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**ACCESS TO THE REGION'S CORE  
FINAL ENVIRONMENTAL IMPACT STATEMENT**

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**Water Quality, Flooding, Navigable  
Waterways, and Coastal Zone Consistency  
Methodology Report**

NJT Contract #03-118

*May 2008*

*Submitted by:*

***Transit Link Consultants***

*A Joint Venture of Parsons Brinckerhoff and SYSTRA Consulting*

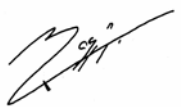
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## REPORT QUALITY CONTROL/QUALITY ASSURANCE

Prepared by:  \_\_\_\_\_

Date: 05/08

Reviewed by:  \_\_\_\_\_

Date 05/08

Approved by:  \_\_\_\_\_

Date: 05/08



## 1. DESCRIPTION AND OBJECTIVE

The purpose of this report is to summarize the methodology that will be used to develop the Water Quality, Flooding, Navigable Waterways and Coastal Zone sections for the ARC Build Alternative.

As the development of the alternatives progresses, this methodology may need to be adjusted or refined. The construction techniques, duration of construction, and proposed sedimentation/erosion control measures are examples of key project decisions that can affect the approach to the identified scope of study.

## 2. DATA REQUIREMENTS

The following data elements will be required to apply this methodology:

<b>Information/ Data Required</b>	<b>Description</b>
Number and construction method for the tunnel(s)	Means of construction (boring or open trench; single barrel or twin barrels) for rail lines and estimated timeframe for the work
Over-water staging areas for barges and other construction equipment	Estimate of over-water coverage to address potential shading/loss of productivity issues for Coastal Zone assessments.
Location and means of tie-ins to municipal (i.e. NYCDEP) stormwater systems for stormwater disposal.	Assess approval method for proposed discharges to identify level and extent of requisite pretreatment prior to discharge.
Sedimentation Control Techniques during construction.	Applicability of control measures (silt curtains, closed dredge bucket, limit hoist speed, avoidance of peak tidal velocities) to each water body as means of reducing project-induced turbidity.
Sediment quality data and analyses	Review sediment data to assess potential water quality contraventions and/or exposure of marine biota to resuspended contaminants as part of the Water Quality assessment.
Site surveys for each alternative	Compare existing ground elevations to flood studies to assess accuracy of flood study data.
Wetland mitigation program	Assess flood storage capacity of created wetlands to offset any loss of flood storage capacity for each alternative.

## 3. CITATIONS OF APPLICABLE GUIDELINES/REGULATIONS

The methodology was prepared in accordance with applicable state, federal and municipal water quality standards, applicable Federal Emergency Management Agency (FEMA) guidelines, and applicable state and municipal Coastal Zone Consistency and Local Waterfront Revitalization Plan guidance documents.

## 4. PROPOSED VARIATIONS FROM FTA GUIDANCE

None

## 5. KEY ASSUMPTIONS

- No additional sediment sampling will be required.
- Disposal/dump site for dredged/excavated material will be identified early during the EIS process.
- Scoping effort will be conducted with relevant federal, state, and local agencies (including USACE, NMFS, USFWS, FEMA, USCG, NJDEP, NYSDEC, NYSDOS, NYCDEP, and NYCDPC) to gather feedbacks and identify key concerns associated with the potential impacts of the project.

## 6. METHODOLOGY APPROACH

### STEP 1: WATER QUALITY

#### Existing Conditions:

- Identify the existing water quality criteria for the identified water bodies and watercourses in the Project Area.
- Acquire and review the different sediment analyses to identify the existing sediment characteristics wherever in-water work and dredging activities would take place for each alternative.
- Identify existing drainage courses associated with proposed parking, rail yard and staging areas within the Project Area for each alternative.
- Identify existing water table conditions within the Project Area wherever dewatering during construction and excavation activities would take place for each alternative.

#### Project Impacts and Mitigation:

- For each alternative, assess the potential sediment re-suspension impacts on water quality of any contaminants as a result of in-water work or dredging activities.
- Assess the potential for direct and indirect discharges of pollutants into surface waterbodies, including wetlands, for each alternative. An impact assessment will be prepared summarizing the potential for project-induced water quality changes.
- Evaluate the proposed closure plans (i. e.; the RAWPA) for the Koppers Coke site and the storm water plans for continuity and compliance with NJDEP guidance and standards.
- Assess potential changes to water quality via stormwater discharge from new impervious surfaces. Identify mitigative measures (manufactured treatment devices, detention, and recharge, or use of municipal storm water systems) to trap sediments and pollutants.
- Assess the potential physical and contaminant impacts on water table associated with dewatering activities.

#### Documentation, Regulatory Compliance, and Permit Applications:

- Identify applicable federal, state, county and municipal/local water quality standards for the identified waterbodies and watercourses in the Project Area, and evaluate any future proposed upgrades or modifications to the water quality criteria. Identify applicable regulated buffer zones for protected waterbodies and watercourses.
- Discuss the anticipated water quality-related construction and operational aspects of each alternative with the technical and regulatory staffs at NYSDEC Region 2, NJDEP, and USACE Eastern Permits to address water quality issues. This discussion may be best accomplished in the context of an interagency meeting where other potentially involved federal agencies (National Marine Fisheries

Service, U. S. Fish & Wildlife Service) can address other issues (fisheries, significant habitats) that could affect the construction techniques.

- Identify necessary dewatering permit application from regulatory agencies.
- Identify applicable agency in-water work windows for waterbodies for each alternative, and identify potential agency permit requirements/special conditions (i.e.; no decanting of liquids from dredged materials to the waterway) applicable to the identified construction techniques.
- The Existing Data summary, the construction plans, the Preliminary Engineering reports, and the environmental impact assessment will be used to identify required permits under applicable state, federal, county and municipal regulations and provide project information for permit applications.

## **STEP 2: FLOODING**

### Existing Conditions:

- Identify Federal Emergency Management Agency (FEMA) base floodplains (areas that have a one percent or greater chance of flooding in any given year) and mapped floodplains within each alternative by examining Flood Insurance Rate Maps, and obtain the applicable Base Flood Elevation (BFE) levels. Obtain and review any local or county flooding studies. Compare the flood studies to existing conditions (new fills, new impervious surfaces, and new stormwater conveyances) to ensure that the studies and referenced BFEs are relevant.
- Prepare maps of the Project Area depicting the location and extent of floodplains with the proposed rail line routes and alignments superimposed.
- Identify flood storage capacity of the floodplains within the Project Area for each alternative as well as the boundaries of the 100-year flood hazard, and the 500-year flood hazard, if available.

### Project Impacts and Mitigation:

- For any incursions into a floodplain, prepare an Alternatives Analysis citing the need to place the structures in the floodplain while comparing to the most practicable but unfeasible alternatives outside the floodplain. Cite if a flood hazard exists and if the proposed alternative will exacerbate flooding in the area.
- Identify any changes in flood storage capacity for each alternative within a floodplain, or that would contribute an increased volume, or would change the runoff pattern (i. e.; increased rate of runoff from impervious surfaces) to a floodplain. Address the need for stormwater features (detention basins, recharge areas) to minimize any increased flooding potential as a result of increased impervious surfaces, fill within the floodplain, or as a result of creating linear structures (rail lines) potentially limiting water movement in an identified floodway.
- Assess changes in flood storage capacity with regard to applicable Coastal Zone Management policies for alternatives that have the potential to affect a Coastal Waterway.
- Design elements to mitigate any impacts of flooding will be identified and discussed. Link the flood control elements with any wetland mitigation measures to assess if the wetland mitigative techniques can be used to trap and/or recharge floodwaters.
- Identify mitigative measures (i.e., use of pile-supported structures instead of hard fill embankments) to maintain flood flow and preclude scouring and/or changes in current velocities.

### Documentation, Regulatory Compliance, and Permit Applications:

- Coordinate with FEMA, NYSDOS, and NJDEP to identify required permits and coastal consistency reviews for each alternative.

### **STEP 3: NAVIGABLE WATERWAYS**

Existing Conditions:

- Identify the presence and proximity of navigable waterways for each alternative.
- Identify navigation channels, anchorage areas, mooring areas, and berthing locations proximate to each alternative.

Project Impacts, Mitigation, and Regulatory Compliance:

- Coordinate with USCG and Harbor Operation Committee to identify if a Hazard to Navigation assessment is required based on each alternative, the construction technique proposed, and duration of the construction work.

### **STEP 4: COASTAL ZONE CONSISTENCY**

Existing Conditions:

- For each alternative, determine any designated coastal zone areas directly involved or adjacent to the project area. Similarly, determine the presence of any special natural waterfront areas and/or significant maritime and infrastructure areas.

Project Impacts, Mitigation, and Regulatory Compliance:

- If within a designated coastal zone, assess the alternative's compliance and consistency with the applicable state (or state-approved Local Waterfront Revitalization Program (LWRP), in the case of the New York City Local Waterfront Revitalization Plan, as administered by the NYC Dept. of City Planning) coastal zone regulations pursuant to the Coastal Zone Management Act of 1972.
- If any of the alternatives is located within a designated significant coastal habitat or special natural waterfront area, analyze the potential project impacts with regard to the identified resources in the area.
- Coordinate with NJDEP, NYSDOS, NYCDCP, and other agencies to identify specific locations of coastal zone encroachment into regulated coastal zones.
- Prepare the NJDEP, NYSDOS, and NYCDCP consistency assessment forms and supporting policy statements for agency approval as part of the environmental review process.

### **STEP 5: DOCUMENTATION**

Results of Water Resources analysis will be incorporated into the FEIS.

# **Supporting Documentation**



**SURFACE WATERS****NEW JERSEY**

Surface water resources in the project area are listed in **Table 4.9-A**.

**TABLE 4.9-A: SURFACE WATER RESOURCES IN THE PROJECT AREA**

Name	Type	Uses(s)
Hudson River	Surface	<ul style="list-style-type: none"> <li>• Navigation</li> <li>• Transportation</li> <li>• Recreation</li> <li>• Fish and wildlife habitat</li> </ul>
Hackensack River	Surface	<ul style="list-style-type: none"> <li>• Navigation</li> <li>• Transportation</li> <li>• Recreation</li> <li>• Fish and wildlife habitat</li> </ul>
Meadowlands	Surface	<ul style="list-style-type: none"> <li>• Aesthetics</li> <li>• Sediment and toxicant retention and uptake</li> <li>• Fish and wildlife habitat</li> </ul>

Source: *Transit Link Consultants 2006*

**Hackensack River**

A Federally authorized navigation channel extends through the project area. The channel, as described in the 1986 U.S. Army Corps of Engineers (USACE) *Project Book*, is authorized to a depth of 34 feet below the plane of mean low water (MLW) in rock and 32 feet below MLW in soft material with a width of 300 feet “...to a point approximately 2,000 feet north of the D.L. & W.R.R. Bridge...with a turning basin deep at the upper end of the channel; thence 15 feet deep, 200 feet wide, to Little Ferry....”

Work on the federal navigation channel is largely incomplete. South of the turning basin, the channel was dredged to 30 feet below MLW, but the project has not been completed. Except for a 4,000-foot section immediately upstream of the turning basin, the remainder of the federally authorized channel to the north remains incomplete. Recent surveys and controlling depth reports posted on the USACE website show that other depth in the project area ranges from 19 feet to 30 feet below MLW, with significant amounts of shoaling occurring throughout the river.

Within the project area, no anchorage or fleeting areas have been authorized by Congress, nor are any areas designated for these purposes by the U.S. Coast Guard or any agency of the State of New Jersey.

The size and type of vessels that can navigate the Hackensack River are restricted not only by the depth of the river, but also by the number and type of bridges that cross the river under which vessels must travel. In the project area, two railroad bridges are located south of the New Jersey Turnpike: the Portal Bridge and the Lower Hackensack Moveable Bridge. The Portal Bridge is a swing bridge with a vertical clearance of 23 feet and a horizontal clearance of 99 feet. The Lower Hackensack Moveable Bridge is a lift bridge with vertical clearances of 135 feet when up and 40 feet when down. The horizontal clearance of this bridge is 150 feet. As a result of the limited clearances of these and other bridges on the Hackensack, the river north of the project

area is used primarily by shallow-draft recreational vessels based in marinas in the Secaucus area. Commercial traffic is also limited on the Hackensack River, with the majority of barges and tankers being bound for facilities on the southern end of the river.

The Hackensack River and its tributaries have been altered at different times to meet specific needs. The lower section within the project area has historically been dredged to handle barge traffic. USACE maintains a shipping channel at an average depth of 12 feet. Additionally, ditches and canals have been dug to control mosquitoes and the flow of water into tidal marshes. In the Meadowlands, major inputs of freshwater to the Hackensack River are from industrial and municipal discharges, stormwater runoff, and water spilling over the Oradell Dam. The Hackensack River has a disturbed flow regime. It acts as a trough in which the tidal waters echo upstream and downstream, only gradually getting flushed to the sea.

### **Long-term Hackensack River Water Quality Monitoring**

The Meadowlands Environmental Research Institute (MERI) of the New Jersey Meadowlands Commission (NJMC) has conducted seasonal water quality monitoring within the Hackensack River and its tidal tributaries from 1993-2006. Quarterly (spring, summer, fall, and winter) samples were collected at 14 survey stations and analyzed for a total of 26 water quality and contaminant parameters, including metals, nutrients, fecal coliforms, biological oxygen demand (BOD), total suspended solids (TSS), turbidity and dissolved oxygen concentration (DO). This comprehensive, long-term record provides a general assessment of water quality in the Hackensack Meadowlands, and can be used to document long-term trends or changes in water quality, and identify problem areas.

In 2004, the monitoring program was expanded with the installation of three permanent monitoring Yellow Springs Instruments 6600 multi-parameter sondes at Berry's Creek, Kearny Point, and Mill Point. These stations collect data on an hourly basis, 24 hours a day and are being used in an ongoing modeling effort by the New Jersey Institute of Technology to determine a relationship among variables and forecast future conditions as a function of the data collected within the past three years.

Several of the MERI long-term water quality monitoring stations were located within or directly adjacent to the study area. The following discussion summarizes major water quality parameters for two stations on the Hackensack River main stem (north and south), Penhorn Creek, and Kearny Marsh.

#### ***Hackensack River North***

At the north main stem Hackensack River station, DO ranged from 1.0 to 17.6 mg/L, with an average of 7.8 mg/L over the 13-year monitoring record. Water temperature ranged from 3.0 to 30.7 degrees C with an average of 16.3. Salinity ranged from 0.1 to 9.5 with an average of 3.0. pH ranged from 5.1 to 8.4 with an average of 7.4. TSS ranged from 2.2 to 910 with an average of 67.2. Ammonium ( $\text{NH}_4^+$ ) concentrations ranged from 0.2 to 39.5 mg/L with an average of 4.1. Nitrate ( $\text{NO}_3^-$ ) concentrations ranged from 0.1 to 13.4 mg/L with an average of 2.6. Fecal coliform counts (MPN/100 ml) ranged from 20 to 16,000 with an average of 2,058.

TABLE 4.9-B: WQ SUMMARY – HACKENSACK RIVER NORTH

Parameter	Units	Min value	Max value	Mean
DO	mg/L	1.0	17.6	7.8
Temp	Degrees C	3.0	30.7	16.3
Salinity	SU	0.1	9.5	3.0
pH	SU	5.1	8.4	7.4
TSS	mg/L	2.2	910	67.2
NH <sub>4</sub> <sup>+</sup>	mg/L	0.2	39.5	4.1
NO <sub>3</sub> <sup>-</sup>	mg/L	0.1	13.4	2.56
Fecal coliforms	MPN/100 ml	20	16000	2058

Source: Transit Link Consultants 2007

### ***Hackensack River South***

At the south main stem Hackensack River station, DO ranged from 2.6 to 11.9 mg/L, with an average of 6.9 mg/L over the 13-year monitoring record. Water temperature ranged from 2.7 to 30.6 degrees C with an average of 16.7. Salinity ranged from 4.8 to 21.2 with an average of 12.2. pH ranged from 6.2 to 8.0 with an average of 7.3. TSS ranged from 0.7 to 234.2 with an average of 29.1. Ammonium concentrations ranged from 0.2 to 4.8 mg/L with an average of 2.1. Nitrate concentrations ranged from 0.06 to 17.7 mg/L with an average of 2.4 mg/L. Fecal coliform counts (MPN/100 ml) ranged from 0 to 16,000 with an average of 567.

TABLE 4.9-C: WQ SUMMARY – HACKENSACK RIVER SOUTH

Parameter	Units	Min value	Max value	Mean
DO	mg/L	2.6	11.9	6.9
Temp	Degrees C	2.7	30.6	16.7
Salinity	SU	4.8	21.2	12.2
pH	SU	6.2	8.0	7.3
TSS	mg/L	0.7	234.2	29.1
NH <sub>4</sub> <sup>+</sup>	mg/L	0.2	4.8	2.1
NO <sub>3</sub> <sup>-</sup>	mg/L	0.06	17.7	2.42
Fecal coliforms	MPN/100 ml	0	16,000	567

Source: Transit Link Consultants 2007

### ***Penhorn Creek***

At Penhorn Creek, DO ranged from 0.3 to 16.9 mg/L, with an average of 5.2 mg/L over the 13-year monitoring record. Water temperature ranged from 2.1 to 27.8 degrees C with an average of 15.2. Salinity ranged from 0.2 to 3.3 with an average of 1.1. pH ranged from 5.8 to 8.8 with an average of 7.2. TSS ranged from 0.6 to 339 mg/L with an average of 30. Ammonium concentrations ranged from 0.3 to 8.9 mg/L with an average of 2.4. Nitrate concentrations ranged from 0.05 to 16.9 mg/L with an average of 1.4. Fecal coliform counts (MPN/100 ml) ranged from 40 to 16,000 with an average of 4,725.

**TABLE 4.9-D: WQ SUMMARY – PENHORN CREEK**

Parameter	Units	Min value	Max value	Mean
DO	mg/L	0.3	16.9	5.2
Temp	Degrees C	2.1	27.8	15.2
Salinity	SU	0.2	3.3	1.1
pH	SU	5.8	8.8	7.2
TSS	mg/L	0.6	339	30
NH <sub>4</sub> <sup>+</sup>	mg/L	0.3	8.9	2.4
NO <sub>3</sub> <sup>-</sup>	mg/L	0.05	16.9	1.4
Fecal coliforms	MPN/100 ml	40	16,000	4,725

Source: Transit Link Consultants 2007

### ***Kearny Marsh***

At Kearny Marsh, DO ranged from 1.5 to 15.8 mg/L, with an average of 8.4 mg/L over the 13 year monitoring record. Water temperature ranged from 0.4 to 29.7 degrees C with an average of 16.3. Salinity ranged from 0.8 to 4.0 with an average of 1.7. pH ranged from 6.0 to 8.3 with an average of 7.4. TSS ranged from 4.5 to 127.9 mg/L with an average of 28.2. Ammonium concentrations ranged from 0.2 to 6.4 mg/L with an average of 1.1. Nitrate concentrations ranged from 0 to 4.9 mg/L with an average of 0.4. Fecal coliform counts (MPN/100 ml) ranged from 20 to 16,000 with an average of 575.

**TABLE 4.9-E: WQ SUMMARY – KEARNY MARSH**

Parameter	Units	Min value	Max value	Mean
DO	mg/L	1.5	15.8	8.4
Temp	Degrees C	0.4	29.7	16.3
Salinity	SU	0.8	4.0	1.7
pH	SU	6.0	8.3	7.4
TSS	mg/L	4.5	127.9	28.2
NH <sub>4</sub> <sup>+</sup>	mg/L	0.2	6.4	1.1
NO <sub>3</sub> <sup>-</sup>	mg/L	0	4.9	0.4
Fecal coliforms	MPN/100 ml	20	16,000	575

Source: Transit Link Consultants 2007

Concentrations of dissolved oxygen (DO) fluctuate according to the balance between processes that produce and consume oxygen. DO concentrations and degree of impairment can vary widely between seasons and from year to year (**Table 4.9-F**). In recent years, summer depletion of DO was found to be most severe in 1995, when sampling took place following a storm event. The highest concentrations were measured during the winter of 1996, when mild February temperatures allowed large amounts of oxygen-rich melt water to enter the drainage basin.

**TABLE 4.9-F: DISSOLVED OXYGEN (MG/L) IN THE HACKENSACK RIVER**

Criteria Concentration = 4.0				
	1993-1994			
	Spring	Summer	Fall	Winter
	Average = 5.8			
Dissolved Oxygen	7.0	3.9	4.2	8.2
# of Impaired Sites	0	9	5	0
	1995			
	Spring	Summer	Fall	Winter
	Average = 6.3			
Dissolved Oxygen	5.8	2.9	8.0	8.4
# of Impaired Sites	1	11	2	1
	1996			
	Spring	Summer	Fall	Winter
	Average = 8.1			
Dissolved Oxygen	6.5	7.7	7.0	11.2
# of Impaired Sites	0	0	0	0

Source: HMDC 1997

Differences in DO measurements between sites appear to be minor. Basin-wide averages reveal that, between 1993 and 1996, concentrations have shown great improvement.

Three electric power-generating facilities discharge “cooling” water in excess of 100 degrees F into the lower Hackensack River. These discharges raise the water temperature in the river to over 90 degrees F during summer months, which violates the state water quality criterion of 85 degrees F. Modeling of oxygen dynamics in the lower Hackensack River has shown that these thermal discharges contribute significantly to the low DO concentrations.

The Lower Hackensack River and its primary tributaries are classified by NJDEP as Surface Type SE-2 (**Table 4.9-G**). This category applies to estuarine surface waters having salinity greater than 3.5 parts per thousand (ppt). Such waters are designated to support maintenance, migration and propagation of the natural and established biota and secondary contact recreation. Some waters within the Meadowlands are classified as FW-2 fresh water, which typically indicates ambient salinity values of less than 3.5 ppt. There are several shallow, unnamed water bodies within the wetlands west of the Malanka Landfill and north of the western arm of the Secaucus Connection. The ponds are considered as Class FW-2 waterbodies by NJDEP. One shallow (approximately one to three feet in depth) pond approximately 1,800 feet in length is located between the Malanka Landfill and the Northeast Corridor embankment. The narrow pond is covered over by a timber access platform remaining from the construction of the Frank R. Lautenberg Station. The pond appears to fluctuate in depth with a water surface elevation of six to seven feet (National Geodetic Vertical Datum). Due to the proximity to the landfill and lack of an inlet or outlet, water quality in the pond is expected to be poor. The salinity level in the pond probably fluctuates dependent upon rainfall and evaporation patterns.

**TABLE 4.9-G: NEW JERSEY SALINE SURFACE WATER CLASSIFICATIONS AND SELECT STANDARDS FOR THE HACKENSACK RIVER IN THE PROJECT AREA**

Description	Class	Definition	Fecal Coliform	DO (mg/L)	PH
Entire length, northwest of intersection at Tremly Point Road and the NJ Turnpike to mouth of river	SE2	Saline surface waters: secondary contact recreation support maintenance, migration and propagation of natural and established biota, maintenance of diadromous fish and wildlife	Monthly geometric average shall not exceed a geometric average of 770 counts/100 mL	4.0	6.5-8.5
Tributaries joining the main stem down stream of Overpeck Creek	FW2	Maintenance, migration and propagation of natural biota, primary and secondary contact recreation, industrial and agricultural water supply, public potable water supply after filtration, any other reasonable uses	Fecal coliform levels shall not exceed a geometric average of 200/100 ml nor should more than 10 percent of the total samples taken during any 30-day period exceed 400/100 ml.	24 hour average not less than 5.0, but not less than 4.0 at any time	6.5-8.5

Source: NJDEP Surface Water Quality Standards, N. J. A. C. 7:9B, (NJDEP 2004).

Basic water quality parameters, including DO, near the project area are provided in **Table 4.9-H**.

**TABLE 4.9-H: WATER QUALITY PARAMETERS FOR THE HACKENSACK RIVER IN THE PROJECT AREA**

Parameter	Units	Begin Date	End Date	min	max	Average
BOD (ppm)	mg/L	25-May-93	7-Jul-99	2.3	13.7	4.84
Ammonia	mg/L	25-May-93	7-Jul-99	1.96	8.2	5.086
Temperature	°C	25-May-93	7-Jul-99	3.3	30.3	16.96
Salinity	ppt	25-May-93	7-Jul-99	1	10.5	6.452
Dissolved Oxygen	mg/L	25-May-93	7-Jul-99	1.6	11.1	5.272
Nitrate	mg/L	25-May-93	7-Jul-99	0.22	0.9	0.46

Source: MERI 1999

The Hackensack River in the project area is regarded as an impaired waterway due to toxic discharges emanating from point sources. Contaminants of concern include arsenic, mercury, lead, zinc and nickel, as well as fecal coliform, polychlorinated biphenyl (PCB), dioxin and chlordane. Seven hazardous waste or Superfund sites are known or suspected to be contaminating local surface waters in the Hackensack watershed. In addition, extensive mercury contamination has occurred. Certain fish from the lower Hackensack River have been found to contain high PCB and chlordane concentrations. Severe impacts from chemical spills, landfills, hazardous waste disposal sites and in-place contaminants have also occurred. **Table 4.9-I** lists heavy metals identified by HMDC in 1997, along with the percent reductions observed over the duration of its study.

**TABLE 4.9-I: HEAVY METAL CONCENTRATIONS: YEARLY AVERAGE (PPB) IN THE HACKENSACK RIVER**

Metal	1993-1994	1995	1996	Reduction
Cadmium	19	16	8	55%
Chromium	21	16	16	24%
Copper	41	24	13	69%
Lead	207	102	114	45%
Nickel	197	131	54	73%
Zinc	92	119	40	57%

Source: HMDC, 1997

For chromium and nickel, the highest concentrations found in the District are one-tenth of the criteria level. Yearly averages reflect a reduction for each of the metals.

The upstream portion of the Hackensack River appears to carry a higher metal load than the downstream portion. A point source of metals was identified in Berry's Creek Canal, but it does not appear to contribute significantly to the main channel of the river. Chromium and zinc trend data indicate that present metal load conditions are less than the elevated levels that occurred in the 1960s. Cadmium and nickel concentrations are low and remain fairly stable.

The sediment of the Hackensack River is such that heavy metals or radionuclides are easily adsorbed. As a result, a variety of contaminants are found in the sediments of this river. Trace organic compounds were measured in the suspended sediment and water, and include PCB, dioxins, furans, polycyclic aromatic hydrocarbons (PAH), pesticides, and metals. Average contaminant loads are estimated to be 0.050 kilogram (kg) per year for total PCBs, 0.050 kg per year for total PAHs, 0.002 kg per year for total pesticides, 17 kg per year for total lead, 0.210 kg per year for total cadmium, and 0.038 kg per year for total mercury.

### **Groundwater Quality**

Bedrock in the area (Newark Supergroup) primarily holds water in bedding-plane separations, but also gains porosity in spaces developed by fractures (joints and faults). Groundwater occurrence in unconsolidated deposits depends on the sand, silt, and clay composition of the glacial outwash and fill. Outwash deposits generally contain water under unconfined conditions.

Movement of fresh groundwater is seaward, with most flow occurring within the glacial deposits due to their greater hydraulic conductivity. The groundwater regime is recharged mainly by precipitation, but leaking water mains, sewers, and septic systems may also contribute to the recharge volume. Recharge in urbanized areas is affected by large expanses of impervious surfaces (buildings, roadways, and parking areas); surface flow is generally directed to municipal systems and unavailable for recharge.

Well drilling in the Meadowlands is limited and yields only small to moderate supplies of groundwater. Many areas are served by municipal water supplies, and groundwater is of little use as a potable water supply. Data on wells tapping the Passaic Formation show that, in general, industrial and municipal supply well yields are ten times as great as domestic well yields.

**Floodplains**

Flooding events associated with excessive rainfall only are rare in the project area due to the system of stormwater conveyances and outfalls. Flooding of low-lying areas is more likely the result of storm surges from tropical storms or “nor’easters” that can surcharge water back into catchment systems combined with heavy precipitation. Flooding in the project area is likely to occur less than once every ten years and is typically restricted to one tidal cycle (a half day). As an example, the project area did not experience significant flooding during the heavy rainfalls in October 2005 as the storms were not accompanied by low barometric pressure or high winds. One or both of these conditions are generally necessary to flood the low-lying areas adjacent to the Hackensack Rivers, such as those that occurred during Hurricane Floyd (September 1999).

The Draft Environmental Impact Statement (DEIS) on the Special Area Management Plan (SAMP) for the Hackensack Meadowlands District, New Jersey (June 1995) cited “a need for improved flood control in the (Hackensack Meadowlands) District, to improve drainage and stormwater management in areas not currently protected.” The SAMP DEIS and its recommendations do not carry the force of law, but serves as a guidance document for the management, development, and preservation of portions of the Hackensack Meadowlands. That DEIS references a 1972 study, “Reconnaissance Report for the Hackensack River Basin, Hudson and Bergen Counties, New Jersey,” which recommended that buildings in the Meadowlands be constructed at a minimum finished floor elevation of +10.00 feet (above the National Geodetic Vertical Datum [NGVD]). As of 1995, HMDC required that structures within the floodplain be constructed at an elevation of one foot above the elevation (approximately 8.5 feet NGVD) published by FEMA for the 100-year storm.

The SAMP DEIS cited the construction of tidal gates as a proposed part of a larger strategy designed not only to control flooding, but to preserve and restore the ecological balance of the Meadowlands. Controlling flooding was cited as a key means to improve the ability of agencies to protect and improve the public health and welfare.

Penhorn Creek is a shallow tributary of the Hackensack River. It enters the Hackensack River at the riverbend (River Mile 7) opposite the Koppers Coke site. The flow in Penhorn Creek is controlled by a tidal gate. The base flood elevations for Penhorn Creek have been determined (FIRM #34003C0264F); the reach upstream of New County Road has a base flood elevation of five feet for the 100-year storm. The base flood elevations for the reach downstream to the Hackensack River range from six to nine feet for the 100-year storm. Recent (10/05) flooding on the upstream portions (Penhorn Avenue and Secaucus Road) has been documented following several days of rainfall totaling 12 inches.

**HUDSON RIVER**

Within the project area, no anchorage or fleeting areas have been authorized by Congress, nor are any areas designated for these purposes by the U.S. Coast Guard or any New York or New Jersey agencies. Vessel traffic within the project area can be divided into four major categories: commercial cargo vessels; cruise ships; ferries and water taxis; and recreational vessels.

Numerous sewage treatment plants (STPs) and Combined Sewer Outflows (CSOs) contribute freshwater to the system. The contribution of these sources is small compared to the river input

during average conditions, but may be proportionally greater under low-runoff conditions in some areas. In addition to various non-point sources, piped stormwater runoff, sewage effluent from CSOs, along with industrial and commercial point sources, contribute pollutants to this reach of the river.

Based on raw data from the New York Harbor Water Quality Survey, the salinity in the project area, between 1990 and 2002, varied from below 1.0 practical salinity unit (psu) or equivalent ppt near the surface, and under 2.5 psu near the bottom of the water column, to over 30.0 psu near both the surface and the bottom. Salinity data collected during November 1994 through October 1995 by NYCDEP and Battelle Ocean Sciences (for NYCDEP) indicate that salinity values can vary by as much as 25 ppt, from 0.1 to 25.6, with an average of 11.0 ppt in the Lower Hudson River. This fluctuation is a result of variable freshwater flow throughout the year. Salinity values from the Battelle survey represent an average of surface- and bottom-water column measurements. **Table 4.9-J** summarizes salinity measurements of the Hudson River, along with other water quality characteristics.

**TABLE 4.9-J: SALINITY, TEMPERATURE AND DISSOLVED OXYGEN IN THE HUDSON RIVER IN THE PROJECT AREA**

Location	Year	Salinity (ppt)	Temperature (°C)	Dissolved Oxygen (ppm)	Source
Lower Hudson River	1994-1995	0.1 – 25.6	Not documented	2.6 – 16.1	Corps 1999
Westway Station WHA1 (RM 1.8)	1979-80	13.8 – 29.1	1.7 – 24.8	1.6 – 11.9	LMS 1980
Westway Station WHB4 (RM 4.0)	1979-80	0.1 – 23.7	1.7 – 25.9	2.5 – 11.0	LMS 1980
HR Center Site(RM 4.0)	1986-88	3.8 – 18.7	1.3 – 24.6	3.5 – 13.0	EEA 1988; Stoecker et al. 1992
Hudson River (W.42 <sup>nd</sup> St.) – Station N4, Surface Waters	1990 - 2002	0.3 – 30.4	1.4 – 26.4	4.2 – 13.99	NYCDEP Harbor Survey 1990-2003
Hudson River (W.42 <sup>nd</sup> St.) – Station N4, Bottom Waters	1990 -2002	2.3 – 44.7*	3.1 – 28.9	1.2 – 12.5	NYCDEP Harbor Survey 1990-2003
World Trade Center (MP-0.5)	1991-93	7.2 – 25.1	2.8 – 28.3	3.1 – 12.2	LMS 1994

Sources: *Surface Water Quality Standards, NJAC 7:9B (NJDEP 2004)* and *Water Quality Regulations: Surface and Groundwater Classifications and Standards, 6 NYCRR parts 700-705 (NYSDEC)*.

\* The reading of 44.7 is significantly higher than the next higher reading of 31.5.

USACE DO measurements (1999) varied from a minimum of 2.6 mg/l to a maximum 16.1 mg/l. Data collected during the New York Harbor Water Quality Survey show DO ranging from just over 4.0 ppm to just below 14.0 ppm near the surface, and slightly above 1.0 ppm to just below 12.5 ppm near the bottom of the river. The water quality criterion for this parameter in both New York and New Jersey is a minimum of 4.0 mg/l. While the data indicate that DO levels in the harbor generally exceeded minimum limits set forth by both states, DO values have occasionally been measured below established minimum criteria in several areas.

Water temperatures in the vicinity of the project area range annually from 1.3°C to 28.9°C. **Table 4.9-J** summarizes water temperatures collected over a number of years at several locations near the Build Alternative tunnel crossings. As expected, temperatures recorded near the bottom of the water column were slightly lower than those at the surface during the warmer months and slightly warmer during the colder months. Variability in water temperatures in the vicinity of the project area is a result of the ambient air temperature, as well as the flow of freshwater and ebb and flow of tidal waters.

The Lower Hudson River, from Spuyten Duyvil to Battery Park, is classified by NYSDEC as a Class I saline surface water, with suitable uses identified as secondary contact recreation, fishing, and fish propagation and survival. The Lower Hudson River in the project area is classified as SE2 by NJDEP. Suitable uses, as defined by the State of New Jersey for this class of water, are secondary contact recreation, maintenance and propagation of biota, and maintenance of diadromous fish and wildlife. **Table 4.9-K** provides information regarding New York and New Jersey water quality classifications for the Hudson River.

**TABLE 4.9-K: SALINE SURFACE WATER CLASSIFICATIONS AND STANDARDS FOR THE HUDSON RIVER IN THE PROJECT AREA**

State	Description	Class	Definition	Fecal Coliform	DO (mg/L)	PH
New Jersey	Entire length, Northwest of intersection at Tremly Point Road and the New Jersey Turnpike to mouth or river.	SE2	Saline surface waters: Secondary contact recreation, support maintenance, migration and propagation of natural and established biota, maintenance of diadromous fish and wildlife	Monthly geometric average shall not exceed a geometric average of 770 counts/100mL	4.0	6.5-8.5
New York	From Battery to New York-Bronx county line within boundaries of New York state	I	Saline Surface Waters Secondary contact recreation and fishing Suitable for fish propagation and survival	Monthly geometric mean, from a minimum of 5 samples, shall not exceed 2,000 counts/100mL	Shall not be less than 4.0	The normal range shall not be extended by more than 0.1 of a pH unit

Sources: *Surface Water Quality Standards, NJAC 7:9B (NJDEP 2004)* and *Water Quality Regulations: Surface and Groundwater Classifications and Standards, 6 NYCRR parts 700-705 (NYSDEC 1998)*.

A wide variety of parameters, including salinity, DO, temperature, pH, Total Suspended Solids (TSS), coliforms, and nutrients, are recorded by NYCDEP as part of their annual harbor survey. Data for several of these parameters are included in **Table 4.9-L**.

**TABLE 4.9-L: WATER QUALITY PARAMETERS FOR THE HUDSON RIVER IN THE PROJECT AREA**

Location	Year	BOD* (ppm)	Ammonia (ppm)	Nitrate/ Nitrite (ppm)	Phosphate (ppm)
Lower Hudson River	1994-1995	1.70	0.26	0.54	0.07
Hudson River (W.42 <sup>nd</sup> St.) – Station N4, Surface Waters	1990-2002	0.4 – 9.3**	0.02-0.57	0.19 – 0.79	0.02 – 0.34***
Hudson River (W.42 <sup>nd</sup> St.) – Station N4, Bottom Waters	1990-2002	0.5 – 5.5	Not collected	Not Collected	Not collected

Sources: *Surface Water Quality Standards, NJAC 7:9B (NJDEP 2004) and Water Quality Regulations: Surface and Groundwater Classifications and Standards, 6 NYCRR parts 700-705 (NYSDEC 1998).*

\* Biological oxygen demand (BOD) readings at Station N4 were taken from 1990 to 1995.

\*\* This one reading of 9.3 is significantly higher than the next two highest readings of 4.3 and 3.3.

\*\*\* Readings at Station N4 are for Total Phosphorous (ppm).

Toxic contaminants known to exist in the Hudson River (water column and sediments) include metals, PCB, dioxin, pesticides, PAH, and VOC. In general, toxic contamination is more prevalent in New York Harbor than in the Hudson River. Metals detected include mercury, copper, cadmium, chromium, nickel, and lead. Elevated concentrations of contaminants (e.g., PCBs, cadmium and dioxin) in certain species of fish and invertebrates taken from the New York Harbor estuary complex have required the issuance of health advisories for many edible aquatic species, and a commercial fishing ban upon striped bass.

Harbor-wide improvements in water quality have been observed since the 1970s, with the abatement of raw sewage discharges through construction and upgrade of the water pollution control plants (WPCPs), and with the increased surveillance and improved maintenance and operation of the entire sewage collection system. Since the early 1990s, continued improvements in water quality can be partly attributed to an increase in maintenance of the existing sewage system, an increase in the management of CSOs, and a reduction in the number of unauthorized discharges.

The complex water flow patterns in the Hudson River Estuary cause its sediment characteristics to vary widely throughout the system. Currents in the vicinity of the project area play an important role in the deposition and distribution of these sediments. The NOAA Navigation Map depicting this reach of the river (Map No. 12335, dated January 10, 1998) characterizes the bottom of the river in the project area as “sy” (sticky). Other sources have classified the river sediment in the project area as clayey silty sand with pockets of clayey sandy silt along the shore line. In 2002, composite core samples (roughly 20 feet in depth), collected slightly upriver and slightly downriver from the project area, show sediments comprised of more than 50 percent silt, more than one-third clay and between 7 percent and 15 percent sand. Gravel comprised 0.2 percent or less of the samples gathered at these two stations, while total organic carbon comprised 4.7 to 4.8 percent of the samples.

Contaminants and pollution discharged into the Hudson River and New York Harbor range from agricultural runoff (e.g., pesticides, fertilizers), to industrial waste, to CSO effluent. River currents, tidal actions and local bathymetry dictate where these contaminants will settle.

A variety of contaminants are found in the sediments of the Hudson River, including PCBs and PAHs. **Table 4.9-M** depicts some of the data collected in the Hudson River during the 2002 sediment sampling. Similar to sediment type, the quality of sediments varies substantially in the estuary. Typically, water bodies adjacent to or downstream from areas that have a history of industrial activity, especially prior to the introduction of environmental regulations in the 1970s, show the greatest potential for having contaminated sediments.

**TABLE 4.9-M: SEDIMENT CONTAMINANT LEVELS DETECTED IN THE HUDSON RIVER IN THE PROJECT AREA**

Contaminant	Measured Level
Mercury	0.01 to 2.58 mg/kg
Arsenic	5.05 to 33.90 mg/kg
Cadmium	0.44 to 2.79 mg/kg
Chromium	12.3 to 116 mg/kg
Copper	5.86 to 150 mg/kg
Lead	4.75 to 143 mg/kg
Nickel	12.2 to 29.7 mg/kg
Zinc	30.6 to 233 mg/kg
PAHs	0.708 to 3730 µg/kg
PCBs	16.9 to 749 µg/kg
Pesticides detected in one sample (4,4'-DDE)	9.46 µg/kg

*Source: Data collected by LMS for a cable installation project, 2002*

Efforts have been initiated to evaluate and improve sediment quality in the harbor area, including the rivers that are part of the estuary. The NY/NJ Harbor Estuary Program (HEP) is coordinating a regional Contaminant Assessment and Reduction Program (CARP). The states of New York and New Jersey, through NYSDEC and NJDEP, respectively, have committed resources toward this effort. Other organizations involved with this program include EPA, USACE, PANYNJ, and the Hudson River Foundation. The primary objectives of CARP are to:

- Identify and evaluate sources of contaminants that need to be reduced or eliminated to ensure that in the future, newly deposited sediments in navigational waterways will be clean enough for ocean remediation.
- Define actions that will be most effective in abating contaminant sources.
- Determine the length of time for sediments to achieve “cleanliness.”

The USACE initiative referred to as Contaminant Reduction is also focused on lowering contaminant levels in the sediments and biota of the harbor.

No natural drainage courses are indicated on the USGS Topographic Quadrangles covering the areas that empty into the Hudson River from either New York or New Jersey in the vicinity of the project area. Existing drainage along both states’ shorelines is conveyed through a system of culverts, pipes and catch basins.

The existing water table in the project area is highly impacted and highly variable. Both sides of the Hudson River in the project area have been significantly altered by placement of fill in

wetlands, the draining of wetlands, and the conversion of impervious surfaces to pervious surfaces. Water tables would be expected at depths no greater than ten feet. On the Manhattan side, leakage from the existing infrastructure may locally elevate the water table.

