areas
Roadway, BRT and CRT Improvements: Rockland and Westchester Counties:		
• **Construction**	• Roadway, BRT and CRT construction activities: excavation, earth moving, construction trucks; stationary machinery; some blasting, pile driving, sheet piling. • Traffic diversion around construction zones	• Noise and vibration • Construction traffic • Air quality (mobile and stationary source) • Land use/neighborhood impacts (near construction zones) • Potential impacts on sensitive land uses (parks, cultural resources, etc.) • Temporary property acquisition for construction staging, storage, etc. • Potential construction-period impacts on wetlands and streams in project corridor
• **Long-Term Presence and Operations**	• Changes in vehicular traffic and transit usage along corridor and on adjacent roadways • BRT and CRT stations, viaducts, tunnels and vehicle operations	• Vehicular traffic (highway, arterials, local streets) • Air quality (mobile and stationary source) • Highway & transit noise • Land use/neighborhood impacts • Potential impacts on sensitive land uses (parks, cultural resources, etc.) • Permanent property acquisition • Visual impacts (new roadway or transit structures)
Replacement Tappan Zee Bridge:		
• **Construction**	• Dredging, pile driving, construction ship and barge activity, foundation and superstructure construction • Demolition of existing bridge • Constructing connections to Rockland & Westchester Counties	• Water quality • Aquatic ecology • Noise and vibration • Impacts on sensitive land uses • Temporary property acquisition
• **Long-Term Presence and Operations**	• Physical presence of a new larger river crossing	• Visual impact from river and adjacent communities • Aquatic ecology • Noise

3 Public and Agency Outreach

FHWA and FTA and the Project Sponsors are committed to maintaining an open and transparent public and agency coordination program that will continue throughout the environmental review process for the Tri-state region including New York, northern New Jersey, and southwestern Connecticut. The program for this project was designed to achieve a comprehensive public involvement process, beginning with public input in defining the goals and objectives for the project. Public involvement activities have been conducted under the guidance of and with the participation of FHWA and FTA.

This chapter will describe the comprehensive public involvement process for the EIS (as developed in the *SAFETEA-LU 6002 Coordination Plan* for the project), including the following:

- Major Public Meetings -- the following are some of the major public meetings conducted to date for the project:
  - Open House Pre-Scoping Meeting (October 2001).
  - Original Public Scoping Meeting (January 2003).
  - Public Workshop 1 – Introduction of Level 1 Elements (April 2003).
  - Public Workshop 2 – Introduction of Level 2 Scenarios (July 2003).
  - Public Workshop 3 – Results of the AA Process (December 2005).
  - Project Update and Development of Alternatives/Options (February 2007).
  - Scoping Update Meeting (February 2008).
  - Public Information Meeting (October 2008).

- Additional major public meetings projected for the EIS project will include:
  - public open house meetings in Rockland and Westchester Counties in February 2010 to go over the alternatives being analyzed in the DEIS,
  - the mandated public hearing on the DEIS, and
  - an Eminent Domain Public Law (EDPL) hearing for the potential acquisition of additional right-of-way (likely to be held concurrently with the DEIS hearing).

- A wide variety of meetings with entities such as:
  - The Inter-Metropolitan Planning Organization (IMPO).
  - Westchester Rockland Tappan Zee Futures Task Force.
  - Environmental and Regulatory Agencies.
  - County and Local Agencies.
  - Stakeholder Committee.
  - Elected Officials.
  - Non-Governmental Organizations.

- **Stakeholders' Advisory Working Groups**. Starting in Spring 2007, the Project Sponsors have engaged members of the public and interested individuals to participate in one of the project's five SAWGs (traffic and transit, environment, land use, bridge-design issues and financial). These hands-on working groups have played an important role as the EIS process moves forward.

- **Community Outreach Centers**. Created in Westchester and Rockland Counties in 2003 to serve as local meeting places and to provide opportunities for community groups and individuals to obtain study information and provide feedback.

- The project Web site (www.tzbsite.com).

- Newsletters.
- The media outreach program.
- Environmental Justice and Title VI outreach, to ensure that all stakeholders have the opportunity to participate fully in this EIS process, the Project Sponsors have developed and will continue to implement in the DEIS phase its Environmental Justice (EJ) Outreach Plan.

4 Transportation: Traffic Operations and Safety

The analysis of transportation impacts of the project in the EIS will address the following topics:

- Local and highway traffic operations and safety, which are discussed in this chapter.
- Regional transportation (including ridership and regional vehicle miles of travel (VMT)), which is also discussed in this chapter.
- Transit operations (discussed in Chapter 5).
- Marine, freight and Bicycle/Pedestrian operations (discussed in Chapter 6).

4.1 Regulatory and Permitting Requirements

4.1.1 Agency Coordination

The Project Sponsors will coordinate the traffic operations and safety analyses with FHWA and FTA and other federal, state, county and local agencies that have jurisdiction and/or interest in the project (e.g., transportation and planning agencies in Westchester and Rockland Counties).

The tool adopted to forecast travel in the region as an impact of the Tappan Zee Bridge/I-287 Corridor project is the Best Practice Model (BPM), developed by the New York Metropolitan Transportation Council (NYMTC). The BPM will be recalibrated to better reflect travel in markets that are affected by this project. The goal of the recalibration is to comply with FTA calibration/validation guidelines and the methodology will be presented to the FTA for their review. Importantly, coordination will also occur with NYMTC on topics related to BPM, including the extrapolation of demographic data to simulate travel conditions beyond what has been officially released by NYMTC (the NYMTC official forecasts go to 2035, and the project requires extrapolation of these projections to allow for analysis years after 2035).

4.1.2 Permit Requirements

While numerous federal and state guidelines apply to the project's plans for highway and local roadway improvements, demonstrating conformance to these is not done via a permit process.

4.2 Affected Environment

4.2.1 Traffic Impacts Study Area

While the study area for the project's regional transportation analyses is the NYMTC/BPM model 28-county area centered on New York City, the traffic and safety studies are focused on Rockland and Westchester Counties. The analysis of localized traffic impacts will generally be within ½-mile of the I-287 right-of-way.

4.2.2 Transportation Surveys

Transportation data (including surveys of travelers at Hudson River crossings in automobiles and trucks, and on select transit services from Rockland and Orange Counties) were collected at the outset of the study. Additionally, a stated-preference survey was conducted in 2003 to determine corridor travelers' modal preferences. Existing highway and local roadway facilities were fully inventoried, including signal locations and timings on arterials.

4.2.3 Baseline Traffic Data and Safety Collection

Baseline traffic data have been obtained from primary and secondary sources, including NYSDOT, Westchester and Rockland Counties, and reports for other projects. To supplement these data and to comply with the Federal Highway Administration (FHWA) coverage requirements, Automatic Traffic Recorder (ATR) counts were collected at approximately 170 locations in 2005. Of the 170 locations, 70 were ramps leading to and from I-287, and 100 were major intersections within the study area. Manual turning-movement counts were collected at 50 of these intersections; for the remaining 50, the manual-count data collected previously by others will be used. The primary purpose of the traffic data collection was to provide data to calibrate the BPM and Paramics models for 2005. The calibrated models will then be used to provide a projection of traffic and transit data for the existing conditions year of 2010 and future analysis years. In addition, information on annual traffic accidents along the highway and nearby roadways in the corridor was obtained from NYSDOT.

4.2.4 Transportation Modeling

BPM has been used to provide estimates of traffic in the corridor and crossing the Hudson River. BPM as developed by NYMTC is a Manhattan-centric model, and was calibrated by NYMTC to address Manhattan trips. As travel patterns in the Tappan Zee Bridge/I-287 Corridor are also cross-corridor trips, the decision was made to recalibrate the BPM to better reflect travel patterns in the I-287 Corridor. Thus, the original traffic data collected in 2005 (and ridership data from Metro-North and New Jersey Transit for 2005 on the transit side) were used to make appropriate model adjustments.

Paramics[1], a traffic analysis tool, relies on the output of BPM for its basic traffic input data. To model and analyze local roadway impacts, separate models using the *Paramics* framework have been created for Rockland and Westchester Counties. The *Paramics* networks include intersections within one-half mile of I-287 interchanges and key arterials (e.g., NY Route 119 in Westchester and NY Route 59 in Rockland). The Westchester *Paramics* model includes greater detail for the White Plains Central Business District due to the many route choices that traffic can make within that area. For the EIS, the *Paramics* model has been recalibrated to 2005 conditions during four time periods (weekday AM and PM and Friday and Sunday PM). The four time periods were selected for the following reasons:

- Weekday AM and PM peak hours: these commuter periods are typically analyzed in an EIS.
- Friday PM peak hour: travel patterns in this period have been observed to be different than other weekday PM peak hours. One of the reasons for this difference could be people driving north along I-87 to get away for the weekend.

[1] A traffic simulation package developed by Quadstone Paramics Ltd

- Sunday PM Peak: the Tappan Zee corridor performs poorly during this period. A large contributing factor is that a relatively low percentage of drivers in that period have E-Z Pass, which causes large queues. The focus of these studies will be on the bridge's toll plaza operations.

As previously indicated, the recalibrated models will be used to present traffic levels for existing conditions (2010) and future analysis years.

4.3 Environmental Consequences

4.3.1 Regional Transportation Analysis

The regional analysis will use the recalibrated BPM to assess the transportation impacts of each alternative. The impacts of alternatives will be assessed relative to the No Build, which is an alternative with no change from the current scenario except for programmed improvements and traffic growth based on socio-economic and demographic forecasts. Some of the criteria utilized in the past to assess various alternatives and likely to be carried forward in the EIS are:

- The impact of the alternative on the share of trips handled by different modes.
- Transit ridership under each alternative.
- Travel time benefits.

Travel-demand forecasts will be developed for the analysis years described in Chapter 1. Those model years will incorporate demographic forecasts also made available by NYMTC. The NYMTC forecasts do not, however, include an assessment of potential traffic impacts due to the induced growth impacts that a transit alternative may have in terms of land use patterns and/or population. The methodology proposed for evaluating the project's potential to induce growth is described in Chapter 28.

A specific set of service plans (which include possible station locations) are required as inputs to the BPM for regional analysis purposes. Those service plans and station locations have been developed in consultation with Metro-North Railroad staff and reviewed with Rockland and Westchester County transportation agencies, based on land use and other information (e.g., wetland locations) that have been collected for the corridor. The service plans reflect the operating plans for CRT and BRT services; restructuring of local and express bus services to reflect the new transit system; provision of parking facilities serving the rail and bus systems; and enhanced traffic operations and improvements in the TDM/TSM facilities and services. The BPM model will be coded to reflect these transportation network details.

The No Build highway and transit networks in BPM were reviewed to confirm that on-going or committed major improvements are reflected in the model, including planned improvements to I-287 in Westchester, the Long Island Railroad East Side Access project, the Second Avenue Subway, and the Access to the Region's Core (ARC) project.

The transit-related performance measures (total transit trips in the corridor, transit travel time savings, etc.) to be extracted from BPM modeling results and used to compare the EIS alternatives are discussed in Chapter 5(Transportation: Transit Operations). BPM-generated traffic measures will include total VMT in region, total vehicles crossing the Hudson River within the study area and travel time savings in key markets.

4.3.2 Traffic Impacts in the Project Corridor

Traffic congestion – as determined by level of service (LOS), traffic speeds, and traffic volumes – will be used to compare the traffic impacts of EIS alternatives. The traffic analysis will also provide input to the air quality, noise, and energy evaluation of alternatives (see Chapters 14, 15 and 16). The following traffic analyses will be conducted:

- BPM trip tables will be converted into *Paramics* trip tables using growth factors from BPM.
- The *Paramics* networks will be updated to reflect the alternatives to be analyzed, including proposed highway improvements such as climbing lanes, and transit-based components such as busway and HOV/HOT lanes.
- *Paramics* will be used to:
  - determine LOS on highway facilities (including mainline, ramp junctions and weaving sections),
  - analyze signalized intersections and arterials with signal control, and
  - analyze Tappan Zee Bridge toll plaza operation through Interchange 8
- Traffic impacts around possible station locations will be assessed based on conceptual station layouts and likely access/egress schemes.

For weekend analysis, a different analytical approach is required, as BPM does not currently produce weekend trip tables or assignments. Instead, the *Paramics* Origin-Destination estimator and planning judgment will be used to generate a trip table from the weekend balanced networks. During weekend periods, arterials and local roads generally show a peak that is lower but which extends for a longer time period than weekday peaks. Weekend analysis will be limited to the mainline highway and critical ramp terminals.

4.3.3 Traffic Safety Impacts

Existing accident data for I-287 and the other primary roadways in the corridor have been compiled. The impacts of the alternatives on transportation safety will be assessed based on a number of factors, including facility type, roadway geometry, traffic control devices, traffic volumes, and VMT. Based on an analysis of these factors, projected accident rates will be compared to those occurring under No Build conditions at comparable locations. Additional safety considerations related to the transit modes, such as the BRT system running on local arterials, will also be assessed qualitatively.

4.4 Mitigation Measures

The impacts likely to affect traffic operation on the arterial and local roadway network will be evaluated in terms of volume and Level of Service (LOS) changes. A process will be developed to identify the most affected locations, where traffic and air quality impacts could potentially be most severe and require

mitigation measures. In general, mitigation measures to improve capacity and reduce congestion will be applied at any location with a Build LOS at least two LOS classification levels lower than the No Build condition, or where the Build LOS is expected to be F. (Locations with a Build LOS better than D would receive minimal mitigation review, as peak-period operations in the A to C LOS range are generally considered acceptable.) These locations will be further analyzed to test the effectiveness of any recommended mitigation. These procedures are consistent with general transportation planning practice, and focus the mitigation analyses on those locations where project-related impacts would be greatest and where mitigation measures being considered would likely be beyond those routinely implemented by local and State transportation agencies to help maintain traffic flow.

5 Transportation: Transit Operations

5.1 Regulatory and Permitting Requirements

5.1.1 Agency Coordination

The Project Sponsors will coordinate the transit operations analyses with FHWA and FTA and other federal, state, county and local agencies that have jurisdiction and/or interest in the project (e.g., transportation and planning agencies in Westchester and Rockland Counties).

As discussed in Chapter 4, the tool adopted to forecast travel in the region as an impact of the Tappan Zee Bridge/I-287 Corridor project is a recalibrated version of NYMTC's Best Practice Model (BPM). The goal of the recalibration is to comply with FTA calibration/validation guidelines which are particularly relevant to the project's transit components. This methodology will be presented to the FTA for their review. Importantly, coordination will also occur with NYMTC on topics related to BPM and the extrapolation of demographic data for purposes of simulating travel conditions beyond what has been officially released by NYMTC (the NYMTC official forecast goes to 2035; extrapolation has to be done for analysis years after 2035).

5.1.2 Permit Requirements

While numerous federal and state guidelines apply to the project's transit elements, demonstrating conformance to these guidelines is not done through a permit process. The EIS analyses and associated technical reports will document the extent to which the proposed bus and rail transit facilities would conform to key operational and design guidelines. However, these considerations would be handled in greater detail as part of future Tier 2 Transit studies, as discussed in Chapter 1.

5.2 Affected Environment

5.2.1 Transit Operations Study Area

The study area for regional transportation analyses is the NYMTC/BPM model 28-county area centered on New York City, with the focus on Rockland and Westchester Counties. The study area for the transit operations analysis encompasses the bus and rail transit operations within and intersecting with the corridor, while to a lesser extent also extending on a regional basis to all transit operations potentially impacted by the proposed project's various highway and transit components.

5.2.2 Transit-Related Data Collection

Transportation data (including surveys of travelers at Hudson River crossings in automobiles and trucks, and on select transit services from Rockland and Orange Counties) were collected at the outset of the study. Additionally, a stated-preference survey was conducted in 2003 to determine corridor travelers'

modal preferences, which are key in assessing their reaction to new transit service in the corridor. Existing transit services were inventoried and existing highway facilities documented, including signal locations and timings on arterials.

5.2.3 Transit Modeling Analyses

BPM has been used to develop an understanding of the ridership potential of alternative transit modes, service plans, and station locations. The model generates an assessment of the ridership impact of various transit service plans and the impact of station spacing on ridership. Its results have been used to determine transit equipment needs (numbers of rail cars, buses, etc.) and projected revenues from various transit system configurations. As noted in Chapter 4, the BPM recalibration analyses depended on ridership data from Metro-North and New Jersey Transit for 2005 to make appropriate model adjustments. As previously indicated, the recalibrated models will be used to present ridership and traffic levels for existing conditions (2010) and for future analysis years.

5.3 Environmental Consequences

5.3.1 Impacts on Transit Ridership and Operations

As noted in Chapter 4, the regional analysis will use the recalibrated BPM to assess the transit and other transportation impacts of each alternative, and travel-demand forecasts will be developed for the analysis years described in Chapter 1. A specific set of service plans and potential station locations are required for the BPM to assess the impacts of new transit services. Those service plans and station locations have been developed based on land use and other information, and include

- the operating plans for CRT and BRT services;
- restructuring of local and express bus services to reflect the new transit system; and
- provision of parking facilities serving the rail and bus systems

The BPM model will be coded to reflect these and other transportation network details. The No Build transit networks in BPM were reviewed to confirm that on-going or committed major improvements are reflected in the model, including the Long Island Railroad East Side Access project, the Second Avenue Subway, and the Access to the Region's Core (ARC) project.

Several transit-related performance measures will be extracted from BPM modeling results and used to compare the EIS alternatives, including factors such as:

- Total transit trips in corridor markets.
- Total riders on new service.
- Total passenger miles on new service.
- Aggregate transit travel-time savings.
- Travel time savings (by all modes) to key markets.
- Total transit trips crossing the Hudson River on various crossings including the Tappan Zee Bridge.

5.3.2 Impacts on Key Travel Markets

The two major travel markets that will be affected by the project are the east-west markets, confined largely to the study corridor, and the markets of those commuting to or from Manhattan. The east-west markets comprise inter-county and intra-county riders as well as cross-Hudson riders. The extensive analyses performed during earlier phases of the project and summarized in the *Transit Mode Selection Report (2009)* confirmed that especially for the rapidly growing but more spread-out Rockland and Orange Counties, a flexible mode such as BRT could serve areas not in the immediate proximity of a "trunk" transit route, while providing a high level of service typical of such modes. In addition to overall corridor and regional transit ridership projections, the transit analysis will therefore review projected demand in some of these key east-west markets (e.g., Suffern to White Plains, Stamford, CT to White Plains).

The other market that has potential in terms of attracting workers from areas served by the proposed transit system is Manhattan. As such, estimates of the number of likely riders that would use this service overall and in key markets (e.g., Spring Valley to Manhattan, Harriman to Manhattan), and its impact on other north-south transit routes (e.g., Port Jervis and Pascack Valley Lines) with connections to Manhattan, would be analyzed as part of the EIS. While these transit ridership and operations studies will be sufficiently thorough and detailed to assess the relative merits of expanded transit services in the corridor, these studies will be done in considerably more detail as part of future Tier 2 Transit EIS studies, as discussed in Chapter 1.

5.4 Mitigation Measures

No detailed assessment of potential measures to mitigate impacts on transit systems will be prepared as part of this EIS. The types of investments that would be needed for existing transit operations to meet future demand from these proposed operations would be discussed, but detailed consideration of such impacts and required mitigation would be handled as part of future Tier 2 Transit studies.

6 Transportation: Marine, Freight and Bicycle/Pedestrian Operations

6.1 Regulatory and Permitting Requirements

6.1.1 Agency Coordination

The Project Sponsors will coordinate the transportation analyses with FHWA and FTA and other federal, state, county and local agencies that have jurisdiction and/or interest in the project (e.g., transportation and planning agencies in Westchester and Rockland Counties).

The BPM regional travel forecast model developed by NYMTC and discussed in Chapters 4 and 5 will be less important for the assessment of marine, freight and bicycle and pedestrian modes in the corridor than for vehicular traffic and transit studies, although freight issues are addressed in the model. Key coordination will be required with the Coast Guard (for marine operations) and Orange and Rockland Counties (for bicycle/pedestrian issues).

6.1.2 Permit Requirements

The Coast Guard permit related to navigational clearances is the major transportation permit that will be issued for the project. While numerous federal and state guidelines apply to other aspects of marine and bicycle/pedestrian facilities and operations, demonstrating conformance to these would not be a permit process. With respect to navigational clearances at Tappan Zee Bridge, the Coast Guard published a Public Notice on January 16, 2009 (Public Notice 1-075) requesting input from the maritime community as to navigation clearances that should be provided by the replacement bridge. The information obtained via responses to that notice will be considered in establishing vertical and horizontal clearances that the bridge would provide for vessel movements along the existing Hudson River shipping channel. The end of the comment period for the Public Notice was February 20, 2009.

6.2 Affected Environment

6.2.1 Marine, Freight and Bicycle/Pedestrian Study Areas

Transportation studies completed to date in these areas have concentrated on the collection of background data and on preliminary estimation of demand and volumes relevant to the analyses of these modes. While the study area for regional transportation analyses is the BPM model 28-county area centered on New York City, the analyses of these modes have a more localized focus. For marine traffic the impacts in question are marine traffic along the Hudson River in the vicinity of the Tappan Zee Bridge; bicycle and pedestrian traffic studies primarily will focus on the Tappan Zee Bridge itself and its bicycle/pedestrian connections in Rockland and Westchester Counties. The proposed project would not include any new or altered bicycle/pedestrian facilities along the I-287 right-of-way, but any project-related transit or traffic issues along the corridor that would potentially result in bicycle/pedestrian impacts will be reviewed where warranted. Preliminary analyses of freight operations along existing rail

freight lines within the corridor have already been analyzed, as reported in the *Freight White Paper* (August 2004). The impact of project alternatives on truck freight issues will extent to the overall traffic study area as defined in Chapter 4, but with its main focus on the I-287 corridor itself.

6.2.2 Data Collection

Transportation data (including surveys of trucks at Hudson River crossings) were collected at the outset of the study. Other transportation data have been collected with respect to bicycle/pedestrian volumes, freight movement (truck, rail, marine) and navigation. These data were collected from existing sources such as NYSDOT, NYMTC, the USCG and the US Army Corps of Engineers (USACE), and from other public and private maritime interests (current navigational usage and restrictions in the vicinity of the Tappan Zee Bridge), as well as the transportation and planning offices of Westchester, Orange and Rockland Counties (primarily bicycle/pedestrian volumes and facility information).

6.2.3 Assessment Methodologies

- **Freight.** The implications of the project's alternatives on goods movement by truck will be assessed based on the likely changes in traffic capacity and travel times in the corridor. In addition, an assessment will be made of the potential for rail freight in the corridor consistent with the conclusions of the *Freight White Paper* (August 2004).

- **Bicycle/Pedestrian.** The principle methodology to be used will be an assessment of the ability of the proposed bicycle/pedestrian facilities on the replacement bridge and the connections to the bicycle/pedestrian networks in Westchester and Rockland Counties, to efficiently and safety handle projected future demand levels. This assessment will be based on comparisons with applicable state and federal standards for such facilities and the extent to which the proposed facilities would provide sufficient capacity to meet these needs.

- **Marine Operations.** Based on information already collected by the project and by others concerning marine traffic in the corridor, bathymetry, tidal conditions, currents, vessel accidents/navigational limitation and wave conditions will be reviewed and documented. Operational impacts of the proposed new bridge (both during construction and long-term), such as those related to bridge height and placement of structures, will then be assessed.

6.3 Environmental Consequences

6.3.1 Impacts on Marine Operations

The primary navigational impacts from the project are expected to occur during the project's construction phase, as a replacement bridge is constructed and demolition of the existing bridge occurs near the shipping channel. There may be short periods of time during which the channel would need to be closed or restricted as a result of construction activities. The EIS will describe potential navigation issues arising from construction activities and the opportunities available to limit impacts to navigation.

6.3.2 Impacts on Truck and Rail Freight Operations

The implications of the four build alternatives relative to existing/No Build conditions on goods movement by truck will be assessed based on the likely changes in traffic capacity and travel times in the corridor (as estimated by the highway operations analyses). In addition, an assessment will be made of the potential for rail freight in the corridor, reviewing the findings and conclusions of the *Freight White Paper* (August 2004) and applying those results to the analyses in the DEIS.

6.3.3 Impacts on Bicycle/Pedestrian Mobility

Potential project effects on existing pedestrian and bicycle paths, on pedestrian and bicycle movement across vehicular facilities, and the effects on pedestrian and bicycle/vehicle conflicts will be quantitatively analyzed. Pedestrian and bicycle facilities provided by project alternatives will be described, and their utility and benefit to non-motorized mobility will be assessed qualitatively. Given the lack of such facilities across the existing Tappan Zee Bridge, their inclusion on the replacement bridge under all alternatives would clearly represent a significant increase in bicycle/pedestrian mobility in the corridor.

6.4 Mitigation Measures

The potential need for mitigation measures in connection with these modes will be reviewed in the EIS, with measures developed and their effectiveness assessed where appropriate.

7 Land Use, Economic Development and Zoning

7.1 Regulatory and Permitting Requirements

Guidance for consideration of the proposed project's impacts on land use, coastal resources and zoning is derived from FHWA's *Environmental Toolkit* and related references and documentation developed jointly by FTA and FHWA (e.g., *Land Use and Transportation Coordination: Lessons Learned from the Domestic Scan Tour* (FHWA, 2004), AASHTO (*Visualization in Transportation* and other documents), and NYSDOT's *Project Development Manual*. No specific permits are anticipated under these disciplines.

7.2 Affected Environment

7.2.1 Land Use/Zoning Study Area

The study area extends to areas along the I-287 corridor that would potentially be affected by the proposed improvements (within approximately one-half mile on each side of the highway centerline and reflecting census and municipal boundaries, as appropriate). Maps and text will describe the existing land use conditions along this 30-mile by one-mile corridor, paying particular attention to sensitive land uses, including residences, community facilities and institutions, parkland, and established business districts.

7.2.2 Data Collection

Baseline data for existing land use, current zoning, and county and local land use policies within the corridor have been developed based on available GIS data at the county level for the two-county (Westchester and Rockland) region.

Based on consultations with county and local planners together with reviews of the local zoning ordinances and master plans for the 21 municipalities along the study corridor, the study team will characterize land use regulations and patterns within the study area. These data will assist in identifying recent and projected development trends in the region,[1]and provide sufficient information to assess the proposed project's potential impacts on, and its compatibility with local land use and public policies.

[1] Chapter 12, Demographic and Economic Studies, will also provide data on population, household and employment to further define these trends.

7.3 Environmental Consequences

7.3.1 Impacts on Corridor Land Use and Development

The DEIS will describe the land use setting for the project area affected by project alternatives. Each alternative and its alignment will be overlain on maps showing: buildout footprints; transit-related parking; open space and vacant land; and other key land use categories, including residential (by density), retail, other commercial and mixed uses, industrial and warehousing, institutional, parkland, etc. Figures showing existing zoning for the impact area will also be prepared.

Impact analysis of bridge and highway improvements will utilize data on existing conditions, as described above, as well as forecasts and assumptions about population, demographics, employment growth, economic development, land use, and transportation developed by the Metropolitan Planning Organization (MPO), the affected counties, and municipalities, so as to provide both context and a baseline for evaluating effects of the Build alternatives.

7.3.2 Consistency with Corridor Zoning and Land Use Plans

Project impacts will be evaluated in terms of their compatibility with surrounding land use, consistency with zoning and Waterfront Revitalization Programs (see Chapter 24 for further details in this area) and with other relevant land use policies, and the effect of the project on land use patterns and trends in the area, including public improvements already adopted and those presently under consideration. Inconsistencies with adopted plans and policies, if any, will be identified.

Working with the counties and municipalities and the MPO, the study team is assisting these groups in developing long-term land use visions for the corridor and smart growth Transit-Oriented Development (TOD) recommendations to document ways in which an appropriate balance of land use and transportation investment can be achieved and potential impacts of localized TOD-type growth can be managed.[2]

7.4 Mitigation Measures

Mitigation measures will be identified and considered in order to address specific unavoidable adverse land use policy impacts where these are identified. Mitigation measures could include buffers between project components and incompatible land uses, regulatory controls or restrictions in leases.

[2] See also Chapter 28 for analyses of indirect and cumulative effects.

8 Land Acquisition, Displacement and Relocation

Potential acquisitions or displacements will be identified from the GIS data on land use accumulated for the project, including identification of tax lots, their owners and property values, and supplemented as needed by further field surveys of areas/properties potentially subject to acquisition or displacement under one or more DEIS alternative.

8.1 Regulatory and Permitting Requirements

Provisions of the federal Uniform Relocation and Assistance and Real Property Acquisition Policies Act of 1970 (42 U.S.C. 4601) will apply. Under state law, the provisions and procedures of the NYS Eminent Domain Procedures Law (EDPL) and its implementing regulations (NYCRR Part 73) will also apply.

8.2 Affected Environment

8.2.1 Displacement/Relocation Study Area

The study area for displacement/relocation is all properties in the immediate vicinity of I-287 and adjacent roadways where relevant in Rockland and Westchester Counties that may potentially be impacted by the proposed project.

8.2.2 Data Collection and GIS Database

The GIS data available from the counties will be a primary data source for identification of property that may potentially be affected by the proposed project. All property parcels adjacent to I-287 in the study area, or which are in close proximity and may be directly affected by acquisitions, will be compiled in a project property data base. Where the GIS data are incomplete, the data will be obtained from the local town's tax rolls. The property data base will enable ready comparison with the defined project alternatives' footprints, as defined in project engineering drawings, as they may extend beyond the state's existing right-of-way (ROW).

8.3 Environmental Consequences

The number and type of acquisitions and displacements will be identified and described. Using GIS methods and field verification of GIS results, as necessary, the acquisitions and displacements associated with each alternative will be compiled. The need for acquisitions, displacements, and relocations will be evaluated using the GIS database accumulated for the study area by projecting onto that database geographically referenced drawings of the alternative alignments. The acquisitions and displacements will be identified by land use type (including residences, businesses, and other institutions), area/dimensions, and property values, where available. Potential future impacts associated with future transit alignments will be handled in a similar manner, to the extent that details are available at this Tier 1 assessment level.

Potential disproportionate adverse effects on special social groups (e.g., minorities and low-income populations, the elderly, the disabled, and children) or adverse impacts to protected properties (parklands and cultural resources protected under Section 4(f) and/or Section 106) will be identified and evaluated in EIS subchapters that address environmental justice (Chapter 13), parklands (Chapter 9), and historical and archaeological resources (Chapters 17 and 18, respectively).

8.4 Mitigation Measures

Efforts to avoid property acquisition have been included in the design of project alternatives to the maximum extent practicable. This section will briefly document for the Tier 2 bridge and highway improvements how the development of these alternatives considered potential acquisitions, and justify that the proposed acquisitions are warranted to meet the project's goals and objectives**.** Where acquisition is identified, procedures will follow the NYS EDPL, and appropriate compensation will be provided to property owners. The same or equivalent procedures would be followed for transit-related acquisitions as part of future Tier 2 Transit environmental procedures.

Where displacement of households would occur, mitigation would include implementation of a relocation program in accordance with the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 as amended. The availability of replacement housing in the area will be compared with the housing needs of displaced households, and measures will be proposed to resolve special relocation needs, if any. A similar evaluation will be conducted for business and employment displacements.

Mitigation options for displacements will need to document that the market inventory of housing or other facilities (such as commercial space or properties) is adequate to relocate displaced activities. Measures to reduce or avoid adverse effects during the construction and operational phases of the proposal will also be identified, as appropriate.

9 Parklands and Public Open Space

Baseline studies related to parklands and public open space have been conducted to identify state, county and local parklands that may be affected by project alternatives. As the alignments and ROW requirements of the DEIS alternatives are further developed, the nature and locations of parks, recreation areas, wildlife or waterfowl areas, wild and scenic rivers, and national trails and natural landmarks in proximity to the proposed project will be refined and described in greater detail (also see Chapter 26 for a discussion of Section 4(f)/6(f) resources).

9.1 Regulatory and Permitting Requirements

As required under Section 4(f) of the Department of Transportation Act of 1966 (as updated in March 2008 – 23 CFR 774) and FHWA's regulations for implementing NEPA (23 CFR 771), it is a national policy to make a special effort to preserve the natural beauty of the countryside, public park and recreation lands, wildlife and waterfowl refuges, and historic sites. FHWA and FTA will not approve any program or project which requires the use of any publicly owned public park, recreation area, or wildlife or waterfowl refuge, or any land from an historic site of national, state, or local significance unless:

- There is no feasible and prudent alternative to the use.
- All possible planning to minimize harm resulting from such use is included.

The Department of Interior is required to issue a finding that no prudent and feasible alternative exists to any federal action that has adverse impacts on properties covered by the act, and that all possible planning has been done to minimize the harm to those properties.

A *de minimis* impact determination subsumes the requirement for all possible planning to minimize harm. For public parks, recreation areas, wildlife or waterfowl refuges, a *de minimis* impact is one that will not adversely affect the features, attributes, or activities that qualify it for protection under Section 4(f).

There are similar requirements to those of Section 4(f) for land acquired or developed under Section 6(f) of the US Land and Water Conservation Fund Act, codified as 16 U.S.C. Section 460 L-8f, and Section 110 of the Urban Parks and Recovery Act, codified as 16 U.S.C. Sections 2501 – 2514.

The acquisition of public parkland in New York State requires that the State Legislature approve an Act of Alienation, releasing the park from its status as parkland.

9.2 Affected Environment

9.2.1 Parkland/Open Space Study Area

The study area is based on the approximately one-mile wide corridor centered on I-287 adopted for land use noted in Chapter 7, but extends beyond that boundary to include parks located along the Hudson River within viewing proximity of the Tappan Zee Bridge (approximately four miles), due to the potential for visual impacts in the study area. All parklands and public open spaces within that area that could potentially be affected by project alternatives include parks, recreation areas, wildlife and waterfowl

areas, state and local trails, and natural landmarks. All of the parklands identified are Section 4(f) resources, while only some have received Section 6(f) funding[1] or Section 110 funding[2]. Any parkland identified within or bordering the study area will be identified.

9.2.2 Data Collection and Mapping Procedures

The information on parklands will be compiled from Internet research, by contacting the parks and recreation departments of the relevant counties and municipalities and the NYSDPRHP as necessary, and through the use of maps and/or GIS coverage provided by the counties. The locations of each park resource will be identified on maps and tables. These data will include: location, jurisdiction, type of resource (active or passive), size, and a brief description of the resource and types of users.

9.3 Environmental Consequences

The DEIS will describe the potential impacts of project alternatives on parkland and public open space resources. Each alternative and its alignment will be overlain on maps showing the buildout footprints, and any identified ancillary facilities as they would affect any parkland and public open space. Potential affects could include the proposed acquisition of parkland, and potential changes to the access or use and enjoyment of the parkland. Such impacts may require permanent acquisition of title or may be only temporary easements required during project construction.

The type and extent of potential impacts to parklands and public open space resources during project construction and operation will be evaluated for each alternative analyzed in the DEIS. Discussion of impacts will also include indirect impacts, such as changes in park use and enjoyment. A graphic will be prepared for each affected resource to show potential conflicts, noting (1) the facilities affected; (2) probable environmental effects (noise, dust, habitat destruction, etc.); (3) effects on access; effects on any unique qualities; and (4) the amount of land remaining.

When a project alternative would have significant adverse impacts on parkland, a Section 4(f)/6(f) review would require an analysis of alternatives that could avoid impacting the resource. Alternatives that would avoid resources will be evaluated based on designs provided by the engineering disciplines. Where an alignment alternative would use parkland from more than one resource, the avoidance alternatives will show avoidance of each and all resources. Avoidance alternatives will be evaluated in sufficient detail to determine their feasibility. If an alternative that avoids a resource is found to be feasible and prudent compared to another alternative, it will be incorporated into the project. (See Chapter 26 for further details on Section 4(f)/6(f) procedures.)

Also to be considered in the analysis of parklands are existing and proposed bike and pedestrian trails that bisect the corridor. Included in the trails that are to be considered are the Piermont Rail Trail in Ramapo (proposed); the Palisades Interstate Parkway Trail (proposed); Riverwalk in Westchester (proposed in the

[1] Facilities receiving Section 6(f) funding are identified from the detailed county listings of parks receiving funding under the Land and Water Conservation Fund, as identified on the National Park Service website: http://waso-lwcf.ncrc.nps.gov/public/index.cfm

[2] Facilities receiving Section 110 funding are identified from the National Center for Recreation and Conservation: Urban Parks and Recreation Recovery , listing of New York projects.- http://www.nps.gov/ncrc/programs/uprr/cities/new_york.html

vicinity of Tappan Zee Bridge); and the Old Croton Aqueduct Trail. The proposed Tappan Zee Bridge will also include a new bike/pedway that will benefit from its careful integration with the Raymond G. Esposito Memorial Trail in Rockland County and the Riverwalk in Westchester County. In addition, existing bridges may be replaced along the corridor, and consideration will be given, in such instances, as to how these replacement bridges can best serve to connect pedestrians and bicyclists to local activity. Bike/pedestrian issues are also covered in the bicycle/pedestrian discussions in Chapter 6 (Transportation: Marine, Freight and Bicycle/Pedestrian Operations).

9.4 Mitigation Measures

Where negative impacts on a parkland resource are identified, appropriate mitigation measures will be recommended. Appropriate mitigation will include factors such as the potential for providing compensation or replacement lands, design features to enhance remaining lands, or special efforts that could be undertaken to lessen harm to the resource. These could include measures to improve pedestrian, bicycle, or auto access; landscaping; noise-abatement measures; special construction methods; and phasing new construction with required demolition.

10 Community Facilities and Services

10.1 Regulatory and Permitting Requirements

Guidance for consideration of the proposed project's impacts on community facilities and services is derived from EIS guidelines and procedures under NEPA (for FHWA and FTA) and SEQRA (for NYSDOT, NYSTA and Metro-North Railroad). No specific permits are anticipated under this discipline.

10.2 Affected Environment

10.2.1 Community Facilities Study Area

The study area is based on the one-mile corridor centered on I-287 but will extend beyond those boundaries when mapping key community facilities, such as hospitals, police and fire services, etc. that provide services along the I-287 Corridor from Suffern to Port Chester. However, religious facilities, which can be very numerous within a one-mile wide study area in certain parts of the corridor, will be identified only when they are within 1,000 ft. of either side of the existing right-of-way (ROW) of I-287.

The study area in Rockland County includes parts of 12 municipalities -- three towns: Clarkstown, Orangetown, and Ramapo, and nine villages: Grand View-on-Hudson, Nyack, and South Nyack (Orangetown); Airmont, Chestnut Ridge, Hillburn, Montebello, Spring Valley and Suffern (Ramapo). Community facilities and services data are presented for those located within or bordering these areas. There are 11 municipalities within the study area in Westchester County -- two cities: Rye and White Plains, and three towns: Rye, Greenburgh, and Harrison. Within the towns are six villages: Rye Brook and Port Chester in the town of Rye; Tarrytown, Elmsford and Irvington in the town of Greenburgh; and the village of Harrison, which is coterminous with the town of Harrison.

10.2.2 Data Collection and Mapping Procedures

Community facilities to be identified in the study area include schools and school districts, recreational areas, community centers and senior facilities, places of worship, libraries, hospitals and emergency services (fire, police, and ambulance). Anticipated impacts from the project to religious facilities are projected to be limited to those immediate locations where project alternatives extend beyond the existing ROW.

Data compiled for each of the identified community facilities and services identified will be presented in a series of GIS-based maps and tables that describe the key service functions and dimensions of each facility. For example, for education services, facilities will be differentiated by level (primary, secondary, higher education) by public and private schools, and by school districts. These facilities will be further elaborated where possible in terms of their enrollment and the type of facility, such as special education.

10.3 Environmental Consequences

Digitized maps of the project alternatives' footprints will be used to identify any direct impacts, such as acquisition of identified community facilities. Any potential acquisitions and or displacements will be identified. Similarly, both permanent and temporary easements affecting community facilities will be identified. The potential impacts of future transit project elements on community facilities will be assessed, to the extent that conceptual design details are available at this Tier 1 Transit assessment level. Potential impacts of possible off-alignment transit facilities (e.g., stations) will be handles more qualitatively. All of these issues will be more fully assessed as part of future Tier 2 Transit environmental procedures.

In addition, any changes to the functioning of the facilities and services will be evaluated based on appropriate criteria, e.g., changes of access that may create delays for emergency vehicles; or changes of access that might restrict the use of a community facility such as a school, library or religious institution.

Indirect effects will also be considered if these are likely to affect the use and functioning of a facility, e.g., if noise levels were to increase in close proximity to a library or other noise sensitive facility. Other indirect effects will be considered for these facilities and services as result of potential changes in demand for their services, e.g., if there would be induced population growth.[1]

10.4 Mitigation Measures

In the event that project alternatives would result in significant adverse impacts on community facilities and services, the EIS will include a discussion of potential measures to avoid or minimize those impacts. Where such impacts would be unavoidable, the early involvement of the agency or institution having jurisdiction of the facility is recommended in developing appropriate mitigation.

[1] Chapter 28 addresses Cumulative and Indirect Impacts.

11 Neighborhood Character & Community Cohesion

11.1 Regulatory and Permitting Requirements

Guidance for consideration of the proposed project's impacts on neighborhoods and overall communities is derived from FHWA's *Environmental Toolkit* and related references and documentation developed jointly by FTA and FHWA or in consultation with them (e.g., *Economic Development and Smart Growth* (International Economic Development Council), and NYSDOT's *Project Development Manual*. No specific permits are anticipated under this discipline. Potential impacts on social groups, neighborhoods, and housing will be evaluated based on FHWA Technical Advisory T6640.8A.

11.2 Affected Environment

11.2.1 Community Assessment Study Area

The community assessment study area will be defined as roughly the same one-mile wide corridor centered on I-287 from Suffern to Port Chester as adopted for land use in Chapter 7.

11.2.2 Data Collection and Analysis Procedures

The data required for these studies will be drawn from those collected in establishing the corridor's land use patterns and trends, as discussed in Chapter 7 (Land Use, Economic Development and Zoning). Particular attention will be paid to any socially, economically, and environmentally sensitive locations or populations in the impact area, i.e., neighborhoods, concentrations of elderly/minority/ethnic groups, low-income populations (to be covered in more detail in the Environmental Justice assessments as described in Chapter 13), and established business areas. Data and analysis will be presented in text, tables and graphic exhibits.

Neighborhood character is an amalgam of elements that give neighborhoods their specific "personality." They include socioeconomic elements, land use patterns, urban design and visual characteristics, historic resources, and traffic and ambient sound levels. Project effects that could alter neighborhood character would include direct or indirect displacement, increases in population or businesses, substantial direct changes to visual features of visual access to such features, the introduction of conflicting land uses, and changes in traffic patterns, vehicle mix or congestion. The procedures will draw on the results of the studies in the various EIS chapters dealing with those potential impact areas to provide a collective sense of how project-related changes in the corridor could alter the character or cohesion of communities within it.

11.3 Environmental Consequences

A neighborhood's character typically deals with such issues as its visual quality, any historic characteristics, its walkability, the mix (single, multi-family) and scale of housing and other buildings, the

level of traffic on its streets, property values and overall demographics, etc. The potential for impacts on neighborhood character will therefore focus on the extent to which any project alternative would potentially results in significant adverse impacts in any of these character-defining areas, drawing on the analyses performed throughout the EIS.

Potential changes in community cohesion are generally associated with project-related actions that would split neighborhoods or isolate a portion of a neighborhood or an ethnic group, create new developments potentially at odds with existing land use types, separate residents from community facilities, etc.

Given these factors, the proposed analysis will:

- Describe the characteristics of neighborhoods along the study corridor and the manner in which project-related impacts could potentially alter those characteristics.
- Describe the other anticipated projects in the study corridor and their potential effects on these neighborhoods.
- Describe changes in the study area's social characteristics as a result of the project alternatives.
- Describe changes to accessibility to community facilities and services as a result of the project alternatives.
- Recommend measures to avoid, minimize, or mitigate negative impacts to neighborhood character and community cohesion.

The potential impacts of future transit project elements will be assessed, to the extent that conceptual design details are available at this Tier 1 Transit assessment level. Potential impacts of possible off-alignment transit facilities (e.g., stations) will be handled more qualitatively. All of these issues will be more fully assessed as part of future Tier 2 Transit environmental procedures.

One project-related area that can have a significant impact on a community is property acquisition and the associated displacement of residents and businesses. Such factors, which are addressed in detail in Chapter 8, will be reflected in the neighborhood and community impact discussions in this chapter.

11.4 Mitigation Measures

When significant adverse impacts on neighborhood character or community cohesion are identified, appropriate mitigation will be identified where feasible and appropriate. Much of this discussion will draw on the review of mitigation measures in other chapters – e.g., those for residents or businesses directly displaced by the project, highway noise barriers, etc.

12 Demographic and Economic Studies

12.1 Regulatory and Permitting Requirements

Guidance for consideration of the proposed project's socioeconomic impacts is derived from FHWA's *Environmental Toolkit* and related references and documentation developed jointly by FTA and FHWA or in consultation with them (e.g., *Economic Development and Smart Growth* (International Economic Development Council), and NYSDOT's *Project Development Manual*. No specific permits are anticipated under this discipline. Potential impacts on community demographics and housing will be evaluated based on FHWA Technical Advisory T6640.8A.

12.2 Affected Environment

12.2.1 Demographic and Economic Study Areas

The detailed study area for socioeconomic analysis will be defined as roughly a one-mile wide corridor centered on I-287 from Suffern to Port Chester, subject to census and municipal boundaries (as adopted for land use in Chapter 7). However, in order to provide a regional context for the discussion of the affected environment, data on population and employment for 15 counties in the NYMTC region will also be provided for the period 1990-2005, together with NYMTC forecasts for these indicators out to year 2035.

12.2.2 Data Collection and Analysis Procedures

Existing demographic and economic data and recent trends for key socioeconomic indicators, e.g., population, housing, employment, will be provided and summarized, based on the 1990 and 2000 US Census for detailed information, and for more recent (but limited) data from the US Census Bureau (USCB) Annual Population Estimates. Additional information on employment/unemployment will be obtained from the NYS Department of Labor. Population and employment forecasts will be drawn from the NYMTC forecasts through to year 2035. Based on projected trends for 2010-2035, a limited number of demographic and economic factors would be estimated at the county level for 2047.

Subchapters of the socioeconomic analysis will focus on:

- Population and housing.
- Economic conditions.
- Neighborhood character.

Particular attention will be paid to any socially, economically, and environmentally sensitive locations or populations in the impact area, i.e., neighborhoods, concentrations of elderly/minority/ethnic groups, low-income populations (to be covered in more detail in the Environmental Justice assessments as described in Chapter 13), and established business areas. Data and analysis will be presented in text, tables and graphic exhibits.

The affected regional and local economies and their dependence on travel, accessibility, and mobility within the corridor will be broadly described based on existing economic data, development plans and projects, and on communication with officials from local jurisdictions, chambers of commerce, and other relevant agencies.

12.3 Environmental Consequences

12.3.1 Impacts on Demographics and Housing

The data collected on existing demographic characteristics and related social and housing characteristics will be compared to and evaluated against the project alternatives' characteristics and impacts. In particular, areas will be evaluated where additional ROW will be required for new ramps, reconstructed interchanges, and reconstructed local bridges that could affect neighborhood cohesion, or result in the displacement of households or businesses.

Direct effects of alternatives and alignments on population and housing, such as displacement of households, will be identified in terms of the numbers of households and persons affected, their socioeconomic characteristics (race/ethnicity, income), type of housing, and other identifiable characteristics.

Indirect effects of project alternatives on populations and housing will be qualitatively evaluated.[1]

12.3.2 Economic Impacts: Construction and Long-Term

The project alternatives' characteristics and impacts will be compared and evaluated against the existing economic conditions analysis and will be summarized here. The analysis will:

1. Qualitatively discuss the general long-term economic benefits of the proposed project.

2. Perform economic-impact modeling of the total economic benefits (employment, wages, output, and taxes) to Rockland and Westchester counties and to New York State (NYS) from the project based on estimated construction costs and using the RIMS II input-output model from the US Bureau of Economic Analysis (USBEA).

3. Describe the economic effects on the regional and local economies, including the economic effects on business districts, established businesses, and economic effects on specific businesses.

4. Qualitatively discuss whether annual property taxes collected by the two counties and the 21 local municipalities would change due to the proposed project (i.e., lost revenues from displacements or gains from potential new development).

5. Qualitatively discuss the project's potential for induced growth in the corridor, and in Westchester, Rockland and Orange counties.[2]

[1] Cumulative and Indirect Effects are specifically addressed in Chapter 28.
[2] Cumulative and indirect effects will include Orange County, see Chapter 28.

Effects on local economies and commercial districts resulting from changes in travel patterns, travel time, congestion, and access – vehicular, commuter, bicycle, and pedestrian – will be described qualitatively. Commercial districts and business centers that would experience changed access or adverse proximity effects will be identified. The potential for new commercial development and economic activity to be generated will also be described.

As discussed above, temporary (construction) employment, both direct and indirect, will be estimated using the US BEA RIMS II model, but forecasts of employment changes due to operational effects are not proposed, based on the limited projected changes in corridor highway operations due to proposed highway and bridge improvements The potential effects of major investments in high-capacity transit systems in the corridor in 2047 would be addressed qualitatively. The potential effect of user fees or other project financing mechanisms on special populations, social groups, households, and businesses within the I-87/I-287 primary travel market will be evaluated based on financing options and estimates of potential toll rates and travel behavior.

12.4 Mitigation Measures

When significant adverse socioeconomic impacts are identified, appropriate mitigation will be identified where feasible and appropriate.

13 Environmental Justice

13.1 Regulatory and Permitting Requirements

Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (*February 11, 1994) requires consideration of whether the proposed action would disproportionately affect minority or low-income groups (59 Federal Register 7629 [1994]). The Environmental Justice (EJ) process requires that no minority or low-income population group should bear a disproportionate share of potential adverse environmental and socioeconomic impacts resulting from major projects such as the Tappan Zee Bridge/I-287 Corridor Project. In addition, special efforts should be made to reach out to EJ communities to ensure that they understand the proposed project and its potential impacts on them. (The project's public outreach efforts have included specific steps to reach out to and hold additional meetings in those communities to address this important need.)

Projects involving federal funding or approvals from the US Department of Transportation (USDOT), or its subsidiary agencies, FHWA or FTA, require an EJ evaluation as part of the environmental review. In addition to EO 12898, federal concerns for nondiscrimination under Title VI of the Civil Rights Act of 1964 are applicable under the EJ process and recipients of federal aid must certify nondiscrimination on the basis of race, color, or national origin.

Each federal agency has developed a strategy to address EJ, with the Council on Environmental Quality (CEQ) responsible for oversight and coordination. The EJ analysis for the Tappan Zee Bridge/I-287 Corridor project will follow the guidance and methodologies recommended in CEQ's *Environmental Justice Guidelines under the National Environmental Policy Act* (December 1997), and the USDOT Final Order on Environmental Justice, April 1997.

New York State has its own environmental review process as part of its SEQRA guidelines, and when the NYS Department of Environmental Conservation (NYSDEC) has a role – as it will on this project with respect to granting permits – it has an EJ review process of its own (CP-29 Environmental Justice and Permitting, March 19, 2003). This process brings environmental justice concerns into NYSDEC's environmental permit review process by ensuring, among other things, that projects potentially impacting environmental justice communities provide enhanced public participation efforts in those communities. As noted in Chapter 3 of this report, the project has an extensive element of its outreach program focused specifically on EJ communities to ensure their understanding of the project and participation in the planning and review process.

13.2 Affected Environment

Using the socioeconomic study area as defined in Chapter 12, data on minority populations – Black/African American, Hispanic, Asian and Pacific Islanders, American Indian, Eskimo, Aleut, and other non-white persons – have been collected from the 2000 Census, identifying both total numbers and percentages of the total population, and comparing these to a larger community context (e.g., county and state). Similarly, 2000 census data on low-income populations (below poverty levels) have been compiled at the census-tract level.

More detailed analysis of census data at the block group level will be compiled where needed, pursuant to USDOT Environmental Justice Guidelines to further refine the geographic extent and neighborhood level of these sensitive populations. The impacts of project alternatives on minority and/or low-income populations will be identified, including: potential displacements and acquisitions, reductions of community services or access to them, adverse economic impacts, and changes to neighborhood character.

Data on other sensitive populations – concentrations of children, elderly, disabled, female-headed households, and transit-dependent populations – that could be affected by the proposed project alternatives will also be compiled and mapped at the block-group level.

13.3 Environmental Consequences

The characteristics and impacts of project alternatives will be evaluated by comparing their proposed build footprints, transit elements, and service plans to the data compiled on these populations of concern. Potential adverse impacts to minority and/or low-income populations will be identified and assessed as to the degree they are disproportionate to impacts on non-EJ populations.

Similar analysis will be conducted for the other populations of concern, including children, elderly, disabled, female-headed households, and the transit-dependent.

13.4 Mitigation Measures

Where project impacts on populations of concern are disproportionately high or adverse, mitigation options will be identified, as appropriate and feasible.

14 Air Quality

14.1 Regulatory and Permitting Requirements

The US Environmental Protection Agency (USEPA), under the requirements of the 1970 Clean Air Act (CAA) as amended in 1977 and 1990 (CAAA), has established NAAQS for six contaminants, referred to as criteria pollutants (40 CFR 50). These are carbon monoxide (CO), nitrogen dioxides (NO_2), ozone (O_3), particulate matter (PM, comprising PM_{10} and $PM_{2.5}$), lead (Pb), and sulfur dioxide (SO_2). The NAAQS were established at levels sufficient to protect public health as well as public welfare with an adequate margin of safety.

The project study area is located in Westchester and Rockland Counties within the New York metropolitan area. These two counties are currently designated as follows in terms of their compliance with NAAQS:

Westchester County:

- Moderate nonattainment area for 8-hour ozone.
- $PM_{2.5}$ nonattainment area.
- CO maintenance area.
- Attainment area for all other criteria pollutants.

Rockland County:

- Moderate nonattainment area for 8-hour ozone.
- $PM_{2.5}$ nonattainment area.
- Attainment for all other criteria pollutants.

The USEPA developed the Transportation Conformity Rule (TCR) regulations of the CAA that are applicable to transportation projects funded or approved by the FHWA or the FTA. The TCR applies to the Tappan Zee Bridge/I-287 Corridor Project since it is a transportation project (i.e., a project funded and ultimately approved by FHWA and FTA) in an ozone and $PM_{2.5}$ nonattainment area and a CO maintenance area. The conformity rule recognizes that a project listed in a conforming Transportation Improvement Program (TIP) is presumed to conform to the State Implementation Plan (SIP) with respect to regional emissions effects. In addition, the TCR requires a project level analysis to show that the project would not cause or contribute to any new violations of the NAAQS.

In addition to the criteria pollutants, the CAA also lists 188 air toxics, known as hazardous air pollutants (HAPs). For air toxic pollutants, USEPA has also identified a group of 93 HAPs as mobile source air toxics, among which a total of seven air toxics are considered the priority Mobile Source Air Toxics (MSATs). These priority MSATs include acrolein, benzene, 1,3-butidiene, diesel particulate matter plus diesel exhaust organic gases (diesel PM), formaldehyde, naphthalene, and polycyclic organic matter. The FHWA released an updated interim guidance on September 30, 2009 indicating that a MSAT analysis is required as part of the NEPA analysis for a transportation project.

As part of energy analysis requirements (Chapter 16) to address the global climate change issue, the NYSDOT also established the analysis guidance (*Draft Energy Analysis Guidelines for Project-Level*

Analysis (November 2003)) for evaluating energy-based greenhouse gas emissions in terms of carbon dioxide (CO_2) emissions associated with a transportation project.

14.2 Affected Environment

14.2.1 Mesoscale (Regional) and Microscale (Local) Study Areas and Procedures

A five-county study area for mesoscale (regional) analyses has been established – Westchester, Rockland, Orange, and Bronx Counties in New York, and Bergen County in New Jersey, the mesoscale roadway network area to be affected by the proposed project. The overall study area for microscale (local) air quality impacts is the same as the traffic study area (approximately ½ mile on both sides of the highway), with a screening process used to select individual locations for detailed analysis (see 14.3.1 below for further details).

The project level air quality impacts of a transportation project are generally evaluated for both operational and construction effects on two scales:

- The microscale level for carbon monoxide (CO), particulate matter (PM) with diameters up to 10 µm (PM_{10}), and particulate matter with diameters up to 2.5 µm ($PM_{2.5}$). A microscale analysis of traffic-related impacts at intersections or free-flow sites provides estimates of localized pollutant concentrations for direct comparison to the National Ambient Air Quality Standards (NAAQS) and/or applicable impact thresholds.

  Additionally, given potentially lengthy construction activities at specific sites, microscale scale level analyses for criteria pollutants from construction equipment, trucks, and material handling process will be performed.

- The mesoscale (area-wide) level for NO_x and VOC (precursors of O_3), CO, and PM (PM_{10} and $PM_{2.5}$). Emissions of these pollutants will be calculated on a mesoscale basis representing the project area. Such an analysis provides a comparison of mesoscale emissions among alternatives.

  In addition to the mesoscale analysis of mobile source criteria pollutant emissions, greenhouse gases (GHGs) in terms of carbon dioxide (CO_2) mesoscale emissions will also be predicted for each alternative.

The air quality analysis will be conducted in accordance with requirements of federal and state conformity regulations and environmental guidelines mainly found in the NYSDOT *Environmental Procedure Manual* (EPM). Methods, computer models, and assumptions used in the analysis will be summarized in the EIS, as will coordination efforts with federal, state, and local agencies. The detailed air quality analysis methodology is presented in the *Air Quality Impact Analysis Protocol* (hereafter "AQ Protocol") included in Appendix A of this report. Although, through consultation with the NYSDOT Environmental Science Bureau (ESB), this protocol was developed by the Consultant and approved three years ago by the NYSDOT ESB, the fundamental analysis methodologies detailed in the AQ Protocol remain valid. The major updates to the protocol include:

- The analysis years would be ETC and ETC+30 as compared to ETC, ETC+10 and ETC+20 in the protocol.

- The roadway network to be analyzed in the mesoscale analyses would include a five-county affected area – Westchester, Rockland, Orange, and Bronx Counties in New York, and Bergen County in New Jersey -- as compared to the traffic network within approximately one-mile distance within Westchester, Rockland, and Orange in New York, Fairfield in Connecticut, previously defined in the protocol.

  A microscale stationary area source impact modeling analysis will be conducted, as necessary, at certain sites where localized large scale construction activities could last for several years. Such an analysis was not considered in the original protocol. The potential location and duration of such activities will be obtained from the project's engineering and design team.

- The FHWA has released an updated Mobile Source Air Toxics (MSATs) interim guidance on September 30, 2009 and the list of priority MSATs has been changed.

These changes are consistent with ESB procedures as defined in the EPM. The USEPA is expected to release guidance by the end of 2009 or early 2010 on how to conduct quantitative microscale analyses for PM to address project-level conformity requirements. While USEPA has already released its new emissions trends estimating model (MOVES) on December 23, 2009, it is unlikely to be fully accepted by agencies for use in an EIS and related documents until later in 2010. Overall, the EIS for this project will be prepared based on the most recent accepted guidance and models updated from both USEPA and NYSDOT at the time the modeling analysis is performed.

Data from the NYS Department of Environmental Conservation's (NYSDEC) state-wide air quality monitoring network, as applicable to the study area, has been tabulated to provide a basis for characterizing existing air quality conditions. Based on those data, comparisons will be made to the NAAQS. The areas within the project corridor where the potential for air quality impacts will be assessed will be selected based on both existing traffic volumes and traffic conditions, and how those conditions will change when the project is implemented. The methods for selecting these analysis locations for the pollutants being assessed are defined in the AQ Protocol in Appendix A.

14.2.2 Air Quality Conformity Procedures

The Air Quality Conformity Analysis will be based on the results of both the mesoscale and microscale analyses as well as the project's status within the region's Transportation Improvement Program (TIP). Further details on these analyses are presented in 14.3 below.

14.2.3 Greenhouse Gas Procedures

Greenhouse gas emissions procedures are directly related to the amount of energy consumed directly by roadway and transit vehicles and indirectly in roadway maintenance and rail and highway construction, consistent with NYSDOT's *Energy and Greenhouse Gas Analysis Guidance – Project Level Analysis* (December 2003). The majority of the greenhouse gas emissions associated with the project will be CO_2, resulting from the combustion of carbon-based fossil fuels. Fossil fuels account for virtually all energy use by motor vehicles (direct energy), and for virtually all energy embedded in the construction materials and used during construction and maintenance of the roadway (indirect energy). Thus, this analysis of potential emissions of greenhouse gases will use the results from the direct and indirect energy analyses (see Chapter 16 for details). The procedures to be followed in these assessments are presented in Appendix C: *Energy and Greenhouse Gas Emissions Protocol* and are discussed further in 14.3.4 below.

14.3 Environmental Consequences

14.3.1 Microscale Analysis (Localized Impacts)

Emission factors for CO, PM_{10}, and $PM_{2.5}$ will be obtained from NYSDOT's ESB for each alternative, for each applicable roadway link, for microscale analysis purposes. These emissions will be applied to the CO, PM_{10}, and $PM_{2.5}$ microscale analysis at selected worst-case intersections and the Tappan Zee Bridge toll plaza. The selection of worst-case locations (intersections) will be based on NYSDOT's screening procedures. At these locations, receptors will be situated at nearby sensitive locations such as sidewalks, places of outdoor activity near residential buildings, restaurants, or vacant areas to which the public has continuous access. The CAL3QHC dispersion model will be used to predict the CO concentrations and CAL3QHC/R or AERMOD will be used to predict PM_{10} and $PM_{2.5}$ concentration levels at these locations.

The microscale air quality analysis will be conducted for the project's estimated time of completion (ETC) and for ETC+30.

The analysis input data to be used for above microscale analysis will be drawn from the EIS traffic analyses and from construction-related information provided by the design team. The data inputs would include operational traffic data based on BPM and Paramics model outputs, construction detour traffic inputs, where applicable, as well as construction schedule, location, equipment type and usage data.

14.3.2 Mesoscale Analysis (Regional Impacts)

Carbon monoxide, oxides of nitrogen (NO_x), volatile organic compounds (VOCs), PM_{10} and $PM_{2.5}$ are regional pollutants associated with transportation projects and they will be quantified using NYSDOT's guidance. A comparison of mesoscale air emissions will be made for each project alternative.

The estimate of mesoscale emission levels will rely on the output of the NYMTC BPM model for input parameters such as VMT, travel speeds, etc. For each alternative, mesoscale daily emission levels will be forecast for the five-county study area – Westchester, Rockland, Orange, and Bronx Counties in New York, and Bergen County in New Jersey. BPM-forecasted changes in VMT, travel speed, and vehicle mix applicable to each alternative will be inputs to the mesoscale analysis.

Based on FHWA's *Updated Interim Guidance on Air Toxic Analysis in NEPA Documents (September 30, 2009)*, if a quantitative analysis is required, the mesoscale priority mobile source air toxic (MSATs) emissions will also be analyzed using emission factors to be provided by NYSDOT's ESB.

14.3.3 Air Quality Conformity Analysis

In order to demonstrate the project-level compliance to the SIP, as per the Transportation Conformity Rule, a transportation conformity determination will be made in the EIS based on the analysis results on both microscale and mesoscale impact analyses. Since the preferred alternative may not be determined during the DEIS process and each DEIS alternative may also have different regional air quality impacts, the inclusion of the project preferred alternative into the TIP would not occur during the DEIS process.

However, the project team will work closely with the New York Metropolitan Transportation Council (NYMTC), the designated Metropolitan Planning Organization (MPO) for the New York metropolitan region, to ensure that NYMTC would appropriately model and include the project in a conforming TIP prior to the final design approval as part of the action in demonstrating the transportation conformity for the project.

14.3.4 Impacts of Greenhouse Gas Emissions

Based on NYSDOT's GHGs emissions analysis guidance and procedures established in 2003, the EIS will utilize the most recent analysis model, Motor Vehicle Emissions Simulator (MOVES) - Roadway and Rail Energy and Greenhouse Gas Analysis Extension (RREGGAE), to predict mesoscale CO_2 emissions resulting from proposed operational and construction activities under each of the alternatives. Alternatives (No Build and four build alternatives) will be compared in terms on total carbon emissions (tons/year).

14.3.5 Construction Impact Analyses

Since it is likely that construction-phase traffic detours would last more than two winter seasons at certain locations, microscale construction-phase CO concentrations will be evaluated for operational conditions (as per NYSDOT's EPM). It is expected that several affected intersections along the main detour routes will be modeled to predict CO concentration levels using NYSDOT-provided emission factors and the CAL3QHC dispersion model configured for construction-detour conditions.

To be consistent with transportation conformity regulations, a detour traffic-associated mesoscale NO_x, VOC, CO and PM emission estimate will be conducted if any construction detours/diversions would last more than five years in any one location. Annual construction equipment PM_{10} and $PM_{2.5}$ emission levels will also be estimated using USEPA's NONROAD model, based on NYSDOT's guidance.

In addition to above detour traffic-related CO concentration and equipment PM emission analyses, a microscale impact analysis for construction activities will also be conducted at certain sites where localized construction activities could last for several years. The concentration impact modeling will be conducted using USEPA AERMOD. The construction emissions would be estimated based on the construction phase, schedule, and equipment types using USEPA NONROAD model for equipment and MOBILE6.2 or MOVES2010 for vehicles. The predicted criteria pollutant concentration levels will be compared with the applicable NAAQS or incremental impact thresholds to determine potential impact significance.

14.4 Mitigation Measures

If the microscale analysis predicts a significant localized impact, practicable mitigation measures that can reduce significant impacts for either operational or construction activities will be evaluated and discussed in the EIS.

15 Noise and Vibration

The analysis of noise and vibration impacts of the project will address the following topics:

- Highway traffic noise impacts.
- Transit-alone noise and vibration impacts.
- Highway traffic and transit combined noise and vibration impacts.
- Noise barrier abatement measures.
- Construction noise impacts.

A detailed discussion of noise and vibration analysis methodology can be found in the analysis protocol developed in the January 2007 *Noise Impact Assessment Protocol* (hereafter "2007 Noise Protocol"), which is included as Appendix B. Although, through consultation with the NYSDOT Environmental Science Bureau (ESB), the 2007 Noise Protocol was developed by the Consultant and approved by the NYSDOT ESB approximately three years ago, the fundamental analysis methodologies detailed in Noise Protocol remain valid. The major updates to be included, and which are reflected in the discussion in this chapter, include:

- The detailed analysis will follow the 2006 updated FTA guidance manual (Transit Noise and Vibration Impact Assessment Manual, 2006) as compared to the early version of FTA guidance references in the 2007 Noise Protocol.

- The analysis year would be ETC+30 as opposed to ETC+20 for highway and ETC+30 for the bridge section that was indicated in the 2007 Noise Protocol.

- Additional existing noise measurements will be collected around major construction sites.

15.1 Regulatory and Permitting Requirements

The FHWA and the FTA have prescribed the policies and procedures in 23 CFR 771 for implementing the National Environmental Policy Act (NEPA). 23 CFR 771 sets forth all FHWA and FTA requirements under NEPA for the processing of highway and urban mass transportation projects.

The FHWA has developed noise regulation and guidelines that are applicable to the evaluation of federal-aid highway projects. The agency's regulation is found at 23 CFR 772 and their guidance is contained in *Procedures for Abatement of Highway Traffic Noise and Construction Noise* (FHWA, June 1995). The FHWA procedures specify the requirements that federal and state highway agencies must meet when using federal aid funds for highway projects.

The NYSDOT has adopted the FHWA's regulation and developed a traffic noise analysis policy (NYSDOT, August 1998) that describes applicability, sets criteria for noise impact, defines traffic noise analysis procedures and designates abatement measures.

The FTA has established a series of noise and vibration assessment requirements and procedures that are applicable to transit projects. These procedures are included in *Transit Noise and Vibration Impact Assessment* (FTA, May 2006). For a project where project-related noise would be generated by a combination of highway and rail transit sources, FTA's guidance provides two project categories for conducting the noise analysis. This would apply to the case where a highway/transit project involves

traffic lanes with preferential treatment for buses or HOVs, for which the state department of transportation (NYSDOT in this case) would also be participating in the environmental impact study. These multi-modal projects fall into two categories, and the appropriate method to use for noise prediction and impact determination depends on whether the highway noise dominates throughout day and night or the transit noise dominates during off-peak and late night hours. If the highway noise dominates, FHWA's noise analysis guidance should be used. The other project category from which the transit noise dominates, the FTA guidance should be applied. For this project, within the areas where transit-alone alignment is proposed, noise and vibration analysis will follow the assessment guidance provided in the FTA guidance manual.

15.2 Affected Environment

15.2.1 Noise Impact Study Area and Analysis Procedures

The noise study area was effectively the full 30-mile length of the project's I-287 Corridor in Rockland and Westchester Counties, including any areas at or near locations where project-related construction would occur or new or expanded transportation facilities would be created. Given the large area involved, the approach taken was to select representative locations within Westchester and Rockland Counties near the highway to define approximate overall sound conditions along and near the entire corridor.

In order to determine the existing noise levels, two steps were taken:

- A 24-hour noise-measurement program was conducted in November 2005 at eight locations – four in Rockland County and four in Westchester County. One important output of the 24-hour measurement effort was a determination of the hours during which highest noise levels occur at the selected measurement locations.

- Additional sites were selected along the corridor for short-term measurement purposes using the 24-hour data as a guide for the appropriate short term measurement period. Approximately three sites per mile of corridor were selected for short term noise monitoring, resulting in noise data being acquired at 95 additional corridor sites.

The noise impact area along the corridor is typically considered within 500 feet on both sides of the roadway/transit improvement alignment and these short-term measurements provide a basis for a further noise model development to predict corridor wide noise levels under each alternative.

Using the FHWA Traffic Noise Model (TNM) Version 2.5 and these measured noise levels, estimates were made of existing noise levels at locations along the entire corridor. To accomplish this, information such as roadway alignments, traffic volumes, vehicle speeds and vehicle mix were input to the TNM computer model. Once an acceptable validation of the model was achieved (i.e., when the differences between model-estimated noise values and those measured in the field are not perceptible, the model then generated noise contours along the entire corridor. The TNM-generated noise contours, along with land use data collected for other DEIS tasks, provide the existing conditions database for further estimating project impacts.

Within those areas where proposed transit improvements would not be aligned with any highway traffic, FTA's 24-hour existing noise data will be collected when transit-alone alignment alternatives are

finalized through the alternative selection process to provide existing noise conditions for further impact analyses using FTA impact criteria.

In addition to the areas of concern under the proposed operational conditions, existing condition noise measurements will also be made at those noise sensitive areas that would likely be affected by major construction activity components, such as residential areas along Hudson River shore line close to the new bridge. These levels (to be done after transit alignments in the Build alternatives are finalized) will provide a basis to evaluate potential noise increases resulting from the bridge construction activities.

The study locations for construction-related noise analyses will be selected based on the civil/structural design team's estimation of where certain high-noise level activities would occur during the construction of various components of the project, based on the nature of such activities and their proximity to sensitive land uses. This process and the analysis procedures to be followed are discussed further in 15.3.3 below.

15.2.2 Vibration Impact Area and Analysis Procedures

Vibration noise impacts will include both construction-related vibration impacts (discussed in 15.3.3 below) and those potentially associated with transit operations. As with construction noise analyses, study locations for construction-related vibration analyses will be selected based on the design team's estimation of where certain vibration-generating activities would occur and their proximity to sensitive land uses.

Vibration impacts will be assessed in accordance with FTA's guidelines following a two-step screening procedure: initial screening and general assessment. Although a detailed analysis may be warranted if exceedances are predicted through the screening process, it is expected that such an analysis would be conducted during the project final design stage since ground-borne vibration is a complex phenomenon that is difficult to model and predict unless both soil conditions and detailed design information are available.

15.3 Environmental Consequences

15.3.1 Noise Impacts

Highway-related noise impacts of project alternatives within the majority of project areas will be predicted by adjusting inputs to the existing condition TNM model to reflect both the geometry of proposed future highway configurations and the projected future traffic volumes under those configurations. Vehicular traffic-noise impacts will be evaluated by comparing predicted future noise levels for the project design year along the I-287 ROW with the noise abatement criteria, existing noise conditions, and future No Build conditions.

The noise criteria applicable to the comparisons will be those established by FHWA and NYSDOT. The design year for the Tappan Zee Bridge and highway noise analysis will be ETC+30 (i.e., 2047) as per the NYSDOT EPM (this is expected to represent a worst case approach). It should be noted that the design year noise from BRT component under each alternative will be analyzed using the same TNM model established to predict future highway noise levels.

The rail transit noise component will be predicted using FTA's assessment guidance. The TNM-predicted highway noise will then be combined with the transit noise to enable development of highway traffic and transit combined noise contours for each alternative. The FHWA's noise impact criteria will then be applied to determine the overall noise implications of the alternatives.

Within those areas where a transit improvement is not aligned with any highway traffic, FTA impact criteria will be used for impact determination.

15.3.2 Vibration Impacts

Vibration noise impacts due to project operations will be identified through the proposed two-step screening procedure (see Appendix C: Noise Protocol, for further details). Any more detailed analysis that may be warranted would be conducted during the project final design stage when more detailed geotechnical information and project design information are available.

15.3.3 Construction Impacts

- **Noise**. Feasible short-term impacts of construction-equipment noise on nearby receptors will be evaluated using the FHWA-developed Roadway Construction Noise Model. This model is used for the prediction of construction-equipment noise during project development and incorporates comprehensive noise-control specifications and an extensive construction-equipment noise database. Construction equipment noise impacts will be determined based on FTA's impact threshold. Potential net noise increase around major construction sites will also be evaluated in the EIS. These major construction sites are those at which (1) the greatest scale of construction activities would occur, and (2) residences are located in close proximity. These, would likely include the on-shore staging areas at both ends of the bridge.

  Since traffic detours can be expected during construction, detoured-traffic noise effects will be analyzed along major detour traffic routes, where applicable, using the same modeling procedures discussed above for operational conditions. Existing noise conditions along these major detour routes will be determined through application of the TNM model. Detour traffic-noise impacts will be determined based on the net change from existing noise levels that occurs at each receptor location.

  The construction activity data inputs would be provided by the project engineering and design team and they include detour traffic inputs, if applicable, as well as construction schedule, location, equipment type and usage data.

- **Vibration**. The potential for construction-related vibration impacts on existing buildings or use in the corridor will be assessed by using GIS mapping to juxtapose areas along the corridor where high vibration-producing construction activities (primarily blasting and pile driving) are likely to occur (to be provided by the project's engineering team) with potentially sensitive land uses or structures. Any information regarding soil or other sub-surface conditions (e.g., bedrock) will be used in completing this assessment. The types of impacts that could occur and the likely range of mitigation measures that could be utilized to minimize such impacts will be documented, consistent with FTA's Transit Noise and Vibration Impact Assessment Manual and utilizing US Bureau of Mines building damage criteria (e.g., the safe blasting limit of 2 inch/sec recommended in *Structure Response and Damage Produced by Ground Vibration from Surface Mine Blasting*, Report of

Investigations 8507, 1980) and similar sources to help identify the potential location and scale of such impacts.

15.4 Mitigation Measures

Feasible and reasonable abatement measures will be identified to reduce traffic-noise levels where impacts due to the proposed project are projected to occur. In each impacted area, a refined noise-barrier abatement analysis will be conducted using the TNM model. Noise levels under both existing and future build conditions will be used to determine abatement-barrier cost and effectiveness by considering changes in barrier height, length and location. Other highway traffic noise abatement measures such as traffic management will also be evaluated qualitatively.

Within those areas where a transit improvement is not aligned with any highway traffic, the mitigation measures established by FTA in the noise and vibration assessment guidance will be evaluated as necessary. Potential transit noise abatement measures include rail lubrication, engine compartment treatment, sound barrier, building insulation, etc.

Mitigation measures related to reducing impacts from construction equipment will also be evaluated. Measures associated with construction-related vibration impacts (primarily from blasting and pile driving or similar activities) would be identified and their likely potential impacts reviewed qualitatively. Detailed studies of their effectiveness and defining actual mitigation programs would be developed where needed during the design phases of the project, when more detailed location-specific information about sub-surface conditions and construction activities would be known.

16 Energy Analyses

The FHWA 1987 guidelines for preparing EISs require quantifying direct and indirect energy consumption due to a highway project. The *State Energy Plan*, adopted in 2002, calls for the state's transportation sector to be more energy efficient and sets goals for reducing consumption. Accordingly, the potential energy effects associated with the proposed action are compared to taking no action (the No-Build alternative).

The energy analysis consists of two components: direct and indirect energy analysis. The direct energy analysis calculates the potential annual energy consumed by both highway and transit vehicles. The indirect energy includes the energy associated with construction and maintenance of the project. A detailed methodology in these areas, *Energy/Greenhouse Gas Analysis* Protocol ("2007 Protocol"), is included as Appendix C. Although, through consultation with the NYSDOT Environmental Science Bureau (ESB), the 2007 Protocol was developed by the Consultant and approved by the NYSDOT ESB approximately three years ago, the fundamental energy analysis methodologies detailed in the protocol remain valid. The major required update to the protocol, which is reflected in the discussion in this chapter, is the use of the most recent updated energy and greenhouse gas emissions analysis model (MOVES-RREGGAE) currently being developed by NYSDOT to predict highway vehicle associated energy consumption. Since energy-related activities are the most significant contributor to US greenhouse gas emissions discussed in Chapter 14, the forecasted energy consumption data under each alternative will be used to assess the project's predicted greenhouse gas emissions.

16.1 Regulatory and Permitting Requirements

The Council on Environmental Quality (CEQ) issued regulations implementing NEPA that specifically require the consideration of direct and indirect energy requirements of various project alternatives and mitigation measures to conserve energy (40 CFR 1502.16(e)).

The US DOT published revisions to its guidance on the format and content of environmental documents in the December 29, 1980 Federal Register. The guidance outlines the potential actions that should be considered in developing an energy assessment. While still not a specific procedure, the guidance does provide a fairly extensive list of analyses which should be performed for major highway projects. FHWA's guidance closely follows USDOT's guidance.

NYSDOT's *Draft Energy Analysis Guidelines for Project-Level Analysis* (November 2003) will be followed, utilizing the most recent energy analysis model, MOVES-RREGGAE, being developed by NYSDOT.

16.2 Affected Environment

16.2.1 Energy Analysis Study Area

There is no specific energy study area for indirect (construction-related) energy use, which is based on the level of project-related construction activities and the materials uses in them. The study area for direct

energy use (highway and transit vehicle use) is the roadway network in Westchester, Rockland, Orange, and Bronx Counties in New York and for Bergen County in New Jersey.

16.2.2 Energy Analysis Data and Procedures

The EIS energy analysis will consist of two components: direct and indirect energy analysis. NYSDOT's MOVES-RREGGAE model will be used to predict both direct and indirect energy consumptions associated with each proposed alternative. No separate data collection is required as all information is already included in the transportation modeling and analyses and engineering design information about the proposed project under its various alternatives.

The direct energy consumption associated with vehicle operations (highway and transit) will be calculated based on the VMT forecasted by the regional trip demand model (Best Practice Model) along various roadway segments for the AM, midday, PM, and nighttime periods for each type of roadway. The analysis will be conducted for the roadway network in Westchester, Rockland, Orange, and Bronx Counties in New York and for Bergen County in New Jersey.

Indirect energy consumption consists of energy usage for roadway and bridge construction, transit construction and system maintenance. The Lane-Mile Approach, which is based on the use of construction energy factors established for various types of roadway construction categories, will be employed to predict construction energy requirements.

16.3 Environmental Consequences

The projected energy impacts of the proposed project's various alternatives will be presented in tabular form, summarizing, in millions of British Thermal Units (BTUs) the amount of annual energy consumption in the analysis years (2017 and 2047). This would include direct energy consumption (annual) and indirect energy consumption, which would be annualized over a 30-year period.

16.4 Mitigation Measures

Given the lack of established energy consumption impact criteria, the analysis results will be used solely for NEPA disclosure purposes. Therefore energy mitigation measures will be discussed qualitatively through providing a brief list of energy conservation options associated with both direct and indirect energy-consumed activities. It is also likely that due to improved highway operation and (for 2047 Build conditions) expanded transit uses, overall annual energy use would be less than under future No Build conditions.

17 Cultural Resources: Historic Properties

Historic properties, or resources, are defined as buildings, structures, sites, objects, and districts that are over 50 years old, possess integrity, and meet the criteria of eligibility for listing in the National Register of Historic Places (National Register) as defined by the National Park Service (NPS). Buildings, structures, objects and districts are discussed in this chapter. Sites are typically archaeological resources, and are discussed in Chapter 18.

Identification and analysis of effects to historic resources will be undertaken in accordance with two major federal statutes: Section 106 of the National Historic Preservation Act (NHPA) (regulations at 36 CFR Part 800 – Protection of Historic Properties) and Section 4(f) of the US Department of Transportation Act (regulations at 23 CFR Part 774 – Parks, Recreation Areas, Wildlife and Waterfowl Refuges, and Historic Sites). Section 106 is described below, and Section 4(f) is described in Chapter 26 (Section 4(f)/6(f) Evaluation).

17.1 Regulatory Requirements

Implementing regulations for Section 106, established by the Advisory Council on Historic Preservation (ACHP), require that lead federal agencies take into account the direct, indirect, and cumulative effects of their actions on any National Register-listed and/or eligible resource within the area of potential effect (APE) defined for an undertaking. Under Section 106 for this project, FHWA and FTA are the lead federal agencies, and have determined that the proposed Tappan Zee Bridge/I-287 Corridor Project constitutes an undertaking. FHWA and FTA are responsible for compliance with Section 106 for this project, and the Project Sponsors, in cooperation with those agencies, will prepare all required documents.

In accordance with Section 106 for this project, Project Sponsors and FHWA and FTA will coordinate with NYSHPO to identify National Register-listed and National Register-eligible properties within the APE. In addition, the agencies will coordinate with NYSHPO to decide whether recommended National Register-eligible historic resources identified within the APE as part of this project possess adequate significance and integrity to be determined eligible for listing in the National Register.

If FHWA and FTA determine that National Register-listed and/or National Register-eligible historic resources would be adversely affected as a result of the undertaking, the regulation requires that the Project Sponsors and FHWA and FTA document that alternatives to avoid or minimize impacts have been considered. If adverse impacts cannot be avoided, these agencies would collaborate with consulting parties to develop and implement measures to mitigate such effects. Consulting parties generally include NYSHPO, Native American tribes, local governments, individuals and organizations with a demonstrated interest in the undertaking, and the general public.

To date, multiple steps have been taken by the Project Sponsors, in cooperation with FHWA and FTA, to comply with Section 106. These include the identification of consulting parties; development of APE guidelines for historic resources; identification and screening of historic resources; archaeological surveys, and a preliminary analysis of the potential Section 106 effects of the Tappan Zee Bridge.

17.1.1 Agency Coordination

The agencies identified as participants in the Section 106 process for this project include:

- Project Sponsors (NYSDOT, NYSTA, and Metro-North).
- Joint Lead Agencies (FHWA and FTA).
- Review Agency/Consulting Party (NYSHPO).

The ACHP, who provides guidance and advice concerning the operation of the Section 106 process, may choose to participate in the Section 106 process under the following circumstances:

- An undertaking has substantial impacts on important historic properties.
- An undertaking presents important questions of policy or interpretation.
- An undertaking has the potential for presenting procedural problems, including, but not limited to, disputes among or about consulting parties which ACHP's involvement could help resolve.
- An undertaking presents issues of concern to Native American tribes (36 CFR Part 800, Appendix A).

ACHP has also been notified by FHWA and FTA about the project. To date it has not formally chosen to participate, but has agreed to provide technical assistance with the Section 106 process in coordination with NEPA (Vaughn, April 17, 2009).

Two meetings have been held to date with Project Sponsors, FHWA, FTA, NYSHPO, and ACHP. In Fall 2008, Project Sponsors, FHWA, and FTA met with NYSHPO to report on the status of the project. In Spring 2009, ACHP requested a field meeting with Project Sponsors, FHWA, and FTA to obtain an update on the project, and view portions of the Tappan Zee Bridge/I-287 Corridor.

In 2008, the Project Sponsors, in cooperation with FHWA and FTA, invited over 35 entities to participate in the project as Consulting Parties, in addition to NYSHPO and ACHP. To date, eight entities responded and have been approved as Consulting Parties. These include:

- Rockland County Historic Preservation Board.
- National Historic Landmark (NHL) Lyndhurst, a property of the National Trust for Historic Preservation.
- NHL Sunnyside, a property of Historic Hudson Valley.
- Friends of the Old Croton Aqueduct (FOCA), a NHL.
- Westchester County Department of Planning.
- Village of Tarrytown Planning Board.
- Stockbridge-Munsee Band of Mohican Indians.
- Delaware Nation.

The Stockbridge-Munsee Band of Mohican Indians and the Delaware Nation are federally recognized tribes with ancestral ties to New York State. Both tribes have been invited and accepted consulting party status for the project and will be involved through coordination with their respective Tribal Historic Preservation Officer.

Project Sponsors have had multiple meetings with select Consulting Parties to date. Six meetings were held with Project Sponsors and NHL Lyndhurst in Spring and Summer 2004, Summer 2007, Spring 2008, Fall 2009, and Winter 2010. One meeting was held in Summer 2007 with Project Sponsors and FOCA, overseers of the NHL Old Croton Aqueduct. One meeting was also held with Project Sponsors and NHL Sunnyside in Winter 2010. The purpose of the meetings was to explain the goals and objectives of the project, and enable Consulting Parties to express their concerns.

In Fall 2008, Project Sponsors, FHWA, and FTA had one meeting with NYSHPO and seven Consulting Parties. Sunnyside did not attend because they were not a Consulting Party at that time. The purpose of the meeting was to explain the goals and objectives of the project, the bridge and transit mode recommendations, the APE guidelines for historic resources, and to allow the Consulting Parties to express their concerns. It is anticipated that additional meetings will be held with the Consulting Parties pertaining to the following issues:

- Review of the APE and identification of historic and archaeological resources within it.
- Review of Section 106 effects assessment.
- Review of proposed measures to mitigate adverse effects.

The purpose of the meetings will be to obtain feedback from the Consulting Parties and address their concerns. Public input will also be sought on these issues during outreach conducted in conjunction with preparation of the EIS, including open houses, general meetings, public hearings, Stakeholder Advisory Working Group (SAWG) meetings, and response to comments provided on documents.

17.1.2 Section 106 Programmatic Agreement

Section 106 allows for phased identification and evaluation of historic and archaeological resources where undertakings consist of corridors or large land areas, as is the case with the Tappan Zee Bridge/I-287 Corridor Project (36 CFR 800.4[b][2]). As noted in Chapter 1, the EIS will be completed using a tiered process to facilitate decision-making. Therefore, a Programmatic Agreement (PA) will be developed throughout the DEIS process by the Project Sponsors, in cooperation with FHWA, FTA, NYSHPO, ACHP, and the Consulting Parties (36 CFR 800.14[b][3]). The PA will accomplish several goals as follows:

- Establish a process for phased identification of historic and archaeological resources within the APE.

- Establish a process to guide assessment of direct, indirect, and cumulative effects of the four Build Alternatives on historic resources and the direct and cumulative effects on archaeological resources within the APE. Effects will be assessed according to the level of design development available during the Tier 1 transit analysis and Tier 2 highway, bridge, and transit alignment accommodations analysis.

- Establish a process to explore avoidance and/or modification of alternatives that adversely affect historic and archaeological resources as described in Subchapter 17.3.

- Establish a process to guide development of mitigation measures and stipulations for adversely affected historic and archaeological resources as described in Subchapters 17.4 and 18.4, respectively.

- Establish a process for resolving concerns raised by FHWA, FTA, NYSHPO, ACHP and the Consulting Parties as the project moves into the design phase, construction phase, and subsequent transit environmental process.

To allow for early concurrence on procedural issues among all required parties, the initial drafts of the PA will focus on the review sequence of the consultation process, and the Tier 1 and Tier 2 assessments to be completed. As DEIS analyses are completed, subsequent drafts of the PA will identify adversely affected historic and archaeological resources, methods to minimize impacts, and stipulations to mitigate unavoidable adverse effects.

The fully executed PA will be signed by all required parties and included in the FEIS prior to issuance of the ROD. Depending on the nature of the stipulations, they will be implemented prior to commencement of, or during construction activities, or in conjunction with the subsequent transit elements environmental process.

17.2 Affected Environment

17.2.1 APE Guidelines for Historic Resources

A required step in the Section 106 process is the identification of historic resources. The APE is used to guide the geographic scope of identification of resources. Section 106 defines the APE as the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic resources. Direct effects typically include, but are not limited to, the complete or partial taking of property, or alterations not consistent with the *Secretary of the Interior's Standards for Treatment of Historic Properties*. Indirect effects typically include, but are not limited to, introduction of visual, atmospheric (e.g., bad odors; degradation of air quality; etc.), or audible elements that diminish the integrity of the property's significant historic features, including its setting.

Section 106 also requires an analysis of cumulative effects, which is also required by NEPA. According to NEPA, cumulative effects are defined as the incremental impact of an undertaking on a historic resource when added to other past, present, and reasonably foreseeable future actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time (40 CFR § 1508.7).

The APE is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking. Section 106 allows for phased identification and evaluation of historic resources where undertakings consist of corridors or large land areas, as is the case with the Tappan Zee Bridge/I-287 Corridor Project (36 CFR 800.4[b][2]).

Table 17-1 provides a description of guidelines for the historic resources APE based on four components associated with the four build alternatives selected for this project. As indicated in Table 17-1, three of the four components are associated with proposed highway, bridge, and transit alignment accommodations along the Thruway in Rockland County, and replacement bridge landings in Rockland and Westchester Counties. All four components are associated with proposed transit elements such as CRT and BRT alignments in Rockland County, and CRT Hudson Line Connector and BRT alignments in Westchester County.

Table 17-1

Guidelines for Historic Resources APE

Construction Type	Boundaries of APE Component [1,2]	Element
1) Thruway modifications in Rockland and Westchester Counties (i.e., highway/bridge) and transit alignments along I-287 in Westchester County	Baseline APE of 500' from either side of centerline of 30-mile Tappan Zee Bridge/I-287 Corridor between Suffern and Port Chester; accommodates proposed transit stations and associated infrastructure	Highway, bridge, and transit alignment accommodations Transit elements
2) Selected road improvements within an *existing* street; selected transit alignments within an *existing* rail corridor or on an *existing* street	50' from centerline of road bed or single-track bed; if multiple tracks, 50' from outermost track; accommodates proposed transit stations and associated infrastructure	Highway, bridge, and transit alignment accommodations Transit elements
3) Selected road alignments at grade within a *new* corridor; selected transit alignments at grade within a *new* corridor	100' from centerline of new corridor	Highway, bridge, and transit alignment accommodations Transit elements
4) Tunnels and below-grade transit alignments	50' from centerline of the tunnel walls	Transit elements

[1] If a property line falls within the boundaries, all buildings on the property will be surveyed.
[2] Boundaries take into account direct and indirect effects. However, indirect effects associated with replacement of the Tappan Zee Bridge and major transit infrastructure in Rockland County necessitate delineation of a more expansive indirect APE in these two areas.

The guidelines in Table 17-1 were presented to NYSHPO at the Fall 2008 meeting, and NYSHPO indicated that these guidelines would be useful when developing a historic resources APE for this project. The guidelines in Table 17-1 were also presented to the seven Consulting Parties in Fall 2008, but they did not offer comments.

After the meeting with NYSHPO, however, the agency indicated that additional guidelines must be developed to more carefully take into account indirect effects of the project. It is anticipated proposed replacement of the Tappan Zee Bridge and major transit infrastructure associated with future transit elements may result in indirect effects to historic resources. Approaches for the indirect APE boundary guidelines have been devised as described in Subchapters 17.2.1.1. and 17.2.1.2.

Furthermore, transit-related structures associated with potential BRT and CRT transit modes may also necessitate revision of proposed historic resources APE guidelines in Table 17-1 because of the potential audible impacts. Architectural historians will utilize noise data to be developed for this project to determine if the historic resources APE guidelines are adequate or require revision.

17.2.1.1 Approach for Indirect APE Boundary Guidelines for the Tappan Zee Bridge

The approach for the indirect APE boundary guidelines associated with proposed replacement of the Tappan Zee Bridge will be implemented by Project Sponsors, in cooperation with FHWA and FTA, as follows:

- Conduct field visit to locations where prominent views of the existing Tappan Zee Bridge and Hudson River could be obstructed or altered by a replacement bridge.
- Develop indirect APE boundary guidelines associated with proposed bridge replacement.
- Conduct reconnaissance-level survey within indirect APE boundary guidelines for two classes of historic resources:
  - Newly identified resources over 50 years old that retain integrity, appear to be eligible for listing in the National Register, and whose significance is based, in part, upon its river views or river setting.
  - Previously identified resources whose National Register eligibility is based, in part, upon its river views and river setting. This will be accomplished by a review of the statement of significance documented in the National Register nomination forms and National Register eligibility assessments on file at NYSHPO and other state and local repositories. In accordance with Section 106, consideration shall be given to all aspects of a historic resource's integrity that render it significant, including those that may have been identified subsequent to the original eligibility assessment, such as river setting.
- Describe and illustrate newly identified and previously identified resources, and seek and address comments from NYSHPO and Consulting Parties.

17.2.1.2 Approach for Indirect APE Boundary Guidelines for Major Transit Infrastructure

The approach for the indirect APE boundary guidelines associated with major transit infrastructure will be implemented by Project Sponsors, in cooperation with FHWA and FTA, as follows:

- Conduct field visits to locations which may be visually affected by proposed major transit infrastructure. These include:
  - CRT structures such as viaducts, tunnel vent shafts, and access shafts approximately 40 to 50 feet or higher than the existing Thruway elevation.
  - BRT structures such as busway viaducts and Texas-T-type structures associated with proposed station locations, which would be approximately 40-50 feet or more above the existing elevations of the Thruway or railroad ROWs.
- Develop indirect APE boundary guidelines associated with major transit infrastructure.
- Conduct reconnaissance-level survey within indirect APE boundary guidelines for two classes of historic resources:
  - Newly identified resources that are over 50 years old, retain integrity, possess significance, and appear to be eligible for listing in the National Register.
  - Previously identified resources whose National Register eligibility may be affected by proposed major transit infrastructure.
- Describe and illustrate newly identified and previously identified resources, and seek and address comments from NYSHPO and Consulting Parties.

17.2.2 Final APE for Historic Resources

Following approval of the indirect APE boundary guidelines for the Tappan Zee Bridge and major transit infrastructure, the Project Sponsors, in cooperation with FHWA and FTA, will revise the guidelines in Table 17-1 to define the final APE for historic resources. The final APE will be based upon the four Build Alternatives to be analyzed in the DEIS.

17.2.3 Corridor Cultural Resources

Project Sponsors, in cooperation with FHWA and FTA, are preparing a historic resources survey to identify historic properties and conduct screening according to the standards of Section 106 and the NYS Education Department *Cultural Resources Survey Program Work Scope Specifications for Cultural Resource Investigations on NYSDOT Projects* (March 2004). Research has been conducted at NYSHPO and repositories in Rockland and Westchester Counties to obtain information on previously identified historic resources within the historic resources APE. Field survey is underway within the same area to identify potentially National Register-eligible resources.

Four categories of resources have been identified within the historic resources APE. These include:

- NHLs.
- National Register-listed resources (NRLs).
- National Register-eligible (NRE) resources, including the Tappan Zee Bridge.
- Recommended NREs - historic resources identified during ongoing field survey and screening that appear to meet the criteria for listing in the National Register will be documented on NYSHPO Blue Forms, and submitted by NYSDOT to NYSHPO for National Register eligibility determinations.

The results of the historic resources survey will be summarized by Project Sponsors, in cooperation with FHWA and FTA, in the EIS, and included in the *Technical Report 8 – Architectural History*. The report will be incorporated as an appendix to the EIS. The EIS and report will be reviewed by NYSHPO and the Consulting Parties. Project Sponsors, in cooperation with FHWA and FTA, will respond to comments and obtain concurrence on the findings from NYSHPO.

17.3 Environmental Consequences

Section 106 requires that Project Sponsors, in cooperation with FHWA and FTA, assess the direct, indirect, and cumulative effects of feasible alternatives on historic resources as defined in Subchapter 17.2. The Criteria of Adverse Effects in Table 17-2 will be applied by Project Sponsors, in cooperation with FHWA and FTA, to determine whether historic resources are adversely affected. For those historic resources adversely affected by the preferred alternative, avoidance of adverse effects will be explored by Project Sponsors, FHWA, and FTA.

Proposed highway, bridge, and transit alignment accommodations are slated along the Thruway in Rockland County, the Hudson River, and replacement bridge landings in Rockland and Westchester Counties. In addition, proposed transit elements are slated along the Thruway and the Piermont Line ROW in the Village of Suffern in Rockland County, and the CRT Hudson Line Connector in the Village of Tarrytown and BRT alignments in Westchester County. The direct effects of these project elements on historic resources will be evaluated in a similar manner. However, indirect effects will be evaluated in a different manner based on the level of design development available as described in Subchapters 17.3.1 and 17.3.2.

The direct and indirect effects analysis will be summarized by Project Sponsors, in cooperation with FHWA and FTA, in the EIS, and included in the *Technical Report 8 – Architectural History*. The report will be incorporated as an appendix to the EIS.

The EIS and *Technical Report 8 – Architectural History* will be reviewed by NYSHPO and the Consulting Parties. Project Sponsors, in cooperation with FHWA and FTA, will respond to comments and obtain concurrence on the findings from NYSHPO.

Cumulative effects on historic resources will be evaluated by Project Sponsors, in cooperation with FHWA and FTA, in Chapter 28 of the EIS.

Table 17-2

Criteria of Adverse Effects

Criteria of an Adverse Effect
"An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of an historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative." Source: (36 CFR 800.5[a][1]).
Examples of Adverse Effects
Adverse effects on historic properties include, but are not limited to: 1. Physical destruction of or damage to all or part of the property; 2. Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation, and provision of handicapped access, that is not consistent with the *Secretary of the Interior's Standards for the Treatment of Historic Properties* (36 CFR Part 68) and applicable guidelines; 3. Removal of the property from its historic location; 4. Change of the character of the property's use or physical features within the property's setting that contribute to its historic significance; 5. Introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features; 6. Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organization; 7. Transfer, lease, or sale of property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance." Source: (36 CFR 800.5[a][2]).

17.3.1 Highway, Bridge, and Transit Alignment Accommodations

Adequate project engineering for proposed highway, bridge, and transit alignment accommodations will be available for Project Sponsors, in cooperation with FHWA and FTA, to prepare an indirect effects analysis in accordance with Section 106 that will evaluate the potential visual, atmospheric, or audible effects that proposed highway, bridge, and transit alignment accommodations may have on historic resources in the historic resources APE. Audible effects will be analyzed according to noise and vibration data presented in Chapter 15 of the EIS. Anticipated indirect effects may include impacts on the integrity of a historic resource, including location, setting, feeling, and association.

Visual simulations of the proposed replacement bridge will also be developed in coordination with the simulations being prepared for Chapter 19 – Visual Resources to assist in this analysis. The simulations will be evaluated to determine if the replacement bridge adversely affects any aspects of a historic resource's integrity that render it significant, including its river setting.

17.3.2 Transit Elements

Project Sponsors, in cooperation with FHWA and FTA, will prepare an indirect effects analysis that will evaluate the potential visual, atmospheric, or audible effects that proposed transit elements may have on historic resources in the historic resources APE. Audible effects will be analyzed according to noise and vibration data presented in Chapter 15 of the EIS. Anticipated indirect effects may include impacts on the integrity of a historic resource, including location, setting, feeling, and association.

Visual simulations of proposed major transit infrastructure will be developed according to the level of design development available in coordination with the simulations being prepared for Chapter 19 – Visual Resources to assist in this analysis. The simulations will be evaluated to determine if the infrastructure adversely affects any aspects of a historic resource's integrity that render it significant.

17.3.3 Section 106 Impacts Analysis of the Tappan Zee Bridge

In 2009, Project Sponsors, in cooperation with FHWA and FTA, prepared a report entitled *Alternatives Analysis for Rehabilitation and Replacement of the Tappan Zee Bridge*. The report recommended that only single- and dual-level bridge replacements be studied in the EIS. As described in the report, the Tappan Zee Bridge was determined to be a NRE resource at the inception of this project in 2003. It was also included on FHWA's 2006 list of 22 features in New York State considered to be nationally and exceptionally significant features of the Federal Interstate Highway System because of its buoyant caissons.

As a result, the above referenced report included, as Appendix D, a preliminary Section 106 effects analysis of the effect that bridge replacement would have on the structure. In accordance with Section 106, the report concluded that rehabilitation and replacement options result in an adverse effect on the Tappan Zee Bridge. While the rehabilitation options would alter the contributing structural elements of the Tappan Zee Bridge, including the causeway, east and west deck truss spans, main span, and buoyant caissons, the replacement options would permanently remove the bridge.

Analysis of the adverse effects that replacement of the Tappan Zee Bridge will have on the NRE bridge will be documented in the EIS and *Technical Report 8 – Architectural History* by Project Sponsors, in

cooperation with FHWA and FTA. The report will be incorporated as an appendix to the EIS. The EIS and report will be reviewed by NYSHPO and the Consulting Parties. Project Sponsors, in cooperation with FHWA and FTA, will respond to comments and obtain concurrence on the findings from NYSHPO.

17.4 Mitigation Measures

Project Sponsors, in cooperation with FHWA and FTA, will consult with NYSHPO, the Consulting Parties, and ACHP to develop mitigation measures that will be included in the PA described in Subchapter 17.1.2. The PA will include specific recommendations for historic resources that would be adversely affected in a direct or indirect manner by highway, bridge, and transit alignment accommodations. Recommendations will also be developed for historic resources that would be affected in a direct manner by transit elements. Sample recommendations are described in Subchapter 17.4.1.

Because of the level of design development available, it will not be possible for the agencies and the Consulting Parties to develop detailed mitigation recommendations for historic resources that would be indirectly affected by transit elements. Therefore, broad general concepts, rather than specific recommendations, will be developed for these elements. Sample concepts are described in Subchapter 17.4.2.

The recommendations and concepts will be summarized by Project Sponsors, in cooperation with FHWA and FTA, in the EIS, and included in the *Technical Report 8 – Architectural History*. The report will be incorporated as an appendix to the EIS. The EIS and report will be reviewed by NYSHPO and the Consulting Parties. Project Sponsors, in cooperation with FHWA and FTA, will respond to comments and obtain concurrence on the findings from NYSHPO.

17.4.1 Mitigation Recommendations

Project Sponsors, in cooperation with FHWA and FTA, will develop mitigation recommendations to be included in the PA described in Subchapter 17.1.2. The recommendations will be developed for historic resources in the APE that would be adversely affected in a direct and indirect manner by preferred highway, bridge, and transit alignment accommodations alternatives, and a direct manner by preferred transit elements alternatives. If adverse effects cannot be avoided, mitigation stipulations may include, but not be limited to:

- Preparation of Historic American Buildings Survey (HABS)/Historic American Engineering Record (HAER) or NYSHPO documentation reports on adversely affected resources, such as the NRE Tappan Zee Bridge. These reports typically include physical descriptions, historic contexts, historic photos and plans, and large-format black & white photographs. Reports concerning nationally significant resources such as the NRE Tappan Zee Bridge are usually filed at the Library of Congress in Washington, DC, and state and local repositories such as NYSHPO and local libraries. Reports concerning resources with state and local significance are filed at state and local repositories.

- Development of publicly distributed brochures; local museum exhibitions with a public education component; and web sites describing the NRE Tappan Zee Bridge and the architectural heritage of the Hudson River Valley.

- Development of context sensitive designs that take into account the location and setting of adversely affected historic resources in their configuration and layout.

17.4.2 Mitigation Concepts

Project Sponsors, in cooperation with FHWA and FTA, will propose mitigation concepts to be included in the PA described in Subchapter 17.1.1.2. The concepts will be developed for historic resources in the APE that would be adversely affected in an indirect manner by preferred transit elements alternatives. Potential mitigation concepts may include identification of key areas of concern, and establishment of a process for resolving concerns as additional information becomes available for transit elements, and the project moves into the design phase, construction phase, and subsequent transit environmental process.

18 Cultural Resources: Archaeology

Archaeological resources are included in the National Park Service's definition of historic resources as buildings, objects, structures, sites, and districts that are over 50 years old, possess integrity, and meet the criteria of eligibility for listing in the National Register. Archaeological resources may date to the prehistoric or historic period; both are expected to be encountered during archaeological investigations along the Corridor.

18.1 Regulatory Requirements

Identification of, and analysis of the potential impacts to archaeological resources will be undertaken in accordance with Section 106 of the NHPA (36 CFR Part 800), Section 4(f) of the USDOT Act (23 CFR Part 774), and NYSDOT/NYSHPO procedures for implementing Section 106, adopted by both agencies in 2001 as discussed above in Chapter 17, Historic Resources. In addition, archaeological assessments and surveys will be conducted pursuant to the standards of the NYS Education Department (SED) Cultural Resources Survey Program Work Scope Specifications for Cultural Resource Investigations on NYSDOT Projects (March 2004).

The SED specifications are designed to assist NYSDOT in meeting its cultural resources compliance needs under Section 106 of the NHPA of 1966 (as amended) for federally sponsored projects and Section 14.09 of Parks, Recreation and Historic Preservation Law of 1980 for state sponsored projects. The March 2004 revised work scope specifications are a result of negotiations between SED, NYSDOT, and the NYSHPO, including those revisions made in January 2001. In January 2001, New Section 106 procedures were established between NYSDOT, SHPO, and FHWA based on revised regulations that went into effect in January 2001. As a result, NYSDOT assumed the responsibility for making National Register eligibility recommendations through the SED Cultural Resources Survey Program. The eligibility determinations were previously made by NYSHPO. The new procedures specify review and concurrence by NYSHPO and FHWA with the recommendations presented in the survey reports. The FHWA retains legal responsibility for all Section 106 findings and determinations.

Multiple steps have been taken to implement the Section 106 process. These include: the identification of consulting parties; the development of guidelines for the archaeological APE (hereafter referred to as the preliminary APE); screening of previously identified archaeological resources; Phase I archaeological survey; and meetings with the FHWA and FTA, Project Sponsors, the consulting parties, and the NYSHPO. These steps are discussed in Chapter 17 (Cultural Resources: Historic Properties).

18.1.1 Agency Coordination

18.1.1.1 Section 106 Participants and Consulting Parties

Several federal and state agencies are participants in the Section 106 process for this project. These are:

- FHWA and FTA (Joint Lead Agencies).
- NYSDOT, NYSTA, and Metro-North (Project Sponsors).
- NYSHPO (Review Agency/Consulting Party).

While the ACHP does not participate in the Section 106 process as a consulting party under normal circumstances, the ACHP does provide guidance and advice regarding the Section 106 process. The ACHP has been notified by FHWA and FTA about this project, and they have agreed to provide technical assistance to the FHWA and FTA and Project Sponsors in carrying out the Section 106 process in coordination with NEPA.

In 2008, the Project Sponsors, in cooperation with the FHWA and FTA, invited over 35 entities to participate in the project as Consulting Parties, in addition to NYSHPO. To date, seven entities responded and have been approved as Consulting Parties. These parties are identified in Chapter 17 (Cultural Resources: Historic Properties).

18.2 Affected Environment

Archaeological resources are potentially affected by direct impacts from construction activity resulting in disturbance to the ground surface such as excavation, grading, compression from movement or storage of heavy objects or equipment, and vibrations such as those caused by movement of heavy equipment. For archaeological resources, it is necessary to determine where and to what degree highway, bridge, and transit alignment accommodations and proposed transit elements will impact potentially undisturbed project area ground surfaces. Alignment accommodations and proposed transit elements that lie on or within existing rail lines or roadways in most cases do not have archaeological concerns due to prior ground disturbance associated with construction.

Archaeological investigations proceed by means of a three-phase survey process in which the need for the next phase is dependent upon the results of the preceding phase.

18.2.1 Corridor Archaeological Resources

Research on previously identified archaeological sites on file at the New York State Museum (NYSM) and NYSHPO located at least one mile to the north and south of the I-287 Corridor has been completed. Previously identified sites within one-half mile north and south of the corridor have been plotted onto project maps, as these sites share the most relevant geographic and topographic conditions with the corridor. Within the preliminary APE, extensive subsurface ground disturbance has been documented through cartographic research and by means of targeted reconnaissance walkover surveys that have been conducted to evaluate historic and modern land use factors that may affect potential archaeological resource preservation. Archival research and historic and modern cartographic research have contributed to the evaluation of the potential for encountering intact archaeological resources within the preliminary APE at locations that appear to be undisturbed by historic or modern activities.

18.2.1.1 Highway, Bridge, and Transit Alignment Accommodations and Proposed Transit Elements

Phase 1 Archaeological Survey

Phase I investigations are conducted when a review process has determined that a proposed project will not affect any known or previously identified sites, but is located in an area where insufficient survey has been conducted, and where there is a moderate to high probability that previously unrecorded sites may

occur. The goals of the Phase I work need to be flexible to reflect the size of the proposed project and stage of project planning, and can be undertaken in two sub-phases, Phase IA and Phase IB, when appropriate (NYAC 1994). In such cases, the Phase IA survey consists of background documentary and cartographic research and a sensitivity assessment, and the Phase IB survey consists of field investigation.

A Phase 1 archaeological survey has been conducted for the highway, bridge, and transit alignment accommodations and the proposed transit elements that comprise the preliminary APE. The objectives of and methods utilized for each component of the Phase I survey are explained below.

Phase 1A Survey

Phase IA investigations are intended to gather data on the environmental conditions and physical setting of a specific project area as well as its cultural setting through background research and a reconnaissance walkover survey. The interrelationship between the physical and cultural setting provides the basis for the sensitivity assessment of a project area. Information gathered has included data on the geomorphology and soils of the project area, the prehistoric and historic context, previously identified archaeological sites, previously conducted archaeological surveys, and areas of prior ground disturbance. The Phase IA documentary and cartographic research provided the rationale for the sensitivity evaluation and selection of an appropriate Phase IB field strategy.

Phase IA background research included a preliminary review of manuscripts, maps, atlases, historical documents, unpublished notes, previous surveys, state and local archaeological site inventories, and published material relevant to the project area, both to locate possible sites and to provide the basis for developing the prehistoric and historic contexts for the project area.

Taken together, the elements of the Phase IA background research help to establish an appropriate context against which to consider the significance of any identified prehistoric or historic archaeological resources.

A reconnaissance walkover survey of the proposed ground disturbance areas and a windshield survey of the entire I-287 Project Corridor to note existing conditions was a component of the Phase IA investigation. The targeted walkover was undertaken to determine if prior ground disturbance may have destroyed previously identified sites and potential site locations, and to locate potentially undisturbed locations that may contain intact archaeological resources.

Phase IA Survey Methodology

- Establish the proposed ground disturbance areas based on the available highway, bridge, and transit alignment accommodations and the proposed transit elements engineering plans.
- Conduct background documentary and cartographic research.
- Develop prehistoric and historic contexts for I-287 Corridor.
- Identify locations of previously recorded archaeological sites.
- Identify project areas of previously conducted archaeological surveys.
- Conduct targeted reconnaissance walkover of highway, bridge, and transit alignment accommodations and proposed transit elements footprints.

- Analyze prior ground disturbance data from research and walkover.
- Develop an archaeological sensitivity map for the preliminary APE.

The Phase IA survey has identified archaeologically sensitive areas that could be directly impacted by the highway, bridge, and transit alignment accommodations and proposed transit elements and has identified previously recorded prehistoric and historic archaeological resources that may exist within the preliminary APE. A reconnaissance walkover survey of targeted portions of the highway, bridge, and transit alignment accommodations and proposed transit elements preliminary APE to note existing conditions has been undertaken to determine whether or not prior ground disturbance may have destroyed previously identified sites and potential site locations, as well as to note undisturbed potential site locations that may contain intact resources.

Phase 1B Survey

Phase IB surveys consist of appropriate field investigation, which may be in the form of subsurface shovel testing, systematic surface survey, and/or remote-sensing studies to determine the presence or absence of archaeological resources. Subsurface testing is most often the major component of this level of investigation and is required except in those cases in which the presence or absence of resources can be determined by direct observation through a surface survey, by the examination of specific documented references, or by the detailed documentation of prior disturbance of such a degree that all traces of intact archaeological resources have been erased (NYAC 1994).

Phase IB field investigation verifies site locations suggested by the Phase IA research and locates previously unknown archaeological sites. The areas targeted for Phase IB testing are selected on the basis of the research completed for the Phase IA sensitivity evaluation and include all probable locations of project construction, staging areas, or any other areas of potential impact that have not been subjected to extensive prior disturbance. Detailed evaluation of identified resources is not carried out at this level of investigation, but the precise locations of identified resources with respect to the proposed project area must be clearly established.

If potentially eligible National Register archaeological resources are identified through the Phase IB survey, a Phase II survey to assess the integrity of the site toward a determination of National Register eligibility would be recommended.

Phase IB Survey Methodology

- Intensive walkover of proposed ground disturbance areas that possess archaeological sensitivity as identified during the Phase IA survey.
- Conduct a subsurface shovel testing survey in undisturbed archaeologically sensitive locations to determine the presence or absence of archaeological resources within the preliminary APE.
- Conduct laboratory processing, cataloguing, and analysis of all artifacts recovered during the Phase IB subsurface testing survey.
- Complete NYS Prehistoric and/or Historic Site Forms for archaeological resources identified during the Phase IB survey that may be eligible for listing in the State and National Registers of Historic Places.

The Phase IB survey, which is in progress, entails a systematic subsurface shovel-testing survey of the undisturbed archaeologically sensitive locations that are within the highway, bridge, and transit alignment accommodations and proposed transit elements preliminary APE, identified through the Phase IA survey. The Phase IB survey will identify any archaeological resources that are actually present within the preliminary APE and identify the need for additional surveys for assessment of National Register eligibility.

NYS Prehistoric and Historic Site Forms will be completed for archaeological resources identified through the Phase IB survey. Pursuant to the SED Work Scope Specifications Revised Section 106 Implementation Procedures of 2004, the site forms will be submitted to NYSDOT for review and comment, and to obtain NYSM site numbers. NYSDOT will seek review and concurrence by the NYSHPO, FHWA, and FTA. The site forms will be contained in an Appendix that will be marked as Confidential – Not for Public Distribution.

18.2.1.2 Highway, Bridge, and Transit Alignment Accommodations

Phase II Survey

The primary goals of a Phase II survey are to obtain detailed information on the integrity, limits, structure, function, and prehistoric/historic context of an archaeological site sufficient to evaluate its potential National Register eligibility (NYAC 1994). Additional subsurface testing, through a combination of shovel tests, excavation units, and/or remote sensing, is a necessary component of the Phase II survey. The recovery and analysis of artifacts during the Phase II survey are critical in the determination of integrity, temporal and cultural affiliation, site function, and research potential toward an evaluation of the site's eligibility for listing in the State and National Registers of Historic Places.

A site is eligible for listing in the National Register if it meets one or more criteria as set forth in 9 NYCRR 427 and 428 or 36 CFR 800. The Phase II determination of site significance provides the initial framework on which to base a subsequent Phase III data recovery program if one is required as part of a mitigation strategy for the site.

Phase II Survey Methodology

- Conduct additional shovel tests to delineate the boundaries of the encountered resource.
- Conduct targeted supplemental background research.
- Excavate test units using hand methods to determine stratigraphic integrity.
- Analyze all artifacts recovered from stratigraphically excavated test units.
- Evaluate the integrity of the resource.
- Determine the National Register eligibility of the resource.

Pursuant to SED work scope specifications, Phase II archaeological surveys will be conducted for archaeological resources encountered during the Phase IB survey of the highway, bridge, and transit alignment accommodations preliminary APE. The results of the Phase II surveys and the eligibility determinations will be prepared, reviewed by NYSDOT, and sent to NYSHPO, FHWA, and FTA for review and concurrence.

18.2.2 Hudson River Archaeological Resources

As part of the Hudson River Estuary Program, the NYSDEC conducted bathymetric surveys of the Hudson River and has published the results as a Geographic Information System (GIS) database. The NYSDEC Hudson River Estuary Program also collected, or derived, a variety of sediment data including sediment type, age, and morphology.

Field surveys were conducted near the Tappan Zee Bridge to more precisely determine conditions in the project study area. These included high resolution bathymetric surveys, acoustic surveys to determine the distribution of recently deposited sediments, and sediment coring to determine sediment physical and chemical properties. The bathymetric and acoustic surveys and sediment core sampling procedures are discussed in Chapter 21, Water Resources.

Acoustic survey methods and sediment coring were used to generate maps of the physical characteristics of the river bottom in the vicinity of the Tappan Zee Bridge. Mapping of the thickness of recent (post-industrial) sediment deposition, sediment texture, potential oyster beds, and suspected anthropogenic features was developed.

In order to determine whether areas of archaeological sensitivity are present within the bridge alignments in the Hudson River itself, Geoarcheology Research Associates, Inc., the geoarchaeology research team subcontracted for the project has reviewed the results of bathymetry surveys, sub-bottom profiles, side-scan sonar data, and the acoustic survey results. In addition, five of the Hudson River core samples have been monitored and analyzed by the geoarchaeology team. The team has recorded pertinent stratigraphic observations and collected up to 15 core soil samples for radiocarbon dating.

The results of the geoarchaeological survey will be summarized by Project Sponsors, and sent to NYSHPO, FHWA, and FTA for review and comments. The geoarchaeology report will be included in the EIS and the Archaeology Technical Report.

18.3 Environmental Consequences

18.3.1 Highway, Bridge, and Transit Alignment Accommodations

The preliminary APE for the highway, bridge, and transit alignment accommodations will consist of horizontal and vertical components. The horizontal extent of the preliminary APE will be defined as the footprint of necessary construction activity that would result in ground disturbance. The vertical extent of the preliminary APE will change across the length of the I-287 Corridor, depending on the type of construction activity, as the depth of subsurface impacts will not be uniform at all locations.

The highway, bridge, and transit alignment accommodations will be evaluated with respect to their potential direct impacts on National Register-eligible archaeological resources. Impacts analyses will reflect the requirements of Section 106 of NHPA (1966), following the procedures set forth in the SED Work Scope Specifications Revised Section 106 Implementation Procedures adopted in 2004.

The results of the impacts analysis will be summarized by Project Sponsors, and sent to FHWA and FTA for review and concurrence. The FHWA and FTA comments will be incorporated and the findings sent to NYSHPO for review and concurrence. The Impacts Analysis will be included in the EIS and the Archaeology Technical Report.

18.3.2 Transit Elements

The proposed transit elements will be evaluated with respect to the potential direct impacts on potential National Register-eligible resources encountered during the course of the Phase IB archaeological survey. National Register eligibility of many resources will remain undetermined, as the evaluation is based on a Phase I effort only. A subsequent transit elements environmental process will be initiated by Project Sponsors, in cooperation with FHWA and FTA, during the highway, bridge, and transit alignment accommodations design phase after a decision has been made to advance the BRT and CRT modes in either a single or sequenced environmental documentation.

18.4 Mitigation Measures

18.4.1 Highway, Bridge, and Transit Alignment Accommodations

Project Sponsors, in coordination with FHWA and FTA, will develop mitigation recommendations for National Register-eligible archaeological resources in the Archaeological APE that would be adversely impacted by the project actions associated with construction for highway, bridge, and transit alignment accommodations. These resources may be located in the I-287 Corridor or within the Hudson River.

Avoidance by redesign would be preferred with respect to archaeological resources. However, if avoidance is not feasible, mitigation strategies may include:

- Phase III excavation of the National Register-eligible site.
- Public education oriented museum/library exhibits, lectures, or brochures.

18.4.2 Section 106 Programmatic Agreement Document

A Programmatic Agreement (PA) will be drafted by the Project Sponsors, FHWA, FTA, and NYSHPO, with participation from ACHP and the Consulting Parties. The document will include agreed-upon stipulations to mitigate adverse effects to archaeological resources and historic properties as noted in Chapter 17. The PA will be developed as part of the DEIS process. The fully executed agreement will be signed by all required parties and included in the FEIS prior to issuance of the ROD. Depending on the nature of the stipulations, they will be implemented prior to commencement of, or during construction activities, or in conjunction with the succeeding transit elements environmental process described above.

19 Visual Resources

19.1 Regulatory and Permitting Requirements

Potential impacts of the proposed project's alternatives on visual resources in the study area will be evaluated in accordance with NEPA and New York State Environmental Quality Review Act (SEQRA) standards. In addition, the visual impact analysis will follow:

- Guidelines suggested by USDOT/FHWA Technical Advisory T 6640.8A (October 30, 1987).
- FHWA recommended procedures cited in *Guidance Material on the Preparation of Visual Impact Assessment*s (1986).
- US Army Corps of Engineers (USACE) *Visual Resources Assessment Procedure* (1988),
- New York State Department of Environmental Conservation (NYSDEC) *Program Policy Assessing and Mitigating Visual Impacts* (DEC-00-2, July 31, 2000).
- NYSDOT Engineering Bulletin (EB) 03-052 (which replaced pages 3 and 4 of Engineering Instruction [EI] 02-025 and supplements EI 02-025).

19.2 Affected Environment

Project improvements under consideration with the potential to impact visual or aesthetic resources would occur mostly within the existing I-287 right-of-way (ROW), or within the Metro-North ROW along the Piermont Line in Rockland County. A study area based on the project viewshed will include all anticipated impacts from the project on valued visual resources. The potential viewshed of the project is based on topography, the built environment (e.g., structures) and natural environment (primarily vegetation). Given the 30-mile length of the project corridor, its varied topography, and the complex built and natural environment, no overall map of the project's viewshed will be provided. Rather, the viewshed will be described in narrative form, particularly focusing on those areas where the I-287 project improvements occur, and discussing affected views both from and of the highway and proposed transit.

For the most part, the viewshed is quite limited in distance from the highway/transit, primarily because of vegetative screening and obstructing structures. The major exception to this limited viewshed is at the Hudson River crossing, where the wide Tappan Zee and the bridge permit extensive views across the river and both north and south for many miles.

Representative landscape districts of the I-287 corridor will be identified, classified, and mapped. A landscape district is defined as an area along the corridor that exhibits a relatively consistent physical and cultural landscape. The classification of landscape districts will consider natural vegetation, proximity to road alignments and improvement sites, automobile impacts, distant views, close views, neighborhoods, landmarks, historic structures, public perception of visual importance, view potentials from alternative bridge designs and corridor-improvement sites, and views from adjacent properties to the alternative

bridge designs and improvement sites. Special features and issues of each district will be further described from a context of existing development, landmarks, local perceptions, and community concerns.

19.3 Environmental Consequences

The evaluation of existing aesthetic resources and potential impacts on them seeks to (1) objectively identify the visual features or resources of the landscape; (2) assesses the character and quality of those resources relative to overall regional character; and (3) identify the importance to people of views and of visual resources in the landscape. Having established this baseline of existing conditions, proposed changes to the landscape as a result of project improvements can be systematically evaluated for their degree of impact.

The degree of impact depends on both the magnitude of change to the visual resource and viewers' responses to and degree of concern for those changes. In adopting this methodology, the two primary factors in a visual impact analysis are: 1) the visual resources of the existing landscape; and 2) viewers in the study area.

Changes that would result from the proposed project's features will be evaluated. Three criteria of visual quality will be evaluated: (1) vividness – how memorable, striking or distinctive a given set of landscape components is and the visual pattern they form; (2) intactness – the integrity of the landscape, whether natural and man-made, where all the various elements seem to "belong" in the view with no encroachment by those that seem out of place; and (3) unity – whether the visual elements form a coherent visual pattern, even if they include some that are not typical features in that type of landscape. All three elements must rate high for a view to be considered high in visual quality.

Major viewer groups (e.g., viewers from the highway or transitway, such as commuters, and viewers of the roadway, such as residents) will be defined and the viewer exposure and sensitivity will be categorized. Information will be gathered by evaluating the physical location of each viewer group, the number of people in each viewer group, and the duration of their views. The resulting information will be categorized and given impact ratings.

A visual resources rating will be generated to assess existing, unmitigated, and resultant visual resources. The visual resources analysis will be summarized based on the conditions described above, plus any specific conditions that would be unique to the transit alignment alternatives. A Visual Impacts Assessment (VIA) will be prepared under NYSDOT's visual assessment policy (Engineering Instruction 02-025 and Engineering Bulletin 03-052).

The visual impact analysis will:

- Describe in text and photographs the visual character of the study area;
- Identify visual resources, viewer groups, and the duration of their view;
- Consider views both from the surrounding neighborhoods and views from the highway/transit facility at specific locations of major project infrastructure elements;

- Assess the potential impacts of project alternatives on the visual character of the area, using drawings and other graphic materials provided by the project engineers; and[1]

- Consider the character of any changes to the visual resources, viewer groups, the duration of their view, and their anticipated responses to these changes.

Photo simulations will be prepared focusing on those locations where substantial physical changes occur as a result of specific project elements. The resulting values derived from each area will be analyzed for opportunities, constraints, and conflicts created by elements of the proposed project.

19.4 Mitigation Measures

General measures to avoid, minimize, or mitigate negative visual impacts will be recommended. Where appropriate and feasible, mitigation measures will be identified and conceptual design alternatives will be discussed for the areas of potential impact. The conceptual mitigation will not be developed beyond written descriptions. The consideration given to design quality, art, and architecture in the project planning will be described.

[1] The type of structure for the replacement Tappan Zee Bridge will not be determined until final design, so that assessments of visual impacts will be limited to how they may affect project alternatives selection, or would result in significant adverse impacts. Design elements that will be known and assessed include (1) its alignment and landing areas; (2) its overall form in terms of single or dual levels and whether it would include two or more structures; (3) the elevations of the pavement above the water and at its landings; (4) the dimensions and spacing of piers, and (5) possible main span bridge types.

20 Topography, Geology, and Soils

The physical conditions of the project area fundamentally affect what can be constructed, and how. The geology of the site, as derived from the types of bedrock and soil, topography, and seismicity influence the basic design of the project, from alignments and profiles to foundation types and drainage systems.

20.1 Regulatory and Permitting Requirements

The regulatory implications of geology as they relate to the project are generally established through building codes or other engineering criteria that dictate design requirements for project elements. Examples include design codes for earthquake resistance, bearing capacity of foundations, etc. Such criteria are typically accounted for during detailed design of project-related structures, and are not addressed as part of this methodology.

20.2 Affected Environment

Geologic features tend to be of large scale, and the data sources to be consulted (as described below) typically cover county-wide (or even larger) areas. The study area is nominally defined as a half-mile radius around the centerline of I-287; however, data describing a larger area may be presented in some areas where the additional data provide relevant context.

Data documenting geologic conditions throughout the project study area are available from a variety of sources. Examples of the data (and potential sources) that will be collected in order to document existing geologic conditions include the following:

- Geophysical provinces (New York State Museum, US Geological Survey [USGS], scientific literature).
- Bedrock formations (New York State Museum, USGS, scientific literature).
- Soil types and engineering features (Natural Resources Conservation Service).
- Historic seismic activity (USGS, scientific literature).
- Topography (USGS, county and municipal planning offices).

Field investigations are not proposed as part of this methodology. Only existing sources of data will be utilized to document geologic conditions throughout the project study area.

20.3 Environmental Consequences

The analysis of project-related impacts to (or from) geologic conditions will generally be limited to certain geologic phenomena not assessed as part of other impact analyses. For example, while the

management of stormwater runoff is related to site geology since soil types impact the rate of runoff, the detailed analysis of stormwater management is included as part of the Water Resources analysis (Chapter 21). Generally, the geologic impact analyses will focus on the potential for increased soil erosion and requirements for large quantities of excavation or fill.

The reduction of vegetated or forested areas, combined with increases in impervious cover types such as pavement, typically result in greater quantities and velocities of stormwater runoff. This, in turn, can lead to increased soil erosion, particularly among certain erosion-prone soil types. This increase in soil erosion can create greater soil and pollutant loadings to local waterways. Potential impacts due to increased soil erosion will be quantified on the basis of total project footprint within areas considered to have highly erodible soils.

Finally, if significant quantities of cut or fill are necessary to construct a project alternative, impacts will be estimated in the DEIS on the basis of approximate cut or fill quantities. The approximate quantities and limits of cut or fill, and any potential residual impacts (e.g., exposing a more erodible soil or removing hydric soils), will be identified.

20.4 Mitigation Measures

Conceptual mitigation measures will be presented as appropriate. This may include recommendations for plantings (to reduce potential soil erosion) and material recycling (to reduce the need to import fill or export excess excavation materials over long distances).

21 Water Resources

Water resources relevant to the Tappan Zee Bridge/I-287 Corridor DEIS include streams, rivers and drainage features that cross or run parallel to I-287 in Rockland and Westchester Counties, groundwater resources in both counties, as well as the Hudson River, which would be spanned by a replacement bridge. The analysis of impacts to water resources considers management of stormwater in compliance with New York State Department of Environmental Conservation's (NYSDEC) regulations, general water-quality impacts of highway/transit improvements, and potential changes to flood elevations resulting from modifications to I-287 stream conveyances. The Hudson River evaluation is focused on the potential that replacement-bridge-related construction activity may increase suspended sediment concentrations, thereby degrading water quality and impacting the river's ecological resources.

21.1 Regulatory and Permitting Requirements

21.1.1 Agency Coordination

The United States Coast Guard (USCG) has the authority to regulate the location and clearances of bridges across navigable waters of the United States, pursuant to Section 9 of the Rivers and Harbors Act. Under this authority, the USCG also regulates discharges of dredged or fill material incidental to the construction of bridges across navigable waters, including cofferdams, abutments, foundation seals, piers and temporary construction and access fill.

The United States Army Corps of Engineers (USACE) has regulatory jurisdiction over waterbodies that may be affected by the Tappan Zee Bridge/I-287 Corridor project. Pursuant to the Rivers and Harbors Act of 1899, the USACE issues permits for proposed construction activities in navigable waters, including activities such as pier construction and dredging. In addition, the USACE regulates the discharge of fill into waters of the United States pursuant to Section 404 of the Clean Water Act (CWA). USACE also regulates the transportation of dredged material for placement in the ocean under Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA). MPRSA regulations will apply to permitting related to the potential placement of dredged material at the Historic Area Remediation Site (HARS). USACE permits are conditioned by approvals from other agencies. For example, depending on the scope of the proposed work, such approvals may include a Water Quality Certificate issued by the NYSDEC pursuant to Section 401 of the CWA to ensure that acceptable water quality conditions will be maintained in affected waterways, and concurrence by the US Fish and Wildlife Service and National Marine Fisheries Service that the proposed action would not adversely affect threatened or endangered species.

NYSDEC's regulatory involvement can be divided into three separate areas of jurisdiction: maintenance of water quality, management of stormwater discharges, and floodplain regulation. NYSDEC sets classifications and water quality standards for all waters within New York State (6 NYCRR Parts 701 to 703), and conditions agency permits with relevant requirements to maintain and protect the quality of state waters. Stormwater discharges from construction and operation of the improvements associated with I-287 will be managed in accordance with NYSDEC's State Pollutant Discharge Elimination System (SPDES) general stormwater permit program (NYSDEC permit GP-0-08-001 applies to this project). NYSDEC generally delegates floodplain management to local governments, but retains oversight of floodplains when state agencies are project sponsors, as would be the case with the Tappan Zee Bridge/I-287 Corridor project.

The United States Environmental Protection Agency (USEPA) has general review authority for all Environmental Impact Statements involving federal actions, and as such may comment on water quality issues. In addition, the USEPA has specific authority to regulate sole source aquifers (SSAs), which are defined as aquifers that provide at least 50 percent of the drinking water consumed in the area overlying the aquifer, and for which there are no feasible alternatives for drinking water supply. Pursuant to Section 1424(e) of the Safe Drinking Water Act (SDWA), the USEPA must approve any project funded in whole or in part with federal funds where the potential to impact a SSA exists.

While they do not have a regulatory role since the Tappan Zee Bridge/I-287 Corridor project is sponsored by state agencies, county and/or local agencies (e.g., planning departments, drainage agencies, etc.) are significant sources of information on conditions in and around local waterbodies. Local agencies often sponsor projects, funded by federal- or state-level programs, which seek to reduce the severity of flooding or restore natural conditions along stream banks. Accordingly, the project team will coordinate with county and town/village agencies to identify stream issues of immediate interest to localities as well as to obtain information on plans for flood control or stream restoration that may impact Build alternatives.

21.1.2 Permit Requirements

In the context of water resources, it is expected that several permits will be required for project construction. The list of required permits and approvals is expected to include the following:

- Rivers and Harbors Act Section 9 Permit for bridge construction (by USCG).
- Rivers and Harbors Act Section 10 Permit for dredging and fill (by USACE).
- Clean Water Act Section 404 Permit for discharge of fill (by USACE).
- Clean Water Act Section 401 Water Quality Certification (by NYSDEC).
- MPRSA Section 103 Permit for HARS placement of dredged material (by USACE)
- Executive Order 11988 floodplain compliance certification (by FHWA and FTA).
- SDWA Section 1424(e) SSA review (by USEPA).
- SPDES general permit for construction activities (by NYSDEC).
- Floodplain management compliance certification (by NYSDEC).
- Coastal Zone Management consistency determination (by New York State Department of State)

A permit regulating the management and discharge of stormwater runoff from the replacement bridge will also be necessary, although the manner in which NYSDEC will regulate that discharge has not been finally established; the general permit for construction may not be relevant, and an individual SPDES permit for the bridge itself may be required. The project team will coordinate with the NYSDEC to establish the appropriate permit form and address permit requirements accordingly.

It should be noted that regulatory programs focused on protection of ecological resources are addressed under methodologies for Terrestrial Ecology and Wetlands (Chapter 22) and Hudson River Ecology (Chapter 23). For instance, a number of federal and state regulatory programs protect wetland resources and are discussed under the ecology methodologies. Also, regulatory programs relevant to navigational issues are addressed in Chapter 6 (Transportation: Marine, Freight and Bicycle/Pedestrian Operations).

21.2 Affected Environment

21.2.1 Corridor Water Resources

The characteristics of a drainage basin (such as its size, extent of impervious cover, and soil type) define how water is transported through the basin, and understanding these characteristics is integral to any effort to model the hydrologic behavior of a drainage basin, including underlying groundwater resources such as aquifers. Studies to define the physical characteristics of entire drainage basins have not been undertaken; rather, existing data collected by others is used to create a database for each waterbody and aquifer within the study area.

Typical sources for inventory data include the National Hydrographic Dataset (NHD), United States Geological Survey (USGS), Natural Resources Conservation Service (NRCS), county planning departments, county and municipal Departments of Public Works (DPWs), and NYSDEC. Since many of the streams and aquifers in Rockland County drain through New Jersey, New Jersey agencies such as the New Jersey Department of Environmental Protection (NJDEP) are also sources for drainage basin inventory data. A summary of the data collected for the inventory is included in Table 21-1.

The limits of the inventory vary depending on the application of each data set. Data used to assess existing water quality conditions of a waterbody at its crossing of I-287 (e.g., basin size, land use types, and soil types) are generally collected for the entire watershed upstream of I-287. Data used to determine impacts from project alternatives to existing uses (e.g., water quality classifications and drinking water sources) are generally collected for the entire run of each waterbody downstream to the point at which it enters a major tidal waterbody (e.g., New York Harbor, Newark Bay, or the Long Island Sound). Finally, data used to assess stream flow behavior (e.g., flooding) is collected for the entire lengths of streams for which models that include the I-287 crossing have previously been developed (although the analysis of impacts may utilize only a portion of the existing models, as described in Subchapter 21.1.3.1).

Using this inventory, the condition of waterbodies and aquifers within the drainage basins that I-287 crosses has been investigated. The focus of the investigations has been on water quality and flooding. This effort included review of pollutant loadings from both I-287 and surrounding land uses and the impacts of culverts, bridges and other structures on water flow and flooding. The resulting assessment serves as a baseline against which the impacts of Build alternatives will be compared.

In addition to obtaining basin-wide information, project-specific maps have been generated that identify the water conveyance systems that are integral to I-287. These conveyances include bridges, culverts, ditches and swales that carry highway runoff and, in some cases, convey major and minor streams across the I-287 corridor. It is expected that, under several alternatives, elements of this infrastructure would be modified with possible implications for stream flows and water quality.

Table 21-1

Inventory Data

Item	Sources
Primary Waterbody Identification	
Waterbody Name	NHD, USGS topographic maps
Drainage Basin Boundary	NHD, County Planning Departments, NYS GIS Clearinghouse
Aquifer and SSA Locations	NYSDEC, USEPA
Physical Characteristics Within Drainage Basins	
Land Use	County Planning Departments
Soil Types and Hydrologic Groups	NRCS
Climatologic Data	National Climatic Data Center
Stream Order	Calculation from USGS topographic maps
Water Quality Classifications	NYSDEC, NJDEP
Flow Rates	USGS & National Oceanographic and Atmospheric Administration gauging station records
Drinking Water Sources	State and County Departments of Health, NYSDEC, NJDEP, Water Companies
Drainage Basins Management Features	
Existing Impoundments / Flow Controls	NYSDEC, NJDEP, County and Local Public Works Departments, Water Companies
Existing Stormwater Control Features	County and Local DPWs
Street Sweeping Programs	County and Local DPWs
Roof Disconnection Programs	County and Local DPWs and Planning Departments

21.2.2 Hudson River Water Resources

Stream flow and physical conditions data for the Hudson River (biota are addressed as part of the Hudson River Ecology Methodology - Chapter 23) have been gathered from a variety of sources. Water surface elevations and water quality conditions are being continuously monitored at a variety of gauging stations. These stations include the National Oceanic and Atmospheric Administration (NOAA) tide monitoring station at The Battery (the southern tip of Manhattan); several USGS gauges, including those at Green Island, Albany, Poughkeepsie, West Point, and Hastings-on-Hudson; and other data monitoring networks such as the Hudson River Environmental Conditions Observing System (HRECOS), which is a consortium of several government and research partners.

Bathymetric surveys (sediment bed elevation) have also been conducted by a variety of agencies on the Hudson River. NOAA, NYSDEC, and the USACE have published survey data for the Hudson River, with the NOAA and NYSDEC data sets generally being the most comprehensive. NOAA publishes nautical charts for the Hudson River and makes the sounding data available online. As part of the Hudson River Estuary Program, NYSDEC also conducted bathymetric surveys of the Hudson River and has published the results as a Geographic Information System (GIS) database. The NYSDEC Hudson River Estuary Program also collected, or derived, a variety of sediment data including sediment type, age, and morphology.

Other sources for general information about the Hudson River include a variety of technical reports, academic papers, and publications by non-profit organizations. These sources include, but are not limited to, reports by the USGS, peer-reviewed papers published by journals (e.g. “Regional Patterns and Local Variations of Sediment Distribution in the Hudson River Estuary” by Nitsche, et al.), research conducted through grants from the Hudson River Foundation, and the Contaminant Assessment and Reduction Project (CARP).

In addition to the large body of data that has been published on the Hudson River, field surveys were conducted near the Tappan Zee Bridge to more precisely determine conditions in the project study area. These included high resolution bathymetric surveys, acoustic surveys to determine the distribution of recently deposited sediments, sediment sampling and analysis, and detailed surveys of water quality and hydrodynamics. These project-specific field surveys are briefly described in the following paragraphs.

The bathymetric survey conducted as part of the Tappan Zee Bridge/I-287 Corridor Project consisted of a detailed “near-field” survey 200 feet south and 700 feet north of the bridge using multi-beam survey methods. A “far-field” survey was also undertaken using single beam echo-sounder survey equipment. The far-field survey provided bathymetric data for the Hudson River from a point just south of the Piermont Pier northward to the northern edge of the special anchorage area designated on NOAA Navigation Chart No. 12343, adjacent to Upper Nyack, NY. In all, the bathymetric survey program covered approximately 4.5 river miles of the Hudson River and extended approximately 2 nautical miles north and south of the existing Tappan Zee Bridge.

Acoustic survey methods and sediment coring were used to generate maps of the physical characteristics of the river bottom in the vicinity of the Tappan Zee Bridge. The mapping program employed acoustic signals of varying frequencies to determine near-surface stratigraphy of river sediments and river-bottom surface texture. In conjunction with precise positioning data and direct sampling techniques to confirm and calibrate the findings of the acoustic methods, mapping of the thickness of recent (post-industrial) sediment deposition, sediment texture, potential oyster beds, and suspected anthropogenic features was developed. In addition to the acoustic methods, sediment cores were analyzed for a variety of chemical and material properties. Chemicals analyzed include semi-volatile organic compounds (SVOCs),

pesticides, polychlorinated biphenyls (PCBs), dioxins, and metals. Grain-size analyses of sediment samples were conducted, as were tests to determine the scour potential of sediments using a hydraulic flume.

Detailed hydrodynamic field surveys were also conducted for the project. These included monitoring of hydrodynamic conditions using a range of equipment and techniques including two stationary Acoustic Doppler Current Profilers (ADCP); two temporary tide gages; a vessel mounted ADCP; and a dye plume study. The detailed field surveys also consisted of a water quality component, which included depth casts from a survey vessel for measurement of conductivity, turbidity and temperature; stationary monitors for measurement of conductivity, turbidity, and temperature; a salt front survey; and grab samples that were analyzed for total suspended solids (TSS) and suspended sediment concentration (SSC).

21.3 Environmental Consequences

21.3.1 Corridor Water Resources

21.3.1.1 Stream Water Quality

Stream water quality is affected by runoff from land uses within the stream's drainage basin; land uses may range from unpopulated forested lands to heavy industrial uses, and each has a different relative contribution to the total pollutant load. In order to assess the relative impact of I-287 and the Build alternatives on streams throughout the corridor, basin-wide estimates of pollutant loadings will be developed. The development and use of basin-wide pollutant load estimates is distinct and separate from the analyses which must be completed pursuant to the SPDES construction general permit, and which are described in Subchapter 21.3.1.3.

Highway, Bridge, and Transit Accommodations

Potential impacts to stream water quality will be estimated using the Windows Source Loading and Management Model (WinSLAMM). The model addresses pollutant loadings from suburban and urban development (including runoff from highways) and focuses on the hydrology associated with small storms – the type of storms during which most pollutants enter local water bodies. The model will enable comparisons of existing condition and Build alternative pollutant loadings, as well as a comparison of the loadings from the redeveloped highway corridor to loadings generated by the rest of the drainage basin being evaluated. Typical pollutant-removal efficiencies for various stormwater management practices, as described in NYSDEC's *Stormwater Management Design Manual*, will be incorporated in the assessment of stormwater discharges from Build alternatives.

Transit Elements

For the transit alternatives, the increase in pollutant loads to local water bodies will be estimated based on the relative increase in impervious surface applicable to each Build alternative. Reductions in pollutant loadings resulting from treatment of stormwater through various stormwater management practices will also be reflected in the assessment of each Build alternative.

21.3.1.2 Stream and Floodplain Geometry

Changes to stream beds and floodplains by development affect the way stream flow is conveyed and controlled. Depending on the nature of the changes, potential consequences may include additional restrictions to flow that can increase upstream water elevations or removal of restrictions to flow that can increase downstream water elevations and flow rates.

Highway, Bridge, and Transit Accommodations

A preliminary hydraulic analysis for each stream crossing I-287 that has an existing Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) will be undertaken. The preliminary analysis will include reviews of existing FEMA FIS models and gauging data to determine whether the I-287 crossing affects stream flow, either under existing or proposed conditions. Where the preliminary hydraulic analysis indicates a crossing requires further study, additional analyses will be performed for the purpose of comparing pre- and post-development water elevations in the vicinity of I-287.

The analysis will be conducted using the USACE Hydrologic Engineering Center (HEC) computer models HEC-HMS (Hydrologic Modeling System) and HEC-RAS (River Analysis System), which will rely on input data from the latest FEMA FISs. The additional study will extend downstream to the nearest controlling structure that significantly regulates flow, or to the limits of FIS modeling data that includes the I-287 crossing. In addition, where stream or culvert geometry is modified as result of project construction, the requirements of the USACE regulatory program as they pertain to aquatic life passage will be considered.

Transit Elements

Planning-level estimates of potential transit alternative impacts will be determined on the basis of the area of each alternative that is within the banks and adjacent floodplain of streams that cross the I-287 corridor. If a Build alternative is proposed for a special flood hazard area, estimates of the project footprint in the flood hazard area will be provided.

21.3.1.3 Stormwater Management

In an effort to improve water quality and control flooding on a basin-wide basis, NYSDEC has implemented a regulatory program that requires treatment and control of stormwater discharges from new development projects. While the construction of I-287 largely predates these regulations, the rules now apply to nearly all new construction, including redevelopment projects, and will be addressed for each Build alternative as described immediately below.

Highway, Bridge, and Transit Accommodations

Stormwater management requirements are detailed in the NYSDEC's *Stormwater Management Design Manual*. For highway and bridge alternatives, water quality treatment volumes will be estimated for each drainage area in the manner specified by the *Design Manual*. In addition, comparisons of existing and post-development peak stormwater flows will be made for each drainage area, and estimates of water quantity control volumes will be developed consistent with the requirements of the *Design Manual.*

Conceptual plans will be developed for stormwater management facilities. These facilities may include retention or detention facilities, methods of increasing the time of concentration so as to reduce peak

flows, mechanical treatment systems, any other stormwater management practice recognized by the NYSDEC in the *Design Manual*, or combinations thereof. The plans will indicate land area requirements and potential locations for the facilities. Where sufficient right-of-way (ROW) is unavailable for stormwater management facilities, off-ROW acquisitions will be considered. Use of wetland areas will be avoided.

Transit Elements

Planning-level estimates of stormwater management quantities will be developed on the basis of the estimated increase in impervious surface for each transit alternative, as compared to overall project area. While these calculations will be generally consistent with the approaches used in the *Design Manual*, they will be approximate and at a planning level of detail to reflect the level of available design information.

21.3.1.4 Groundwater and Aquifers

Impacts to groundwater as a result of project development are possible. The USEPA has specific review authority regarding potential impacts to SSAs, and must review and approve any project with federal funding that might impact an SSA. Generally, it is assumed that such impacts would occur primarily from the infiltration of chlorides (a residue of roadway deicing) or roadway pollutants (e.g., petroleum products, heavy metals, etc.) into the groundwater. It is assumed that potential impacts to aquifers from non-chloride contaminants as a result of project-related construction would be controlled through compliance with the water quality provisions of the stormwater management regulations (see Subchapter 21.3.1.2), and so no additional analysis for these pollutants specific to groundwater resources are included in the analysis.

Highway, Bridge, and Transit Accommodations

Assessments will focus on potential impacts to existing aquifers due to chloride infiltration, and will be estimated on the basis of Toler analyses. Toler analyses estimate total chloride loads to an aquifer on the basis of additional lane miles constructed within the aquifer's drainage basin.

Transit Elements

For the transit alternatives, the analysis will focus on potential impacts to SSAs and will also be estimated on the basis of Toler analyses. Although similar in nature to the analysis of highway elements, the analysis for transit elements will be based on the relative increases in impervious surface due to transit element construction as compared to the actual increase in lane miles determined for the highway elements, and scaled accordingly. Because of the differing level of design detail, the SSA impact assessment for transit elements will be approximate in nature.

21.3.2 Hudson River Water Resources

21.3.2.1 Hudson River Water Quality

For the Hudson River, the principal water quality resources issues are the resuspension of river sediments during construction of the replacement bridge and during removal of existing bridge foundations, and the discharge of stormwater runoff from the decks of the replacement bridge. Increases in sediment or stormwater pollutant concentration may have a negative effect on biota, including biological function, migration, and reproduction. The methodologies presented in this chapter focus on water quality, while

the impact of water quality changes on biota is addressed in the methodology for Hudson River Ecology (Chapter 23).

Highway, Bridge, and Transit Accommodations

The analysis of sediment resuspension will address dredging operations, pile driving, sheet pile installation and removal, and vessel movement. Three primary components of the analysis have been identified: the sediment load generated by construction activities (where sediment enters the water column), the transport and dispersion of suspended sediment, and the deposition of sediment (where sediment leaves the water column). These three physical processes, as they relate to construction activities at the Tappan Zee Bridge, are described below:

- **Resuspension** – Sediment can be resuspended by various construction activities. During dredging, sediment may be lost from the dredge to the water column, and disturbances to the sediment bed by dredging operations may induce resuspension. Sheet pile installation/removal and pile driving may also result in resuspension. Vessel movements generate hydrodynamic forces, particularly from vessel propellers, that may also resuspend sediment. The objective is to develop estimates of the sediment load that is introduced to the water column by each construction activity.

- **Transport (as Suspended Sediment)** – Subsequent to its release to the water column, suspended sediment will be transported by river flow. During transport the sediment is subject to a variety of processes, including dispersion, which tends to dilute concentrations over time. An objective of the analysis is to assess the relative increase (compared to seasonal ambient conditions) in suspended sediment concentration resulting from principal construction activities.

- **Deposition** – At some point after being resuspended, sediment will settle in depositional areas within the estuary system. This material will become part of the natural sediment transport cycle in the Hudson River estuary and will undergo additional cycles of resuspension and deposition. An assessment of the initial depositional area and rate, and a qualitative assessment of the subsequent sediment cycle, will be developed as part of the sediment morphology analyses.

The impacts of stormwater runoff impacts will be analyzed using an appropriate hydrodynamic model to assess the potential for exceedances of relevant water quality standards due to the discharge of runoff from the replacement bridge. The assessment will consider the impacts of both total runoff, and the increment that occurs due to the additional paved deck area of the replacement bridge as compared to the existing structure.

Modeling Methods

Several methods will be employed to evaluate the behavior of sediments after resuspension, each of which is selected to appropriately handle relevant temporal and spatial scales. The immediate resuspension of sediment from construction activities creates near-field plumes that evolve on time-scales less than tidal periods. The sediment flux from produced by construction activities will be predicted with empirical/mechanistic models that are based on field observations and basic physical processes dominating sediment transport. These models will predict near-field concentrations of sediment.

The near-field concentrations will be input to a large-scale (or far-field) hydraulic model that will predict the velocity and dispersion characteristics of the estuary, and will be able to track the sediment plume as it evolves over time periods of several tidal cycles. In addition, sediment depositional rates and locations will be predicted using the far field model. The depositional rate and location results will be used in the

sediment morphology analyses presented below. Finally, the fate of sediments beyond a timeframe of several tidal periods is difficult to assess in a deterministic manner, and thus a conceptual model will be used to address long term transport. It is expected the long term behavior of project induced suspended sediment will be similar to that of natural transport processes in the Hudson River estuary.

A primary component of the overall sediment transport analysis is the ability to track the sediment plume with a large-scale numerical model. The Lower Hudson River Estuary in the vicinity of the Tappan Zee Bridge exhibits well documented stratified conditions from salt water intrusion throughout the year. Because of this and other complex estuary characteristics, it is necessary to conduct the dispersion analysis using a three-dimensional numerical model. Based upon a detailed review of the current state of numerical codes, the Environmental Fluid Dynamics Code (EFDC) model was selected for use on this project. EFDC is a public-domain modeling package for simulating three-dimensional flow, sediment transport and water quality. It was originally developed at the Virginia Institute of Marine Science and is currently supported by USEPA. The model has been extensively tested and documented in well over 100 modeling studies.

A model developed by Research Management Associates (RMA) will also be used to enhance the efficiency of the modeling effort and to provide additional validation of the EFDC code. RMA-2 is a 2D (depth averaged) hydrodynamic model developed for the USACE. It is a widely tested model, and is used extensively for bridge scour evaluations in tidal estuaries. The RMA model provides a model-to-model comparison of results for select conditions when the Lower Hudson River Estuary can be considered well-mixed throughout its depth (e.g., during the spring freshet).

Transit Elements

Transit alternatives may impact water quality resources of the Hudson River as a consequence of the sediment resuspension that would occur during construction of a CRT connection to the MNRR Hudson Line. Impacts will be estimated using information obtained from the analysis performed for replacement bridge construction. The scale of construction work for the Hudson Line connection will be compared to similar scale activities for the replacement bridge and an estimate of potential impacts will be generated on the basis of that comparison.

21.3.2.2 Hudson River Sediment Morphology

Changes in sediment morphology, including short term effects such as increased deposition from higher suspended sediment concentrations and long term effects such as development of depositional or scour zones near new bridge piers, may impact benthic resources of the Hudson River estuary. The methodologies presented in this chapter describe short and long term changes to river morphology resulting from replacing the Tappan Zee Bridge. Methodologies describing ecological impacts are addressed in Chapter 23 (Hudson River Ecology).

Highway, Bridge, and Transit Accommodations

Impacts to sediment morphology during construction occur primarily as a result of dredging and other construction activities (e.g., vessel movements), that remove sediments from one location in the estuary and deposit them at other locations. The transport processes between resuspension and deposition are similar to those that were described as affecting water quality and, consequently, the same analytical methods (models) will be applied. However, while the water quality analyses focus on water column concentrations of suspended sediment, the sediment morphology analysis focuses on removal and deposition of sediment.

The release of sediment to the water column from construction activities will be estimated using the methods previously described. These are a combination of observed data and fundamental sediment transport processes. Inputs to the analysis include the area and volume of sediment being dredged, the number of vessel movements occurring at different construction stages, and the resuspension potential of placing cofferdams, piles and other bridge permanent and temporary structures.

Depositional rates and locations will also be estimated using the same hydraulic models and analytical techniques previously described. Once initial deposition occurs, the sediment may be subsequently resuspended as part of the natural sediment transport processes within the Hudson River estuary. These cycles of resuspension and deposition may occur over larger time periods than those considered by the hydraulic analysis, on the order of weeks and months. Published information suggests that large discharge events can flush long term sediment deposits within the estuary into New York Harbor and Bay on a decadal time scale. In order to better understand the long term fate of sediment, a conceptual or qualitative model will be produced based on a literature review of past studies and previous data collection programs.

In addition to effects of construction activities on sediment morphology, permanent structures such as new bridge piers can also have morphological effects by altering local hydrodynamic conditions. While the exact effects depend on pier configuration, piers typically both increase and decrease localized water velocities, resulting in scour or accretion of bed material at different locations. In assessing the effects of pier scour, the main question is whether or not a depression is likely to develop at a particular pier and if so, to what extent and depth. This question will be addressed through use of laboratory data (as described above), classic pier scour calculations per HEC-18 (the FHWA Bridge Scour Manual), and existing scour observations from hydrographic surveys. The results of this assessment will depict the likely scour extent and depth adjacent to several typical bridge piers.

Finally, depositional mounds have been observed near the existing Tappan Zee Bridge piers and upon removal of the piers it is likely that the mounds will scour as the estuary bed forms its new equilibrium. An assessment of sediment quality and an estimate of the rate of scour will be established based on the results of chemical and geotechnical analyses performed on sediment samples collected from these mounds during the sampling program described in Subchapter 18.2.2. Using the laboratory-based scour rates, and coupling these rates to seasonal velocity/discharge conditions in the vicinity of the Tappan Zee Bridge, the time period for complete scour of the mounds will be estimated.

Transit Elements

Transit alternatives may impact river morphology as a result of making a CRT connection to the MNRR Hudson Line. The impact would be from permanently placing fill in the Hudson River; this effect will be estimated in terms of the area of river that would be either temporarily or permanently filled to enable the connection.

21.4 Mitigation Measures

21.4.1 Corridor Water Resources

In those limited cases where the flooding analysis identifies potentially significant water elevation changes for a Build alternative, conceptual mitigation measures will be identified. The mitigation measures may be directed at the stream conveyances beneath I-287, expansion of stormwater storage facilities or other methods to control upstream and downstream water volumes. Should the Build

alternatives involve modifications to the bed and banks of any streams, concepts for restoration of the streams to maintain hydraulic capacity will be developed. Any potential ecological impacts of changes to the bed and bank of streams are considered under the methodology for Terrestrial Ecology and Wetlands (Chapter 22).

The WinSLAMM model will enable comparisons of pollutant loadings from the existing I-287 corridor and the Build alternatives both with and without the benefits of implementing various mitigation measures. The model will be used to recommend the most effective and feasible control measures in light of the many spatial constraints that exist along the I-287 corridor.

As described above, for transit alternatives, planning-level estimates of project impacts to streams that cross the I-287 corridor will be developed on the basis of the total area of each alternative that encroaches on stream banks and adjacent floodplains. General mitigation options for transit-related stream impacts will be provided.

Finally, methods to eliminate or reduce potential impacts to SSAs will be considered, where appropriate. The primary impact to SSAs is expected to occur as a result of chloride infiltration. Potential mitigation methods that may be considered include deicing strategies, and stormwater runoff treatment systems (to reduce chloride and pollutant loads to SSAs).

21.4.2 Hudson River Water Resources

A variety of best management practices will be considered to reduce the effects of replacement bridge construction on Hudson River water quality. These include employment of environmental dredging equipment, silt curtains, cofferdams, and other modifications to construction equipment and methods, including those referenced in TOGS 5.1.9 (In-water and Riparian Management of Sediment and Dredged Material, NYSDEC, November 2004). The expected decrease in sediment load due to such practices will be estimated using available empirical data and the near-field mechanistic source models previously described. Using the revised estimates of sediment loading as input, the far-field numerical model (also previously described) will be employed to estimate water column sediment concentrations. Results of this analysis (mass of sediment resuspended and average water column concentrations) will enable a comparison of replacement bridge construction activity taking place with and without the employment of various best management practices.

Mitigation measures that address impacts to ecological resources as a consequence of sediment resuspension (e.g., restoration of wetlands or subaquatic vegetation) are considered in the methodology for the Hudson River Ecology analysis, as described in Chapter 23.

22 Ecology: Terrestrial Ecology and Wetlands

The Tappan Zee Bridge/I-287 Corridor Project study area (study area) for corridor ecology consists of a one mile-wide area north and south of I-287 from Suffern to Port Chester centered on the highway. For information regarding natural resources of the Hudson River occurring below the high tide line (e.g., fish, benthic invertebrates, etc.), refer to Chapter 23, Hudson River Ecology.

Throughout the study area, there are a variety of habitats that are utilized by floral and faunal species. These habitats include: wooded, scrub/shrub, and herbaceous uplands and wetlands and surface waters, and in some instances, urban areas provide habitat for species. Moreover, certain surface waters are directly utilized by human populations as drinking water sources.

Wetlands, surface waters, and certain habitats that support endangered species, receive protection under federal, state and local statutes and regulations. Impacts to protected or regulated areas could require: a detailed demonstration that there are no other practicable alternatives for minimizing or avoiding impacts to the particular regulated habitat, changes in construction methodologies, and/or increased mitigation requirements. Moreover, certain habitats, for instance wetlands, may have a regulated adjacent area that surrounds the wetland boundary; this adjacent area receives a level of regulatory protection.

Although impacts to protected or regulated areas can be measured in discreet metrics (i.e., the quantity of fill material discharged or impact area); the taking of multiple, contiguous habitats could also have ecological implications that are more difficult to quantify. The taking of large swath(s) of vegetated areas can have detrimental effects to the local or regional ecology by isolating faunal populations, fragmenting habitats, and/or disrupting migratory patterns. For instance, due to the developed urban/suburban character of the study area, larger vegetated parcels often consist of parks or preserves. These parcels are often connected to each other by vegetated tracts (vegetated corridors) within and/or adjacent to the highway ROW. Removal of the vegetated corridors would result in discontinuous vegetated parcels thereby isolating populations and disturbing the ecological balance. On the other hand, ecological features could be incorporated into future designs to connect currently isolated vegetated parcels and provide an ecological benefit.

A sampling plan to identify the potentially affected ecological resources in the study area was prepared and submitted to the cooperating regulatory agencies (i.e., National Marine Fisheries Service [NMFS], United States Army Corps of Engineers [USACE], United States Fish and Wildlife Service [USFWS], USEPA, NYSDEC and, New York Department of State [NYSDOS]) for review and approval (Appendix D). The sampling plan was revised to incorporate the comments of the agencies and was subsequently approved and studies to obtain the necessary data were performed.

22.1 Regulatory and Permitting Requirements

This subchapter provides a summary of the agency coordination meetings and subsequent changes to the sampling plan. A chronology of the plan's review and approval process is provided in Subchapter 22.1.1.1. A description of the environmental laws and regulations that pertain to the corridor ecology are also described in this subchapter. For a detailed description of the sampling plan's field program, refer to Subchapter 22.3 (Affected Environment).

22.1.1 Agency Coordination

Prior to the commencement of the sampling plan, available data from regulatory agencies were obtained. These data were reviewed and a sampling program was prepared and provided to the cooperating regulatory agencies for comment. The sampling program included a robust field mapping of habitats as well as studies of floral and faunal resources. The sampling plan's field mapping component is described in detail in Subchapter 22.2.2.

A listing of the meetings and correspondence with the regulatory agencies and sampling plan is provided in Table 22-1. The comments by the agencies were incorporated into the sampling plan and the resulting regulatory agency-reviewed Sampling Plan was finalized.

Table 22-1

Chronology of Sampling Plan Agency Review

Version of Sampling Plan	Date	Notes
Version 1	9/5/03	Presented to NYSDEC at a meeting on September 8, 2003.
Version 2	9/16/03	Revisions based on NYSDEC comments. Presented to Federal (USACE, USEPA, NMFS, USFWS) and state agencies (NYSDEC and NYSDOS) at a meeting on September 18, 2003.
Version 3	10/03	This version reflects the response to comments received at the September 18, 2003 meeting with federal and state agencies and the follow-up meeting with NYSDEC on September 25, 2003. In addition, follow-up comments to the September 18 meeting were received from NYSDOS (email) and USFWS (correspondence) and were also addressed in this version.
Version 4	3/1/04	The Sampling Plan was revised based on the then current understanding of Level 2 Alternatives for a meeting with NMFS on March 2, 2004.
Version 5	10/14/05	The Sampling Plan was revised based on revisions to the recommended DEIS alternatives. A revised fish sampling methodology was prepared based on telephone conversation with NMFS sturgeon permit personnel in Silver Springs, MD and Gloucester, MA.
Version 6	3/10/06	Revised based on comments received from NYSDEC Region 3 on November 30, 2005,

22.1.2 Federal Regulatory and Permitting Requirements

22.1.2.1 Section 10 Rivers and Harbors Act

The Rivers and Harbors Act (RHA) was enacted (33 US Code [USC] 403) to ensure that navigable waters of the United States (US) are not obstructed by work or altered by the placement of material. Under Section 10 of the RHA, USACE approval is required for work in or affecting navigable waters.

As defined in 33 CFR 329.12(a)(2), in coastal areas, the shoreward limits of jurisdiction under Section 10 extends to the line on the shore reached by the plane of the mean (average) high water. Wetlands and similar areas are regulated under Section 10 but only so far as the areas are subject to inundation by the mean high waters.

A permit is required pursuant to Section 10 of the Rivers and Harbors Act for construction of any structure in or over a navigable water of the US or any obstruction or alteration of navigable waters. Because some of the small rivers and streams in the corridor may be considered navigable waters, the proposed work in these waters requires a Section 10 permit. A determination of navigability will be based on consultations with the USACE.

22.1.2.2 Section 401 Water Quality Certification and Section 404 Clean Water Act

The Clean Water Act (CWA) was enacted to protect surface water quality in the US. Under Section 404 of the CWA (33 USC §1344), USACE approval is required for the discharge of dredge or fill material and/or mechanized land clearing, ditching, draining, channelization or other excavation activities in waters of the US, including wetlands adjacent to those waters. Under Section 401 of the CWA, 33 USC §1341, the state where dredged or fill material would be placed in waters of the US must certify that the action would not contravene the state's water quality standards. (See 22.1.3.3 for role of NYSDEC in this certification process.)

The term "waters of the US" includes navigable lakes, rivers, streams, tributaries to navigable waters, all waters which are subject to the ebb and flow of the tide, interstate waters and tributaries. Waters of the US also include wetlands adjacent to any of the above and <u>all</u> other waters of the US not identified above, such as intermittent streams and other waters, the destruction of which could affect interstate or foreign commerce.

As defined in 33 CFR 328.4(b), under Section 404 of the Clean Water Act, the landward limits of USACE jurisdiction in tidal waters extends to the high tide line. The term "high tide line" means the line of the water's surface at the maximum height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges (33 CFR 328.3[d])). When adjacent non-tidal waters of the US are present, the USACE jurisdiction under Section 404 extends to beyond the line of the high tide line.

Section 404 of the Clean Water Act requires authorization from the USACE. Because the project would impact waters of the United States including wetlands, a Section 404 permit would be required.

The USACE is the agency responsible for issuing Section 10 and Section 404 permits. When these two permits are required for one project, the permit application is prepared and submitted jointly. Since both a Section 10 and Section 404 permit will be required for the proposed work in the corridor, the project

sponsors will address them both in the permit application. For the role of state regulatory agencies in this permit, refer to Subchapter 22.1.3.3.

Minimization of Wetland Impacts

In order to minimize the impacts to wetlands, the project has incorporated the following actions:

- Wetlands within the study area were mapped and each wetland's ecological functions and values were identified. The mapping of wetlands was accomplished by recording the approximate boundaries of each wetland with a Global Positioning System (GPS) with +/- 1-meter accuracy.
- Wetlands that occur within and/or immediately adjacent to the preferred alignment will be formally delineated using the USACE 1987 manual. Also, wetlands regulated by the State of New York will be delineated as per the *New York State Freshwater Wetlands Delineation Manual*. The exact boundaries of all wetlands will be surveyed in the field with a GPS with centimeter accuracy.
- If a wetland would be impacted by the preferred alignment, alternatives to the alignment would be evaluated to determine if it is practicable to avoid or further reduce the potential wetland impacts.
- For unavoidable wetland impacts, wetland mitigation would be identified in consultation with the regulatory agencies and conducted to compensate for the wetland loss.

22.1.2.3 Endangered Species Act

The Endangered Species Act (ESA) (16 USC 1531 to 1543) applies to federal actions in two respects. First, the ESA requires that federal agencies that propose an action, in consultation with the NMFS and/or USFWS, ensure that proposed actions are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat (16 USC 1536 [a][2]). Regulations implementing the ESA expand the consultation requirement to include those actions that "may affect" a listed species or adversely modify critical habitat. Second, if an agency's proposed action would lead to the taking of a listed species, then the agency must obtain an incidental take statement from the NMFS and/or USFWS. The ESA defines the term "take" to mean "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt any such conduct" [16 USC 1532(19)].

Consultations will occur with the NMFS and USFWS on the effects that the construction and operation of the proposed bridge and transit alignments and demolition of the existing bridge may have on listed species under their jurisdiction. No threatened or endangered species were observed within the corridor ecology study area; however, endangered species were observed on the bridge and within the river. For consultation regarding aquatic species in the Hudson River, and the need for an incidental take permit, refer to Chapter 23 (Hudson River Ecology).

The project will evaluate potential impacts to species under the jurisdiction of the USFWS, based on the USFWS' guidance. The USFWS has a three-step process for any federal action (i.e., any project authorized, funded or carried out by a federal agency). A synopsis of these steps follows:

Step 1 - Determine whether any listed, proposed, or candidate threatened or endangered species (TES) are likely to occur within the location of the proposed project action:

Step 2 - Determine whether any TES are likely to occur within the habitat present within the proposed project action area

Step 3 - Based on the results of the habitat survey and a description of the proposed project (including whether any potential TES habitat may be directly or indirectly[1] affected), the involved federal agency may determine:

- The proposed project will result in no effect to any TES and no further coordination or consultation with the USFWS is required;
- Additional information (e.g., surveys) is required to determine whether any TES are likely to occur within the proposed project area; or
- The proposed project "may affect" a TES and consultation with the USFWS is required.

22.1.2.4 Executive Order 11990 Protection of Wetlands

This order of May 24, 1977 directs federal agencies to take action to protect wetlands on their property and mandates review of proposed actions on wetlands through procedures established by NEPA. If federal jurisdictional wetlands are impacted, the FHWA will need to approve a Wetlands Finding.

22.1.2.5 Executive Order 11988 Floodplain Management

This order sets forth federal agency responsibilities for reducing the risk of flood loss or damage to property, minimizing the impact of flood loss, and restoring the natural and beneficial functions of floodplains. This order was issued in furtherance of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Construction for this project that would occur in floodplain areas will be submitted for public review. Floodplain management and the handling of this requirement in connection to the proposed project are discussed in Chapter 21

22.1.2.6 Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) provides assistance to states, in cooperation with federal and local agencies, for developing land and water use programs for the coastal zone. This includes the protection of natural resources and management of coastal development.

The application of these regulations to the proposed project is discussed in Chapter 24 (Coastal Zone Management).

22.1.2.7 Magnuson-Stevens Fishery Conservation & Management Act

Projects proposed for estuarine or coastal waters that require a permit from the USCG or the USACE will most likely also require that consultation occur with NMFS to assess potential impacts on essential fish

habitat (EFH) as per the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). Also, tributaries that flow to a coastal water body within the I-287/Tappan Zee project area that do not have an impoundment (dam etc.) between the project location and the coastal water body are too subject to the MSFCMA.

The relevant federal permitting agency will determine whether the project could affect EFH and, if so, will request a consultation with NMFS. The permitting agency must then provide an initial EFH assessment detailing the manner in which the proposed activity may affect fish habitat, and must then respond to recommendations provided by NMFS.

The EFH assessment for this project will include:

- A description of the proposed action.
- An analysis of the effects, including cumulative effects, of the proposed action on EFH, including; the managed species and associated species, such as major prey species, including affected life-history stages.
- The federal agency's (USCG's or USACE's) views regarding the effects of the action on EFH.
- Proposed mitigation, if applicable. The assessment will also include: the results of an on-site inspection; the views of recognized experts on the habitat or species effects, and a literature review; an analysis of alternatives to the proposed action; and other relevant information. This consultation usually occurs at the regional level, and is merged with reviews required under the ESA, NEPA, CWA, and the Coastal Zone Management Act (CZMA).

22.1.3 New York State Regulatory and Permitting Requirements

22.1.3.1 Tidal Wetlands

The New York State Legislature passed the Tidal Wetland Act (Article 25 of the Environmental Conservation Law) in 1973. New York State recognized the importance of tidal wetlands and sought to insure its protection from filling and dredging. Typically, tidal wetlands have a regulated "adjacent area" that extends 300 feet landward of the most landward boundary of a tidal wetland. Any activity that would disturb a tidal wetlands and/or adjacent areas would be subject to NYSDEC regulation under Article 25.

The proposed alignments for the bridge, highway, and transit elements of the project would require alteration to the shoreline. A tidal wetlands permit would need to be obtained for these activities.

22.1.3.2 New York State Freshwater Wetlands

The New York State Legislature passed the Freshwater Wetlands Act (Article 24 of the Environmental Conservation Law) in 1975 with the intent to preserve, protect and conserve freshwater wetlands and their benefits, consistent with the general welfare and beneficial economic, social and agricultural development of the state. To be protected under the Freshwater Wetlands Act, a wetland must be 12.4 acres (ac) in size or greater. Wetlands smaller than 12.4 acres may be protected if they are considered of unusual local importance. Generally, adjacent to every regulated freshwater wetland is a regulated adjacent area of 100 feet that is also protected to provide a buffer for the wetland. Any activity that would disturb a state

freshwater wetland and/or adjacent area would be subject to New York State Department of Environmental Conservation (NYSDEC) regulation.

Pursuant to the Freshwater Wetlands Act, this project would require a Freshwater Wetlands permit since the Highway, Transit Accommodations and Transit Elements would disturb New York State-regulated wetlands.

22.1.3.3 New York State Water Quality Certification

Under Section 401 of the CWA, 33 USC §1341, the NYSDEC would need to issue a Water Quality Certificate for the placement of dredged or fill material in waters of the US to certify that the action would not contravene New York's water quality standards.

22.1.3.4 New York Natural Heritage Program and NYSDEC Incidental Take Permit

The New York Natural Heritage Program (NHP) is a partnership between the NYSDEC and The Nature Conservancy. The NHP's mission is to facilitate conservation of rare animals and rare plants, commonly referred to as Threatened and Endangered Species [TES]), as well as natural communities. The NHP maintains New York's most comprehensive database on the status and location of rare species and natural communities. The NHP presently monitors 174 natural community types, 727 rare plant species, and 432 rare animal species across New York.

In the environmental documentation process, an applicant wishing to do work within the State of New York, would first contact the NHP to obtain information regarding the presence or absence of TES within and or adjacent to the project's action area. If a species is identified as potentially present in the project action area, the project's sponsor would need to conduct an evaluation (e.g., field survey, habitat assessment, etc.) to first determine if there is suitable habitat to support the species and whether the species does, in fact, utilize the action area. Should the project's proposed alignments, construction, and/or operation impact any TES, the project's sponsors would need to obtain an incidental take permit from the NYSDEC. The take of a TES is prohibited without a permit from NYSDEC pursuant to Article 11 Section 0535 of the State of New York's Environmental Conservation of Law.

22.2 Affected Environment

The western portion of the study area begins at the foothills of the Appalachian Mountains. The eastern portion of the study area begins within the coastal plain – only several miles from Long Island Sound. The study area consists of a variety of upland, wetland, and surface water habitats, including the crossing of some 20+ rivers, streams, and other drainage courses.

A sampling plan to obtain data on ecological resources throughout the project study area was conducted. This sampling plan included:

- The collection of published data documenting ecologic resources throughout the project study area. These data are available from a variety of sources and are described in Subchapter 22.2.1; and

- Field investigations to document the ecologic resources. These investigations are described in Subchapter 22.2.2.

22.2.1 Data Collection – Published Documents

Data on ecological resources within the study area were obtained from regulatory agencies and natural resource organizations. The obtained data included:

- USFWS National Wetland Inventory Maps.
- US Forest Service Ecological Unit Mapping.
- NYSDEC Tidal and Freshwater Maps.
- NYSDEC Wildlife and Bird Conservation Areas.
- NYSDEC Water Quality Classifications of freshwater streams and lakes.
- NYSDEC Amphibian and Reptile Atlas Project.
- NYSDEC Wildlife (Mammal Data) including pelt sealed records and deer take data.
- NYSDEC Fish Stocking Program – identification of stocked waterbodies in the study area.
- NYSDEC Stream Biomonitoring Program – Benthic Invertebrate Data.
- County and Municipal Critical Environmental Areas Parks, Nature Preserves.
- Avifauna Data – NY Breeding Bird Atlas Survey and Audubon Christmas Counts Data.
- Threatened and Endangered Species – Written correspondence was obtained from USFWS, NMFS, and NYSDEC' Natural Heritage Program. Also, the aforementioned agencies websites were reviewed.

22.2.2 Data Collection – Field Program

The cornerstone of the field program was an extensive habitat mapping exercise. In order to establish the extent of study area's uplands and wetlands that could be potentially affected, a field investigation was conducted within parcels that construction activity will occur. The parcels included the following:

- **I-287 Corridor Right-of-Way (ROW)** in Rockland and Westchester Counties.
- **Hackensack River Area** - 100 feet beyond the edge of the ROW line and 50 feet landward on either river bank.
- **Hudson River Shorelines** - 500 feet north and south of the Tappan Zee Bridge/I-287 ROW along the shoreline of the Hudson River. (This area also measures 50 feet landward of the high tide line.)

- **Metro-North Railroad ROW (Hudson Line)**. In Westchester County from the Tarrytown Station to Irvington Station, from the high tide line to the eastern construction limits along the Hudson Line.

- **Piermont ROW** - from Suffern to Airmont Road (Exit 15).

- **Areas Adjacent to the I-287 ROW** – Selected parcels in Rockland and Westchester Counties outside of the I-287 ROW that could be impacted by transit accommodations or elements.

A team of scientists traversed the study area and mapped all habitats, which were evaluated to determine cover type and dominant flora. The boundary of each habitat was surveyed using a GPS unit with sub-meter accuracy. Utilizing the GPS data, a base map of the study area was developed to depict the various cover types. In addition to depicting the approximate boundaries of upland habitats, the faunal usage and floral coverage of these habitats was also characterized. Ecological communities were identified as per the New York Natural Heritage Program's *Ecological Communities of New York State* (Edinger, 2002).

The scientists identified wetlands in the field using techniques specified in the 1987 *Corps of Engineers Wetland Delineation Manual* (1987 Manual). Also, boundaries of currently mapped state wetlands were confirmed and consideration was given to wetlands mapped pursuant to local laws (see note at the end of this subchapter. Also, to aid in impact and mitigation assessment, observations were made of each wetland's functions and values, as per the USACE document *The Highway Methodology Workbook Supplement: Wetland Functions and Values: A Descriptive Approach*" (USACE,1999). A list of these functions and values are the following:

- Groundwater recharge/discharge.
- Flood-flow alteration.
- Fish and shellfish habitat.
- Sediment and toxicant removal.
- Nutrient removal/retention transformation.
- Production export.
- Sediment/shoreline stabilization.
- Wildlife habitat.
- Recreation.
- Education/scientific value.
- Uniqueness/heritage.
- Visual quality/aesthetics.
- Endangered species (ability to support).

To better assist in the analysis of wetlands and associated ecological resources along the I-287 ROW and the Metro-North ROW, color aerial-infrared photographs from 2007 were obtained. The area covered by the photos is approximately 100 feet beyond the ROW on either side of I-287 and from Tarrytown to Irvington stations from the high tide line to the eastern construction limits along the Hudson Line.

With respect to local regulation of wetlands, the City of White Plains identifies wetlands by two methods: (1) as per the 1989 *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (1989 Manual) (which is different from the 1987 Manual); and (2) lands and waters of the state that meet the definition provided in subdivision 24-0107.1 of the New York State Freshwater Wetlands Act (Article 24 of the New York Environmental Conservation Law [ECL]) but without regard to the minimum size standards set forth in the ECL.

Also, the Town of Greenburgh identifies wetlands as Critical Environmental Areas. As such, these wetlands may be regulated under Article 24 of the ECL.

It is unlikely that the municipalities' regulation of wetlands would be of significance to the project as little, if any, construction activities would occur within wetlands in these municipalities. Moreover, due to the generally disturbed nature of wetlands within these municipalities and the minor discrepancies between the delineation of wetlands in accordance with the 1987 Manual, 1989 Manual, or the New York State *Freshwater Wetlands Delineation Manual*, there would not likely be a difference in the total amount of acreage of delineated wetlands within the preferred alternative. Prior to delineation of wetlands within the Preferred Alternative, the current local regulations of wetlands for all municipalities will be re-reviewed to obtain the most up-to-date local regulations.

22.2.2.1 Faunal Studies

In addition to the habitat mapping, wildlife surveys of avifauna and mammals were performed along the Hudson River shorelines. Also, surveys of benthic invertebrates were performed within select streams and rivers in Rockland and Westchester Counties that are crossed by the I-287 Corridor.

As part of faunal studies, a 4-season avifauna sampling program was conducted. The program consisted of 15 observation days over a 2-month period in both the fall and winter seasons of 2006, and the spring and summer seasons of 2007. Sampling was conducted from a boat and on land. Each sampling day was initiated before dawn and continued through midday. Surveys were conducted within 1 mile of the bridge and in the reference areas, located approximately four miles north of the bridge. Figure 22-1 identifies the approximate areas of where avifauna and mammal observations were done.

A mammal survey was conducted along the Hudson River shorelines simultaneously with the 4-season avifauna sampling program described above. The observation sites on each shoreline of the river are located within the study area and one site on each shoreline was located approximately four miles north of the bridge in a selected as reference areas. These areas were chosen based on accessibility, proximity to the bridge, and habitat availability. Mammal searches were conducted during nocturnal conditions (approximately 1.5 hours before sunrise), in early morning, and at midday.

Sampling for benthic invertebrates was conducted in the ecologically significant water bodies (i.e., waterbodies that are Class A waters, NYSDEC-regulated class I or II wetlands, trout streams, or waterbodies on the NYS List of Impaired waters) that would be impacted by the preferred alternative.

Fish and herptofauna habitat for each water body that would be impacted by the preferred alternative will be characterized from observations of each water body's physical characteristics (e.g., depth, flow, bottom type, aquatic vegetation, and benthic community composition).

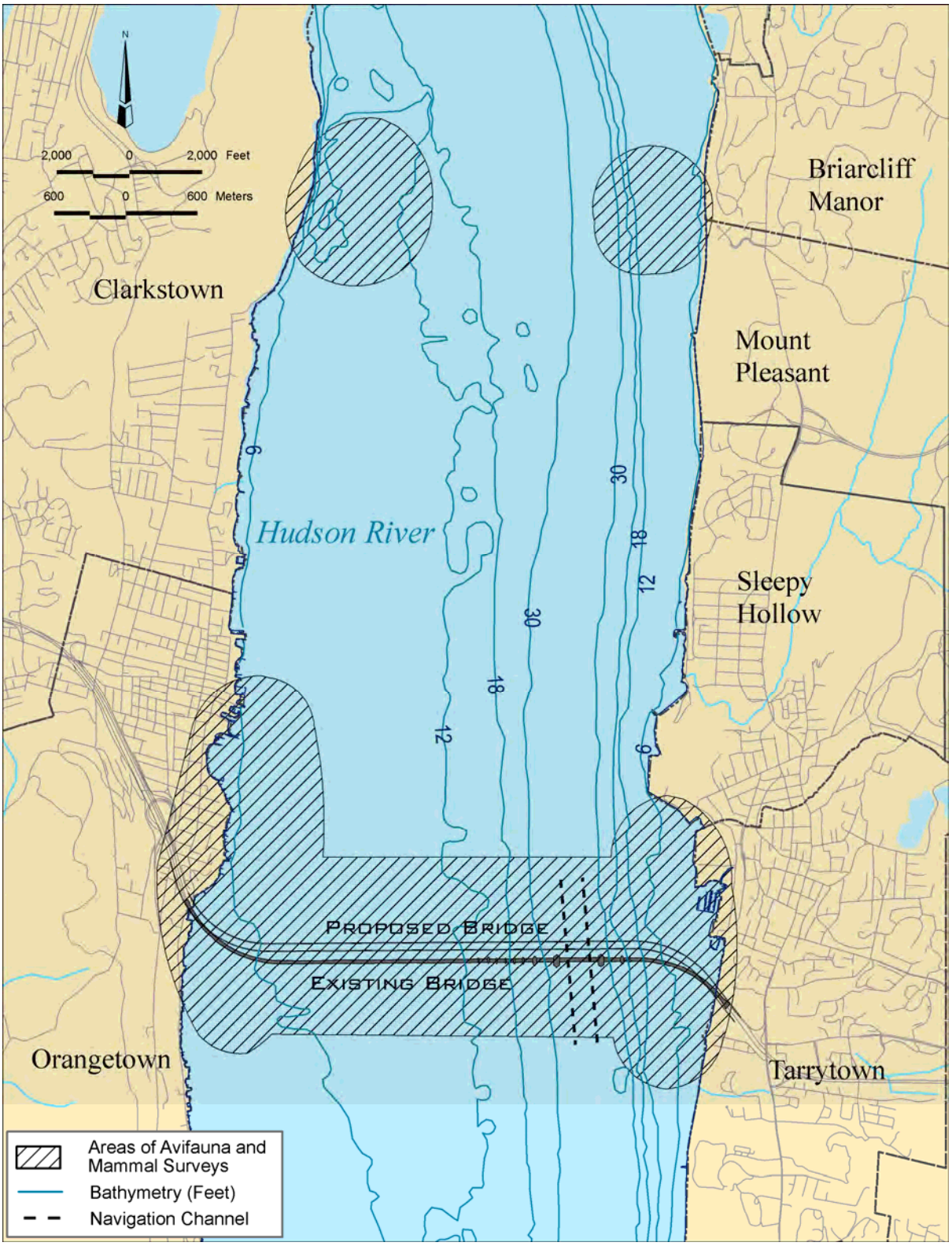

Figure 22-1 Avifauna and Mammal Survey Locations

22.3 Environmental Consequences

The principal focus of the impact assessment will be the aquatic and terrestrial habitats and their associated flora and fauna species that the proposed project alternatives would directly impact in Rockland and Westchester Counties. Potential impacts to corridor ecosystems may occur both during construction and during long-term operation of the project. Construction of the proposed project would result in a wide-range of impacts to adjacent ecosystems. The impacts include: loss of habitat due to removal; alterations to habitat (e.g., the rerouting of a watercourse); the fragmentation of a habitat, which would convert one high-value contiguous habitat into two or more lower-value habitats. Also, construction adjacent to a habitat may result in indirect impacts (e.g., through shading of the vegetation). The placement of noise walls, elevated roadways and bridges, etc., could permanently reduce the normal sunlight to a particular habitat. Increases in impervious surfaces would increase stormwater runoff and convey excess hydrology which may stress vegetation in the area. Also, increased hydrology could result in increased erosion and /or stream bed alteration.

In general, in assessing the potential impacts of specific transit elements of the alternatives, the transit alignments would be evaluated in the same manner as highway and bridge alignments. However, for other transit elements (e.g., stations), the analysis will consider only direct impacts and not those resulting from construction activities needed to implement a particular alternative. For impacts to the Hudson River aquatic ecological resources resulting from bridge pier construction, refer to Chapter 23.

22.3.1 Wetland Impacts

For each alternative the acreage of wetlands that would be directly impacted will be identified. Also, the DEIS will summarize the extent of expected wetland loss and the functions and values of the impacted wetlands. The DEIS will also identify and evaluate the number of drainage courses that may be relocated or modified. The level of modification would be studied to determine if the proposed alternative would fundamentally alter the ecologic character of the waterbody and associated wetlands and floodplains. Also potential impacts to drinking water sources will be discussed.

22.3.2 Impacts on Vegetation and Wildlife

For each alternative, the DEIS will identify the acreage of high-quality terrestrial and aquatic habitats that would be directly impacted. This would include the potential for an alternative to fragment a high quality habitat or remove the vegetative corridor connecting two or more larger habitats. Construction-related loss of habitat will be described, and the area and extent of the impacts will be estimated. Also, the DEIS will review plans of the proposed the bridge alternative's superstructures to determine potential impacts to resident and migrating avifauna.

22.3.3 Threatened and Endangered Species Impacts

The DEIS will identify habitats that are used or could potentially be used by threatened and endangered species (TES). The alignment of each alternative will be reviewed to determine if a TES habitat will be impacted. For each affected TES habitat, an analysis would be provided to determine the potential impact

to the species or if the ecological value of the habitat would be reduced so as to no longer serve as viable habitat for TES.

22.4 Mitigation Measures

The DEIS will discuss mitigation scenarios to offset potential impacts to natural resources. These mitigation scenarios would include the following:

(1) In order to offset potential wetland impacts and work towards “no net loss” of wetlands as required in Executive Order 11990; wetland mitigation would include: the creation of new wetlands, the restoration of existing degraded wetlands, and/or use of a wetland mitigation bank);

(2) In order to offset potential impacts to ecoystems and wildlife, mitigation may include identification of areas where migratory corridors for wildlife could potentially be incorporated into future designs (to increase the ecological value and safety for wildlife through the reduction of impacts with vehicles); and

(3) Areas where stormwater retention may be beneficial to the local ecology would be identified. The exact design or location of these areas and the measures involved in each cannot be established until the project’s design phase. The mitigation measures will therefore often be conceptual in nature at this stage, but with sufficient detail to define the nature and extent of the mitigation that could likely be provided to offset potential impacts that are defined.

23 Ecology: Hudson River

Natural resources that occur below the high tide line (e.g., benthic invertebrates, fish, etc.) in the Hudson River are discussed in this chapter. For natural resources that occur within the footprint of the river, but above the high tide line (e.g., avifauna, etc.), those resources are discussed in Chapter 22, Terrestrial Ecology and Wetlands.

Replacing the Tappan Zee Bridge will result in some disruption to ecological resources of the Hudson River. It is expected that most of the impacts to the river's ecological resources will occur during construction of the replacement bridge and will be temporary in nature; however, there may also be long term impacts associated with the new structure. The methodology presented herein describes the approach that will be taken to analyze both the construction phase and permanent impacts of replacing the bridge.

23.1 Regulatory and Permitting Requirements

23.1.1 Agency Coordination

The Hudson River has been the focus of a major survey program specifically developed for the Tappan Zee Bridge/I-287 Corridor Project (Appendix D). The goal of the program was to determine whether the existing Tappan Zee Bridge provides an important habitat for the river's aquatic life and whether construction of a replacement bridge would have the potential to impact the river's fisheries. The program was developed in consultation with the NMFS, USACE, USEPA, USFWS, NYSDEC, and NYSDOS. It should be noted that the Tappan Zee reach of the Hudson River is not a NYS Significant Habitat but the reach is within the federally designated significant habitat complex of the Lower Hudson River Estuary.

During development of survey program protocols, several meetings were held with NMFS, USACE, USEPA, USFWS, NYSDEC, and NYSDOS to obtain specific concurrence on the ecological, geophysical and hydrodynamic sampling program that would be implemented. Refer to Subchapter 22.1.1 for a chronology of the agency coordination with respect to the field program. In addition, NMFS provided direction on the usage of the electric utility survey data that has been collected in the Hudson River since 1974.

23.1.2 Permit Requirements

The construction of the new bridge and demolition of the old structure are subject to various regulatory programs at both the federal and state level; including:

23.1.2.1 USACE Section 404 Clean Waters Act Permit, Section 10 Rivers and Harbors Act, and Section 103 Marine Protection, Sanctuaries and Research Act

The Clean Water Act (CWA) was enacted to protect surface water quality in the US. Under Section 404 of the CWA (33 USC §1344), USACE approval is required for the discharge of dredged or fill material and/or mechanized land clearing, ditching, draining, channelization or other excavation activities in

waters of the US, including wetlands adjacent to those waters. Under Section 401 of the CWA, 33 USC §1341, the state where dredged or fill material would be placed in waters of the US must certify that the action would not contravene the state's water quality standards.

The USACE is responsible for implementing the permit program specified under Section 404 of the Clean Water Act. Because the project would impact waters of the US including wetlands, a Section 404 permit would be required.

A permit is required from the USACE pursuant to Section 10 of the Rivers and Harbors Act for construction of structures, except bridges, in or over a navigable water of the US or any obstruction or alteration of navigable waters. As discussed further below, the US Coast Guard has responsibility for approving new bridge projects under Section 9 of the Rivers and Harbors Act. Thus, for the replacement Tappan Zee Bridge it is expected that the USACE jurisdiction will relate to ancillary structures associated with the new bridge such as temporary platforms and permanent non-bridge structures.

USACE also regulates the transportation of dredged material for placement in the ocean under Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA). As previously discussed in Subchapter 21.1.1, this regulation applies only to permitting related to the potential discharge of dredged material at the Historic Area Remediation Site.

23.1.2.2 Endangered Species Act - NOAA Incidental Take Permit

The Endangered Species Act (ESA) (16 US Code [USC] 1531 to 1543) applies to federal actions in two respects. First, the ESA requires that federal agencies, in consultation with the responsible wildlife agency, ensure that proposed actions are not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of critical habitat [16 USC 1536 (a)(2)]. Regulations implementing the ESA expand the consultation requirement to include those actions that "may affect" a listed species or adversely modify critical habitat.

Second, if an agency's proposed action would lead to the taking of a listed species, then the agency must obtain an incidental take statement from the responsible wildlife agency. The ESA defines the term "take" to mean "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt any such conduct" [16 USC 1532(19)].

To date, NMFS has advised the project' sponsors that due to the presence of the shortnose sturgeon (a federally listed species) in the Hudson River, a NOAA Incidental Take permit would be required for this project. Also, NMFS has informed the project's sponsors that the Atlantic Sturgeon, a candidate species for listing under ESA, will likely be listed in the near future, and an incidental take permit for that species would also be required.

23.1.2.3 US Coast Guard Section 9 Permit

A Bridge Permit is required from the USCG pursuant to Section 9 of the Rivers and Harbors Act of 1899, the General Bridge Act of 1946, and the Act of March 23, 1906 (33 CFR Parts 114 and 115). This permit is required for the construction of a bridge, dam, dike or causeway over or in any port, roadstead, haven, harbor, canal, navigable river or other navigable water of the U.S., under the River and Harbors Act of 1899. Per the recent recommendation of a replacement, a USCG Bridge Permit will be required.

The applicant must provide the necessary information required for the USCG Bridge Permit Environmental Investigation, as follows:

- Coastal Zone Management Consistency Determination.
- Executive Order 11990, Protection of Wetlands.
- Executive Order 11998, Protection of Floodplains.
- Section 401 Water Quality Certification.
- Threatened and Endangered Species.
- Magnuson-Stevens Fishery Conservation and Management Act Consultation (Essential Fish Habitat Determination.).
- Wild and Scenic Rivers Consistency Determination.

23.1.2.4 NYSDEC ECL Article 25 Tidal Wetlands Permit

A 6 NYCRR Part 661 Environmental Conservation Law (ECL) Article 25 Tidal Wetlands Permit is required for any activity which will alter tidal wetlands or Adjacent Areas, including the construction, reconstruction and /or expansion of structures, including roads, driveways and bridges. New York's tidal wetlands are mapped and include salt water shores, bays, inlets, canals and estuaries. Adjacent areas extend from the wetland boundaries for a distance up to 300 feet.

23.1.2.5 NYSDEC ECL Article 34 Coastal Erosion Permit

Regions of the New York State coastline are protected from potential erosion by Environmental Conservation Law (ECL), Article 34 Coastal Erosion Control Permit, 6 NYCRR Part 505. The purpose of this permit is to prevent and reduce erosion from construction and other activities. The protected New York State Coastal line includes the Hudson River south of the Federal Dam in Troy and thus, the project is subject to the requirements of this program.

23.1.2.6 NYSDEC Dredging and Disposal

The upland disposal of dredged material at sites within New York State is subject to 6 NYCRR 360, the Solid Waste Management Facilities Regulations. All upland-disposed dredged material must be disposed of in an authorized waste management facility. As an alternative to landfill disposal, certain dredged material can be reused as fill material. Dredged material that may be eligible for fill material must be managed in accordance to the generic or a case-specific beneficial use determination (BUD). Dredged material is tested for contamination, and the results of the chemical analysis are used to determine whether the indicated use of the fill material meets the standards of the BUD. Material that is uncontaminated and certain levels of contaminated soil can be reused depending on the proposed use and whether it meets the standards of the BUD.

23.1.2.7 NYSDOS Use of State-Owned Lands

Authorization for Use of State-Owned Underwater Lands (9 NYCRR 270) is required for any project proposing to occupy such property. Authorization for use of these lands is provided upon the issuance of a permit or interim permit which grants an easement. The use of underwater lands is under the jurisdiction of the New York State Office of General Services (NYSOGS).

23.1.2.8 NYSDEC General Permit for Stormwater Discharges from Construction Activity (GP-0-08-001)

The State Pollutant Discharge Elimination System (SPDES) Program (6 NYCRR 750) regulates discharges to the state's waters. Activities requiring a SPDES permit include point source discharges of wastewater into surface or groundwaters of the state, discharge of stormwater; and construction activities that disturb one acre or more, among others.

The current GP for the Tappan Zee Bridge expires April 30, 2010 (or later, if the new permit [GP-0-10-001] is not finalized by that date). The construction site operators for the Tappan Zee Bridge/I- 287 Corridor Project will be required to obtain a SPDES General Permit for Stormwater Discharges from Construction Activity (GP-0-08-002) because the project construction activities will disturb one or more acres of land. For more information regarding SPDES permitting, refer to Chapter 21.1.

23.1.3 Regulatory Certifications and Consultations

23.1.3.1 NYSDEC Section 401, Water Quality Certification

In accordance with Section 401 of the Clean Water Act, any applicant proposing an action that could result in discharge of a pollutant to state waters is required to obtain a certification from the state in which the activity is to occur. The state will verify that the materials to be discharged into a wetland or water will comply with state effluent limitations, water quality standards, and any other applicable conditions of the state law. Although this is a federal regulation, in New York State, it is administered by the NYSDEC.

Review and issuance of a 6 NYCRR 608 Section 401 Water Quality Certification (WQC) occurs simultaneously with the Freshwater Wetlands, Tidal Wetlands and/or Protection of Waters permits by the NYSDEC. Section 401 Water Quality Certification ensures that surface and groundwater resources are being protected during construction and operation of the proposed project.

23.1.3.2 NYSDOS Federal Coastal Zone Management Consistency Determination

The New York State Department of State (NYSDOS) oversees all regulated activities in the state's coastal zone consisting of coastal waterways (including the Hudson River), their shorelines, and adjacent inland areas under the CZM program. A consistency determination is required for any federal, state or local action within the coastal zone of New York State. This is discussed in greater detail in Chapter 24.

23.1.3.3 Threatened and Endangered Species

Impacts to both the federally listed and New York State listed shortnose sturgeon will be evaluated in the DEIS. At the suggestion of NMFS, the Atlantic sturgeon will also be evaluated in the Section 7 Biological Assessment (BA). The Atlantic sturgeon is listed as a Species of Concern by NMFS and was noticed as a Candidate Species. NMFS believes that the Atlantic sturgeon may be listed prior to the construction of the bridge. These species are known to inhabit the study area during some portion of their life cycle. The BA will be based on data from the field surveys described above and, in addition, surveys conducted by others. Views of recognized experts on the listed species, a literature review, and analysis of direct and indirect effects of the alternatives on the species will also be developed. The BA will evaluate potential effects on the species from the construction and operation of the project. The complete BA will be in a separate report submitted to NMFS.

23.1.3.4 Magnuson-Stevens Fishery Conservation and Management Act

Projects proposed for estuarine or coastal waters that require a permit from the USCG or the USACE will most likely also require that consultation occur with NMFS to ascertain impacts on essential fish habitat (EFH) as per the Magnuson-Stevens Fishery Conservation and Management Act. The relevant federal permitting agency will decide whether the project can affect EFH and, if so, will request a consultation with NMFS. The permitting agency must then provide an initial EFH assessment detailing the manner in which the proposed activity may affect fish habitat, and must then respond to recommendations provided by NMFS.

The EFH assessment for this project will include:

- A description of the proposed action.
- An analysis of the effects, including cumulative effects, of the proposed action on EFH, the managed species, and associated species, such as major prey species, including affected life-history stages.
- The Federal agency's (USCG's or USACE's) views regarding the effects of the action on EFH.
- Proposed mitigation, if applicable. The assessment will also include: the results of an on-site inspection; the views of recognized experts on the habitat or species effects, and a literature review; an analysis of alternatives to the proposed action; and other relevant information. This consultation usually occurs at the regional level, and is merged with reviews required under the ESA, NEPA, CWA, and the Coastal Zone Management Act (CZMA).

23.2 Affected Environment

The aquatic and adjoining terrestrial environment at the Tappan Zee Bridge has been documented through field investigations of benthic macroinvertebrates, fish, shellfish, submerged aquatic vegetation (SAV), wetlands, and avian and mammal species populations. Additionally, water chemistry, sediment chemistry, bathymetry, tidal currents and tidal elevations have been monitored or mapped in the immediate vicinity of the bridge. Results of these project surveys are being integrated with the larger compilation of Hudson

River-wide data that has been accumulated by federal and state agencies as well as by utilities with operations on the river.

The results of the evaluation of the collected data will be used to both describe existing conditions in the Hudson River, at the bridge and to evaluate construction and operational project impacts to the estuary, threatened and endangered species, fisheries resources, avian species, benthic communities, sub-aqueous vegetation, wetlands, and mammals.

Prior to the commencement of the sampling program, available data from regulatory agencies, the technical literature, and the electric utilities' Long River Surveys were obtained. These data were reviewed and a sampling program was prepared and provided to the regulatory agencies for comment. The agencies that reviewed and commented on the sampling program included the NMFS, the USACE, USEPA, USFWS, NYSDEC), and NYSDOS. Their comments were incorporated and the resulting regulatory agency-reviewed Hudson River Sampling Program is described in the following paragraphs. Table 23-1 provides a synopsis of the sampling program.

Bridge habitat-specific fish sampling occurred in locations anticipated to be disturbed by the removal of the existing bridge and the construction and operation of a replacement bridge. Bi-monthly sampling was conducted using multiple fish traps and gill nets at six locations directly adjacent and underneath the bridge. Avian and mammalian presence data were obtained from quarterly surveys within the area of potential impact and of two reference areas north of the existing bridge. The presence of SAV was confirmed using NYSDEC mapping, physical sampling of the river bottom, and acoustic imaging in late summer in the study area. Bi-monthly benthic community data were obtained at 41 stations within the existing and proposed bridge footprints. At each location, sediment samples were collected and sorted to remove the benthic organisms. These organisms were preserved and identified at a later date in a laboratory setting. In addition, divers photographed and sampled the faunal and floral species that inhabited the bridge piers.

As part of the field efforts, field surveys for bathymetry, tidal fluctuations, and river velocities were performed in the immediate bridge vicinity to supplement available information for other river reaches and to fill in data gaps for the project area. These surveys were conducted to:

- Provide a base on which to illustrate other geo-referenced data, such as wetlands, SAV areas, and oyster reefs, among others.
- Assist in evaluating and understanding fish and benthic data (e.g., fish may prefer areas of higher rugosity [i.e., three-dimensionality] in the river bottom and near bridge piers).
- Provide a basis for estimating the volume of sediment that would need to be dredged and disposed.
- Enable development of a multi-dimensional model for estimating sediment resuspension and dispersion.
- Assist with preliminary design work as necessary.

In addition to the hydrographic survey, a single-event river current survey was conducted to facilitate calibration of a hydrodynamic and water-quality model that will be developed for this project.

Table 23-1

Summary of Hudson River Ecological Investigations

Parameter	Description/Objective
Sediment	Sediment sampling was implemented to gather additional data about the physical and chemical characteristics of Hudson River sediments in the immediate vicinity of the Tappan Zee Bridge. The program utilized vibracore samplers to obtain 4-inch-diameter sediment cores from 38 locations across the river. Except where the vibracore device encountered refusal at shallower depths, each vibracore was driven to a depth of at least 6 feet. A total of 156 samples from 38 cores were submitted for sediment chemistry analyses, including Semivolatile Organic Compounds (SVOCs)-base/neutral [BN] fraction, pesticides, PCBs and metals. A subset of 17 samples from 10 cores was also submitted for dioxins analysis. A total of 80 samples from 36 cores were also submitted for geotechnical analyses (e.g., grain size, plastic index, etc.).
Benthic Macro-invertebrates	Bi-monthly sampling at 41 locations in the project area. The 11 sampling stations were placed along one transect within the bridge alignment and 22 sampling stations along two transects 50 and 150 feet north of the bridge, respectively. In addition, sampling occurred at additional locations south of the bridge near the shoreline within the proposed footprint of the potential temporary causeway. Also, four sampling locations were located within 100 feet of the southeast shoreline for the potential rail ROW expansion in the river.
Fish and Shellfish	Bi-monthly collections were accomplished by means of traps and gill nets at six stations underneath and adjacent to the bridge, as well as at three reference stations. In addition, bi-monthly acoustic surveys collected data on fish populations within the study area. Data from the technical literature, regulatory agency data, and the electric utilities' Long River Survey data were evaluated and incorporated in the existing conditions chapter and the impacts analysis chapter. The blue claw crab population within the existing and proposed footprints was analyzed from April to November. Crab populations were identified by the deployment of commercial crab pots and by enumerating all crabs that became entangled within gill nets and fish traps.
Submerged Aquatic Vegetation	Surveys were performed to confirm existing NYSDEC data within the study area and to identify the dominant submerged and emergent vegetation.
Oyster Bed Survey	A survey of oyster beds in an area two miles north and two miles south of the Tappan Zee Bridge was performed using side scan sonar technology. The presence/absence of live oysters of all mapped beds was field confirmed with benthic grab samples.
Multi-Dimensional Water Quality Modeling	Surveys were performed to collect data on bathymetry, tidal fluctuations, and tidal currents to develop and calibrate a multi-dimensional sediment-transport model.
Acoustic Monitoring and Modeling	In order to identify potential acoustic impacts, an acoustic modeling program would be initiated. The goal of the program will be to model various construction scenarios and to compare the emission levels from these scenarios to acoustic levels that have been found not to cause impacts to fish populations that inhabit the Tappan Zee reach of the Hudson River. Activities would include: monitoring ambient noise levels in and around the bridge; predicting the extent of acoustic emissions from construction activities; obtaining relevant information from the NMFS as to their database of information on such impacts.

Information on threatened and endangered species was obtained from the NYSDEC Natural Heritage Program (NHP), NMFS, and the USFWS.

Based on these survey results, no significant areas of SAV were found within the area of potential impact from either the construction of the replacement bridge or the demolition of the existing bridge.

23.3 Environmental Consequences

The project area of the Hudson River is a productive estuary that provides regionally significant ecological values and functions for many species including anadromous, catadromous, estuarine, and certain marine species that are dependent on the river for spawning, nursery, feeding, and overwintering activities. The methods by which ecological impacts related to bridge replacement are discussed below in 23.3.1 (Highway, Bridge, and Transit Accommodations), while those associated with potential impacts from the future implementation of transit elements are detailed in 23.3.2 (Transit Elements).

The potential impacts of removing the existing bridge will also be evaluated. The value of the existing bridge's inter-pier habitat will be based on information collected during the sampling program. Included as part of that program are video observations of the underwater portion of the bridge structure. These observations, along with fish and benthic sampling, will enable a general assessment to be made of the quality and quantity of the habitat being provided by the bridge itself. Also, the potential for the proposed action to spread invasive species will be evaluated.

23.3.1 Highway, Bridge, and Transit Accommodations

23.3.1.1 Suspended and Deposited Sediments

Construction within the river has the potential to re-suspend and re-deposit sediments that may, in turn, cause direct impacts to the river's ecological resources. Re-suspended sediment can negatively influence water quality and provide for the bioaccumulation of contaminants and thereby generate a direct impact on aquatic populations including delaying spawning, interrupting fish migrations, or increasing bioaccumulation of sediment contaminants for fish residing near the bridge. Re-deposited sediment and changes in water chemistry can affect benthic communities and early fish life stages through burying or through direct mortality. Analysis of these potential negative effects will be accomplished by application of the multi-dimensional hydrodynamic and water-quality model described in Chapter 21 (Water Resources).

Meetings were held with the Cooperating Agencies in Spring 2009 to review bridge construction in relation to suspended sediment issues. Follow-up meetings during Fall 2009 were also held to further review the procedures to be used to assess these issues and their potential impacts to aquatic life. The need for and scale of dredging was discussed with the Cooperating Agencies as were the criteria and modeling methods that would be used to assess impacts to the aquatic ecosystem. The EIS will employ the "onset of effects" TSS criteria and the computer models presented at the meetings to evaluate impacts of dredging operations and other construction activities.

23.3.1.2 Acoustic Effects

Since pile driving will be necessary for constructing bridge foundations, underwater sound pressure levels that exceed fish tolerance levels may be generated. Background underwater acoustic levels will first be established though an acoustic monitoring program to be performed in the vicinity of the bridge. To evaluate the effects of in-water construction, estimates of underwater pressure levels generated by pile driving operations will be obtained from other projects where acoustic levels had been monitored. The information obtained from monitored construction sites will be input to agency reviewed empirical models and projections made of the extent of harmful sound pressure levels. Based on the model results, a range of applicable best management practices will be evaluated for the purpose of reducing the pile driving related acoustic signal.

Due to the seasonal variations in faunal assemblages and populations in the Tappan Zee Reach, the impact analysis of the sound pressure levels will consider what species may or may not be present (seasonally) during the construction activities. At an upcoming meeting with the cooperating agencies, the procedures to be followed in assessing acoustic effects will be further reviewed, with the results of these discussions reflected in the eventual assessment methodology.

23.3.1.3 Loss of Habitat

The primary impacts of the project are anticipated to occur during its construction phase. Future operational-phase impacts to Hudson River resources will also be addressed in the DEIS. Potential loss of habitat resulting from bridge construction activities will be described in the DEIS, including the acreage of river bottom, SAV, and wetlands that may be lost. The loss will be evaluated based on whether it is a permanent or temporary loss of habitat. Habitat loss may occur from increased sedimentation and total suspended solids levels, disruption of habitat from vessel movement or sound pressure levels from pile-driving, the physical removal or permanent alteration of habitat, and/or the synergistic effects of multiple stressors.

Permanent loss of habitat will be based on the number of acres of impacted river bottom. Estimates of permanent impacts will be based on the area (in acres) of river bottom that would be permanently impacted by the placement of fill in the river (e.g., bridge piers). Other components include the construction of bulkheads and docking facilities.

Temporary loss of habitat will be based on the number of acres of impacted river bottom. Estimates of temporary impacts were based on the extent (in acres) of river bottom that would be temporarily disturbed during construction work due to the construction of platforms and mooring facilities.

Also, considered will be the loss of high-value habitats such as oyster beds and SAV. The total loss of these habitats due to the project would be quantitatively compared to the remaining available habitat within the Tappan Zee Reach. Also, a qualitative comparison will occur between the loss of habitat in the project area as compared to the Hudson River in general. An analysis would be performed to determine if the loss of the high value habitats poses a substantial risk to species within the Tappan Zee Reach and the lower Hudson estuary.

The significance of the loss will be determined using data collected from the river-related field programs discussed above. These data will enable a characterization of the quality and spatial extent of study-area

habitats and allow for an estimation of the significance of construction-related disturbance to Tappan Zee Reach habitats.

23.3.1.4 Operating Stage Impacts

At the operational stage, impacts may result from stormwater discharges, coming off bridge paved surfaces, to the river and shading of nearby habitats. The implications of such discharges for water quality and shading will be estimated in the DEIS.

23.3.1.5 Threatened and Endangered Species

In written correspondence dated February 3, 2003, NMFS indicated that the study area contains the endangered shortnose sturgeon. Subsequent meetings with NMFS in 2009 indicated that the shortnose sturgeon was the only listed species within the Tappan Zee Reach but that the Atlantic sturgeon is a Species of Concern by NMFS and was noticed as a Candidate Species. NMFS indicated that the Atlantic sturgeon may be listed prior to the construction of the bridge.

The shortnose sturgeon was listed as endangered throughout its range on March 11, 1967, under the Endangered Species Preservation Act of 1966 (a predecessor to the Endangered Species Act of 1973). NMFS later assumed jurisdiction for shortnose sturgeon under a 1974 government reorganization plan (38 FR 41370).A listed species makes it illegal to "take" (e.g., harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to do these things) that species. Federal agencies may be allowed limited take of species through interagency consultations with NMFS. Effects to the listed species must be minimized and in some cases conservation efforts are required to offset the take.

A Section 7 Biological Assessment (BA) will be prepared for the Shortnose Sturgeon and the Atlantic sturgeon since they are known to inhabit this river area during some portion of their life cycle. While the Atlantic Sturgeon is not currently listed, it is under consideration for listing in the near future.

The BA will be based on field surveys for the current effort and surveys conducted by others. Views of recognized experts on the listed species, a literature review, and analyses of direct and indirect effects of the alternatives on the species will also be developed. The BA will evaluate potential effects on the species from the construction and operation of the project. The BA will be a separate report to NMFS and be appended to the Hudson River Technical Report.

23.3.1.6 Essential Fish Habitat Evaluation

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) was reauthorized and amended by the Sustainable Fisheries Act (1996). The original Magnuson Act (1976) created an exclusive economic zone (EEZ), the area of federal waters adjacent to state waters, extending from 3 to 200 nautical miles offshore. The MSA (1996) required Councils to describe and identify essential fish habitat (EFH) for each region and to specify actions to conserve and enhance that EFH.

EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.” Any proposed project that requires a federal permit from the US Coast Guard or Army Corps of Engineers requires consultation with NMFS to comply with the above referenced statutes (MSA, Endangered Species Act, etc.). The federal permitting agency will decide if the project can affect essential

fish habitat and, if so, the agency will request a consultation with NMFS, which may coordinate with the appropriate Fishery Management Council. The federal permitting agency must provide an initial EFH assessment detailing the manner in which the proposed activity (*e.g.*, dredging) may affect fish habitat and then must respond to any recommendations provided by NMFS or the Council.

During recent discussions with NMFS in February 2008, NMFS informed the project team that not only will there be a required EFH analysis for the Hudson River but for any tributaries that feeds a coastal water body within the I-287/Tappan Zee project area that does not have an impoundment (dam etc.) between the project location and the coastal water body. Based on a review of the streams in the project corridor the water courses that will require a separate EFH analysis are the Sunnyside Brook and Shelden Brook on the Westchester shoreline. Also, any small stream within Rockland and Westchester Counties that crosses the roadway without an impoundment would require an EFH analysis.

The EFH assessment for this project will include the following:

- A description of the proposed action. This will include the number of vessels, work crews, schedule, and areas of temporary and proposed disturbance. Also, the specific locations of pile driving activities, including, frequency and intensity.

- An analysis of the effects, including cumulative effects, of the proposed action on EFH, the managed species, and associated species, such as major prey species, including affected life history stages.

- The Federal agency's (US Coast Guard or US Army Corps of Engineers) views regarding the effects of the action on EFH.

- Proposed mitigation, if applicable. The assessment will also include: the results of an on-site inspection; the views of recognized experts on the habitat or species affects, and a literature review; an analysis of alternatives to the proposed action; and any other relevant information. This consultation usually occurs at the regional level and is merged with reviews required under the ESA, NEPA, Clean Water Act, Coastal Zone Management Act, etc.

23.3.2 Transit Elements

In general, potential impacts of transit elements will be identified based on available regulatory agency data, the results of the investigations conducted specifically for the replacement bridge project, and data available from other investigations that have taken place in or near the Tappan Zee Reach. Acoustic data has been obtained along the Hudson River shoreline adjacent to the Metro-North Hudson Line. In addition, wetlands have been mapped along the railroad from Tarrytown to Irvington and streams that discharge to the river beneath the tracks have also been identified.

The principal transit element that will be addressed in the DEIS under Hudson River Ecology is the connection that would be made to the Metro-North Hudson Line to allow riders from Rockland County to have a one-seat commute to Grand Central Terminal in New York City. The connection could be in the form of either a trestle or a shoulder tunnel. The trestle would involve construction of a relatively short additional bridge structure that would carry the new commuter service from the main replacement bridge (at about 150 feet MSL) down to the Hudson Line whose tracks are at approximately 10 feet MSL. Impacts of the trestle connection would primarily occur during its construction stage when new footings

would be placed in the Hudson River and when some disturbance would occur to the Hudson River shoreline where the actual rail connection would be made.

The shoulder tunnel connection would not entail an in-river trestle but could result in disturbance to the Hudson River shoreline where the actual rail connection would be made. Impacts of the two connection options would be addressed in the DEIS. The assessment would draw on the data that has been collected and reviewed for the replacement bridge, as well as, additional information that has been collected along the Hudson Line right-of-way. The impact assessment will consider the scale of construction work that would occur and the habitats that could be disturbed by that work. This would include the level of disturbance within tidal wetlands and open water, proximity to the mouth of creeks, and the amount of tidally influenced wetlands and open waters located east of the Hudson Line, which are likely used by Hudson River fauna as spawning and foraging habitat.

23.4 Mitigation Measures

For project-related impacts that cannot otherwise be avoided, conceptual mitigation methods will be presented. These methods may include replacement or enhancement of wetlands, benthic habitat creation (e.g., oyster reefs) and other strategies to improve habitat conditions for the river's fishery resources.

24 Coastal Zone Management

24.1 Regulatory and Permitting Requirements

24.1.1 Coastal Zone Consistency Determination

The New York State Department of State (NYSDOS) oversees all regulated activities in the State's coastal waterways, their adjacent shorelines, and in some inland waters including the Hudson River. A consistency determination is required for any federal, state or local action within the coastal areas of New York State. The applicant must demonstrate compliance with the State's 44 coastal policies. The NYSDOS will review all federal permits (i.e., the USACE/NYSDEC Joint Permit Application package) and applications for federal funding, as well as their own consistency application. Following review of all documents, the NYSDOS will make decision regarding consistency or inconsistency with the state coastal policies. The permit application will therefore include a compliance statement for all 44 state coastal zone management policies.

Local waterfront revitalization programs (LWRPs) in New York State are developed pursuant to the Waterfront Revitalization and Coastal Resources Act (WRCRA) of 1981. In New York State, the Coastal Management Program (CMP) is under the direction of the NYS Department of State. The state legislation authorizes at least partial control to municipalities when they develop local plans that are approved by the state. Several municipalities in the study area have developed local waterfront revitalization plans that have been approved or are in the process of review.

24.1.2 Additional Coastal Area Regulations

- **Coastal Erosion Hazard Act** -- The New York State Coastal Erosion Hazard Area program managed by NYSDEC includes the shorelines of the Hudson River south of the federal dam in Troy. Any project that would involve grading, excavating, dumping, mining, dredging, filling or any disturbance of soil in that area requires a coastal erosion management permit from NYSDEC. Erosion control issues are discussed further in Chapter 21 (Water Resources).

- **Federal Coastal Barrier Resources Act** – This 1982 act, along with the Coastal Barrier Improvement Act passed in 1990, represented an effort to reduce loss of life and property by better controlling development in high-risk coastal barrier areas and preserve these important ecological areas. The proposed project area does not fall into any of the Coastal Barrier Resource System Units maps that define these sensitive areas.

24.2 Affected Environment

The affected environmental for CZM determination are those portions of the State's coastal waterways that potentially would be affected by the construction, operation or presence of the proposed project. This would include the nearby portions of the Westchester and Rockland County shorelines and adjacent

inland areas considered by the counties and involved municipalities to be part of their coastal zone management areas.

24.3 Environmental Consequences

The study team will initially complete the *New York State Department of State Coastal Zone Management Program Federal Consistency Assessment Form*, which provides an initial screening of the consistency of the proposed actions with state and local CZM policies as discussed above. Given the magnitude of the project, including the fact that an EIS is being prepared, the proposed project and its four Build alternatives will then be compared against each of the State's coastal management policies and any additional relevant policies included in accepted LWRP plans in adjacent communities within the study area. For any policy where the proposed project would be shown to potentially be inconsistent with a given policy, the study team will identify the specific policy and briefly assess the potential effects of the project on that policy and how it would be consistent with it. The completed certification report, including the applicant's findings on certification, is submitted to the NYSDOS for their concurrence.

24.4 Mitigation Measures

The need to mitigate aspects of the project's construction or long-term presence in the area in terms of their consistency with State and local CZM policies will be reviewed, with references made to planned mitigation strategies discussed elsewhere in the EIS that would strive to insure the project's consistency with these policies.

25 Hazardous Waste and Contaminated Materials

The presence of contaminated materials can impact project cost and schedule if special means of handling, transporting or disposing of contaminated material are required. Contamination in some instances can require special training and protective equipment for site workers, which impact labor cost and productivity. In light of these potential impacts, identifying project-related construction sites that may be impacted by contamination is crucial to establishing reasonable cost and schedule estimates for project alternatives.

Hazardous and contaminated conditions can result from a variety of current or past activities, including manufacturing and dry cleaning operations, spills and leaks, and landfilling (including fill to create land, as well as industrial and sanitary landfills). Contaminants may have also migrated to a site from offsite sources through groundwater flow. Building products used in the past may include materials now known to pose a threat to human health or the environment, such as asbestos, lead, polychlorinated biphenyls (PCBs) and mercury. While legal at the time of installation, such materials (e.g., asbestos pipe insulation, lead-based paint, PCB-containing caulking, mercury-containing fluorescent light ballasts) must be managed in accordance with current worker safety and disposal regulations when disturbed by construction activity.

For purposes of this methodology, the terms “hazardous material” and “contaminant” mean any substance that poses a threat to human health or the environment. This definition is independent of whether a particular substance is also a “hazardous waste,” which is a specific regulatory term defined by the Resource Conservation and Recovery Act (RCRA) in the Code of Federal Regulations (CFR) at 40 CFR Part 261.3; hazardous wastes are *a priori* contaminated materials, but the classification as such engenders specific handling and disposal requirements that do not necessarily apply to all contaminated materials. In general, given the context of this investigation, the specific concern to be addressed is the presence of “contaminated materials” at a site, which is generally defined to include not only hazardous materials and contaminants in pure form, but also any material (e.g., soil, groundwater, or building material) that contains or has been mixed with a hazardous material or contaminant. In addition, for the purposes of this methodology, a distinction is also made between contaminated site materials such as soil, fill, groundwater and soil gas (collectively referred to as “site contamination”) and building materials containing hazardous materials, such asbestos pipe insulation, lead-based paint, light ballasts, and caulking (collectively referred to as “building contamination”).

25.1 Regulatory and Permitting Requirements

The management of site contamination is subject to various regulatory programs at both the federal and state level. Examples include the federal Comprehensive Environmental Response, Compensation and Liability Act (CERLCA, commonly referred to as “Superfund”) and its state-level equivalent, the National Contingency Plan, the state Brownfield Cleanup Program, and the state Environmental Restoration Program.

The management of building contamination is also subject to a variety of regulatory programs, which are often implemented not only at the federal and state levels, but also at the municipal level. Municipal regulation in this regard is most often encountered in the form of building codes or other administrative controls regarding the protection of surrounding communities during demolition or abatement, although some municipalities also maintain specific training and monitoring requirements for personnel in the

demolition or abatement industries. For the purposes of this methodology, only federal or state rules and regulations will be considered.

Generally, these regulatory programs focus on the remediation of known site or building contamination, as opposed to screening large areas to identify potentially contaminated sites that could impact a project's construction. The studies to be done for the EIS will determine whether site or building contamination is reasonably believed to exist at project-related construction sites, due to on-site sources or the migration of contaminants from nearby sites.

To that end, this investigation is designed largely to satisfy the requirements of the "all appropriate inquiry" rule at 40 CFR Part 312 under CERCLA. While this rule only defines the minimum requirements to establish an "innocent landowner" or similar defense from liability under CERCLA, industry practice has made this rule a *de facto* standard for establishing whether any site is reasonably believed to be free of contamination, or if further investigation is warranted. It is therefore frequently used as a standard screening tool to establish basic environmental conditions at a site.

Research and investigative requirements to meet these standards have been established in the American Society for Testing and Materials (ASTM) Standard E1527-05, entitled *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process* (ASTM E1527). While not a government regulation, ASTM E1527 is widely accepted as an industry standard to identify potential contamination. The screening process being used for this project has been designed to be as consistent with the requirements of ASTM E1527. However, given the inherent difficulties in compiling the required data for the thousands of parcels within the search radii prescribed by the standard (including interviewing property owners and occupants), the screening is not the equivalent of a fully-compliant Phase I ESA for all potential project construction sites. Such deviations from the full ASTM E1527 standard are appropriate given the size of the project and the overall study area.

25.2 Affected Environment

The affected environment within the study area will be evaluated on the basis of existing data describing environmental conditions in the study area, consistent with the requirements of ASTM E1527. These data sources are grouped into two broad categories: regulatory databases containing data on known contaminated sites and/or sites permitted to generate, handle, treat or store hazardous materials, and land use data (such as zoning maps, historic fire insurance maps and aerial photography) to identify current and/or former potentially-contaminating site uses. In addition to existing data, site reconnaissance constitutes an additional data source that will be employed in the screening process. The methods to be used to define those areas that warrant screening or further more detailed studies are reviewed below.

25.2.1 Environmental Records Sources

A commercial database search firm was utilized to conduct a search of the data sources specified in ASTM E1527, and provide the results of the search in a Geographic Information System (GIS) deliverable that identifies the location of all relevant records within the search radii prescribed by the standard. A full listing of the records sources that *must* be searched as part of a fully standards-compliant Phase I ESA ("standard environmental records"), as well as sources that *should* be searched when available ("additional environmental records") is provided in ASTM E1527. Sample standard sources include (but are not limited to) the:

- National Priorities List.
- Comprehensive Environmental Response, Compensation, and Liability Act Information System database.
- Resource Conservation and Recovery Act Information System database.
- New York State Inactive Hazardous Waste Disposal Site database.
- New York State Brownfields Cleanup Program database.

25.2.2 Land Use Records Sources

Various contemporary and historic map and photographic records can be used to determine past land uses. Most typically, historic site usage information is gathered from historic fire insurance maps and aerial photographs. The intervals at which historic fire insurance maps (e.g., Sanborn maps) or aerial photographs are available depend on a variety of factors, and often vary by municipality (for example, fire insurance maps are typically issued by municipality, and adjacent municipalities may have been mapped in different years).

Where available, historic fire insurance maps for the study area were obtained as close as possible to but preceding the construction of the New York State Thruway and Cross-Westchester County Expressway. During the screening process, the availability of historic aerial imagery for the study will be assessed, and a representative range of photographs will be reviewed to identify historic land use at potential project-related construction sites.

In addition, contemporary land use and/or zoning information from the municipalities and counties within the study area will be reviewed to identify concentrations of potentially-contaminating land uses (such as manufacturing, or other industrial uses). The results of this review will help to focus the site reconnaissance process.

Due to the inherent difficulties in compiling the required data for all parcels on which project-related construction might occur, certain data sources that are considered to be “standard” historical records in ASTM E1527 will not be consulted for this screening, except for the limited number of sites for which full Phase I ESAs are to be prepared (as described below). Excluded sources include property tax files, recorded land title records, local street directories, and building department records. If other required data sources are not consulted on either a study-wide or localized basis (or if any other “data gap,” as defined in ASTM E1527, should occur), such incidences will be specifically noted in the Technical Report.

25.2.3 Site Reconnaissance

In addition to the review of the available data sources described above, a physical reconnaissance of the study area will be conducted to confirm the findings of the data review, and to identify any sites that might be of concern for reasons other than what may be discerned through a records review (for example, clusters of vehicular service stations not subject to bulk petroleum storage reporting requirements, undocumented dumping sites, etc.). During the site reconnaissance, areas that exhibit visual evidence of

the potential presence of hazardous materials or waste spills will be identified. Relevant indicators would include lack of vegetation in undeveloped areas, unusual odors, and stained soil and surface water.

The site reconnaissance effort is not intended to fulfill the site visit requirement for a fully standards-compliant ASTM E1527 Phase I ESA for the entire study area. Such an investigation would require an inspection of all sites directly impacted by project-related construction, and interviews with site owners and occupants. Rather, the reconnaissance program is designed only to confirm the general character of the study area and the results of the records reviews. Assessments will be based only on observations that can be made from publicly-accessible locations, with the exception of a limited number of sites for which full Phase I ESAs are to be prepared (as described below).

25.2.4 Site Specific Investigations

At a limited number of sites for which the screening described above reveals an elevated level of concern about potential site contamination, a full ASTM E1527-compliant Phase I ESA will be conducted. These detailed, site-specific investigations would be conducted only for sites (1) not within the existing highway right-of-way, and (2) where project-related highway, bridge or transit accommodation construction would be required. For any such sites not owned or controlled by NYSDOT, NYSTA or Metro North Railroad, the completion of the full Phase I ESA is contingent upon site owners cooperating with NYSDOT requests to conduct the Phase I ESA investigation. If the property owner does not cooperate, the assessment of the site will be based only on the review of environmental and historic records and the site reconnaissance, as described above.

In addition to the site-specific reviews of potential site contamination, preliminary structure-specific reviews of structures likely to require demolition or substantial modification will be undertaken to identify potentially-contaminated building materials. This will include reviews of record drawings and maintenance records, where available, to determine whether potentially contaminated building materials (e.g., lead-, asbestos-, PCB- or mercury-containing materials) were used and/or removed or abated within a given structure. For structures not owned, maintained or otherwise controlled by NYSDOT, NYSTA or Metro-North Railroad, inquiries will be made with the structure owner. If no additional information is provided, assessments of the potential for contaminated building materials will be made based on the age of the structure. No sampling and laboratory analysis of building materials for any structure will be conducted at this stage.

25.3 Environmental Consequences

25.3.1 Site Contamination

Sites with some type of environmental record (e.g., past spill) will be classified as being of low, medium, or high concern for potential impacts to proposed project construction, based on the type of available data; e.g., CERCLA sites might be considered of high concern, while a commercial property listed as a chemical bulk storage site with no spill reports might be of low concern.

Following the initial screening, the available data for medium- and high-concern sites will be reviewed in greater detail. For example, for some listings narrative site descriptions that describe the type and extent of contamination and any remedial activities that have been undertaken may be available. Records such as historic fire insurance maps and aerial photography will be reviewed, if available, to confirm site use

history. The geologic setting of these potential sites of concern in relation to project-related construction will also be considered (for example, to determine if preferential pathways exist that allow for identified sites of concern to impact the project corridor). Potential sites of concern will be evaluated on the basis of this additional review; if a determination can be made that the potential site of concern is either not contaminated or is unlikely to impact project-related construction, it will be eliminated from further consideration.

Those sites not eliminated as a potential source of contamination impacts to project-related construction based on the more detailed review of available records will be considered sites of concern. For these sites, efforts will be made to obtain additional site information to aid in determining whether there is a potential impact to project-related construction. The availability of additional site information will vary based on the reason(s) the site of concern has been identified, but will likely include existing site ESAs, remedial investigations, remedial feasibility studies, etc. For some sites, obtaining this information may require submitting Freedom of Information Law (FOIL) requests to state or municipal agencies such as the New York State Department of Environmental Conservation (NYSDEC), or Freedom of Information Act (FOIA) requests to federal agencies such as the United States Environmental Protection Agency (USEPA). In addition, for sites on which project-related construction is proposed, this may include the completion of a full ASTM E1527 Phase I ESA, as described above.

Where possible, based on review of the additional information gathered during the detailed site information review, a determination will be made that a site of concern has or has not impacted project-related construction sites. If it is still not possible to determine whether a site of concern has or has not impacted a project-related construction site, the potentially-impacted construction sites will be identified and recommendations for site-specific investigations (which may include soil, soil gas or groundwater sampling) will be made.

The DEIS impacts discussion will summarize the findings of the site contamination investigation. Recommendations for further investigations during the post-DEIS period will be made, as appropriate. The impacts assessment will consider the potential for encountering contamination during construction, the significance of the contamination, and worker and public-safety issues.

The potential impacts of future transit project elements will be assessed, to the extent that conceptual design details are available at this Tier 1 Transit assessment level. Potential impacts of possible off-alignment transit facilities (e.g., stations) will be handled more qualitatively. All of these issues will be more fully assessed as part of future Tier 2 Transit Environmental Documentation.

25.3.2 Building Contamination

The DEIS impacts discussion will summarize the findings of the building contamination investigation. Recommendations for further investigations during the post-DEIS period will be made as appropriate. The impacts assessment will consider the potential for encountering contamination during construction, the significance of the contamination, and worker and public-safety issues.

25.4 Mitigation Measures

Where site contamination is confirmed or suspected, conceptual mitigation methods will be presented. This will include mitigating the problem at either the source or at the construction site, and may include

contaminant removal (e.g., excavation of contaminated material) or treatment (e.g., bioremediation). Regulatory concerns and worker safety issues, and potential methods of managing these risks, will be presented if sufficient information from the screening process is available. The cost and schedule implications of encountering contamination will also be discussed, where possible. Where building contamination is suspected, conceptual methods of managing contaminant exposure (for example, disposal during demolition or abatement during partial demolition) will be presented, and the cost and schedule implications of eliminating or remediating contaminated building materials will be discussed, where possible.

26 Section 4(f)/6(f) Evaluation

26.1 Applicability of Section 4(f)/6(f)-Related Regulations

26.1.1 Section 4(f)

Section 4(f) of the Department of Transportation Act (DOT Act) of 1966 states that the lead federal transportation agency, in this case FHWA and FTA, shall not approve a transportation program or project requiring the use of any land in a public park, recreation area, wildlife or waterfowl refuge, or historic site unless there is no feasible and prudent avoidance alternative to the use of such land, and the program or project includes all possible planning to minimize harm. Historic sites include NHLs, NRLs, and NRE resources.

Section 4(f) defines use as follows:

- When land and/or a historic site is permanently incorporated into a transportation facility.
- When there is a temporary occupancy of land and/or a historic site that is adverse in terms of the statute's preservation purposes.
- When there is a constructive use (i.e., project's proximity impacts are so severe that the protected activities, features or attributes of the land and/or a historic site are substantially impaired).

A *de minimis* impact determination eliminates the requirement for all possible planning to minimize harm. For public parks, recreation areas, wildlife or waterfowl refuges, a *de minimis* impact is one that will not adversely affect the features, attributes, or activities that qualify it for protection under Section 4(f). For historic sites, a *de minimis* impact means that FHWA and FTA has determined in accordance with Section 106 that no historic property is affected by the project or that the project will have no adverse effect on the historic site.

26.1.2 Section 6(f) and Section 1010

Section 6(f) of the Land and Water Conservation Fund Act, codified as 16 USC Section 460 L-8f, requires that (1) no property acquired or developed with this form of financial assistance can be converted to anything other than public outdoor recreational use without the approval of the Secretary of Interior, and (2) only when this conversion is consistent with the Comprehensive Statewide Outdoor Recreation Plan, and a substitute property is provided of equal market value and usefulness as that being converted. The Urban Park and Recreation Recovery Program, codified as 16 USC Sections 2501 through 2514, carries a provision, Section 1010, substantially the same as Section 6(f). A review of the study area has confirmed that no properties or facilities covered by the Section 1010 provisions are located within these areas.

Open-space resources – whether parklands, wildlife-protection resources, or other recreation resources that have received Section 6(f) funding – have similar protections to those for Section 4(f) resources. Baseline data related to Section 6(f) resources have been collected, identifying resources that may be

affected by project alternatives. Among the identified Section 6(f) resources are Hook Mountain State Park/Rockland Lake State Park and the Bronx River Pathway/Reservation.

26.2 Project Description, Purpose and Need

Studies conducted for this project have shown that several transportation improvements, including improved mobility, transit options, and safety, are needed in order to meet the growing travel demands of the corridor. Travelers in the corridor experience significant delays due to congestion, as corridor facilities often operate near capacity, particularly in the vicinity of the Tappan Zee Bridge. Rockland County is one of the fastest-growing communities in the Metropolitan Region, and Westchester is experiencing employment growth in areas around White Plains and the Platinum Mile. The Tappan Zee Bridge and the corridor provide an important link between these communities and to the overall regional transportation network. In addition to the capacity constraints of the corridor, the Tappan Zee Bridge is aging and in need of a regular and extensive maintenance program. As the region grows, travel demand will increase on an already-strained roadway network.

Based on these considerations, the Project Purpose and Need is to:

- Preserve the river crossing as a vital link in the regional and national transportation network.
- Provide a river crossing that has structural integrity, meets current design criteria and standards, and accommodates transit.
- Improve highway safety, mobility, and capacity throughout the corridor.
- Improve transit mobility and capacity throughout the corridor and travel connections to the existing north-south and east-west transit network.

Further details regarding the Purpose and Need for the proposed project and the associated Goals and Objectives will be included in the Project Purpose and Need chapter of the EIS.

26.3 Description of Proposed Action and Project Alternatives

The proposed action would involve highway, bridge and transit improvements along a 30-mile section of the I-287 corridor extending from Suffern in Rockland County to Rye in Westchester County. In the initial phases of the project, the study team developed a number of alternatives to be analyzed in the EIS. These alternatives were selected based on their potential to meet the project's goals and objectives as summarized above. The EIS will include an analysis of the No Build Alternative (Alternative A) and four build alternatives (Alternatives B, C, D, and E) which incorporate BRT and CRT transit modes. Common elements of the four build alternatives are described below, followed by a summary of the elements within each alternative.

26.3.1 Common Elements of Build Alternatives

- **Bridge Component**. Each alternative will include a single- or dual-level replacement bridge that accommodates BRT and CRT in addition to the highway lanes would be built. All bridge configurations will feature two CRT tracks and the same number and width of lanes, busways or BRT/HOV/HOT lanes, shoulders, and bicycle/pedestrian facilities. These single- and dual-level replacement bridge options will be refined further to optimize the location of the highway lanes and transit modes on the structure(s), with one single-level and one dual-level bridge option analyzed in the DEIS.

- **CRT in Rockland County**. The CRT service included in all alternatives would begin in Suffern, connect to the Port Jervis Line and continue across Rockland County to a direct connection with the Hudson Line in Tarrytown. Rail service would then continue from Tarrytown providing a one-seat ride to the ultimate GCT destination.

- **Roadway Components and TSM Measures**. A reconstructed highway to accommodate the recommended transit solution would be built. Other features to be studied include interchange reconfiguration and climbing lanes, and HOV/HOT lanes in Rockland County (incorporating BRT) under several alternatives. East of Exit 9 (Tarrytown) in Westchester County, there are no proposed highway improvements that are not related to transit. Potential TDM/TSM measures include ramp metering and congestion pricing.

26.3.2 DEIS Alternatives

- **Alternative A -- No Build Alternative**. Consistent with NEPA requirements, a No Build Alternative (Alternative A) will be analyzed in the DEIS. Under this alternative, the bridge and highway would be maintained sufficiently to avoid severe deterioration and operational and safety deficiencies. Projects include any planned transportation improvements, including on-going highway improvements in Westchester County, others in the Long Range Transportation Plan (LRTP) for the region, and projects separately identified by the project team.

- **Alternative B – Full Corridor Busway and Rockland CRT**. Alternative B would provide BRT service between Suffern and Port Chester by implementing BRT in Rockland and Westchester Counties in a busway, as well as CRT service in Rockland County. The alignment provides a BRT trunk route, primarily along I-287, that is intended to operate like a rail system. The trunk would extend from Suffern to Port Chester, connecting the NJ Transit Suffern Station to the Port Chester New Haven Line Station.

- **Alternative C – Busway/Bus Lanes and Rockland CRT**. Alternative C would provide BRT service between Suffern and Port Chester by means of BRT in a Rockland County busway and BRT in Westchester County in bus lanes, as well as provide CRT service in Rockland County.

- **Alternative D – HOV/HOT/Busway and Rockland CRT**. Alternative D would provide BRT service between Suffern and Port Chester by means of BRT in Rockland County in HOV/HOT lanes (which would combine buses with carpools and (under HOT lane options) cars that pay a toll for the lane's use) and BRT in Westchester County in a busway, and provide CRT service in Rockland County.

- **Alternative E – HOV/HOT/Bus Lanes and Rockland CRT**. Alternative E would provide BRT service between Suffern and Port Chester by means of BRT in Rockland County in HOV/HOT lanes (as under Alternative D) and BRT in Westchester County in bus lanes, and provide CRT service in Rockland County.

Further details regarding project alternatives are provided in Chapter 2 (Description of Alternatives).

26.4 Section 4(f) and 6(f) Resource Impacts

26.4.1 Section 4(f) Resource Impacts

Baseline data related to Section 4(f) resources, including state, county and municipal parks, and historic sites that may be affected by project alternatives have been collected and incorporated into the project's GIS database (see Chapters 9, 17, and 18 for details). Proposed bike and pedestrian trails that bisect the corridor will be considered with parklands (see the discussion in Subchapter 9.2). As alignments and ROW requirements of project alternatives are further developed, the nature and locations of parks; recreation areas; wildlife or waterfowl areas; wild and scenic rivers; national trails and natural landmarks; and other historically significant properties will be refined and described in greater detail. In addition, *de minimis* impacts, if applicable, will also be identified and discussed.

If a property is subject to use under Section 4(f), the analyses will evaluate the type and extent of potential impacts on the property for each bridge, highway and transit alternative analyzed in the DEIS, including constructive use. The analyses will be accompanied by figures and graphics and will include a discussion of facilities affected, probable environmental effects (noise, dust, habitat destruction, etc.), effects on access, and effects on any other unique qualities.

The NRE Tappan Zee Bridge is considered a Section 4(f) resource, and a preliminary Section 4(f) evaluation was prepared as noted under Subchapter 17.3.3. The analysis concluded that rehabilitation options result in a Section 4(f) use of the bridge, and there are no feasible and prudent avoidance alternatives which avoid the use. All possible planning to minimize harm in accordance with Section 4(f) will be documented in the DEIS and the final Section 4(f) evaluation.

26.4.2 Section 6(f) Resource Impacts

The type and extent of potential impacts on Section 6(f) resources during construction and operation will be evaluated for each alternative and analyzed with a similar methodology to that described for Section 4(f) resources.

26.5 Avoidance Alternatives

Where a build alternative would use land from a Section 4(f) resource, avoidance alternatives would be developed and evaluated in sufficient detail to determine their feasibility. If an alternative that avoids a Section 4(f) resource is found to be feasible and prudent compared to another alternative, it will be incorporated into the project. If a similar condition occurs in connection with a Section 6(f) resource, the

potential availability of an avoidance alternative would be reviewed in the same manner as described for 4(f) resources.

26.6 Measures to Minimize Harm

Where negative impacts on a Section 4(f) resource are unavoidable, appropriate measures to minimize harm will be recommended, including the potential for providing compensation or replacement lands; design features to enhance remaining lands, or special efforts that could be undertaken to lessen harm to the Section 4(f) resource. These could include measures to improve pedestrian, bicycle, or auto access; landscaping; noise-abatement measures; special construction methods; and phasing new construction with required demolition. Measures to minimize harm to Section 4(f) resources will be fully documented in the EIS. The same approach would hold true if unavoidable negative impacts to Section 6(f) resources were projected.

As discussed in Section 1.3 in Chapter 1, some details regarding transit elements of the Build alternatives will not be known at this time. In those instances, impacts and the possible measures to minimize harm will be discussed qualitatively in the EIS, and addressed in more detail in the Future Tier 2 Transit Environmental Documentation.

26.7 Coordination and Consultation

Section 4(f) requires that FHWA and FTA, in conjunction with Project Sponsors, coordinate with appropriate federal, state, and local agencies that may have jurisdiction over Section 4(f) resources in the Tappan Zee Bridge/I-287 Corridor. For parks, these include state and local parks agencies and organizations in Rockland and Westchester Counties. This same consultation process would apply, if required, for potentially impacted Section 6(f) resources. For historic sites, this includes federal agencies such as NPS who has jurisdiction over NHLs, and state agencies such as NYSHPO who has jurisdiction over NRLs and NREs.

Coordination requires FHWA and FTA to conduct meetings with Project Sponsors, state and local parks agencies and organizations, NPS, and NYSHPO. The purpose of the meetings is to discuss identification of Section 4(f) resources, and develop avoidance alternatives and measures to minimize harm. FHWA and FTA will also respond to comments offered by agencies on the Section 4(f) process and analyses. Official correspondence with agencies will be included as an appendix to the DEIS. . This same coordination process would once again apply, if required, for potentially impacted Section 6(f) resources.

27 Construction Impacts

Project construction will result in temporary impacts to the environment during the period of active construction. Impacts will vary temporally and spatially as construction progresses, and the specific resources affected at any one time may also vary with the specific type of construction occurring at that particular time and place. The analysis of construction impacts to environmental resources will be analyzed as part of the overall analysis for each particular resource, as detailed throughout this document; as such, the specific methodologies for analyzing construction-phase impacts are found in the chapters dealing with each specific resource. Accordingly, the Construction Impacts Chapter of the DEIS will focus on describing the construction methods, scenarios and activities to be analyzed, and summarizing the results of those analyses as it relates to construction impacts and mitigation measures.

27.1 Regulatory and Permitting Requirements

The regulatory and permitting requirements regarding analysis of construction-phase impacts vary with the specific resource affected. For example, construction-phase impacts to surface water resources are governed by NYSDEC's stormwater general permit for construction activities (specifically, a sediment and erosion control is required at all times when bare soil is exposed). However, the consideration of construction period impacts across most areas of potential impact –noise, traffic, land use, etc – is part of the overall impact assessment, and the procedures and methods to be used are presented in the various impact chapters of this Methodology Report.

27.2 Affected Environment

The environment affected by construction work varies for each resource, and is described in the chapter for each specific resource. In order to describe the various construction activities that can impact environmental resources, the affected environment discussion specific to the construction impacts subchapters of the DEIS will focus on summarizing the various types of construction expected to be associated with each alternative. This discussion will be driven primarily by input from the project engineering and design team, which will identify the type, location and duration of the major construction items that are to be considered in the analysis of construction-phase impacts in each impact area.

The types of major construction activities to be addressed (which are discussed in greater detail in the individual impact chapters of this report) and the projected range of impact areas involved in each will include:

- Major traffic diversion plans (where diversion would last for two years or longer) –traffic, air quality and noise);
- Pile driving, sheet piling, blasting and extensive excavation or fill activities –noise and vibration impacts and associated potential impacts on nearby properties or buildings;
- Defined areas of other construction activities along the corridor – noise and air quality and the full range of other impact areas (wetlands, ecology, land use, parks, historic and archaeological resources, etc.); and

- Various stages of bridge work in the Hudson River (dredging, pile driving, tug boat activity, etc.).

All details regarding construction methods, scenarios, activities and areas will be defined in consultation with the project's engineering and design teams. The information will involve the location and duration of activities, the areas likely to be graded, filled or otherwise involved in construction/reconstruction segments along the corridor, the types of equipment involved and their operating profiles, and similar information needed to complete construction-period impact analyses, as defined in each of the impact area chapters in this report.

27.3 Environmental Consequences

The analysis of construction-phase impacts is described in detail in the chapter for each specific resource. The results of the various analyses will be summarized in the Construction Impacts Chapter of the DEIS.

27.4 Mitigation Measures

Conceptual mitigation measures for construction-phase impacts will be developed according to the methodologies for each specific environmental resource as described throughout this document, and will be presented as appropriate in the Construction Impacts Chapter of the DEIS. In analyzing the potential construction period impacts of various transit alignments and modes, some details regarding those transit options will not be known at this stage in the planning process. In those instances, the impacts of those options and the possible measures to mitigate those impacts where required will be discussed qualitatively in this DEIS and addressed in more detail in the Tier 2 Transit Environmental Documentation (see the Tiering process discussion in Chapter 1).

28 Indirect and Cumulative Effects

Indirect and cumulative effects account for impacts that are not directly associated with a proposed action but which could combine with a project's direct impacts to generate additional stress on environmental resources. To fully appreciate the overall ramifications of a proposed action such as the Tappan Zee Bridge/I-287 Corridor Project, it becomes necessary to place the project in a larger spatial framework than simply the immediate vicinity of proposed construction.

In addition, the timeframe that would be considered in order to establish a more comprehensive assessment of impacts needs to reflect past conditions in the larger study area, as well as the circumstances that have led to the current state of environmental resources there. Finally, reasonably foreseeable developments that overlap in time with the construction and operation of the proposed action, and that are within the study area for the cumulative impacts analysis, need to be addressed. The areas in which the indirect and cumulative effects analyses will focus are discussed in Section 28.3.2 below.

28.1 Regulatory and Permitting Requirements

The Council on Environmental Quality's (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) are found at 40 CFR 1500-1508. Indirect effects are defined in those regulations as impacts caused by a proposed action but that occur later in time than the proposed action or that are geographically removed from the action's direct impact area (see definition at 40 CFR 1508.8). Since indirect effects are removed in time and space from the proposed action they need to be reasonably foreseeable to be included in a project's NEPA analysis. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air, water, and other natural systems, including ecosystems.

Several important characteristics of indirect effects are the following:

- Indirect effects are caused by the proposed action, but are not the direct impacts.
- These effects are reasonably foreseeable in that they are relatable to the proposed project or development.
- In the case of induced development, a clear causal relationship should exist between the proposed project and future developments before future development impacts are considered as indirect impacts of a project.
- Whether the indirect effects of a transportation project include changes in land use, development patterns, and/or growth rates depends on the relationship of the transportation project to the size of the area affected, the ability to control change, community goals and plans, and the extent to which future development is certain to occur.
- For transportation projects, induced growth is attributed to changes in accessibility caused by the project; accessibility influences where development will occur.

Cumulative impacts are defined in CEQ's regulations (40 CFR 1508.7) as "the impact on the environment which results from the incremental impact of the proposed action when added to other past, present, and

reasonably foreseeable future actions." The goal of the cumulative impact analysis is to inform decision-makers who are evaluating individual projects about changes that may occur in an area from the combined effects of incremental actions. The following are important clarifications to the concept of a cumulative-effects analysis:

- The other actions referred to in the definition of cumulative effects include actions by other agencies, private citizens, and corporations.

- The other actions that need to be considered in a cumulative-effects analysis are not related to or induced by the proposed action.

28.2 Affected Environment

From a geographic perspective, the aereal extent of the analysis will primarily be driven by the expected scale of indirect effects, particularly induced growth effects. Transportation projects have the potential to induce growth when they reduce access time to developable areas or when means of access is made more attractive or less expensive as could be the case when a new transit system operates. Since this project's proposed transit systems would operate in Westchester, Rockland and Orange Counties, the discussion of Affected Environment will need to encompass relevant portions of those three counties. (There would be additional CRT service in Orange County and Orange County buses could use the BRT system across Rockland and Westchester Counties). In addition, based on the proximity of a proposed CRT station at Suffern/Hillburn to development sites in North Bergen County, NJ, the study area for the analysis will need to consider limited portions of North Bergen as well.

Thus, the EIS will present a general description of the potentially affected environment within portions of the four counties where the proposed action may alter growth patterns. In such areas, existing environmental conditions will be described in terms of the following:

- Demography, land use patterns, and historic resources.
- Drainage basins, streams, wetlands, and other significant habitats.
- Water supply and wastewater infrastructure.

Information on the character of the built and natural environment will be obtained from sources such as NYSDEC (natural environment), the several Counties (built and natural environment), NYMTC (socio-economic data), and the US Census (demographic data), among others.

A critical element for the analysis will be information obtained from County and local planning agencies in the form of land use plans, zoning maps and regulations, waterfront revitalization plans, and other similar documents. Planning documents such as these will suggest the manner in which and locations where development is being directed at the local level. Coupled with direct discussions with county and local planners it will be possible to develop a general understanding of where growth induced by the project is likely to be focused, and consequently, which resources of the natural and built environment may be affected.

Our understanding of the aereal extent of project-related induced growth will also be heavily influenced by NYMTC's socioeconomic forecasting methodology. NYMTC's forecasting method is a top down approach that begins with national and then regional trends. Once regional forecasts are accomplished the results are then applied to the counties within the NYMTC district. NYMTC discusses county results with the relevant local officials to determine if their allocation of regional growth to each county appears

appropriate from the local perspective. The county discussions address matters such as known development projects that can influence the scale of growth as well as the geographical distribution of growth within the county. Thus, the conclusions reached by individual counties and NYMTC, with regard to growth levels and distributions, will importantly inform the geographic extent of this analysis.

Orange County is a special case in relationship to NYMTC since it is not within the NYMTC district. Orange County has its own MPO and coordinates its transportation planning activities with other Hudson Valley MPOs through NYSDOT Region 8. Thus, discussions with county planning staff there will be comparable to that had with both NYMTC and Westchester/Rockland planning officials.

28.3 Environmental Consequences

28.3.1 Indirect or Induced Growth

Indirect impacts, frequently referred to as "induced" impacts, are those "caused by an action and are later in time or farther removed in distance, but are still reasonably foreseeable" (40 CFR 1508.8). The approach that will be taken in the DEIS for assessing indirect effects will generally follow recommendations found in the National Cooperative Highway Research Program Report 466 (2002) entitled *Desk Reference for Estimating the Indirect Effects of Proposed Transportation Projects*. For highway, bridge and transit accommodations the analysis will be at a traditional NEPA level while for transit elements a planning level analysis will be presented.

The analysis of induced growth (a principal component of Indirect Effects for this project) will rely, in part on growth projections for Westchester, Rockland, and Orange Counties developed by NYMTC as input to the BPM regional travel-demand model (NYMTC also generates forecasts of Orange County growth for modeling purposes). The NYMTC growth projections will essentially become the future no-build condition for the analysis.

Potential growth inducing effects will be estimated based on the following:

- A review of land use and other planning documents developed by the affected counties for purposes of managing growth.
- Review and evaluation for relevance of case histories for other transportation projects where induced growth has been analyzed (e.g., through other project EISs).
- Discussions with NYMTC to develop a full understanding of the basis for their socio-economic projections.
- Discussions with county and local planning officials during which the transportation benefits (travel time reductions, improved access, etc.) of the proposed action will be presented and a local perspective on the scale of and locations for growth would be obtained.
- A synthesis of the information obtained from the preceding communications and analyses, specific to each county that reflects the NYMTC projections, county planning, the benefits of the proposed transportation improvements and other relevant factors.

The final step above essentially establishes the scale and location of induced growth effects in the subject counties and sets the study area for the cumulative effects analysis. In addition to the guidance received

from NYMTC and county planners, BPM output is also expected to assist in establishing the zone of influence of the proposed transportation improvements, if necessary. Results of the analysis will be reviewed with NYMTC and local planners and an assessment of impacts to the built and natural environment will be undertaken.

28.3.2 Cumulative Effects

As defined in 40 CFR 1508.7, cumulative impacts represent the consequences of a proposed action when added to other reasonably foreseeable future actions – i.e., those included in the future No-Build conditions analyzed throughout the EIS. To the extent that the project-related analysis of induced growth shows the proposed action may further modify the scale and direction of No-Build projections developed by NYMTC and affected counties, a study area will be established for purposes of evaluating these cumulative effects. The study area will be drawn as follows:

- To encompass the areas where growth changes, beyond those in current projections, are expected to occur.
- To include logical boundaries (e.g., drainage basins, villages, etc.) for evaluating effects on resources of the natural and built environment that may be impacted by induced growth changes.
- To encompass reasonably foreseeable projects that may have cumulative impacts to the same resources as are affected by the proposed transportation improvements.

As requested by NYSDEC, for Orange County, the analysis will include cumulative effects of the proposed action with improvements to Route 17 and developments at Stewart Airport. To establish cumulative effects at other locations within the study area, a database of significant projects is being accumulated of such projects. It is expected that some of the information for the database will be obtained from NYMTC and additional input will be had from the NYSDEC Environmental Notice Bulletin, through ongoing communications with county officials, and by reference to local newspapers. Essentially, NYMTC's socioeconomic projections, and major study-area development projects identified through research, will form a future No Build for the project.

To place project effects in perspective, an assessment of past and ongoing events that have and are influencing resources within the study area will be presented. The retrospective will begin at a point in time when the Tappan Zee Bridge was being completed (1955) and will describe trends in population, land use and other socio-economic factors that have in turn impacted both the natural and built environment of the study area at this point in time. This analysis will both provide a baseline against which to compare project impacts can lead to recommendations for effective mitigation measures.

The key resource areas on which the consideration of cumulative and indirect impacts will focus are projected to be traffic and transit operations and demand levels, land use and economic development, noise and air quality, corridor and Hudson River ecology and economic and fiscal issues. The overall analysis will have both quantitative and qualitative elements, given the nature of the projects being made and the time frames involved. For the highway, bridge and transit accommodations portions of the effort it is expected that the analysis will be focused on Westchester and Rockland Counties, and will address impacts to specific resources (e.g., historic structures, wetlands, flooding, etc.), providing greater analytical detail.

For the transit analysis, specific locations where impacts could occur will not be known and, therefore, the effects analysis will be largely qualitative and generic. For instance, it would not be possible to identify which wetland or historic resource could be impacted by new, transit-driven development since the location of that development could occur anywhere within the broad study area and the nature of that development would only be generically known (e.g., 100 new residential units in eastern Orange or 100,000 square feet of commercial facilities along Route 17). These transit-related factors will be considered in greater detail in the future Tier 2 Transit Environmental Documentation as discussed in Chapter 1.

28.4 Mitigation Measures

Where indirect and cumulative effects are projected to occur as a result of implementing the proposed highway, bridge and transit accommodations, mitigation concepts will be identified for those impacts consistent with the level of detail available for projects contributing to resource impacts. Implementation of potential mitigation measures will necessitate coordination between project sponsors and local governments since many of the impacts would occur well beyond the timeframe for initial operation of the proposed action. With regard to the proposed transit systems, recommended mitigation measures will be highly conceptual and reflect both the extended timeframe over which estimated impacts would occur and the conceptual level of detail for project elements.

29 Other NEPA Considerations

Under NEPA guidelines (40 CFR 1502), three additional subchapters are required to be included in the EIS. These include:

- **Unavoidable Adverse Impacts.** Summarizes all instances presented within the various impact analyses of the EIS where a significant adverse impact of the various project alternatives could not be avoided by changes to the project or mitigated by readily available and feasible mitigation measures. The EIS will include, in matrix format for easy comparison, instances where such impacts are unavoidable and could not be mitigated to a less-than-significant level.

- **Relationship between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity.** This subchapter summarizes those instances where short-term impacts to the environment are necessary in order to maintain and enhance the long-term effectiveness of the transportation systems in the corridor, drawing on the results of the relevant impact chapters of the EIS.

- **Irretrievable and Irreversible Commitments of Resources.** This section, as indicated, summarizes those instances where various man-made or natural resources committed to the construction or operation of the proposed project would represent an irreversible and irretrievable commitment of those resources. These assessments generally relate to the use of non-renewable resources (e.g., petroleum) but also to, for example, certain natural assets (a portion of a river shoreline) the use of which would be irreversibly lost by the construction of an effectively permanent transportation facility. Any such conditions identified throughout the various chapters of the EIS will be summarized in this subchapter.

30 Evaluation of Alternatives

The process by which project alternatives were developed and selected for inclusion in the DEIS, as reviewed in Chapter 2, was built around (1) their likely ability to meet the project's goals and objectives, thereby addressing the underlying purpose and need for the project, and (2) the benefits they would provide and the associated environmental impacts (beneficial and adverse) they would produce. The review of the detailed assessment of these alternatives as provided throughout the DEIS follows this same approach, leading to the eventual selection of the preferred alternative in the DEIS. The following sections outline the approach to be taken in producing this summary evaluation of alternatives.

30.1 Performance in Satisfying Purpose and Need

Chapter 1 of the EIS will present the Project Purpose and Need and the associated goals that the analyzed alternatives are intended to meet:

- Goal 1: Improve mobility of people, goods, and services for travel markets served by the Tappan Zee Bridge.
- Goal 2: Maximize the flexibility and adaptability of new transportation infrastructure to accommodate changing long-term demand.
- Goal 3: Maintain and preserve vital elements of the transportation infrastructure.
- Goal 4: Improve the safety and security of the transportation system.
- Goal 5: Avoid, minimize and/or mitigate any significant adverse environmental impacts caused by feasible and prudent improvements.
- Goal 6: Develop feasible, cost effective solutions that can be implemented within a reasonable time horizon.

The extent to which each of the project alternatives would meet these identified project goals would be presented, based on a number of generally qualitative performance measures or criteria by which the extent of compliance with each goal would be assessed. This approach would be similar to the screening and comparisons of alternatives that were used in the recently completed *Transit Mode Selection Report* and *Alternatives Analysis for Rehabilitation and Replacement of the Tappan Zee Bridge*.

30.2 Comparative Benefits and Environmental Effects

The benefits and environmental effects of each of the project alternatives will be presented in a simple matrix format, with the results of the various impact analyses grouped under common headings (Transportation, Socioeconomic, Environmental, etc.), and the benefits and impacts summarized for each of the five alternatives (No Build and four Build Alternatives. In some instances, the values shown will be quantitative in nature (e.g., transit ridership, project costs, VMT reduction, acres of wetlands, etc.) while others will be more qualitative (e.g., land use impacts, visual impacts, etc.)

30.3 Identification of Preferred Alternative

Based on the information provided in the two side-by-side comparisons of the relative merits of the project alternatives, the process by which the Project Sponsors choose a Preferred Alternative in the DEIS will be fully documented. The section will present (1) the criteria used to compare the relative merits of the proposed alternatives, and the measures used to assess each alternative's consistency with that criterion; (2) the results of the assessment under these criteria, presented in both prose and matrix formats to allow for easy comparison; and (3) the primary reasons for the eventual selection of the Preferred Alternative – those factors that were most important to the recommendation, from consistency with project goals to projected benefits or impacts under the various impact criteria. FHWA and FTA will not identify a Preferred Alternative until the FEIS, and the final selection of this alternative will be identified in the ROD after comments received on the FEIS have been reviewed.

31 References

This chapter of the EIS will include a listing of pertinent references that were used in the development of the document.

32 List of Preparers

This *EIS Methodology Report* was prepared under the direction of the New York State Department of Transportation, New York State Thruway Authority, and Metro-North Railroad by:

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33 Index

The EIS will include an appropriate index of terms.

Appendix A

Air Quality Impact Analysis Protocol

Thruway Authority

New York State Department of Transportation

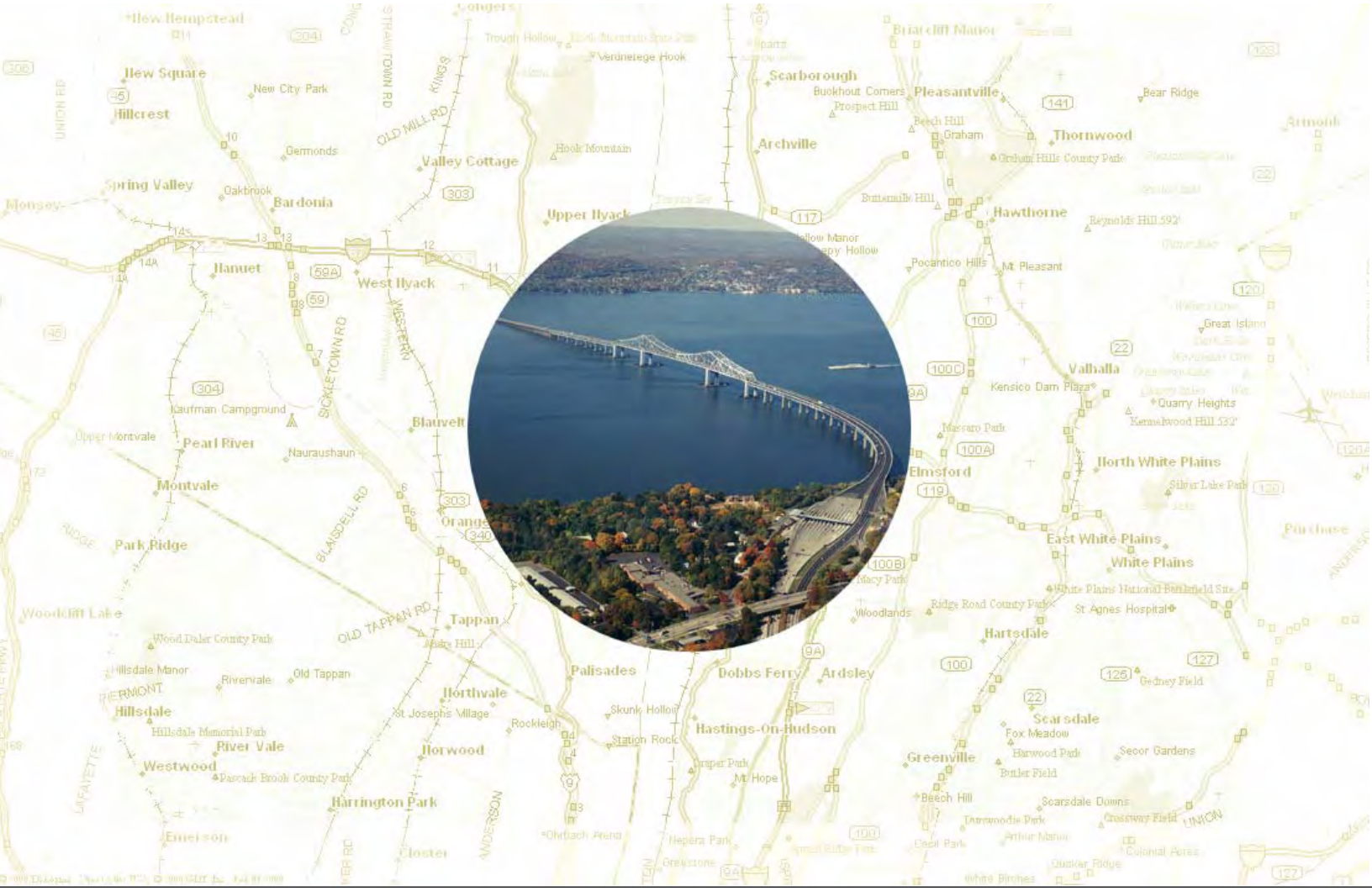
Metro-North Railroad

TAPPAN ZEE BRIDGE/I-287
ENVIRONMENTAL REVIEW

Environmental Impact Statement for

Tappan Zee Bridge/I-287 Corridor

Air Quality Impact Analysis Protocol



December 7, 2006

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1 INTRODUCTION

This report presents the protocol for conducting air quality analyses for the Tappan Zee Bridge/I-287 Corridor project being planned by the New York State Thruway Authority (NYSTA) and Metropolitan Transportation Authority/Metro-North Railroad (MTA/MNR). The project is now in its second stage during which an Environmental Impact Statement (EIS) will be prepared. The protocol presented here describes the air quality analyses that will be conducted as part of the EIS.

1.1 Study Area

The Tappan Zee Bridge/I-287 Corridor extends from Suffern, Rockland County, NY to Port Chester, Westchester County, NY, a distance of approximately 30 miles (Figure 1-1). The corridor encompasses a critical section of the New York State Thruway and all of the Cross Westchester Expressway (CWE). It connects a number of major interstate highways including I-87 north to Albany, I-287 south to New Jersey, I-87 south to New York City, I-684 north to Connecticut, and both the north and south directions of I-95. The corridor provides a critical link in the national system of interstate and defense highways, as well as links to a number of key north-south and east-west regional routes.

The study area includes significant portions of both Westchester and Rockland counties, including the cities and towns of Rye, Harrison, White Plains, Greenburgh, Elmsford, Tarrytown, Nyack, Nanuet, Spring Valley, and Suffern. Development patterns in the corridor are predominantly suburban, with intermixing commercial areas, business centers, and residential neighborhoods. The corridor passes through pockets of more dense urban development predominantly in the White Plains area.

1.2 Project Alternatives

The Alternative Analysis (AA) process culminated in the identification of six alternatives to be carried forward into the DEIS:

- Alternative 1 - No Build.
- Alternative 2 - Bridge Rehabilitation with TDM/TSM Measures.
- Alternative 3 – Full Corridor BRT and Highway Improvements in Rockland.
- Alternative 4A – Full Corridor CRT and Highway Improvements in Rockland.
- Alternative 4B – Manhattan-Bound CRT with LRT in Westchester County and Highway Improvements in Rockland.

Figure 1-1 Study Corridor

- Alternative 4C – Manhattan-Bound CRT with BRT in Westchester County and Highway Improvements in Rockland.

1.2.1 Alternative 1 - No Build

As per NEPA and SEQRA requirements, a No Build Alternative will be analyzed in the EIS. The potential impacts of this alternative were identified in the No Build Scenario studied in the Alternative Analysis (AA), which was created to establish the baseline against which to measure the impacts of the other scenarios. However, it was determined that the No Build Scenario would not meet the goals and objectives established for the study. One of the key findings of the AA was that both highway and transit improvements were necessary to improve mobility in the corridor. The key components of Alternative 1 (Figure 1-2) include:

- Maintenance of the bridge structure and highway to avoid unacceptable levels of deterioration that would lead to operational and safety deficiencies.

- Projects in the Transportation Improvement Program (TIP) (FY 2004-2006).

1.2.2 Alternative 2 - Bridge Rehabilitation with TDM/TSM Measures

Rehabilitation of the Tappan Zee Bridge was studied in the AA. The bridge would be retained and structurally rehabilitated to provide an additional 50 to 100 years of reliable service. The rehabilitation would include the retrofit measures necessary to bring the bridge into compliance with the current seismic criteria, as befits a lifeline structure.

Traffic Demand Management/Transportation System Management (TDM/TSM) measures were also studied in the AA. However, it was concluded that the combination of TDM/TSM measures, ramp metering and congestion pricing would not be effective in meeting corridor needs as a stand alone option, but together with major capital investments would offer benefits worthy of further consideration. These relatively low-cost strategies will be advanced as part of a package of improvements in all of the DEIS build alternatives.

The key components of Alternative 2 (Figure 1-3) include:

- **Projects in the TIP** (FY 2004-2006).

- **Highway/Bridge** - Rehabilitation of the highway and seismic retrofit of the bridge.

- **Transit** – Proposed transit improvements in the 2025 Metro-North and New Jersey Transit Capital Investment Schedule for West of Hudson.

- **TDM/TSM Measures –** Including I-287 park & ride facilities, three-lane high-speed toll plaza, expanded weekend E-ZPass program, ramp metering, congestion pricing, and others.

1.2.3 Alternative 3 – Full Corridor BRT and Highway Improvements in Rockland

The key components of Alternative 3 (Figure 1-4) are:

- **Highway** – six general purpose lanes, two HOT lanes, westbound climbing lane from a replacement Tappan Zee Bridge to Interchange 14A, and new eastbound climbing lane from Interchange 12 to 11 (which connects to the existing eastbound fourth lane) in Rockland County.

- **Transit** – BRT from Suffern to Port Chester with transfer in Tarrytown. Buses would use HOT lanes in Rockland County and a barrier-separated facility (exclusive busway) in portions of Westchester County (alongside I-87/I-287) and exclusive bus lanes on Route 119 in Tarrytown and White Plains. (It should be noted that bus origins/destinations include locations both west of Suffern and east of Port Chester.) Service connections would be possible to the Port Jervis, Pascack Valley, Harlem, and New Haven Lines.

- **TDM/TSM Measures –** Same as Alternative 2**.**

- **River Crossing –** New bridge with two HOT lanes and eight general purpose lanes. The bridge would also potentially include amenities such as a full-length pedestrian/bicycle path linking Rockland and Westchester, belvederes (periodic widenings) for viewing and respite along the pathway, and designated recreation areas (e.g., for fishing and picnicking).

1.2.4 Alternative 4A – Full Corridor CRT and Highway Improvements in Rockland

The key components of Alternative 4A (Figure 1-5) are:

- **Highway –** Same as Alternative 3.
- **Transit** – CRT from Suffern to Port Chester with a direct connection to the Hudson Line in Tarrytown for one-seat ride to Manhattan and a New Tarrytown South station below the existing toll plaza for both Manhattan and I-287 commuter rail services. Connections would be possible to the Port Jervis (direct), Pascack Valley (transfer), Harlem (transfer), and New Haven Lines (direct).

- **TDM/TSM Measures** – Same as Alternative 2.

- **River Crossing -** New bridge with two HOT lanes, eight general purpose lanes, and two rail tracks. The bridge would also potentially include amenities such as a full-length pedestrian/bicycle path linking Rockland and Westchester, belvederes (periodic widenings) for viewing and respite along the pathway, and designated recreation areas (e.g., for fishing and picnicking).

1.2.5 Alternative 4B – Manhattan-Bound CRT with LRT in Westchester County and Highway Improvements in Rockland

The key components of Alternative 4B (Figure 1-6) are:

- **Highway -** Same as Alternative 3.

- **Transit –** CRT from Suffern to Tarrytown and LRT from the existing Hudson Line Tarrytown station to Port Chester. Manhattan-bound CRT would start in Suffern and connect to the Hudson Line as in Alternative 4A. There would be a new transfer facility (Tarrytown South) for LRT service near the existing bridge toll plaza.

  The LRT service would start at Tarrytown (allowing transfer to/from the existing Hudson Line) and follow a hybrid high-speed/in-street LRT alignment. The In-Street alignment would be used on Route 119 and through White Plains. The high-speed alignment along I-287 would be used in a portion of Greenburgh and for the connection to Port Chester Station (i.e., avoiding use of Route 120A). Future commuter rail service across the I-287 corridor would not be precluded. Service connections would be possible to the Port Jervis, Pascack Valley, Harlem, and New Haven Lines.

- **TDM/TSM Measures –** Same as Alternative 2.

- **River Crossing -** New bridge with two HOT lanes, eight general purpose lanes, and two rail tracks. The bridge would also potentially include amenities such as a full-length pedestrian/bicycle path linking Rockland and Westchester, belvederes (periodic widenings) for viewing and respite along the pathway, and designated recreation areas (e.g., for fishing and picnicking).

1.2.6 Alternative 4C – Manhattan-Bound CRT with BRT in Westchester County and Highway Improvements in Rockland

The key components of Alternative 4C (Figure 1-7) are:

- **Highway –** Same as Alternative 3.

- **Transit -** CRT from Suffern to Tarrytown and BRT from the existing Hudson Line Tarrytown station to Port Chester. Manhattan-bound CRT would start in Suffern and connect to the Hudson Line as in Alternative 4A. There would be a new transfer facility (Tarrytown South) for BRT service near the existing bridge toll plaza.

  The BRT service would start at Tarrytown (allowing transfer to/from the existing Hudson Line) and would follow with a barrier-separated facility (exclusive busway) in portions of Westchester County (alongside I-87/I-287) and exclusive bus lanes on Route 119 in Tarrytown and White Plains. Future commuter rail service across the I-287 corridor would not be precluded. Service connections would be possible to the Port Jervis, Pascack Valley, Harlem, and New Haven Lines.

- **TDM/TSM Measures** – Same as Alternative 2.

- **River Crossing** – New bridge with two HOT lanes, eight general purpose lanes, and two rail tracks. The bridge would also potentially include amenities such as a full-length pedestrian/bicycle path linking Rockland and Westchester, belvederes (periodic widenings) for viewing and respite along the pathway, and designated recreation areas (e.g., for fishing and picnicking).

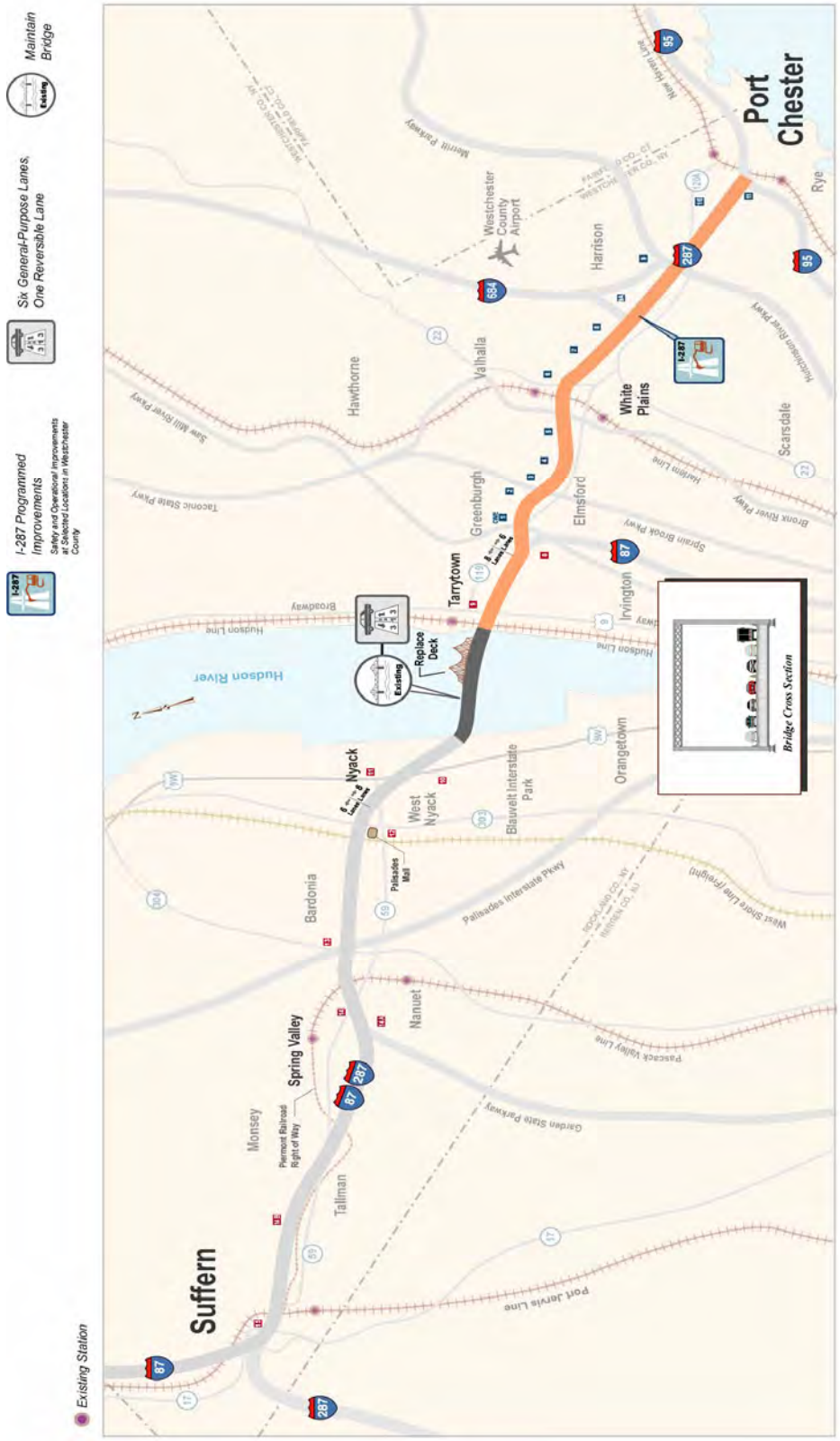

Figure 1-2
Alternative 1 - No Build

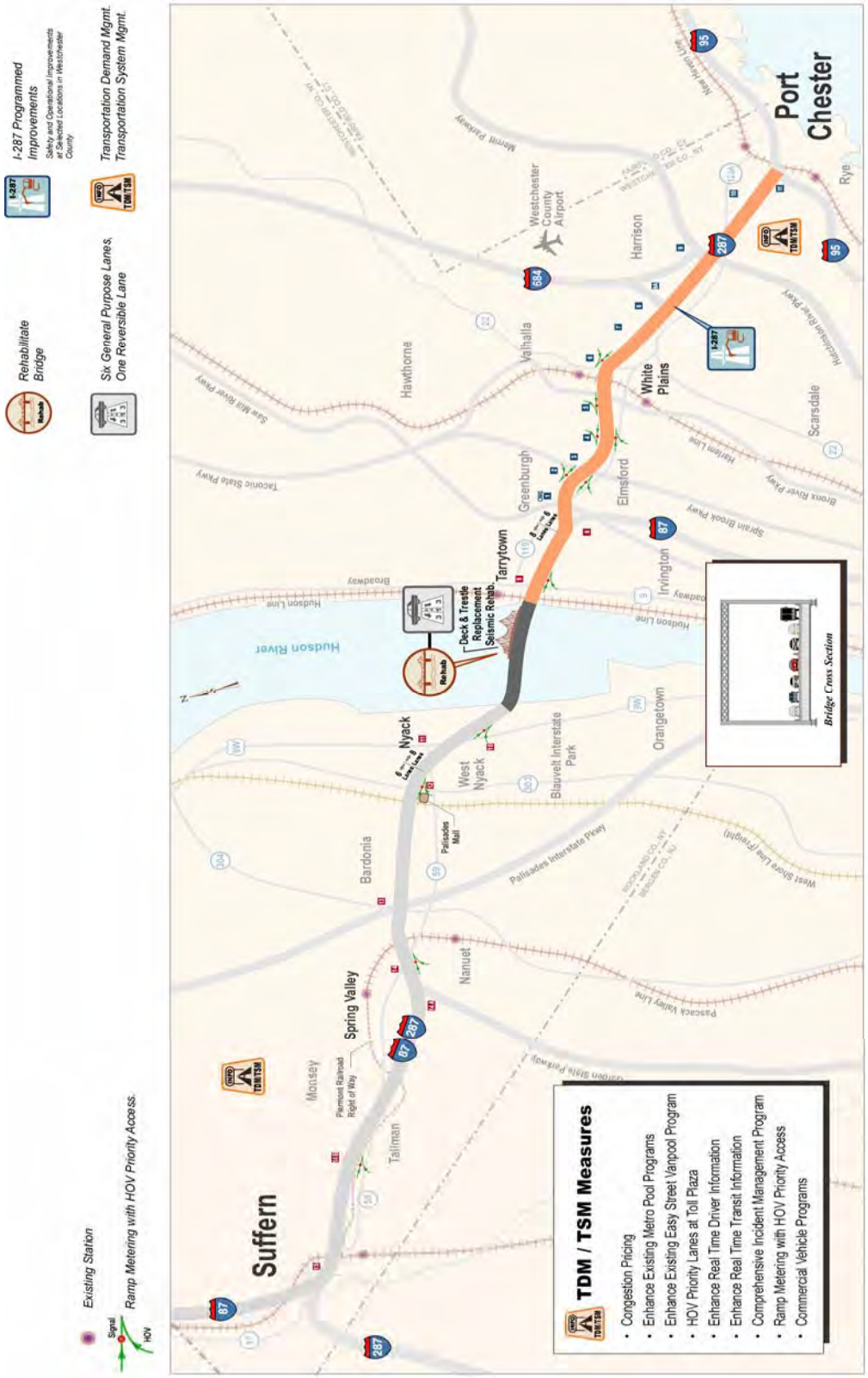

Figure 1-3
Alternative 2 - Rehabilitate Tappan Zee Bridge with TDM/TSM Measures

Figure 1-4
Alternative 3 - Full Corridor BRT

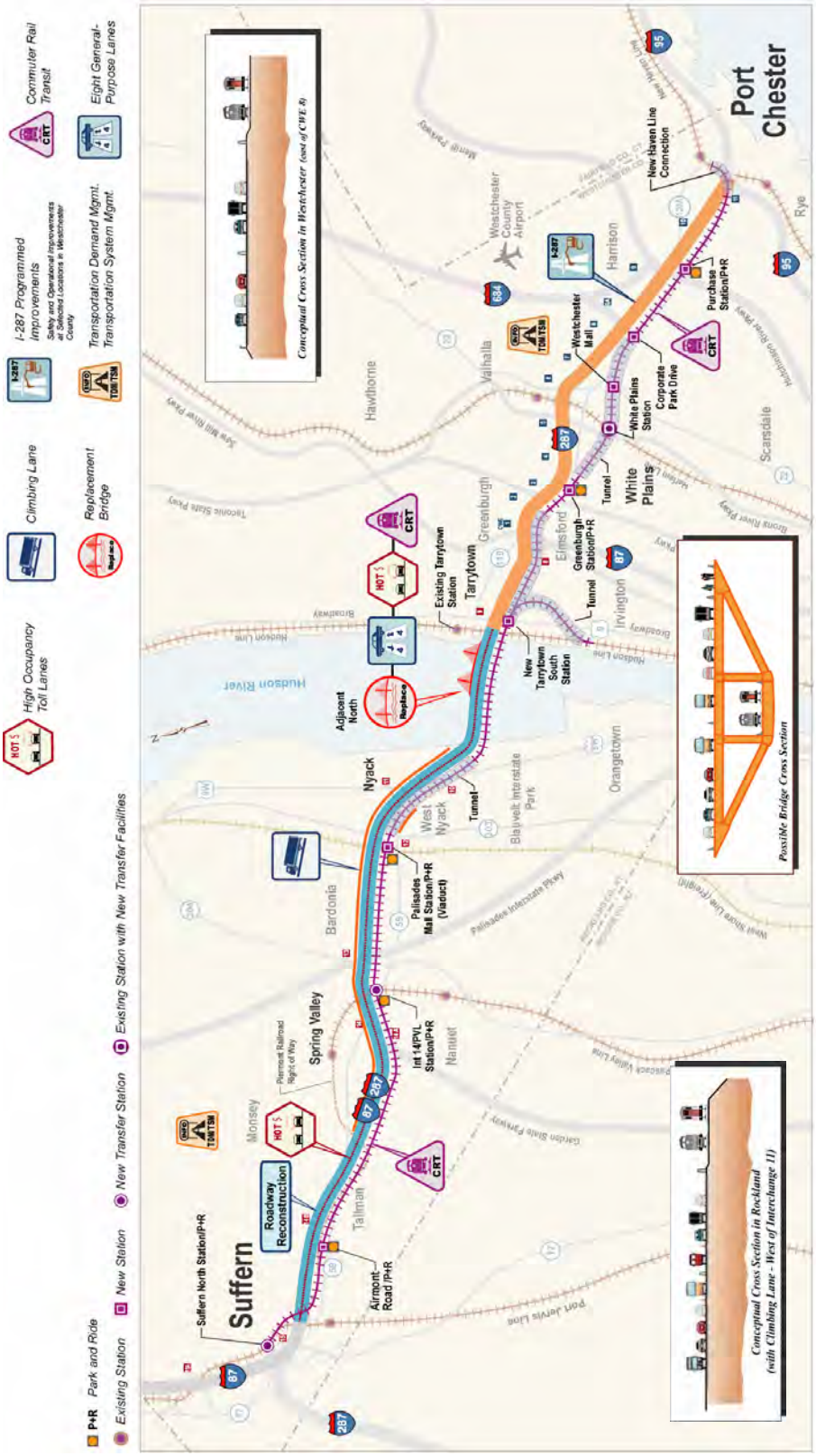

Figure 1-5
Alternative 4A - Full Corridor CRT

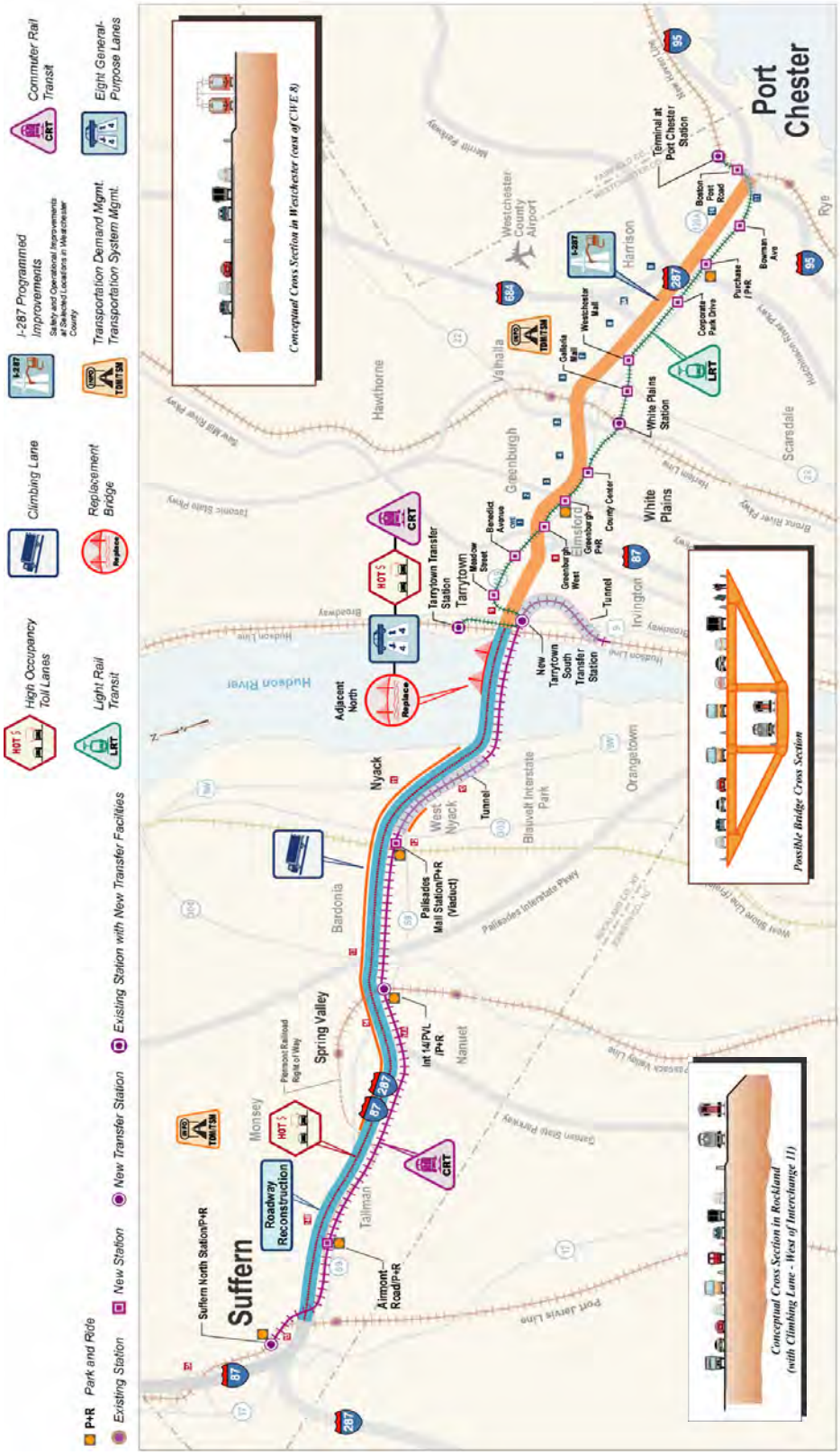

Figure 1-6

Alternative 4B - Manhattan-Bound CRT with LRT in Westchester County

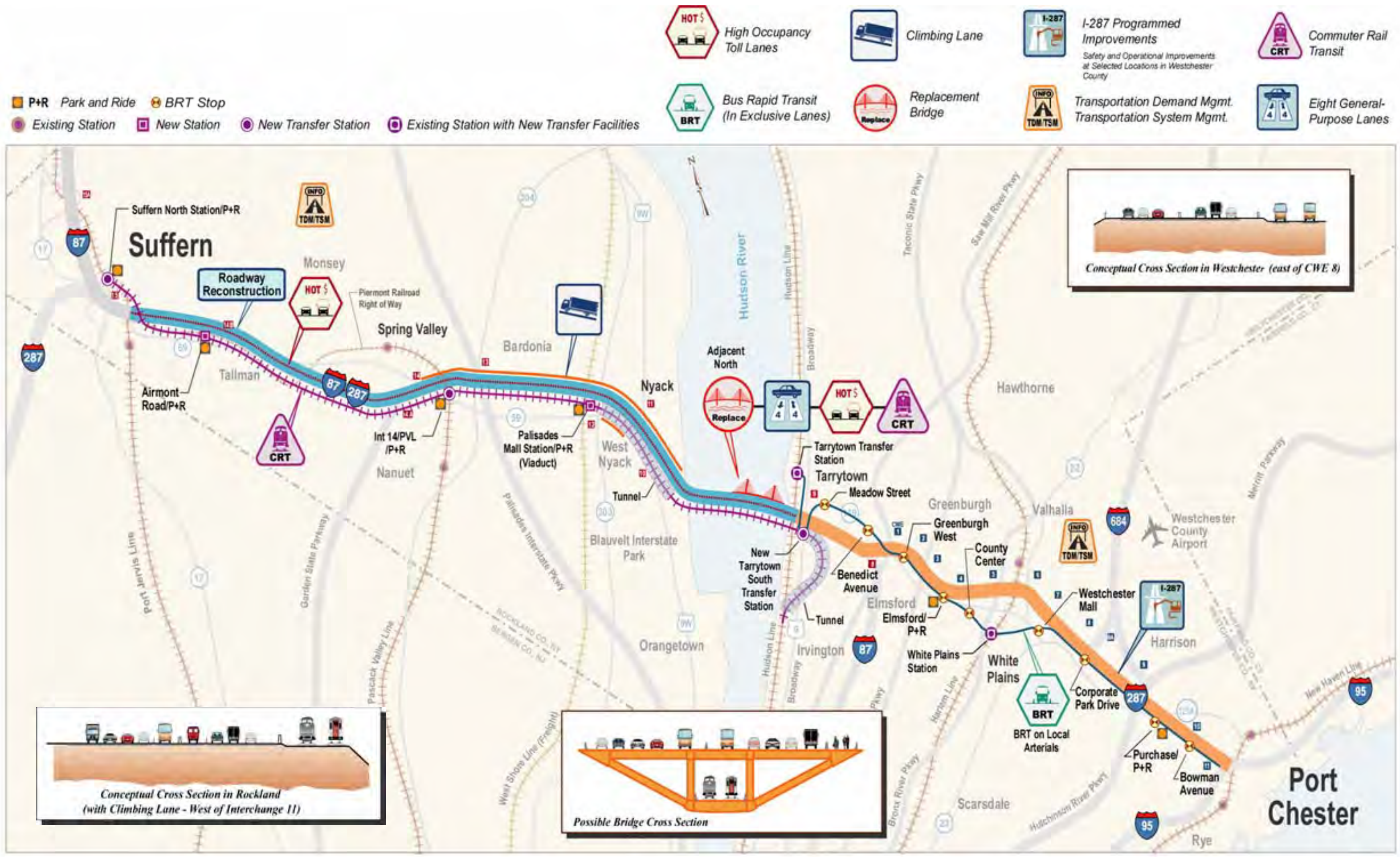

Figure 1-7

Alternative 4C - Manhattan-Bound CRT with BRT in Westchester County

1.3 Purpose of the Protocol

An analysis of potential air quality impacts generated during construction and operation of the project alternatives will be presented in the EIS. The EIS analysis will focus on the following:

- Potential adverse air quality impacts on a regional level due to changes in traffic patterns along the I-287 corridor and throughout the region.
- Potential adverse air quality impacts along roadways in Westchester and Rockland Counties due to diversion of traffic to or from I-287.
- Potential adverse air quality impacts from new project-related stationary sources such as highway tunnel portals, ventilation shafts, parking facilities, etc.
- Potential adverse air quality impacts from construction activities.

This protocol describes the procedures primarily established by the New York State Department of Transportation (NYSDOT) that will be used to assess potential project related air quality impacts. The protocol addresses:

- The pollutants of concern.
- Assumptions and methodologies to be used for the analyses.
- The procedures for addressing potential air quality issues that will be carried through the EIS process.

2 AIR QUALITY ISSUES TO BE ADDRESSED

The US Environmental Protection Agency (USEPA), under the requirements of the 1970 Clean Air Act (CAA) as amended in 1977 and 1990 (CAAA), has established National Ambient Air Quality Standards (NAAQS) for six contaminants, referred to as criteria pollutants (40 CFR 50). These are carbon monoxide (CO), nitrogen dioxides (NO_2), ozone (O_3), particulate matter (PM, comprising PM_{10} and $PM_{2.5}$), lead (Pb), and sulfur dioxide (SO_2). The NAAQS were established at levels sufficient to protect public health as well as public welfare with an adequate margin of safety. In addition to the criteria pollutants, the CAA also lists 188 air toxics, known as hazardous air pollutants (HAPs).

2.1 Pollutants of Concern

2.1.1 On-Road Mobile Sources

Mobile sources relevant to this project are primarily motor vehicles, buses and diesel locomotives. Primary vehicle-related air pollutants are CO and O_3 precursors (nitrogen oxides [NO_x] and volatile organic compounds [VOCs]). PM (PM_{10} and $PM_{2.5}$) can also be of concern from mobile sources especially from heavy-duty diesel trucks and buses. Lead emissions from gasoline-fueled vehicles have been virtually eliminated through the use of unleaded gasoline. Potential emissions of SO_2 from mobile sources are insignificant in comparison with non-mobile emission sources, especially after the implementation of the USEPA's Clean Diesel Truck and Bus Rule (December 21, 2000) and Clean Air Nonroad Diesel Rule (May 11, 2004) that cut 99 percent of sulfur in diesel fuel. Therefore, potential air quality impacts of vehicular emissions of CO, PM (PM_{10} and $PM_{2.5}$), NO_x, and VOC emissions are of possible concern and will be analyzed in the EIS.

For air toxic pollutants, USEPA has identified a group of 21 HAPs as mobile source air toxics, among which a total of six air toxics are considered the priority Mobile Source Air Toxics (MSATs). These priority MSATs include benzene, formaldehyde, acetaldehyde, diesel particulate matter/diesel exhaust organic gases, acrolein, and 1,3-butadien and the potential emission levels for each of above six priority MSATs will be analyzed for each alternative in the EIS.

The number of locomotives that would operate under any of the commuter rail alternatives being evaluated at this time is limited. Although locomotive emissions (as mobile sources) are expected to be negligible at both microscale (local) and mesoscale (regional) level, particularly when compared to motor vehicle emissions, the EIS will address air quality effects from locomotive emissions on 1) mesoscale levels along the corridor and 2) microscale levels in rail yards and tunnels, which will be described later. The locomotive emissions will be determined based on the USEPA-published locomotive emissions standards (April 16, 1998) and the

applicable locomotive model year, engine type and size applicable to the proposed project, which will be provided by Metro-North Railroad.

2.1.2 Stationary Sources

Several stationary sources of air emissions may be developed as part of the build alternatives including CRT tunnels, ventilation facilities, rail yards, parking facilities, etc. However, in these facilities, the only conventional stationary sources (i.e., the sources that are regulated under CAA Title V permit regulation) are space heating boilers, which would be likely minor sources with minimal air quality impacts and exempt from state air permit regulations. The majority of emission sources from these stationary facilities are, in fact, mobile sources (such as moving and idling cars, locomotives, non-road vehicles, etc.).

According to CAA Section 302(z) and New York State Department of Environmental Conservation (NYSDEC)'s Part 201-3.3 (c) (11), such sources are not considered conventional stationary sources regulated under CAA Title V and, therefore, no air permits are expected to be required in order to construct and operate these stationary facilities. However, potential impacts from such facilities would be assessed, treating them as stationary sources, for the same pollutants of concern for on-road mobile sources plus SO_2 associated with heating boilers.

2.2 Regulatory Requirements

2.2.1 NAAQS Attainment Status

Areas that meet the NAAQS standard for a criteria pollutant are designated as being "in attainment" while areas where criteria pollutant levels exceed the NAAQS are designated as "nonattainment". Ozone (O_3) nonattainment areas are further classified, based on the severity of the pollution problem, as either marginal, moderate, serious, severe, or extreme. A maintenance area is an area that has recently been re-designated as an attainment area from a former nonattainment area. However, during the maintenance period, most of the CAA rules for a nonattainment area are still applicable to a maintenance area. The project study area is located in Westchester and Rockland counties within the New York metropolitan area. These two counties are currently designated as follows:

Westchester County

- Moderate nonattainment area for 8-hour ozone.
- $PM_{2.5}$ nonattainment area.
- CO maintenance area.
- Attainment area for all other criteria pollutants.

Rockland County

- Moderate nonattainment area for 8-hour ozone.
- $PM_{2.5}$ nonattainment area.
- Attainment for all other criteria pollutants.

2.2.2 State Implementation Plan

If an area is designated as nonattainment for a criteria pollutant with the NAAQS, state governments must develop and implement control plans to reduce the emission level of that pollutant. A New York State Implementation Plan (SIP) has been developed by NYSDEC to meet deadlines established by the CAAA to achieve the federal ozone standard on a regional basis. The New York Metropolitan Transportation Council (NYMTC), the designated Metropolitan Planning Organization (MPO) for the New York metropolitan region, is responsible for developing the SIP conforming Transportation Improvement Program (TIP) to address mobile source emissions within the region, which includes Westchester and Rockland Counties. The TIP outlines the staged development with priority projects selected for programming in the first year of the five-year program.

The TIP includes a regional emissions analysis that addresses regional emissions impacts from all projects that are included in the TIP. Thus, once FHWA and FTA determine that the TIP conforms to the SIP, projects identified in the TIP do not require a regional emissions analysis on a project level, as their emissions are included in the TIP's emissions analysis.

The TZB/I-287 Corridor Project is currently listed in the NYMTC 2006-2010 TIP only for purposes of funding the NEPA/SEQRA process. The project was not included in the current conforming TIP that was developed for purposes of demonstrating SIP conformance since the project is still in the early stages of DEIS process. However, once the preferred alternative is determined through the DEIS process, the project will have to be included in the TIP. Such an inclusion is expected to occur in the FEIS stage.

2.2.3 CAA Conformity Rules

USEPA developed two sections of the conformity regulations in the CAA that are applicable to a federal action. These regulations differentiate federal actions into the following:

- Transportation projects funded or approved by the Federal Highway Administration (FHWA) or the Federal Transit Administration (FTA), which are governed by the Transportation Conformity Rule (TCR).

- Non-transportation-related projects or non-transportation components of a transportation project requiring actions by non-transportation agencies, which are governed by the General Conformity Rule (GCR). Since the project is a transportation project covered by the TCR, the general conformity rule is not applicable to the project as per 40 CFR Parts 6, 51 and 93.

The Transportation Conformity Rule applies to the TZB/I-287 Corridor Project since it is a transportation project (i.e., a project funded and ultimately approved by FHWA and FTA) in an ozone and PM2.5 nonattainment area and a CO maintenance area. As stated above, the conformity rule recognizes that a project listed in a conforming TIP is presumed to conform to the SIP with respect to regional emissions effects. In addition, the conformity rule requires a project level analysis to show that the project would not cause or contribute to any new violations of the NAAQS.

As per the TCR, as well as the guidance provided by the New York State Department of Transportation (NYSDOT), the project level air quality impacts of a transportation project are generally evaluated for both operational and construction effects on two scales:

- Microscale level for CO and PM (PM_{10} and $PM_{2.5}$). A microscale analysis of traffic-related impacts at intersections or free flow sites provides estimates of localized pollutant concentrations for direct comparison to the NAAQS and/or applicable impact thresholds.

- Mesoscale level for NO_x and VOC (precursors of O_3), CO, and PM (PM_{10} and $PM_{2.5}$). Emissions of these pollutants will be calculated on a mesoscale basis representing the project area. Such an analysis provides a comparison of mesoscale emissions among alternatives.

2.2.4 Summary

In conclusion, the following air quality impact analyses will be presented in the EIS:

1) Microscale impact analysis for PM (PM_{10} and $PM_{2.5}$) and CO for mobile sources.

2) Mesoscale emissions burden analysis for CO, NO_x, VOC and PM (PM_{10} and $PM_{2.5}$) and for six identified MSATs for mobile sources.

3) Microscale impact analysis for CO, PM (PM_{10} and $PM_{2.5}$), SO_2, and NO_2 for stationary facilities.

4) Construction period microscale and mesoscale impact analysis for NO_x, VOC, CO and PM (PM_{10} and $PM_{2.5}$), when applicable.

5) Transportation Conformity determination regarding the transportation component of the project based on both microscale and mesoscale analysis results as well as the status of inclusion of the proposed project in the TIP.

3 AIR QUALITY ANALYSES METHODOLOGIES

3.1 Microscale Mobile Source PM (PM_{10}/$PM_{2.5}$) Analysis

Particulate matter (PM_{10} and $PM_{2.5}$) is emitted into the atmosphere from a variety of sources including industrial facilities, power plants, construction activity, non-road mobile sources, and on-road vehicles, especially from diesel trucks and buses. The PM emissions from mobile sources are getting more and more public attention since USEPA implemented a recent NAAQS for fine particulate ($PM_{2.5}$). The $PM_{2.5}$ standards require that the total ambient $PM_{2.5}$ concentration not exceed an annual average of 15 µg/m^3 and a 24-hour average of 65 µg/m^3. However, USEPA has not yet provided specific guidance for refined $PM_{2.5}$ impact analyses, as they have previously done for other criteria pollutants. In order to address such potential impacts quantitatively from various emission sources, state agencies (NYSDEC and NYSDOT) have jointly developed guidance for both PM_{10} and $PM_{2.5}$ analyses. The following most recent documents are the basis for formulating the PM analysis approach presented herein:

- Project Level Particulate Matter Analysis Final Policy (NYSDOT, September 2004).
- Assessing and Mitigating Impacts of Fine Particulate Matter Emissions Policy (NYSDEC, December 29, 2003).

The EIS will address potential PM_{10} and $PM_{2.5}$ impacts quantitatively (as described below) based on the current analysis procedures established by NYSDEC and NYSDOT, which is consistent with the purposes of making the project-level transportation conformity determination as prescribed in the USEPA's guidance. However, USEPA recently issued a transportation conformity guidance for qualitative hot-spot analyses in PM_{10} and $PM_{2.5}$ nonattainment areas. According to this guidance, the project level conformity determination with respect to hot-spot concerns can be discussed through a qualitative and approximate approach essentially based on a comparison of the emission levels at specific hot-spots and available monitored levels at a comparable monitoring site. This qualitative approach may also be implemented should NYSDOT revise its analysis procedures.

3.1.1 Impact Criteria

NYSDOT and NYSDEC have established microscale Potential Significant Impact Thresholds (PSITs) for PM_{10} and $PM_{2.5}$. Based on build/no-build analysis comparisons for all project alternatives, maximum concentration differences found to be greater than those thresholds listed below will be determined to represent a potential significant environmental impact and feasible mitigation measures will need to be considered:

- The incremental PM_{10} concentrations (Build – No Build) are:
  - Greater than 1.0 µg/m^3 annual average level; or
  - Greater than 5.0 µg/m^3 24-hour average level.

- The incremental $PM_{2.5}$ concentrations (Build – No Build) are:
  - Greater than 0.3 µg/m^3 annual average level; or
  - Greater than 5.0 µg/m^3 24-hour average level.

The incremental PSITs were developed primarily for the use at those locations where there are high ambient concentration levels under the no build condition (such as at those congested intersections with high traffic volumes).

3.1.2 Selection of Analysis Sites

The NYSDOT final analysis policy provides general ranking procedures in selecting potentially impacted locations for a microscale PM modeling analysis. The first step is to choose the top three locations with the highest traffic volume for a microscale analysis. If exceedances of PSITs were predicted at one of the first three intersections, the next ranked three intersections will have to be analyzed. Such a stepped procedure should be employed until no exceedances are predicted for the last group of intersections. Since the analysis is to screen for the intersections or free flow sites with the greatest potential to result in exceedances, those locations with highest traffic volume, highest number of traffic lanes, and/or highest percentage of diesel trucks and buses will be initially considered in the analysis. Detailed microscale analysis will be applied only at these expected worst-case sites in the first analysis stage. These sites will be selected using the following criteria:

- Locations identified in the SIP. The intersection of Route 119 and Route 100A in White Plains, which is within a half-mile of the project corridor, is one of the locations used for the NYS CO SIP demonstration purposes.
- The top three (3) intersections with highest traffic volumes in each county.
- Additional locations covering areas with special concerns as required: locations with high diesel truck or bus percentages, or locations with potential worst-case traffic volume increase and/or truck/bus mix. These include locations such as the toll plaza (existing and proposed), high population areas that are immediately adjacent to the corridor segments where major roadway widening would occur, etc.

In order to select the appropriate intersections, traffic conditions at each evaluated intersection will be ranked for the following parameters:

- LOS condition.
- Total approaching volume.
- Heavy-duty diesel truck and bus volume.
- Net increase in heavy-duty diesel truck and bus volumes over the no build condition.

It is expected that a total of 15 locations including both intersections and free flow sites will be selected for microscale PM analyses. However, the final selection will be made after consultation with NYSDOT.

If incremental PM concentrations are predicted to exceed the PSIT levels at selected sites using NYSDOT-defined Level I approach (discussed below in Subchapter 3.1.5.1), a NYSDOT-defined Level II analysis (discussed in Subchapter 3.1.5.2) will be conducted at these sites. If the Level II analysis still shows exceedances of PSIT, an evaluation of microscale modeling inputs at these sites will be performed to eliminate conservative modeling assumptions used in the Level II assessment such as changing 24-hour traffic profile over seven days, etc. If exceedances are still predicted after model inputs are refined, the main factor (i.e., volume or truck percent increase, etc.) contributing to the impact would be identified. Meanwhile, additional intersections or free flow sites with the next highest ranking would be selected and analyzed in the second analysis stage to ensure that all potential exceedances are addressed in the EIS.

3.1.3 Analysis Years

According to the NYSDOT Environmental Procedures Manual (EPM), screening and/or microscale PM and CO (discussed later) impact analyses are required to be done for the Estimated Time of Completion (ETC) and the worst year (i.e., the year with highest corridor emission levels) of ETC+10 and ETC+20 since the project area (i.e., both Rockland and Westchester counties) is in a $PM_{2.5}$ nonattainment area and part of the project area (i.e., Westchester County) is in a CO maintenance area.

Therefore, in order to conduct PM and CO impact analyses for the project using the EPM guidance, traffic forecasts would potentially need to be provided for three future years:

- ETC (2015).
- ETC+10 (2025).
- ETC+20 (2035).

NYMTC's regional Best Practices Model (BPM) will be used as the primary tool to forecast project related changes in regional traffic patterns. Use of the BPM requires significant traffic forecasting effort. In order to reduce the traffic analysis requirements, while meeting the air quality analysis needs, it is proposed to forecast traffic conditions for two analysis years in the EIS using the regional BPM model, instead of three years, based on the rationale described below.

The purpose of evaluating potential emissions for three different analysis years (ETC, ETC+10 and ETC+20) is to capture the worst-case conditions by considering the fact that the two key inputs to the emission factor estimates have the opposite effect on the estimates for later analysis years:

- Higher traffic volumes result in increased congestion and emissions.
- Emission factors in future years are lower resulting in lower emissions.

The outputs of BPM model runs for ETC and ETC+20 would be used as the basis for the emission calculations for those years. The BPM would not be run for ETC+10. The critical analysis year between ETC+10 and ETC+20 will be determined based on traffic forecasts for:

- ETC+20 predicted by BPM.
- ETC+10 by applying the typical volume growth factor (e.g., one percent per year) to the BPM-forecasted traffic for ETC.

In order to determine the critical analysis year between ETC+10 and ETC+20, the emission source strength will be evaluated along the main I/287 corridor as compared to specific analysis sites (intersections) given the large scale of the project. The emission source strength along the project corridor will be determined using the following input data:

- Peak hour volume.
- Average speed associated with the peak hour volume.
- Corridor vehicle classification.
- Mobile6-predicted emission factors for individual vehicle class at corresponding travel speed.

Peak hour volume will be multiplied by the emission factors to determine the corridor emission strength. The year with the highest emission source strength will be the critical analysis year among ETC+10 and ETC+20.

Detailed air quality analyses would be conducted for ETC and the critical analysis year (ETC+10 or ETC+20). However, if ETC+10 is selected as the critical analysis year, traffic forecasts for ETC+10 at all analysis locations will be factored based on the traffic for ETC plus the annual growth rate.

3.1.4 Emission Factor Model

PM emissions occur whenever vehicles travel over a paved surface such as a road or parking lot. PM emissions are due to both direct emissions from vehicles in the form of engine exhaust, brake wear, and tire wear emissions and from resuspension of loose material on the road surface (i.e., fugitive dust). However, according to USEPA's guidance and NYSDOT's final policy, $PM_{2.5}$ components in fugitive dust are considered negligible and do not need to be modeled in mobile source microscale modeling analysis. Therefore, emissions to be addressed in the EIS would only include emissions from engine exhaust, brake wear, and tire wear for $PM_{2.5}$. The fugitive dust component for PM_{10} modeling analysis will be determined using AP-42-established

emission factors and calculation procedures associated with various types of roadways (USEPA, December 2003).

For all analysis years, emissions estimates for both states (NY and CT) will be predicted by running MOBILE6.2 with the most recent input files to be provided by EAB at the time the analysis is performed. If the intersection-specific vehicle classifications can be obtained through traffic survey (e.g., from toll plaza data record) and/or sub-regional traffic model forecasts, they will be used for emission factor modeling. Otherwise the NYSDOT-provided default vehicle classifications that are applicable for various roadway types within Westchester and Rockland counties will be incorporated in the emission factor modeling. It should be noted that since MOBILE6.2 does not predict idling emission factors for light-duty vehicles and heavy-duty gasoline vehicles, a zero idling emission rate will be assumed in predicting PM concentrations from these vehicles.

3.1.5 Dispersion Model and Meteorological Data

In order to predict PM concentrations at selected intersections, geometric models will be developed for the roadway network and secondary intersections within a 1,000-foot radius of each primary intersection. Traffic links behind buildings that are not adjacent to the primary intersection will not be included in these models.

NYSDOT's EPM and PM Analysis Final Policy prescribes two levels (Level I and Level II [a refined analysis]) of microscale analysis, a Level II analysis will be necessary only if the Level I analysis fails.

3.1.5.1 Level I Analysis

The 1-hour average PM Level I modeling under both 2015 (ETC) and 2035 (ETC+20) will be performed using EPA's CAL3QHC with the dispersion parameters and the worst-case meteorological conditions summarized in Table 3-1. Both no build and build conditions will be modeled. The predicted incremental PM ambient concentration levels at each location due to the project will be compared to the PM PSITs to determine whether a Level II analysis is required.

Table 3-1

CAL3QHC Model Input Parameters and Options

Operation	Selected Parameter
Traffic Volume	Peak hour
Traffic Speed	Forecasted speed from sub-regional traffic model.
Stability	D (assuming effected intersections are in an urban area)
Surface Roughness	108 cm for single family residential 175 cm for office area 321 cm for central business district
Wind Speed	1 m/s
Wind Direction	One-degree interval for 360 wind angles
Mixing Height	1,000 m
Source Height	0.0 m
Persistent Factors	0.4 for 24-hour average 0.08 for annual average

3.1.5.2 Level II Analysis

If a Level II analysis is required, the USEPA-developed refined mobile source model, CAL3QHCR, will be used to analyze impacts at receptors near each applicable intersection. The conservative Tier 1 modeling approach (applying a uniform peak hour volume profile over a 24-hour period) will be employed assuming peak hour traffic running for a 24-hour period.

The most recent five years (2000 - 2004) of meteorological data will be used in the analysis. These data consist of (1) surface observations from the National Weather Service (NWS) station at LaGuardia Airport and (2) the coincident mixing height data from the NWS station at Brookhaven, New York. LaGuardia Airport is approximately 20 miles south of Tappan Zee Bridge, while Brookhaven is roughly 40 miles due southeast. LaGuardia Airport and Brookhaven are continually operating monitoring sites for which off-site meteorological data appropriate for use in regulatory dispersion models is available.

The predicted incremental PM ambient concentration levels at each location due to the project will be compared to the PM PSITs to determine whether potential significant PM impacts would result from the proposed alternative(s) that require mitigation measures.

3.1.6 Receptor Locations

Receptors will be placed at nearby sensitive locations such as sidewalks, outdoor activity places near residential buildings, restaurants, or vacant lot to which the public has continuous access. The receptors placed on sidewalks will be located at least 3.01 meters from each of the traveled roadways. PM concentrations will be calculated at receptors placed at 25-meter intervals along the sidewalk. All receptors would be at a height of 1.8 meters.

3.1.7 Mitigation Measures

If a project alternative exceeds the PSIT levels, practicable mitigation measures that can reduce significant PM impacts would be considered. Such measures include one or a combination of the following:

- Design configuration changes (e.g., adding or deleting turn lanes, medians, or geometry realignments).
- Operational changes (e.g., signal timing modification), etc.

3.2 Microscale Mobile Source CO Impact Analysis

According to the EPM (NYSDOT, January 2001), a microscale CO impact analysis will be required at a specific intersection and/or free flow site if the screening analysis fails at that particular location.

3.2.1 CO Screening Analysis

The screening criteria defined in the EPM will be used first at each intersection to be analyzed through the traffic impact analysis for the project.

3.2.1.1 Level of Service (LOS) Screening

Intersections impacted by the proposed project with a ETC and ETC+20 LOS of A, B, or C are generally excluded from a microscale air quality analysis. All studied intersections will be screened first using this criterion.

3.2.1.2 Capture Criteria Screening

Intersections and roadways impacted by the project and exhibiting ETC or ETC+20 build LOS D, E, or F will be screened by the following criteria:

- A 10 percent or more reduction in the source receptor distance.
- A 10 percent or more increase in traffic volume on affected roadways for ETC and/or ETC+20.
- A 10 percent or more increase in vehicle emissions for ETC and/or ETC+20.
- Any increase in the number of queued lanes for ETC and/or ETC+20 at signalized intersections.
- A 20 percent reduction in speed, when build estimated average speed limit is at 30 miles per hour (mph) or less.

If a SIP intersection is located within half mile of the project, which is the case for this project (i.e., the intersection of Route 119 and Route 100A in White Plains), the following criteria will be applicable:

- A 5 percent or more reduction in the source receptor distance.
- A 5 percent or more increase in traffic volume on affected roadways for ETC and/or ETC+20.
- A 5 percent or more increase in vehicle emissions for ETC and/or ETC+20.
- Any increase in the number of queued lanes for ETC and/or ETC+20 at signalized intersections.
- A 10 percent reduction in speed, when build estimated average speed limit is at 30 miles per hour (mph) or less.

If the impacted intersection or roadway meets any one of the above applicable criteria, a use of the volume and emission factor chart is needed to perform a further volume threshold screening.

3.2.1.3 Volume Threshold Screening

The volume thresholds established as a function of emission factor in Tables 3a, 3b and 3c in Chapter 1.1 of the EPM (January 2001) will be used in the final ranking of intersections and/or free flow sites that require a further microscale CO impact analysis.

3.2.2 CO Microscale Analysis

The CO microscale dispersion modeling analysis will be conducted in the similar manner as for PM microscale modeling analysis with the following:

- Two analysis years (ETC and ETC+10 or ETC+20).
- NYSDOT-published MOBILE6.2 emission factors.
- Level I modeling approach with the modeling parameters summarized in Table 3-1. However, a Level I persistence factor of 0.7 will be used to convert modeled one-hour CO concentration levels to eight-hour levels.

- Sidewalks and other sensitive spots at each site as receptor locations to be modeled.

Given the low and improving CO ambient levels recorded throughout the entire state, no Level II refined analysis is expected to be necessary at those selected locations.

Background levels approved for modeling purposes by NYSDOT and provided in Table 8 of NYSDOT's EPM Chapter 1.1 will be included in predicting the total CO concentration levels, which will then be compared to the NAAQS to determine potential impact significance. Rollback calculations as specified in the EPM will be performed to estimate future year background levels using the following base year (1997) data:

For Westchester County:

- 3.7 ppm for 1-hour average level.
- 2.6 ppm for 8-hour average level.

For Rockland County:

- 3.1 ppm for 1-hour average level.
- 2.2 ppm for 8-hour average level.

3.3 Mesoscale Mobile Source Emission Burden Analysis

The purpose of conducting a mesoscale emission burden analysis is to permit a comparison of pollutant emission levels for each project alternative. The analysis will be conducted for both ETC and the design year (ETC+20).

As has been mentioned previously, Westchester and Rockland Counties are currently designated as nonattainment for both ozone and $PM_{2.5}$. Westchester County is also in a CO maintenance area (formerly nonattainment area). Therefore, the mesoscale emissions analysis will be performed for ozone precursors (NO_x and VOC), $PM_{2.5}$ and CO. According to the NYSDOT's policy (September 2004), a mesoscale emissions analysis will also be required for PM_{10} emissions.

According to the FHWA-adopted Interim Guidance on Air Toxic Analysis in NEPA Documents (February 3, 2006), a mesoscale air toxic pollutant emission burden analysis will be conducted given the project scale. The priority Mobile Source Air Toxics (MSATs) to be analyzed for each EIS alternative include benzene, formaldehyde, acetaldehyde, diesel particulate matter/diesel exhaust organic gases, acrolein, and 1,3-butadien.

3.3.1 BPM Model Output

The traffic forecasts to be used for mesoscale emission analysis will be obtained from the BPM. The principal traffic inputs for emission estimates that are available as outputs from BPM are:

- Vehicle Miles Traveled (VMT) for the AM, Mid-day, PM, and night time periods for each type of roadway, by county, within the region.
- Vehicle Hours Traveled (VHT) during AM, Mid-day, PM, and night time periods for each type of roadway, by county, within the region.

Each VMT estimate developed by BPM will be divided by the corresponding VHT to derive an average travel speed, for each analyses period, along each type of roadway. The mesoscale emissions burden based on changes in VMT and speed will be computed for the traffic network within approximately one-mile distance from the corridor to be forecasted by the BPM. This network will cover portions of areas in the following counties:

- Westchester, Rockland, and Orange in NY.
- Fairfield in CT.

3.3.2 Emission Factor Model

The NYSDOT-provided MOBILE6.2 emission factors based on roadway type and county will be used for predicting NO_x, VOC, CO and PM emissions within New York State. The applicable emission factors for Connecticut will be predicted using MOBILE6.2 model with model inputs to be provided by NYSDOT EAB.

Air toxic emission factors will also be predicted using MOBILE6.2 with input parameters to be developed in consultation with NYSDOT EAB.

BPM-predicted VMT levels will then be multiplied by the emission factors for each pollutant to determine the mesoscale emission burden under each alternative for analysis years. A comparison of each alternative with respect to mesoscale emission burdens will be made.

3.4 Stationary Source Impact Analysis

The proposed action would introduce several new stationary sources that may result in increases in air pollutant emissions at specific locations. Potential impacts resulting from such stationary sources will be analyzed at a total of up to five (5) locations. These new sources may include:

- Tunnels with vent exhausts.
- Vehicle/bus parking facilities.

- Rail yards.

Emission sources within these facilities would be mainly mobile sources such as vehicles and non-road maintenance equipment. Heating sources within new structures may be the only conventional stationary sources associated with the project; however, these are normally considered minor emission sources and have negligible air quality impact. Emissions from new stationary facilities will be estimated primarily from the following guidance or documents:

- MOBILE6.2 for on-road vehicular exhaust emissions when applicable.
- AP-42 (January 1995 and December 2003) for boilers and fugitive dust.
- Exhaust and Crankcase Emission Factors for Non-road Engine Modeling - Compression-Ignition (April 2004) for non-road maintenance equipment and on-road vehicular emissions if they are not covered under MOBILE6.2, such as SO_2.
- Median Life, Annual Activity, and Load Factor Values for Non-road Engine Emissions Modeling (April 2004) for maintenance equipment.
- Procedures for Emission Inventory Preparation - Volume IV-Mobile Sources (July 1992).
- Final Emissions Standards for Locomotives (December 1997).

3.4.1 Emission Rate Estimates

In order to compare the impacts of stationary sources to the applicable NAAQS, an emission rate must be established that corresponds to the time averaging period of the applicable ambient air quality standard. Accordingly, hourly emission rates (corresponding to standards that have 1-hour, 3-hour and 8-hour averaging periods) and daily emission rates (corresponding to standards with 24-hour and annual averaging periods) will be derived.

3.4.1.1 CRT Tunnel Exhaust Vents or Vent Building

It is anticipated that no naturally ventilated short tunnels would result from project implementation and all project-related tunnels would be mechanically ventilated. Vent exhausts are considered point sources. Emissions within tunnels would result from locomotive exhausts. Therefore, total emissions over a specific time frame within a tunnel can be derived based on a combination 1) EPA-defined locomotive emission factors and 2) transit schedule. Since the air exchange provided by the ventilation system is normally sufficient to diminish the natural airflow at both ends of a tunnel, locomotive emissions released at tunnel ends due to natural ventilation are small compared to vent emissions. Therefore, emissions within a vented tunnel will be assumed to emit only from exhaust vents. Air exhaust rates for each vent will be determined based on the preliminary design of the tunnel ventilation system.

3.4.1.2 Parking Areas

Parking areas include parking lots, parking garages, and multilevel naturally ventilated parking facilities. These facilities will be generally modeled as stationary area sources. However, potential mechanically ventilated indoor facilities are considered point sources. Emissions from a parking facility will be estimated using the same emission factor model, MOBILE6.2, for both CO and PM as discussed above. Start emissions will be considered in the CO microscale analysis at these facilities using start emission factors to be provided by NYSDOT EAB. These VMT-basis emission factors will then be multiplied by 1) the average traveling length and idling time for each trip and 2) average volume turn over rate on an hourly basis. Both short-term and long-term emission rates will be further averaged over the entire parking area or ventilation points when applicable to determine appropriate area or point source emission rates. The New York City Environmental Quality Review (CEQR) Technical Manual (October 2001) provides procedures for estimating parking area emission rates as well as the modeling approach for various parking facilities. These CEQR procedures will be followed in the EIS.

3.4.1.3 Rail Yards

Rail yards will also be simulated as stationary area sources for pollutants of concern associated with rail facility operations. In addition to typical vehicle activities (i.e., truck loading and unloading activities) that will be estimated using MOBILE6.2, potential operations of non-road equipment (such as a diesel loader, a diesel forklift, etc.) and locomotives within the rail facility will also result in emissions. The USEPA has developed a database for non-road engine emission factors as a function of the type and size of the equipment and has provided guidance for developing emission inventories for these engines. The USEPA recommends use of the following formula to calculate hourly emissions from non-road engine sources:

$$M_i = N \times HP \times LF \times EF_i$$

where:
- M_i = mass of emissions of ith pollutants during inventory period (grams/hr);
- N = source population (units);
- HP = average rated horsepower (hp);
- LF = typical load factor (%);
- EF_i = average emissions of ith pollutant per unit of use (e.g., grams per horsepower-hour).

This formula can also be used for emission rate estimates of locomotive engine exhausts within a rail yard. The locomotive emission standards established by the USEPA (December 1997), the average horsepower of typical locomotive, and the total engine run time would be determined and used in emission rate estimates.

3.4.2 Dispersion Modeling

USEPA's AERMOD model will be used to analyze potential impacts from stationary sources described above. USEPA has officially recommended AERMOD, as of September 8, 2003, as the preferred regulatory model to gradually replace the ISCST model that has been in use for this purpose for decades.

AERMOD is a steady-state plume dispersion model and simulates transport and dispersion from multiple point, area, or volume sources based on an up-to-date characterization of the atmospheric boundary layer. Dispersion characteristics may be selected to model rural or urban conditions, and terrain effects can be modeled to reflect simple or complex terrain. AERMOD accounts for building wake effects (i.e., plume downwash). The model employs hourly sequential preprocessed meteorological data to estimate concentrations for selected averaging times from one hour to one year.

For regulatory applications of AERMOD, the regulatory default option will be used for modeling. The default option requires the use of terrain elevation data, stack-tip downwash, sequential date checking, etc. Terrain elevation data from the US Geological Survey 7.5-Minute Digital Elevation Model will be used if local terrain conditions around the stationary facility are complex. Once facility sites are defined for EIS purposes, consultation with NYSDEC will be undertaken to confirm the need to use complex terrain data in the modeling effort. AERMOD will be used in association with the same meteorological data described in Subchapter 3.1.5.2.

Given the type and expected elevation of emission sources within project facilities (mostly at or near ground level), a one-kilometer (1-km) radius receptor grid is large enough to capture the potential worst-case impacts at receptor locations beyond each facility. The receptor grid will be a combination of a polar grid and discrete receptors at sensitive locations within the 1-km radius. The following receptor groups will be used in the modeling:

- A total of 36 site boundary polar receptor locations to be placed at 10-degree intervals.
- A 10-degree interval polar grid with 100-meter spacing from 0-meter to 1-km radius. The origin of the grid will be at the center of each modeled facility.
- Additional discrete receptors at sensitive locations, such as residences, within the polar grid.

Modeled criteria pollutant concentrations will be compared to the applicable NAAQS by including the applicable monitored background concentrations. Additionally, the PM PSITs will also be used to evaluate potential significant impacts in the neighborhood of each studied new facilities based on the level of incremental change from no build to build condition.

4 CONSTRUCTION IMPACT ANALYSIS

According to NYSDOT's EPM, a project level transportation conformity determination will also be required for various aspects of project construction:

- A microscale CO impact analysis for detoured traffic if construction detours would last more than two CO seasons (two years) at a local level.
- A mesoscale NO_x, VOC, CO, and PM emission estimate for detoured traffic if construction detours/diversions would last more than five years in any one location.
- A project level PM emission estimate for construction activity associated with non-road construction equipment operations based on the final NYSDOT policy (September 2004).

4.1 Detour Traffic Air Quality Analysis

It is expected that I-287 main line traffic would be maintained under the proposed action but traffic disruption during the construction period at various locations, particularly at interchanges, would likely occur. It can be expected that detours/diversions at a specific location (e.g., an interchange) undergoing construction would last more than two CO (winter) seasons. It is assumed that the Maintenance and Protection of Traffic (MPT) data during the construction phase would be available during the EIS process in order to address CO impacts from detour. The EPM-established screening criteria (LOS, Capture Criteria and Volume Thresholds) (see Subchapter 3.2.1) will be used first at those potential detour traffic impacted intersections to determine whether a further microscale impact analysis is required at each applicable screened site.

For those intersections that fail the screening process, a CO microscale analysis will be further conducted in the same manner for evaluating operational CO conditions as discussed in Subchapter 3.2.2.

However, traffic detours/diversions are not expected to persist continuously for more than five years at any one site. Therefore, mesoscale emissions analyses as per the EAB's project-level conformity requirements for construction detour traffic are not required in the EIS.

4.2 Construction Equipment Air Quality Analysis

Annual non-road equipment PM emissions will be initially calculated using the NYSDOT-provided methodology. That methodology employs a simple ratio that relates annual NYSDOT

regional transportation construction emissions and annual NYSDOT regional transportation construction expenditure obtained from the NYSDOT Capital Program (currently covering 2004 through 2014), with the proposed project-level annual construction cost. If PM emissions predicated by this simple ratio approach were to exceed 15 tons per year (tpy) of either PM_{10} or $PM_{2.5}$, a more refined emission estimate will be generated using USEPA's NONROAD Model (April 2004). It is expected that such a refined emission analysis will be required for this project given the project construction scale.

In addition, non-road equipment emissions of other nonattainment criteria pollutants (CO, NO_x, and VOC) during the construction period will be identified on an annual basis in a similar way to that used for estimating PM emissions. These predicted annual emissions associated with construction equipment operational activities will be disclosed as part of the EIS.

The mitigation measures recommended in NYSDOT's policy to reduce construction emissions will be evaluated and developed through consultation with NYSDOT.

5 CONFORMITY DETERMINATION

In order to demonstrate the project-level compliance to the SIP, as per the Transportation Conformity Rule, a transportation conformity determination will be made in the EIS based on the results developed using the methodologies described in:

- Sections 3.1 and 3.2 for addressing microscale air quality impacts from operational activities.
- Sections 4.1 and 4.2 for addressing potential concerns related to construction activities.

Since the preferred alternative may not be determined during the DEIS process and each DEIS alternative may also have different regional air quality impacts, the inclusion of the project preferred alternative into the TIP would not occur during the DEIS process. However, the project team will work closely with NYMTC to ensure that NYMTC would appropriately model and include the project in a conforming TIP prior to the final design approval as part of the action in demonstrating the transportation conformity for the project.

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Appendix B

Noise Impact Analysis Protocol

Thruway Authority

New York State
Department of Transportation

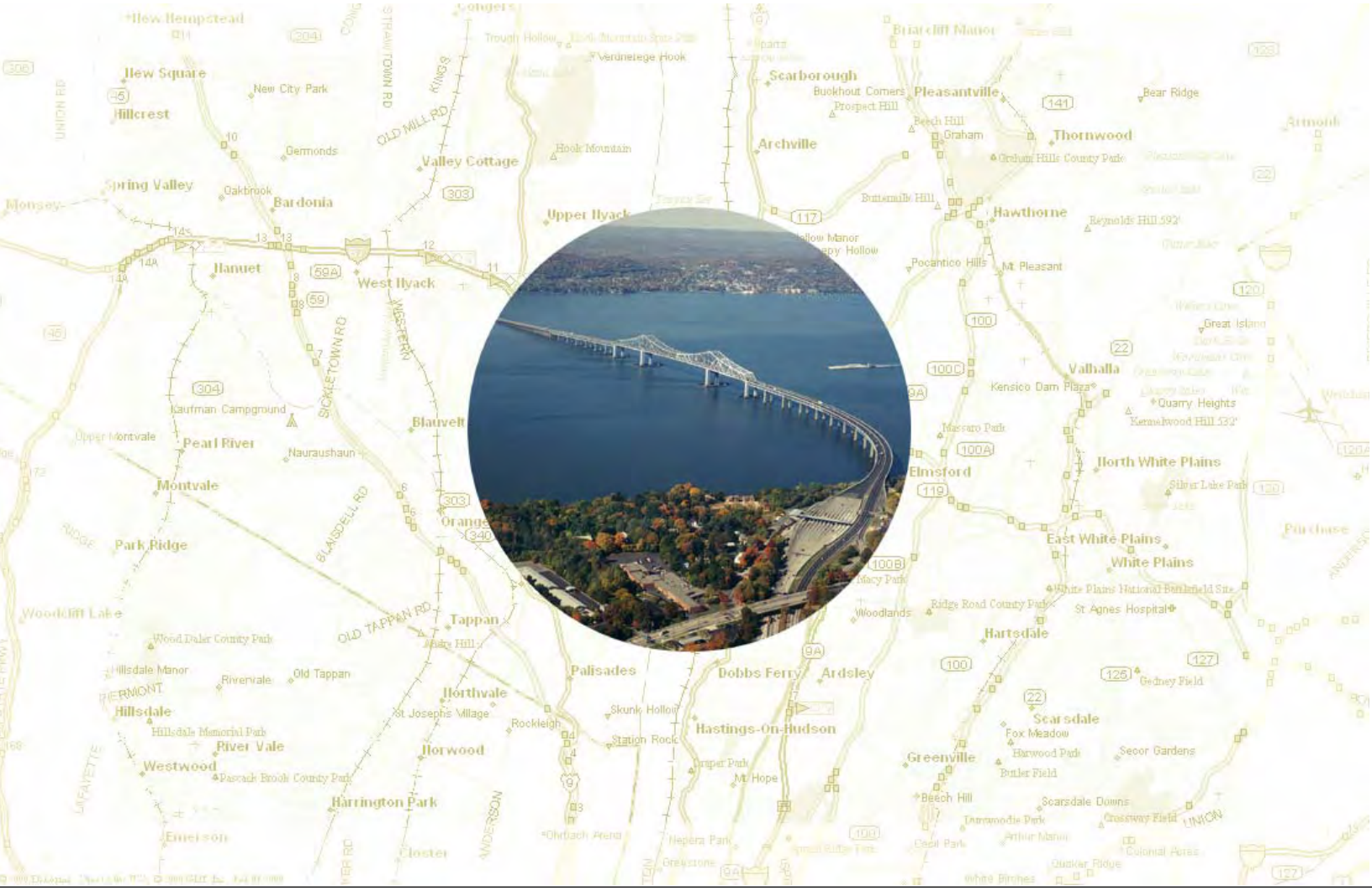
Metro-North
Railroad

TAPPAN ZEE BRIDGE/I-287
ENVIRONMENTAL REVIEW

Environmental Impact Statement for

Tappan Zee Bridge/I-287 Corridor

Noise Impact Analysis Protocol



January 4, 2007

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1 INTRODUCTION

This report presents the protocol for conducting noise analyses for the Tappan Zee Bridge/I-287 Corridor project being planned by the New York State Thruway Authority (NYSTA) and Metropolitan Transportation Authority/Metro-North Railroad (MTA/MNR). The project is now in its second stage during which an Environmental Impact Statement (EIS) will be prepared. The protocol presented here describes the noise measurement and analyses that will be conducted as part of the EIS.

1.1 Study Area

The Tappan Zee Bridge/I-287 Corridor extends from Suffern, Rockland County, NY to Port Chester, Westchester County, NY, a distance of approximately 30 miles (Figure 1-1). The corridor encompasses a critical section of the New York State Thruway and all of the Cross Westchester Expressway (CWE). It connects a number of major interstate highways including I-87 north to Albany, I-287 south to New Jersey, I-87 south to New York City, I-684 north to Connecticut, and both the north and south directions of I-95. The corridor provides a critical link in the national system of interstate and defense highways, as well as links to a number of key north-south and east-west regional routes.

The study area includes large portions of both Westchester and Rockland counties, including the cities and towns of Rye, Harrison, White Plains, Greenburgh, Elmsford, Tarrytown, Nyack, Nanuet, Spring Valley, and Suffern. Development patterns in the corridor are predominantly suburban, with intermixing commercial areas, business centers, vacant lands, and residential neighborhoods. The corridor passes through pockets of more dense urban development predominantly in the White Plains area.

1.2 Project Alternatives

The Alternative Analysis (AA) process culminated in the identification of six alternatives to be carried forward into the DEIS:

- Alternative 1 - No Build.
- Alternative 2 - Bridge Rehabilitation with TDM/TSM Measures.
- Alternative 3 – Full Corridor BRT and Highway Improvements in Rockland.
- Alternative 4A – Full Corridor CRT and Highway Improvements in Rockland.
- Alternative 4B – Manhattan-Bound CRT with LRT in Westchester County and Highway Improvements in Rockland.

Figure 1-1 Study Corridor

- Alternative 4C – Manhattan-Bound CRT with BRT in Westchester County and Highway Improvements in Rockland.

1.2.1 Alternative 1 - No Build

As per NEPA and SEQRA requirements, a No Build Alternative will be analyzed in the EIS. The potential impacts of this alternative were identified in the No Build Scenario studied in the Alternative Analysis (AA), which was created to establish the baseline against which to measure the impacts of the other scenarios. However, it was determined that the No Build Scenario would not meet the goals and objectives established for the study. One of the key findings of the AA was that both highway and transit improvements were necessary to improve mobility in the corridor. The key components of Alternative 1 (Figure 1-2) include:

- Maintenance of the bridge structure and highway to avoid unacceptable levels of deterioration that would lead to operational and safety deficiencies.

- Projects in the Transportation Improvement Program (TIP) (FY 2004-2006).

1.2.2 Alternative 2 - Bridge Rehabilitation with TDM/TSM Measures

Rehabilitation of the Tappan Zee Bridge was studied the AA. The bridge would be retained and structurally rehabilitated to provide an additional 50 to 100 years of reliable service. The rehabilitation would include the retrofit measures necessary to bring the bridge into compliance with the current seismic criteria, as befits a lifeline structure.

Traffic Demand Management/Transportation System Management (TDM/TSM) measures were also studied in the AA. However, it was concluded that the combination of TDM/TSM measures, ramp metering and congestion pricing would not be effective in meeting corridor needs as a stand alone option, but together with major capital investments would offer benefits worthy of further consideration. These relatively low-cost strategies will be advanced as part of a package of improvements in all of the DEIS build alternatives.

The key components of Alternative 2 (Figure 1-3) include:

- **Projects in the TIP** (FY 2004-2006).

- **Highway/Bridge** - Rehabilitation of the highway and seismic retrofit of the bridge.

- **Transit** – Proposed transit improvements in the 2025 Metro-North and New Jersey Transit Capital Investment Schedule for West of Hudson.

- **TDM/TSM Measures –** Including I-287 park & ride facilities, three-lane high-speed toll plaza, expanded weekend E-ZPass program, ramp metering, congestion pricing, and others.

1.2.3 Alternative 3 – Full Corridor BRT and Highway Improvements in Rockland

The key components of Alternative 3 (Figure 1-4) are:

- **Highway** – six general purpose lanes, two HOT lanes, westbound climbing lane from a replacement Tappan Zee Bridge to Interchange 14A, and new eastbound climbing lane from Interchange 12 to 11 (which connects to the existing eastbound fourth lane) in Rockland County.

- **Transit** – BRT from Suffern to Port Chester with transfer in Tarrytown. Buses would use HOT lanes in Rockland County and a barrier-separated facility (exclusive busway) in portions of Westchester County (alongside I-87/I-287) and exclusive bus lanes on Route 119 in Tarrytown and White Plains. (It should be noted that bus origins/destinations include locations both west of Suffern and east of Port Chester.) Service connections would be possible to the Port Jervis, Pascack Valley, Harlem, and New Haven Lines.

- **TDM/TSM Measures –** Same as Alternative 2**.**

- **River Crossing –** New bridge with two HOT lanes and eight general purpose lanes. The bridge would also potentially include amenities such as a full-length pedestrian/bicycle path linking Rockland and Westchester, belvederes (periodic widenings) for viewing and respite along the pathway, and designated recreation areas (e.g., for fishing and picnicking).

1.2.4 Alternative 4A – Full Corridor CRT and Highway Improvements in Rockland

The key components of Alternative 4A (Figure 1-5) are:

- **Highway –** Same as Alternative 3.

- **Transit** – CRT from Suffern to Port Chester with a direct connection to the Hudson Line in Tarrytown for one-seat ride to Manhattan. New Tarrytown South station below the existing toll plaza for both Manhattan and I-287 commuter rail

services. Connections would be possible to the Port Jervis (direct), Pascack Valley (transfer), Harlem (transfer), and New Haven Lines (direct).

- **TDM/TSM Measures** – Same as Alternative 2.

- **River Crossing -** New bridge with two HOT lanes, eight general purpose lanes, and two rail tracks. The bridge would also potentially include amenities such as a full-length pedestrian/bicycle path linking Rockland and Westchester, belvederes (periodic widenings) for viewing and respite along the pathway, and designated recreation areas (e.g., for fishing and picnicking).

1.2.5 Alternative 4B – Manhattan-Bound CRT with LRT in Westchester County and Highway Improvements in Rockland

The key components of Alternative 4B (Figure 1-6) are:

- **Highway -** Same as Alternative 3.

- **Transit –** CRT from Suffern to Tarrytown and LRT from the existing Hudson Line Tarrytown station to Port Chester. Manhattan-bound CRT would start in Suffern and connect to the Hudson Line as in Alternative 4A. There would be a new transfer facility (Tarrytown South) for LRT service near the existing bridge toll plaza.

  The LRT service would start at Tarrytown (allowing transfer to/from the existing Hudson Line) and follow a hybrid high-speed/in-street LRT alignment. The In-Street alignment would be used on Route 119 and through White Plains. The high-speed alignment along I-287 would be used in a portion of Greenburgh and for the connection to Port Chester Station (i.e., avoiding use of Route 120A). Future commuter rail service across the I-287 corridor would not be precluded. Service connections would be possible to the Port Jervis, Pascack Valley, Harlem, and New Haven Lines.

- **TDM/TSM Measures –** Same as Alternative 2.

- **River Crossing -** New bridge with two HOT lanes, eight general purpose lanes, and two rail tracks. The bridge would also potentially include amenities such as a full-length pedestrian/bicycle path linking Rockland and Westchester, belvederes (periodic widenings) for viewing and respite along the pathway, and designated recreation areas (e.g., for fishing and picnicking).

1.2.6 Alternative 4C – Manhattan-Bound CRT with BRT in Westchester County and Highway Improvements in Rockland

The key components of Alternative 4C (Figure 1-7) are:

- **Highway –** Same as Alternative 3.

- **Transit -** CRT from Suffern to Tarrytown and BRT from the existing Hudson Line Tarrytown station to Port Chester. Manhattan-bound CRT would start in Suffern and connect to the Hudson Line as in Alternative 4A. There would be a new transfer facility (Tarrytown South) for BRT service near the existing bridge toll plaza.

  The BRT service would start at Tarrytown (allowing transfer to/from the existing Hudson Line) and would follow with a barrier-separated facility (exclusive busway) in portions of Westchester County (alongside I-87/I-287) and exclusive bus lanes on Route 119 in Tarrytown and White Plains. Future commuter rail service across the I-287 corridor would not be precluded. Service connections would be possible to the Port Jervis, Pascack Valley, Harlem, and New Haven Lines.

- **TDM/TSM Measures** – Same as Alternative 2.

- **River Crossing** – New bridge with two HOT lanes, eight general purpose lanes, and two rail tracks. The bridge would also potentially include amenities such as a full-length pedestrian/bicycle path linking Rockland and Westchester, belvederes (periodic widenings) for viewing and respite along the pathway, and designated recreation areas (e.g., for fishing and picnicking).

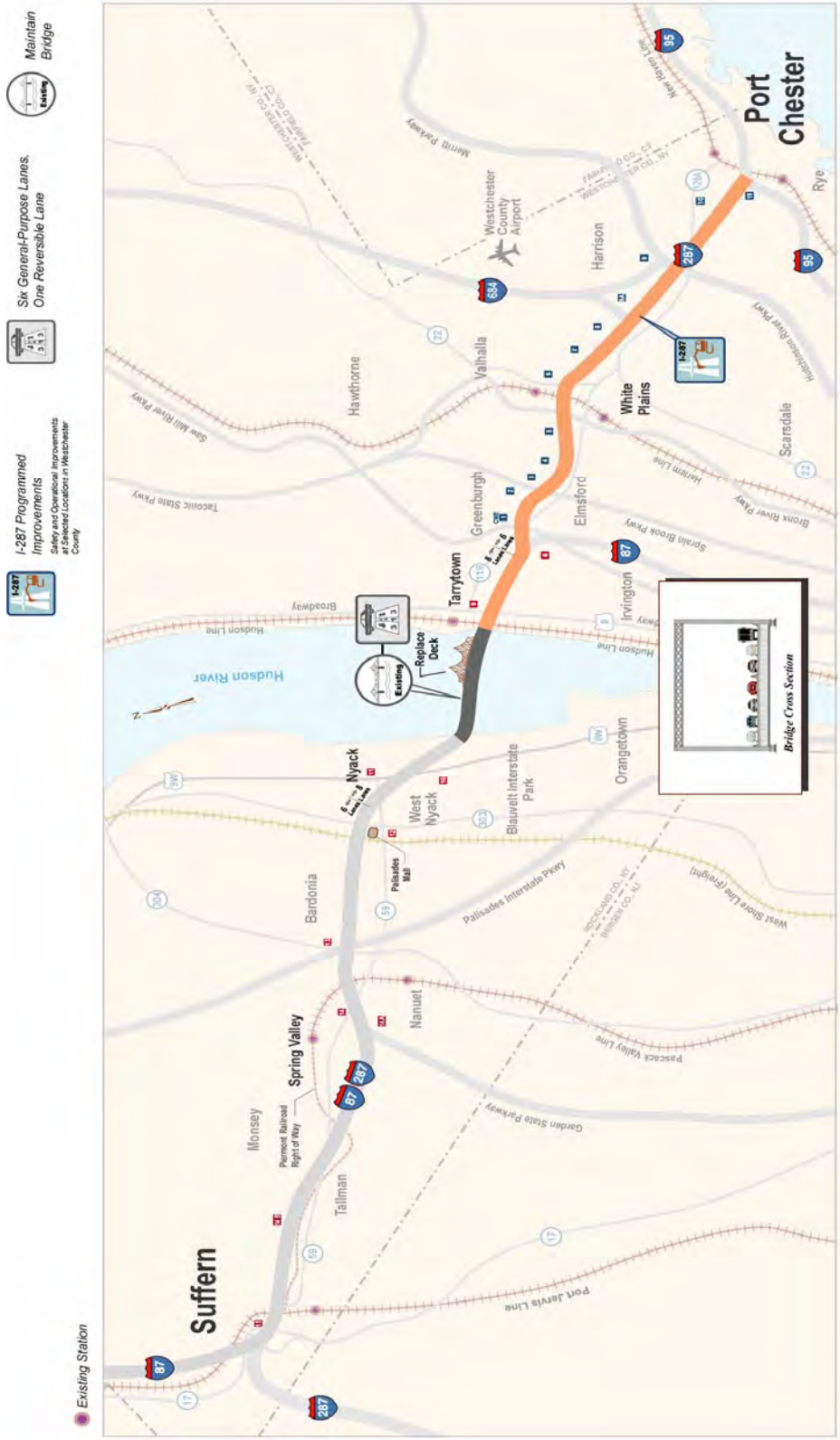


Figure 1-2
Alternative 1 - No Build

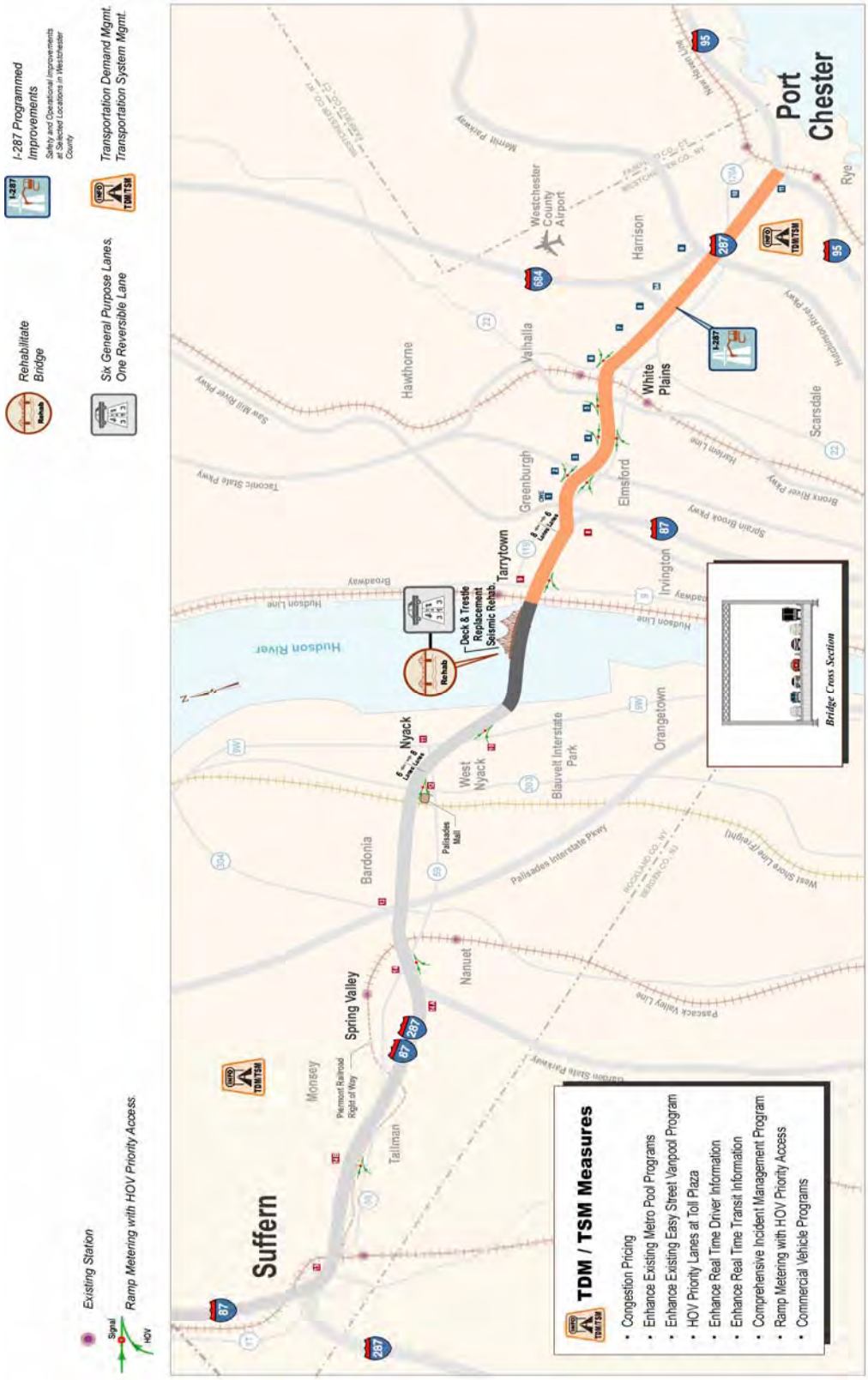


Figure 1-3
Alternative 2 - Rehabilitate Tappan Zee Bridge with TDM/TSM Measures

Figure 1-4
Alternative 3 - Full Corridor BRT

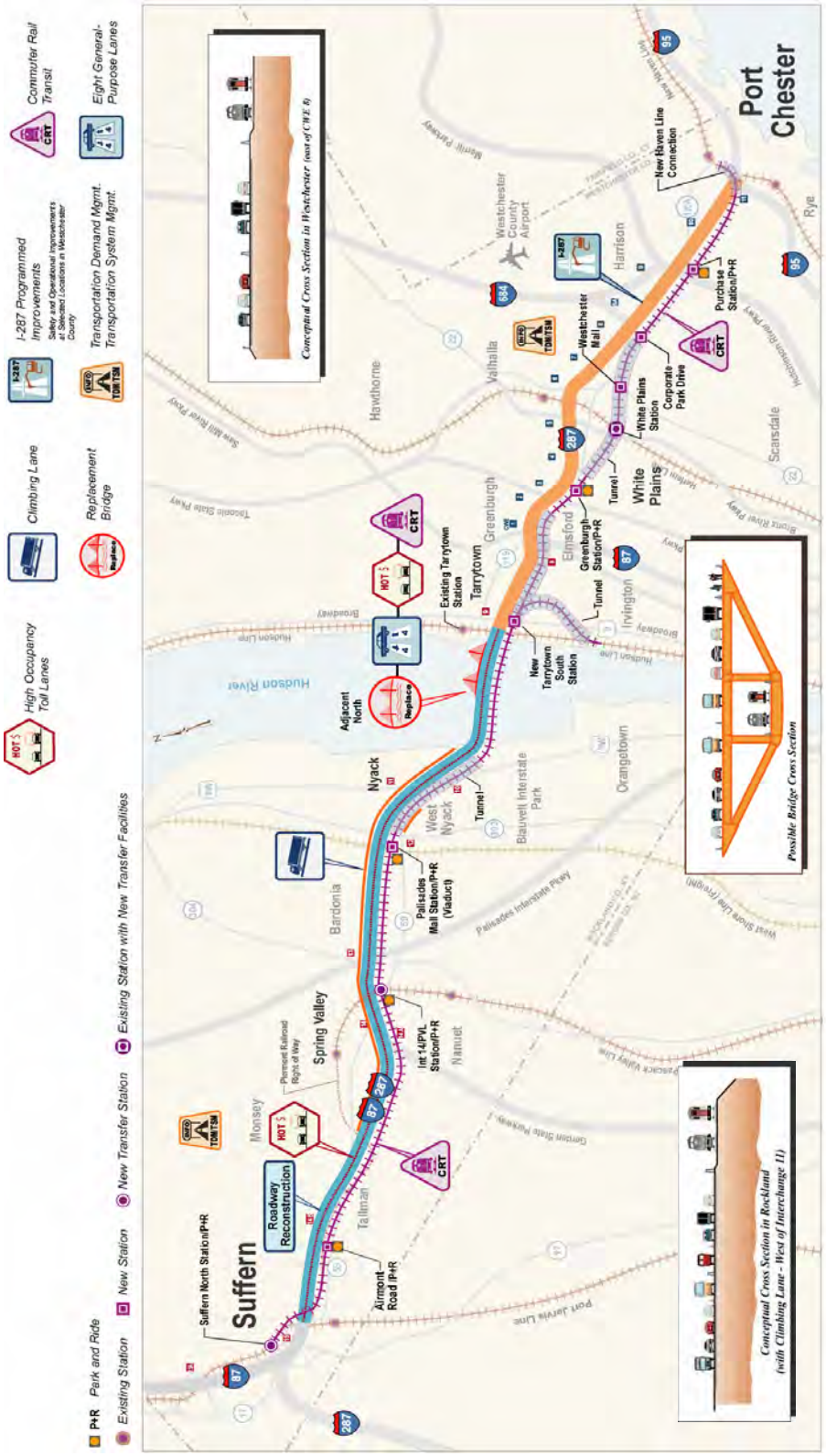


Figure 1-5
Alternative 4A - Full Corridor CRT

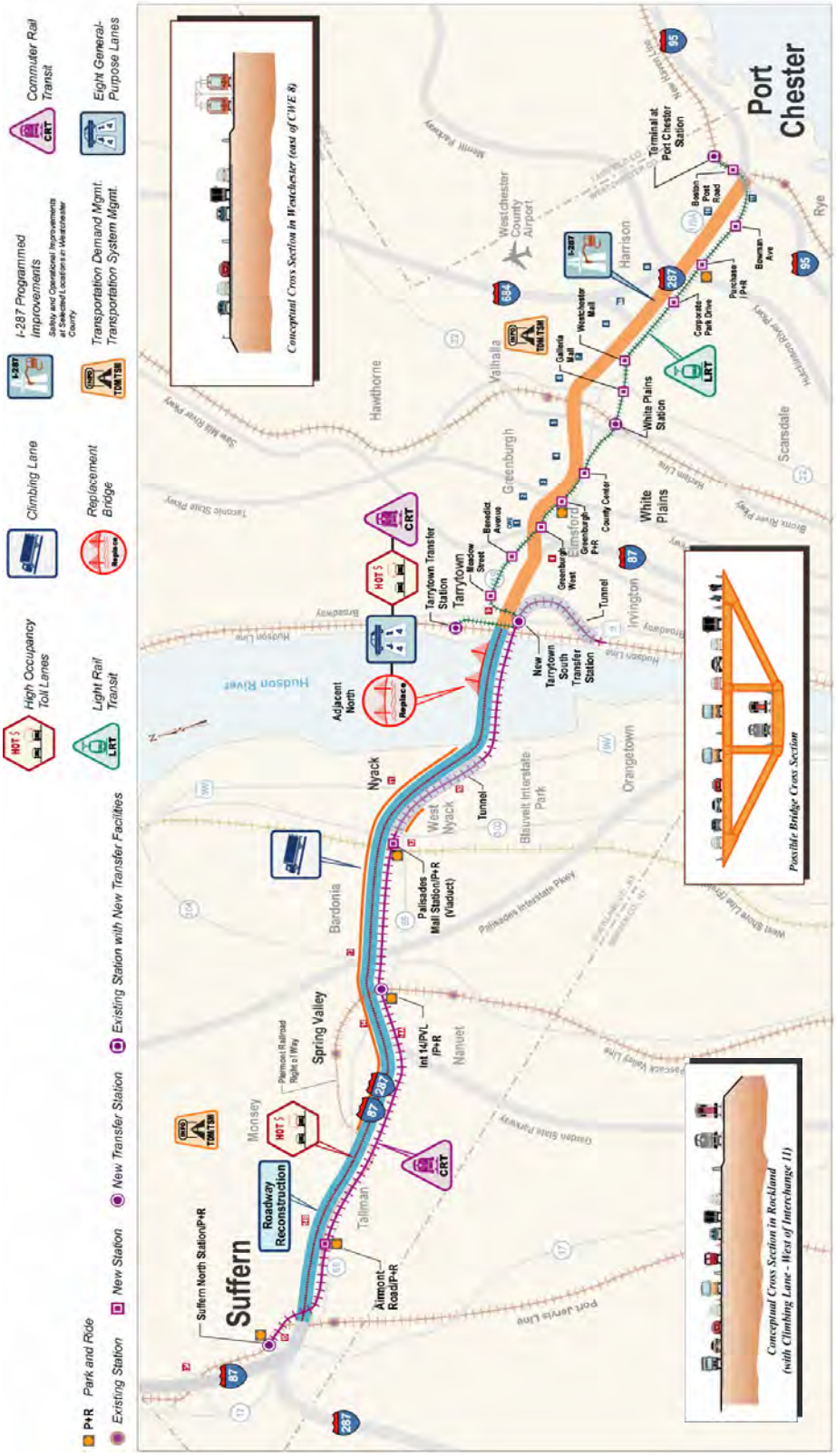


Figure 1-6
Alternative 4B - Manhattan-Bound CRT with LRT in Westchester County

Figure 1-7

Alternative 4C - Manhattan-Bound CRT with BRT in Westchester County

1.3 Purpose of the Protocol

An analysis of expected noise impacts generated during construction and operation of project alternatives will be presented in the EIS. The EIS analysis will focus on the following sources of project-induced noise impacts:

- Potential traffic noise impacts along the I-287 corridor in Rockland and Westchester counties due to changes in highway traffic volume, speed, and classification along the study corridor.
- Potential transit noise and vibration impacts along rail lines in Westchester and Rockland Counties due to the proposed transit alternatives.
- Potential noise and vibration impacts from operation of equipment during the construction period.

This protocol has been prepared to describe the New York State Department of Transportation (NYSDOT) and Federal Transit Administration (FTA) procedures that will be implemented to assess project related noise impacts focusing on the following:

- Appropriate noise metrics.
- Procedures, assumptions, and methodologies to be used for the analyses.
- The framework for addressing potential noise issues that will be carried through the DEIS process.

2 REGULATORY REQUIREMENTS

2.1 Regulations

The Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) have prescribed the policies and procedures in 23 CFR 771 for implementing the National Environmental Policy Act (NEPA). 23 CFR 771 sets forth all FHWA, FTA and DOT requirements under NEPA for the processing of highway and urban mass transportation projects.

According to 23 CFR 771, the proposed action falls into the Class I action category that requires an EIS and normally involves actions such as:

- A new controlled access freeway.
- A highway project of four or more lanes on a new location.
- New construction or extension of fixed rail transit facilities (e.g., rapid rail, light rail, commuter rail, automated guideway transit).
- New construction or extension of a separated roadway for buses or high occupancy vehicles not located within an existing highway facility.

2.1.1 Noise

A number of standards and guidelines have been adopted by federal and state agencies for assessing noise impacts as part of the requirements established in 23 CFR 771 described above. These regulations and standards are useful to review in that they provide both a characterization of the quality of the existing noise environment as well as a measure of project-induced impacts.

2.1.1.1 Federal Highway Administration Highway Noise Regulation (23 CFR 772)

The FHWA has developed noise regulation and guidelines that are applicable to the evaluation of federal-aid highway projects. The agency's regulation is found at 23 CFR 772 and their guidance is contained in *Procedures for Abatement of Highway Traffic Noise and Construction Noise* (FHWA, June 1995). The FHWA procedures specify the requirements that federal and state highway agencies must meet when using federal aid funds for highway projects. These procedures include:

- Identification of land uses or activities that may be affected by traffic noise under project operation.
- Measurement of existing community noise levels.
- Prediction of traffic noise for the no build and build alternatives.
- Examination and evaluation of noise abatement measures to reduce or eliminate noise impacts.
- An analysis of noise associated with project construction.

FHWA has developed criteria for the noise levels at which consideration of abatement measures is required (Table 2-1). The noise abatement criteria (NAC) are related to the potentially impacted land use types indicated in Table 2-1. For the I-287 corridor, Category B, which includes residences, parks and churches, represents a typical land use type that would be given particular attention in the EIS.

Table 2-1
FHWA Noise Abatement Criteria

Activity Category	L_{eq}(h)	Description of Activity Category
A	57 (exterior)	Land for which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (exterior)	Developed lands, properties or activities not included in Categories A or B above.
D	---	Undeveloped lands.
E	52 (interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Note: The L_{eq} designations represent hourly A-weighted sound levels expressed in decibels (dBA).
Source: US Department of Transportation, FHWA, 1995.

If the EIS noise analysis indicates a traffic noise impact would occur when the predicted traffic noise level approaches or exceeds the NAC or a substantial noise increase over existing levels occurs, feasible and reasonable abatement measures will be considered.

23 CFR 772 specifies abatement measures that must be considered to reduce or eliminate noise impacts from the proposed action. These measures will be considered where traffic noise impacts are identified, including:

- Traffic management.
- Alteration of roadway geometry.
- Noise barriers construction.
- Buffer zone.
- Noise insulation of publicly owned schools.

The decision as to whether to implement any or a combination of such measures will depend on 1) their acoustical effectiveness, 2) feasibility of implementation, and 3) reasonability of implementing the measure(s) including cost benefit, community concurrence, and other factors.

It should be noted that these criteria are generally applicable to a Type I noise project, such as the proposed action. Type I projects have been defined in 23 CFR 772.5(h) as a federal or federal-aid highway project for:

- Construction of a highway on a new location.
- Physical alteration of an existing highway that significantly changes either the horizontal or vertical alignment.
- Increasing the number of through-traffic lanes.

2.1.1.2 New York State Department of Transportation Noise Policy

The NYSDOT has adopted the FHWA's regulation and developed a traffic noise analysis policy (NYSDOT, August 1998) that describes applicability, sets criteria for noise impact, defines traffic noise analysis procedures and designates abatement measures.

Traffic Noise Impact Criteria

This project will utilize NYSDOT's definition of noise impact for a Type I highway project, defined if either of the following two conditions occurs:

- Predicted L_{eq} (1) noise levels approach or exceed the NAC provided in Table 2-1. Noise levels that approach the criteria are defined as occurring at 1 dBA less than the applicable criteria (e.g., 66 dBA for Category B land use and 71 for Category C land use).

- A substantial increase in predicted noise levels over existing noise levels occurs. An increase of 6 dBA L_{eq} (1) or more in noise levels is considered a substantial noise increase.

Noise Abatement Barrier Effectiveness Criteria

When a noise barrier abatement analysis is required because of the predicted traffic impacts, the acoustical effectiveness as well as cost effectiveness of all noise barriers should be evaluated further based on the following criteria:

- A noise barrier is considered acoustically effective if it achieves a substantial reduction (10 dBA or greater) at an impacted receptor. The barrier is not considered acoustically effective and a reasonable option if it provides a maximum insertion loss that is less than 7 dBA at an impacted receptor.

- A benefited property is defined as one where a minimum 5-dBA noise reduction occurs at a point where there is frequent human use regardless of whether or not

the property is identified initially as impacted. A noise barrier would not be cost effective if the cost exceeds the applicable cost index below:

- $50,000 per benefited property for a unit barrier cost of $200 per square meter ($m^2$) or greater.

2.1.1.3 Federal Transit Administration Noise Regulations

Transit and Highway Integrated

The FTA has defined several noise metrics and developed a series of noise assessment procedures that are applicable to transit projects. However, FTA noise assessment guidance (April 1995) indicates that:

> *When mass transit projects are integrated with modified or newly-constructed highways (e.g., exclusive bus/HOV lanes constructed within or alongside a highway), noise impact should be determined using existing FHWA assessment procedures and noise abatement guidelines.*

Since proposed mass transit alignments would be mostly integrated with the I-87/I-287 main corridor under various alternatives, combined noise effects would result from both transit and highway traffic. Thus, the FHWA-established noise analysis procedures and criteria will be applicable to such transit components of the EIS analysis.

Transit Alone

However, proposed transit alignments under certain alternatives (or segments thereof) are expected to occur in several areas where there is no highway traffic noise component. In such cases, transit is the only noise source with potential effects and, therefore, the FTA's noise analysis procedures and criteria will be applicable. Possible areas include:

- Tarrytown area between Tarrytown Station and proposed new Tappan Zee Station.
- Hudson Line south of Lyndhurst.
- White Plains area with potential new transit alignment.
- Suffern area with potential extended new transit line.

Table 2-2 summarizes the applicable noise metrics for each corresponding land use type. Figure 2-1 illustrates noise impact thresholds established for transit-related noise.

Table 2-2
FTA Land Use Categories and Metrics for Transit Noise Impact Criteria

Land Use Category	Noise Metric (dBA)	Description of Activity Category
1	Outdoor L_{eq} (1)	Tracts of land where quiet is an essential element in their intended purpose. This category includes tracts of land set aside for serenity and quiet and such land uses as outdoor concert pavilions, as well as National Historic Landmarks with significant outdoor use.
2	Outdoor L_{dn}	Residences and buildings where people normally sleep. This category includes homes, hotels and hospitals where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor L_{eq} (1)	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, churches, and active parks where it is important to avoid interference with such activities as speech, meditation, and concentration on reading materials. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios, and concert halls fall into this category. Places for meditation or study associated with cemeteries, monuments, museums. Certain historical sites, parks, and recreational facilities are also included in this category.

Note: The L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity.
Source: US Department of Transportation, FTA, April 1995.

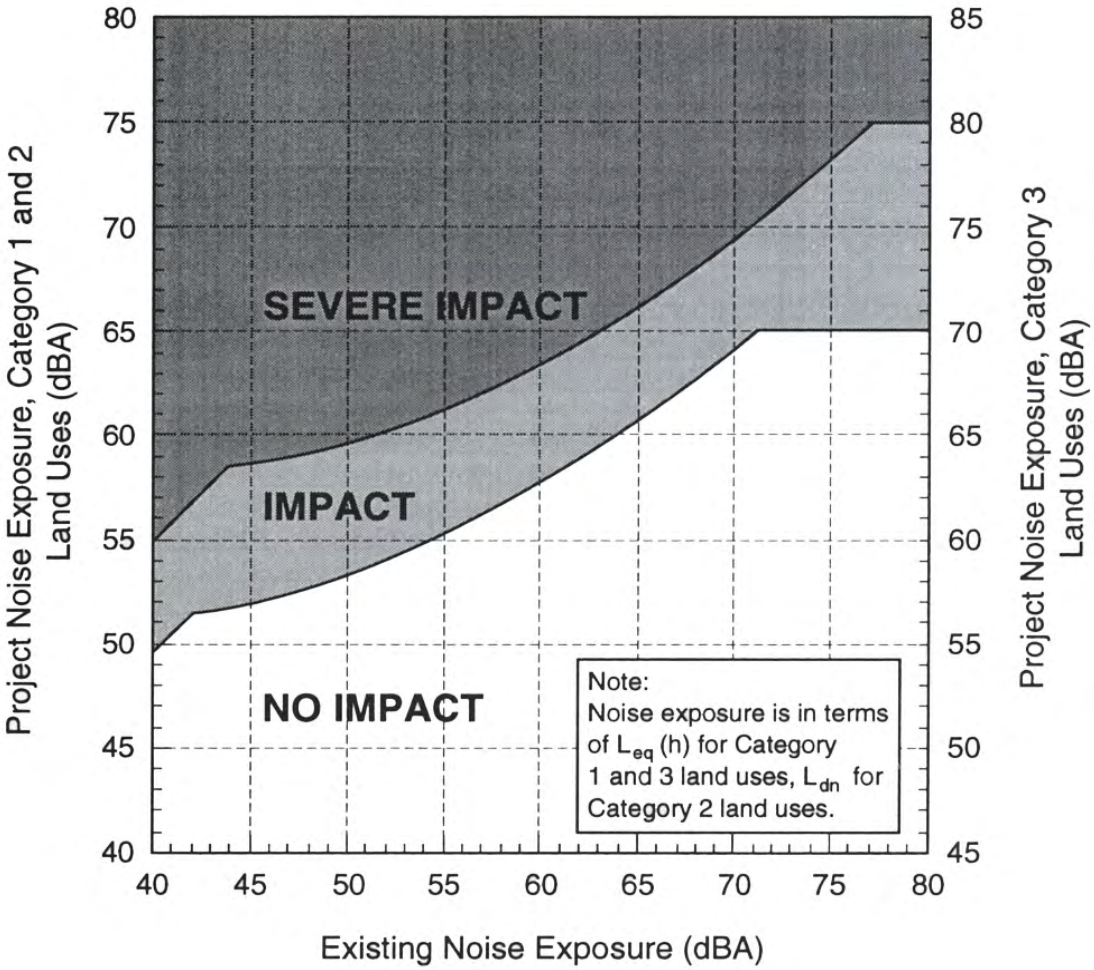


Figure 2-1

Noise Impact Criteria for Transit Projects

Construction Activities

The FTA has developed criteria (Table 2-3) for assessing construction equipment-generated noise levels based on land use type.

Table 2-3
FTA Construction Noise Impact Criteria

Land Use	$L_{eq}(1)$ in dBA	
	Daytime	Nighttime
Residential	90	80
Commercial	100	100
Industrial	100	100

2.1.1.4 New York State Department of Environmental Conservation Noise Program Policy

The New York State Department of Environmental Conservation (NYSDEC) issued a program policy, DEP-00-1 "Assessing and Mitigating Noise Impacts", for facilities undergoing State Environmental Quality Review Act (SEQRA) processes for NYSDEC permits (2000). The policy document provides guidelines for evaluating noise from stationary facility operations (including both stationary and mobile equipment) and their potential impact on adjacent incompatible land uses. The document recommends that an increase of 6 dBA or more be judged as significant. However, it should be noted that this policy is applicable to stationary facilities and is not applicable to a highway or a transit project.

2.1.2 Ground-borne Vibration

The FTA vibration guideline applicable for both mass transit operations and construction equipment operations is based on the maximum vibration levels by land use categories (Table 2-4). The criteria for vibration are expressed in terms of RMS velocity levels in decibels (VdB) referenced to 10^{-6} inch per second. The guideline limits are expressed for the three land-use categories defined in Table 2-4.

Table 2-4
FTA Ground-borne Vibration Impact Criteria

Land Use Category	Vibration Impact Levels (VdB re 1 micro inch/sec)	
	Frequent Events[1]	Infrequent Events[2]
Category 1: Buildings where low ambient vibration is essential for interior operations	65 VdB[3]	65 VdB[3]
Category 2: Residents and buildings where people normally sleep	72 VdB	80 VdB
Category 3: Institutional land uses with primarily daytime use	75 VdB	83 VdB

[1] "Frequent Events" is defined as more than 70 vibration events per day. Most rapid transit projects fall into this category.

[2] "Infrequent Events" is defined as fewer than 70 vibration events per day. This category includes most commuter rail systems.

[3] This criterion limit is based on levels that are acceptable for most moderately sensitive equipment, such as optical microscopes. Vibration-sensitive manufacturing or research will require detailed evaluation to define acceptable vibration levels.

2.1.3 Summary

Based on the review presented above of agency regulations and guidelines for conducting noise analysis, the following analyses will be presented in the EIS:

- Highway traffic (including construction detour traffic) noise impact analyses.
- Transit (including stationary facilities) noise and vibration impact analyses.
- Construction equipment noise and vibration impact analysis.

The sections that follow present detailed protocols for conducting the EIS noise analysis.

2.2 Noise and Vibration Metrics

2.2.1 Noise

Two noise metrics will be used in the EIS analyses:

- L_{eq}, which is the constant sound level that, in a given situation and time period {e.g., one-hour L_{eq} [$L_{eq}(1)$], or 24-hour L_{eq} [$L_{eq}(24)$]}, conveys the same sound energy as the actual time-varying sound. The $L_{eq}(1)$ descriptor has been identified by the FHWA and FTA as one of the most appropriate criteria for estimating the degree of speech interference, or annoyance that increased noise levels from both highway and rail traffic would cause in the neighborhoods.

- In determining $L_{eq}(1)$ from transit operations, Sound Exposure Level (SEL) is also used. The SEL is normally used to evaluate event noise level assuming all the energy of the noise-generating event is compressed into a one-second time duration.

- L_{dn}, defined as the sound level in decibels during a 24-hour period with a 10-dB weighting applied to nighttime sound levels [i.e., increasing 10 decibels to each nighttime (10pm to 7am) $L_{eq}(1)$ before 24-hour totaling], is often used to account for the difference in response of people in residential areas to noises that occur during sleeping hours as compared to waking hours. The L_{dn} descriptor has been recommended by various federal agencies including the FTA as one of the appropriate criteria for estimating the degree of annoyance that increased noise levels would cause in residential neighborhoods.

2.2.2 Ground-borne Vibration

In addition to the airborne noise described above, ground-borne noise (vibration) can be of concerns from rail and rapid transit systems. Ground-borne vibration results primarily from the wheel-rail interaction and is influenced by such factors as wheel and rail roughness, truck dynamic characteristics, rail support stiffness, transit structure design, soil characteristics, and building structure (receptor) design. In general, ground-borne vibration originates from the wheel-rail interface, passes through the rail and rail fasteners, and into the rail (e.g., ballasted track, elevated track, etc.) structure, which radiates vibration energy into the soil. The face of the nearest foundation or underground building wall responds to the incident ground-borne vibration and propagates the waves throughout the building. The resulting ground-borne vibration is a function of the magnitude of the energy source, distance from the source, response blasting specific characteristics of the transmitting media (rock/soil), and response characteristics of the structural element (building).

Vibration consists of rapidly fluctuating motions with an average motion of zero. There are several different methods that are used to quantify vibration amplitude. One method uses the peak particle velocity (PPV) in inches per second (in/sec) to describe the maximum instantaneous positive or negative peak of the vibration signal. PPV is often used in measurement of blasting vibration since it is related to the stresses that are experienced by buildings. However, such a measure is not suitable for evaluating human responses. It takes a longer time interval for humans to respond to a vibration signal and therefore the average vibration amplitude is more appropriate for assessing human response. Because the net average of a vibration signal is zero, the Root Mean Square (RMS) amplitude is used to describe the "smoothed" average vibration amplitude.

The FTA guideline specifies RMS velocity in the metric of VdB (Velocity Level in Decibel) defined as:

$$VdB = 20 \log_{10} \left(\frac{v}{v_o} \right)$$

where:

v is the vibration velocity in in/sec.
v_o is the reference velocity at 10^{-8} inch/sec.

3 HIGHWAY TRAFFIC NOISE ANALYSES

The principal steps in the highway traffic noise impact analyses are as follows:

- Conduct of land use surveys within the corridor to determine land use criteria in selecting existing noise measurement locations.
- Measurement of existing noise levels to establish sufficient baseline data for noise model to be developed in agreement with measurements.
- Prediction of existing noise levels throughout the corridor.
- Development of existing noise contours.
- Prediction of future noise levels and contours for each project alternative.
- Determination of traffic impacts based on FHWA and NYSDOT impact criteria.
- Evaluation of abatement measures as applicable.

3.1 Existing Noise Conditions

3.1.1 Identification of Land Use

Potentially affected areas mainly include Category B land uses (such as residences, parks, churches, schools, hotels, etc.), Category C land uses (such as developed lands for industrial and commercial uses), and some Category D land uses (i.e., undeveloped lands that will be delineated but not subject to a noise analysis) on either side of I-287 within Rockland and Westchester Counties. Also, additional areas may be of noise concern, depending on the proposed transit alignments, and will also need to be surveyed. In order to identify land uses immediately adjacent to the corridor, a walkover survey will be conducted primarily within 500 feet (ft) of I-287. During the survey, the following information will be collected:

- Land use type.
- Topographical conditions at developed land uses adjacent to the corridor.
- Existing noise barrier conditions including locations and dimensions.
- Candidate existing noise measurement locations.

3.1.2 Selection of Noise Measurement Sites and Existing Noise Measurements

3.1.2.1 24-hour Sites

Since traffic noise is greater when traffic volume or speed increases, the worst hourly noise condition will be determined from changes in both traffic parameters. However, for a congested highway such as I-287, traffic noise may increase with greater volume but decrease with lower,

congestion-induced speeds. Therefore, the hour with peak traffic volume may not be the hour with highest noise levels. Consequently, for noise impact analysis, it is important to determine the critical analysis hour(s) [the hour(s) with the worst noise condition] prior to initiating detailed short-term measurement.

In order to determine the 24-hour highway noise profile [and therefore, the hour(s) with highest noise levels] along the corridor, measurement sites need to be selected where corridor traffic volume, speed and classification are potentially affected by changes in traffic through the connection to those major interchanges with other highways, such as the interchange traffic from Garden State Parkway, etc. A total of eight (8) sites were selected (Figures 3-1 through 3-4) for 24-hour noise measurement at representative noise locations between:

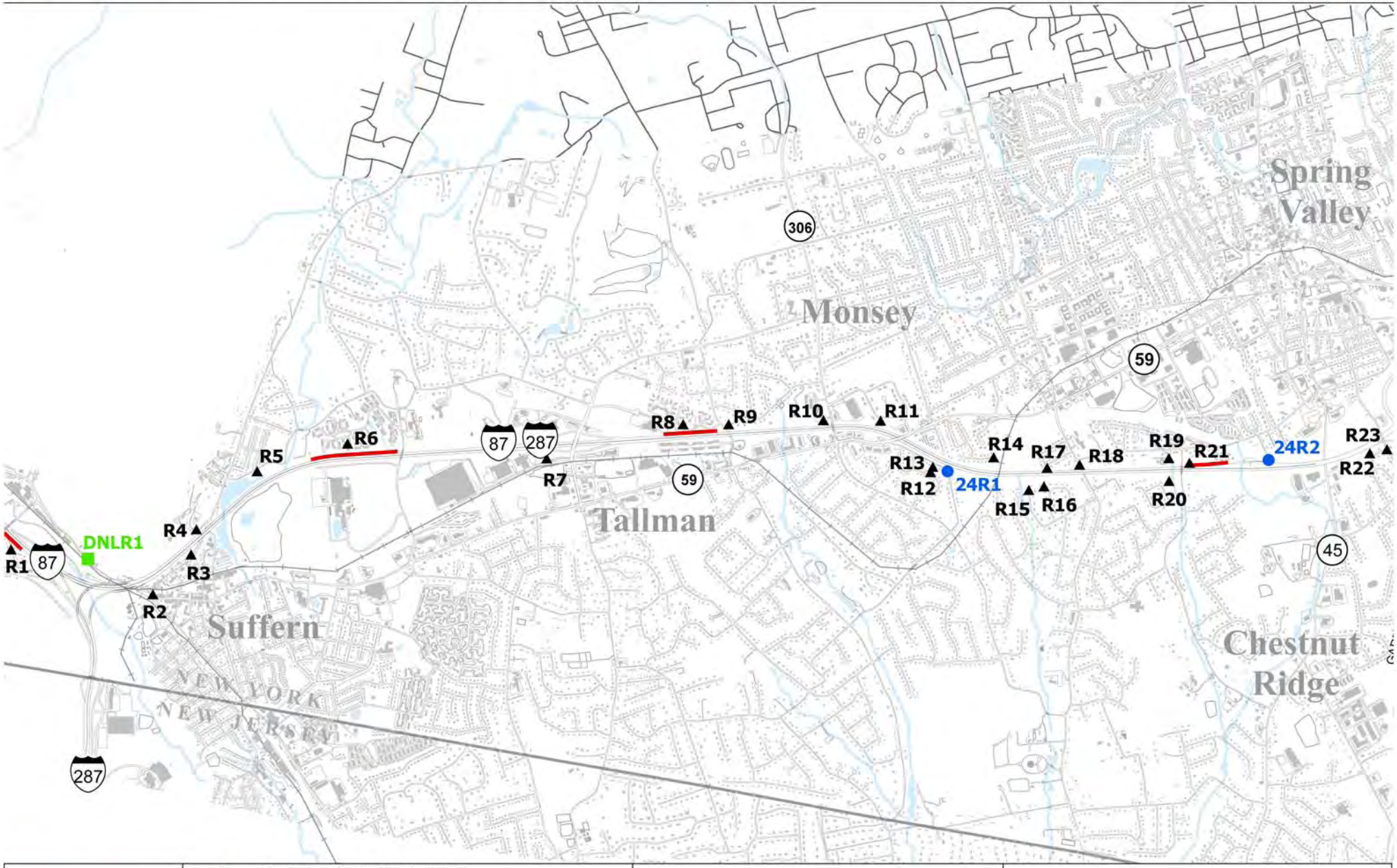
- Suffern and Garden State Parkway with two sites.
- Palisades Interstate Parkway and Route 9W (Exit 10).
- Exit 10 and Tappan Zee Bridge.
- Tappan Zee Bridge and Sprain Brook State Parkway.
- Sprain Brook State Parkway and Hutchinson Parkway with two sites.
- Hutchinson Parkway and Port Chester.

In order to determine the existing 24-hour L_{dn} conditions at those areas with potential new transit alignments alone, for purposes of analyzing transit noise impacts in those areas, an additional four (4) 24-hour L_{dn} measurement sites (Figures 3-1 through 3-4) were selected within the following areas:

- Suffern where new CRT alignment would be constructed on east side of the main corridor.
- Tarrytown Station.
- Hudson Line south of Lyndhurst.
- White Plains where new BRT/LRT alignment would merge with the main corridor (specific site location will be determined when the refined alignment is established during the EIS process).

These 24-hour L_{dn} sites will be used to evaluate transit noise effects on residential land uses from potential new transit alignments using FTA noise assessment criteria based on the L_{dn} metric. Since the new CRT alignment in the southern Tarrytown area in Westchester County would be constructed within a tunnel, which would shield CRT noise, no L_{dn} measurement sites are selected along the alignment within the tunnel for the CRT component in this area. The list of selected sites is summarized in Table 3-1.

Thruway Authority | New York State Department of Transportation | Metro-North Railroad



EarthTech
A tyco International Ltd. Company

- ▲ Peak-Hour Noise Monitoring Site
- ● 24-Hour Traffic Noise Monitoring Site
- ■ 24-Hour Ldn Noise Monitoring Site
- Existing Noise Barrier

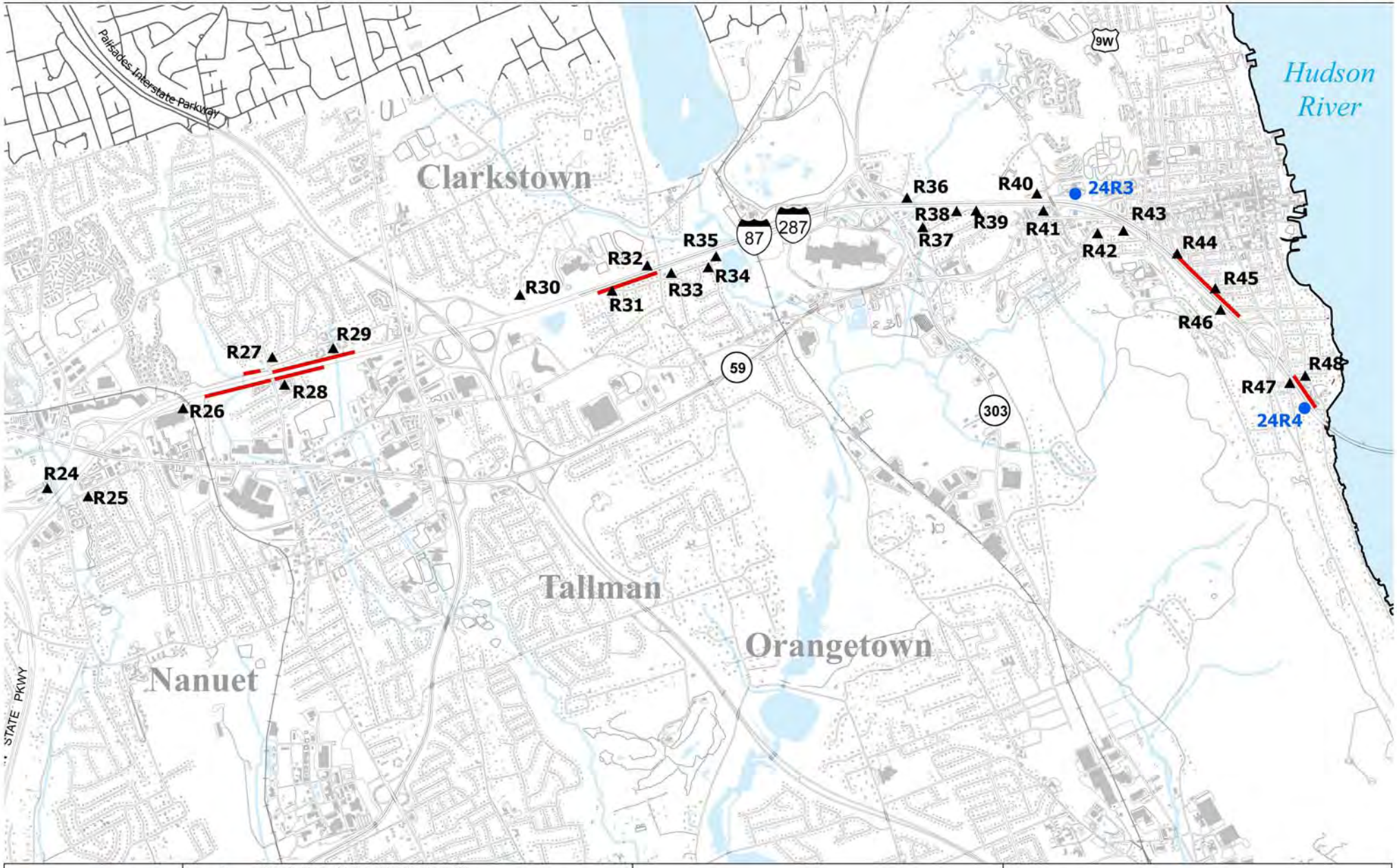
3,400 0 3,400
Scale in Feet

N

Noise Monitoring Locations
Rockland County - West

Figure 3-1

Thruway Authority | New York State Department of Transportation | Metro-North Railroad



EarthTech
A tyco International Ltd. Company

▲ Peak-Hour Noise Monitoring Site
● 24-Hour Traffic Noise Monitoring Site
Existing Noise Barrier

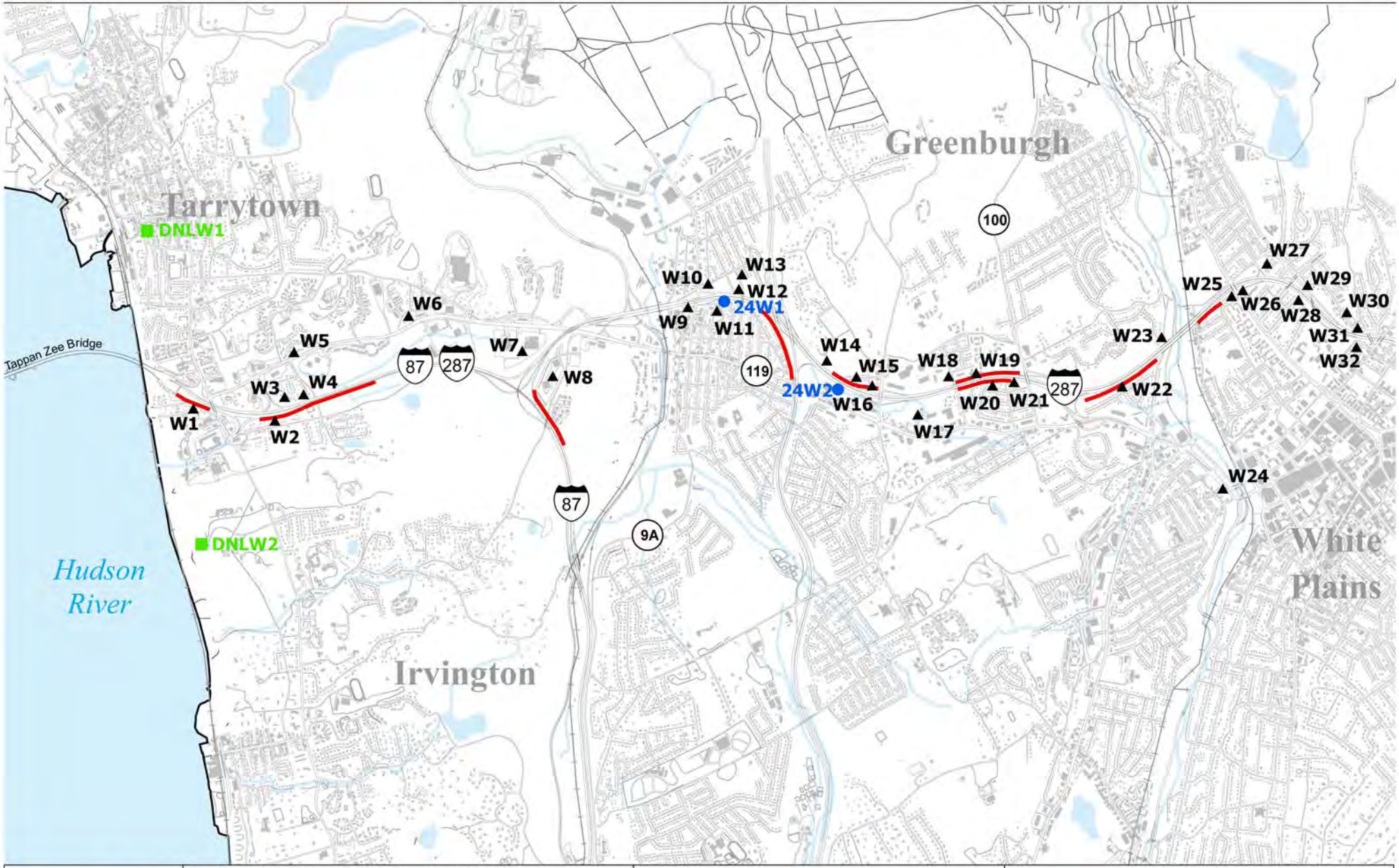
3,400 0 3,400
Scale in Feet

N

Noise Monitoring Locations
Rockland County - East

Figure 3-2

Thruway Authority | New York State Department of Transportation | Metro-North Railroad



EarthTech
A tyco International Ltd. Company

▲ Peak-Hour Traffic Noise Monitoring Site
● 24-Hour Traffic Noise Monitoring Site
■ 24-Hour Ldn Noise Monitoring Site
Existing Noise Barrier

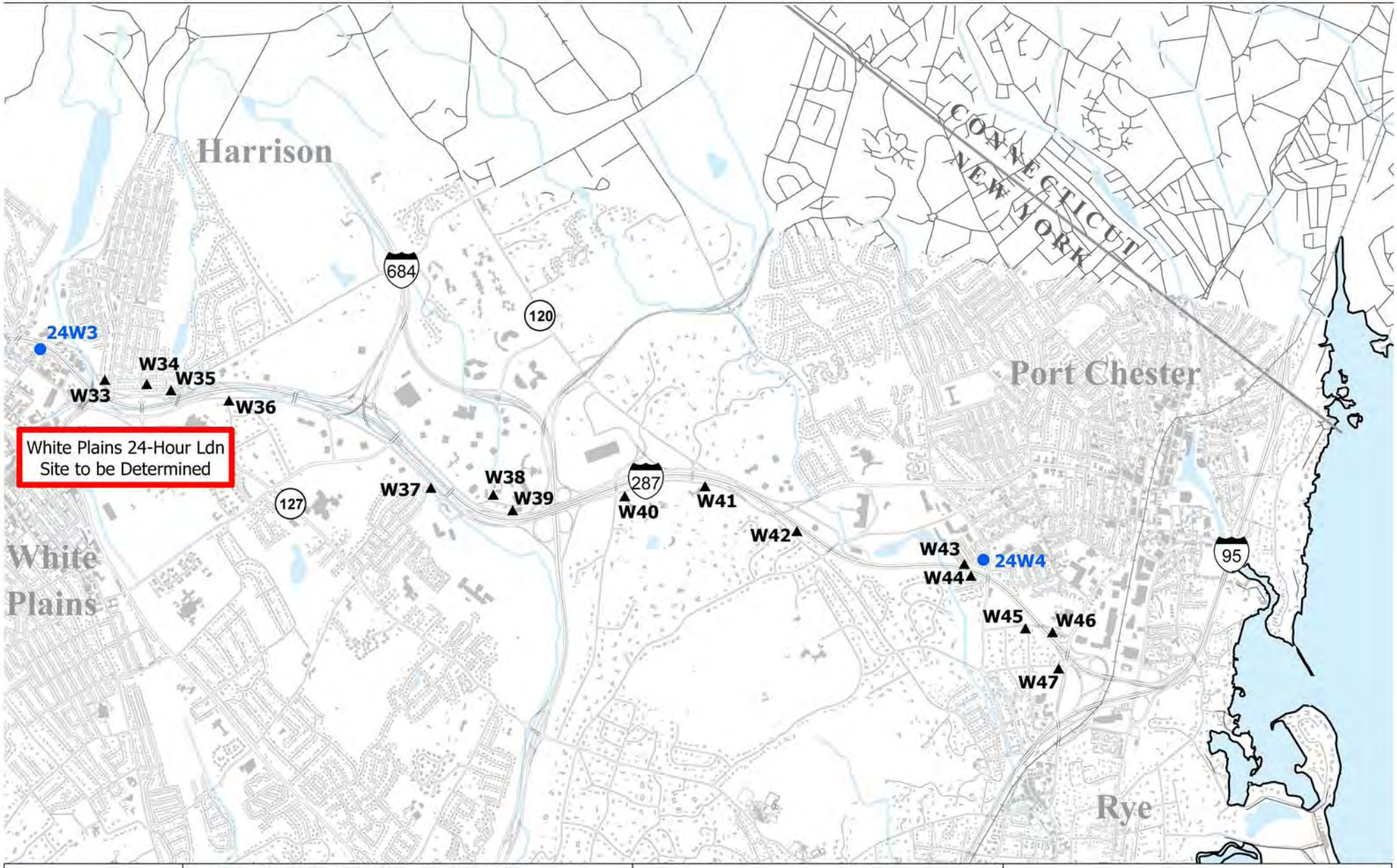
3,400 0 3,400
Scale in Feet

N

Noise Monitoring Locations
Westchester County - West

Figure 3-3

Thruway Authority | New York State Department of Transportation | Metro-North Railroad



EarthTech
A tyco International Ltd. Company

▲ Peak-Hour Traffic Noise Monitoring Site
● 24-Hour Traffic Noise Monitoring Site

3,400 0 3,400
Scale in Feet

N

Noise Monitoring Locations
Westchester County - East

Figure 3-4

Table 3-1

24-hour and L_{dn} Noise Measurement Locations

Site #	Location	Town
24-hour Highway Noise Measurement Site		
24R1	Monsey Heights Rd, E of Kenneth St	Monsey
24R2	Sima Ln, entrance to toll plaza and new development site	Chestnut Ridge
24R3	Tappan Zee Manor (Retirement Home) off Mountainview Ave	Nyack
24R4	Ferris Ln	South Nyack
24W1	Frontage St and Mortimer Ave	Elmsford
24W2	Mall along Rt. 119 between Knollwood Rd & Sprain Brook Pkwy	Elmsford
24W3	Main St and Hadden Ave	White Plains
24W4	Highview Ave, north of I-287	Port Chester
24-hour L_{dn} Transit Noise Measurement Site		
DNLR1	Franklin Turnpike (SR-59)	Suffern
DNLW1	Near Tarrytown Station.	Tarrytown
DNLW2	South of Lyndhurst.	Tarrytown
DNLW3	To be determined.	White Plain

3.1.2.2 Short-term Measurement Sites

Given the scale of this study corridor, a total of 100 short-term measurement sites will be selected for establishing existing peak period noise conditions along the corridor assuming approximately an average of three to four sites per mile of corridor. Figures 3-1 through 3-4 present a total of 95 locations selected for short-term measurement. Additional five (5) sites will be further selected when proposed new transit alignments are more refined during the EIS process.

Among the shown 95 sites, approximately half of them are previously measured locations discussed in the below historical noise studies:

- Westchester County: *Noise Technical Memorandum – Cross Westchester Expressway Improvements Project*, NYSDOT, July 1994.
- Rockland County: *Noise Study Technical Report – Interstate Route 87 from The Hudson River to The Orange County Line and The Garden State Parkway Connection*, NYSTA, May 1996.

Tables 3-2 and 3-3 provide the list of selected short-term noise measurement sites within Westchester County and Rockland County, respectively. The same sites measured in early studies are noted in these tables.

Table 3-2
Short-term Noise Measurement Locations in Rockland County

Site #	Location	Town	Measured in Previous Studies
R1	Terrace Ave, S. of 4th St	Hillburn	
R2	Orange Ave and Lafayette Ave	Suffern	
R3	Apt off of Wayne Ave btw Washington Ave and Cross St	Suffern	
R4	Bend in Pavillion Rd. near Wayne Ave.	Suffern	Yes
R5	Memorial Dr (Park) [N. of CWE]		Yes
R6	Apt Complex at Kensico Ct	Suffern	
R7	Dunnigan Dr, W. of N. Airmont Rd	Tallman	Yes
R8	Dashew Dr	Monsey	
R9	Spook Rock Rd, N. of I87/287	Monsey	
R10	Fountain View Apt on College Rd	Monsey	
R11	Bend on Horton Dr (W. of Witzel Ct)	Monsey	Yes
R12	Bensen Pkwy.	Monsey	Yes
R13	Monsey Heights Rd.	Monsey	Yes
R14	Johanna Ln Dead End	Monsey	
R15	End of Kile Ct.	Monsey	Yes
R16	Algonquin Circle, NW. cul-de-sac	Monsey	
R17	Summit Ave and Meile Rd	Monsey	
R18	Main St and Old Nyack Turnpike	Monsey	
R19	Dykstras Way E. near Synagogue	Monsey	
R20	Between Chelsea Ln & Hungry Hollow Rd.	Chestnut Ridge	Yes
R21	Between Hungry Hollow Rd & Zachery Ct	Spring Valley	Yes
R22	End of Gail Ct.	Chestnut Ridge	Yes
R23	Gail Ct and Scotland Hill Rd	Chestnut Ridge	

Table 3-2 (continued)
Short-term Noise Measurement Locations in Rockland County

Site #	Location	Town	Measured in Previous Studies
R24	Tudor Hill Condominiums on Old Nyack Tpke.	Nanuet	Yes
R25	Old Nyack Tpke. & Charles St.	Nanuet	Yes
R26	End of Hutton Ave.	Nanuet	Yes
R27	James Dr, near Middletown Rd	West Nyack	
R28	Apt Complex of Middletown Rd, S of I-87/I-287	West Nyack	
R29	Apt Complex at end of James Dr.	West Nyack	
R30	Demarest Mill Rd Dead End	West Nyack	
R31	Deer Meadow Dr, W of Strawtown Rd	West Nyack	
R32	Church on Samantha Way	West Nyack	Yes
R33	Church on Strawtown Rd and Hunter Pl	West Nyack	
R34	Klein Ave. & Lousie Dr., Southwest side	West Nyack	Yes
R35	Klein Ave. & Louise Dr., North side	West Nyack	Yes
R36	Greenbush Rd. N. & Strawberry Hill Ln.	Central Nyack	Yes
R37	Greenbush Rd. N. & Stony Hill Ln.	Central Nyack	Yes
R38	Middle/Near end of Stony Hill Ln.	Central Nyack	Yes
R39	Stony Hill Ln Dead End	Central Nyack	
R40	Central Ave, N. of I-87/287	Central Nyack	
R41	Central Ave, S. of I-87/287	Central Nyack	
R42	Hall St. near Waldrow Depew Ave.	Central Nyack	Yes
R43	Kilby St. & Waldrow Depew Ave.	Central Nyack	Yes
R44	Cedar Mill Ave, N. of I-87/287	South Nyack	
R45	Clinton Ave and White Ave	South Nyack	
R46	Hillside Ave. (S. of CWE/I-287)	South Nyack	Yes
R47	Smith Ave near Broadway	South Nyack	
R48	Elizabeth Pl and Broadway	Upper Grand View	

Table 3-3
Short-term Noise Measurement Locations in Westchester County

Site #	Location	Town	Measured in Previous Studies
W1	Van Wart Ave and Washington Pl	Tarrytown	
W2	Sheldon Ave and Chester Ave	Tarrytown	
W3	Summit St & Hillside	Tarrytown	Yes
W4	Meadow St, N of I87/287	Tarrytown	
W5	Meadow St and White Plains Rd	Tarrytown	
W6	Near residences E. of Old White Plains Rd. and W. of Benedict Ave	Greenburgh	
W7	Marriott Hotel on TarryTown Rd (Rt 119)	Elmsford	Yes
W8	565 Taxter Rd (Corporate Park)	Elmsford	Yes
W9	6 William St.	Elmsford	Yes
W10	White Plains Ave and N. Lawn	Elmsford	
W11	N. Hillside Ave @ Park/Baseball Fld	Elmsford	Yes
W12	N. Evarts Ave, N. of I-287	Elmsford	
W13	Winthrop Ave, N. of CWE	Elmsford	Yes
W14	Knollwood Golf Course	Elmsford	Yes
W15	Woodside Ave and Alma St	Elmsford	
W16	Alma Place	Greenburgh	Yes
W17	Yosemite Park	Elmsford	Yes
W18	Elm St and Manhattan Ave	Greenburgh	
W19	Christ Temple Church (walled)	Greenburgh	Yes
W20	On Chester Pl, off Riverdale Ave	Elmsford	Yes
W21	Shoneham Pl, N. of I-287 near Riverdale Ave	Greenburgh	
W22	Country Center Rd, S. of I-287 near Randolph Rd	Greenburgh	
W23	Kent Rd. (N. of CWE/I-287)	Greenburgh	Yes
W24	School St and Tarrytown Rd	White Plains	
W25	Church St. Residence near Westview	White Plains	Yes
W26	N. Broadway to I-287 E. on-ramp	White Plains	
W27	Griffin Pl.	White Plains	Yes
W28	46 Lenox Ave	White Plains	Yes
W29	Kensico Ave and George St	White Plains	
W30	85 Old/No. Kensico	White Plains	Yes
W31	Kensico Ave and George St	White Plains	
W32	Ross St	White Plains	Yes

Table 3-3 (continued)
Short-term Noise Measurement Locations in Westchester County

Site #	Location	Town	Measured in Previous Studies
W33	42/48 Underhill Rd Apartments	Harrison	Yes
W34	White Plains Rd & Locust	Harrison	Yes
W35	Locust Ave E, W. of Main Pl	Harrison	
W36	Westchester Ave and Meadowbrook Rd	White Plains	
W37	Haviland Lane and Ridgeway	White Plains	
W38	West Red Oak Lane	Harrison	Yes
W39	Berkley School (W. Red Oak Ln)	Harrison	Yes
W40	Congregation Emanu-El	Harrison	Yes
W41	Westchester Ave and Convent Lane	Harrison	
W42	Purchase St between Pilgrim and Plymouth roads	Harrison	
W43	Roanoke Ave, N. of I-287	Port Chester	
W44	Roanoke Ave, S. of I-287	Rye	
W45	High St (W. of CWE [I-287])	Rye	Yes
W46	1000 High St.	Port Chester	
W47	Hillside Rd & Route 1 (E. of CWE/I-287)	Rye	Yes

3.1.2.3 Measurements

The measurements will be conducted at selected receptor locations using Type I or Type II sound level meters. Noise measurements will be conducted as per the procedures described in NYSDOT's manual "*Field Measurement of Existing Noise Levels*." Microphone height for all receptors will be 1.5 meters (m) above ground level. A wind screen will be used to minimize wind noise across the face of the microphone. Measurements at each location will be made on the A-scale (dBA) for a period of 15 to 25 minutes depending on whether each noise reading is stable. A second measurement will be made to verify the level measured at the first time.

3.1.3 TNM Prediction of Existing Noise Levels

3.1.3.1 Methodology

The FHWA Traffic Noise Model (TNM 2.5) will be used to predict noise levels of project alternatives. The TNM computes highway traffic noise at nearby receptors and, models the effects of, and aids in the design of highway noise barriers. It is considered a state-of–the-art approach for estimating traffic noise.

Various site-specific parameters and factors can influence the mathematical modeling of noise levels in the corridor vicinity and need to be addressed when the model is being configured. The site specific factors include the following:

- Existing topographic conditions such as roadway geometry and profile and receptor elevation.

- Existing traffic volumes, speeds, and associated vehicle classifications. For this purpose, five vehicle classifications will be considered:

  - Automobile.
  - Medium truck (2 axels with 6 wheels).
  - Heavy truck (more than two axels).
  - Bus.
  - Motorcycles.

- Noise shielding effects at specific receptor locations from building structures, vegetation, earthberms, or existing noise barriers constructed from early corridor projects.

3.1.3.2 Predicted Existing Noise Levels

The model will be first used to predict existing noise levels at the measurement locations. When the model is configured to best approximate the existing topography and other site-specific factors and the existing traffic conditions, the differences between the model-estimated and measured noise levels are expected to be less than 3 dBA. Then the model will be considered ready for use in estimating future conditions. It will be used to predict noise levels along the project corridor under both existing and future conditions.

Existing noise levels will be predicted at a total of 1,000 additional receptor locations along both sides of the corridor within 500-ft distance. The noise predictions at these receptor locations will be used for interpolating both the 66-dBA and 71-dBA noise contours under existing conditions. Both Category B land uses within the 66-dBA contour and Category C land uses within the 71-dBA contour can then be identified.

3.2 Future Traffic Noise Prediction

According to the NYSDOT's noise abatement policy, traffic noise analyses should be conducted for the project design year. The design year is that future year for which the highway has been designed from a traffic carrying capacity perspective. Usually the design year is 20 years (30 years for a bridge project) beyond the construction completion date and is expressed as ETC+20 (ETC = estimated time of completion).

While this project has at its center a replacement or rehabilitated bridge, the bridge itself must be viewed as a component of a highway project that is 30 miles long. As an integral component of the larger highway system, use of a design year of ETC+20 for a highway project would be appropriate to characterize both traffic and noise impacts.

Furthermore, since the entire corridor is already heavily congested with many roadways at capacity, there would be little change in peak hour traffic volumes over the 10-year period from ETC+20 (2035) to ETC+30 (2045) with a roughly 10-percent increase. As it would take a doubling of traffic volumes to cause a 3-dBA increase in noise levels, which is barely perceptible, ETC+20 noise levels would essentially be the same as levels at ETC+30. Thus, ETC+20 has been selected as the design year for the EIS noise impact analysis purposes.

However, in addition to the complete corridor noise impact analyses for ETC+20, traffic noise impacts will also be modeled for the bridge design year (ETC+30) along the bridge segment between Interchanges 9 and 10. TNM will be used to predict vehicular traffic noise including noise from BRT component transit noise along this segment. Noise contours between these two exits will be developed based on the modeling results reflecting ETC+30 traffic conditions.

Corridor traffic noise for ETC+20 (and bridge segment traffic noise for ETC+30) will be modeled for a total of six alternatives (including the no build alternative). The model will be configured to address the following changes from existing conditions:

- Horizontal alignment and vertical profiles for each roadway segment.
- Additional traffic lanes and associated assignment of traffic, including HOV lane, rapid bus transit lane, etc.
- Traffic speed, volume and classifications for each modeled link.

For each alternative, future noise levels will be predicted at the same 1,000 receptor locations previously mentioned. The noise predictions at these receptor locations will then be used for 1) interpolating the 66-dBA and 71-dBA noise contours and 2) determining potential traffic noise impacts under each build alternative based on FHWA and NYSDOT noise impact criteria. The number of dwelling units and number of other Category B land uses within the 66-dBA contour will be identified for each township along the study corridor. The Category C land uses within the 71-dBA contour will also be identified. Additionally, Category E interior land uses will be identified based on potential noise levels at exterior parking lots of residences, hotels, motels,

schools, libraries, churches, hospitals, offices, etc. that are greater than 76 dBA (equivalent to approaching 51-dBA interior NAC).

Rail transit peak activity hour noise (see Subchapter 4.1) will be combined with highway peak traffic noise at each receptor location, as applicable, to develop the ultimate combined noise contours.

3.3 Noise Abatement Measures

According the FHWA and NYSDOT traffic noise regulations (see Subchapters 2.1.1.1 and 2.1.1.2), feasible and reasonable noise abatement measures should be considered to reduce or eliminate a traffic noise impact on developed lands if the predicted traffic noise level approaches or exceeds the NAC (66 dBA or greater) or if a substantial noise increase (6 dBA or more) over existing levels occurs. Among those FHWA-identified measures, the noise barrier modeling analysis is a major component in addressing reducing traffic noise impacts that are associated with a transportation project. A noise barrier modeling analysis will be conducted in the EIS when applicable.

Construction of a noise barrier to reduce or eliminate highway traffic noise is a common practice. Noise barriers are solid obstructions, built between the roadway and nearby noise receptors. Effective barriers can reduce noise levels by 10 dBA or more, reducing the perceived loudness of traffic noise by more than half. Barriers can be constructed in the form of earthen berms, or high, vertical walls built out of wood, concrete masonry, or other materials.

Where impacts are identified, and noise barrier appears to be an option, noise barrier modeling analysis will be conducted based on 1) the TNM model developed for each build alternative for vehicular traffic noise and 2) FTA methodology for the rail traffic noise. The resultant noise levels from the two types of sources will be combined. The attenuations by the noise barrier will be accounted for separately in TNM for roadway traffic and in an FTA computation for rail using the equations defined in Table 6-9 of the FTA Transit Noise and Vibration Impact Assessment report (April 1995), with site specific geometry input. The barrier effectiveness will reflect the barrier attenuation effects on both types of noise. Noise barrier walls along the corridor will be modeled to determine the optimized barrier width and height for each source type. The walls that could conservatively and effectively attenuate both types of noise (the wider and taller barriers) will be recommended. The acoustical effectiveness as well as cost effectiveness of modeled noise barrier walls will be evaluated further based on the criteria described in Subchapter 2.1.1.2.

The results of the barrier analysis will be summarized in the EIS. These preliminary noise barrier designs will be finalized during the project final design phase using the NYSTA's barrier wall design criteria.

3.4 Construction Detour Traffic Noise Analysis

3.4.1 Traffic Noise

If the Maintenance and Protection of Traffic (MPT) data during the construction phase are available during the EIS process and such location-specific detour traffic would occur more than two years, noise from construction phase detours will be estimated in the same manner as described in Subchapters 3.1 and 3.2. It is assumed that a total of four major detour routes for a total of four build alternatives with major highway and transit improvement components will be studied. In order to determine potential detour noise impacts, existing traffic noise along the detour routes will be predicted from available traffic data.

Although the NYSDOT noise policy does not specify the impact criteria that are applicable to detour traffic as compared operational traffic, it does define the impact criteria for those projects which are not Type I but are subject to NEPA or SEQRA requirements. Because detour traffic should not be considered as a Type I action, therefore the non-Type I impact criteria will be used for assessing detour traffic noise impact during the construction period. Detour noise impacts would be considered to occur if a substantial noise increase (6 dBA or greater) over existing levels were predicted. In this analysis, the likely duration of each construction phase detour along a specific route will also be discussed for informational purposes in order to focus on the temporary nature of such impacts.

3.4.2 Abatement Measures

If a substantial noise increase is predicted along a specific route where noise receptors are located, typical noise abatement measures will be presented in the EIS. The feasibility and reasonableness of the abatement measures will be also evaluated. It is assumed that traffic detours would occur mostly along local roads where the installation of noise barriers would not be feasible or reasonable and therefore the need for noise barrier analysis is not anticipated.

4 TRANSIT NOISE AND VIBRATION ANALYSES

For the transit component of the project, noise impacts are likely to occur whenever transit operations are in close proximity to noise sensitive sites, particularly residences. Transit noise impact analysis will be conducted using FTA's assessment procedures (April 1995), which include the following steps:

- Determining receptors of interest concurrently with the land use survey conducted for the traffic noise analysis. The survey will be conducted in communities likely to be near proposed rail lines, terminals, stations and maintenance facilities.
- Establishing existing ambient noise conditions with respect to peak hour L_{eq} and L_{dn}, as appropriate, at potential impacted receptor locations through ambient noise measurement.
- Projecting noise reference levels for each source type, such as rail car, diesel locomotive, etc.
- Predicting noise levels for each proposed alternative.
- Combining transit noise levels with highway noise levels to determine the overall noise impacts for each alternative.
- Determining noise impact based on FHWA and NYSDOT impact criteria for transit alternatives with alignments that are integrated with the I-87/I-287 highway corridor. In such case, peak hour L_{eq} (1) is the metric to be used.
- Determining noise impact based on FTA impact criteria within limited areas where only the transit component has potential noise effects. In such cases, peak hour L_{eq} (1) is the metric to be used for all land uses but residences. L_{dn} will be used as the metric for evaluating potential noise impacts on residential land uses, when applicable.
- Determining vibration impact based on FTA impact criteria.
- Evaluating mitigation measures, where applicable.

4.1 Existing Noise Measurements

4.1.1 Transit and Highway Integrated

Since FHWA and NYSDOT impact criteria are applicable to a transit project when it is integrated with a highway project, existing noise measurement requirements for purposes of transit noise analysis and the selection of receptor locations are the same for the highway component of the project as discussed and covered in Subchapter 3.1.2.

4.1.2 Transit Alone

Within those areas where a transit improvement is not aligned with any highway traffic, FTA's impact criteria based on both L_{eq} and L_{dn} metrics are applicable. In order to evaluate potential noise impact using FTA impact criteria, existing noise conditions must be established.

For Category 1 and 3 land uses, L_{eq} is the metric to be used and it is the same metric used for the highway noise impact analysis. Therefore, the determination of existing L_{eq} conditions within these areas would be part of the effort discussed in Subchapter 3.1.2.

For Category 2 residential places within these areas, 24-hour L_{dn} existing conditions will be established through a measurement program discussed in Subchapter 3.1.2 at four representative locations along new transit lines to be further refined during the EIS process. The measurement at these locations will follow the same procedures used for 24-hour existing noise measurement discussed in Subchapter 3.1.2 except a 10-dBA penalty will be employed to nighttime hours.

4.2 Transit Fixed Guideway Noise Analysis

4.2.1 Noise Reference Level

The L_{eq} (1) noise reference level (at 50-ft distance) for each type of transit vehicle will be estimated, as described below. Additional information such as train operational conditions and published reference noise levels from manufacturers will also be considered in the analysis.

4.2.1.1 Locomotives

The following acoustical relationship will be used for predicting locomotive noise reference levels:

$$L_{eqL}(1) = SEL_{ref} + 10\log(N_{locos}) + 6 - 10\log\left(\frac{S}{50}\right) + 10\log(V) - 35.6$$

where:

SEL_{ref} is the sound exposure level at 50 feet from the source, e.g., 92 dB is for a diesel-powered locomotive, 90 dB for an electric-powered locomotive, etc.
N_{locos} is average number of locomotives per train.
S is train speed in miles per hour.
V is average hourly volume of train traffic.

4.2.1.2 Rail Cars

The following relationship will be used for predicting rail car noise reference levels:

$$L_{eqC}(1) = SEL_{ref} + 10\log(N_{car}) + 20\log\left(\frac{S}{50}\right) + 10\log(V) - 35.6 + ADJ$$

where:

SEL_{ref} is the sound exposure level at 50 feet from both commuter rail or light rail cars, e.g., 82 dB is a typical reference level.
N_{cars} is average number of rail cars per train.
ADJ is track type adjustment factor.

4.2.1.3 Warning Horns

The following equation will be used for predicting warning horn noise reference levels:

$$L_{eqH}(1) = SEL_{ref} - 10\log\left(\frac{S}{50}\right) + 10\log(V) - 35.6$$

4.2.1.4 Combined Referenced Level

Once reference levels are estimated for three typical source categories associated with transit operations, the combined reference level (the reference level from three sources combined) will be predicted as follows:

$$L_{eq}(1) = 10\log\left[10^{(LeqL/10)} + 10^{(LeqC/10)} + 10^{(LeqH/10)}\right]$$

4.2.2 Transit Noise Prediction

4.2.2.1 Transit and Highway Integrated

Once estimates of noise exposure at 50 feet from each source are generated, noise propagation characteristics will be taken into account to compute the noise levels at the receptors of interest using the following formulation:

For rail car passbys:

$$L_{eq}(1) = L_{eq}(1)\ (@\ 50\ \text{feet}) - 10\log\left(\frac{D}{50}\right) - 10\,G\log\left(\frac{D}{42}\right)$$

where:

D is the distance in feet.
G is the ground factor to reflect various ground noise attenuation effect including noise barriers.

For locomotive passbys:

$$L_{eq}(1) = L_{eq}(1)\ (@\ 50\ \text{feet}) - 10 \log\left(\frac{D}{50}\right) - 10\ G \log\left(\frac{D}{29}\right)$$

Total noise levels will then be estimated using basic acoustical principles (see Subchapter 4.1.1.4) to determine the overall transit noise at each receptor. Then transit noise and highway noise will be combined to enable development of overall 66-dBA noise contours for each alternative. Finally, the FHWA's noise impact criteria will be applied to determine the overall noise implications of the alternatives.

4.2.2.1 Transit Alone

Within those limited areas where only transit improvements occur, the applicable peak $L_{eq}(1)$ levels along proposed transit alignments will be predicted using the same methodology described above. The L_{dn} will be calculated as follows with a 10-decibel penalty applied to the equivalent sound level during the nighttime hours of 10 pm to 7 am:

$$L_{dn} = 10 \log_{10} \{\frac{1}{24}\ [\ 15\ \times\ 10^{\ Ld/10}\ +\ 9\ \times\ 10^{\ (Ln/\ +\ 10)/10}\ ]\}$$

where:

L_d is the daytime $L_{eq}(1)$ and L_n is the nighttime $L_{eq}(1)$ defined as:

$L_d = 10 \log_{10} \frac{1}{15} \sum_{1}^{15} 10^{Li/10}$ and L_i is the hourly L_{eq} between 7 am to 10 pm, and

$L_n = 10 \log_{10} \frac{1}{9} \sum_{1}^{9} 10^{Li/10}$ and L_i is the hourly L_{eq} between 10 pm to 7 am.

The overall noise implications of the alternatives within these areas will be made in comparison of FTA's noise impact criteria.

4.2.3 Noise Mitigation Measures

Since noise propagates from a fixed transit system much as it does from a highway, noise mitigation measures for highways are considered applicable to transit noise. It should be noted that the highway noise barrier analysis previously described would also consider noise contributions from transit operations.

Within those limited areas where only project transit component occurs, the applicable mitigation measures will be discussed according to the FTA guidance. In addition to those similar measures used for highway traffic noise, mitigation measures at noise sources (e.g.,

enforcing more stringent but achievable noise specifications on transit vehicles, etc.) will also be evaluated.

4.3 Stationary Source Noise Analysis

4.3.1 Noise Prediction

Stationary sources of noise associated with transit systems include locomotive idling, bus idling, HVAC equipment, cooling towers, car washes, etc. The following equation, with stationary source-specific reference noise level inputs, will be used for analyzing stationary sources associated with transit systems:

$$L_{eqS}(1) = SEL_{ref} + 10\log(N) + 10\log\left(\frac{E}{3600}\right) - 35.6$$

where:

N is the number of events of this type that occur during one hour.
E is the duration of one event in seconds.

The source type and operational conditions will be evaluated for each proposed stationary facility. Combined noise impacts will be estimated for a total of three (3) facilities. The resulting noise levels will be compared to the FHWA and NYSDOT incremental impact threshold (6 dBA or greater than existing conditions), which is also comparable to the NYSDEC's substantial noise increase threshold.

4.3.2 Noise Mitigation

Establishing appropriate equipment noise specifications can be an effective method for mitigating noise impacts from stationary sources associated with a transit system. Operational restrictions are also an option to limit noise impacts from stationary facilities.

4.4 Transit Vibration Noise Analysis

Vibration noise impacts from transit operations will be assessed in accordance with FTA's guidelines following a two-step screening procedure: initial screening and general assessment. Although a detailed analysis may be warranted if exceedances are predicted through the screening process, it is expected that such an analysis would be conducted during the project final design stage since ground-borne vibration is a complex phenomenon that is difficult to model and predict unless both soil conditions and detailed design information are available.

4.4.1 Initial Distance Screening

Various categories of land use will be screened for further analyses based on the critical distances summarized in Table 4-1.

Table 4-1
Screening Distances for Vibration Assessment

Type of Project	Critical Distance for Land Use Categories (distance in feet from right-of-way or property line)		
	Category 1: Buildings where low ambient vibration is essential for interior operations	Category 2: Residents and buildings where people normally sleep	Category 3: Institutional land uses with primarily daytime use
Commuter Rail Road	600	200	120
Rail Rapid Transit	600	200	120
Light Rail Transit	450	150	100
Source: FTA, April 1995.			

4.4.2 General Assessment

The general assessment is an extension of the screening procedure. It uses available generalized data to develop a curve of vibration level as a function of distance from the track. The vibration levels at specific buildings are estimated by reading values from the curve and applying adjustments to account for factors such as track support system, vehicle speed, type of buildings, and track and wheel condition. The general assessment procedure will be applied to each alternative following the methodologies detailed in the FTA's guidelines (April 1995) including using the combination of published "Generalized Ground Surface Vibration Curve" and "Adjustment Factors for Generalized Predictions of Ground-borne Vibration and Noise".

The predicted generalized vibration levels will then be compared with FTA's guidelines as follows:

- If the predicted levels are below the impact thresholds, no vibration impact would likely occur.
- If the predicted levels are greater than the impact thresholds, these impacts will be disclosed in the EIS and a site-specific detailed analysis will be conducted for the impacted areas during the project final design stage.

4.4.3 Mitigation Measures

The purpose of vibration mitigation is to minimize the adverse effects that project-induced vibration will have on sensitive land uses. However, because vibration is not as common a problem as environmental noise, the mitigation approaches have not been well established. As indicated above, detailed vibration analysis would not be conducted until the project reaches the final design stage. Consequently, vibration mitigation strategies can only be discussed in a qualitative way in the EIS.

5 CONSTRUCTION EQUIPMENT NOISE AND VIBRATION ANALYSES

Construction equipment noise and vibration will be considered as part of the EIS for the proposed action.

5.1 Equipment Noise Analysis

5.1.1 Equipment Noise

Noise generated by construction equipment will be estimated using the FHWA-developed Roadway Construction Noise Model (RCNM) Version 1.0. This model is a screening tool that can be used for the prediction of construction equipment noise during the project development and construction phases by incorporating the most comprehensive noise control specification and extensive equipment noise database. The RCNM predicts noise from highway construction operations based on a compilation of empirical data and the application of acoustical propagation formulas.

As applicable, both daytime and nighttime noise levels from equipment operations will be calculated for each stage of construction work. The extent of affected land uses and the duration of the impacts will be identified after comparing the estimated noise levels with FTA impact thresholds.

The duration and level of impact are a function of construction phase. Typical phases include the following:

- Demolition and removal of existing structures, trees, soils, etc.
- Excavation.
- Placement of roadway and/or rail foundation.
- Erection of structural steel.
- Finishing including filling, grading, paving, landscaping, and cleanup operation, etc.

Moreover, the duration and level of impact are a function of the specific construction activity occuring within a particular phase. For example, construction of a roadway segment may include the following stages:

- Stage 1: driving piles.
- Stage 2: installing structure steel and concrete.
- Stage 3: paving.

It is assumed that such construction phasing data will be available and a total of nine construction phases will be identified and analyzed in the EIS. Otherwise, a qualitative discussion will be provided in the EIS.

5.1.2 Mitigation Measures

To mitigate short-term construction equipment noise impacts (exceeding FTA's construction equipment noise criteria), standard construction noise specifications that require the contractor to make every reasonable effort to minimize construction noise would be incorporated in the construction plans. Abatement measures and useful construction procedures that can be evaluated include:

- Providing timely public notice to each affected community of the upcoming construction activities.
- Setting up a noise complaint hotline(s) in order to address potential noise complaints during construction.
- Mandating that all construction equipment with an internal combustion engine be equipped with a properly maintained muffler.
- Utilizing new construction equipment as much as possible since these are generally quieter than older equipment.
- Constructing temporary noise walls at particular locations.
- Minimizing impact pile driving operations where possible.
- Limiting hours for potential nighttime construction activities, etc.

5.2 Equipment Vibration Noise Analysis

5.2.1 Equipment Vibration Noise

Vibration levels for construction equipment have been published (Table 5-1). Since the primary concern with regard to construction vibration is building damage, the peak particle velocity (PPV) in inches per second defined in Subchapter 2.2.2 will be used for assessment of vibration levels. The available vibration damage thresholds have been established as:

- 0.20 in/sec (approximately 100 VdB) for fragile buildings.
- 0.12 in/sec (approximately 95 VdB) for extremely fragile buildings.

The PPV level at a building can be estimated using the following equation:

$$PPV_{equip} = PPV_{ref} \times \left(\frac{25}{D} \right)^{1.5}$$

where:

PPV_{equip} is the peak particle velocity of the equipment adjusted for distance.
PPV_{ref} is the reference peak particle velocity level at 25 feet from Table 5-1.
D is the distance from the equipment to the receiver.

The impact criteria discussed for operational activity at vibration sensitive locations (see Table 2-4) will also be used for the evaluation of potential temporary construction vibration noise impact. Potential vibration impacts will be analyzed in the EIS for the worst-case phase, which is expected to involve pile driving activities.

5.2.2 Mitigation Measures

Vibration impacts are unlike noise impacts because vibration levels drop rapidly beyond the immediate construction areas. Therefore potential mitigation measures for vibration impacts on adjacent buildings will be investigated.

Table 5-1
Typical Vibration Emission Levels for Construction Equipment

Type of Equipment	PPV at 25 ft (inch/second)
Pile Driver (Impact) – Upper Range	1.518
Typical	0.644
Pile Driver (sonic) – Upper Range	0.734
Typical	0.170
Clam shovel drop	0.202
Hydromill - in soil	0.008
in rock	0.017
Large bulldozer	0.089
Caisson drilling	0.089
Loaded trucks	0.076
Jackhammer	0.035
Small bulldozer	0.003
Source: FTA, April 1995.	

6 References

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Appendix C

Energy and Greenhouse Gas Analysis Protocol

Thruway Authority

New York State Department of Transportation

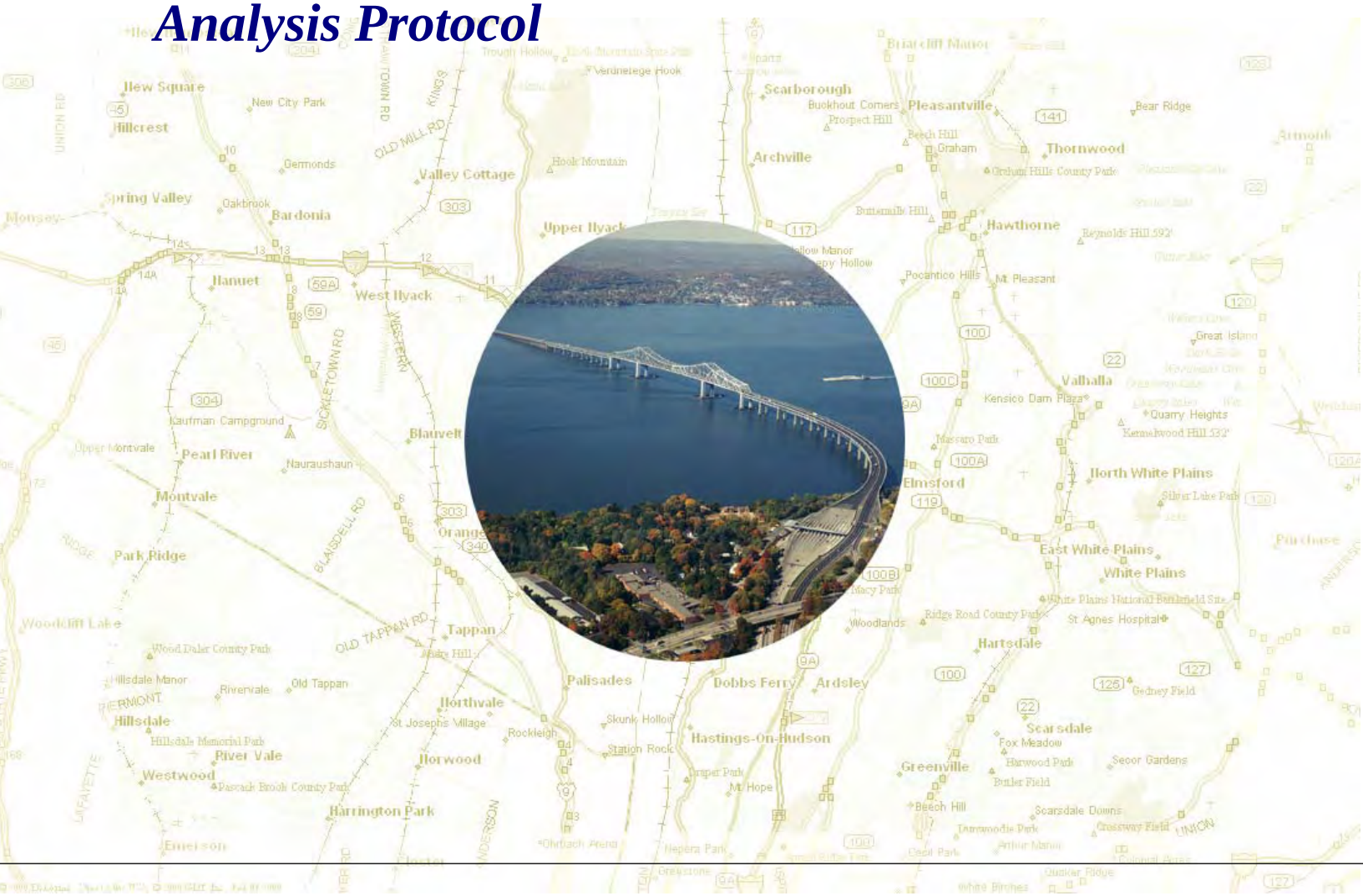
Metro-North Railroad

TAPPAN ZEE BRIDGE/I-287
ENVIRONMENTAL REVIEW

Environmental Impact Statement for

Tappan Zee Bridge/I-287 Corridor

Energy/Greenhouse Gas Analysis Protocol



December 7, 2006

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1 INTRODUCTION

This report presents the protocol for conducting energy/greenhouse gas analyses for the Tappan Zee Bridge/I-287 Corridor project being planned by the New York State Department of Transportation (NYSDOT), the New York State Thruway Authority (NYSTA), and Metropolitan Transportation Authority/Metro-North Railroad (MTA/MNR). The project is now in its second stage during which an Environmental Impact Statement (EIS) will be prepared. The protocol presented here describes the energy/greenhouse analyses that will be conducted as part of the EIS.

1.1 Study Area

The Tappan Zee Bridge/I-287 Corridor extends from Suffern, Rockland County, NY to Port Chester, Westchester County, NY, a distance of approximately 30 miles (Figure 1-1). The corridor encompasses a critical section of the New York State Thruway and all of the Cross Westchester Expressway (CWE). It connects a number of major interstate highways including I-87 north to Albany, I-287 south to New Jersey, I-87 south to New York City, I-684 north to Connecticut, and both the north and south directions of I-95. The corridor provides a critical link in the national system of interstate and defense highways, as well as links to a number of key north-south and east-west regional routes.

1.2 Project Alternatives

The Alternative Analysis (AA) process culminated in the identification of six alternatives to be carried forward into the DEIS:

- Alternative 1 - No Build.
- Alternative 2 - Bridge Rehabilitation with TDM/TSM Measures.
- Alternative 3 – Full Corridor BRT and Highway Improvements in Rockland.
- Alternative 4A – Full Corridor CRT and Highway Improvements in Rockland.
- Alternative 4B – Manhattan-Bound CRT with LRT in Westchester County and Highway Improvements in Rockland.
- Alternative 4C – Manhattan-Bound CRT with BRT in Westchester County and Highway Improvements in Rockland.

Figure 1-1 Study Corridor

1.3 Purpose of the Protocol

The United States (US) depends almost entirely on petroleum to fuel its transportation sector and transportation accounts for approximately 67 percent of all the petroleum consumed in the US. Therefore the conservation of energy is part of the planning concerns for a regionally significant transportation project such as the proposed action. Moreover, the level of greenhouse gas emissions is directly related to the level of energy consumption since the majority of greenhouse gas emissions result from fossil fuel combustion. The greenhouse gas emissions further contribute to the global warming, which occurs from the emission of carbon dioxide (CO_2) and other gases into the upper atmosphere that trap heat and warm the earth. Therefore, for a regionally significant transportation project, a mesoscale analysis of potential impacts on energy consumption and associated greenhouse gas emissions on a project level is necessary.

Because the various project alternatives including transit alternatives would cause changes in travel volume, speed and mix along the project corridor and large scale construction activities, the proposed project has the potential to affect both energy and energy-related greenhouse gas emissions during the construction and operation of the project alternatives. Therefore, an analysis of potential energy/greenhouse gas effects will be conducted and presented in the EIS. The EIS analysis will focus on the following:

- Potential energy consumption and greenhouse gas emissions on a mesoscale level due to changes in traffic patterns along the I-287 corridor and adjacent major arterial roadways.
- Potential energy consumption and greenhouse gas emissions related to the construction of the proposed project alternatives.

This protocol describes the procedures established by the New York State Department of Transportation (NYSDOT) that will be used to assess potential project related energy/greenhouse gas impacts.

2 ENERGY ANALYSES

The energy analyses consist of two components: direct and indirect energy analysis. The direct energy analysis calculates the potential annual energy consumed by vehicles. The indirect energy includes the energy associated with construction and maintenance of the project.

2.1 Direct Vehicle Energy

As recommended by NYSDOT Environmental Analysis Bureau (EAB), the Urban Fuel Consumption Method to predict direct vehicle energy usage will be used. The method will use the traffic forecasts obtained from the Best Practice Model (BPM). The principal traffic inputs for direct energy estimates that are available as outputs from BPM are:

- Vehicle Miles Traveled (VMT) for the AM, Mid-day, PM, and night time periods for each type of roadway, by county, within the region.
- Vehicle Hours Traveled (VHT) during AM, Mid-day, PM, and night time periods for each type of roadway, by county, within the region.

Each VMT estimate developed by BPM will be divided by the corresponding VHT to derive an average travel speed, for each analyses period, along each analyses roadway link. Varying grades along each analysis link will also be identified. The mesoscale direct vehicle energy analysis based on changes in VMT will be computed for the traffic network within approximately half-mile distance on both sides from the corridor. This network will cover portions of areas in the following counties:

- Westchester, Rockland, and Orange in NY.
- Fairfield in Connecticut (CT).

2.1.1 Roadway Vehicle Energy

Roadway VMT will be divided into three vehicle categories:

- Light duty vehicles including vehicle classifications of LDGV, LDGT1, LDGT2, LDGT3, LDGT4, LDDV, and LDDT12.

- Medium trucks including vehicle classifications of HDGV2b, HDGV3, HDGV4, HDGV5, HDDV3, HDDV2b, HDDV3, HDDV4, and HDDV5.

- Heavy trucks including vehicle classifications of HDGV6, HDGV7, HDGV8a, HDGV8b, HDDV6, HDDV7, HDDV8a and HDDV8b.

The VMT levels (miles) will then be multiplied by the 1980 Base Year fuel consumption rate provided in Table 1 of NYSDOT's guidance (December 2003) for each of three vehicle categories to determine the total 1980 Base Year roadway vehicle fuel consumption. The 1980 Base Year fuel consumption will then be converted to the analysis future year(s) fuel consumption at 0 grade condition using the fuel correction factors presented in Table 2 of NYSDOT's guidance (December 2003). Finally, the grade correction factors presented in NYSDOT's guidance (December 2003) will be applied to each analyzed link based on its grade and speed condition to determine the ultimate total vehicle direct energy.

2.1.2 Transit Vehicle Energy

Transit bus, light rail and commuter rail energy will be predicted using the corresponding energy intensities in BTU per vehicle-mile provided in Table 13 in NYSDOT's guidance (December 2003). The total vehicle miles traveled from the three types of transit vehicles will be determined based on the forecasts from BPM.

2.2 Indirect Energy

The indirect energy consumption associated with the proposed project consists of energy to be consumed for roadway maintenance, roadway construction, and rail construction.

2.2.1 Roadway Maintenance

Roadway maintenance includes activities such as patching, crack sealing, lighting, landscape maintenance, etc. Based on the paving condition and the number of lanes and length of the main corridor, the main corridor roadway maintenance energy will be calculated using the energy per lane-mile index provided in Table 6 in NYSDOT's guidance (December 2003).

2.2.2 Roadway Construction

The Lane-Mile Approach using construction energy factors established for various types of roadway construction categories will be used in predicting the roadway construction energy. Since the project area covers urban and suburban areas, the proposed urban per lane-mile construction levels (as compared to available rural levels) will be identified for the following construction categories associated with the project:

- New construction.
- Reconstruction.
- Rehabilitation.

- Resurfacing.
- Major widening.
- Minor widening.
- New bridges and/or bridge replacement.
- Major and/or minor bridge rehabilitation.

Based on the published highway construction energy factors in BTU per urban lane-mile (NYSDOT, December 2003), the annualized total roadway construction energy will be calculated by multiplying the energy factors established for the urban per lane mile construction of a roadway or a bridge.

2.2.3 Rail Construction

Rail construction energy analysis will include an estimate of the combined energy consumption from the construction of 1) tracks, 2) work associated structures, substations, signals, etc., 3) overhead electrical distribution, and 4) supply lines. The inputs to be used in energy calculations consist of parameters such as length of track miles, volume of gravel needed, volume of timber needed, and other various construction items.

2.2.3.1 Track Work

In order to determine track work energy, the type and volume of material to be used on a per track mile basis will be estimated first. The energy factors and/or material densities in Table 14 of the NYSDOT's guidance (December 2003) will then be applied to each applicable track material type (e.g., crushed gravels, steel trackage, etc.) to estimate the track material processing energy. The total track material energy will be the combination of all types of material energy covering the entire track length plus 10 percent additional energy associated with other miscellaneous material energy. Track work (placement) energy is considered 30 percent of the total material energy.

2.2.3.2 Structure, Substations, Signal, etc.

According to NYSDOT's guidance, the energy associated with rail facility construction is a function of construction cost. This type of energy will be determined based on the ratio of the 1977 base year cost and the future year cost associated with each alternative for the construction of the following facility components:

- Structures.
- Electric substations – structure housing.
- Electric substations – transformers.
- Signals.
- Stations, stops, and terminals.

- Parking with asphalt surfacing.

The construction cost for each type of above facilities will be first developed for each analyzed alternative. The cost ratio will then be multiplied to the dollar-to energy factors established for each of the above facility components for the 1977 base year to predict the overall energy consumption levels.

2.2.3.3 Overhead Electrical Distribution

The overhead electrical line placement energy will be calculated using the same approach discussed for track work energy except using the overhead electrical distribution line density and energy factors provided in Table 14 of NYSDOT's guidance (December 2003) for the following:

- Trolley line.
- Feeder line.
- Cross street suspension.

2.2.3.4 Supply Lines

The total supply line placement energy will be calculated by applying the placement cost ratio between supply lines and electrical distribution to the electrical distribution energy consumption estimated in Subchapter 2.2.3.3.

3 GREENHOUSE GAS EMISSIONS ANALYSIS

Since energy-related activities are the most significant contributor to US greenhouse gas emissions, the greenhouse gas emissions under each proposed alternative will be calculated based on both direct and indirect energy consumption discussed in Chapter 2. As 83 percent of energy-related greenhouse gases is carbon dioxide (CO_2) emissions, the EIS will consider CO_2 as the representative greenhouse gas emission and predict CO_2 levels for each alternative.

3.1 Direct Energy Related CO_2 Emissions

For CO_2 emissions from project direct energy consumption, it is assumed that the energy consumed from vehicles is a result of the combustion of vehicle gasoline or diesel fuel. Carbon emission coefficients vary between gasoline and diesel fuel types. Therefore this analysis will employ carbon emission coefficients for both fuel types to calculate the CO_2 emissions related to the direct energy consumption levels associated with the roadway and rail operations. Direct energy consumption levels discussed in Chapter 2 will be divided into gasoline direct energy and diesel direct energy for both roadway vehicles and transit vehicles as below:

- Roadway vehicles: the total VMT levels used for direct energy calculations will be divided into two types of fuel, gasoline and diesel, based on the applicable gasoline and diesel vehicle registration distribution profile used in the Mobile6.2 emission factor model.

- Transit vehicles:
    - Buses: the gasoline and diesel fuel percentage to be applied to divide the total transit bus VMT will use appropriate published transit bus mix data (e.g., MTA data).
    - Rail line miles traveled assuming all diesel-powered equipment.

Both gasoline and diesel carbon emission coefficients provided in NYSDOT's energy analysis guidance (December 2003) will be used in predicting direct energy related CO_2 emissions.

3.2 Indirect Energy Related CO_2 Emissions

For CO_2 emissions from indirect energy consumption from construction activities, it is assumed that the energy consumed is a result of diesel fuel usage only. Therefore, the carbon emission coefficients for diesel fuel will be used to calculate the CO_2 emissions related to the indirect energy consumption levels associated with the construction activity discussed in Chapter 2. The diesel fuel coefficient is provided in NYSDOT's energy analysis guidance (December 2003).

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Appendix D

Proposed Ecological Investigations within the Hudson River and Along the I-287 Corridor

Thruway Authority

New York State Department of Transportation

Metro-North Railroad

TAPPAN ZEE BRIDGE/I-287
ENVIRONMENTAL REVIEW

New York State Department of Transportation
New York State Thruway Authority
MTA Metro-North Railroad

Proposed Ecological Investigations within the Hudson River and Along the I-287 Corridor

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Version 6

March 10, 2006

EarthTech
A tyco International Ltd. Company

Version History

Version 1	Date 9/5/03	Presented to NYSDEC at a meeting on September 8, 2003.
Version 2	Date 9/16/03	Revisions based on NYSDEC comments. Presented to federal/state agency at a meeting on September 18, 2003.
Version 3	Date 10/03	This version reflects comments received at the Sept 18, 2003 federal/state agency meeting and at the follow-up meeting with NYSDEC on September 25, 2003. In addition, follow-up comments to the September 18 meeting have been received from NYSDOS (email) and USFWS (correspondence) and have also been reflected in this version. As requested by the agencies, this version identifies proposed in-river sampling locations.
Version 4	Date 3/1/04	Revised based on most current understanding of Level 2 Alternatives for meeting with National Marine Fisheries Service on March 2, 2004.
Version 5	Date 10/14/05	Revised based on recommended DEIS alternatives. Revised fish sampling methodology based on telephone conversation with NOAA Fisheries sturgeon permit personnel in Silver Springs, MD and with NOAA Fisheries in Gloucester, MA.
Version 6	Date 3/10/06	Revised based on comments received from NYSDEC Region 3 on November 30, 5005, Earth Tech responses of December 23, 2005, and final scope agreement reached on January 10, 2006.

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1 Introduction/Background

This document provides a description of field investigations that will be conducted to characterize ecological resources in the Tappan Zee Bridge/I-287 Project study area. A detailed and comprehensive review of available ecological data for the Tappan Zee Bridge/I-287 Corridor has demonstrated the need for collection of additional ecological information to adequately characterize study area ecosystems prior to preparation of the project's Environmental Impact Statement (EIS).

For convenience, the corridor has been bifurcated into ecological resources of the Hudson River and those resources along the I-287 highway corridor that runs between Suffern and Nyack in Rockland County and Tarrytown and Port Chester in Westchester County. This division, however, is not intended to suggest that a definitive boundary can be drawn between the study area's ecological resources.

1.1 Study Area for the I-287 Corridor

The study area for the I-287 corridor extends from Suffern to Port Chester, New York and for purpose of this program consists of the following three components:

- Terrestrial, wetland, and aquatic habitats within and immediately adjacent to the I-287 Right-of-Way (ROW) from Exit 15 in Suffern to the I-287/I-95 interchange in Port Chester (excluding the Tappan Zee bridge).

- Rail lines and the terrestrial, wetland, and aquatic habitats within and immediately adjacent to their ROWs that may be potentially affected by the various project alternatives.

- Undeveloped areas that may be selected for the construction of new transit stations, rail yards, and parking areas in Rockland and Westchester Counties.

Within the study area a mix of terrestrial, freshwater wetland, and aquatic habitats are present. Terrestrial habitats include wooded areas, young and old fields, and maintained grass areas adjacent to the roadway. Wetland habitats include forested, shrub/scrub wetlands, and emergent wetlands. Approximately two dozen rivers, streams, and other waterbodies cross the study area and provide important aquatic habitat.

Project highway and transit alternatives (e.g., widening of I-287, construction of rail lines and stations, improvements to adjacent arterials, etc.) may affect ecosystems along I-287 east and west of the Hudson River from Suffern to Port Chester, NY. Ecological field investigations will be conducted in the corridor to identify locations where potential impacts to natural resources may occur. Most project construction activities would occur within and immediately adjacent to the I-287 corridor.

1.2 Study Area for Hudson River Crossing

Construction of a new bridge across the Hudson River may potentially cause disruptions to various habitats that occur within that ecosystem. Habitats that could be disrupted include wetlands, submerged aquatic vegetation, benthic and deepwater habitats. In addition, removal of the existing bridge could impact a micro-habitat consisting of existing bridge structures that provide a hard substrate to which sessile estuarine organisms affix themselves and that also provide shelter for motile organisms. The ecological study area for the Hudson River is derived from an assessment of the likely alignment of new river crossings that will be evaluated in the EIS. The study area includes those portions of the river under the existing bridge and within a 1,000-foot swath north of the bridge. Also included are a 1,000 by 4,000-foot swath along the east and west shores of the Hudson River where the bridge connects to land, and a narrow band along the eastern shoreline, about a mile south of the bridge, where rail connections may be made to the existing Hudson Division Tracks.

1.3 Replacement Bridge Options

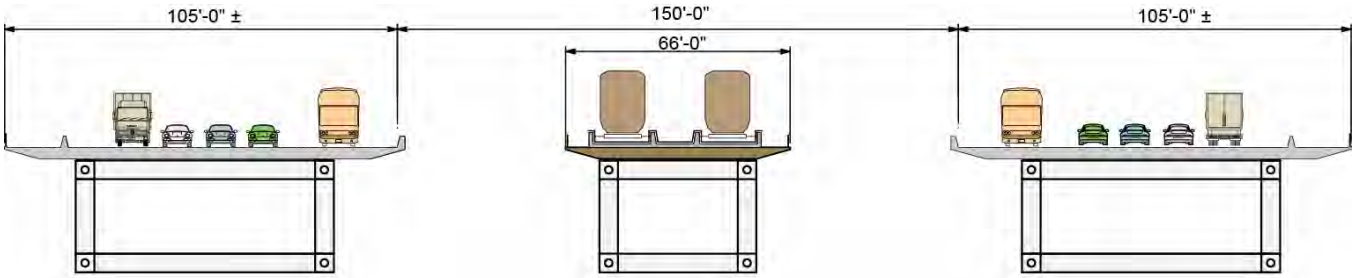
In the Alternatives Analysis (AA) process for this project, a number of bridge alignments and cross-sections were studied. The process recommended that the new bridge alignment be just north of the existing bridge (Figure 1-1). Two generic types of cross-sections were analyzed:

- Single-Level Bridge, where all highway traffic and transit modes are on one level (Figure 1-2). The total estimated area occupied by pilecaps in the river would be 8 acres.

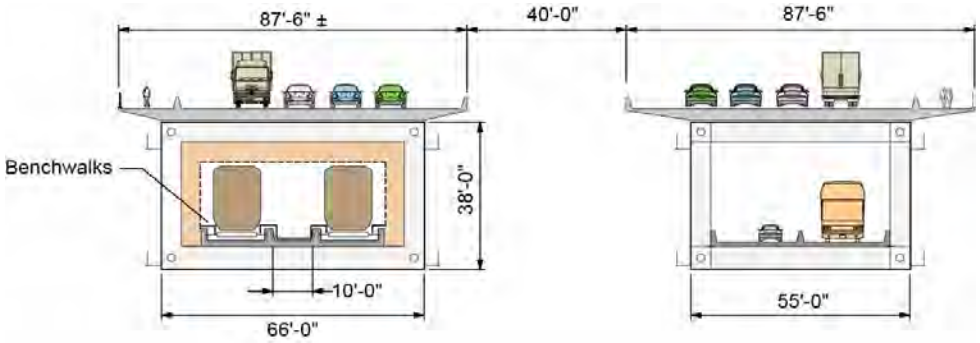
- Dual-Level Bridge, where highway traffic is on the upper level and transit modes on the lower level (Figure 1-3). The total estimated area occupied by pilecaps in the river would be 6 acres.

Both concepts will be carried forward into the EIS.

Potential Replacement Bridge Alignment
Figure 1-1



Conceptual Single-Level Bridge Cross-Section
Figure 1-2



Conceptual Dual-Level Bridge Cross-Section
Figure 1-3

2 Existing Ecological Data

A detailed review of available literature was performed that focused on fish, shellfish, benthic macro invertebrates, plankton, sub-aqueous vegetation, water chemistry, sediment chemistry, sediment toxicity, avian fauna, terrestrial wildlife, bathymetry, tidal fluctuations, currents, wave conditions, turbidity, state wetland and National Wetland Inventory maps, and existing aerial photography. This historic data collection effort centered on an area from Stony Point in the north to Spuyten Duyvil in the south for the Hudson River and from Suffern to Port Chester, New York for the corridor.

Information was collected from natural resource agencies and other appropriate entities including: US Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), New York State Department of Environmental Conservation (NYSDEC), New York State Department of Transportation, New York State Thruway Authority, US Environmental Protection Agency, Army Corps of Engineers, several universities (*e.g.*, Rensselaer Polytechnic Institute, Columbia University, New York University), Westchester and Rockland County agencies, and several municipalities within the study area. Based on these data collection efforts, baseline reports were prepared that provide the basis for establishing the project's study area and the monitoring and sampling that are proposed within the study area.

2.1 Hudson River Data

2.1.1 Sediments

Construction of a new bridge may potentially involve dredging, and therefore, entail the disposal of dredged sediments. In addition, dredging and other construction activities may resuspend sediments thereby resulting in the degradation of downstream and upstream water quality. An analysis of dredged material management and sediment resuspension requires obtaining data on the degree and depth of contamination in study area sediments.

Sediment core and grab chemistry data were obtained from various sources including:

- Bopp (1979), Ph.D. Dissertation.
- Chillrud (1996), Ph.D. Dissertation.
- NOAA's Watershed Database.
- NYSDEC's New York State Sediment Chemistry Database.
- NYSDEC's Biocriteria Project (Versar, 2003 unpublished data).

Samples collected by these investigations were generally analyzed for metals, PCBs, PAHs, and pesticides.

In addition, sediment data from the NYSDEC's Benthic Mapping Project, available as of November 2002, were reviewed. However, these data were derived from samples collected one-mile and further north of the Tappan Zee Bridge and provide geophysical information and not sediment chemistry. Recent discussions with NYSDEC on this program indicate that there are additional geophysical data (not sediment chemistry) available for locations nearer to the bridge. These data will be reviewed for applicability to the EIS.

As shown on Figure 2-1, virtually all of the available sediment chemistry data have been collected outside the study area and are primarily limited to surface grabs. However, based on conversations with Richard Bopp, as well as available information on dated cores, the Tappan Zee reach is not a significant depositional location in the Hudson River. Given the available information, it is therefore expected that the depth of contamination is primarily limited to the top 2 to 3 feet of sediment.

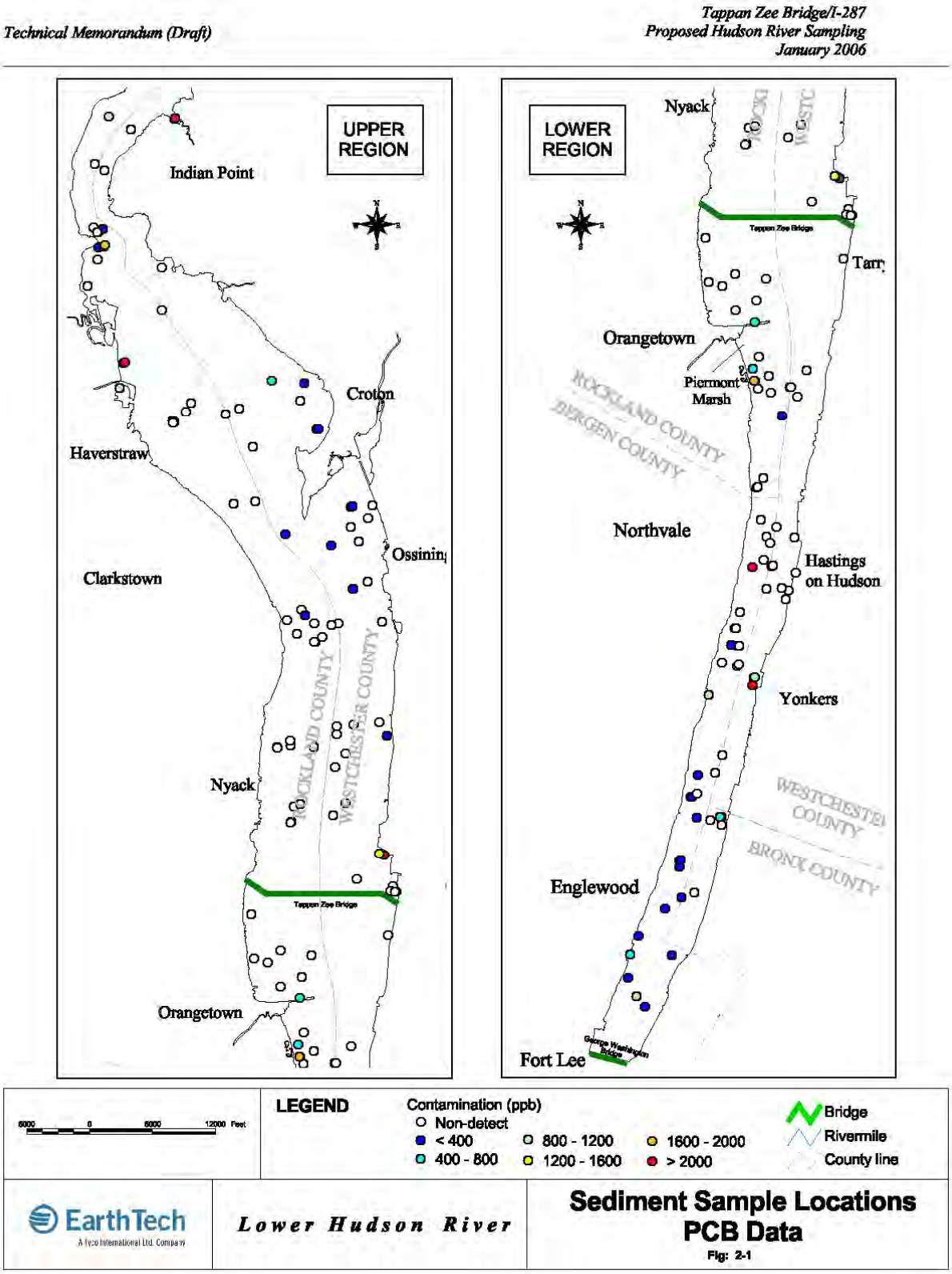
2.1.2 Benthic Macro-Invertebrates

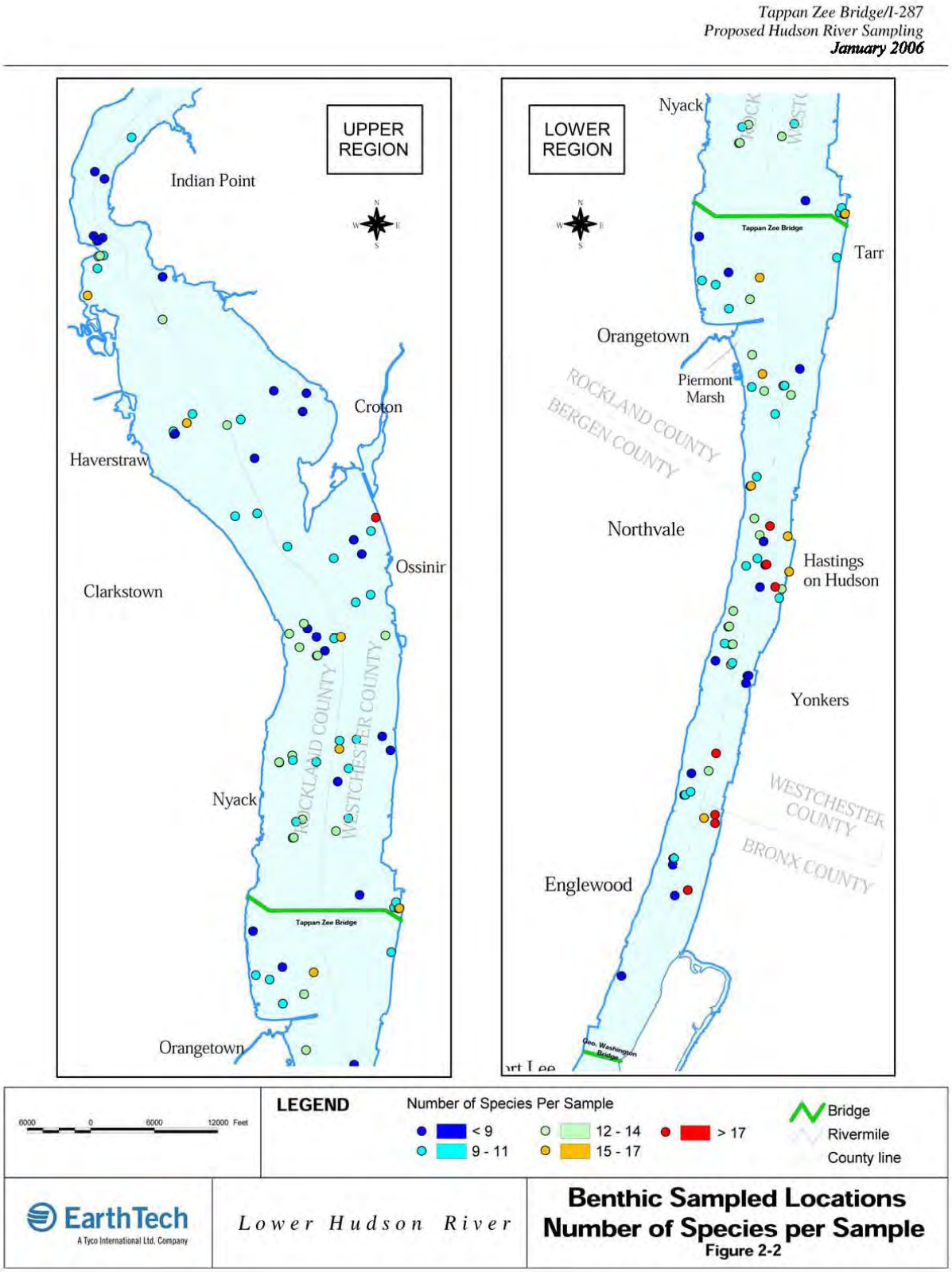
Benthic organisms are an essential resource for the Hudson River's fish populations. Impacts to benthic communities resulting from project construction can be considered an indirect impact to the viability of those fish that rely on this resource. Consequently, it is necessary to characterize the benthic community in the study area so that project impacts to fisheries can be addressed in the EIS.

For the NYSDEC Bio-criteria Program (2000 and 2001), Versar, Inc. collected 130 Hudson River benthic community samples between river miles (RM) 11 and 40 (Figure 2-2). The samples with the highest number of species per sample were collected generally south of the Tappan Zee Bridge, while samples with the lowest number of species per sample were collected north of the Tappan Zee Bridge. The number of samples collected in the project study area (the available data suggests only two samples) is considered inadequate to address potential construction and operational impacts on the benthic community.

2.1.3 Zooplankton

Zooplankton survey data were not found for the study area during a search of historic data sources. The available data are limited to the years 1977 and 1978 for the area from the George Washington Bridge south to the Narrows. These data show that copepods were the most abundant group of zooplankton in the estuary and the Hudson River plume.


Technical Memorandum (Draft)
Tappan Zee Bridge/I-287
Proposed Hudson River Sampling
January 2006
UPPER REGION
Indian Point
Croton
Haverstraw
Ossining
Clarkstown
ROCKLAND COUNTY
WESTCHESTER COUNTY
Nyack
Tappan Zee Bridge
Orangetown
LOWER REGION
Nyack
Tarry
Orangetown
Piermont Marsh
ROCKLAND COUNTY
BERGEN COUNTY
Northvale
Hastings on Hudson
Yonkers
WESTCHESTER COUNTY
BRONX COUNTY
Englewood
Fort Lee
LEGEND
Contamination (ppb)
Non-detect
< 400
400 - 800
800 - 1200
1200 - 1600
1600 - 2000
> 2000
Bridge
Rivermile
County line
EarthTech
A Tyco International Ltd. Company
Lower Hudson River
Sediment Sample Locations
PCB Data
Fig: 2-1


Tappan Zee Bridge/I-287
Proposed Hudson River Sampling
January 2006
UPPER REGION
Indian Point
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Ossinir
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ROCKLAND COUNTY
WESTCHESTER COUNTY
Nyack
Tappan Zee Bridge
Orangetown
LOWER REGION
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Piermont Marsh
ROCKLAND COUNTY
BERGEN COUNTY
Northvale
Hastings on Hudson
Yonkers
WESTCHESTER COUNTY
BRONX COUNTY
Englewood
Geo. Washington Bridge
6000 0 6000 12000 Feet
LEGEND
Number of Species Per Sample
< 9
9 - 11
12 - 14
15 - 17
> 17
Bridge
Rivermile
County line
EarthTech
A Tyco International Ltd. Company
Lower Hudson River
Benthic Sampled Locations
Number of Species per Sample
Figure 2-2

2.1.4 Fish and Shellfish

Project related construction work could directly impact Hudson River fish populations by removing habitat, resuspending sediment, and generating physical intrusions. To evaluate the potential for and severity of such impacts, it is necessary to establish the extent to which fish populations utilize the study area.

Hudson River fisheries data have been collected by the Hudson River electric utilities since 1974 when initial operating licenses were issued for their on-river generating stations. These data, primarily consisting of larval and juvenile fish, have been used to evaluate in-river distributions of important Hudson River fishes and as such will be used to characterize fish populations in areas adjacent to the bridge. However, they do not provide information on the value of the habitat afforded by the existing bridge piers and the presence of adult fish.

Blue crabs (*Callinectes sapidus*) are considered the most important shellfish inhabiting the Tappan Zee reach. They use the Tappan Zee reach for essential ecological purposes and are a species of concern that is managed under the Fish and Wildlife Coordination Act. From a search of historic records, information on blue crab abundance and tissue contaminant data have been found. The abundance of crab was examined from May to November 1989, May to October 1990, June to October 1991, and June 1992 at 10 sites between the Beacon-Newburgh area of the Hudson River and New York Harbor. Blue crabs were sampled monthly using an otter trawl and throw trap (Wilson and Able, 1992). In addition during calendar years 2000 and 2001 NYSDEC conducted surveys of commercial crab fisherman and, as a result, developed additional information on blue crab use of the Tappan Zee area.

2.1.5 Avifauna

The Hudson River serves as a habitat resource for numerous resident and migratory avian species. Construction of new river crossings will involve work in near shore areas that are potential habitats for both migratory and resident avifauna. Thus, it is necessary to determine the extent to which avifauna utilize the study area in order to assess potential impacts that project development will have on these populations.

General avian data have been collected by the NYSDEC Breeding Bird Atlas survey (1980 to 1985 and 2000 to 2002) and the Audubon Society's annual Christmas count in 2002. However, avifauna survey data, specific to the study area, have not been found. Birds on the New York State Threatened/Endangered/Special Concern list that regularly occur 3 miles south of the study area (*i.e.*, Piermont Marsh) include:

- Peregrine falcon (*Falco peregrinus*) (nesting on the Tappan Zee Bridge).
- Short-eared owl (*Asio flammeus*)**.**
- Pied-billed grebe.
- Least bittern (confirmed breeder).
- American bittern.

- Bald eagle **(***Haliaeetus leucocephalus*).
- Northern harrier **(***Circus cyaneus*).
- Osprey (*Pandion haliaetus*).
- Sharp-shinned hawk **(***Accipiter striatus*).
- Horned lark (*Eremophila alpestris*).
- Brant (*Branta bernicla*).
- American black duck.
- Willow flycatcher **(***Empidonax traillii*)**.**

In addition, a member of the Rockland County Audubon Society reported that three peregrine falcons, three or more ravens, and two bald eagles have been observed below Hook Mountain, Rockland County, New York. That individual also indicated that the peregrines and the ravens had been nesting on the cliff face for 2 or more years.

2.1.6 Mammals

It is likely that the shoreline of the Hudson River is used as a resource by a variety of mammals including coyote, beaver, otter, and others. Construction of a new river crossing will involve extensive work along both east and west river shorelines where it can be expected that these species will be found. Thus, it is necessary to know the extent to which mammals utilize study area resources in order to evaluate project impacts.

Data collected by NYSDEC, including pelt sealed records from 1996 to 2002 for otter, coyote, and beaver, are available for Rockland and Westchester Counties. However, mammal data, specific to the study area, have not been found.

2.1.7 Submerged Aquatic Vegetation (SAV)

Submerged aquatic vegetation provides vital habitat and food resources for a variety of fish as well as the organisms on which fish prey. This habitat type is typically found in shallow areas, such as the west side of the Hudson River in the study area. Since considerable construction work can be expected within the river's shallow reaches, should a new crossing be constructed, it is necessary to determine both the extent and the quality of the SAV habitat that occurs in the study area in order to assess project impacts. NYSDEC has recently mapped SAV beds in the Hudson near Tappan Zee. While the mapping provides important information on the range of SAV habitat it is not expected to provide the level of detail needed for the EIS.

2.1.8 Tidal Wetlands

Wetlands provide shelter and food resources for fish and other aquatic organisms in the Tappan Zee reach, and as such, are an important habitat resource. Within the Tappan Zee, wetlands are typically found in shallow waters along the shoreline, within embayments, and at the mouths of streams. Wetlands are also afforded significant protection under various federal and state conservation programs. Since considerable construction work can be expected along the river's shoreline, and in shallow water environments, it is necessary to determine both the extent and the quality of wetlands that may be impacted by project alternatives.

NYSDEC considers the near shore area at Tappan Zee to be either tidal or fresh water wetland as identified on recent and historic maps that have been generated by the agency. In addition, the presence of mapped and unmapped wetland resources has been identified during the earlier data compilation efforts.

2.1.9 Hyrodynamic and Geophysical Data

Project related activities such as dredging, movement of construction vessels, and construction of bridge foundations have the potential to resuspend sediments. Suspended sediment can physically impact fish and benthic organisms and change local water quality conditions. Therefore, in order to determine impacts resulting from the project's construction activities, it is necessary to determine the extent of potential sediment-related influences on the ecosystem in the study area.

Available hydraulic, hydrographic and geophysical data for the Hudson River have been obtained and reviewed (McFadden, 1978; Lamont Doherty Earth Laboratory, 2002). While the available data is a significant resource, and is sufficient to provide a general assessment of conditions in the Tappan Zee reach, more refined information for the immediate bridge vicinity (hydrographic, hydraulic, and geophysical data) is needed. Thus, an element of the program presented herein includes collecting additional geophysical data, tidal elevation readings north and south of the bridge, and tidal velocity profiles.

2.2 I-287 Corridor Ecology

2.2.1 Wetlands

Wetlands are important components of the regional and local ecology in the area of the project corridor. Wetlands provide numerous ecological values such as serving as areas of flood water retention, primary production, habitat resource, etc. As such, the US Army Corps of Engineers and NYSDEC regulate impacts to wetlands. In order to determine wetland resources within the project corridor, several reference resources were consulted including the following:

- National Wetland Inventory (NWI) mapping.

- NYSDEC freshwater wetlands maps.
- Field visits during the Fall, 2002 and Spring, 2003.

Based on a review of wetland maps and field visits to the I-287 Corridor, the majority of the wetlands within the project corridor are palustrine, emergent, shrub-scrub, and/or forested wetlands. The wetlands vary in size from small linear ditches adjacent to roadways to large complexes measuring several hundred acres in size.

The NYSDEC classifies mapped wetlands into Classes I-IV depending on their ecological value. Class I wetlands, the most valuable, are often adjacent to drinking water sources and/or serve as habitat to threatened and endangered species. Within the project area there are several Class I and II wetlands.

2.2.2 Terrestrial and Aquatic Ecology

2.2.2.1 Terrestrial Ecology

Review of the United States Department of Agriculture (USDA) Forest Service's Map of Ecological Units indicates that the project corridor lies within three ecological units. Ecological units are areas of similar physical makeup (e.g., vegetation, soils, altitude, etc.). The three units are as follows:

- ***221Ae Hudson Highlands*** –Vegetation associated with this ecological unit include hemlock-white pine (*Tsuga canadensis-Pinus strobus* L.) forest, red oak (*Quercus rubra* L.)-white pine and sugar maple-Chinquapin oak (*Acer saccharum-Quercus prinoides*) forests. This ecological unit varies in elevation from 1,000 to 1,500 feet and is typically situated on open high hills and steep sided valleys.

- ***221Dc Newark Piedmont*** –. Vegetation associated with this ecological unit includes oak-heath dry forest, sugar maple-Chinquapin oak forest, red maple-black ash (*Fraxinus nigra*) swamp, and freshwater and tidal marshes. This ecological unit varies in elevation from sea level to 879 feet and is typically situated on gently rolling broad lowlands with high ridges

- ***221 Ad Southern New England Coastal Lowland*** –Vegetation associated with this ecological unit includes hemlock-white pine-oak and red oak-hardwood forests, and maritime dune communities. This ecological unit varies in elevation from sea level to 600 feet and is typically situated on gently irregular plain and hills.

Review of the NYSDEC website indicated that there are no Bird Conservation Areas or Wildlife Management Areas in and/or adjacent to the project corridor; however, several large tracts of

undeveloped land occur near the I-287 corridor. Large tracts of undeveloped land are a valuable habitat resource, especially given the level of development in and around the project corridor.
On the basis of field visits to the project corridor it was determined that there are various terrestrial habitats along I-287 including young and old fields, wooded areas, maintained grass areas, etc. These areas provide habitat resources for terrestrial flora and fauna.

2.2.2.2 Threatened and Endangered Species

As stated in correspondence from USFWS, no federally threatened or endangered species have been identified as occurring in the corridor. Four threatened and endangered species have been identified by the New York State Natural Heritage Program (NHP) as potentially occurring in the study corridor (Table 2-1).

Table 2-1

State Threatened and Endangered Species Observed in the Study Corridor Region

Species		Status
Common Name	Scientific Name	
Pied-billed grebe*	*Podilymbus podiceps*	Threatened
Bog turtle*	*Clemmys muhlenbergii*	Endangered
Timber rattlesnake*	*Crotalus horridus*	Threatened
Peregrine falcon**	*Falco peregrinus*	Endangered
Notes: * Observed only in Rockland County. ** Observed only in Westchester County.		

Based on conversations with NYSDEC personnel, it was determined that no known occurrences of the pied-billed grebe, bog turtle, or timber rattlesnake have been documented within 100 to 200 feet of the roadway. However, the peregrine falcon is known to nest on the bridge. During the corridor ecological investigation, areas that are observed to be suitable habitat for State listed threatened and endangered species will be noted and will be further investigated for the presence and/or evidence of these organisms. Suitable habitats for these three species and the peregrine falcon are as follows:

- **Pied-billed Grebe Habitat** – This species nests in freshwater marshes associated with slow-moving rivers or ponds, lakes, bogs, and impoundments. Breeding sites are typically interspersed with submerged or floating aquatic vegetation and dense emergent vegetation in depths ranging from 1 to 6.5 feet.

- **Bog Turtle Habitat** – The bog turtle is generally found in open, early successional types of habitats such as wet meadows or open calcareous boggy areas generally dominated by sedges (*Carex spp.*) or sphagnum moss. The turtle requires habitats with a good deal of solar penetration for basking and nesting.

- **Timber Rattlesnake Habitat** – Rattlesnake dens are typically located on a rocky, sparsely to moderately wooded steep slopes that face the southwest.

- **Peregrine Falcon Habitat** – Falcons nest on high ledges, 50 to 200 feet off the ground.

2.2.2.3 Aquatic

Several resources were consulted in order to obtain information on surface water resources in the project. These resources included the following:

- NYSDEC surface water classifications.
- New York State 303(d) List of Impaired Waters.
- NYSDEC website to obtain information on trout waters and trout stocking schedules in the project corridor.

From a review of the above regulations and publications, it was determined that surface waters within the project corridor have classifications ranging from Class A Drinking Waters to those identified on the State's 303(d) List of Impaired Waters. Also, several water bodies that cross the highway corridor are listed as trout streams. Therefore, aquatic sampling will be conducted in several study area streams in order to quantify potential project impacts to ecologically important water courses.

3 Hudson River Sampling Program

Documentation of current ecological conditions within the Hudson River portion of the study area will be accomplished by means of a series of ecological field investigations. The configuration of the particular field investigation tasks described herein is based on a review of data collected from numerous sources (as described in Chapter 2) including federal and state agencies, private parties that either operate or have proposed to operate facilities on the river, and several meetings with federal and state resource agencies.

3.1 Sediments

Sediment sampling locations are linked to the potential project river crossing options and associated temporary work areas in the river. As shown on Figure 3-1 sediment sampling will occur in locations anticipated to be disturbed as a result of removal of the existing bridge (near field) and construction and operation of a replacement bridge.

Near field sediment sampling based on the removal of the existing bridge will occur at 10 stations along a transect within 50 feet of the existing bridge. For the replacement bridge, sediment sampling will occur at 10 stations along two transects (northside) within 1,000 feet of the existing bridge and at four locations each along a) the southeast shoreline for the potential rail right-of-way expansion in the river, b) the southeast side of the existing bridge for a potential temporary causeway, and c) the southwest side of the existing bridge for a potential temporary causeway.

Sampling will be conducted by means of piston or vibra-cores with sediment samples retrieved at one foot intervals from each core which on average is expected to be 6 feet in length. Sediments will be collected from 42 locations for a total of 252 samples plus necessary QA/QC samples. The cores will be processed, cut into 1-foot segments, photographed and logged, and shipped to a NYSDEC approved laboratory for analysis. The sediment samples from each 1-foot segment will be analyzed for semi-volatile organics, pesticides, metals, polychlorinated biphenyls (PCBs), with one-quarter of the samples being analyzed for dioxins. Each core segment will also be analyzed for geotechnical parameters including grain size distribution (including fine-grained materials), Atterberg limits, moisture content, total solids content, organic content and specific gravity. The analysis of the cores will be phased so that the top three samples corresponding to the top 3 feet will be analyzed while the remaining three samples will be frozen until it is deemed necessary to perform the analytical work. This will result in a total initial analysis of at least 126 samples.

Sediment sample locations will be located within both scour and depositional areas near bridge piers and where possible under the bridge itself. This information will be relevant to evaluating impacts to biotic resources due to sediment borne contaminants potentially being released into the water column during construction and demolition activities.

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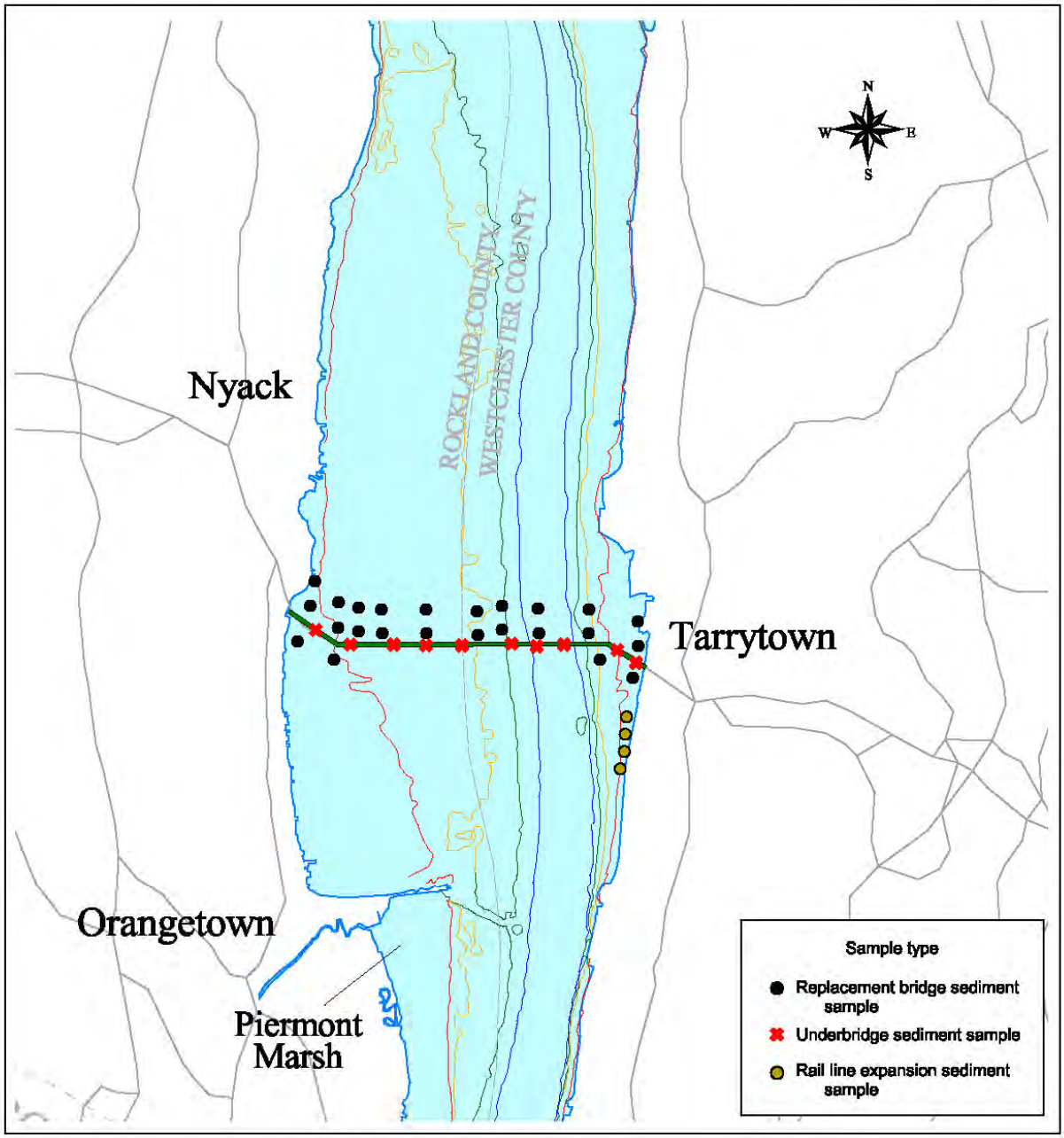

2000 0 2000 4000 Feet

LEGEND

Bridge
Rivermile
County line
Road

Bathymetry (feet)
6
12
18
30

EarthTech

Lower Hudson River

Sediment Sampling
Figure 3-1

Lamont-Doherty Earth Observatory of Columbia University will conduct geophysical surveys that will assist in selecting sediment sampling locations, calculation of sediment volumes, mapping the extent of sedimentary units, identifying the locations of existing or emerging oyster reefs, and identifying the locations of potentially significant cultural/archeological objects. This work will occur in a 1,000 foot swath north and south of the existing bridge and a 1,000 x 4,000 foot swath along the east and west side of the Hudson River where the bridge connects to the shore. Sub-bottom profiling will be used to accurately image the sediment below the surface. Sub-bottom data have been successfully used for predictions of erosion and deposition.

3.2 Benthic Macro-Invertebrates

Benthic macro-invertebrate sampling locations are linked to the construction and demolition activities that will be evaluated in the EIS. As shown on Figure 3-2, benthic sampling will occur in locations anticipated to be disturbed during either the removal of the existing bridge or construction and operation of a replacement bridge.

With regard to removal of the existing bridge, benthic community sampling will occur at 11 stations along a transect within 50 feet of the bridge. In addition, 11 benthic sampling stations will be placed along two northside transects within 1,000 feet of the existing bridge, and at four locations each along a) the southeast shoreline for the potential rail right-of-way expansion in the river, b) the southeast side of the existing bridge for a potential temporary causeway, and c) the south west side of the existing bridge for a potential temporary causeway. Benthic sample locations will be within both scour and depositional areas near bridge piers and, where possible, under the bridge itself. Sampling sites will be selected in consultation with NYSDEC staff based on the bathymetry and sediment texture maps that will be developed as part of the EIS program.

Sampling will be conducted bimonthly over a one-year time frame concurrent with the fish sampling. Sampling methods will include use of a modified Van Veen grab. Three replicates per location will be collected. Samples will be sieved in the field through a No. 35 mesh (0.5mm), preserved in 70 percent ethyl alcohol and rose bengal and shipped to a laboratory for identification to the lowest practicable taxon. Species identifications will be verified by a third party. In situ water quality measurements (i.e., temperature, dissolved oxygen, and salinity) will be collected at each station.

3.3 Zooplankton

Zooplankton surveys are not planned as part of this field investigation effort as it is not anticipated that construction and operation of project alternatives would significantly affect zooplankton populations in the Hudson River. Available data will be used to generally characterize populations in the study area.

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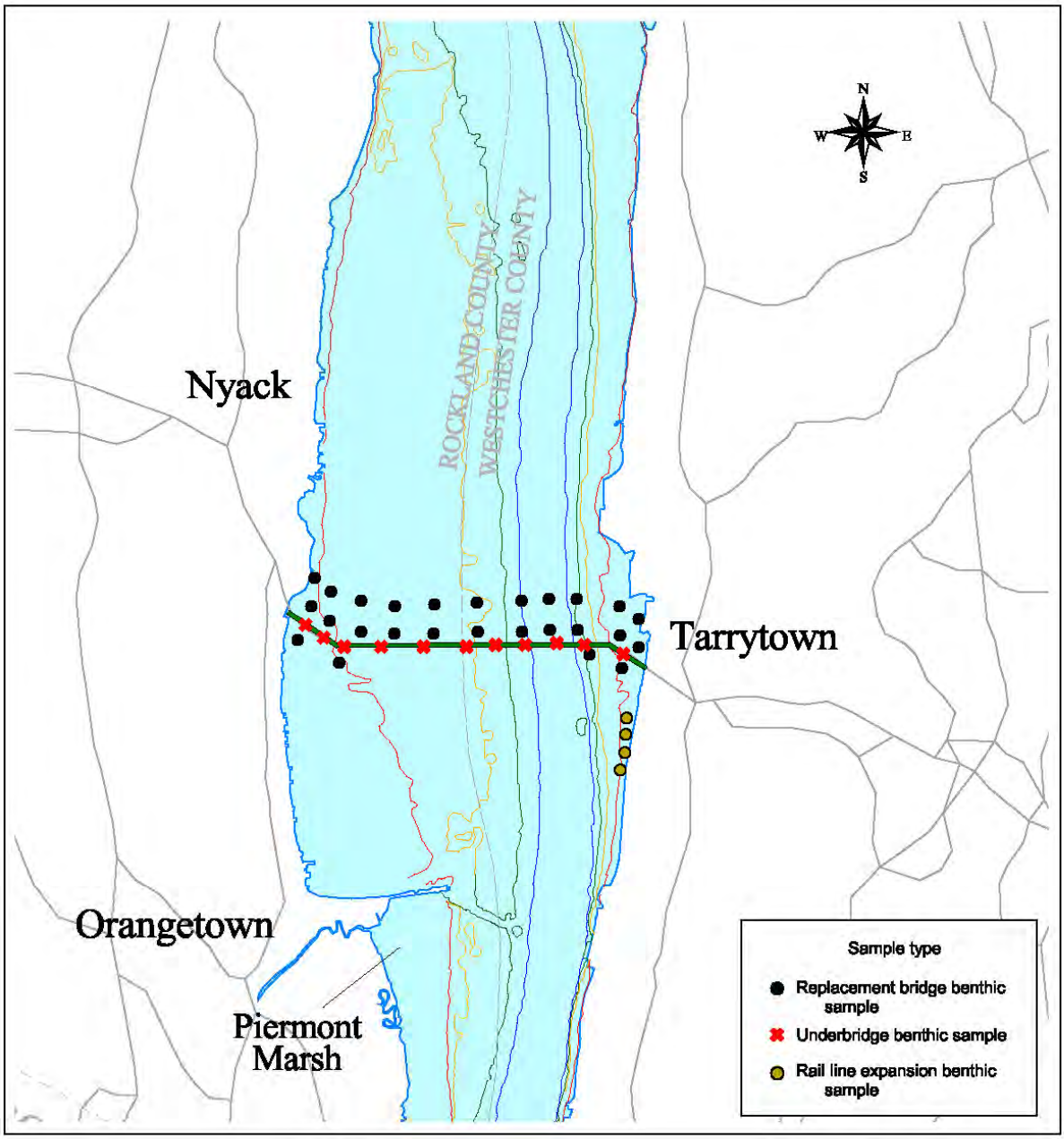

2000 0 2000 4000 Feet

LEGEND

Bridge
Rivermile
County line
Road

Bathymetry (feet)
6
12
18
30

EarthTech
A Tyco International Ltd. Company

Lower Hudson River

Benthic Sampling Locations
Figure 3-2

3.4 Fish and Shellfish

As shown on Figure 3-3, fish sampling will occur at locations anticipated to be disturbed by the removal of existing bridge and construction and operation of a replacement bridge. Bimonthly sampling will be conducted, using multiple fish traps, and gill nets at six locations directly adjacent to and underneath the bridge to enable a determination of habitat conditions near the existing bridge. In addition, three locations comparable in depth and bottom type to the bridge sampling locations, will be selected as reference sampling locations. These reference locations will be sited approximately 700 feet north of the bridge. Comparable sampling methods and materials will be used at the bridge and reference locations. Comparability between the open water reference and bridge habitat will be assessed using density and catch per unit effort estimates and fish species abundance.

Fish sampling will be conducted every other month over a two-week time frame during a calendar year. Bimonthly sampling will allow identification of seasonal variations in fish populations in the immediate bridge vicinity. Specific dates and actual activity duration will depend on vessel availability and weather. At each sample and reference location, between the 6 foot and 16 foot bathymetric contour, experimental gill nets will be set perpendicular to the river flow. If problems arise due to net lay-down, the gillnets will then be set in line with river flow. The gill nets will be 8 feet high by 125 feet long and consist of 5 gill net panels (25 feet per panel) having mesh sizes ranging between 1 and 5 inches (*i.e.*, 1”, 2”, 3”, 4”, and 5”). Although gill nets are manufactured with float lines and lead lines, additional large surface floats will be added to assist in keeping the net vertical in the water. These attached safety orange floats, similar to barrier buoys (18”x30”) or Poly Float Inflatable Buoys (19”), will be attached every 15 to 20 feet. In addition, within 100 feet of the gill nets marker buoys will be set to provide a warning to navigation. The attached lead line will be supplemented with additional weights (1 to 2 lb. dive belt weights) every 15 to 20 feet to keep the net on the river bottom.

The gill nets will be set in place using 2 inch steel piping at either end and at mid-net; the piping will be driven into the sediment using a slide hammer. The piping will consists of 10 foot sections that are connected together by threaded joints and driven to a maximum embedment of 6 feet. Each section of pipe will be painted with 1 foot markings to ensure that the bottom of the net is sitting on the river bottom. The nets will be attached at the top and bottom of the pipe to a welded ring using thimbles. In addition, it may be possible, at bridge piers, for the top of the net to be tethered to bridge fenders for additional support.

In addition to the gill nets, the presence of adult fish will be monitored by acoustic surveying using methods similar to a didson camera (Sound Metrics Corp.) or an acoustic echo sounder (BioSonics) during the bimonthly sampling effort.

Data collected by the Hudson River electric utilities since 1974, primarily consisting of larval and juvenile fish, will be used to characterize fish populations in the areas adjacent to the bridge. However, those data do not provide information on the value of the habitat afforded by the existing bridge piers nor do they identify the presence of adult fish.

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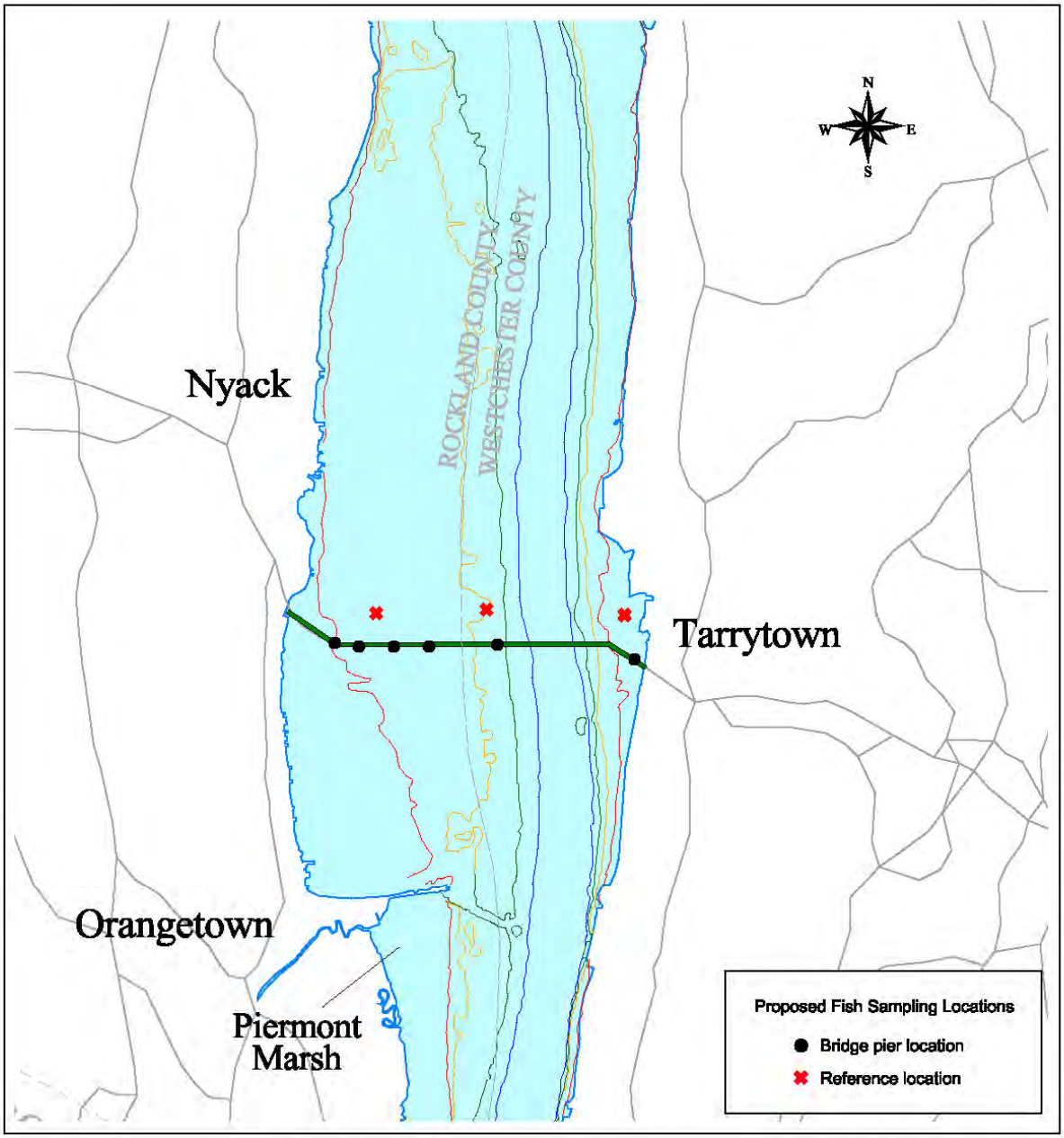

2000 0 2000 4000 Feet

LEGEND

Bridge
Rivermile
County line
Road

Bathymetry (feet)
6
12
18
30

EarthTech

Lower Hudson River

Proposed Fish Sampling Locations
Figure 3-3

Two un-baited fish traps constructed of welded steel (91 x 46 x 30 cm) with 2 mm mesh stretched over the frame with a single V-shaped throat (2.5 x 46 cm) and a 3 mm nylon mesh cod end will be deployed per location sized for small, young of year fish. These traps will be weighted and marked with buoys for easy retrieval. The size of the throat will inhibit blue crabs from entering the traps thereby further reducing fish mortality.

To reduce fish mortality, sampling will occur for 4 hours at bottom temperatures <15°C and will not exceed 2 hours in water temperatures >15°C. These soak times are consistent with "*A Protocol for Use of Shortnose and Atlantic Sturgeons* (Moser et al. 2000). Captures will be identified by species and their lengths recorded. Entangled shortnose sturgeon will be held in a flow-through tank that will allow water replacement every 15 to 20 minutes and no longer than 2 hours when water temperatures are equal to or less than 27°C and no longer than 30 minutes when water temperature is >27°C.

In order to characterize the crab population under the existing bridge, from April to November one commercial baited crab pot will be deployed during the same period as the fish and benthic community sampling. This trap will, however, be placed at least 3 bridge sections away from fish sampling gear so that the bait does not attract fish. The trap will measure 24" x 24" x 20", have 4 ways in, a bait holder, and a lost trap crab release.

Finally, the presence of oyster reefs in the project area will be determined from a review of NYSDEC's Benthic Mapping Project and the output of the geophysical survey program proposed herein.

In addition to fish sampling, six locations on different bridge piers will be inspected by remote video methods to develop an understanding of the extent to which fish use these structures as habitat. If possible, contingent on diver safety, twenty 0.5 meter quadrats will be sampled by divers scrapping off attached organisms into sampling containers. If un-safe conditions exist and direct sampling is not possible then still photographs of the sample quadrats will be made to assist in identifying sessile and attached organisms.

3.5 Avifauna

Avian surveys will be conducted in each of four seasons over a 12-month time frame. Survey work will include a maximum of 15 survey days over a 2-month time period every quarter. Work will typically be performed in the early morning hours through mid-day. A maximum of four sites in the Tappan Zee area will be surveyed: two reference areas north of the existing bridge on either side of the river and one along each shoreline encompassing the reach immediately north and south of the existing bridge (Figure 3-4). The surveys will be performed on-river with two stations being surveyed per day. These surveys will be conducted by either anchoring or floating the survey vessel through each observation site over a 2-hour time frame. In-river surveys for falcons nesting on the bridge will span the full length of the structure.

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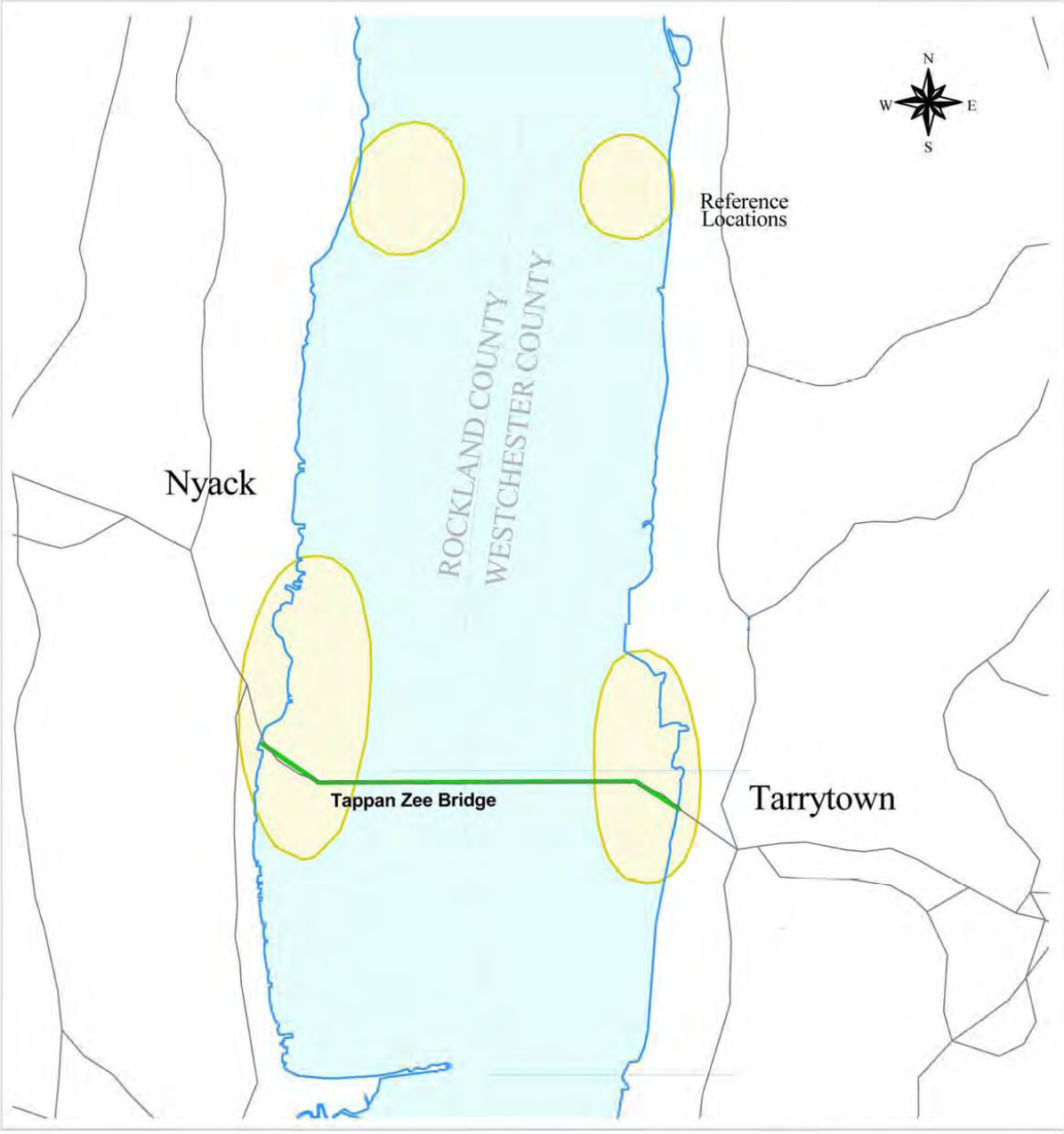


2000 0 2000 4000 6000 Feet

LEGEND

Area of Interest
Transect
Bridge
Rivermile

EarthTech
A Tyco International Ltd. Company

Lower Hudson River

Location of Proposed Avian, Mammal, Tidal Wetlands, and SAV Surveys
Figure 3-4

Avian ecologists will identify avifauna by visual and audible observations. When observed, avifauna will be identified to species and the number of individuals per species will be estimated. Furthermore, on-site activity of the avifauna would be noted. In this regard, the ecologist will assess whether the organism is passively (i.e., flying over at a high altitude) or actively (e.g., nesting, swimming, breeding/courtship displays, feeding, etc.) utilizing a particular site.

3.6 Mammals

Due to the lack of historic data, mammal surveys will be conducted to coincide with the avian surveys (Figure 3-4). However, additional land based locations along the river will be included in the program; no mammal trapping is planned. The surveys will occur in each of four seasons over a 12-month timeframe. Surveys will be conducted for a maximum of 15 survey days over a 2-month time period per quarter. Work will typically be performed in the early morning hours through mid-day. A maximum of six sites will be identified within the Tappan Zee study area. These surveys are intended to confirm the existence of certain mammal species that are known to prefer habitats of the type found in the study area.

3.7 Submerged Aquatic Vegetation (SAV)

Using NYSDEC mapping and aerial photography as a guide, surveys will be conducted in late summer to confirm the extent and characteristics of SAV in the study area. These surveys will be performed in the bridge study area along both shorelines (Figure 3-4). The investigations will be conducted during mid-late summer and will include observations to determine both the dominant SAV species and the range of species present. The SAV maps for the study area will be a composite of NYSDEC and survey data. In addition, the collection of biological community data from other sampling efforts (*i.e.,* benthic macro invertebrates, fish) will be used to evaluate potential impacts.

3.8 Tidal Wetlands

Surveys will be conducted in the bridge study area (Figure 3-4) to determine the extent of wetlands that may be impacted by the project. NYSDEC maps would be consulted to determine initial locations of wetland areas. These locations will then be “ground truthed” to confirm study area conditions and to characterize the wetland community. Also, non-mapped areas will be investigated for the presence of wetlands and these will be mapped, as well, as part of the overall wetlands investigation. The boundaries of observed wetlands would be recorded by GPS with a 1-meter radius of accuracy.

Upon completion of the observations and data collection, maps will be generated depicting the location of wetland communities and ecological habitats within the near shore zone. These maps will allow for an overlay of proposed project activities, and therefore, a determination of the extent of project impacts to wetlands.

3.9 Multi-Dimensional Water Quality Model

Field surveys for bathymetry, tidal fluctuations, and river velocities will be performed in the immediate bridge vicinity to supplement available information for other river reaches and to fill in data gaps for the project area. A hydrographic survey of the bridge vicinity will be conducted to:

- Provide a base on which to illustrate other geo-referenced data such as wetlands, SAV areas, and oyster reefs, among others.
- Assist in evaluating and understanding fish and benthic data (e.g., fish may prefer depressions in the river bottom near bridge piers).
- Aid in identifying other bottom features such as large debris fields that may impact selection of sample locations and sampling results.
- Provide a basis for estimating the volume of sediment that would need to be disposed.
- Enable development of a multi-dimensional model for estimating sediment resuspension and dispersion.
- Assist with preliminary design work as necessary.

In addition to the hydrographic survey, a single event river current survey will be conducted to facilitate calibration of a hydrodynamic and water quality model that will be developed for this project. As part of this survey, tide stage measurements will be obtained at the approximate boundary points of the model; tidal velocity profiles will be determined by means of an Acoustical Doppler Profiling System.

Data obtained from these surveys effort will enable structuring a multi-dimensional water quality model that will be used to evaluate and quantify impacts from project construction. The model will enable estimates to be made of the extent of the suspended sediment plume generated by project related construction activities including vessel traffic and dredging. To support model development, samples of total suspended solids will be obtained from the water column at the same time that benthic samples are taken.

4 I-287 Corridor Sampling Program

This section describes ecological field investigations that will occur within the I-287 Corridor Environmental Study Area (CESA) in Rockland and Westchester Counties. The parcels that comprise the CESA are the following:

- The I-287 ROW in Westchester and Rockland Counties.
- Along the Hackensack River ecological investigations would occur along the river bank 100 feet beyond the ROW line and 50 feet on either side of the river banks.
- At new station and parking facility locations.
- 500 feet north and south of the Tappan Zee Bridge/I-287 ROW along the shoreline of the Hudson River (this area would measure50 feet landward of the high tide line).
- In Westchester County from Tarrytown to Irvington station from the high tide line to the eastern construction limits along the Hudson Line.
- At new storage and maintenance yards.
- Within the proposed footprints of alternatives that occur outside of the I-287 ROW. For the CRT lines and associated new rail stations northwest of Suffern, ecological investigations would extend 25 feet on either side of the proposed footprints and would terminate at Exit 15A.

4.1 Wetlands Mapping

In order to establish the extent of corridor wetlands, a field investigation will be conducted along the corridor in both Rockland (Nyack to Suffern) and Westchester (Tarrytown to Port Chester) Counties. A team of scientists will traverse the CESA and identify wetlands using techniques specified in the 1987 Corps of Engineers Wetland Delineation Manual (1987 Manual). Also, boundaries of currently mapped state wetlands will be confirmed and consideration will be given to wetlands mapped pursuant to local laws. During the field investigation, approximate boundaries of wetlands will be established through the use of Global Positioning System (GPS) techniques. The GPS system is expected to have an accuracy of +/- 1 meter with regard to horizontal position.

Wetlands will be further categorized by vegetative cover type. Also, to aid in impact and mitigation assessment, observations will be made of wetland functions and values, which include the following:

- Groundwater recharge/discharge.
- Flood-flow alteration.
- Fish and shellfish habitat.
- Sediment and toxicant removal.
- Nutrient removal/retention transformation.
- Production export.
- Sediment/shoreline stabilization.
- Wildlife habitat.
- Recreation.
- Education/scientific value.
- Uniqueness/heritage.
- Visual quality/aesthetics.
- Endangered species (ability to support).

To better assist in the analysis of wetlands and associated ecological resources along the corridor, color aerial-infrared photographs, at a 1 inch = 50 feet scale and 1 foot per pixel resolution, will be obtained. The area covered by the photos would be approximately 100 feet beyond the ROW on either side of the corridor and from Tarrytown to Irvington station from the high tide line to the eastern construction limits along the Hudson Line. Upon completion of data collection, maps will be prepared depicting the location of wetlands within the study area. These will allow for an overlay of the proposed project alternatives and existing wetlands for presentation and evaluation in the EIS. No formal wetland delineation will be conducted at this time.

4.2 Terrestrial and Aquatic Ecological Investigations

4.2.1 Terrestrial Ecological Investigations

Terrestrial Habitats

During the wetland mapping effort, the approximate boundaries of terrestrial habitats within the corridor will be located by GPS to establish habitat boundaries. In addition to depicting the approximate boundaries of upland habitats, the faunal usage and floral coverage of these will also be characterized. Characterization will be accomplished by creating an ecological community habitat map of the mapped areas. Ecological communities will be identified as per the New York Natural Heritage Program's *Ecological Communities of New York State*. Also, along the length of the roadway, areas that could serve as corridors for organisms to transit underneath and/or over the roadway will be noted and recorded with GPS.

Mammals, Amphibians, Reptiles, Birds, and Flora

During the course of the ecological field investigations, a list of dominant flora and fauna within each recorded habitat area (as defined by *Ecological Communities of New York State*) will be prepared. The expected usage of these habitats by various wildlife and flora will be based on existing literature, sightings during the field investigations, and professional judgments.

4.2.2 Threatened and Endangered Species

During the corridor ecological investigation, areas that are observed to be suitable habitat for New York State-listed threatened and endangered species will be further investigated in the fall of 2005 and and/or spring, summer, and/or fall of 2006 for the presence and/or evidence of these organisms. Such habitats, and their approximate location, will be recorded by the use of GPS.

4.2.3 Aquatic Ecological Investigations

Ecological communities associated with waterbodies within the corridor will be identified as per the New York Natural Heritage Program's *Ecological Communities of New York State*. Due to the length of the study corridor, and fact that there are over 20 waterbodies that occur within the corridor, water quality and aquatic faunal sampling will be directed to waterbodies of ecological importance (e.g., Class A waterbodies, Class I and II wetlands, etc.) and waterbodies that are on the NYS Section 303(d) List of Impaired Waters (Figure 4-1). Table 4-1 provides the waterbodies that have been selected within each county.

Water Quality

Sampling for water quality would occur under typical stream flow conditions and under rainfall (i.e., first flush) conditions.

Typical Conditions

Since one gauge of a stream's condition is its typical water quality, a water quality sampling event will be focused on establishing average or typical water quality conditions within the selected corridor streams. Sampling will not occur within 72 hours of a rainfall event to avoid immediate impacts of runoff from roadway surfaces. By ascertaining typical conditions, comparisons can be made as to the upstream and downstream influences of runoff during rainfall events.

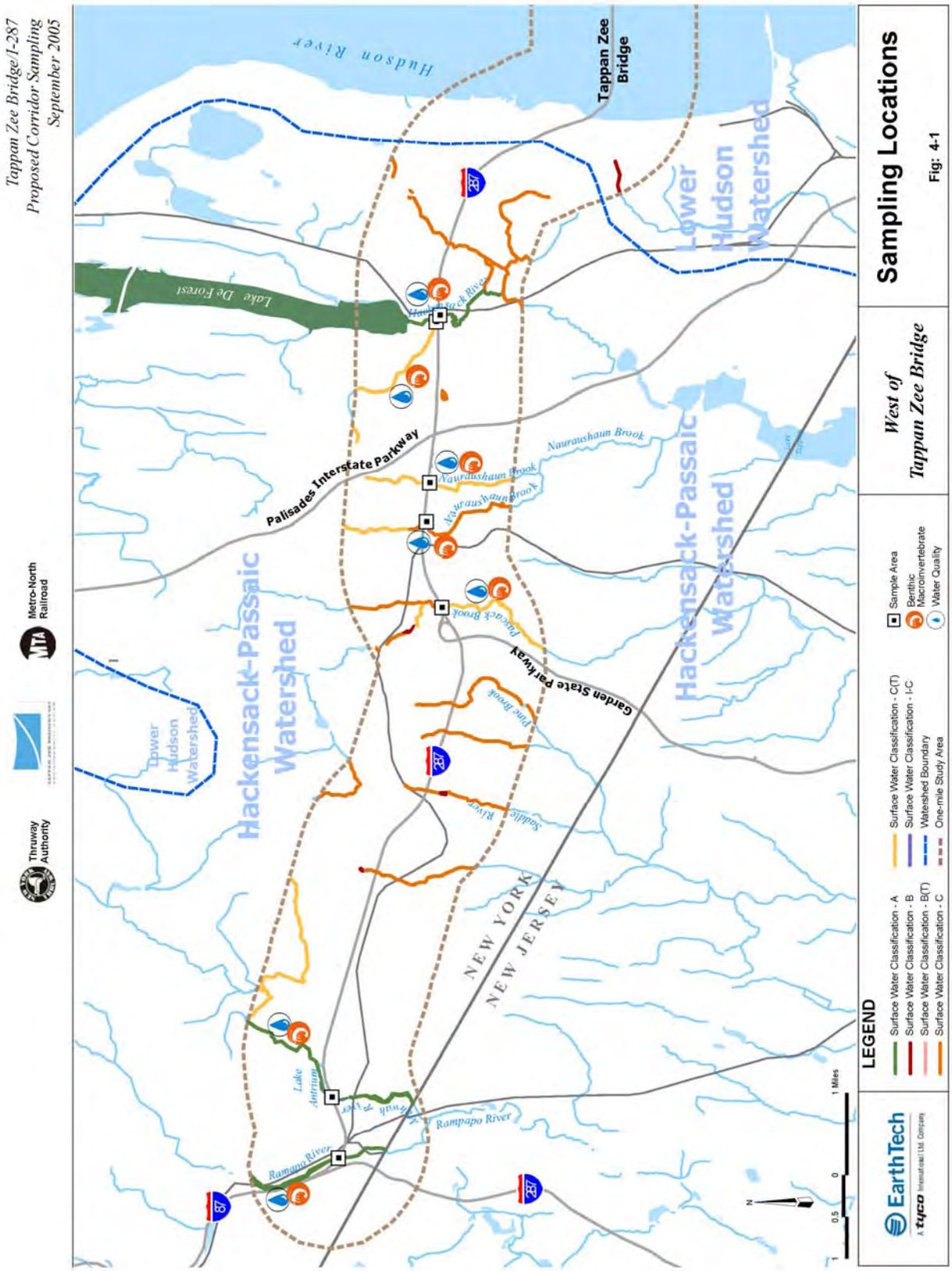
Within each water body listed in Table 4-1, water quality samples will be collected. A total of 12 samples will be collected immediately downstream of the I-287 Corridor, except for the Hackensack River tributary where one sample would be collected near the tributary's confluence with the Hackensack River. The water samples will be analyzed for the following parameters:

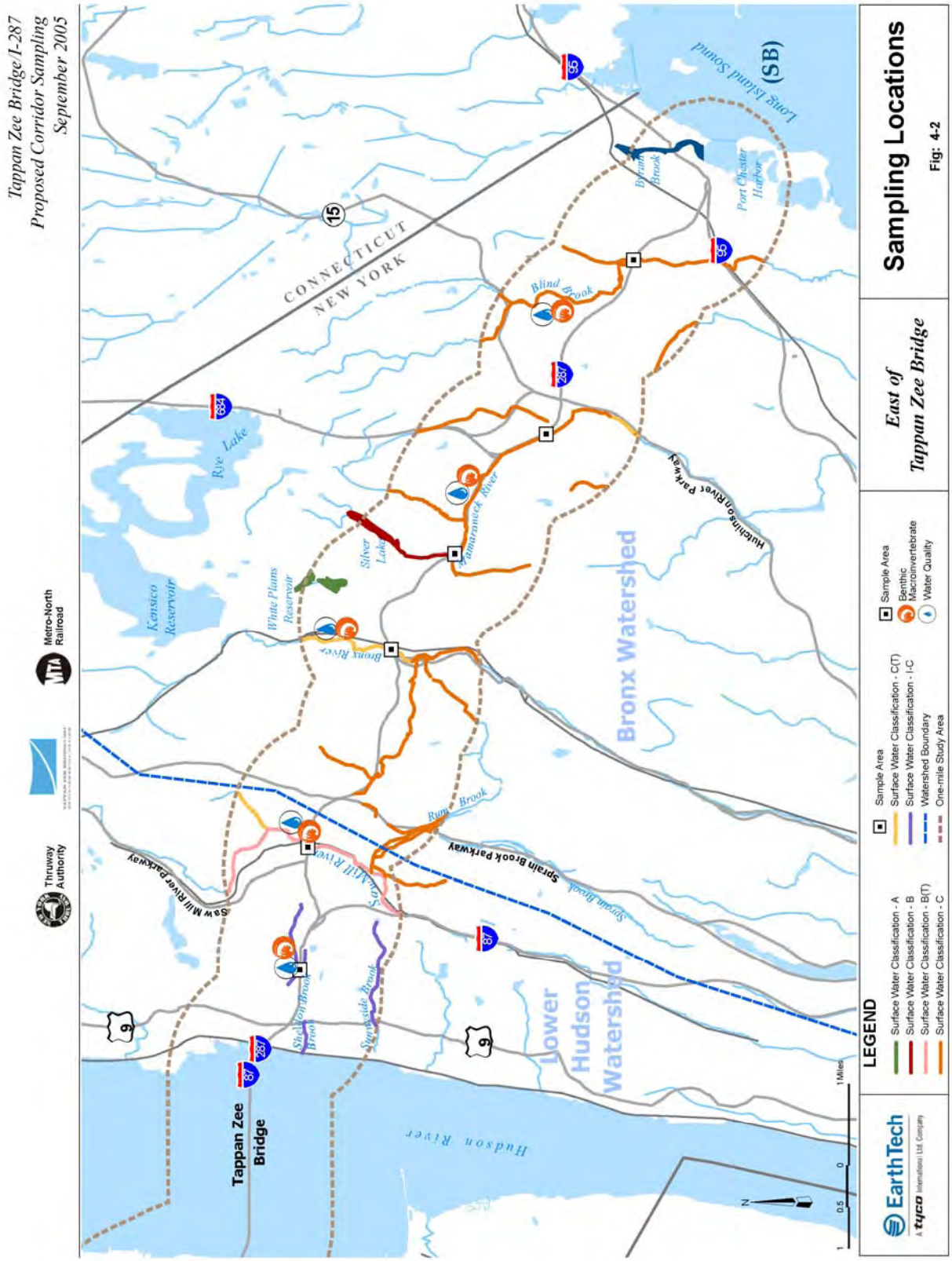
Table 4-1

Sampling Locations

County	Location
Rockland	Ramapo River [A]
	Mahwah River [A]
	Pascak Brook [T]
	Naurshaun Brook (east branch) [W]
	Naurshaun Brook (west branch) [T W]
	Hackensack River [A]
	Hackensack River Tributary [T]*
Westchester	W-3 Wetlands (Sheldon Brook) [W]
	Bronx River [I]
	Mamaroneck River (east location) [I]*
	Mamaroneck River (west location) [I]*
	Blind River [I]
	Saw Mill River [T]

Notes:
A NYSDEC Class A Waterbody
I Listed on Section 303(d) List of Impaired Waters
T Trout stream
W Adjacent to Class I or II Wetland
* The Hackensack River Tributary flows parallel to the north side of I-287 until its confluence with the Hackensack River north of the highway. Sampling locations for roadway runoff would be placed near the confluence with the Hackensack River and further upstream within the ROW.
** The Mamaroneck River flows parallel to the corridor for approximately 1.8 miles. Two sampling locations will be placed in the Mamaroneck River at approximately the east and western extent of the stretch of river that parallels the highway.


Tappan Zee Bridge/I-287
Proposed Corridor Sampling
September 2005
Thruway Authority
Metro-North Railroad
Hudson River
Tappan Zee Bridge
Lake De Forest
Palisades Interstate Parkway
Garden State Parkway
Hackensack-Passaic Watershed
Lower Hudson Watershed
Hackensack-Passaic Watershed
Lower Hudson Watershed
Nauraushaun Brook
Pascack Brook
Saddle River
Lake Antrim
Ramapo River
NEW YORK
NEW JERSEY
LEGEND
Surface Water Classification - A
Surface Water Classification - B
Surface Water Classification - B(T)
Surface Water Classification - C
Surface Water Classification - C(T)
Surface Water Classification - I-C
Watershed Boundary
One-mile Study Area
Sample Area
Benthic Macroinvertebrate
Water Quality
EarthTech
A tyco International Ltd. Company
West of Tappan Zee Bridge
Sampling Locations
Fig: 4-1


Tappan Zee Bridge/I-287
Proposed Corridor Sampling
September 2005
Thruway Authority
Metro-North Railroad
Tappan Zee Bridge
Hudson River
Long Island Sound
CONNECTICUT
NEW YORK
Kensico Reservoir
Rye Lake
White Plains Reservoir
Silver Lake
Bronx River
Sawmill River
Saxon Brook
Sunnyside Brook
Rum Brook
Spratin Brook
Blind Brook
Byram Brook
Port Chester Harbor
Hutchinson River Parkway
Sprain Brook Parkway
S.&W. Mill River Parkway
Bronx Watershed
Lower Hudson Watershed
(SB)
LEGEND
Surface Water Classification - A
Surface Water Classification - B
Surface Water Classification - B(T)
Surface Water Classification - C
Surface Water Classification - C(T)
Surface Water Classification - I-C
Watershed Boundary
One-mile Study Area
Sample Area
Benthic Macroinvertebrate
Water Quality
EarthTech
A tyco International Ltd. Company
East of Tappan Zee Bridge
Sampling Locations
Fig: 4-2

- Target Compound List (TCLs) (including Volatile Organic Compounds [VOCs], Semi-volatile Organic Compounds [SVOCs], Pesticides and Polychlorinated Biphenyls [PCBs]).
- Target Analyte List [TAL] inorganics and cyanide.
- Total Dissolved Solids and Total Suspended Solids.
- Chloride, phosphate, sulfate, and nitrogen.

In situ measurements of DO, temperature, pH, turbidity, visibility, and conductivity will be collected during each sampling event.

Rainfall "First Flush" Conditions

To assess potential impacts from roadway runoff, water quality samples will also be collected during a rainfall event, to approximately capture the so-called first flush effect. For the Hackensack River Tributary water samples will be collected in the locations identified in Table 4-1. Water samples will be collected approximately 100 feet upstream and downstream of the roadway at the 12 other locations identified in Table 4-1. A total of 26 samples will be collected for this task. These will be analyzed for the following parameters:

- TCL (including VOCs, SVOCs).
- TAL inorganics + cyanide.
- Total Dissolved Solids and Total Suspended Solids.
- Chloride, phosphate, sulfate, and nitrogen.

In situ measurements of DO, temperature, pH, turbidity, visibility, and conductivity will be collected during each sampling event.

Aquatic Faunal Sampling

Aquatic faunal sampling will be limited to sampling for benthic invertebrates. Benthic invertebrates are organisms that spend at least a portion of their life cycles within or upon available substrates in a water body. Due to their limited mobility and relatively long life spans, benthic invertebrates are often used as indicators of the prevailing environmental conditions. Benthic invertebrate samples will be collected via a ponar grab in the same locations as the water quality samples. In each of the 13 locations identified in Table 4-1, nine benthic samples would be collected. A triplicate sample will be collected at each bridge and approximately 100 feet upstream and downstream, resulting in a total 117 samples for the aquatic faunal sampling program. For the Hackensack River tributary, a triplicate sample will be collected at both water quality sampling locations, and a third location in between the other two sample locations. Samples would be preserved for analysis and later, in a laboratory, the taxa will be identified to the lowest taxa practicable and enumerated.

No sampling for fish or herpetofauna is proposed. Fish and herpetofauna habitat for each waterbody will be characterized by means of observations of each waterbody's physical characteristics (e.g., depth, flow, bottom type, aquatic vegetation, and benthic community

composition, etc.). In addition, based on discussions with NYSDEC, available data is expected to be sufficient to identify fish and herpetofauna species within these waterbodies.

Aquatic Vegetation

Rooted submerged and floating aquatic vegetation within corridor streams will be documented during the water quality and benthic macroinvertebrate surveys. Data will be collected on the species present and the spatial extent of the vegetation. General locations of aquatic plants within corridor streams will be noted on maps presented in the EIS and the data collected will be factored into the assessment of the quality of habitat provided by the stream.

5 Sampling Program Summary

A summary of the field surveys discussed above is provided in Tables 5-1 and 5-2. The tables are divided into corridor surveys and river surveys.

Table 5-1

Summary of Corridor Ecological Investigations

Task	Description/Objective
Wetland Mapping	Mapping and identification of wetlands within a 30-mile corridor using GPS for setting boundaries.
Ecological Reconnaissance	Mapping and identifying ecological communities and habitats with a GPS unit within the I-287 ROW, Piermont Railroad ROW and new station and parking locations. Also, mapping of suitable habitat for listed threatened and endangered species.
Faunal Sampling	Sampling of benthic macroinvertebrates and water quality within 12 streams.

Table 5-2

Summary of River Ecological Investigations

Parameter	Description/Objective
Sediment	Sampling (i.e., grain size, total organic carbon, and sediment chemistry) along one transect within 50 feet of the bridge and two transects within the 1,000-foot study area. Along each transect, sampling will occur at 10 stations. In addition, sampling will occur at four locations each along a) the southeast shoreline for the potential rail right-of-way expansion in the river, b) the southeast side of the existing bridge for a potential temporary causeway, and c) the southwest side of the existing bridge for a potential temporary causeway. Samples will be collected at one-foot intervals to approximately 6 feet in depth from 42 locations for a total of 252 samples plus QA/QC samples.
Benthic Macro-invertebrates	Conducted bi-monthly at 11 sampling stations along one transect within 50 feet of bridge and along two transects within 1,000 feet north of existing bridge. In addition, sampling will occur at four locations each along a) the southeast shoreline for the potential rail right-of-way expansion in the river, b) the southeast side of the existing bridge for a potential temporary causeway, and c) the southwest side of the existing bridge for a potential temporary causeway.
Fish and Shellfish	Collections will be bi-monthly traps, gill nets and acoustic surveys at six stations underneath and adjacent to the bridge as well as three reference stations. Use electric utility Long River Survey data to evaluate potential replacement bridge impacts. In order to characterize the crab population under the existing bridge from April to November one commercial baited crab pot will be deployed during the same weeks as the fish and benthic community sampling.
Avian and Mammals	Quarterly inwater and shoreline surveys at four general areas.
Submerged Aquatic Vegetation	Survey to confirm existing NYSDEC data within study area to identify the dominant submerged and emergent vegetation during the late summer.
Wetlands	Mapping and identification of wetlands within the bridge study area to determine the extent of wetlands that may be impacted by the project.
Multi-Dimensional Water Quality Modeling	Single event surveys to collect data on bathymetry, tidal fluctuations, and tidal currents to develop and calibrate a multi-dimensional sediment transport model.

6 References

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