FINAL REPORT

Feasibility Study
GE Fort Edward Plant OU-5
(Former 004 Outfall)

General Electric Company
Albany, New York

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O'BRIEN & GERE

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Feasibility Study
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Prepared for:
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TABLE OF CONTENTS

List of Tables (in text) iii
List of Tables (at end of report) iii
List of Figures iii
List of Appendices iii
List of Exhibits iii
List of Acronyms iv
Executive Summary vi
1. Introduction 1
1.1 General 1
1.2 Project Objectives and Scope 1
1.3 Report Organization 1
1.4 Site Description and Background 2
1.4.1 Regulatory Framework 2
1.4.2 Summary of Remedial Investigation Activities 3
1.4.3 2013 Monitoring and DNAPL Recovery Activities 4
2. Site Setting 6
2.1 Site Geologic and Hydrogeologic Conditions 6
2.2 Groundwater Use and Public Water Supplies 7
2.3 Surface Water 7
2.4 Fish and Wildlife Resources Impact Analysis 7
3. Remedial Investigation Results 8
3.1 General 8
3.2 Nature and Distribution of DNAPL 8
3.2.1 DNAPL Analysis 8
3.2.2 Spatial Distribution of DNAPL 8
3.2.3 DNAPL Migration Processes 8
3.2 Nature and Distribution of Constituents in Bedrock 10
3.3 Nature and Distribution of Constituents in Surface Water 10
3.4 Conceptual Site Model 10
4. Development and Screening of Remedial Alternatives 13
4.1 Development of Remedial Action Objectives 13
4.1.1 Land Use 13
4.1.2 Identification of SCGs 13
4.1.3 Contaminant Migration Pathways 14
4.1.4 Contaminant Exposure Pathways 14
4.1.5 Remedial Action Objectives 14
4.2 Physical and Technical Limits to Remediation 14
4.3 General Response Actions 15

4.4 Identification of Areas and Volumes of Media 15
4.5 Identification and Screening of Remedial Technologies and Process Options 16
4.6 Evaluation of Process Options 17
4.6.1 Shallow DNAPL 18
4.6.2 Deep DNAPL 19
4.7 Assembly of Remedial Alternatives 21
4.7.1 Alternative 1 – No Further Action 21
4.7.2 Alternative 2 – Monitoring and Institutional Controls 21
4.7.3 Alternative 3 – Continued DNAPL Collection, Monitoring and Institutional Controls 22
4.7.6 Alternative 4 – Enhanced DNAPL Collection, Monitoring and Institutional Controls 23
4.8 Screening of Remedial Alternatives 24
4.8.1 Effectiveness Screening 24
4.8.2 Implementability Screening 24
4.8.3 Cost Screening 25
4.8.4 Results of the Screening of Remedial Alternatives 25
5. Detailed Analysis of Remedial Alternatives 26
5.1 Individual Analysis of Remedial Alternatives 26
5.1.1 Overall Protection of Human Health and the Environment 26
5.1.2 Compliance with SCGs 26
5.1.3 Long-Term Effectiveness and Permanence 26
5.1.4 Reduction of Toxicity, Mobility or Volume through Treatment 27
5.1.5 Short-Term Effectiveness 27
5.1.6 Implementability 27
5.1.7 Cost 28
5.1.8 Land Use 28
5.1.9 State Acceptance 28
5.1.10 Community Acceptance 28
5.2 Comparative Analysis of Remedial Alternatives 29
5.2.1 Overall Protection of Human Health and Environment 29
5.2.2 Compliance with SCGs 29
5.2.3 Long-Term Effectiveness and Permanence 29
5.3.4 Reduction of Toxicity, Mobility or Volume through Treatment 30
5.3.5 Short-Term Effectiveness 30
5.2.6 Implementability 30
5.2.7 Cost 31
5.2.8 Land Use 31
5.2.9 Community Acceptance 31
6. Summary and Recommendations 32
References 34

LIST OF TABLES (IN TEXT)

5 Cost Estimate Summary – Remedial Alternatives

LIST OF TABLES (AT END OF REPORT)

1-1 2013 Surface Water Sample Results

1-2 Dense Non-Aqueous Phase Liquid Recovery Summary

4-1 Evaluation of Potential Standards, Criteria, and Guidance

4-2 Identification and Screening of Remedial Technologies for Shallow DNAPL

4-3 Identification and Screening of Remedial Technologies for Deep DNAPL

4-4 Evaluation of Process Options for Shallow DNAPL

4-5 Evaluation of Process Options for Deep DNAPL

4-6 Components of Remedial Alternatives

4-7 Screening of Remedial Alternatives

5-1 Detailed Analysis of Remedial Alternatives

5-2 Alternative 1 Cost Estimate

5-3 Alternative 2 Cost Estimate

5-4 Alternative 3 Cost Estimate

LIST OF FIGURES

1-1 Site Location Map

1-2 Former 004 Outfall Site Plan

1-3 2013 Surface Water Sample Results

1-4 Lower Snake Hill Shale/Glens Falls Limestone Monitoring Well Location Map

1-5 2013 DNAPL Recovery Quantities

6-1 Recommended Remedy

LIST OF APPENDICES

A Fish and Wildlife Resources Impact Analysis

LIST OF EXHIBITS

A Remedial Investigation Report Figures

A-1 Potentiometric Section B-B' – November 13, 2012 (RI Report Figure 7-9)

A-2 Potentiometric Section C-C' – November 13, 2012 (RI Report Figure 7-10)

A-3 Conceptual Block Diagram (RI Report 8-2)

B GE Fort Edward Plant Operable Unit 4

B-1 OU-4 Site Layout Map from NYSDEC 2000 Record of Decision for OU-3 and OU-4

LIST OF ACRONYMS

bgs	Below ground surface
CDM	Camp, Dresser & McKee
cm/sec	Centimeters per second
CFR	Code of Federal Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DNAPL	Dense non-aqueous phase liquid
DER	Division of Environmental Remediation
FS	Feasibility Study
FRTR	Federal Remediation Technologies Roundtable
FWRIA	Fish and Wildlife Resources Impact Analysis
GE	General Electric Company
GRA	General Response Action
L	Liters
µg/g	Micrograms per gram
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MNA	Monitored natural attenuation
ng/L	Nanograms per liter
NCP	National Contingency Plan
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OSHA	Occupational Safety and Health Administration
O&M	Operation and maintenance
PCBs	Polychlorinated biphenyls
PRAP	Proposed Remedial Action Plan
ROD	Record of Decision
RAO	Remedial Action Objective
RI	Remedial Investigation

RI/FS	Remedial Investigation/Feasibility Study
SCGs	Standards, Criteria and Guidelines
SVOCs	Semi-volatile organic compounds
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound

EXECUTIVE SUMMARY

This *Feasibility Study (FS) Report* has been developed by O'Brien & Gere Engineers, Inc. (O'Brien & Gere) on behalf of the General Electric Company (GE) for the GE Fort Edward Plant– Operable Unit 05 (OU-5), Former 004 Outfall Site (the Site), located in Fort Edward, New York (Figure 1-1). The GE Fort Edward Plant is currently listed in the New York State Registry of Inactive Hazardous Waste Disposal Sites (Site No. 5-58-004) as a Class 2 site. The Former 004 Outfall Site consists of dense non-aqueous phase liquid (DNAPL) in bedrock in the vicinity of the Former 004 Outfall, which was the historic wastewater and storm water discharge from the GE Fort Edward Plant to the Hudson River. This FS was conducted pursuant to an Order on Consent (Index No. A5-0521-0705) for GE Fort Edward Plant – OU-05 executed between the New York State Department of Environmental Conservation (NYSDEC) and GE on August 26, 2005 (NYSDEC 2005). The FS was completed in accordance with the NYSDEC-approved *Remedial Investigation/ Feasibility Study (RI/FS) Project Work Plan for GE Fort Edward Plant OU-5 (RI/FS Work Plan)* prepared by Camp, Dresser & McKee (CDM) (CDM 2007) and incorporated into the Order on Consent.

The Site consists of a flat narrow river bank, approximately 25 ft wide, along the eastern edge of the Hudson River that serves as a gravel access road to reach monitoring wells associated with investigations in this area (Figure 1-2). The gravel access road was placed over shale bedrock adjacent to the river. Immediately to the east of the access road, the shale bluff rises to approximately 130 ft above river level. Immediately west of the access road is the Hudson River. No buildings are currently at or in the vicinity of the Site. Due to ongoing monitoring and maintenance activities at the Site and the nearby Polychlorinated Biphenyl (PCB) Remnant Site and the periodic flooding of the Site, the reasonably anticipated future use of the Site is expected to remain unchanged.

Historic discharges from the GE Fort Edward Plant through the Former 004 Outfall have resulted in an area of discontinuous PCB-containing DNAPL present in the fractured Snake Hill Shale beneath the Former 004 Outfall along the shore of the Hudson River (see Figure A-3 presented in Exhibit A). Evidence of discontinuous DNAPL occurrence was found to a depth of 270 feet below the Hudson River and at a distance of 600 feet south of the location of the Former 004 Outfall. DNAPL was not observed in bedrock east of the river bank area or on the west side of the Hudson River. DNAPL in Site bedrock is present primarily at residual saturation, and thus, is generally considered not mobile. DNAPL has only been demonstrated to be recoverable at isolated locations, and DNAPL recovery rates have been declining.

Groundwater flow in the Snake Hill Shale in the vicinity of the Former 004 Outfall is generally westerly toward the Hudson River. In close proximity to the river, there is predominantly vertically upward flow from the bedrock toward the Hudson River. While there is a potential for migration of shallow DNAPL in the bedrock at or above the elevation of the bottom of the river, it is unlikely that DNAPL present in deeper bedrock has the potential to migrate to the river. Infrequent detections of PCB concentrations in the surface water samples in the river are an indication that mass flux from the DNAPL in the bedrock, if any, to the Hudson River is small.

This FS was conducted consistent with the requirements of NYSDEC's Division of Environmental Remediation (DER), *Technical Guidance for Site Investigation and Remediation* (DER-10) (NYSDEC 2010a) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). As such, Remedial Action Objectives (RAOs) were identified to address the elimination or mitigation of significant threats to human health and the environment presented by affected media at the Site, as required by Chapter 6 of the New York Code of Rules and Regulations (NYCRR) Part 375-2.8(a) and the cost-effective protectiveness of human health and the environment and attainment of SCGs as required by CERCLA. The threats to human health and the environment are identified through evaluation of exposure pathways and comparison of site media to Standards, Criteria and Guidelines (SCGs), where identified.

The FS addresses PCB-containing DNAPL in shallow and deep bedrock, the affected medium for the Site, which has limited potential to migrate to the Hudson River where human and ecological receptors could become exposed. There are currently no complete exposure pathways for human receptors to DNAPL in bedrock at the Site. No current or potential future complete exposure pathways have been identified for ecological receptors to DNAPL in bedrock at the Site. No chemical-specific SCGs were identified for DNAPL at the Site. Accordingly, the following four remedial action objectives were identified for the FS:

- Eliminate, to the extent practicable, potential migration of DNAPL in bedrock at the Site to nearby surface water
- Eliminate, to the extent practicable, potential future exposure of human receptors to DNAPL in bedrock at the Site
- Provide a means for verification of continued protection of surface water receptors
- Provide a means for verification that DNAPL in bedrock is not migrating.

Following an evaluation of technologies, four remedial alternatives were developed. The alternatives ranged from a no action alternative as required by the National Contingency Plan (NCP) to a DNAPL and groundwater removal alternative aimed at restoration of the area to pre-disposal conditions, as required by NYSDEC's DER-10. Following a screening of alternatives, three remedial alternatives were evaluated in detail in accordance with nine evaluation criteria consistent with DER-10 and CERCLA.

Based on the detailed evaluation of the three alternatives developed in the FS, Alternative 3 is the recommended remedy for the Site. Alternative 3 is recommended because it satisfies the two threshold criteria, overall protection of human health and the environment, and compliance with SCGs, to the extent practicable, and provides the best balance with respect to the primary balancing criteria (long-term and short-term effectiveness and permanence, reduction in toxicity, mobility and volume, implementability and cost). Alternative 3 includes the following remedial elements:

- Institutional Controls
  - » Notice of environmental conditions, site management plan, and periodic reviews
  - » DNAPL, groundwater and surface water monitoring
- Continued collection of recoverable DNAPL from shallow and deep bedrock wells, when Site access is possible
- Off-site disposal of recovered DNAPL
- Treatment of recovered groundwater
- Natural attenuation of residual DNAPL

Figure 6-1 presents a conceptual plan of Alternative 3. Alternative 3 addresses the RAOs as follows:

Eliminate, to the extent practicable, potential migration of DNAPL in bedrock at the Site to nearby surface water. Alternative 3 addresses potential migration of DNAPL through continued collection of recoverable DNAPL, thereby removing DNAPL from the bedrock.

Eliminate, to the extent practicable, potential future exposure of human receptors to DNAPL in bedrock at the Site. Alternative 3 addresses potential future exposure of human receptors to DNAPL in bedrock at the Site through a notice of environmental conditions and collection and removal of recoverable DNAPL.

Provide a means for verification of continued protection of surface water receptors. Alternative 3 provides a means for verification of continued protection of surface water receptors through continued monitoring of surface water adjacent to the Site.

Provide a means for verification that DNAPL in bedrock is not migrating. Alternative 3 provides a means for verification that DNAPL in bedrock is not migrating though continued monitoring of DNAPL, groundwater, and surface water at the Site.

1. INTRODUCTION

1.1 GENERAL

This *Feasibility Study (FS) Report* has been developed by O'Brien & Gere Engineers, Inc. (O'Brien & Gere) on behalf of the General Electric Company (GE) for the GE Fort Edward Plant – Operable Unit 05 (OU-5), Former 004 Outfall (the Site), located in Fort Edward, New York (Figure 1-1). The GE Fort Edward Plant is currently listed in the New York State Registry of Inactive Hazardous Waste Disposal Sites (Site No. 5-58-004) as a Class 2 site. The Former 004 Outfall Site consists of dense non-aqueous phase liquid (DNAPL) in bedrock in the vicinity of the Former 004 Outfall, which was the historic wastewater and stormwater discharge from the GE Fort Edward Plant to the Hudson River. The Site is also referred to as the Former 004 Outfall Site. The FS was conducted pursuant to an Order on Consent (Index No. A5-0521-0705) for GE Fort Edward Plant – OU-05 executed between the New York State Department of Environmental Conservation (NYSDEC) and GE on August 26, 2005 (NYSDEC 2005). The FS was completed in accordance with the NYSDEC-approved *Remedial Investigation/ Feasibility Study (RI/FS) Project Work Plan for GE Fort Edward Plant OU-5 (RI/FS Work Plan)* prepared by Camp, Dresser & McKee (CDM) (CDM 2007) and incorporated into the Order on Consent.

1.2 PROJECT OBJECTIVES AND SCOPE

The Order on Consent required the implementation of the *Supplemental Remedial Investigation Work Plan for Former 004 Outfall* (GeoTrans 2005) and the 2007 *RI/FS Work Plan* (CDM 2007). Development of the FS represents Task 4 of the NYSDEC-approved *RI/FS Work Plan*. The objective of the FS was to develop and evaluate remedial alternatives to address DNAPL in bedrock that was evaluated during the RI for the Site.

The *RI Report* (TetraTech Geo and JG Environmental 2012) was submitted to NYSDEC in December 2012. In a letter dated May 23, 2013, NYSDEC provided comments on the 2012 *RI Report*. The comments were addressed in an *RI Addendum* (GE 2013a) provided to NYSDEC on June 18, 2013. The *RI Addendum* was subsequently approved by NYSDEC in a letter dated September 5, 2013 (NYSDEC 2013a). In a letter dated September 30, 2013 (GE 2013b), GE indicated that based on conversations with NYSDEC, the *FS Report* would be provided to NYSDEC on or before December 13, 2013. Following meetings with NYSDEC regarding the scope and approach for the FS, GE requested an extension until January 17, 2014 to allow for the development of a Fish and Wildlife Resources Impact Analysis (FWRIA) to be included with the FS Report (GE 2013c). This request was granted in NYSDEC's letter of December 6, 2013 (NYSDEC 2013b).

1.3 REPORT ORGANIZATION

The *FS Report* contains six sections. The remainder of this section presents a brief discussion of the history and background of the Site, a summary of RI activities and current monitoring activities. Section 2 documents the site geologic and hydrogeologic conditions. Section 3 provides a discussion of the nature and distribution of DNAPL in bedrock and the conceptual site model for the Site. Section 4 documents the first two phases of the FS, the development and screening of remedial alternatives, and includes the following:

- Remedial action objectives (RAOs);
- General response actions (GRAs);
- Identification of areas and volumes of media;
- Identification and screening of remedial technologies and process options;
- Evaluation of process options;
- Assembly of remedial alternatives; and
- Screening of remedial alternatives.

Section 5 summarizes the detailed analysis of remedial alternatives. Each alternative was analyzed individually and comparatively with respect to the following nine evaluation criteria:

- Overall protection of human health and environment;

- Compliance with standards, criteria and guidance (SCGs);
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility or volume through treatment;
- Short-term effectiveness;
- Implementability;
- Cost;
- Land use; and
- Community acceptance.

The final evaluation criterion, community acceptance, will be addressed by NYSDEC in its Proposed Remedial Action Plan (PRAP) and subsequent Record of Decision (ROD) and associated Responsiveness Summary.

Section 6 presents the summary and recommendations of the FS, and the recommended alternative for the Site.

1.4 SITE DESCRIPTION AND BACKGROUND

The GE Fort Edward Plant is a 32-acre area located approximately 800 feet east of the Hudson River in the Town of Fort Edward (Figure 1-1). The plant was constructed in 1942 when it was first operated as an aircraft turret manufacturing plant. Later the plant was used to manufacture selsyn motors and most recently, since 1946, for the manufacture of industrial capacitors. Prior to 1977, the capacitor dielectric fluids used by GE contained polychlorinated biphenyls (PCBs) that included Aroclors 1254, 1242 and 1016. Until 1976, untreated industrial wastewater was discharged to the Hudson River via the 004 Outfall. Use of PCB-containing material ceased in 1977 (CDM 2007). The Site consists of an area of DNAPL in fractured bedrock in the vicinity of the Former 004 Outfall. The Former 004 Outfall was located approximately 800 feet west of the GE Fort Edward plant, at the base of a bluff, on the eastern bank of the Hudson River. The bluff rises approximately 130 feet above today's river level.

Prior to 1973, the Former 004 Outfall discharged below the surface of the Hudson River into the pool behind the Fort Edward Dam. The Fort Edward Dam was located approximately 7,000 feet downstream of the Former 004 Outfall. The dam was intentionally breached in 1973, thereby draining the pool. Between 1973 and 1976 the Former 004 Outfall discharged above the river level. In 1976 discharge of untreated wastewater ceased, and wastewater was directed to the newly constructed wastewater treatment plant at the GE Fort Edward Plant (TetraTech Geo and JG Environmental 2012). The Former 004 Outfall pipe was removed in two efforts during 1994 and 1996 (O'Brien & Gere 1996).

Today, the Site consists of a flat narrow bank, approximately 25 ft wide, along the eastern edge of the Hudson River that serves as a gravel access road to reach monitoring wells associated with investigations in this area. The gravel access road was placed over shale bedrock adjacent to the river edge. The gravel access road and monitoring wells are inundated by the river on occasion. Immediately to the east of the access road, the shale bluff rises to approximately 130 ft above river level. There is little or no soil present in this area.

Site 3 of the Fort Edward PCB Remnants Deposits is located directly downstream from the Site along the river bank. Site 3 of the PCB Remnants Deposits is an approximately 17-acre sediment consolidation area that received river sediments accumulated upstream of the Fort Edward Dam. The Site 3 area has a maintained, vegetated, engineered clay cover.

1.4.1 Regulatory Framework

The NYSDEC has divided the GE Fort Edward Plant into the following Operable Units (OUs):

- OU-1: Off-Site Overburden Groundwater;
- OU-2: On-Site Groundwater and Source Control;
- OU-3: On-Site Residual Contamination;

- OU-4: Former 004 Outfall Sediment and Soil; and
- OU-5: Former 004 Outfall DNAPL in Fractured Rock.

Operable Units 1 and 2 were addressed by remedial programs in 1989 and 1990. The OU-1 remedy consists of groundwater recovery and treatment for shallow groundwater south of the facility. The OU-2 remedy consisted of removal of soil, groundwater recovery and treatment at the facility and removal of PCB oil from the subsurface at the facility (NYSDEC 2000). In January 2000, the NYSDEC issued the ROD for OU-3 and OU-4 (NYSDEC 2000). The ROD identified the OU-3 remedy as an expansion of the existing facility groundwater collection and treatment system, additional soil removal, and long-term monitoring. The ROD also described the Former 004 Outfall area (OU-4) as the area of contaminated soils and sediment adjacent to the Former 004 Outfall on the eastern shore of the Hudson River (Figure 1-1). The ROD presented the selected remedy for OU-4 and included the following components:

- Excavation of soil and sediment in the Former 004 Outfall area extending from approximately 160 feet upstream of the Former 004 Outfall location downstream to the northern end of remnant deposit 3/3A (see Exhibit B);
- Off-site disposal of all excavated material from this area; and
- Confirmatory sampling, including testing of the underlying bedrock.

In 2003 and 2004, NYSDEC implemented the ROD-selected remedial action for OU-4. During that project, in the immediate vicinity of the original outfall pipe, NYSDEC observed droplets of DNAPL within the fractured bedrock that was exposed during the excavation. Analysis of DNAPL samples confirmed the presence of PCBs. The PCB-containing DNAPL was also observed in fractures after several inches of shale was removed. As part of the NYSDEC remedial action, following excavation of the unconsolidated deposits and loose shale fragments from the bedrock surface, the Former 004 Outfall structure location was covered with a carbon blanket. To protect the area from erosion, portable concrete barriers (Jersey Barriers) were placed adjacent to the backfilled material along the eastern edge of the river, and rip rap was placed over the carbon blanket and backfill to the top of the concrete barriers. In addition, NYSDEC installed six shallow bedrock monitoring wells in the area where DNAPL had been observed and collected groundwater samples for PCB analyses from these wells (E&E 2004).

As a result of the observation of DNAPL in the vicinity of the Former 004 Outfall, NYSDEC determined that additional investigation was necessary to evaluate the nature and extent of DNAPL in the bedrock, and to evaluate potential remedial options. The area to be investigated was designated as OU-5. As discussed above, an Order on Consent (Index No. A5-0521-0705) for GE Fort Edward Plant – OU-05 was executed between NYSDEC and GE on August 26, 2005 (NYSDEC 2005) and required the completion of RI/FS activities.

1.4.2 Summary of Remedial Investigation Activities

Remedial investigations have been conducted in several phases for the Site. The following is a chronology of the work plans, scope modification letters and reports submitted to NYSDEC since completion of the remedial action selected in the 2000 ROD for the Former 004 Outfall Area.

The original scope of work, as described in the 2005 *Supplemental RI Work Plan* (GeoTrans 2005), included redeveloping the existing monitoring wells, installation of seven additional monitoring wells, and collection and analysis of groundwater and surface water samples. The results of that investigation were presented in the 2007 *Supplemental Remedial Investigation Summary Report for Former 004 Outfall* (GeoTrans 2007).

A second scope of work was developed, as described in the *2007 RI/FS Work Plan* (CDM 2007). As the investigations progressed, the scope of work was modified and approved in letters between GE and NYSDEC. In general, the 2007 *RI/FS Work Plan* and subsequent modifications included the following:

- Installation of monitoring wells;
- Rock core sampling and analysis;
- Hydraulic testing;

- Borehole logging;
- Groundwater sampling and analysis;
- DNAPL collection and analysis;
- Surface water sampling and analysis; and
- DNAPL bail down tests.

The results of these investigation activities are included in the *2010 Data Summary Report for Former 004 Outfall* (GeoTrans *et al.* 2010).

Following submittal of the *2010 Data Summary Report for Former 004 Outfall*, GE and NYSDEC met to discuss the scope of work needed to complete the RI. Several scope modification letters were submitted, and approved by NYSDEC. In general, investigation activities included:

- Characterization of PCB concentrations in the Hudson River adjacent to, as well as upstream and downstream of the Former 004 Outfall;
- Hydraulic testing of the shallow bedrock zone;
- Evaluation of DNAPL recovery rates from the shallow bedrock zone;
- Delineation of the extent of DNAPL in the deep bedrock zone;
- Groundwater sampling and analysis;
- DNAPL collection and analysis; and
- Surface water sampling and analysis.

The RI field work required by the work plans and modification letters was completed in July 2012. The results of these investigations were summarized in the *2012 Remedial Investigation Report – Former 004 Outfall – OU-5* (TetraTech Geo and JG Environmental 2012).

1.4.3 2013 Monitoring and DNAPL Recovery Activities

Although not required by NYSDEC, collection and analysis of routine monitoring data was conducted during the 2013 monitoring season (May through November) at the Former 004 Outfall Area. Surface water sampling and DNAPL monitoring and recovery activities conducted during the 2013 monitoring season are relevant to the FS, and are described in the following sections.

Surface Water Sampling

Monthly surface water samples were collected from three existing sample locations in the Hudson River between May and November 2013. Surface water grab samples were collected from locations identified as 004_HR_N, 004_HR_S, and 004_HR_A, which are located upstream of, downstream of, and adjacent to, the Former 004 Outfall, respectively (Figure 1-2). Hudson River surface water samples were submitted for laboratory analyses of PCBs using Method NE207_03 and total suspended solids (TSS) using Method 2540D.

Of the twenty-one surface water samples collected in 2013, only two samples, both located adjacent to Former 004 Outfall, exhibited concentrations above the detection limit at concentrations ranging from 8.91 J to 14.1 J nanograms per liter (ng/L). Table 1-1 presents a summary of 2013 surface water sampling results. Figure 1-3 presents a graphical representation of the sample results.

DNAPL Monitoring and Recovery

An annual monitoring event was conducted at 27 monitoring wells associated with Former 004 Outfall on July 18, 2013 for the purpose of monitoring the presence or absence of measureable DNAPL. Subsequent monthly DNAPL recovery events were conducted between July and November 2013 at five monitoring well locations (MW-1D6, MW-1D7, MW-2D, MW-7D2, and MW-18D6) where recoverable DNAPL was consistently identified. DNAPL was collected using bailers and consolidated in a dedicated storage area and disposed off-site.

Groundwater collected during DNAPL recovery was transported to the GE Fort Edward treatment plant for treatment. DNAPL recovery locations are depicted on Figure 1-2.

DNAPL recovery from all but one (MW-18D6) of the wells exhibiting recoverable DNAPL in 2013 was less than 0.7 L each month, while quantities ranging from 0.62 L to 13.15 L were collected each month from MW-18D6. Table 1-2 and Figure 1-5 present a summary of DNAPL recovery volumes.

2. SITE SETTING

The following descriptions of the Site geologic and hydrogeologic conditions are based on information and data summarized in the *RI Report* (Tetra Tech Geo and JG Environmental 2012) and the June 2013 *RI Addendum* (GE 2013a). This summary describes the Site conditions which have had the most significant effect on the distribution of DNAPL in the bedrock and which are relevant for selecting appropriate remedial action(s) for the DNAPL.

2.1 SITE GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

Stratigraphic units that have been identified at the Site are the Snake Hill Shale and the Glens Falls Limestone. The Snake Hill Shale is the uppermost bedrock formation and is exposed in the bluff adjacent to the Former 004 Outfall location. The Snake Hill Shale is approximately 240 feet thick at the Former 004 Outfall, but thickens to the southeast to approximately 445 feet at monitoring well MW-21D8. For the purpose of these investigations and evaluations, the Snake Hill Shale has been subdivided into the upper Snake Hill Shale and the lower Snake Hill Shale. The middle Snake Hill Shale, which is present in the vicinity of the GE Hudson Falls plant, does not appear to be present in the vicinity of the Former 004 Outfall. A network of near-vertical fractures and sub-horizontal bedding parallel fractures are present in the Snake Hill Shale. These fractures are the principal geologic controls on the occurrence and movement of groundwater and DNAPL. This inter-connected fracture network is exposed in the bluff adjacent to the location of the Former 004 Outfall.

The Glens Falls Limestone lies conformably beneath the Snake Hill Shale. The Glens Falls Limestone was encountered at depths ranging from 240 to 275 feet below ground surface (bgs) in the general vicinity of the Former 004 Outfall and at a depth of about 360 feet bgs approximately 2,500 feet south of the Former 004 Outfall.

Groundwater flow in the Snake Hill Shale in the vicinity of the Former 004 Outfall is generally westerly toward the Hudson River. In close proximity to the river, there is predominantly vertically upward flow from the Glens Falls Limestone and the lower Snake Hill Shale toward the Hudson River. Surface water and groundwater elevation data show that the upper Snake Hill Shale is in direct hydraulic connection with the river and that the hydraulic effects of changes in river stage decrease in the bedrock with increasing depth below the river. Because of the relatively small annual variation of the river stage, water levels in the shallow bedrock zone also have a relatively small annual variation.

Monitoring wells and potentiometric sections identified as B-B’ and C-C’ are discussed in the following sections and presented on Figure 1-4. Potentiometric sections B-B’ and C-C’, developed by TetraTech Geo, are presented in Exhibit A in Figures A-1 and A-2, respectively. The two sections were prepared using the November 13, 2012 water level measurements. As illustrated by the potentiometric sections, there is a groundwater divide in the area of Lower Allen Street, between the Hudson River and the GE Fort Edward plant. Groundwater on the western side of the divide flows westerly towards and discharges to the Hudson River. Beneath the river the hydraulic head in the Glens Falls Limestone is higher than the hydraulic head in the Snake Hill Shale, and the hydraulic head in the Snake Hill Shale is higher than the hydraulic head in the river, indicating that the groundwater flow beneath the river is upward towards and discharges to the river. Based on a review of the quarterly water level measurements, the November 2012 water level data are representative of the groundwater flow conditions in the area of the Former 004 Outfall.

The hydraulic conductivity of the bedrock was evaluated through packer testing and slug testing. For water-yielding portions of the boreholes, estimated hydraulic conductivity values ranged from $1.4x10^{-08}$ centimeters per second (cm/sec) to $2.6x10^{-02}$ cm/sec (GeoTrans, *et al*, 2010). The wide range in hydraulic conductivity values are typical of fractured bedrock and reflect the relative spacing of water-yielding fractures compared to the length of the hydraulic testing interval.

During the RI, hydraulic fracturing was attempted on the open interval of monitoring wells MW-15D6 and MW-21D8 to try to connect the open boreholes to hydraulically-active fractures that may be near the boreholes. The packer was set at different depths in the wells and the packed intervals were pressurized. No decrease in the pressure or increase in the flow rate into the well was observed in either MW-15D6 or MW-21D8. The hydraulic fracturing attempts did not open any fractures in these wells.

2.2 GROUNDWATER USE AND PUBLIC WATER SUPPLIES

A search for water supply wells which could potentially be impacted by the contaminants from the Former 004 Outfall area was documented in the *RI Report* (TetraTech Geo and JG Environmental 2012). Public records were searched and the public water supply utilities were contacted to gather data on water supply wells. One private residential well was identified at 7 Robert Rogers Avenue in Moreau, approximately 1.3 miles from the Site. The well was reported to be drilled into the Glens Falls Limestone. A sample of groundwater from the well was collected on May 27, 2010. The sample was analyzed for PCBs by EPA Method 608. No PCBs were detected in the sample.

2.3 SURFACE WATER

With the exception of during periodic flooding, surface water is not present within the boundaries of the Site. The Hudson River is located directly to the west of the Site.

2.4 FISH AND WILDLIFE RESOURCES IMPACT ANALYSIS

A Fish and Wildlife Resources Impact Analysis (FWRIA) was completed for the Site, and is provided as Appendix A. Based on the relatively low magnitude of exceedances and low detection frequency of PCBs in surface water in the vicinity of the Site (particularly in recent years), potential impacts to ecological receptors in the Hudson River from Site-related constituents, if any, are *de minimis*, and a *Part II - Ecological Impact Assessment*, was not deemed necessary for this Site.

3. REMEDIAL INVESTIGATION RESULTS

3.1 GENERAL

The objective of the RI was to evaluate the vertical and lateral extent of PCB-containing DNAPL at the Site. The results of the RI are discussed below. A more detailed discussion of RI results and the nature and distribution of contamination are provided in the *RI Report* (TetraTech Geo and JG Environmental 2012) and the *RI Addendum* (GE 2013).

3.2 NATURE AND DISTRIBUTION OF DNAPL

3.2.1 DNAPL Analysis

As described in the *RI Report*, DNAPL analyses indicate that the primary constituent of the DNAPL is Aroclor 1242. The DNAPL also exhibited lower concentrations of volatile organic compounds (VOCs) 1,2,3-trichlorobenzene, 1,2,4 trichlorobenzene, and 1,4-dichlorobenzene, and one sample contained trichloroflouromethane. No other VOCs were detected. The total VOC concentrations of the DNAPL samples ranged from 304,000 µg/kg to 1,070,500 µg/kg. Semi volatile organic compounds (SVOCs) detected in the DNAPL included: 1,1-biphenyl, 1,2,4-trichlorobenzene, acenaphthene, bis(2-ethylhexyl)phthalate, and diphenyl ether. The total SVOC concentration of the DNAPL samples ranged from 1,840 mg/kg to 61,882 mg/kg. Petroleum identification analyses were performed on four DNAPL samples and the results indicated diesel range organics at concentrations ranging from 868,000 µg/kg to 1,490,000 µg/kg, (GeoTrans, *et al*. 2010).

3.2.2 Spatial Distribution of DNAPL

As described in the *RI Report*, there were several criteria used during the RI to evaluate the spatial extent of PCB DNAPL. These criteria were:

- Direct observation of DNAPL during drilling either as recoverable DNAPL or the presence of DNAPL on rock core;
- Direct observation of DNAPL during monitoring well gauging or sampling events;
- Observations of DNAPL sheens in return water during drilling and/or in collected groundwater samples;
- PCB concentrations in groundwater samples at or near the solubility limit of approximately 200 micrograms per liter (µg/L) for Aroclor 1242; and
- PCB detected in crushed rock core samples at concentrations greater than 10 micrograms per gram (µg/g).

Based on these criteria it was concluded that an area of discontinuous DNAPL is present in the fractured Snake Hill Shale beneath the Former 004 Outfall. The rock core and groundwater analyses and observations of DNAPL in the monitoring wells indicate that DNAPL is present, primarily at residual saturation levels, in some portion of the rock fractures in the upper Snake Hill Shale and extends from the MW-10 well cluster, approximately 60 feet upstream of the Former 004 Outfall, to the MW-4 well cluster approximately 160 feet downstream of the Former 004 Outfall (Figure 1-4). In the lower Snake Hill Shale, including the contact with the Glens Falls Limestone, evidence of discontinuous DNAPL occurrence was found to a depth of 270 feet below the Hudson River and at a distance of 600 feet south of the location of the Former 004 Outfall. No indications of DNAPL were observed in the wells installed east of the river bank area or on the west side of the Hudson River. A schematic block diagram illustrating the spatial distribution of DNAPL is presented as Figure A-3 in Exhibit A.

3.2.3 DNAPL Migration Processes

As described in the *RI Report*, vertical downward DNAPL migration into the bedrock may have been facilitated by several factors. These include:

- Accumulation of DNAPL on the bedrock surface adjacent to the Former 004 Outfall;
- A DNAPL specific gravity greater than 1;
- The presence of vertical fractures in the bedrock; and

- Downward hydraulic gradients created by the water level behind the Fort Edward dam in the portion of the Hudson River adjacent to the Former 004 Outfall.

Lateral migration of DNAPL would have occurred in the sub-horizontal bedding parallel fractures when downward DNAPL migration was impeded due to reductions in the aperture width of vertical fractures. The stratigraphic contacts between the upper Snake Hill Shale and the lower Snake Hill Shale, as well as the contact between the lower Snake Hill Shale and the Glens Falls Limestone appear to have been somewhat preferential pathways for lateral DNAPL migration and areas of localized accumulations of recoverable DNAPL (TetraTech Geo and JG Environmental 2012).

Removal of the Fort Edward dam in 1973 and the cessation of DNAPL discharge at the Former 004 Outfall by at least 1976 would have likely stopped the entry of DNAPL into the underlying bedrock. The lowered Hudson River water level would have eliminated or reduced the two principal driving forces for downward DNAPL migration; the accumulation of DNAPL pools on the bedrock surface and the downward hydraulic gradient from the river to the shallow bedrock. Removing the dam in 1973, and the consequent lowering of the Hudson River water level, would have caused a reversal of vertical hydraulic gradients between river and the underlying bedrock. Downward hydraulic gradients that likely existed during the time the dam was in place would have changed to the upward hydraulic gradients that are present today. The transition to upward hydraulic gradients would not only have reduced the potential for downward DNAPL migration, but may also have caused some upward migration of DNAPL from the upper Snake Hill Shale bedrock to the Hudson River, thereby reducing the amount of DNAPL present in the shallow bedrock adjacent to and beneath the river (TetraTech Geo and JG Environmental 2012).

The upward hydraulic gradient between the Glens Falls Limestone and Lower Snake Hill Shale is likely sufficient to prevent the downward migration of DNAPL into the Glens Falls Limestone. The specific gravity of Aroclor 1242, the dominant component of the DNAPL present at the Former 004 Outfall, ranges from 1.3 to 1.39, (Monsanto 1995). An upward hydraulic gradient greater than 0.3 to 0.39 would be high enough to overcome the downward-acting gravitational forces due to the difference in specific gravity between the DNAPL and water and create a hydraulic barrier to the downward DNAPL migration. As shown on the cross-section Figures A-1 and A-2 provided in Exhibit A, there is a large upward hydraulic gradient from the Glens Falls Limestone. The estimated upward vertical gradient between wells MW-14D8 and MW-1D7 is 1.4 and the upward hydraulic gradient between MW-18D7 and MW-18D6 is approximately 0.6. The calculated upward hydraulic gradients indicate that the head difference between the Glens Falls Limestone and the overlying Snake Hill Shale are sufficient to create a hydraulic barrier to further downward migration of the DNAPL (TetraTech Geo and JG Environmental 2012).

Within the upper Snake Hill Shale, DNAPL is generally present at residual saturation, and is generally present within 75 feet of the location of the Former 004 Outfall. However, there are only four locations where periodic DNAPL recovery has been possible. Those monitoring wells are MW-1D, MW-1D2, MW-2D and MW-7D2 (Figure 1-4). Within the lower Snake Hill Shale periodic DNAPL recovery has been possible at three well locations. These wells are MW-1D6, MW-1D7, and MW-18D6 (Figure 1-4). More recently in 2013, recoverable DNAPL has been limited to wells MW-1D6, MW-1D7, MW-2D, MW-7D2 and MW-18D6.

For the purpose of this FS, it is assumed that shallow DNAPL includes DNAPL in the upper Snake Hill Shale extending from the top of bedrock down to the elevation of the river bottom. This DNAPL has the potential to migrate to the river should it become remobilized. DNAPL in bedrock below the elevation of the river bottom is considered deep DNAPL and would not be expected to migrate upward through the bedrock to the river.

The rate of annual cumulative DNAPL recovery from all of the wells has declined each year since regular DNAPL recovery began. Monitoring well MW18D6, completed in the Lower Snake Hill Shale, has yielded the largest volume of DNAPL, approximately 200 liters (L), and continues to yield DNAPL at a rate greater than 2 L per month. Removal of DNAPL from the upper Snake Hill Shale bedrock wells has effectively been depleting the volume of DNAPL in the Snake Hill Shale fractures. In 2013 the monthly recovery rates from the lower Snake Hill Shale wells have ranged from approximately 0.07 L/month from MW-1D6 to approximately 13.15 L/month from MW-18D6, as summarized in Table 1-2 and illustrated on Figure 1-5.

During the RI, a pumping test was conducted using monitoring well MW-2D as the pumping well, to evaluate the effect of pumping groundwater on DNAPL recovery. The small volume of DNAPL recovered during the test indicates that the groundwater pumping from MW-2D did not significantly enhance the DNAPL recovery. Pumping did not enhance DNAPL recovery because of the generally residual nature of the DNAPL accumulation and the relatively high viscosity of the mobile PCB DNAPL (TetraTech Geo and JG Environmental 2012).

3.2 NATURE AND DISTRIBUTION OF CONSTITUENTS IN BEDROCK

As described in the *RI Report*, and based on the subsequent sampling in 2013, groundwater in the DNAPL zone contains PCBs at concentrations less than the aqueous solubility limit and at concentrations greater than the NYS Class GA Groundwater Standard. These results suggest that DNAPL in bedrock is a source of localized groundwater contamination.

Based on samples collected prior to 2010 from a few monitoring wells, groundwater also contained low concentrations of trichloroethene, (and its breakdown byproducts cis and trans 1,2-dichlorethene and vinyl chloride), trichlorobenzene compounds and toluene. Low dissolved concentrations of some of the SVOC constituents of the DNAPL, primarily bis(2-ethylhexyl)phthalate, were also detected in some groundwater samples, (GeoTrans, *et al*. 2010). Some of these concentrations were above the corresponding NYS Class GA Groundwater Standards.

3.3 NATURE AND DISTRIBUTION OF CONSTITUENTS IN SURFACE WATER

As described in the *RI Report*, PCBs have been detected intermittently in samples collected from the Hudson River in the vicinity of the Former 004 Outfall, though most sample results have been below the detection limit. The infrequent detections of PCB concentrations in the surface water samples are an indication that mass flux from the DNAPL present in the fractured Snake Hill Shale beneath the Former 004 Outfall area to the Hudson River is small.

3.4 CONCEPTUAL SITE MODEL

The conceptual model provides a summary description of the Site conditions which have had the most significant effect on the distribution and migration of the PCB DNAPL in bedrock documented at the Former 004 Outfall area and which are relevant for selecting appropriate remedial action(s) for the DNAPL.

- The Former 004 Outfall was located on the eastern bank of the Hudson River approximately 800 feet west of the GE Fort Edward Plant. The Former 004 Outfall was located at the approximate elevation of the Hudson River and at the base of a bluff that is approximately 130 feet above the river level.
- Prior to 1976 the Former 004 Outfall was used for discharge of untreated industrial wastewater and storm water from the GE Fort Edward Plant.
- Prior to 1973 the Former 004 Outfall discharged below the surface of the Hudson River into the pool behind the Fort Edward Dam. The Fort Edward Dam was located approximately 7,000 feet downstream of the Former 004 Outfall.
- The dam was intentionally breached in 1973, thereby draining the pool behind it. Between 1973 and 1976 the Former 004 Outfall discharged above the river level.
- The wastewater treatment plant at the GE Fort Edward Plant was completed in 1976 and discharge of untreated wastewater through Former 004 Outfall ceased.
- The Former 004 Outfall pipe was removed in 1996.
- Stratigraphic units that have been identified beneath the location of the Former 004 Outfall are the Snake Hill Shale and the Glens Falls Limestone. For the purpose of the Site evaluations, the Snake Hill Shale has been subdivided into the upper Snake Hill Shale and the lower Snake Hill Shale.
- The Snake Hill Shale is approximately 240 feet thick at the Former 004 Outfall. This unit thickens to the south east to approximately 445 feet.

- The Glens Falls Limestone was encountered at depths ranging from 240 to 275 feet bgs in the general vicinity of the Former 004 Outfall and 360 feet bgs approximately 2,500 feet south of the Former 004 Outfall.
- A network of near-vertical and sub-horizontal bedding parallel fractures that are present in the Snake Hill Shale are the principal geologic controls on the occurrence and movement of groundwater and DNAPL. A portion of this inter-connected fracture network is exposed in the bluff adjacent to the location of the Former 004 Outfall.
- The hydraulic conductivity of the bedrock ranges from 1.4×10^{-08} cm/sec to 2.6×10^{-02} cm/sec. The wide range in hydraulic conductivity is typical of fractured bedrock.
- Groundwater flow in the Snake Hill Shale in the vicinity of the Former 004 Outfall is generally westerly toward the Hudson River. In close proximity to the river, there is predominantly vertically upward flow from the Glens Falls Limestone and the Snake Hill Shale toward the Hudson River.
- An area of discontinuous DNAPL is present in the fractured Snake Hill Shale beneath and in the area of the Former 004 Outfall.
- Historic vertical downward DNAPL migration into the bedrock was apparently facilitated by a DNAPL specific gravity greater than 1, the presence of vertical fractures in the bedrock, and the downward hydraulic gradients created by the water level in the pool behind the Fort Edward dam in the portion of the Hudson River adjacent to the Former 004 Outfall.
- Historic lateral migration of DNAPL would have occurred in the sub-horizontal bedding parallel fractures when downward DNAPL migration was impeded due to reductions in the aperture width of vertical fractures.
- The stratigraphic contacts between the upper Snake Hill Shale and the lower Snake Hill Shale, as well as the contact between the lower Snake Hill Shale and the Glens Falls Limestone appear to have been somewhat preferential pathways for lateral DNAPL migration.
- Currently the upward hydraulic gradient between the Glens Falls Limestone and Lower Snake Hill Shale is likely sufficient to prevent the downward migration of DNAPL into the Glens Falls Limestone.
- The extent of DNAPL in the bedrock was defined to be in close proximity to the Former 004 Outfall. In the Snake Hill Shale, including the contact with the Glens Falls Limestone, evidence of discontinuous DNAPL occurrence was found to a depth of 270 feet below the Hudson River and at a distance of 600 feet south of the location of the Former 004 Outfall. DNAPL was not observed in bedrock east of the river bank area or on the west side of the Hudson River.
- DNAPL analyses indicate that the primary constituent of the DNAPL is Aroclor 1242. The DNAPL also includes lower concentrations of some VOCs, SVOCs, and petroleum constituents.
- For the purpose of this FS, it is assumed that shallow DNAPL is DNAPL that could migrate to the river and includes DNAPL in the upper Snake Hill Shale extending from the top of bedrock down to the elevation of the river bottom. DNAPL in bedrock below the elevation of the river bottom is considered deep DNAPL and would not be expected to migrate to the river.
- Groundwater hydraulically down gradient of the DNAPL zone contains PCBs at concentrations less than the aqueous solubility limit. Samples from a few monitoring wells also contained low concentrations of some VOC and SVOC constituents of the DNAPL.
- Infrequent detection of PCB concentrations in the surface water samples is an indication that mass flux from the DNAPL from the bedrock to the Hudson River is small.
- Within the bedrock, DNAPL is present at residual saturation levels with localized accumulations of recoverable DNAPL. Residual saturation means the DNAPL is not mobile under existing conditions. There were only isolated locations where DNAPL recovery has been possible.
- The stratigraphic contacts between the upper Snake Hill Shale and the lower Snake Hill Shale, as well as the contact between the lower Snake Hill Shale and the Glens Falls Limestone appear to be areas of localized accumulations of recoverable DNAPL.

- The annual cumulative amounts of DNAPL recovery from the wells has declined each year since regular DNAPL recovery began. Removal of DNAPL from the Snake Hill Shale bedrock wells has effectively been depleting the volume of DNAPL in the Snake Hill Shale fractures. The current monthly recovery rates from the lower Snake Hill Shale wells have ranged from approximately 0.1 L/month from MW-1D6 to approximately 2.5 L/month from MW-18D6.
- Pumping did not enhance DNAPL recovery because of the generally residual nature of the DNAPL accumulation and its relatively high viscosity.

Based on the above summarized information, the following can be concluded regarding contaminant transport for the Site:

Historic discharges from the GE Fort Edward Plant through the Former 004 Outfall have resulted in an area of discontinuous PCB-containing DNAPL present in the fractured Snake Hill Shale beneath the Former 004 Outfall near the shore of the Hudson River (see Figure A-3 presented in Exhibit A). Evidence of discontinuous DNAPL occurrence was found to a depth of 270 feet below the Hudson River and at a distance of 600 feet south of the location of the Former 004 Outfall. DNAPL was not observed in bedrock east of the river bank area or on the west side of the Hudson River. DNAPL in Site bedrock is present at residual saturation, or in localized accumulations, and thus, is generally considered not mobile. DNAPL has only been demonstrated to be recoverable at isolated locations, and total DNAPL recovery rates have been declining.

Groundwater flow in the Snake Hill Shale in the vicinity of the Former 004 Outfall is generally westerly toward the Hudson River. In close proximity to the river, there is predominantly vertically upward flow from the bedrock toward the Hudson River. While there is a potential for migration of shallow DNAPL in the bedrock at or above the elevation of the bottom of the river, it is unlikely that DNAPL present in deeper bedrock has the potential to migrate to the river. Infrequent detections of PCB concentrations in the surface water samples in the river are an indication that mass flux from the DNAPL in the bedrock to the Hudson River is small.

4. DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES

This section documents the development and screening of remedial alternatives for the Site, and describes the following:

- Remedial action objectives;
- General response actions;
- Estimated areas and volumes of media;
- Identification and screening of remedial technologies and process options;
- Evaluation of process options and selection of representative process options;
- Assembly of remedial alternatives; and
- Screening of remedial alternatives.

4.1 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

RAOs are medium-specific goals for protecting human health and the environment. RAOs form the basis for the FS by providing overall goals for site remediation. The RAOs are considered during the identification of appropriate remedial technologies, development of alternatives for the Site, and later during the evaluation of remedial alternatives.

Consistent with the United State Environmental Protection Agency's (USEPA's) *Guidance for Conducting Remedial Investigations and Feasibility Studies Under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)* (USEPA 1988) and NYSDEC's Division of Environmental Remediation (DER), *Technical Guidance for Site Investigation and Remediation* (DER-10) (NYSDEC 2010a), the development of RAOs is based on engineering judgment, risk-based information, and the nature and extent of compounds exceeding potentially applicable SCGs. In addition, consistent with DER-10, the current, intended and anticipated future land use at the Site and its surroundings is considered in the identification of RAOs.

4.1.1 Land Use

The Site consists of a flat narrow river bank along the eastern edge of the Hudson River that serves as a gravel access road to reach monitoring wells associated with investigations in this area. The gravel access road is placed over shale bedrock adjacent to the river. Immediately to the east, the shale bluff rises to approximately 130 ft above river level. Immediately west of the access road is the Hudson River.

Prior to 1976, the Former 004 Outfall was used for discharge of untreated industrial wastewater and storm water from the GE Fort Edward Plant. Until 1973, when the Fort Edward Dam was intentionally breached, the Former 004 Outfall was below the surface of the river. In 1976 discharge of untreated wastewater ceased, and wastewater was directed to the newly constructed wastewater treatment plant at the GE Fort Edward Plant.

Site 3 of the Fort Edward PCB Remnants Deposits is located directly downstream from the Site along the river bank. Site 3 of the PCB Remnants Deposits is an approximately 17-acre sediment consolidation area. The Site 3 area has a maintained, vegetated, engineered clay cover. The gravel access road that services both the Site and the PCB Remnant Site is not accessible to the public and is used solely to access these areas by GE and personnel conducting monitoring and maintenance field activities.

No buildings are currently at or in the vicinity of the Site. The gravel access road and monitoring wells become periodically inundated by the river during periods of high river flow. Due to ongoing monitoring and maintenance activities at the Site and the nearby PCB Remnant Site 3 and the periodic flooding of the Site, the reasonably anticipated future use of the Site is anticipated to remain unchanged.

4.1.2 Identification of SCGs

As presented in the December 2012 *RI Report* and June 2013 *RI Addendum*, investigations have concluded that DNAPL containing high concentrations of PCBs is present in the bedrock. As shown on Table 4-1, no applicable, relevant or applicable chemical-specific SCGs are identified for DNAPL at the Site.

4.1.3 Contaminant Migration Pathways

Groundwater flow in the Snake Hill Shale in the vicinity of the Former 004 Outfall is generally westerly toward the Hudson River. Small amounts of DNAPL were observed in bedrock at the river bank during the remedial action conducted by NYSDEC in 2003. As described in Section 1.4.1, observed DNAPL, unconsolidated deposits and loose shale fragments were removed from this area in 2003 and 2004. The potential for shallow DNAPL migration to the Hudson River exists for DNAPL present in bedrock at or above the elevation of the river bottom. Based on surface water quality in the Hudson River, DNAPL present in the bedrock at the Site has a minimal impact on the total PCB concentration in the Hudson River.

DNAPL present below the depths of the Hudson River is primarily at residual saturation levels with localized accumulations of recoverable DNAPL that are not considered to be mobile to the river. In addition, based on the currently upward hydraulic gradient between the Glens Falls Limestone and Lower Snake Hill Shale it is not likely that DNAPL is migrating downward into the Glens Falls Limestone. DNAPL has not been documented in the Glens Falls Limestone formation located beneath the Snake Hill Shale.

4.1.4 Contaminant Exposure Pathways

There are currently no complete exposure pathways identified for human receptors to DNAPL in the Snake Hill Shale bedrock. There are no current or potential future exposure pathways for ecological receptors to DNAPL in the Snake Hill Shale bedrock.

As described above, based on surface water quality in the Hudson River, DNAPL present in the bedrock at the Site has a minimal, if any, effect on the total PCB concentration in the Hudson River. There are complete exposures pathways for human and ecological receptors to surface water in the Hudson River.

4.1.5 Remedial Action Objectives

The objective of the RI for GE Fort Edward Plant OU-5, as presented in the 2007 *RI/FS Work Plan* (CDM 2007), was to delineate the vertical and horizontal nature and extent of NAPL. Consistent with this objective, the *RI Report* presents a delineation of the extent of DNAPL at the Site, and therefore this FS focuses on DNAPL in bedrock.

There are no applicable, relevant or appropriate chemical-specific SCGs identified for DNAPL at the Site. Currently there are no direct exposures for human receptors to DNAPL in bedrock at the Site. There are also no current or potential future direct exposures for ecological receptors to DNAPL in bedrock at the Site.

As described above, shallow DNAPL in the bedrock has the potential to migrate to the Hudson River where human and ecological receptors have the potential to be exposed to surface water, though, based on analytical results of surface water samples, DNAPL that may be migrating to surface water has a minimal effect on total PCB concentrations in the river. Accordingly, four remedial action objectives were identified for the FS, as follows:

- Eliminate, to the extent practicable, potential migration of DNAPL in bedrock at the Site to nearby surface water.
- Eliminate, to the extent practicable, potential future exposure of human receptors to DNAPL in bedrock at the Site.
- Provide a means for verification of continued protection of surface water receptors.
- Provide a means for verification that DNAPL in bedrock is not migrating.

4.2 PHYSICAL AND TECHNICAL LIMITS TO REMEDIATION

Site conditions limit the alternatives available for remediation of the Site. Specifically, the following physical and hydrogeologic conditions limit the technical practicability of subsurface remediation technologies at this Site:

- The site is a flat narrow river bank that is subject to frequent inundation and ice flow and is limited to the east by an approximately 130 ft tall shale bluff and to the west by the adjacent Hudson River.
- Substrate at the site consists of a narrow gravel roadway underlain by shale bedrock.

- DNAPL is present in discontinuous areas at residual saturation, with only isolated locations from which accumulations of DNAPL are recoverable;
- DNAPL is present in a network of near-vertical and sub-horizontal bedding parallel fractures, extending as deep as 270 ft below the nearby Hudson River;
- Although *in situ* technologies can be used to reduce concentrations of DNAPL, they have not demonstrated the ability to remediate sources to meet groundwater standards in a reasonable period of time (National Research Council 2012);
- As is typical of fractured bedrock, a wide range of hydraulic conductivity values has been documented at the Site ($1.4x10^{-8}$ cm/sec to $2.6x10^{-2}$ cm/sec); thus, the formation is very heterogeneous, limiting effectiveness of extraction or *in situ* treatment technologies;
- The DNAPL in bedrock is present in close proximity to the Hudson River. Uncontrolled migration of shallow DNAPL could result in discharges to the river, thus limiting the ability to implement DNAPL recovery enhancement technologies;
- The total rate of DNAPL recovery from the wells has declined since regular DNAPL recovery began;
- A pumping test was conducted to evaluate the effect of pumping groundwater on DNAPL recovery. Pumping did not enhance DNAPL recovery because of the generally residual nature of the DNAPL accumulation and the relatively high viscosity of the mobile DNAPL.

These physical and technical limitations were taken into consideration during the evaluation of technologies and the screening of remedial alternatives.

4.3 GENERAL RESPONSE ACTIONS

GRAs are types of actions which may, either alone or in combination, form alternatives to address the RAOs. GRAs identified for DNAPL in bedrock, based on the RAOs, are summarized as follows:

- ***No action.*** No action must be considered in the FS, as specified in the National Contingency Plan (NCP) [40 Code of Federal Regulations (CFR) Part 300.430].
- ***Institutional controls/limited actions.*** Actions that provide site access and use restrictions, provisions for continued operation of the remedy, and monitoring of remedy effectiveness.
- ***Natural recovery actions.*** Actions that rely on natural processes to attenuate DNAPL in bedrock.
- ***Containment actions.*** Actions that contain or divert DNAPL in bedrock.
- ***In situ treatment actions.*** Actions that treat contaminants in place.
- ***Collection actions.*** Actions that collect and/or control DNAPL in bedrock.
- ***Collection enhancement actions.*** Actions that enhance the removal of DNAPL in bedrock.
- ***Disposal actions.*** Actions that treat and/or dispose of extracted DNAPL and incidental groundwater.

4.4 IDENTIFICATION OF AREAS AND VOLUMES OF MEDIA

The nature and distribution of DNAPL, RAOs, and potential chemical-specific and location-specific SCGs were used to identify the estimated area of media for the FS. The nature and extent of contamination was presented in the RI, as summarized previously in Sections 3 of this report. RAOs and potential chemical-specific and location-specific SCGs were identified in Section 4.1.2.

DNAPL in bedrock has been documented to extend about 60 ft north and 600 ft south of the Former 004 outfall. The eastern extent of DNAPL impacted bedrock has been documented to be within 25 ft from the river bank. For the purpose of this FS the western extent is assumed to be in close proximity to the edge of the Hudson River. While the depth of DNAPL in bedrock varies across the Site, the maximum documented depth is about 270 ft below the ground surface.

4.5 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

Potentially applicable remedial technology types and process options were identified for each GRA during this step. Technologies and process options were screened on the basis of technical implementability. Technical implementability for each identified process option was evaluated with respect to contaminant information, physical site characteristics, and areas and volumes of media.

The identification of relevant remedial technologies and process options for DNAPL in bedrock were based on engineering experience and a review of relevant literature and technology databases. The following technology databases and literature were reviewed:

- Federal Remediation Technologies Roundtable (FRTR), Remediation Technologies Screening Matrix (2007);
- NYSDEC DER, *Technical Guidance for Site Investigation and Remediation* (DER-10) (2010);
- NYSDEC Program Policy, *Green Remediation* (DER-31) (2010);
- USEPA Superfund Remediation Technologies; and
- USEPA Contaminated Site Clean-Up Information (CLU-IN)

Descriptions of technologies and process options identified for the FS are presented in Tables 4-2 and 4-3. Technologies and process options to address DNAPL in bedrock were evaluated for shallow and deep bedrock zones. Technologies and process options that were viewed as not implementable were not considered further in the FS. The remedial technologies and process options retained for further consideration are listed below.

- ***Shallow DNAPL.***
  - No action
  - Institutional controls/limited actions
    - Proprietary controls (notice of environmental conditions)
    - Government controls (site management plan)
    - Monitoring (monitoring)
    - Periodic reviews (periodic site reviews)
  - Natural recovery
    - Natural attenuation (natural attenuation, monitored natural attenuation)
  - Containment
    - Physical barrier wall (grout curtain)
    - Hydraulic barrier (groundwater extraction)
  - *In situ* treatment
    - Treatment barrier (treatment trench)
  - Collection
    - DNAPL collection (bailers/sorbents/pumps)
  - Collection enhancement
    - Groundwater pumping (vertical extraction wells, collection trench)
  - Disposal
    - Off-site disposal (DNAPL) (commercial facility)
    - Disposal (groundwater) (treatment facility)

- ***Deep DNAPL***.
  - No action
  - Institutional controls/limited actions
    - Proprietary controls (notice of environmental conditions)
    - Government controls (site management plan)
    - Monitoring (monitoring)
    - Periodic reviews (periodic site reviews)
  - Natural recovery
    - Natural attenuation (natural attenuation, monitored natural attenuation)
  - Containment
    - Physical barrier wall (grout curtain)
    - Hydraulic barrier (groundwater extraction)
  - Collection
    - DNAPL collection (bailers/sorbents/pumps)
  - Collection enhancement
    - Groundwater pumping (vertical extraction wells)
  - Disposal
    - Off-site disposal (DNAPL) (commercial facility)
    - Disposal (groundwater) (treatment facility)

4.6 EVALUATION OF PROCESS OPTIONS

Remedial technologies and process options were evaluated further according to the criteria of effectiveness, implementability, and cost. The effectiveness criterion includes the evaluation of:

- Potential effectiveness of the process option in meeting the RAOs and handling the estimated lengths, areas and/or volumes of media summarized in Section 4.3;
- Potential effects on human health and the environment during implementation (including, as appropriate, construction and operation); and
- Reliability of the process options for site contaminants and conditions.

Technical and institutional aspects of implementing the process options were assessed for the implementability criterion.

The capital and operation and maintenance (O&M) costs of each process option were evaluated as to whether they were high, medium, or low relative to other process options of the same technology type.

Based on the evaluation, the more favorable process options of each technology type were chosen as representative process options. The selection of representative process options simplifies the assembly and evaluation of the alternatives, but does not eliminate other process options from consideration. The representative process option provides a basis for conceptual design during the FS, without limiting flexibility during the remedial design phase. An alternative process option may be selected during the remedial design phase as a result of design evaluations or testing (*e.g.,* the substitution of air stripping with chemical oxidation for water treatment). The evaluation of process options is presented in Tables 4-4 and 4-5. A description of the selected representative process options for retained technologies is presented, by GRA and technology for each medium, in the following sections.

4.6.1 Shallow DNAPL

No Action

The no action alternative must be considered in the FS, as required by the NCP (40 CFR Part 300.430). No remedial actions addressing DNAPL in shallow bedrock would be conducted.

Institutional Controls/Limited Actions

Notice of environmental conditions, site management plan, monitoring and periodic site reviews were identified as representative process options associated with the institutional controls/limited actions GRA for DNAPL in shallow bedrock.

- ***Notice of environmental conditions.*** A notice of site environmental conditions as they pertain to groundwater use restrictions could be implemented.
- ***Site management plan.*** A site management plan could document site institutional and engineering controls and any physical components of the selected remedy requiring operation, maintenance and monitoring to provide for continued effectiveness of the remedy. The site management plan could also present provisions for periodic site reviews and requirements for annual NYSDEC required certification.
- ***Monitoring.*** Monitoring could involve periodic monitoring of DNAPL, groundwater and surface water to verify that DNAPL migration is not occurring and evaluate the effectiveness of the selected remedy. Monitoring of surface water would also verify that DNAPL continues to have minimal, if any, effect on surface water in the Hudson River. Monitoring would be limited to the period of the year when the river bank is safely accessible, which is assumed to be from May to November.
- ***Periodic site reviews.*** Periodic reviews are required by 6 NYCRR Part 375 where institutional and engineering controls, monitoring and/or O&M activities are required at the Site. The purpose of the periodic review is to evaluate the Site with regard to the continuing protection of human health and the environment and document remedy effectiveness. In accordance with 6 NYCRR Part 375-1.8(h)(3), the frequency of periodic reviews should be annual, unless a different frequency is approved by NYSDEC.

Natural Recovery

Natural attenuation and monitored natural attenuation were identified as representative process options associated with the natural recovery GRA for DNAPL in shallow bedrock.

- ***Natural attenuation.*** Natural attenuation relies on naturally occurring *in situ* physical, chemical, and/or biological processes to degrade organic constituents in the bedrock groundwater over time. Processes including biodegradation, sorption, dilution, dispersion, and/or transformation of contaminants can reduce their toxicity, mobility, and/or volume (USEPA 1999). Specifically:
  - Dissolution of DNAPL would attenuate mobility by reducing mass and increasing viscosity;
  - Biodegradation would reduce dissolved DNAPL constituents in groundwater and thereby increase the rate of DNAPL dissolution; and
  - Diffusion of DNAPL constituents into the bedrock matrix would attenuate DNAPL mobility by reducing DNAPL mass.
- ***Monitored natural attenuation.*** MNA adds a monitoring component to natural attenuation. This would involve the implementation of a long-term monitoring plan to monitor the natural attenuation of PCB concentrations in groundwater.

Collection

Bailers/sorbent/pumps were identified as representative process options associated with the collection GRA for DNAPL in shallow bedrock.

- ***Bailers/sorbents/pumps.*** Collection of DNAPL can be accomplished through the use of bailers (tube-type collection vessels that fit into wells) or sorbent-type materials that are placed manually into groundwater wells where DNAPL is present. These recovery tools collect the DNAPL present and are manually retrieved.

Alternatively, DNAPL could be collected through the use of sump-style in-well pumps that operate based on DNAPL thickness in the well to automatically remove liquids when present. Bailers are currently used to collect DNAPL at the Site. The collected materials require subsequent management. DNAPL collection would be limited to the period of the year when the river bank is safely accessible, which is assumed to be from May to November.

Collection Enhancement

Vertical extraction wells were identified as the potentially implementable process options associated with the collection enhancement GRA for DNAPL in shallow bedrock.

- ***Vertical extraction wells.*** Shallow bedrock groundwater could be collected by pumping from vertical extraction wells. Collection of shallow bedrock groundwater may result in enhancement of DNAPL recovery. The collected groundwater would require subsequent management. There is a potential for fouling of wells, piping, pumps, and treatment system as a result of naturally-occurring inorganics. In addition, installation of wells and conveyance piping, if used, would be difficult due to limited access and presence of bedrock substrate at the site.

Disposal

Disposal at a commercial facility and a treatment facility were identified as representative process options associated with the disposal GRA for DNAPL and groundwater extracted from shallow bedrock, respectively.

- ***Commercial facility.*** Transport of recovered DNAPL to an off-site permitted commercial facility for treatment/disposal.
- ***Treatment facility.*** Extracted groundwater could be discharged to the GE Fort Edward Plant WWTP through conveyance piping for subsequent treatment. Evaluation of available treatment plant capacity and existing treatment components would be required.

4.6.2 Deep DNAPL

No Action

The no action alternative must be considered in the FS, as required by the NCP (40 CFR Part 300.430). No remedial actions addressing DNAPL in deep bedrock would be conducted.

Institutional Controls/Limited Actions

Notice of environmental conditions, site management plan, monitoring and periodic site reviews were identified as representative process options associated with the institutional controls/limited actions GRA for DNAPL in deep bedrock.

- ***Notice of environmental conditions.*** A notice of site environmental conditions as they pertain to groundwater use restrictions could be implemented.
- ***Site management plan.*** A site management plan could document site institutional and engineering controls and any physical components of the selected remedy requiring operation, maintenance and monitoring to provide for continued effectiveness of the remedy. The site management plan could also present provisions for periodic site reviews and requirements for annual NYSDEC required certification.
- ***Monitoring.*** Monitoring could involve periodic monitoring of DNAPL and groundwater to verify that DNAPL migration is not occurring and evaluate the effectiveness of the selected remedy. Monitoring would be limited to the period of the year when the river bank is safely accessible, which is assumed to be from May to November.
- ***Periodic site reviews.*** Periodic reviews are required by 6 NYCRR Part 375 where institutional and engineering controls, monitoring and/or O&M activities are required at the Site. The purpose of the periodic review is to evaluate the Site with regard to the continuing protection of human health and the environment and document remedy effectiveness. In accordance with 6 NYCRR Part 375-1.8(h)(3), the frequency of periodic reviews should be annual, unless a different frequency is approved by NYSDEC.

Natural Recovery

Natural attenuation and monitored natural attenuation were identified as representative process options associated with the natural recovery GRA for DNAPL in deep bedrock.

- ***Natural attenuation.*** Natural attenuation relies on naturally occurring *in situ* physical, chemical, and/or biological processes to degrade organic constituents in the bedrock groundwater over time. Processes including biodegradation, sorption, dilution, dispersion, and/or transformation of contaminants can reduce their toxicity, mobility, and/or volume (USEPA 1999). Specifically:
  - Dissolution of DNAPL would attenuate mobility by reducing mass and increasing viscosity;
  - Biodegradation would reduce dissolved DNAPL constituents in groundwater and thereby increase the rate of DNAPL dissolution; and
  - Diffusion of DNAPL constituents into the bedrock matrix would attenuate DNAPL mobility by reducing DNAPL mass.
- ***Monitored natural attenuation.*** MNA adds a monitoring component to natural attenuation. This would involve the implementation of a long-term monitoring plan to monitor the natural attenuation of PCB concentrations in groundwater.

Collection

Bailers/sorbent/pumps were identified as representative process options associated with the collection GRA for DNAPL in deep bedrock.

- ***Bailers/sorbents/pumps.*** Collection of DNAPL can be accomplished through the use of bailers (tube-type collection vessels that fit into wells) or sorbent-type materials that are placed manually into groundwater wells where DNAPL is present. These recovery tools collect the DNAPL present and are manually retrieved. Alternatively, DNAPL could be collected through the use of sump-style in well pumps that operate based on DNAPL thickness in the well to automatically remove liquids when present. Bailers are currently used to collect DNAPL at the Site. The collected materials require subsequent management. DNAPL collection would be limited to the period of the year when the river bank is safely accessible, which is assumed to be from May to November.

Collection Enhancement

Vertical extraction wells were identified as the potentially implementable process options associated with the collection enhancement GRA for DNAPL in deep bedrock.

- ***Vertical extraction wells.*** Deep bedrock groundwater could be collected by pumping from vertical extraction wells. Collection of deep bedrock groundwater may result in enhancement of DNAPL recovery. The collected groundwater would require subsequent management. There is a potential for fouling of wells, piping, pumps, and treatment system as a result of naturally-occurring inorganics. In addition, installation of wells and conveyance piping, if used, would be difficult due to limited access and presence of bedrock substrate at the site.

Disposal

Off-site disposal to a commercial facility and an off-site treatment facility were identified as representative process options associated with the disposal GRA for DNAPL and groundwater extracted from deep bedrock, respectively.

- ***Commercial facility.*** Transport of recovered DNAPL to an off-site permitted commercial facility for treatment/disposal.

- ***Treatment facility.*** Extracted groundwater could be discharged to the GE Fort Edward Plant WWTP through conveyance piping for subsequent treatment. Evaluation of available treatment plant capacity and existing treatment components would likely be required.

4.7 ASSEMBLY OF REMEDIAL ALTERNATIVES

Remedial alternatives were developed by assembling general response actions and representative process options into combinations that address the RAOs. As discussed in the following subsections, four remedial alternatives were developed to address DNAPL in shallow and deep bedrock. Remedial alternative components are summarized in Table 4-6. The four remedial alternatives are as follows:

- Alternative 1 is the no further action alternative. This alternative is required to be evaluated by the NCP (40 CFR Part 300.430) and serves as a benchmark for the evaluation of other alternatives.
- Alternative 2 is an institutional controls/limited actions alternative. This alternative includes a notice of environmental conditions, site management plan, periodic site reviews, DNAPL, groundwater and surface water monitoring, and natural attenuation of residual DNAPL.
- Alternative 3 is a DNAPL collection alternative. This alternative includes continued shallow and deep bedrock DNAPL collection with off-site disposal of DNAPL, and natural attenuation of residual DNAPL. Alternative 3 also includes a notice of environmental conditions, site management plan, periodic site reviews, and DNAPL, groundwater and surface water monitoring.
- Alternative 4 includes enhanced DNAPL collection (DNAPL and groundwater collection), with off-site disposal of DNAPL and treatment of extracted groundwater, and natural attenuation of residual DNAPL. Alternative 4 also includes a notice of environmental conditions, site management plan, periodic site reviews, and groundwater, DNAPL, and surface water monitoring.

A description of each alternative is included in the following subsections.

4.7.1 Alternative 1 – No Further Action

Alternative 1 is the no further action alternative, which is required by the NCP as a consideration and serves as a benchmark for comparison to other alternatives. This alternative provides for an assessment of the environmental conditions if no remedial actions are taken.

Under Alternative 1, DNAPL collection would be discontinued, as would the ongoing DNAPL, surface water, and groundwater monitoring programs. Natural attenuation of DNAPL would also occur under this alternative, though no monitoring components are included to assess it.

Natural Attenuation

Natural attenuation would consist of attenuation of organic constituents in bedrock over time. It is anticipated that natural attenuation mechanisms including dissolution, biodegradation, and diffusion of DNAPL constituents would contribute to DNAPL mass attenuation in bedrock.

4.7.2 Alternative 2 – Monitoring and Institutional Controls

Alternative 2 is an institutional controls/limited actions alternative. Alternative 2 would include routine DNAPL, surface water, and groundwater monitoring; a notice of environmental conditions; site management plan; and periodic site reviews. Natural attenuation, as described in Section 4.6.1 would also occur. The effectiveness of natural attenuation would be monitored with data obtained through the monitoring program. The remedial components of Alternative 2 are described in this section.

Routine DNAPL Monitoring

DNAPL monitoring would continue to be implemented to track the presence of DNAPL in shallow and deep bedrock. Specific monitoring locations, parameters, and frequencies would be identified during remedial design. For the purposes of remedial alternative cost estimates, it was assumed that the current DNAPL monitoring program would continue. The DNAPL monitoring program consists of annual monitoring using an oil-water interface probe at 27 site wells. DNAPL monitoring would be limited to the period of the year when the river bank is safely accessible, which is assumed to be from May to November.

Routine Surface Water Monitoring

Surface water monitoring would continue to be implemented to track constituent concentrations in the vicinity of Former 004 Outfall from DNAPL present in bedrock beneath the Former 004 Outfall area. Specific monitoring locations, parameters, and frequencies would be identified during remedial design. For the purposes of remedial alternative cost estimates, it was assumed that the current surface water monitoring program would continue. The surface water monitoring program consists of monthly sampling at three locations in the Hudson River during times of the year when the shoreline is accessible. The samples are assumed to be analyzed for PCBs and TSS. Surface water sampling would be limited to the period of the year when the river bank is safely accessible, which is assumed to be from May to November.

Routine Groundwater Monitoring

Groundwater monitoring would continue to be implemented to track constituent concentrations in groundwater to monitor the potential for DNAPL migration in bedrock. Specific monitoring locations, parameters, and frequencies would be identified during remedial design. For the purposes of remedial alternative cost estimates, it was assumed that the monitoring program would be consistent with the existing monitoring program. The groundwater monitoring program consists of annual sampling of seven groundwater monitoring wells when the shoreline is accessible. In addition, for the purposes of cost estimation, up to three new bedrock monitoring wells are assumed to be installed and sampled in connection with the groundwater monitoring program, should these be deemed necessary. The samples are assumed to be analyzed for PCBs. For cost estimation purposes, it is assumed that new wells would be completed to depths of approximately 50-ft bgs, 150-ft bgs, and 250-ft bgs. Groundwater sampling would be limited to the period of the year when the river bank is safely accessible, which is assumed to be from May to November.

Notice of Site Environmental Conditions

GE does not own the property in the vicinity of Former 004 Outfall, and, thus, cannot impose deed restrictions. However, as a means of future protection of human receptors to DNAPL in bedrock, site environmental conditions would be made known, such that groundwater extraction restrictions would be communicated to property owners. The notice of site environmental conditions would indicate that extraction of groundwater at the site as a potable water source should not be performed without proper treatment activities and avoidance of exposure to DNAPL without prior review and approval by NYSDEC.

Site Management Plan

A site management plan would guide future activities at the facility by documenting the institutional controls and by developing requirements for periodic site reviews and implementation of monitoring activities for the selected remedy. In addition, consistent with 6 NYCRR Part 375-1.8(h)(3), the site management plan would require annual certification of institutional controls.

Periodic Site Reviews

Periodic site reviews would be conducted in accordance with the site management plan to evaluate the site with regard to continuing protection of human health and the environment as evidenced by information such as documentation of field inspections and DNAPL, surface water, and groundwater monitoring. 6 NYCRR Part 375-1.8(h)(3) specifies that the frequency of periodic site reviews should be every year, unless a different frequency is approved by NYSDEC.

4.7.3 Alternative 3 – Continued DNAPL Collection, Monitoring and Institutional Controls

Alternative 3 would involve the continued collection of DNAPL from bedrock wells. Additionally, routine monitoring and institutional controls would be included in Alternative 3. As described in Section 4.7.2, these consist of DNAPL, surface water and groundwater monitoring, a notice of Site environmental conditions, site management plan, and periodic site reviews. Natural attenuation, as described in Section 4.7.1., would also occur. The effectiveness of the remedy would be monitored with data obtained through the monitoring program. The remedial components of Alternative 3, other than those described above for Alternatives 1 and 2 are described in this section.

DNAPL Collection

DNAPL collection would continue to be implemented to continue mass removal of DNAPL from bedrock in the vicinity of Former 004 Outfall. Specific DNAPL recovery locations and frequencies would be identified during remedial design. For the purposes of remedial alternative cost estimates, it was assumed that the current DNAPL collection program would continue. The DNAPL collection program consists of monthly removal of recoverable DNAPL from five monitoring wells at the Site during times of the year when the shoreline is accessible. DNAPL would be removed from the monitoring well using manual bailers. Collected fluids from the monitoring wells would be decanted into a clean container and examined. Recovered DNAPL would be containerized for off-site disposal at a permitted facility. Recovered groundwater would be containerized and transported to the GE Fort Edward Plant and discharged to the sludge holding tank for subsequent treatment/processing. DNAPL collection would be limited to the period of the year when the river bank is safely accessible, which is assumed to be from May to November.

Disposal

Collected DNAPL and incidental groundwater would be disposed of. DNAPL would be transported to an off-site treatment/disposal facility. Groundwater would be transported to the GE Fort Edward Plant WWTP for subsequent *ex situ* treatment using coagulation, filtration and carbon adsorption. Effluent from the carbon adsorption unit would be discharged to the Hudson River under the facility State Pollutant Discharge Elimination System (SPDES) Permit.

4.7.6 Alternative 4 – Enhanced DNAPL Collection, Monitoring and Institutional Controls

Alternative 4 represents the alternative intended to restore the bedrock to pre-disposal conditions, which is required for consideration by DER-10. This alternative is intended to restore the bedrock such that unrestricted use is possible. Alternative 4 includes DNAPL and groundwater collection. Additionally, until the bedrock is restored to pre-disposal conditions, routine monitoring and institutional controls would be included in Alternative 4. As described in Section 4.7.2, these consist of DNAPL, surface water and groundwater monitoring, a notice of environmental conditions, site management plan, and periodic site reviews. Natural attenuation, as described in Section 4.7.1., would also occur. The effectiveness of natural attenuation would be monitored with data obtained through the monitoring program. It is not anticipated that bedrock would be restored such as to allow unrestricted use within the 30-year timeframe used in the analysis of this and the other alternatives. The remedial components of Alternative 4 other than those described above for Alternatives 1, 2 and 3, are described in this section.

Enhanced DNAPL Collection (Groundwater Collection)

Shallow and deep bedrock groundwater extraction wells would be installed in the vicinity of the Former 004 Outfall and along the gravel access road to the south for collection of shallow and deep bedrock groundwater for the purpose of enhancing DNAPL removal. Pumping tests would be conducted prior to remedial design to evaluate groundwater pumping rates, areas of influence, and define well spacing.

A conceptual approach for shallow and deep groundwater collection was assembled for the purposes of this FS. It was assumed that one shallow bedrock and one deep bedrock groundwater vertical extraction well would be installed in the immediate vicinity of the Former 004 Outfall. Three additional shallow and/or deep bedrock extraction wells would be installed along the gravel access road to the south of the Former 004 Outfall. Shallow and deep bedrock extraction wells would be installed to depths between 20 feet and 250 feet. These wells would be approximately 6-inches in diameter and screened across the target bedrock unit. It should be noted, that given the limited access, constructability of recovery and conveyance systems would be difficult. Further, effectiveness of DNAPL recovery enhancement using pumping wells may be limited based on the generally residual nature of the DNAPL resulting in limited amounts of DNAPL potentially available to be mobilized, and on results of a pumping test conducted during the RI which did not show significantly enhanced DNAPL recovery in response to groundwater pumping. The wells would discharge to a common header and convey collected groundwater to the equalization basin at the GE Fort Edward Plant WWTP.

Disposal

Extracted groundwater would be conveyed via above grade and subsurface piping to the equalization basin at the GE Fort Edward Plant WWTP for subsequent *ex situ* treatment using coagulation, filtration and carbon adsorption. It should be noted, that given the limited access and presence of bedrock substrate, constructability of DNAPL recovery and conveyance systems would be difficult. In addition, frequent inundation and potential for ice damage is likely to present safety concerns regarding DNAPL and groundwater discharge to the river. Effluent from the carbon adsorption unit would be discharged to the Hudson River under the facility SPDES Permit. For the purpose of the FS, the GE Fort Edward Plant WWTP is assumed to have sufficient capacity to receive and treat extracted groundwater without requiring system upgrades. A treatability study would likely be required during the design phase to evaluate influent concentrations and treatment system capacity.

4.8 SCREENING OF REMEDIAL ALTERNATIVES

The final step of the development and screening of remedial alternatives is the screening of the four assembled remedial alternatives. The screening of remedial alternatives was conducted consistent with USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA 1988) and NYSDEC's DER-10 (NYSDEC 2010a). The following subsections describe the screening of the four assembled remedial alternatives with respect to three broad criteria: effectiveness, implementability and cost. The screening of remedial alternatives is summarized in Table 4-7 and described in the following subsections.

4.8.1 Effectiveness Screening

In the effectiveness screening of the remedial alternatives, each alternative was evaluated with respect to protection of human health and the environment, effectiveness in providing reductions in toxicity, mobility or volume and both short-term and long-term effectiveness. Short-term effectiveness refers to the construction and implementation period, while long-term effectiveness refers to the period following construction. The screening of remedial alternatives with respect to effectiveness is presented in Table 4-7.

Alternatives 1 and 2 rely on natural attenuation to address DNAPL in bedrock. Natural attenuation alone is not anticipated to be an effective means of addressing DNAPL in bedrock in the foreseeable future. Alternatives 3 and 4 each provides an effective means of DNAPL recovery. Alternatives 4 includes groundwater collection in addition to DNAPL recovery, however, this added element is not anticipated to substantially improve mass removal when compared to Alternative 3. As described in Section 4.2, Site conditions limit the technical practicability of subsurface remediation at the Site. Specifically, the technical limitations resulting from the presence of PCB-containing DNAPL at depth in the bedrock at the Site make it unlikely that available technologies can remediate the Site to remove all DNAPL in the foreseeable future. Thus, Alternative 4 is not anticipated to be more effective than Alternative 3.

4.8.2 Implementability Screening

During the implementability screening of the remedial alternatives, each alternative was evaluated with respect to technical and administrative feasibility of constructing, operating and maintaining a remedial action alternative. Technical feasibility refers to the ability to construct, reliably operate, and meet technology-specific requirements until the remedial action is complete. Technical feasibility also refers to operation, maintenance, replacement, and monitoring of technical components of the remedy. Administrative feasibility refers to the ability to obtain approval from agencies, as well as the availability of treatment, storage and disposal services; capacity; and specialists. The screening of remedial alternatives with respect to implementability is presented in Table 4-7.

Alternatives 1, 2 and 3 are readily implementable. Alternative 4 is less implementable due to the logistical difficulties related to installation of power, collection, conveyance and storage of remedial elements. Specifically, the following factors impede implementation of Alternative 4:

- The proximity of the Site to the Hudson River raises safety concerns relative to the potential for accidental discharge of collected/conveyed DNAPL and groundwater to the river during periods of high river flow. In addition, personnel safety concerns are raised relative to operation and maintenance of the system that may require access during winter periods when access to the river bank is unsafe.

- Limited access and egress and space available for construction equipment;
- The presence of shallow bedrock presents added difficulty to construction of conveyance and electrical appurtenances that are resilient to flooding and ice flow;
- Construction of remedial elements along the river bank in areas prone to inundation and ice flow present permitting and design challenges related to installation of remedial elements in a floodplain.

4.8.3 Cost Screening

During the cost screening of the remedial alternatives, each alternative is evaluated with respect to cost. For the purposes of this step, relative costs were assigned to the alternatives. The screening of remedial alternatives with respect to cost is presented in Table 4-7. Alternative 4 is anticipated to be significantly more costly than the other alternatives.

4.8.4 Results of the Screening of Remedial Alternatives

As a result of the screening of remedial alternatives, Alternative 4 was eliminated from further consideration in the FS. Alternative 4 is anticipated to be significantly less implementable and more costly than the remaining active alternatives. Furthermore, despite the addition of groundwater recovery in addition to DNAPL recovery, it is not anticipated that Alternative 4 will be more effective at meeting the RAOs as compared to Alternative 3. As a result, the following three remedial alternatives are retained in the FS for further detailed evaluation:

- Alternative 1, the no further action alternative;
- Alternative 2, the monitoring and institutional controls alternative; and
- Alternative 3, the DNAPL collection with monitoring and institutional controls alternative.

5. DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

This section documents the detailed analysis of three remedial alternatives that were developed during the FS and remain following the screening of remedial alternatives. The detailed analysis of the alternatives was conducted consistent with USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA 1988) and NYSDEC's DER-10 (NYSDEC 2010a). In addition, sustainability was considered in accordance with USEPA's *Superfund Green Remediation Strategy* (USEPA 2010) and NYSDEC DER's *Green Remediation Program Policy* (DER-31) (NYSDEC 2010b). This section describes the individual and comparative analysis of the remedial alternatives with respect to nine evaluation criteria that embody the specific statutory requirements that must be evaluated to satisfy the DER-10 and CERCLA remedy selection requirements.

The preambles to the NCP (Federal Register 1990) and NYSDEC DER-10 Section 4.2 indicate that, during remedy selection, selection criteria should be categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria. The two threshold criteria, overall protection of human health and the environment and compliance with SCGs, must be satisfied in order for an alternative to be eligible for selection. Long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term impact and effectiveness; implementability; and cost are primary balancing criteria that are used to balance the differences between alternatives. An additional primary balancing criterion under NYSDEC DER-10 includes an evaluation of land use. The modifying criterion of community acceptance is formally considered after public comment is received.

The objective of the detailed analysis of remedial alternatives is to analyze and present sufficient information to allow the alternatives to be compared and a remedy selected. This analysis consisted of an individual assessment of each alternative with respect to the eight above-referenced evaluation criteria (all but community acceptance) that encompass statutory requirements and overall feasibility and acceptability. Sustainability considerations were evaluated as part of the long-term and short-term effectiveness criteria. Following the individual assessment, a comparative analysis was completed.

5.1 INDIVIDUAL ANALYSIS OF REMEDIAL ALTERNATIVES

In the individual analysis of remedial alternatives, each of the remedial alternatives was evaluated with respect to seven evaluation criteria and consideration of land use. The criteria are described below and the summary of this analysis is presented in Table 5-1.

5.1.1 Overall Protection of Human Health and the Environment

The analysis of each alternative with respect to this criterion provides an evaluation of whether the alternative would achieve and maintain adequate protection and a description of how site risks would be eliminated, reduced, minimized or controlled through treatment, engineering, or institutional controls. The ability of each alternative to achieve RAOs is also described. The evaluation of each alternative with respect to overall protection of human health and the environment is presented in Table 5-1.

5.1.2 Compliance with SCGs

Each alternative was evaluated to assess whether it would attain SCGs or, if not, whether there are adequate grounds for invoking one or more of the available waivers. Potential chemical-specific, location-specific, and action-specific SCGs were identified in Table 4-1. The evaluation of each alternative with respect to compliance with SCGs is presented in Table 5-1.

5.1.3 Long-Term Effectiveness and Permanence

Each alternative was evaluated to assess the long-term effectiveness and permanence it would afford. Factors that were considered included the following:

- Magnitude of potential residual risk from materials remaining at the conclusion of the remedial activities. The characteristics of the remaining materials are considered to the degree that they remain hazardous, taking into account their mobility, toxicity and volume, as well as their propensity to bioaccumulate.

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- Adequacy and reliability of controls, such as containment systems and institutional controls, necessary to manage materials remaining at the site. This factor addresses the uncertainties of remedial components, the assessment of the potential need to replace components of the alternative, and the potential exposure pathways and risks posed should the remedial action need replacement.
- Long-term sustainability of the remedy, considering total environmental and sustainability impacts (*e.g.*, greenhouse gas sources, materials reused on-site versus disposed off-site, remedy maintenance requirements), and metrics related to direct and indirect impacts for each alternative (*e.g.*, energy usage, quantity of emissions, fuel consumption, volume of material reused on-site versus disposed off-site).

The evaluation of each alternative with respect to long-term effectiveness and permanence is presented in Table 5-1.

5.1.4 Reduction of Toxicity, Mobility or Volume through Treatment

For each alternative, the degree to which the alternative results in the reduction of mobility, toxicity or volume was assessed. Factors that were considered included the following:

- Treatment or recycling processes the alternative would employ and the materials it would treat;
- Amount of hazardous substances, pollutants, or contaminants that would be treated or recycled;
- Degree of expected reduction of mobility, toxicity or volume of the material due to treatment or recycling and the specification of which reduction(s) would occur;
- Degree to which treatment would be irreversible;
- Type and quantity of residuals that would remain following treatment, considering the persistence, toxicity, mobility and propensity to bioaccumulate; and
- Degree to which treatment would reduce the inherent hazards posed by the facility.

The evaluation of each alternative with respect to reduction in toxicity, mobility or volume through treatment is presented in Table 5-1.

5.1.5 Short-Term Effectiveness

The short-term impacts of each alternative were assessed, and considered the following:

- Potential short-term risks that might be posed to the community during implementation of the alternative;
- Potential threats to workers during implementation of the remedy and the effectiveness and reliability of protective measures;
- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation;
- Time until protection would be achieved; and
- the short-term sustainability of the remedy, considering DER-31 *Green Remediation* (NYSDEC, 2010b), total environmental and sustainability impacts (*e.g.*, greenhouse gas sources and materials reused on-site versus disposed during construction-phase activities) and metrics related to direct and indirect impacts, and construction-phase impacts (*e.g.*, energy, emissions, fuel, volume of material reused and disposed off-site).The evaluation of each alternative with respect to short-term effectiveness is presented in Table 5-1.

5.1.6 Implementability

Each alternative was assessed relative to the ease or difficulty of implementation by considering the following types of factors, as appropriate:

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, the ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy;

- Administrative feasibility, including activities needed to coordinate with other agencies and/or entities;
- Ability and time required to obtain any necessary approvals and permits from agencies; and
- Availability of services and materials, including the availability of adequate off-site treatment, storage and disposal capacity and services, the availability of necessary equipment and specialists, provisions to obtain necessary additional resources, and the availability of prospective technologies.

The evaluation of each alternative with respect to implementability is presented in Table 5-1.

5.1.7 Cost

To evaluate this criterion, cost estimates were prepared for each alternative based on vendor information and quotations, cost estimating guides, and experience. Cost estimates were prepared for the purpose of comparing costs for the various alternatives and were based on facility-specific information, when available. The cost estimates include capital costs, annual O&M costs, and present worth costs. The present worth costs for the alternatives were calculated based on the expected/assumed duration of the remedy using a 7% discount rate, consistent with USEPA's *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* [Office of Solid Waste and Emergency Response (OSWER) 9355.0-75, USEPA, 2000]. The individual cost estimates for the remedial alternatives are included in Tables 5-2 through 5-4.

5.1.8 Land Use

Pursuant to NYSDEC DER-10 Section 4.2(i), each alternative is assessed relative to the current, intended and reasonably anticipated future use of the site and its surroundings by considering the following factors, as appropriate:

- Current land use and historical and/or recent development patterns
- Consistency of proposed land use with applicable zoning laws and maps
- Brownfield opportunity areas
- Consistency of proposed land use with applicable comprehensive master plans or any other applicable land-use plan formally adopted by a municipality
- Proximity to property currently used for residential use and to urban, commercial, industrial, agricultural and recreational areas
- Written and oral comments submitted by the public as part of citizen participation activities on the proposed land use
- Environmental justice concerns
- Proximity of the facility to cultural and natural resources
- Vulnerability of groundwater to contamination that might migrate from the facility
- Final use determination of the facility.

Land use is discussed for each of the off-site areas in Section4.1.1.. The evaluation of each alternative with respect to land use is presented in Table 5-1.

5.1.9 State Acceptance

State acceptance will be addressed by NYSDEC, in consultation with New York State Department of Health (NYSDOH), during preparation of the PRAP that will be released for public comment.

5.1.10 Community Acceptance

Community acceptance will be addressed during the public comment period on the PRAP presented by NYSDEC, in consultation with NYSDOH. The ROD subsequently issued by NYSDEC will include a Responsiveness

Summary, in which NYSDEC will address the verbal and written comments received on the PRAP during the public comment period.

5.2 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

The comparative evaluation of remedial alternatives was completed to consider the relative performance of the alternatives and identify major trade-offs among the alternatives. The comparative analysis of alternatives is presented in below.

5.2.1 Overall Protection of Human Health and Environment

As documented in the *RI Report*, and Section 4.1.4 above, no current complete exposure pathways were identified for human receptors to DNAPL in the Snake Hill Shale bedrock. Alternatives 1, 2 and 3 would be protective of potential future exposure of human receptors to DNAPL through monitoring and institutional controls. Additional protection is afforded through DNAPL recovery in Alternative 3.

Also as documented above in Section 4.1.4, there are no complete exposure pathways identified for ecological receptors to DNAPL in the Snake Hill Shale bedrock. Complete exposure pathways were identified for ecological receptors to surface water in the Hudson River, though, based on the relatively low magnitude of exceedances and low detection frequency of PCBs in surface water in the vicinity of the Site (particularly in recent years), potential impacts to ecological receptors in the Hudson River from Site-related constituents, if any, are *de minimis*.

Alternatives 1 and 2 would rely on natural attenuation to address potential risks to the environment associated with migration of DNAPL from bedrock. Alternatives 2 and 3 include DNAPL, groundwater and surface water monitoring to document the progress of natural attenuation and monitor environmental conditions. Alternative 3 would provide for greater protection of the environment, compared to Alternative 2, through continued DNAPL recovery. DNAPL collection in Alternative 3 would reduce the volume of DNAPL in bedrock over time, therefore, reducing potential risks to surface water and associated receptors.

5.2.2 Compliance with SCGs

No chemical-specific SCGs were identified for DNAPL in bedrock at the Site. Location and action-specific SCGs were identified in Table 4-1.

Location-specific SCGs were identified as the Site is located within a riverine wetland, within the 100-year floodplain, and is located adjacent to a body of water. Monitoring activities in Alternatives 2 and 3 and DNAPL recovery activities in Alternative 3 could be implemented in accordance with requirements of location-specific SCGs.

Action specific-SCGs were identified for Alternatives 2 and 3. No action-specific SCGs were identified for Alternative 1, as no actions are proposed. Monitoring activities in Alternatives 2 and 3 will be conducted in accordance with Occupational Safety and Health Administration (OSHA) requirements regarding the health and safety of workers. In addition, the implementation of DNAPL recovery and off-site disposal in Alternative 3 would be conducted in conformance with applicable transportation and disposal requirements.

5.2.3 Long-Term Effectiveness and Permanence

Minimal risk has been identified to surface water in the Hudson River as a result of DNAPL present in bedrock at the Site. Potential risk associated with future exposure and potential migration of DNAPL would remain in Alternatives 1 and 2. Natural attenuation would be relied upon in Alternatives 1 and 2 to address residual DNAPL. Potential future human health risks associated with potential exposure to DNAPL in bedrock would be reliably addressed through institutional controls in Alternatives 2 and 3. DNAPL collection included in Alternative 3 would afford greater reduction in risks to ecological and human receptors associated with DNAPL migration to surface water.

Monitoring and periodic reviews in Alternatives 2 and 3 would provide an adequate and reliable means of assessing and documenting performance and effectiveness of the remedy, and continued protection to ecological receptors. DNAPL recovery in Alternative 3 would be an adequate and reliable method of collection of DNAPL in bedrock. Table 1-2 and Figure 1-5 summarize DNAPL recovery rates during 2013.

Alternative 1, followed by Alternative 2, would be anticipated to result in the lowest environmental footprint of the alternatives evaluated. Transportation of DNAPL and groundwater for ultimate management in Alternative 3 would contribute to a larger environmental footprint as compared to Alternatives 1 and 2, however, it should be noted that Alternative 3 would provide a greater level of protectiveness than either Alternative 1 or Alternative 2.

5.3.4 Reduction of Toxicity, Mobility or Volume through Treatment

No active treatment processes are included in Alternatives 1 and 2. Treatment of collected DNAPL and incidental groundwater entrained during DNAPL collection are included in Alternative 3. DNAPL collection included in Alternative 3 would result in a reduction of the volume and mobility of DNAPL in shallow and deep bedrock. The average DNAPL removal rate per year between 2008 and 2013 has been approximately 12 gallons (46 liters) per year. Treatment through natural attenuation processes would occur for each alternative. Treatment residues associated with treatment included under Alternative 3 are anticipated.

5.3.5 Short-Term Effectiveness

There is no remedial action in Alternative 1. Existing restricted access to the Site would provide for community protection during remedial activities in Alternatives 2 and 3. Implementation of institutional controls in Alternatives 2 and 3 would provide for additional protection of the community from potential future exposures to DNAPL in bedrock. Remedial actions including monitoring activities in Alternatives 2 and 3 and DNAPL collection in Alternative 3 would not impact the community. The use of appropriate protection equipment during remedial activities in Alternatives 2 and 3 would minimize potential risks to remedial workers at the Site.

The RAO addressing the prevention of DNAPL migration is nearly achieved, as DNAPL migration to nearby surface water is anticipated to be minimal at this time. The RAO related to the continued protection of ecological receptors would not be achieved in Alternative 1; however, surface water monitoring in Alternatives 2 and 3 would provide a means of verifying continued protection of ecological receptors.

Alternatives 1, 2, and 3 would be environmentally sustainable over the short-term. No construction activities are required for Alternatives 1, and site work associated with Alternatives 2 and 3 would have minimal short-term impacts. It is anticipated that there would be nominal greenhouse gas emissions, fuel/energy use and water use during the installation of additional monitoring wells associated with Alternatives 2 and 3. Transportation of DNAPL included in Alternative 3, would result in greenhouse gas emissions and fuel use.

5.2.6 Implementability

Each alternative is considered to be readily implementable. Alternative 1 does not require construction-related activities, and Alternatives 2 and 3 require only minimal construction activities associated with monitoring well installation. Monitoring included in Alternatives 2 and 3 is an adequate and reliable means of evaluation of groundwater and surface water quality and the presence of DNAPL. Institutional controls would be an adequate and reliable means of addressing potential future exposures to DNAPL in bedrock. DNAPL recovery is readily implementable and would be a reliable means of collection of DNAPL from bedrock.

Readily available off-site hazardous waste disposal facilities would be required for management of recovered DNAPL in Alternative 3. Sampling and monitoring equipment, personnel and laboratory analytical services would be readily available for Alternatives 2 and 3. Monitoring well drillers would be readily available for installation of additional monitoring wells in Alternatives 2 and 3.

5.2.7 Cost

Detailed cost estimates for Alternatives 1 through 3 are included as Tables 5-2 through 5-4. The following table provides a comparison of the estimated costs.

TABLE 5: COST ESTIMATE SUMMARY – REMEDIAL ALTERNATIVES

ALTERNATIVE	ESTIMATED CAPITAL COST	ESTIMATED O&M COST	TOTAL ESTIMATED PRESENT WORTH
Alternative 1: No Further Action	$0	$0	$0
Alternative 2: Monitoring and Institutional Controls	$210,000	$74,000	$1,145,000
Alternative 3: Continued DNAPL Recovery, Monitoring and Institutional Controls	$210,000	$94,100	$1,378,000

5.2.8 Land Use

Implementation of Alternatives 2 and 3 would be consistent with current, intended and reasonably anticipated future use of the Site. Land use restrictions would not be implemented under Alternative 1, the no further action alternative.

5.2.9 Community Acceptance

Community acceptance will be addressed during the public comment period on the PRAP presented by the NYSDEC. The ROD subsequently issued by NYSDEC will include a Responsiveness Summary, in which NYSDEC will address verbal and written comments received on the PRAP during the public comment period.

6. SUMMARY AND RECOMMENDATIONS

The FS was conducted consistent with the requirements of NYSDEC DER-10 and CERCLA. As such, RAOs were identified to address the elimination or mitigation of significant threats to human health and the environment presented by historical operations at the Site, as required by 6 NYCRR Part 375-2.8(a) and the cost-effective protectiveness of human health and the environment and attainment of SCGs as required by CERCLA. The threats to human health and the environment were identified through evaluation of exposure pathways and comparison of concentrations in affected media to SCGs.

As documented in the *RI Report*, the affected media at the Site is DNAPL in shallow and deep bedrock which has limited potential to migrate to the Hudson River, Analytical results indicate that DNAPL present at the Site has a minimal impact, if any, on the total PCB concentration in the Hudson River. No chemical-specific SCGs were identified for DNAPL at the Site. As described in this FS, four remedial action objectives were identified for the FS, as follows:

- Eliminate, to the extent practicable, potential migration of DNAPL in bedrock at the Site to nearby surface water.
- Eliminate, to the extent practicable, potential future exposure of human receptors to DNAPL in bedrock at the Site.
- Provide a means for verification of continued protection of surface water receptors.
- Provide a means for verification that DNAPL in bedrock is not migrating.

Following an evaluation of technologies and development and screening of alternatives, three remedial alternatives were evaluated in detail in accordance with ten evaluation criteria consistent with DER-10 and CERCLA.

Based on a detailed evaluation of the three alternatives developed in the FS using specific criteria required by the pertinent regulations and guidance, Alternative 3 is recommended as the final remedy for the Site. Alternative 3 is recommended because it satisfies the two threshold criteria, overall protection of human health and the environment, and compliance with SCGs, to the extent practicable, and provides the best balance with respect to the primary balancing criteria (long-term and short-term effectiveness and permanence, reduction in toxicity, mobility and volume, implementability and cost). Alternative 3 includes the following remedial elements:

- Institutional Controls
  - Notice of environmental conditions, site management plan, periodic reviews
  - DNAPL, groundwater and surface water monitoring
- Continued collection of recoverable DNAPL from shallow and deep bedrock wells
- Off-site disposal of recovered DNAPL
- Treatment of recovered groundwater
- Natural attenuation of residual DNAPL

Figure 6-1 presents a conceptual plan of Alternative 3. Alternative 3 addresses the RAOs as follows:

Eliminate, to the extent practicable, potential migration of DNAPL in bedrock at the Site to nearby surface water. Alternative 3 addresses potential migration of DNAPL through continued collection and removal from the bedrock of recoverable DNAPL.

Eliminate, to the extent practicable, potential future exposure of human receptors to DNAPL in bedrock at the Site. Alternative 3 addresses potential future exposure of human receptors to DNAPL in bedrock at the Site through a notice of environmental conditions and collection and removal from the bedrock of recoverable DNAPL.

Provide a means for verification of continued protection of surface water receptors. Alternative 3 provides a means for verification of continued protection of surface water receptors through continued monitoring of surface water adjacent to the Site.

Provide a means for verification that DNAPL in bedrock is not migrating. Alternative 3 provides a means for verification that DNAPL in bedrock is not migrating though continued monitoring of DNAPL, groundwater, and surface water at the Site.

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Table 1-1
2013 PCB Surface Water Sample Results
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

Well ID	November 2013	October 2013	September 2013	August 2013	July 2013	June 2013	May 2013
004_HR_N	< 7.91	< 7.91	< 8.99	< 7.91	< 8.99	< 7.91	< 7.52
004_HR_A	< 7.91	8.91 J	< 7.91	< 7.91	14.1 J	< 8.24	< 7.52
004_HR_S	< 7.91	< 7.91	< 7.91	< 7.91	< 7.91	< 7.91	< 7.52

Notes:
1) Results reported in ng/L.

Table 1-2
Dense Non-Aqueous Phase Liquid Recovery Summary
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

Well ID	July 2013	August 2013	September 2013	October 2013	November 2013	December 2013	Total DNAPL Recovered 2013
MW-1D6	0.67	0.335	Trace	0.39	0.07	0.04	1.505
MW-1D7	0.27	0.14	0.1	0.25	0.12	0.085	0.965
MW-2D	0.09	0.105	0.18	0.175	0.12	0.065	0.735
MW-7D2	0.14	0.055	0.55	0.075	0.035	0.03	0.885
MW-18D6	13.15	2.24	0.625	2.505	1.67	2.98	23.17

Notes:

1) DNAPL recovery data reported in liters.

Table 4-1
Evaluation of Potential Standards, Criteria, and Guidance
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

Medium/Location/ Action	Citation	Requirements	Comments	Potential SCG	Alt(s)
DNAPL in Bedrock	No chemical-specific SCGs identified for DNAPL.			None	All
Potential Location-Specific SCGs					
Wetlands	6 New York Codes, Rules and Regulations (NYCRR) 663 - Freshwater wetland permit requirements	Actions occurring in a designated freshwater wetland (within 100 feet (ft)) must be approved by the New York State Department of Environmental Conservation (NYSDEC) or its designee. Activities occurring adjacent to freshwater wetlands must: be compatible with preservation, protection, and conservation of wetlands and benefits; result in no more than insubstantial degradation to or loss of any part of the wetland; and be compatible with public health and welfare.	Not applicable based on available mapping which shows State-mapped wetlands are not within 100 feet of the site.	No	None
	Executive Order (EO) 11990 - Protection of Wetlands (May 24, 1977)	Activities occurring in wetlands must avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands. The procedures also require the United States Environmental Protection Agency (USEPA) to avoid direct or indirect support of new construction in wetlands wherever there are practicable alternatives or minimize potential harm to wetlands when there are no practicable alternatives.	Potentially applicable. The site consists of a riverine wetland area, characterized by an unconsolidated shoreline which becomes temporarily flooded by the adjacent Hudson River.	Yes	2 and 3
	USEPA Office of Solid Waste and Emergency Response (OSWER) Directive 9280.0-02 (August 1985) - Policy on Floodplains and Wetlands Assessments for Comprehensive Environmental Response, Compensation, and Liability Act) CERCLA Actions	Superfund actions must meet the requirements of EO 11990 (Protection of Wetlands) and EO 11988 (Floodplain Management).	Potentially pplicable.This order relates to EO 11990 (Protection of Wetlands) and EO 11988 (Floodplain Management). The site consists of a riverine wetland area and is located within the 100-year floodplain.	Yes	2 and 3
100-yr floodplain	United States Environmental Protection Agency (USEPA) Office of Solid Waste and Emergency Response (OSWER) Directive 9280.0-02 (August 1985) - Policy on Floodplains and Wetlands Assessments for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Actions	Superfund actions must meet the substantive requirements of EO 11988 (Floodplain Management). Executive Order 11988 requires that consideration of flood hazards and floodplain management including restoration and preservation as natural undeveloped floodplains be included in the evaluation of the potential effects of remedial actions.	Potentially pplicable. The site is located within the 100-yr floodplain.	Yes	2 and 3

Medium/Location/ Action	Citation	Requirements	Comments	Potential SCG	Alt(s)
Potential Location-Specific SCGs (continued)					
100-yr floodplain	6 NYCRR 373-2.2 - Location standards for hazardous waste treatment, storage, and disposal facilities - 100-yr floodplain	Hazardous waste treatment, storage, or disposal facilities located in a 100-yr floodplain must be designed, constructed, operated and maintained to prevent washout of hazardous waste during a 100-yr flood.	Potentially applicable. The site is located within the 100-yr floodplain.	Yes	3
Within 61 meters (200 ft) of a fault displaced in Holocene time	40 Code of Federal Regulations (CFR) Part 264.18	New treatment, storage, or disposal of hazardous waste is not allowed.	Not applicable. The site is not located within 200 feet of a fault displaced in Holocene time, as listed in 40 CFR 264 Appendix VI.	No	None
Wilderness area	Wilderness Act 50 CFR Part 35 - Wilderness Preservation and Management	Provides for protection of federally-owned designated wilderness areas.	Not applicable. Site is not located in a wilderness area.	No	None
Wildlife refuge	National Wildlife Refuge System Administration Act 50 CFR Part 27 - Prohibited Acts	Provides for protection of areas designated as part of National Wildlife Refuge System.	Not applicable. Site is not located in or near an area designated as part of National Wildlife Refuge System.	No	None
Wild, scenic, or recreational river	Wild and Scenic Rivers Act (October 2, 1968)	Provides for protection of areas specified as wild, scenic, or recreational.	Not applicable. The site and adjacent Hudson River is not identified as a wild, scenic or recreational river per the Wild and Scenic Rivers Act.	No	None
Protection of waters	33 USC 1341 - Clean Water Act Section 401, State Water Quality Certification Program	States have the authority to veto or place conditions on federally permitted activities that may result in water pollution.	Potentially applicable to site.	Yes	2 and 3
River or stream	16 United States Code (USC) 661 - Fish and Wildlife Coordination Act	Requires protection of fish and wildlife in a stream when performing activities that modify a stream or river.	Not applicable. Modifications are not anticipated during remedial activities.	No	None

Table 4-1
Evaluation of Potential Standards, Criteria, and Guidance
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

Medium/Location/ Action	Citation	Requirements	Comments	Potential SCG	Alt(s)
Potential Location-Specific SCGs (continued)					
Habitat of an endangered or threatened species	6 NYCRR 182	Provides requirements to minimize damage to habitat of an endangered species.	Not applicable. Based on NYSDEC Environmental Resource Mapper, endangered or threatened species or their habitat were not found at the site.	No	None
	Endangered Species Act	Provides a means for conserving various species of fish, wildlife, and plants that are threatened with extinction.	Not applicable. Based on NYSDEC Environmental Resource Mapper, endangered or threatened species or their habitat were not found at the site.	No	None
Historical property or district	National Historic Preservation Act	Remedial actions are required to account for the effects of remedial activities on any historic properties included on or eligible for inclusion on the National Register of Historic Places.	Potentially applicable. Based on New York State Historic Preservation Office Public Access GIS, the site is not identified as a historic property. The site is identified within an archaeologically sensitive area.	No	None
Construction in a floodplain	6 NYCRR 500 - Floodplain management regulations development permits	Hazardous waste treatment, storage, or disposal facilities located in a 100-yr floodplain must be designed, constructed, operated and maintained to prevent washout of hazardous waste during a 100-yr flood.	Potentially applicable. Site is located within the 100-year floodplain.	Yes	3
Potential Action-Specific SCGs					
General excavation	6 NYCRR 257-3 - Air Quality Standards	Provide limitations for generation of constituents including particulate matter.	Not applicable. Excavation at the Site is not anticipated during remedial activities.	No	None
	40 CFR 50.1 through 50.12 - National Ambient Air Quality Standards.	Provides air quality standards for pollutants considered harmful to public health and the environment. The six principle pollutants include carbon monoxide, lead, nitrogen dioxide, particulates, ozone, and sulfur oxides.	Not applicable. Excavation at the Site is not anticipated during remedial activities.	No	None
Generation and disposal of hazardous material and treatment residuals	6 NYCRR 360 - Solid Waste Management Facilities	Provides requirements for management of solid wastes, including disposal and closure of disposal facilities.	Potentially applicable to recovered DNAPL.	Yes	3
Construction	29 CFR Part 1910 - Occupational Safety and Health Standards - Hazardous Waste Operations and Emergency Response	Remedial activities must be in accordance with applicable Occupational Safety and Health Administration (OSHA) requirements.	Potentially applicable for construction phase of remediation.	Yes	3
	29 CFR Part 1926 - Safety and Health Regulations for Construction	Remedial construction activities must be in accordance with applicable OSHA requirements.	Potentially applicable for construction phase of remediation.	Yes	3

Table 4-1
Evaluation of Potential Standards, Criteria, and Guidance
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

Medium/Location/ Action	Citation	Requirements	Comments	Potential SCG	Alt(s)
Potential Action-Specific SCGs (continued)					
Transportation	6 NYCRR 364 - Waste Transporter Permits	Hazardous waste transport must be conducted by a hauler permitted under 6 NYCRR 364.	Based on analytical results of the DNAPL, DNAPL exhibit concentrations of PCBs in excess of 50 mg/kg, and thus, is categorized as hazardous waste in New York State.	Yes	3
	6 NYCRR Part 372 - Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities	Substantive hazardous waste generator and transportation requirements must be met when hazardous waste is generated for disposal. Generator requirements include obtaining a USEPA Identification Number and manifesting hazardous waste for disposal.	Based on analytical results of the DNAPL, DNAPL exhibit concentrations of PCBs in excess of 50 mg/kg, and thus, is categorized as hazardous waste in New York State.	Yes	3
	49 CFR 172-174 and 177-179 - Department of Transportation (DOT) Regulations	Hazardous waste transport to off-site disposal facilities must be conducted in accordance with applicable DOT requirements	Based on analytical results of the DNAPL, DNAPL exhibit concentrations of PCBs in excess of 50 mg/kg, and thus, is categorized as hazardous waste in New York State.	Yes	3
Land disposal of hazardous waste	6 NYCRR 376 - Land disposal restrictions	Provides treatment standards to be met prior to land disposal of hazardous wastes.	Not applicable. Remedial activities are not anticipated to result in land disposal of hazardous waste.	No	None
Treatment actions	6 NYCRR 373 - Hazardous waste management facilities	Provides requirements for managing hazardous wastes.	Based on analytical results of the DNAPL, DNAPL exhibit concentrations of PCBs in excess of 50 mg/kg, and thus, is categorized as hazardous waste in New York State.	Yes	3

Table 4-1
Evaluation of Potential Standards, Criteria, and Guidance
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

Medium/Location/ Action	Citation	Requirements	Comments	Potential SCG	Alt(s)
Potential Action-Specific SCGs (continued)					
Disposal of Toxic Substances Control Act (TSCA) waste	40 CFR 761	Provides requirements for disposal of TSCA wastes.	Based on analytical results of the DNAPL, DNAPL exhibit concentrations of PCBs in excess of 50 mg/kg, and thus, be categorized as TSCA waste. Potentially applicable.	Yes	3
Construction storm water management	NYSDEC General permit for storm water discharges associated with construction activities. Pursuant to Article 17 Titles 7 and 8 and Article 70 of the Environmental Conservation Law.	The regulation prohibits discharge of materials other than storm water and all discharges that contain a hazardous substance in excess of reportable quantities established by 40 CFR 117.3 or 40 CFR 302.4, unless a separate NPDES permit has been issued to regulate those discharges. A permit must be acquired if activities involve disturbance of 5 acres or more. If the project is covered under the general permit, the following are required: development and implementation of a storm water pollution prevention plan; development and implementation of a monitoring program; all records must be retained for a period of at least 3 years after construction is complete.	Not applicable. Management of storm water is not anticipated to be required during remedial activities.	No	None

Notes:
CFR - Code of Federal Regulations
DOT - Department of Transportation
GIS - Geographic Information System
NPDES - National Pollutant Discharge Elimination Discharge System
NYCRR - New York Code of Rules and Regulations
NYSDEC - New York State Department of Environmental Conservation
PCB - Polychlorinated biphenyl
TOGS - Technical and Operational Guidance Series
TSCA - Toxic Substances Control Act
USEPA - United States Environmental Protection Agency

Table 4-2
Identification and Screening of Remedial Technologies for Shallow DNAPL
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
No action	None	No action	No action.	Applicable. Required for consideration by the NCP.
Institutional controls/limited actions	Proprietary controls	Notice of Environmental Conditions	Site conditions are made know as they pertain to restrictions of groundwater use.	Potentially applicable
	Governmental controls	Site management plan	Documentation of site restrictions and provisions for continued operation and maintenance of the remedy. Presents requirements for monitoring and includes a provision for periodic site reviews, and annual certifications as required by NYSDEC.	Potentially applicable
	Monitoring	Monitoring	Periodic sampling and analyses as a means of monitoring for DNAPL and its effects. Groundwater, surface water and DNAPL monitoring would also provide a means of monitoring remedy effectiveness. Periodic sampling and analyses of groundwater and surface water and the presence of DNAPL is currently being conducted.	Potentially applicable
	Periodic reviews	Periodic site reviews	Periodic reviews are required by 6 NYCRR Part 375 where institutional and engineering controls, monitoring plans, and/or operations and maintenance activities are implemented at a site. The purpose of periodic reviews is to evaluate the site with regard to the continuing protection of human health and the environment and to provide documentation of remedy effectiveness.	Potentially applicable
Natural recovery	Natural attenuation	Natural attenuation	The natural attenuation of organic contaminants by *in situ* physical, chemical and/or biological processes. Over time, the mass of PCB-containing DNAPL can be reduced by processes that include dissolution, biodegradation, and diffusion.	Potentially applicable
		Monitored natural attenuation	Long-term monitoring of the natural attenuation of organic contaminants by *in situ* physical, chemical and/or biological processes.	Potentially applicable
Containment	Physical barrier wall	Grout curtain	Injection of grout to drilled points to restrict DNAPL migration.	Potentially Applicable. Difficult to implement due to limited accessibility and presence of bedrock substrate at the site.

Table 4-2
Identification and Screening of Remedial Technologies for Shallow DNAPL
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
Containment (cont.)	Physical barrier wall (cont.)	Sheet piles	Sheet piles installed along the perimeter of the area of contamination to contain groundwater. Sheet pile materials include HDPE, fiberglass, vinyl and steel. Sheet piles should extend into a confining unit.	Not applicable for installation in bedrock
		Slurry wall	Soil- or cement-bentonite slurry wall placed along the perimeter of the area of contamination to contain shallow and deep groundwater. Containment wall should extend into a confining unit.	Not applicable for installation in bedrock
	Hydraulic barrier	Groundwater extraction	Use of groundwater extraction to induce changes in flow patterns that result in containment of DNAPL migration.	Potentially Applicable. Difficult to implement due to limited accessibility and presence of bedrock substrate at the site. Difficult to install conveyance systems that are resilient to flooding and ice damage.
In situ treatment	Physical/chemical treatment	Chemical oxidation	Addition of oxidation agents such as hydrogen peroxide, ozone, sodium persulfide and/or permanganate into groundwater. Oxidation reactions chemically convert contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. Oxidation can also increase dissolution rate of DNAPL. Potentially effective for DNAPL.	Not applicable. Potential for uncontrolled migration of DNAPL to Hudson River.
	Biological treatment	Enhanced bioremediation	Injection of microbial populations, nutrient sources, or electron donors into groundwater to enhance biological degradation of organic contaminants. Increase degradation of dissolved contaminants can increase dissolution rate of DNAPL. Potentially effective for DNAPL.	Not applicable. Potential for uncontrolled migration of DNAPL to Hudson River.
	Treatment barrier	Treatment trench	Placement of treatment medium such as activated carbon in a trench to intercept or collect and treat shallow bedrock groundwater discharging to the river. Activated carbon would treat organics potentially present in groundwater.	Potentially applicable for shallow depths. Difficult to implement at depth given bedrock substrate and proximity to river.
Collection	DNAPL collection	Bailers/sorbent/pumps	Removing DNAPL from bedrock wells via bailers, sorbent material or pumps placed within wells.	Potentially applicable

Table 4-2
Identification and Screening of Remedial Technologies for Shallow DNAPL
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
Collection enhancement	Groundwater pumping	Vertical extraction wells	Conversion of existing vertical monitoring wells to extraction wells and/or installation of new extraction wells to pump groundwater as a means of enhancing DNAPL migration to wells for collection. Would require management of collected groundwater.	Potentially Applicable. Difficult to implement due to the generally residual nature of the DNAPL results in limited amounts of DNAPL potentially available to be mobilized. Pumping test conducted during the RI did not significantly enhance DNAPL recovery.
	Groundwater pumping	Horizontal extraction wells	Use of horizontal extraction wells to pump groundwater as a means of enhancing DNAPL collection.	Not applicable; heterogeneous distribution of isolated locations of recoverable DNAPL not conducive to the use of horizontal wells; lack of sump in horizontal well creates potential for uncontrolled migration of DNAPL to Hudson River.
		Collection trench	Removal of groundwater by pumping from a shallow collection trench as a means of enhancing DNAPL collection.	Potentially applicable for shallow depths. Difficult to implement at depth given bedrock substrate and proximity to river.

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Table 4-2
Identification and Screening of Remedial Technologies for Shallow DNAPL
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
Collection enhancement (cont.)	Permeability enhancement	Pneumatic/hydraulic fracturing	Injection of high pressure air or water into subsurface to create permeable channels or fractures in subsurface material to enhance DNAPL collection.	Not applicable. Not implementable due to nature of bedrock shale and likely inability to produce of large-scale fractures. Potential for uncontrolled DNAPL migration to Hudson River during fracturing. Hydraulic fracturing was attempted during the RI without success in one bedrock monitoring well.
	Injection	Steam injection	Injection of steam to subsurface to elevate temperatures to increase DNAPL mobility. Difficult to control migration of DNAPL.	Not applicable. Not implementable in close proximity to river. Physical access would limit the ability to control distribution and migration of steam. Potential for uncontrolled migration of DNAPL to Hudson River.
		Surfactant injection	Injection of surfactants into groundwater zone. Surfactants reduce the surface tensions between liquids or between a liquid and a solid, increasing the solubility of contaminants, and enhancing the removal of DNAPL. Difficult to control migration of DNAPL.	Not applicable. Not implementable in close proximity to river. Potential for uncontrolled migration of DNAPL to Hudson River.

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Table 4-2
Identification and Screening of Remedial Technologies for Shallow DNAPL
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
Collection enhancement (cont.)	Thermal	In-well warming	Localized warming of the bedrock and DNAPL adjacent to DNAPL recovery wells to enhance DNAPL migration to the collection well.	Not applicable. Potential for uncontrolled migration of DNAPL to Hudson River.
Disposal	Off-site disposal (DNAPL)	Commercial Facility	Transportation of recovered DNAPL to an off-site permitted commercial facility for treatment/disposal.	Potentially applicable
	Disposal (Groundwater)	Treatment Facility	Off-site treatment of extracted groundwater at Fort Edward Plant Site WWTP.	Potentially applicable

Notes:
HDPE- High Density Polyethelyne
NCP - National Contingency Plan
NYCRR - New York State Code of Rules and Regulations
PCBs - Polychlorinated biphenyls
DNAPL refers to dense non-aqueous phase liquid. For this site, DNAPL primarily contains PCBs.
WWTP - Wastewater Treatment Plant

Table 4-3
Identification and Screening of Remedial Technologies for Deep DNAPL
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
No action	None	No action	No action.	Applicable. Required for consideration by the NCP.
Institutional controls/limited actions	Proprietary controls	Notice of environmental Conditions	Site conditions are made know as they pertain to restrictions of groundwater use.	Potentially applicable
	Governmental controls	Site management plan	Documentation of site restrictions and provisions for continued operation and maintenance of the remedy. Presents requirements for monitoring and includes a provision for periodic site reviews, and annual certifications as required by NYSDEC.	Potentially applicable
	Monitoring	Monitoring	Periodic sampling and analyses as a means of monitoring for DNAPL and its effects. Groundwater, surface water and DNAPL monitoring would also provide a means of monitoring remedy effectiveness. Periodic sampling and analyses of groundwater and surface water and the presence of DNAPL is currently being conducted.	Potentially applicable
	Periodic reviews	Periodic site reviews	Periodic reviews are required by 6 NYCRR Part 375 where institutional and engineering controls, monitoring plans, and/or operations and maintenance activities are implemented at a site. The purpose of periodic reviews is to evaluate the site with regard to the continuing protection of human health and the environment and to provide documentation of remedy effectiveness.	Potentially applicable
Natural recovery	Natural attenuation	Natural attenuation	The natural attenuation of organic contaminants by *in situ* physical, chemical and/or biological processes. Over time, the mass of PCB-containing DNAPL can be reduced by processes that include dissolution, biodegradation, and diffusion.	Potentially applicable
		Monitored natural attenuation	Long-term monitoring of the natural attenuation of organic contaminants by *in situ* physical, chemical and/or biological processes.	Potentially applicable
Containment	Physical barrier wall	Grout curtain	Injection of grout to restrict DNAPL migration.	Potentially Applicable. Difficult to implement due to limited accessibility and presence of bedrock substrate at the site.
		Sheet piles	Sheet piles installed along the perimeter of the area of contamination to contain groundwater. Sheet pile materials include HDPE, fiberglass, vinyl and steel. Sheet piles should extend into a confining unit.	Not applicable for installation in bedrock or at deep bedrock depths

Table 4-3
Identification and Screening of Remedial Technologies for Deep DNAPL
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
Containment (cont.)	Physical barrier wall (cont.)	Slurry wall	Soil- or cement-bentonite slurry wall placed along the perimeter of the area of contamination to contain shallow and deep groundwater. Containment wall should extend into a confining unit.	Not applicable for installation in bedrock or at deep bedrock depths
	Hydraulic barrier	Groundwater extraction	Use of groundwater extraction to induce changes in flow patterns that result in containment of DNAPL migration.	Potentially Applicable. Difficult to implement due to limited accessibility and presence of bedrock substrate at the site. Difficult to install conveyance systems that are resilient to flooding and ice damage.
In situ treatment	Physical/chemical treatment	Chemical oxidation	Addition of oxidation agents such as hydrogen peroxide, ozone, sodium persulfide and/or permanganate into groundwater. Oxidation reactions chemically convert contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. Oxidation can also increase dissolution rate of DNAPL. Potentially effective for DNAPL.	Not applicable. Potential for uncontrolled migration of DNAPL.
	Biological treatment	Enhanced bioremediation	Injection of microbial populations, nutrient sources, or electron donors into groundwater to enhance biological degradation of organic contaminants. Increase degradation of dissolved contaminants can increase dissolution rate of DNAPL. Potentially effective for DNAPL.	Not applicable. Potential for uncontrolled migration of DNAPL.
Collection	DNAPL collection	Bailers/sorbent/pumps	Removing DNAPL from bedrock wells via bailers, sorbent material or pumps placed within wells.	Potentially applicable
Collection enhancement	Groundwater pumping	Vertical extraction wells	Conversion of existing vertical monitoring wells to extraction wells and/or installation of new extraction wells to pump groundwater as a means of enhancing DNAPL migration to wells for collection. Would require management of collected groundwater.	Potentially Applicable. Difficult to implement due to the generally residual nature of the DNAPL results in limited amounts of DNAPL potentially available to be mobilized. Pumping test conducted during the RI did not significantly enhance DNAPL recovery. Difficult to install conveyance systems that are resilient to flooding and ice damage.

Table 4-3
Identification and Screening of Remedial Technologies for Deep DNAPL
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
Collection enhancement (cont.)	Groundwater pumping (cont.)	Horizontal extraction wells	Use of horizontal extraction wells to pump groundwater as a means of enhancing DNAPL collection.	Not applicable; heterogeneous distribution of isolated locations of recoverable DNAPL not conducive to the use of horizontal wells; lack of sump in horizontal well creates potential for uncontrolled migration of DNAPL.
		Collection trench	Removal of groundwater by pumping from collection trench as a means of enhancing DNAPL collection.	Not applicable; infeasible for depths of contamination, in bedrock conditions and in such proximity of the river.
	Permeability enhancement	Pneumatic/hydraulic fracturing	Injection of high pressure air or water into subsurface to create permeable channels or fractures in subsurface material to enhance DNAPL collection.	Not applicable. Not implementable due to nature of bedrock shale and likely inability to produce of large-scale fractures. Potential for uncontrolled DNAPL migration during fracturing. Hydraulic fracturing was attempted during the RI without success in one bedrock monitoring well.
	Injection	Steam injection	Injection of steam to subsurface to elevate temperatures to increase DNAPL mobility. Difficult to control migration of DNAPL.	Not applicable. Potential for uncontrolled migration of DNAPL.

Table 4-3
Identification and Screening of Remedial Technologies for Deep DNAPL
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
Collection enhancement (cont.)	Injection (cont.)	Surfactant injection	Injection of surfactants into groundwater zone. Surfactants reduce the surface tensions between liquids or between a liquid and a solid, increasing the solubility of contaminants, and enhancing the removal of DNAPL. Difficult to control migration of DNAPL.	Not applicable. Potential for uncontrolled migration of DNAPL.
	Thermal	In-well warming	Localized warming of the bedrock and DNAPL adjacent to DNAPL recovery wells to enhance DNAPL migration to the collection well.	Not applicable. Potential for uncontrolled migration of DNAPL.
Disposal	Off-site disposal (DNAPL)	Commercial Facility	Transportation of recovered DNAPL to an off-site permitted commercial facility for treatment/disposal.	Potentially applicable
	Disposal (Groundwater)	Treatment Facility	Off-site treatment of extracted groundwater at Fort Edward Plant Site WWTP.	Potentially applicable

Notes:
HDPE- High Density Polyethelyne
NCP - National Contingency Plan
NYCRR - New York State Code of Rules and Regulations
PCBs - Polychlorinated biphenyls
DNAPL refers to dense non-aqueous phase liquid. For this site, DNAPL primarily contains PCBs.
WWTP - Wastewater Treatment Plant

Table 4-4
Evaluation of Process Options for Shallow DNAPL
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

General Response Action	Remedial Technology	Process Option	Effectiveness	Implementability	Relative Cost
No action	None	**No action**	Effectiveness relies on natural attenuation. DNAPL expected to decrease over time through natural attenuation.	Readily implementable.	No capital No O&M
Institutional controls/limited actions	Proprietary controls	**Notice of environmental conditions**	Effective means of precluding the use of groundwater and documenting site use restrictions. Limits future site uses.	Readily implementable.	Low capital No O&M
	Government controls	**Site management plan**	Effective means of documenting site restrictions and remedy components, including operation, maintenance, monitoring, and certification requirements.	Readily implementable.	Low capital Low O&M
	Monitoring	**Monitoring**	Effective method for monitoring conditions. Useful for evaluating mobility of DNAPL and conditions in surface water and groundwater to evaluate remedy effectiveness.	Readily implementable. DNAPL, groundwater and surface water monitoring are currently conducted periodically at the site.	No capital Low O&M
	Periodic reviews	**Periodic site reviews**	Effective means of documenting status and progress of remedies requiring long-term operation and maintenance.	Readily implementable.	No capital Low O&M
Natural recovery	Natural attenuation	**Natural attenuation**	Potentially effective over the long-term for attenuation of contaminants. Treatability study would be required.	Readily implementable.	No capital No O&M
		Monitored natural attenuation	Potentially effective over the long-term for attenuation of contaminants. Treatability study would be required.	Readily implementable.	Low capital Low O&M
Containment	Physical barrier wall	Grout curtain	Potentially effective for containing DNAPL. Treatability study would be required.	Potentially Implementable. Difficult to implement given fractured bedrock conditions and proximity to the river.	High capital Low O&M
	Hydraulic barrier	Groundwater extraction	Potentially effective for containing DNAPL. Treatability study would be required.	Implementable. Difficult to implement given fractured bedrock conditions and proximity to the river. Likely to generate high volumes of groundwater for little DNAPL collection.	Medium capital High O&M
In situ treatment	Treatment barrier	Treatment trench	Potentially effective for treatment of bedrock groundwater potentially discharging to Hudson River.	Difficult to implement given bedrock conditions and proximity to the river. Blasting of rock may be required for installation resulting in potential for additional fractures in bedrock or initiation of additional migration of DNAPL.	High capital Medium O&M
Collection	DNAPL Collection	**Bailers/sorbent/ Pumps**	Potentially effective means of DNAPL collection. DNAPL is currently recovered from site wells by bailers.	Implementable. Currently being used for collection of DNAPL from several bedrock wells.	Low Capital Low O&M

Table 4-4
Evaluation of Process Options for Shallow DNAPL
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

General Response Action	Remedial Technology	Process Option	Effectiveness	Implementability	Relative Cost
Collection enhancement	Groundwater collection	**Vertical extraction wells**	Potentially effective means of enhancing DNAPL recovery from shallow bedrock. Pumping test potentially required to indentify well placement and appropriate pumping rates.	Potentially implementable. Collected groundwater would require treatment prior to discharge. Potential for fouling of wells, piping, pumps, and treatment system as a result of naturally-occurring inorganics. Difficult to install conveyance piping given bedrock conditions and proximity to the river.	High Capital High O&M
	Groundwater pumping	Collection trench	Potentially effective means of enhancing shallow DNAPL recovery from bedrock.	Potentially implementable. Difficult to implement given bedrock conditions and proximity to the river. Blasting of rock may be required for installation resulting in potential for additional fractures in bedrock or initiation of additional migration of DNAPL. Potential to generate high volumes of groundwater for little DNAPL collection.	Medium capital High O&M
Disposal	Off-site disposal (DNAPL)	**Commercial Facility**	Effective means of managing DNAPL.	Currently being used for management of collected DNAPL.	Low capital High O&M
	Disposal (Groundwater)	**Treatment Facility**	Effective means of managing recovered groundwater.	Currently being used for treatment of groundwater in other Site Operable Units. Potentially implementable with evaluation of available capacity and existing treatment components.	Low capital High O&M

Notes:
Process options in **bold** indicate representative process options, retained for evaluation and development of remedial alternatives for groundwater.
DNAPL refers to dense non-aqueous phase liquid. For this site, DNAPL primarily contains PCBs.
O&M - Operation and maintenance
PCBs - Polychlorinated biphenyls

Table 4-5
Evaluation of Process Options for Deep DNAPL
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Ft Edward, New York
Feasibility Study Report

General Response Action	Remedial Technology	Process Option	Effectiveness	Implementability	Relative Cost
No action	None	**No action**	Effectiveness relies on natural attenuation. DNAPL expected to decrease over time through natural attenuation.	Readily implementable.	No capital No O&M
Institutional controls/limited actions	Proprietary controls	**Notice of environmental Conditions**	Effective means of precluding the use of groundwater and documenting site use restrictions. Limits future site uses.	Readily implementable.	Low capital No O&M
	Government controls	**Site management plan**	Effective means of documenting site restrictions and remedy components, including operation, maintenance, monitoring and certification requirements.	Readily implementable.	Low capital Low O&M
	Monitoring	**Monitoring**	Effective method for monitoring conditions. Useful for evaluating mobility of DNAPL and conditions in surface water and groundwater to evaluate remedy effectiveness.	Readily implementable. DNAPL, groundwater and surface water monitoring are currently conducted periodically at the site.	No capital Low O&M
	Periodic reviews	**Periodic site reviews**	Effective means of documenting status and progress of remedies requiring long-term operation and maintenance.	Readily implementable.	No capital Low O&M
Natural recovery	Natural attenuation	**Natural attenuation**	Potentially effective over the long-term for attenuation of contaminants. Treatability study would be required.	Readily implementable.	No capital No O&M
		Monitored natural attenuation	Potentially effective over the long-term for attenuation of contaminants. Treatability study would be required.	Readily implementable.	Low capital Low O&M
Containment	Physical barrier wall	Grout curtain	Potentially effective for containing DNAPL. Treatability study would be required.	Potentially Implementable. Difficult to implement given fractured bedrock conditions and proximity to the river.	High capital Low O&M
	Hydraulic barrier	Groundwater extraction	Potentially effective for containing DNAPL. Treatability study would be required.	Implementable. Difficult to implement given fractured bedrock conditions and proximity to the river. Likely to generate high volumes of groundwater for little DNAPL collection.	Medium capital High O&M
Collection	DNAPL Collection	**Bailers/sorbent/ pumps**	Potentially effective means of DNAPL collection. DNAPL is currently recovered by passive collection from site wells.	Implementable. Currently being used for collection of DNAPL from several bedrock wells.	Low Capital Low O&M
Collection enhancement	Groundwater collection	**Vertical extraction wells**	Potentially effective means of enhancing DNAPL collection from deep bedrock. Pumping test potentially required to indentify well placement and appropriate pumping rates.	Potentially implementable. Collected groundwater would require treatment prior to discharge. Potential for fouling of wells, piping, pumps, and treatment system as a result of naturally-occurring inorganics. Difficult to install conveyance piping given bedrock conditions and proximity to the river.	High Capital High O&M

Table 4-5
Evaluation of Process Options for Deep DNAPL
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Ft Edward, New York
Feasibility Study Report

General Response Action	Remedial Technology	Process Option	Effectiveness	Implementability	Relative Cost
Disposal	Off-site disposal (DNAPL)	**Commercial Facility**	Effective means of managing DNAPL.	Currently being used for management of collected DNAPL.	Low capital High O&M
	Off-site disposal (Groundwater)	**Treatment Facility**	Effective means of managing recovered groundwater.	Currently being used for treatment of groundwater in other Site Operable Units. Potentially implementable with evaluation of available capacity and existing treatment components.	Low capital High O&M

Notes:
Process options in **bold** indicate representative process options, retained for evaluation and development of remedial alternatives for groundwater.
DNAPL refers to dense non-aqueous phase liquid. For this site, DNAPL primarily contains PCBs.
NYCRR - New York State Code of Rules and Regulations
O&M - Operation and maintenance
PCBs - Polychlorinated biphenyls
USEPA - United States Environmental Protection Agency

Table 4-6
Components of Remedial Alternatives
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

MEDIA	GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY/PROCESS OPTION	Alternative 1 No Further Action	Alternative 2 Monitoring and Instititional Controls	Alternative 3 Continued DNAPL Collection, Monitoring and Institutional Controls	Alternative 4 Enhanced DNAPL Colletion (DNAPL and Groundwater Collection), Monitoring and Institutional Controls
Shallow DNAPL	Institutional controls/limited actions	Notice of environmental conditions, site management plan and periodic reviews		X	X	X
		DNAPL, groundwater and surface water monitoring		X	X	X
	Natural recovery	Natural attenuation of residual DNAPL		X	X	X
	Collection	DNAPL collection using bailers or sorbent or pumps			X	X
	Collection enhancement	Shallow groundwater collection using vertical extraction wells				X
	Disposal	Off-Site management of recovered DNAPL			X	X
		Treatment of extracted groundwater at Fort Edward Plant Site WWTP				X
Deep DNAPL	Institutional controls/limited actions	Notice of environmental conditions, site management plan and periodic reviews		X	X	X
		DNAPL, groundwater and surface water monitoring		X	X	X
	Natural recovery	Natural attenuation of residual DNAPL		X	X	X
	Collection	DNAPL collection using bailers or sorbent or pumps			X	X
	Collection enhancement	Deep groundwater collection using vertical extraction wells				X
	Disposal	Off-Site management of recovered DNAPL			X	X
		Treatment of extracted groundwater at Fort Edward Plant Site WWTP				X

Notes:

DNAPL refers to dense non-aqueous phase liquid. For this site, DNAPL primarily contains PCBs.
PCBs - Polychlorinated biphenyls
WWTP - Wastewater Treatment Plant

Table 4-7
Screening of Remedial Alternatives
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Ft Edward, New York
Feasibility Study Report

Criterion	Alternative 1 - No further action	Alternative 2 - Monitoring and Institutional Controls	Alternative 3 - Continued DNAPL Collection, Monitoring and Institutional Controls	Alternative 4 - Enhanced DNAPL Collection (DNAPL and groundwater collection), Monitoring and Institutional Controls
	● No further action	● Institutional Controls - Notice of environmental conditions, site management plan, periodic reviews. ● Monitoring - DNAPL, groundwater and surface water monitoring ● Natural attenuation of residual DNAPL	● Institutional Controls - Notice of environmental conditions, site management plan, periodic reviews. ● Monitoring - DNAPL, groundwater and surface water monitoring ● Continued DNAPL collection from shallow and deep bedrock ● Disposal - Off-site disposal of recovered DNAPL, treatment of recovered groundwater at Ft Edward WWTP ● Natural attenuation of residual DNAPL	● Institutional Controls - Notice of environmental conditions, site management plan, periodic reviews. ● Monitoring - DNAPL, groundwater and surface water monitoring ● Continued DNAPL collection from shallow and deep bedrock ● Enhancement of DNAPL collection - Groundwater collection of shallow and deep bedrock groundwater (additional wells) ● Disposal - Off-site disposal of recovered DNAPL ● Treatment - Treatment of recovered groundwater at Ft Edward WWTP ● Natural attenuation of residual DNAPL and residual groundwater concentrations
Effectiveness				
Overall protection of human health	Relies on natural attenuation to address overall protection of human health.	Protection of human health is provided through institutional controls.	Protection of human health is provided through institutional controls and removal of DNAPL.	Protection of human health is provided through institutional controls and removal of DNAPL and groundwater.
Overall protection of the environment	Relies on natural attenuation to address overall protection of the environment.	Relies on natural attenuation to address overall protection of the environment. Monitoring provides a means for evaluating protection of ecological resources.	Removal of DNAPL in addition to natural attenuation of DNAPL to address overall protection of the environment. Monitoring provides a means for evaluating protection of ecological resources.	Removal of DNAPL and groundwater in addition to natural attenuation of DNAPL to address overall protection of the environment. Monitoring provides a means for evaluating protection of ecological resources.
Short-term Effectiveness	No remedial actions.	Health and safety measures and current site access restrictions are effective means of protecting workers and community during installation of remedy.	Health and safety measures and current site access restrictions are effective means of protecting workers and community during installation of remedy.	Health and safety measures and current site access restrictions are effective means of protecting workers and community during installation of remedy.
Long-Term Effectiveness and Permanence	Relies on natural attenuation for long term effectiveness and permanence.	Institutional controls are an effective means of long-term control of potential exposures to DNAPL in bedrock for human receptors. Relies on natural attenuation for long term effectiveness and permanence with respect to ecological receptors. Monitoring would provide an effective means of evaluating long-term effectiveness of this alternative.	Institutional controls are reliable means of managing residual risks due to the presence of DNAPL in bedrock. Monitoring would provide an effective means of evaluating long-term effectiveness of this alternative. Removal of DNAPL provides a greater degree of effectiveness than institutional controls and natural attenuation alone.	Institutional controls are reliable means of managing residual risks due to the presence of DNAPL in bedrock. Monitoring would provide an effective means of evaluating long-term effectiveness of this alternative. Removal of DNAPL provides a greater degree of effectiveness than institutional controls and natural attenuation alone. Added groundwater collection is not anticipated to greatly increase the effectiveness of this alternative as compared to DNAPL removal alone.
Reduction of Toxicity, Mobility, or Volume through Treatment	No treatment actions proposed for this alternative.	No treatment actions proposed for this alternative.	Removal of DNAPL from shallow and deep bedrock would result in the reduction of volume of DNAPL in bedrock, and subsequently overall potential for mobility of DNAPL. Treatment of DNAPL and incidental groundwater included in this alternative provide a reduction in toxicity.	Removal of DNAPL from shallow and deep bedrock would result in the reduction of volume of DNAPL in bedrock. Removal of DNAPL would also result in control of mobility of the DNAPL. Removal of groundwater in addition to DNAPL is not anticipated to result in greater reduction in volume of DNAPL over the foreseeable future. Treatment of DNAPL and groundwater included in this alternative provide a reduction in toxicity.

Table 4-7
Screening of Remedial Alternatives
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Ft Edward, New York
Feasibility Study Report

Criterion	Alternative 1 - No further action	Alternative 2 - Monitoring and Institutional Controls	Alternative 3 - Continued DNAPL Collection, Monitoring and Institutional Controls	Alternative 4 - Enhanced DNAPL Collection (DNAPL and groundwater collection), Monitoring and Institutional Controls
	● No further action	● Institutional Controls - Notice of environmental conditions, site management plan, periodic reviews. ● Monitoring - DNAPL, groundwater and surface water monitoring ● Natural attenuation of residual DNAPL	● Institutional Controls - Notice of environmental conditions, site management plan, periodic reviews. ● Monitoring - DNAPL, groundwater and surface water monitoring ● Continued DNAPL collection from shallow and deep bedrock ● Disposal - Off-site disposal of recovered DNAPL, treatment of recovered groundwater at Ft Edward WWTP ● Natural attenuation of residual DNAPL	● Institutional Controls - Notice of environmental conditions, site management plan, periodic reviews. ● Monitoring - DNAPL, groundwater and surface water monitoring ● Continued DNAPL collection from shallow and deep bedrock ● Enhancement of DNAPL collection - Groundwater collection of shallow and deep bedrock groundwater (additional wells) ● Disposal - Off-site disposal of recovered DNAPL ● Treatment - Treatment of recovered groundwater at Ft Edward WWTP ● Natural attenuation of residual DNAPL and residual groundwater concentrations
Implementability				
Ability to construct and operate the technology	There are no technologies to be constructed in this alternative.	Monitoring is readily implementable limited only by site accessibility due to weather conditions or river stage.	Monitoring and DNAPL recovery are both readily implementable limited only by site accessibility due to weather conditions or river stage.	Monitoring is readily implementable limited only by site accessibility due to weather conditions or river stage. Constructability of DNAPL and groundwater recovery systems through well pumping would be impeded due to site conditions such as bedrock substrate, limited space, proximity to river, frequent inundation and potential for ice damage during winter. Operation of a DNAPL and groundwater recovery system would also be impeded due to site conditions. The frequent inundation of the Site by surface water during high flow periods and the potential for ice damage to conveyance piping and storage tanks would limit the amount of time the system could be operated. The system would only be operated on a seasonal basis (*i.e.* , late spring through the fall) and would be subject to flood damage all year long making this alternative difficult if not impossible to reliably implement.
Reliability of technology	There are no technologies to be constructed in this alternative.	Monitoring is demonstrably reliable for evaluating subsurface conditions. Institutional controls are reliable means of managing residual risks due to the presence of DNAPL in bedrock.	Bailers, sorbents and pumps are reliable methods for recovery of DNAPL from wells. Monitoring is demonstrably reliable for evaluating subsurface conditions. Institutional controls are reliable means of managing residual risks due to the presence of DNAPL in bedrock.	Potential for interruptions in pumping due to seasonal constraints, damage to power, discharge of collected DNAPL and groundwater should conveyance piping be compromised, or interruptions in operations due to site conditions reduces the reliability of active pumping options. Bailers, sorbents and pumps are reliable methods for recovery of DNAPL from wells. Monitoring is demonstrably reliable for evaluating subsurface conditions. Institutional controls are reliable means of managing residual risks due to the presence of DNAPL in bedrock.
Ability to monitor effectiveness of remedy	Effectiveness of the remedy could be readily monitored.	Effectiveness of the remedy could be readily monitored. Periodic review would be included in this alternative.	Effectiveness of the remedy could be readily monitored. Periodic review would be included in this alternative.	Effectiveness of the remedy could be readily monitored. Periodic review would be included in this alternative.
Coordination with other agencies and property owners	No coordination necessary to implement this alternative.	No coordination necessary to implement this alternative.	No coordination necessary to implement this alternative.	No coordination necessary to implement this alternative.
Costs				
Capital	None	Low	Low	Very High
Operation and Maintenance	None	Low	Medium	Very High

Notes:
DNAPL - Dense non-aqueous product liquids
NYSDEC - New York State Department of Environmental Conservation
OSHA - Occupational Safety and Health Administration
PCB - Polychlorinated biphenyl
RAO - Remedial Action Objective
USEPA - United States Environmental Protection Agency

Table 5-1
Detailed Analysis of Remedial Alternatives
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Ft Edward, New York
Feasibility Study Report

Criterion	Alternative 1 - No further action	Alternative 2 - Monitoring and Institutional Controls	Alternative 3 - Continued DNAPL Collection, Monitoring and Institutional Controls
	● No further action	● Institutional Controls - Notice of environmental conditions, site management plan, periodic reviews. ● Monitoring - DNAPL, groundwater and surface water monitoring ● Natural attenuation of residual DNAPL	● Institutional Controls - Notice of environmental conditions, site management plan, periodic reviews. ● Monitoring - DNAPL, groundwater and surface water monitoring ● Continued DNAPL collection from shallow and deep bedrock ● Disposal - Off-site disposal of recovered DNAPL, treatment of recovered groundwater at Ft Edward WWTP ● Natural attenuation of residual DNAPL
Overall Protection of Human Health and the Environment			
Overall protection of human health	Due to the lack of complete pathways, no current risks have been identified for human health.	Due to the lack of complete pathways, no current risks have been identified for human health. Institutional controls preclude the potential for future exposure of human receptors to DNAPL in bedrock.	Due to the lack of complete pathways, no current risks have been identified for human health. Institutional controls preclude the potential for future exposure of human receptors to DNAPL in bedrock.
Overall protection of the environment	Minimal risk has been identified to surface water in the Hudson River as a result of DNAPL present in shallow and deep bedrock at the Site. This alternative relies on natural attenuation to address potential risks to the environment.	Minimal risk has been identified to surface water in the Hudson River as a result of DNAPL present in shallow and deep bedrock at the Site. This alternative relies on natural attenuation to address potential risks to the environment. Monitoring included in this alternative affords protection through verification of field conditions.	Minimal risk has been identified to surface water in the Hudson River as a result of DNAPL present in shallow and deep bedrock at the Site. This alternative includes DNAPL removal as well as natural attenuation to address potential risks to the environment. Monitoring included in this alternative affords protection through verification of field conditions.
Compliance with Standards, Criteria, and Guidance (SCGs)			
Compliance with chemical-specific SCGs	No chemical-specific SCGs were identified for DNAPL in bedrock.	No chemical-specific SCGs were identified for DNAPL in bedrock.	No chemical-specific SCGs were identified for DNAPL in bedrock.
Compliance with location-specific SCGs	No location-specific SCGs have been identified for this alternative.	Monitoring would be performed in accordance with SCGs relating to activates occurring in and in the vicinity of wetlands (riverine), the 100-year floodplain, and bodies of water (Hudson River).	Monitoring and DNAPL recovery would be performed in accordance with SCGs relating to activates occurring in and in the vicinity of wetlands (riverine), the 100-year floodplain, and bodies of water (Hudson River).
Compliance with action-specific SCGs	No actions proposed for this alternative.	Site activities would be conducted in accordance with OSHA safety requirements.	Site activities would be conducted in accordance with OSHA safety requirements. Management, transportation and disposal of DNAPL would be conducted in accordance with regulatory requirements.

Table 5-1
Detailed Analysis of Remedial Alternatives
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Ft Edward, New York
Feasibility Study Report

Criterion	Alternative 1 - No further action	Alternative 2 - Monitoring and Institutional Controls	Alternative 3 - Continued DNAPL Collection, Monitoring and Institutional Controls
	● No further action	● Institutional Controls - Notice of environmental conditions, site management plan, periodic reviews. ● Monitoring - DNAPL, groundwater and surface water monitoring ● Natural attenuation of residual DNAPL	● Institutional Controls - Notice of environmental conditions, site management plan, periodic reviews. ● Monitoring - DNAPL, groundwater and surface water monitoring ● Continued DNAPL collection from shallow and deep bedrock ● Disposal - Off-site disposal of recovered DNAPL, treatment of recovered groundwater at Ft Edward WWTP ● Natural attenuation of residual DNAPL
Long-Term Effectiveness and Permanence			
Magnitude of residual risk	Minimal risks have been identified due to DNAPL in bedrock. This alternatives relies on natural attenuation to mitigate these risks.	Minimal risks have been identified due to DNAPL in bedrock. Potential future risk to human health would be effectively addressed through institutional controls. This alternative relies on natural attenuation to minimize residual risks.	Minimal risks have been identified due to DNAPL in bedrock. Potential future risk to human health would be effectively addressed through institutional controls. DNAPL recovery included in this alternative provides greater effectiveness in addressing risks than institutional controls and natural attenuation alone.
Adequacy and reliability of controls	No controls are included in this alternative.	Institutional controls are reliable means of minimizing the potential for future exposure of human receptors to DNAPL. Monitoring and periodic review are reliable means of assessing adequacy of remedy.	Institutional controls are reliable means of minimizing the potential for future exposure of human receptors to DNAPL. Recovery of DNAPL is a reliable method of addressing DNAPL in bedrock. Monitoring and periodic review are reliable means of assessing adequacy of remedy.
Long-term sustainability	No active remedial components, therefore, no environmental or sustainability impacts are associated with implementation of the remedy.	Minimal environmental or sustainability impacts are associated with implementation of the remedy.	Long-term environmental or sustainability impacts for this alternative are limited to transportation of collected DNAPL as a result of implementation of this remedy.
Reduction of Toxicity, Mobility, or Volume through Treatment			
Treatment process used and materials treated	No treatment processes included in this alternative.	No treatment processes included in this alternative.	Treatment of DNAPL (incineration) and incidental groundwater (coagulation, filtration and carbon adsorption) are included in this alternative.
Amount of hazardous material destroyed or treated	No treatment processes included in this alternative. Natural attenuation is not anticipated to appreciably reduce the volume of DNAPL within the foreseeable future.	No treatment processes included in this alternative. Natural attenuation is not anticipated to appreciably reduce the volume of DNAPL within the foreseeable future.	Treatment of DNAPL is anticipated to destroy DNAPL contaminants. DNAPL recovery has historically resulted in approximately 12 gallons (46 liters) of DNAPL removed each year, based on an average of annual DNAPL recovered between 2008 and 2013.
Degree of expected reduction in toxicity, mobility, or volume	No treatment processes included in this alternative. Natural attenuation is not anticipated to appreciably reduce the volume of DNAPL within the foreseeable future.	No treatment processes included in this alternative. Natural attenuation is not anticipated to appreciably reduce the volume of DNAPL within the foreseeable future.	DNAPL recovery would result in a reduction in volume of DNAPL in bedrock. DNAPL recovery has historically resulted in approximately 12 gallons (46 liters) of DNAPL removed each year, based on an average of annual DNAPL recovered between 2008 and 2013.
Degree to which treatment is irreversible	No treatment processes included in this alternative.	No treatment processes included in this alternative.	Removal and treatment of DNAPL is irreversible.
Type and quantity of residuals remaining after treatment	No treatment processes included in this alternative.	No treatment processes included in this alternative.	Minimal treatment residues expected as a result of DNAPL and incidental groundwater treatment included in this alternative.

Table 5-1
Detailed Analysis of Remedial Alternatives
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Ft Edward, New York
Feasibility Study Report

Criterion	Alternative 1 - No further action	Alternative 2 - Monitoring and Institutional Controls	Alternative 3 - Continued DNAPL Collection, Monitoring and Institutional Controls
	● No further action	● Institutional Controls - Notice of environmental conditions, site management plan, periodic reviews. ● Monitoring - DNAPL, groundwater and surface water monitoring ● Natural attenuation of residual DNAPL	● Institutional Controls - Notice of environmental conditions, site management plan, periodic reviews. ● Monitoring - DNAPL, groundwater and surface water monitoring ● Continued DNAPL collection from shallow and deep bedrock ● Disposal - Off-site disposal of recovered DNAPL, treatment of recovered groundwater at Ft Edward WWTP ● Natural attenuation of residual DNAPL
Short-Term Impact and Effectiveness			
Protection of community during remedial actions	No active remedial actions included in this alternative.	Community is restricted from access to the Site. Monitoring will not affect community.	Community is restricted from access to the Site. Monitoring will not affect community. Proper precautions would be taken during transportation and storage of recovered DNAPL for the protection of the community.
Protection of workers during remedial actions	No active remedial actions included in this alternative.	Proper health and safety measures would be established and implemented during remedial activities, and would be effective in protecting workers from exposure to contaminants.	Proper health and safety measures would be established and implemented during remedial activities, and would be effective in protecting workers from exposure to contaminants.
Short-term sustainability	No active remedial actions included in this alternative.	Negligible short-term fuel/energy use, greenhouse gas emissions and water use associated with drilling equipment during installation of monitoring well(s), should these be deemed necesary. Minimal resource use and impacts to water and ecology.	Negligible short-term fuel/energy use, greenhouse gas emissions and water use associated with drilling equipment during installation of monitoring well(s), should these be deemed necesary. Minimal resource use and impacts to water and ecology.
Time until RAOs are achieved	The RAO to prevent DNAPL migration is nearly met, as DNAPL migration to nearby surface water is anticipated to be minimal at this time. A means of verifying the continued protection of ecological receptors would not be provided.	The RAO to prevent DNAPL migration is nearly met, as DNAPL migration to nearby surface water is anticipated to be minimal at this time. Protection of human receptors from DNAPL exposure is afforded immediately upon implementation of Alternative 2. A means of verifying the continued protection of ecological receptors would be provided through surface water monitoring upon implementation of Alternative 2.	The RAO to prevent DNAPL migration is nearly met, as DNAPL migration to nearby surface water is anticipated to be minimal at this time. Recovery of DNAPL included in this alternative further reduces the likelihood of DNAPL migration, thus meeting the RAO to prevent DNAPL migration from bedrock to the Hudson River. Protection of human receptors from DNAPL exposure is afforded immediately upon implementation of Alternative 3. A means of verifying the continued protection of ecological receptors would be provided through surface water monitoring upon implementation of Alternative 3.

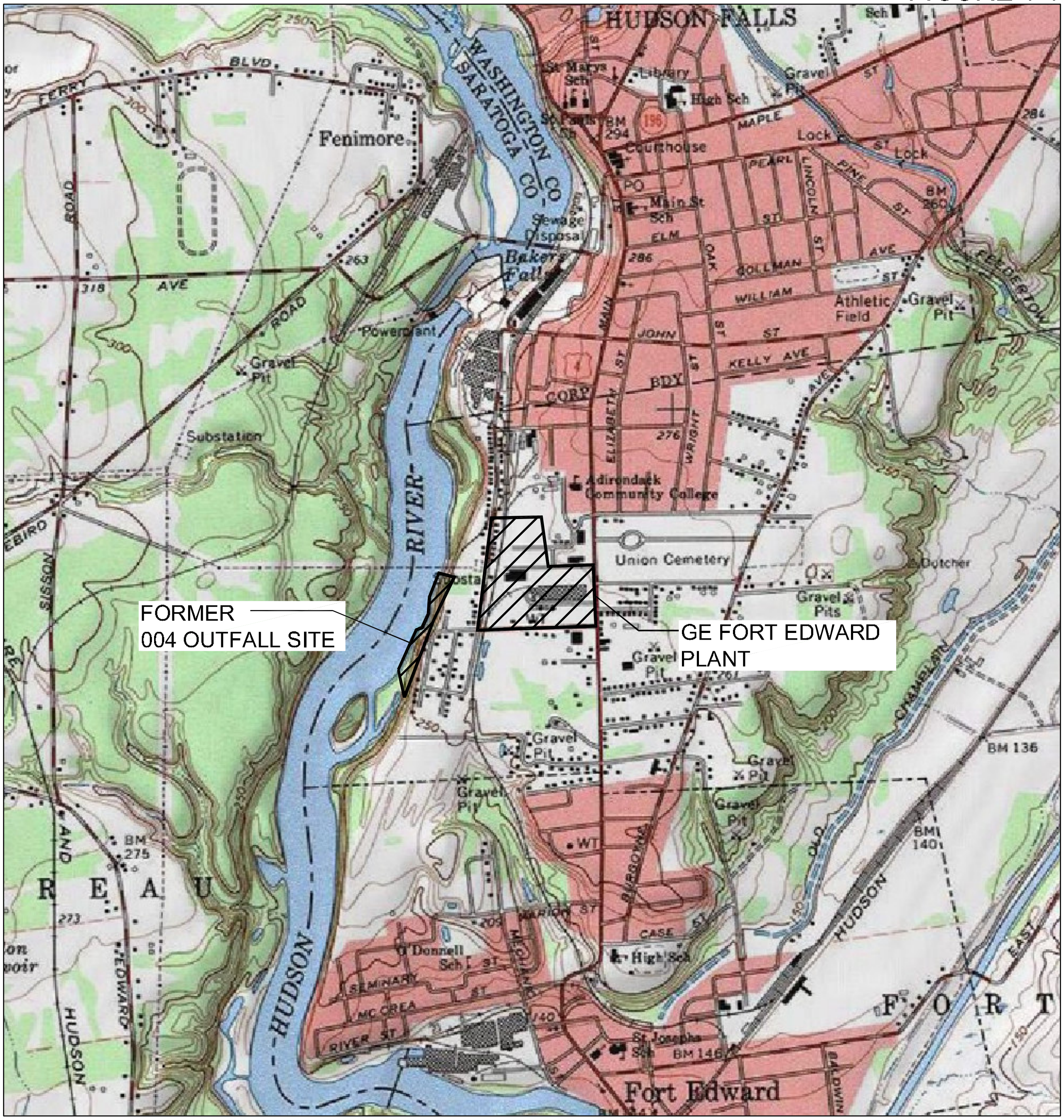
Criterion	Alternative 1 - No further action	Alternative 2 - Monitoring and Institutional Controls	Alternative 3 - Continued DNAPL Collection, Monitoring and Institutional Controls
	● No further action	● Institutional Controls - Notice of environmental conditions, site management plan, periodic reviews. ● Monitoring - DNAPL, groundwater and surface water monitoring ● Natural attenuation of residual DNAPL	● Institutional Controls - Notice of environmental conditions, site management plan, periodic reviews. ● Monitoring - DNAPL, groundwater and surface water monitoring ● Continued DNAPL collection from shallow and deep bedrock ● Disposal - Off-site disposal of recovered DNAPL, treatment of recovered groundwater at Ft Edward WWTP ● Natural attenuation of residual DNAPL
Implementability			
Ability to construct and operate the technology	There are no technologies to be constructed or operated in this alternative.	Monitoring wells, should these be deemed necessary, are readily constructible. Monitoring and institutional controls are readily implementable.	Monitoring wells, should these be deemed necessary, are readily constructible. Monitoring, DNAPL recovery, and institutional controls are readily implementable.
Reliability of technology	No technologies included in this alternative.	Institutional controls are reliable means of managing residual risks due to DNAPL in bedrock. Monitoring is a reliable means for evaluating the groundwater and surface water quality. Monitoring of DNAPL in monitoring wells is a reliable means for evaluating DNAPL presence in bedrock.	Institutional controls are reliable means of managing residual risks due to DNAPL in bedrock. Monitoring is a reliable means for evaluating the groundwater and surface water quality. Monitoring of DNAPL in monitoring wells is a reliable means for evaluating the DNAPL presence in bedrock. DNAPL recovery is a reliable means for removing DNAPL in bedrock.
Ease of undertaking additional remedial actions, if necessary	Additional remedial actions, if necessary, would be readily implementable.	Additional remedial actions, if necessary, are readily implementable.	Additional remedial actions, if necessary, are readily implementable.
Ability to monitor effectiveness of remedy	No means to monitor effectiveness.	DNAPL, groundwater and surface water monitoring would indicate changes in groundwater and surface water quality. Periodic review would be included in this alternative.	DNAPL, groundwater and surface water monitoring would indicate changes in groundwater and surface water quality. Periodic review would be included in this alternative.
Coordination with other agencies and property owners	No coordination necessary to implement this alternative.	No coordination necessary to implement this alternative.	No coordination necessary to implement this alternative.
Availability of off-site treatment storage and disposal services and capacities	No off-site treatment, storage and disposal services identified for this alternative.	No off-site treatment, storage and disposal services identified for this alternative.	Off-site disposal facilities are readily available to manage recovered DNAPL. Treatment facility is readily available to manage small volumes of groundwater recovered during DNAPL recovery activities.
Availability of necessary equipment, specialists, and materials	No equipment, specialists and materials are identified for this alternative.	Equipment, specialists and materials are readily available.	Equipment, specialists and materials are readily available.

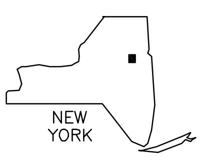
Table 5-1
Detailed Analysis of Remedial Alternatives
General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Ft Edward, New York
Feasibility Study Report

Criterion	Alternative 1 - No further action	Alternative 2 - Monitoring and Institutional Controls	Alternative 3 - Continued DNAPL Collection, Monitoring and Institutional Controls
	● No further action	● Institutional Controls - Notice of environmental conditions, site management plan, periodic reviews. ● Monitoring - DNAPL, groundwater and surface water monitoring ● Natural attenuation of residual DNAPL	● Institutional Controls - Notice of environmental conditions, site management plan, periodic reviews. ● Monitoring - DNAPL, groundwater and surface water monitoring ● Continued DNAPL collection from shallow and deep bedrock ● Disposal - Off-site disposal of recovered DNAPL, treatment of recovered groundwater at Ft Edward WWTP ● Natural attenuation of residual DNAPL
Costs			
Capital cost	$0	$210,000	$210,000
Present worth of operation and maintenance cost	$0	$74,000	$94,100
Approximate total net present worth cost	$0	$1,145,000	$1,378,000
Land Use			
Evaluation of land use factors	No actions are included in Alternative 1.	Alternative 2 results in the ability to use the property consistent with current, intended and reasonably anticipated future use of the off-site areas.	Alternative 3 results in the ability to use the property consistent with current, intended and reasonably anticipated future use of the off-site areas.

Notes:
DNAPL - Dense non-aqueous product liquids
NYSDEC - New York State Department of Environmental Conservation
OSHA - Occupational Safety and Health Administration
PCB - Polychlorinated biphenyl
RAO - Remedial Action Objective
SCGs - Standards, Criteria and Guidance
USEPA - United States Environmental Protection Agency

FIGURE 1-1





ADAPTED FROM: HUDSON FALLS QUADRANGLE, NEW YORK STATE U.S.G.S. 7.5 MIN. QUAD

GENERAL ELECTRIC COMPANY
FORT EDWARD PLANT OU-5, FORMER 004 OUTFALL
FORT EDWARD, NEW YORK

SITE LOCATION MAP

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 5 0 1 KILOMETER

SCALE: 1:24000

FILE NO. 612.50647-FIG1-1
JANUARY 2014

O'BRIEN & GERE

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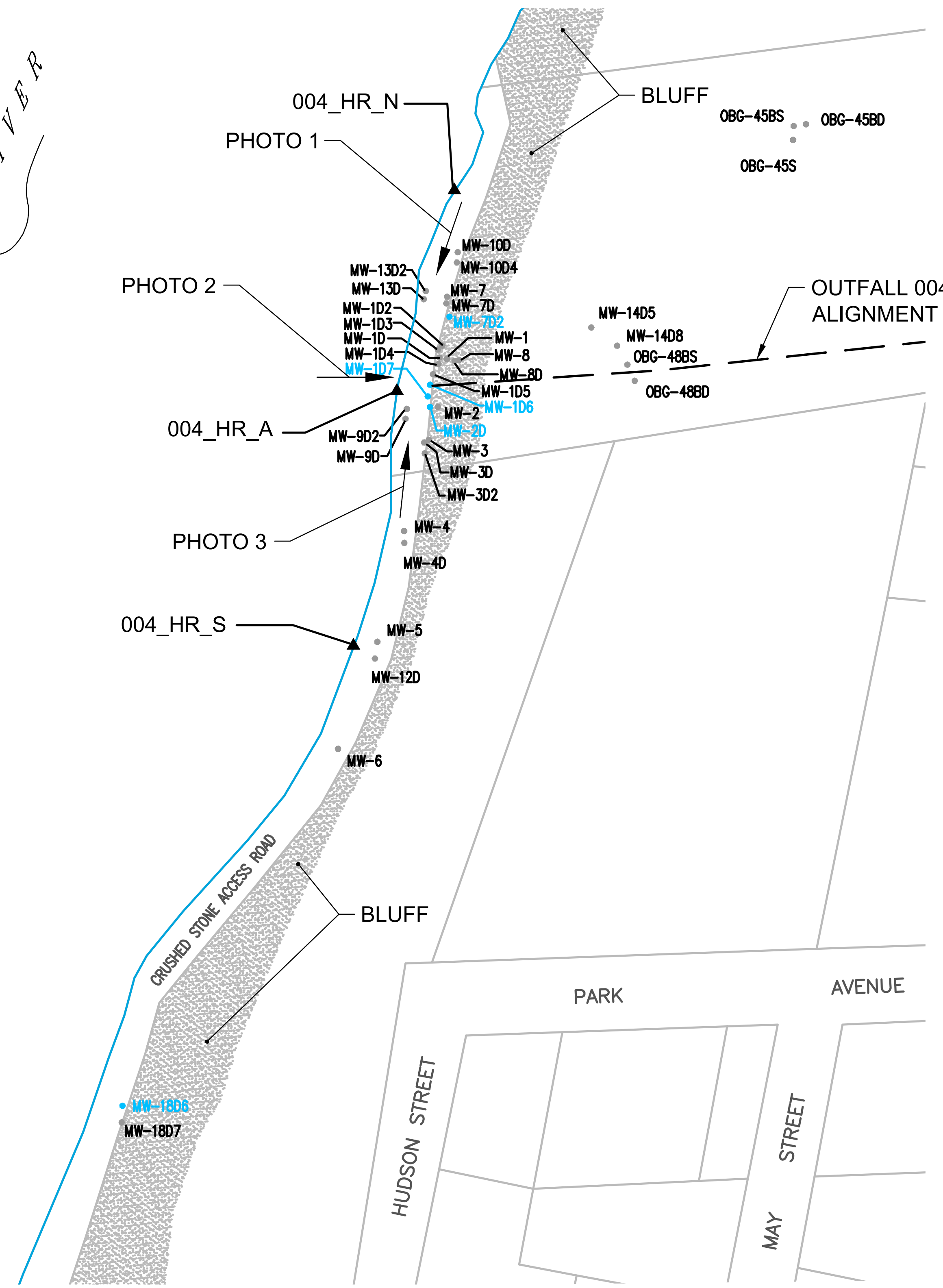

PHOTO 1 - ACCESS ROAD VIEWING SOUTH

PHOTO 2 - FORMER 004 OUTFALL

PHOTO 3 - ACCESS ROAD VIEWING NORTH

FIGURE 1-2

LEGEND

MW-18D7 • MONITORING WELL LOCATION

MW-1D7 • DNAPL COLLECTION WELL (2013)

004_HR_A ▲ SURFACE WATER SAMPLING LOCATION

THIS FIGURE DEVELOPED IN COLOR. REPRODUCTION IN BLACK AND WHITE MAY NOT REPRESENT DATA AS INTENDED.

GENERAL ELECTRIC COMPANY
FORT EDWARD PLANT OU-5,
FORMER 004 OUTFALL
FORT EDWARD, NEW YORK

SITE PLAN

1"=120' 120 0 120

FILE NO. 612.51119-FIG1-2
JANUARY 2014

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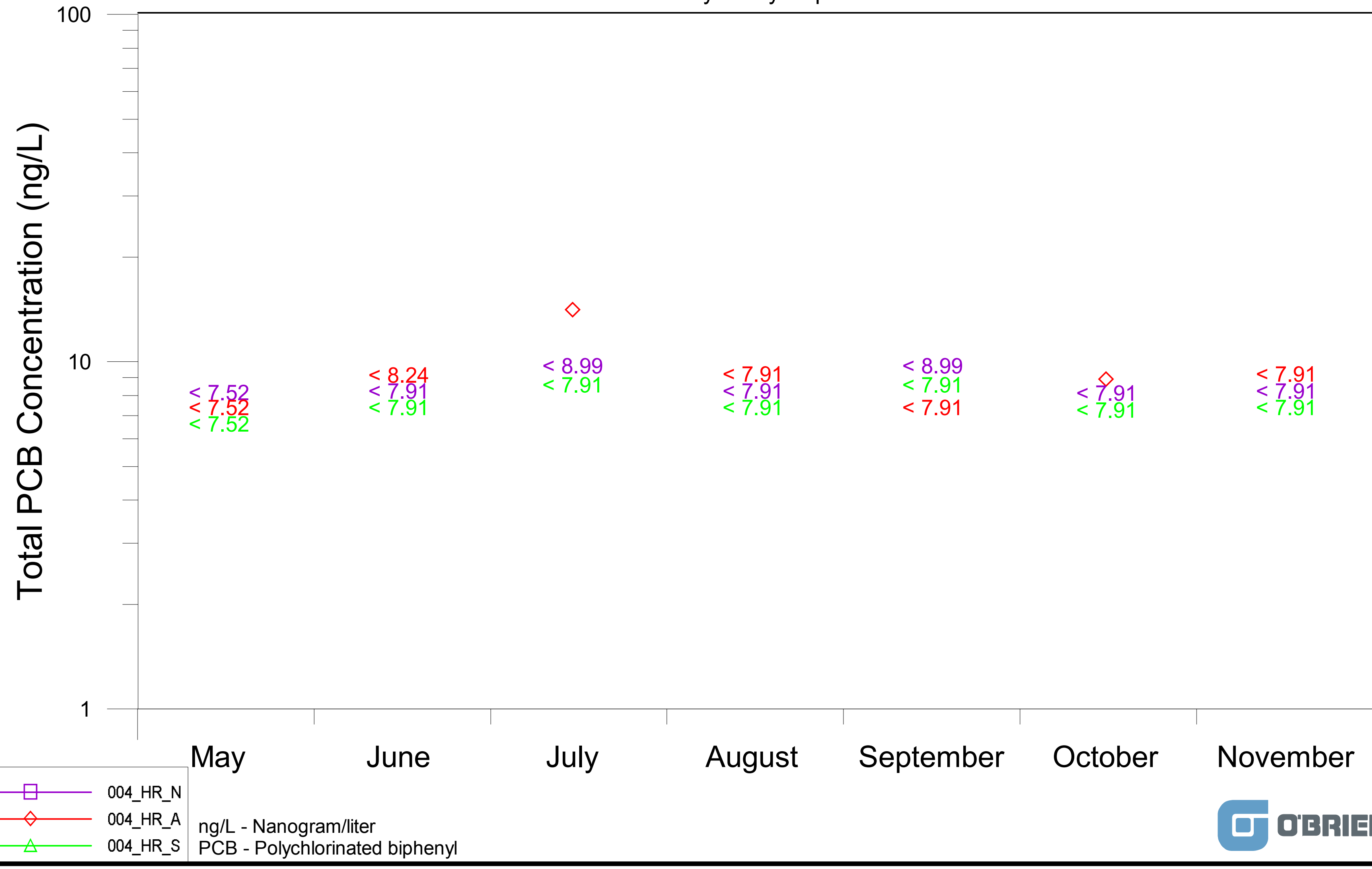
Figure 1-3
2013 Surface Water Sample Results

General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report



ng/L - Nanogram/liter
PCB - Polychlorinated biphenyl

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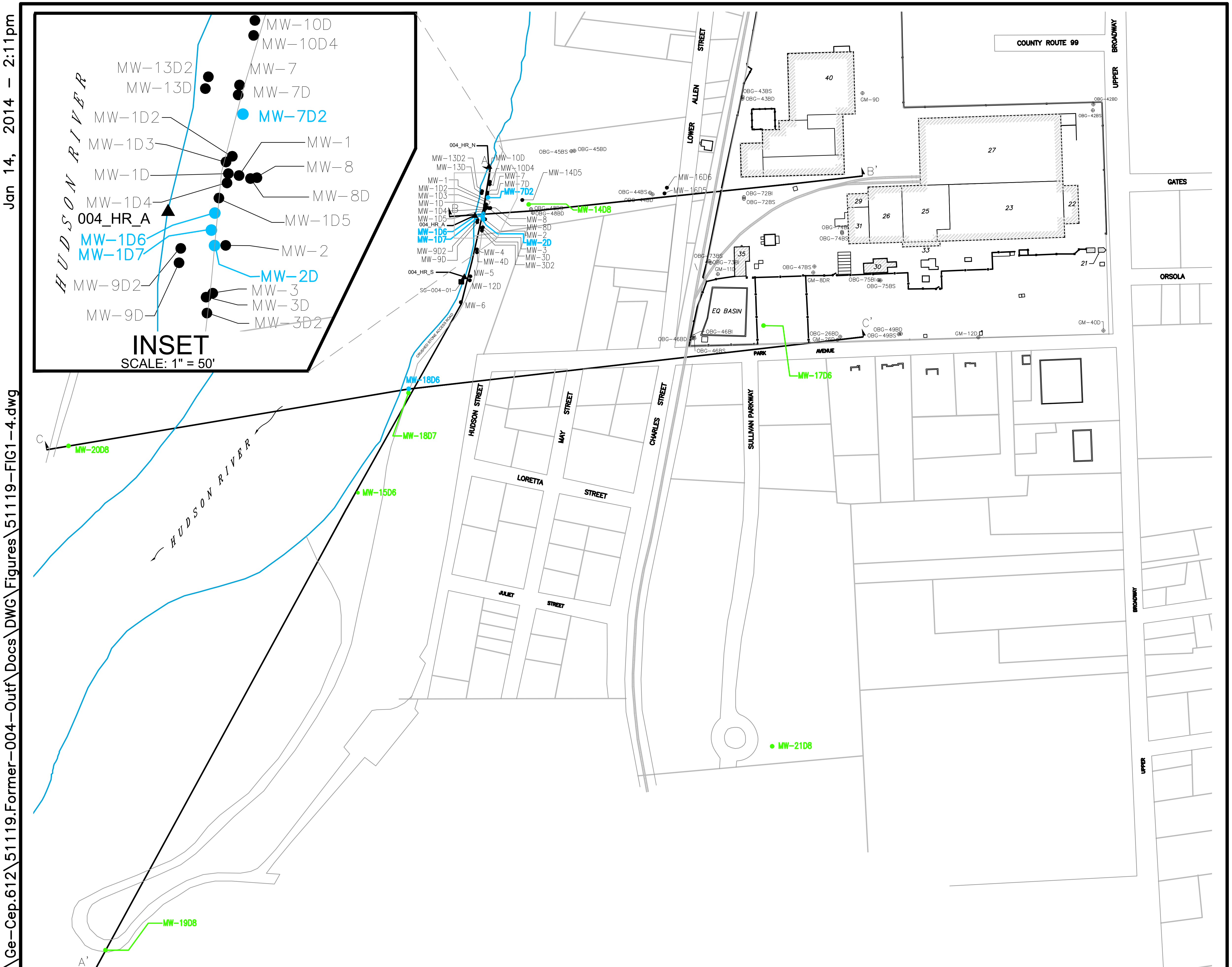
FIGURE 1-4



EXPLANATION

- MW-16D6 — FORMER 004 OUTFALL MONITORING WELL
- MW-2D — DNAPL RECOVERY WELL (2013)
- MW-14D8 — MONITORING WELL SAMPLED FOR GROUNDWATER (2013)
- SG-004-01 — FORMER 004 OUTFALL STAFF GAUGE
- A — A' — LINE OF SECTION
- 004_HR_S ▲ — SURFACE WATER SAMPLING LOCATION

THIS FIGURE DEVELOPED IN COLOR. REPRODUCTION IN BLACK AND WHITE MAY NOT REPRESENT DATA AS INTENDED.

NOTES:

1. ALL LOCATIONS ARE APPROXIMATE.
2. SECTION LINES INTERPRETED FROM TETRA TECH GEO. 2012. REMEDIAL INVESTIGATION REPORT - FORMER 004 OUTFALL - OU-5. FIGURE 7-2. DECEMBER 21, 2012.
3. CORRESPONDING CROSS-SECTIONS PRESENTED IN EXHIBIT A.

GENERAL ELECTRIC COMPANY
FORT EDWARD PLANT OU-5,
FORMER 004 OUTFALL
FORT EDWARD, NEW YORK

LOWER SNAKE HILL SHALE/ GLENNS FALLS LIMESTONE MONITORING WELL LOCATION MAP

1"=300' 300 0 300

FILE NO. 612.51119-FIG1-4
JANUARY 2014

O'BRIEN & GERE

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Figure 1-5
2013 DNAPL Recovery Quantities

General Electric Company
Fort Edward Plant OU-5
Former 004 Outfall
Fort Edward, New York
Feasibility Study Report

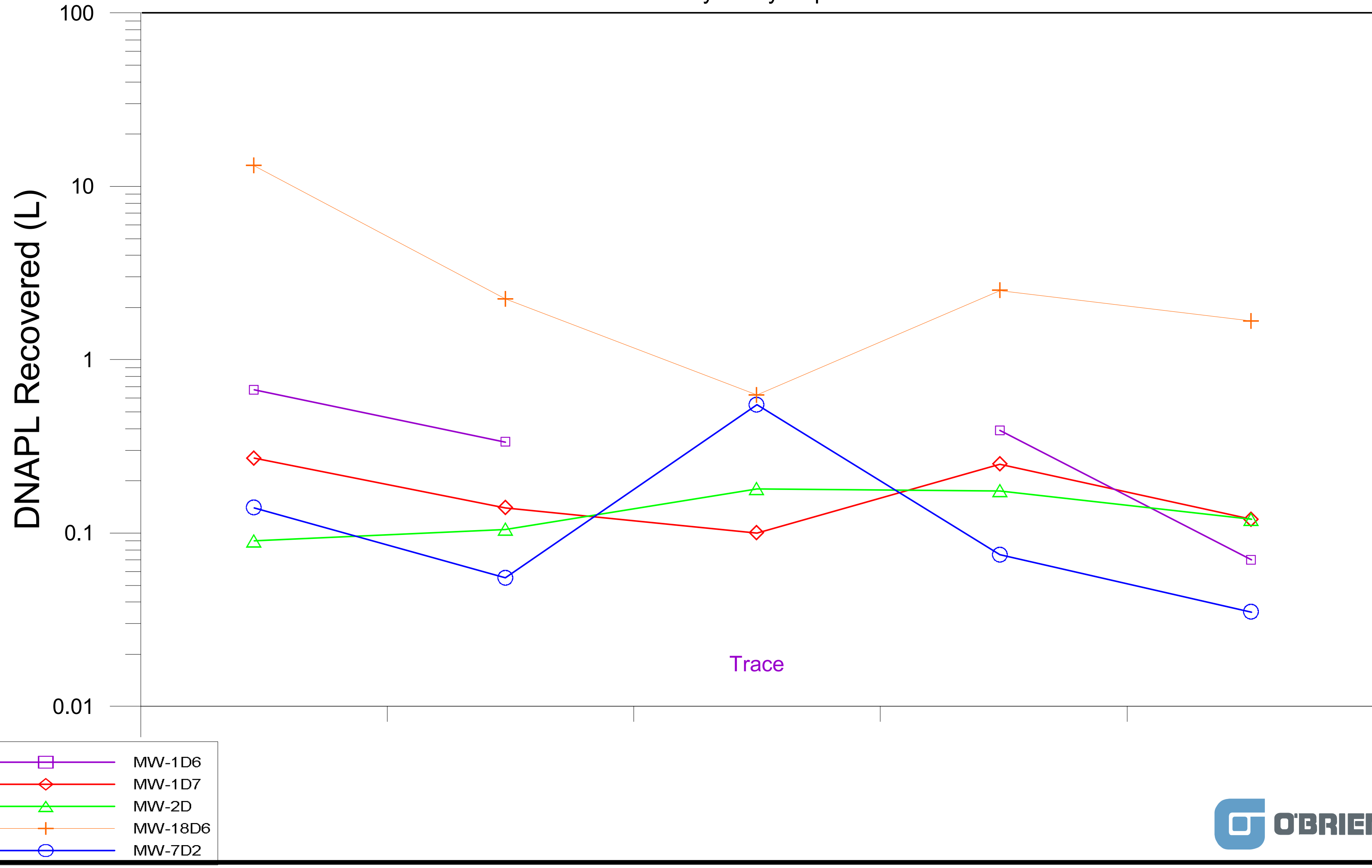

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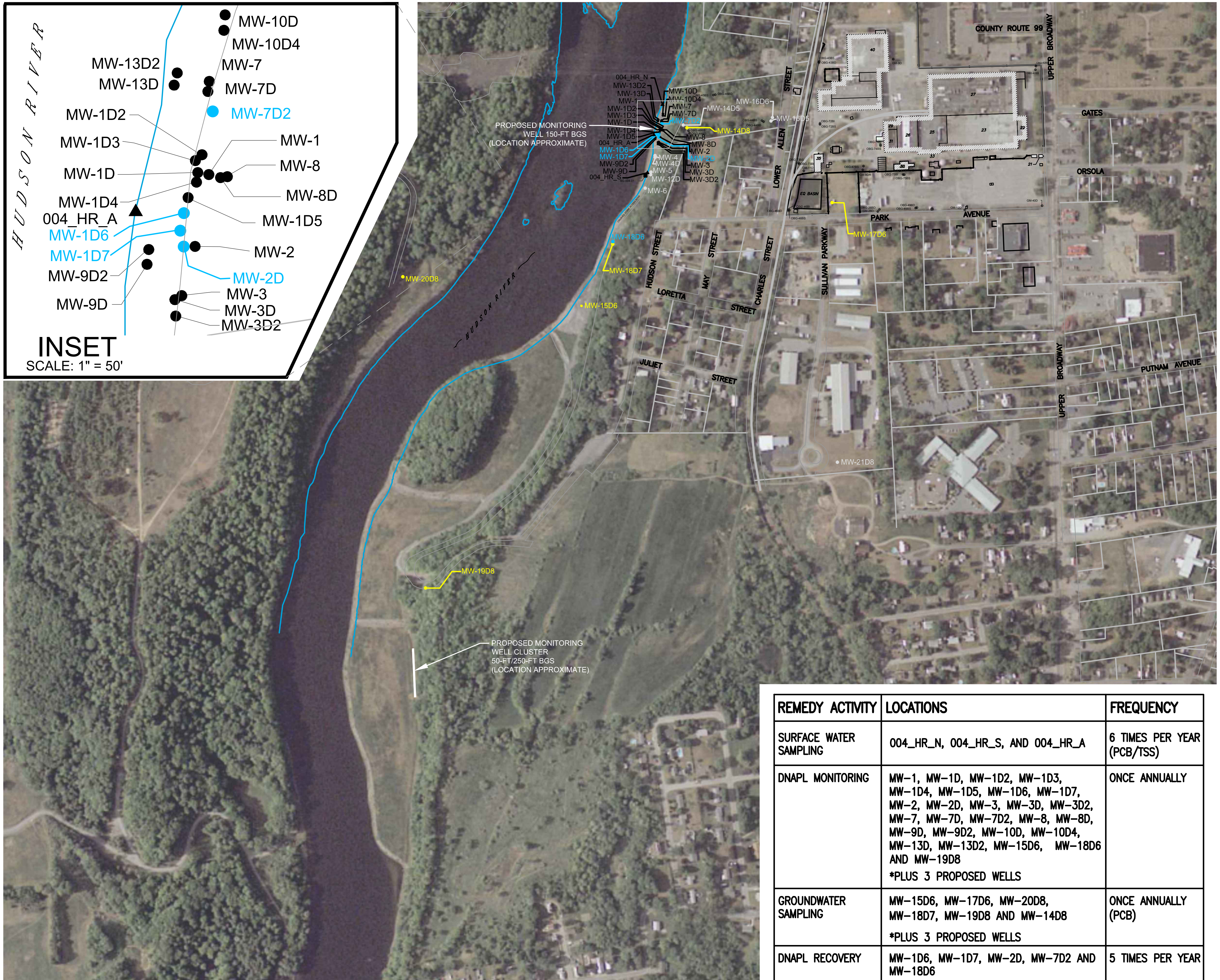
FIGURE 6-1



REMEDY ACTIVITY	LOCATIONS	FREQUENCY
SURFACE WATER SAMPLING	004_HR_N, 004_HR_S, AND 004_HR_A	6 TIMES PER YEAR (PCB/TSS)
DNAPL MONITORING	MW-1, MW-1D, MW-1D2, MW-1D3, MW-1D4, MW-1D5, MW-1D6, MW-1D7, MW-2, MW-2D, MW-3, MW-3D, MW-3D2, MW-7, MW-7D, MW-7D2, MW-8, MW-8D, MW-9D, MW-9D2, MW-10D, MW-10D4, MW-13D, MW-13D2, MW-15D6, MW-18D6 AND MW-19D8 *PLUS 3 PROPOSED WELLS	ONCE ANNUALLY
GROUNDWATER SAMPLING	MW-15D6, MW-17D6, MW-20D8, MW-18D7, MW-19D8 AND MW-14D8 *PLUS 3 PROPOSED WELLS	ONCE ANNUALLY (PCB)
DNAPL RECOVERY	MW-1D6, MW-1D7, MW-2D, MW-7D2 AND MW-18D6	5 TIMES PER YEAR

EXPLANATION

- ● MW-1D2 — GROUNDWATER LEVEL AND DNAPL MONITORING WELLS
- ● MW-2D — DNAPL RECOVERY WELL
- ● MW-16D6 — GROUNDWATER SAMPLING WELL
- ● MW-14D8 — GROUNDWATER LEVEL MONITORING WELLS
- 004_HR_S ▲ — SURFACE WATER SAMPLING LOCATION

THIS FIGURE DEVELOPED IN COLOR. REPRODUCTION IN BLACK AND WHITE MAY NOT REPRESENT DATA AS INTENDED.

NOTES:
1. ALL LOCATIONS ARE APPROXIMATE.
2. DNAPL RECOVERY AND GROUNDWATER SAMPLING WELLS WILL ALSO BE MONITORED FOR DNAPL AND GROUNDWATER LEVEL.

GENERAL ELECTRIC COMPANY
FORT EDWARD PLANT OU-5,
FORMER 004 OUTFALL
FORT EDWARD, NEW YORK

LOWER SNAKE HILL SHALE/
GLENNS FALLS LIMESTONE
RECOMMENDED REMEDY

1"=500' — 500 0 500

FILE NO. 612.51119-FIG6-1
JANUARY 2014

O'BRIEN & GERE

Fish and Wildlife Resource Impact Assessment

FINAL REPORT

Fish and Wildlife Resources Impact Analysis GE Fort Edward Plant OU-5 (Former 004 Outfall)

General Electric Company
Albany, New York

January 2014

O'BRIEN & GERE

612 | 51119

Fish and Wildlife Resources Impact Analysis GE Fort Edward Plant OU-5 (Former 004 Outfall)

Prepared for:
General Electric Company
Albany, New York

WILLIAM A. SCHEW, PHD., VICE PRESIDENT
O'Brien & Gere Engineers, Inc.

TABLE OF CONTENTS

TABLE OF CONTENTS i
List of Tables ii
List of Figures ii
List of Appendices ii
List of Acronyms ii
1. Introduction 1
1.1 Report Organization 1
2. Site And Study Area Description 2
2.1 Site Description 2
2.1.1 Conceptual Site Model 2
2.2 Description of Fish and Wildlife Resources 3
2.2.1 Study Area Vegetative Covertypes 3
2.2.2 Study Area Terrestrial Covertypes 3
2.2.3 Study Area Aquatic and Palustrine Covertypes 4
2.2.4 Site and Off-Site Study Area Fauna 5
2.2.5 Other Physical Resources 6
2.2.6 Observations of Stress 7
2.3 Description of Fish and Wildlife Resource Value 7
2.3.1 Value of Habitat to Associated Fauna 7
2.3.2 Value of Resources to Humans 9
2.4 Potentially Applicable Fish and Wildlife Regulatory Criteria 9
2.4.1 Site-specific FWRC 9
2.4.2 Chemical-specific FWRC 10
3. Contaminant-Specific Impact Assessment 11
3.1 Potential Pathways 11
3.1.1 Terrestrial Exposure Pathway 11
3.1.2 Groundwater Exposure Pathway 11
3.1.3 Aquatic Habitat - Surface Water Exposure Pathway 11
3.2 Criteria Specific Analysis 12
3.2.1 Surface Water Screening Results (2010-2012) 12
3.2.2 Surface Water Sampling Results (2013) 12
4. Summary and Conclusions 13
5. References 14

LIST OF TABLES

1 Potential Wildlife Associated with Study Area Covertypes
2 New York State Breeding Bird Atlas Information for Survey Block Nos. 6079D and 6179C
3 Characteristics of Wetlands within 0.5-Mile Site Radius
4 Potentially Applicable Fish and Wildlife Regulatory Criteria
5A Hudson River 2010 -2012 Surface Water Sample Results –Upstream of Former 004 Outfall
5B Hudson River 2010 -2012 Surface Water Sample Results –At Former 004 Outfall
5C Hudson River 2010 -2012 Surface Water Sample Results –Downstream of Former 004 Outfall
6 Data and Summary and Criteria Comparison of 2013 Hudson River Surface Water Samples

LIST OF FIGURES

1 Site Location
2 Site Plan
3 Study Area Covertypes
4 Natural Resources

LIST OF APPENDICES

A Photograph Log
B New York Natural Heritage Program Correspondence
C U.S. Fish & Wildlife Service Endangered Species Data

LIST OF ACRONYMS

bgs	Below ground surface
BTAG	Biological Technical Assistance Group
CDM	Camp, Dresser & McKee
CFR	Code of Federal Regulations
CSM	Conceptual site model
DNAPL	Dense non-aqueous phase liquid
DER	Division of Environmental Remediation
FS	Feasibility Study
FWIA	Fish and Wildlife Impact Analysis
FWRC	Fish and Wildlife Regulatory Criteria
FWRIA	Fish and Wildlife Resources Impact Analysis
GE	General Electric Company
L	Liters
µg/g	Micrograms per gram
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter

mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
ng/L	Nanograms per liter
NWI	National Wetland Inventory
NYCRR	New York Code of Rules and Regulations
NYNHP	New York Natural Heritage Program
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSFW	New York State Freshwater Wetlands
PCBs	Polychlorinated biphenyls
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

1. INTRODUCTION

This Fish and Wildlife Resources Impact Analysis (FWRIA) report was prepared by O'Brien & Gere Engineers, Inc., (O'Brien & Gere) on behalf of the General Electric Company (GE) for the GE Fort Edward Plant – Operable Unit 05 (OU-5), Former 004 Outfall (the Site), in Fort Edward, New York (Figure 1). The GE Fort Edward Plant is currently listed in the New York State Registry of Inactive Hazardous Waste Disposal Sites (Site No. 5-58-004) as a Class 2 site. The Former 004 Outfall Site consists of dense non-aqueous phase liquid (DNAPL) in bedrock in the vicinity of the Former 004 Outfall, which was the historic wastewater and stormwater discharge point from the GE Fort Edward Plant to the Hudson River.

The FWRIA was conducted pursuant to an Order on Consent (Index No. A5-0521-0705) for GE Fort Edward Plant – OU-05 executed between the New York State Department of Environmental Conservation (NYSDEC) and GE on August 26, 2005 (NYSDEC 2005a). The FWRIA was conducted pursuant to the NYSDEC-approved *Remedial Investigation/Feasibility Study (RI/FS) Project Work Plan for GE Fort Edward Plant OU-5 (RI/FS Work Plan)* prepared by Camp, Dresser & McKee (CDM) (CDM 2007) and incorporated into the Order on Consent. This report is included as part of the *Feasibility Study (FS) Report* developed by O'Brien & Gere (O'Brien & Gere 2014) for the Site.

The FWRIA was performed in accordance with NYSDEC DER-10 entitled Technical Guidance for Site Investigation and Remediation (DER-10) Section 3.10.1 (NYSDEC 2010) and the NYSDEC's Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites (FWIA) guidance document (NYSDEC 1994). Specifically, this report presents the results of Part 1- Resource Characterization of NYSDEC's DER-10 (Section 3.10.1) and Step IIB (Contaminant-Specific Impact Analysis) of the FWIA guidance (NYSDEC 1994). The objective of Part 1 – Resource Characterization is to describe the Site and study area in terms of topography, vegetative covertypes, drainage, fish and wildlife resources and value, and to identify actual or potential impacts to the identified fish and wildlife resources from potential exposure to Site-related constituents.

1.1 REPORT ORGANIZATION

This FWRIA Report contains the following additional sections:

Section 2 - Site Description. This section presents a conceptual model of the Site, a description of the natural communities of the Site and vicinity and identifies potential ecological receptors. This section also discusses resources other than wildlife that exist in the Site vicinity, such as documented significant habitats, rare, threatened, or endangered species, surface waters, and freshwater wetlands.

Section 3 – Contaminant-Specific Impact Analysis. This section presents an analysis of Site-related constituents and potential pathways of contaminant migration to potential ecological receptors at or in the vicinity of the Site. In this analysis, Site-specific contaminant levels that have been established for specific media are compared to numerical criteria to assess the potential ecological impacts.

Section 4 – Conclusions. This section presents the assessment conclusions and recommendations for further study based on the findings of the FWRIA.

Section 5 – References. This section provides citations for the literature and information sources used in completion of this report.

Tables, figures, and appendices are included to provide information that supports the FWRIA.

2. SITE AND STUDY AREA DESCRIPTION

This section provides descriptions of the physical and biological components of the Site and study area. The objective of FWRIA Part 1 is to identify the natural resources and ecological covertypes of the study area, associate wildlife species with the covertypes, and evaluate the ability of the covertypes to provide the habitat components required by the identified wildlife species.

In accordance with the FWRIA guidance, the study area is defined as the Site and areas surrounding within a one-half mile radius of the Site. Ecological covertypes (vegetative communities) present within the one-half mile radius are described herein. Also, major natural resources that exist within a one-half mile radius of the Site are described. Major natural resources include, but are not limited to, regulated wetlands, streams, lakes endangered species habitat and/or rare natural communities.

2.1 SITE DESCRIPTION

The Site is situated within the Town of Fort Edward, Washington County, New York. Today the Site (Former 004 Outfall location) consists of a flat narrow river bank along the eastern edge of the Hudson River that serves as a gravel access road to reach monitoring wells associated with investigations in this area. The gravel access road is placed over shale bedrock adjacent to the river edge. The gravel access road and monitoring wells are inundated by the river on occasion. Immediately to the east, the shale bluff rises to approximately 130 feet (ft) above river level. Immediately west of the access road is the Hudson River. There is little or no soil present in this area.

Prior to 1976, the Former 004 Outfall was used for discharge of untreated industrial wastewater and storm water from the GE Fort Edward Plant. Prior to 1973, the Former 004 Outfall discharged below the surface of the Hudson River into the pool behind the Fort Edward Dam. The Fort Edward Dam was located approximately 7,000 ft downstream of the Former 004 Outfall. The dam was intentionally breached in 1973, consequently draining the pool. Between 1973 and 1976 the Former 004 Outfall discharged above the river level. In 1976 discharge of untreated wastewater ceased and wastewater was directed to the newly constructed wastewater treatment plant at the GE Fort Edward Plant (TetraTech Geo and JG Environmental 2012). The Former 004 Outfall pipe was removed in 1996 (O'Brien & Gere 1996). Figure 2 presents a Site Plan and Appendix A presents representative photographs of the Site area.

2.1.1 Conceptual Site Model

A conceptual site model (CSM) was developed for the Site based on qualitative and quantitative data collected by GE between 2004 and 2012 and used in preparation of the *Remedial Investigation Report* (Tetra Tech Geo and JG Environmental 2012), as well as additional monthly surface water monitoring data that has been collected since May 2013.

Historic discharges from the GE Fort Edward Plant through the Former 004 Outfall have resulted in an area of discontinuous polychlorinated biphenyls (PCB)-containing DNAPL present in the fractured Snake Hill Shale formation beneath the Former 004 Outfall along the shore of the Hudson River. Evidence of discontinuous DNAPL occurrence was found to a depth of 270 ft below the Hudson River and at a distance of 600 ft south of the location of the Former 004 Outfall. DNAPL was not observed in bedrock east of the river bank area or on the west side of the Hudson River. DNAPL in Site bedrock is primarily present at residual saturation, and thus, is generally considered not mobile. DNAPL has only been demonstrated to be recoverable at isolated locations, and DNAPL recovery rates have been declining.

Groundwater flow in the Snake Hill Shale in the vicinity of the Former 004 Outfall is generally westerly toward the Hudson River (see Exhibits A-1 and A-2 of the FS Report (O'Brien & Gere 2014)). In close proximity to the river, there is predominantly vertically upward flow from the bedrock toward the Hudson River. While there is a potential for migration of shallow DNAPL in the bedrock at or above the elevation of the bottom of the river, it is unlikely that DNAPL present in deeper bedrock has the potential to migrate to the river. Infrequent detections of PCB concentrations in the surface water samples in the river are an indication that migration of the DNAPL in the bedrock, if any, to the Hudson River is minimal.

2.2 DESCRIPTION OF FISH AND WILDLIFE RESOURCES

Consistent with the FWRIA guidance (NYSDEC 2010 and 1994), fish and wildlife resources have been identified in the vicinity of the Site. Major vegetative communities (covertypes) have been identified on and within a one-half mile radius of the Site, defined as the *study area* (Figure 3), and major natural resources have been identified within a one-half mile radius of the Site (Figure 4). The identified covertypes and fish and wildlife resources are described in the following sections.

2.2.1 Study Area Vegetative Covertypes

Vegetative covertypes present on and within a one-half mile radius of the Site (study area) were identified during field investigatory activities conducted on October 28, 2013 and from available aerial photographs of the Site area (see Figure 3). A covertype is defined as an area characterized by a distinct pattern of natural or cultural land use (Edinger *et al.* 2002). Covertype designations were applied to the study area based primarily on the dominant vegetation observed during field investigations. Covertype designations follow the ecological community descriptions presented in the New York Natural Heritage Program (NYNHP) document *Ecological Communities of New York State, Second Edition* (Draft) (Edinger *et al.* 2002). A description of each identified covertype, below, includes a list of the dominant woody and herbaceous plant species that were observed. Not all areas within the study area were accessible for direct observation during the study area investigation due to access restrictions (*e.g.,* fencing, limited public access).

The study area covertypes identified on Figure 3 consist of *natural* and *cultural* terrestrial, wetland and aquatic communities. The *cultural* designation reflects the extent of human disturbance to the study area for land uses such as residences, parks, roadways, and industrial areas. The identified covertypes have a secure global and state ranking, meaning they are not rare ecological communities requiring preservation (Edinger *et al.* 2002). Below are descriptions of the covertypes identified within the study area.

2.2.2 Study Area Terrestrial Covertypes

The majority of the upland ecological communities associated with the Site and vicinity are considered *terrestrial cultural* covertypes, as described in Edinger *et al.* (2002). Residential and commercial development has eliminated much of the natural habitat to the east of the Hudson River and has replaced it with urban wildlife habitats consisting primarily of mowed lawns, paved roads, parking lots, and urban structure exteriors. The *urban structure exterior* covertype is characterized by the exterior surfaces of structures such as commercial buildings, houses, apartment buildings, barns, and bridges in an urban or densely and sparsely populated suburban area (Edinger *et al.* 2002). This covertype is present primarily at areas to the east and south of the Site. This covertype is associated with sub-communities typical of the *paved* and *unpaved road/path*, and *mowed lawn with trees* covertypes. Included in this covertype are paved parking lots. Areas associated with the Former 004 Outfall location are identified as *unpaved road/path* communities. These areas are considered *cultural* covertypes by Edinger *et al.* (2002) since they provide habitat for urban wildlife. Some *natural* covertypes also exist in the study area. The terrestrial covertypes identified within the study area are described below.

Off-Site Study Area

Beech-maple Mesic Forest

Forested areas were observed above the Former 004 Outfall Site, on the western portion of the study area (across the Hudson River from the Site), and southeast of the Former 004 Outfall area (see Figure 3). Based on observations, these areas contain a mixture of hardwood tree species and are classified as a *beech-maple mesic forest* community (Figure 3). Dominant canopy species typically observed for this covertype consist of sugar maple (*Acer saccharum*) and beech (*Fagus grandifolia*) (Edinger *et al.* 2002). Supporting tree species commonly identified in this community include yellow birch (*Betula alleghaniensis*), white ash (*Fraxinus americana*), eastern hop hornbeam (*Ostrya virginiana*), and red maple (*Acer rubrum*) (Edinger *et al.* 2002). Although there are generally few shrub and herbaceous species present in this community, characteristic shrubs and herbs that may be observed include American hornbeam (*Carpinus caroliniana*), striped maple (*Acer pensylvanicum),* common wood-sorrel (*Oxalis montana*), and trillium species (*Trillium spp.*) (Edinger *et al.* 2002).

Successional Old Field

An area of *successional old field* was identified southeast of the Former 004 Outfall Site (Figure 3). According to Edinger *et al.* (2002), successional old field is a meadow dominated by forbs and grasses that occurs on sites that have been cleared and plowed at some point and then left unattended. Common herbaceous species observed in the *successional old field* include goldenrods (*Solidago altissima, S. nemoralis, S. canadensis, S. rugosa, S. juncea*, and *Euthamia graminifolia*), bluegrasses (*Poa pratensis, P. compressa*), timothy (*Phleum pretense*), Queen Anne's-lace (*Daucus carota*), ragweed (*Ambrosia artemisiifolia*), hawkweeds (*Hieracium spp*.), and asters (*Symphyotrichum spp*.)(Edinger *et al.* 2002). Characteristic shrubs that may occur include dogwoods (*Cornus spp*.), arrowwood (*Viburnum recognitum*), raspberries (*Rubus spp*.), sumac (*Rhus spp*.), and eastern red cedar (*Juniperus virginiana)* (Edinger *et al.* 2002).

Urban Structure Exterior and Mowed Lawn with Trees

A majority of the eastern portion of the study area (Figure 3) is represented by the *urban structure exterior* covertype which is characterized by the exterior surfaces of structures such as commercial buildings, houses, apartment buildings, and bridges in an urban or densely populated suburban areas (Edinger *et al.* 2002). This covertype is associated with sub-communities typical of the *paved* and *unpaved road/path* covertypes, which includes paved parking lots (Edinger *et al.* 2002).

Mowed Lawn

Site 3 of the Fort Edward PCB Remnants Deposits is located directly downstream from the Site along the eastern river bank. Site 3 of the PCB Remnants Deposits is an approximately 17-acre sediment consolidation area. The area has a maintained, vegetated, engineered clay cover. This area is identified as a *mowed lawn* covertype (Figure 3). The gravel access road that services both the Site and the PCB Remnant Site is not accessible to the public and is solely used to access these areas by GE and personnel conducting monitoring and maintenance field activities. According to Edinger *et al.* (2002), mowed lawn communities are dominated by grasses with less than 30% cover of trees, and the groundcover is maintained by mowing.

Mowed Lawn with Trees

An area of *mowed lawn with trees* was identified across the river from the Site on the southwestern side of the study area (Figure 4). According to Edinger *et al.* (2002), mowed lawn communities are dominated by grasses and forbs with at least 30% tree cover, and the groundcover is maintained by mowing.

Unpaved Road/Path

A gravel access road to reach Site monitoring wells was observed along the eastern edge of the Hudson River. A characteristic plant identified for this covertype is path rush (*Juncus tenuis*) (Edinger *et al.* 2002).

2.2.3 Study Area Aquatic and Palustrine Covertypes

Aquatic and palustrine (wetland) covertypes identified in the study area are described in this section. The Hudson River is the primary aquatic resource present in the vicinity of the Site and is located adjacent to (west of) the Site. No aquatic or palustrine habitats were identified on the Site.

Off-Site Study Area

Unconfined River

The portion of the Hudson River within the study area, immediately west of the Site and located between Glens Falls and the Troy Dam, is classified as an *unconfined river* community (Figure 3). An *unconfined river* covertype is a community of large, quiet, base level sections of stream with very low gradient (Edinger *et al*. 2002). The Hudson River flows south within the study area and is approximately 420 ft wide (average) at the Site location. This portion of the river is likely used for recreation (*i.e.,* boating, fishing, etc.).

Marsh Headwater Stream

An unnamed tributary on the western side of the Hudson River (Figure 3) flows into the river northwest of the Site. According to Edinger *et al*. (2002), this stream is a *marsh headwater stream* community as it originates from a marsh, fen, or swamp (National Wetlands Inventory (NWI) wetlands PFO1/4E and PSS1E). A *marsh headwater stream* is characteristically a marshy perennial brook with low gradient, slow flow rate, and cool to warm water which flows through a wetland habitat at its origin (Edinger *et al*. 2002).

Intermittent Stream
An unnamed tributary on the western side of the Hudson River (Figure 3) flows into the river southwest of the Former 004 Outfall location. An *intermittent stream* community is often a streambed with moderate to steep gradient where water flows only during the spring or after a heavy rain (Edinger *et al*. 2002).

Floodplain Forest
Floodplain forest communities were observed along the eastern and western banks of the Hudson River (Figure 3). A *floodplain forest* community is a hardwood forest that occurs on low terraces of river floodplains or deltas (Edinger *et al*. 2002). Common species observed in this community include red maple, silver maple (*A. saccharinum*), ashes, American elm (*Ulmus americana*), slippery elm (*Ulmus rubra*), eastern cottonwood (*Populus deltoides*), American sycamore (*Platanus occidentalis*), river birch (*Betula nigra*), and box-elder (*Acer negundo*) (Edinger *et al*. 2002).

Shrub Swamp
Two small areas of *shrub swamp* were observed north of the Site in the middle of the Hudson River. *Shrub swamp* communities typically are dominated by tall shrubs such as dogwoods, alders (*Alnus incana and A. serrlata*), and arrowwood (*Viburnum recognitum*), and occur along the shores of lakes and rivers (Edinger *et al*. 2002).

2.2.4 Site and Off-Site Study Area Fauna

The presence of fish and wildlife in the study area was evaluated from reconnaissance observations, contact with regulatory agencies, and literature review. During the Site and study area reconnaissance performed by O'Brien & Gere, very few wildlife species were identified based on actual sightings or other indicators (*e.g.*, tracks, burrows, scat, *etc*.); however, songbirds were heard vocalizing and seen flying transient to the Site area and waterfowl were observed on the river upstream of the Site, but species identification was not determined. No wildlife was observed on the Site.

Lists of avian, mammalian, amphibious, and reptilian wildlife species potentially inhabiting the identified covertypes of the study area are presented in Table 1 as referenced from *Integrating Timber and Wildlife Management* (Chambers 1983), Edinger *et al.* (2002), and the *New York State Herp Atlas Project* (NYSDEC 2007). Table 2 presents a list of potential breeding bird species recorded from the study area as part of the NYS Breeding Bird Atlas (NYSDEC 2005b).

Study Area – Typical Fauna

Beech-maple Mesic Forest
Terrestrial mammals expected to utilize this covertype in the study area are similar to what is expected in the *Appalachian oak-pine forest* and include white-tailed deer (*Odocoileus virginianus*), eastern gray squirrel (*Sciurus carolinensis*), and raccoon (*Procyon lotor*) (Chambers 1983). Typical birds in this community include American redstart (*Setophaga ruticilla*), red-eyed vireo (*Vireo olivaceus*), ovenbird (*Seiurus aurocapillus*), black-throated blue warbler (*Dendroica caerulescens*), least flycatcher (*Empidonax minimus*), Acadian flycatcher (*Empidonax virescens*), and red-bellied woodpecker (*Melanerpes carolinus*) (Edinger *et al.* 2002).

Successional Old Field
According to Edinger *et al.* (2002), the field sparrow (*Spizella pusilla*) is a bird species commonly found in a *successional old field* community. Terrestrial mammals expected to utilize this covertype in the study area are similar to what is expected in *early stage forest growth* covertype in Chambers (1983) which includes meadow vole (*Microtus pennsylvanicus*), eastern cottontail (*Sylvilagus floridanus*) and woodchuck (*Marmota monax*) (Chambers 1983).

Urban Structure Exterior and Mowed Lawn/Mowed Lawn with Trees
Wildlife commonly found in these covertypes include gray squirrel (*Sciurus carolinensis*), common nighthawk (*Chordeiles minor*), American robin (*Turdus migratorius*), rock pigeon (*Columba livia*), killdeer (*Charadrius vociferus*), house sparrow (*Passer domesticus*) mourning dove (*Zenaida macroura*), and mockingbird (*Mimus polyglottos*) (Edinger *et al.* 2002).

Unconfined River
Fish species commonly found in this habitat, based on information presented in Edinger *et al.* (2002), include redhorses (*Moxostoma spp.*), northern pike (*Esox lucius*), pickerel (*E. americanus*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieu*), brown bullhead (*Ameriurus nebulosus*), and white sucker (*Catostomus commersoni*). Multiple piscivorous (fish-eating) animals may potentially frequent this river community to forage, *e.g.*, mink (*Mustela vison*) and great blue heron (*Ardea herodias*).

Marsh Headwater Stream
Fish species expected to utilize this habitat, based on information presented in Edinger *et al.* (2002), include fathead minnow (*Pimephales promelas*), northern redbelly dace (*Phoxinus eos*), golden shiner (*Notemigonus crysoleucas*), central mudminnow (*Umbra limi*), pumpkinseed, white sucker, longnose sucker (*C. catastomus*), brown bullhead, bluntnose minnow (*Pimephales notatus*), brook trout (*Salvelinus fontinalis*), and longnose dace (*Rhinichthys cataractae*). A characteristic mammal that may frequent this stream community includes a beaver (*Castor canadensis*) (Edinger *et al.* 2002).

Intermittent Stream
Based on information presented in Edinger *et al.* (2002), animal species expected to utilize an *intermittent stream* community include amphibians such as the green frog (*Rana clamitans*) and macroinvertebrates (*i.e.,* mayflies, caddiflies, stoneflies, midges, blackflies, crayfish) (Edinger *et al.* 2002).

Floodplain Forest
Characteristic birds found in *floodplain forest* communities include, yellow-throated vireo (*Vireo flavifrons*), tufted titmouse (*Parus bicolor*), red-bellied woodpecker, and pileated woodpecker (*Dryocopus pileatus*) (Edinger *et al.* 2002). Terrestrial mammals expected to utilize the floodplain forest include white-tailed deer, eastern cottontail rabbit, gray squirrel, and raccoon (Chambers 1983).

Shrub Swamp
Bird species commonly found within this covertype include the common yellow throat (*Geothlypis trichas*), alder flycatcher (*Empidonax alnorum*), and willow flycatcher (*Empidonax traillii*) (Edinger *et al.* 2002).

2.2.5 Other Physical Resources

As presented in the DER-10 guidance (NYSDEC 2010), Section 3.10.1-1i requires the identification of other fish and wildlife resources that may be present within one-half mile of the Site, such as significant wildlife habitats; rare, threatened, or endangered (RTE) species; regulated wetlands; or special surface waters. These resources were identified through contact with regulatory agencies and review of New York State Freshwater Wetlands (NYSFW) and NWI Maps, as discussed below. Figure 4 presents the location of these natural resources in relation to the Site.

Significant Habitats and Rare, Threatened, or Endangered Species
The presence of significant habitats and RTE species within one-half mile of the Site was evaluated through contact with the NYNHP (Appendix B) and a search of the U.S. Fish and Wildlife Service (USFWS) Endangered Species – Ecological Services (IPaC) website (USFWS 2013a; Appendix C).

According to NYNHP's letter response (NYNHP 2013) and the NYSDEC Environmental Resource Mapper (NYSDEC 2013), two historically endangered plant records were identified for this area, the small whorled pogonia (*Isotria medeolodies*) and Hooker's orchid (*Platanthera hookeri*). Small whorled pogonia was last documented in Fort Edward, NY on June 12, 1875 and Hooker's orchid on August 30, 1912. These species were not observed during the Site reconnaissance; although, the Site reconnaissance was conducted after the flowering period for these species. Additionally, Natural Heritage Community Occurrences data (NYSDEC 2009) obtained from the NYSDEC website did not indicate any significant habitats are present on or within one-half mile of the Site. The NYNHP and NYSDEC website also did not identify any surface waters within the study area designated as Wild, Scenic or Recreational in accordance with the Wild, Scenic and Recreational Rivers Act.

A review of the USFWS IPaC website (USFWS 2013a; accessed November 15, 2013) indicated the following species and status potentially occurring within the study area:

- Indiana bat (*Myotis sodalis*) (Population: entire) – endangered
- northern long-eared bat (*Myotis septentrionalis*) (Population: not provided) – proposed endangered.

Results of the associated USFWS IPaC website search (2013a) are provided as Appendix C. No indication of the presence of these species was observed at the Site, and the habitat requirements reported to support them were not observed at the Site. Summer roosting habitat for the Indiana bat (USFWS 2007) and northern long-eared bats (USFWS 2013b) are potentially present in forested communities within the study area. The nearest known hibernaculum to the study area is located in Essex County (USFWS 2007) and is approximately 40 miles north of the study area. Northern long-eared bats often share hibernacula with other bat species, which includes the Indiana bat (WDNR 2013). The Indiana bat typically migrates 35 to 40 miles from hibernacula (USFWS 2007). The study area is at the furthest extent of the migratory range of the Indiana bat and feasibly the northern long-eared bat; therefore, there is a low probability that these bats are present in the suitable study area habitats.

Wetland Habitats

The potential presence of freshwater wetlands within a one-half mile radius of the Site was evaluated through a review of the NYSDEC and USFWS NWI mapped data downloaded from their respective data repositories (NYSDEC 2013, 2001, 1999a, 1999b and USFWS 2013c, 2012). The NYSFW Mapping presents the approximate boundaries of wetlands regulated by the NYSDEC and the NWI Mapping presents approximate boundaries of wetlands inventoried by USFWS to monitor waterfowl habitats. The NWI maps have no regulatory significance but provide an indication of areas potentially meeting the federal wetland criteria for wetlands that are regulated by the U.S. Army Corps of Engineers (USACE). NWI habitats and NYSFWs within one-half mile of the Site are presented on Figure 4 and Table 3. Additional information concerning wetlands is presented in Section 2.4.1.

As presented on Figure 4 and Table 3, twelve types of NWI wetland habitats (20 total mapped wetlands) exist within one-half mile of the Site. There are no state-regulated wetlands mapped in this area. The wetland in closest proximity to the Site are NWI-mapped wetlands designated R2UBH and R3USA which are associated with the Hudson River located immediately west of the Site. Additionally, an apparent stormwater pond is located on the southwest corner of the GE Plant and identified as a PUBHx (palustrine, unconsolidated bottom, permanently flooded, excavated) habitat.

2.2.6 Observations of Stress

Observations of physical or biotic stress (*e.g.,* abnormal fish and wildlife activity, morphology or mortality, reduced vegetative growth or density, stained soils, leachate seeps, or changes in vegetative communities) were recorded, if observed, during the site visit. During the study area reconnaissance, no signs of physical or biotic stress were observed on or in the immediate vicinity of the Site.

2.3 DESCRIPTION OF FISH AND WILDLIFE RESOURCE VALUE

The value of the study area covertypes to wildlife and humans, as described in this section, was qualitatively evaluated based on the habitat requirements of identified wildlife species and potential resource utilization by humans. The habitat requirements considered were feeding preferences, home range, and cover for species identified in the study area. Field observations used to evaluate habitat quality included the diversity of observed wildlife, the availability of suitable habitat on the Site, the size of the habitat, and adjacent land use patterns. A quantitative assessment of the habitat value of the study area was not performed as part of this FWRIA.

2.3.1 Value of Habitat to Associated Fauna

The habitat value for fauna of each covertype at the Site and off-Site study area was evaluated qualitatively based on field observations of physical characteristics. For evaluations of habitat quality of terrestrial covertypes, resident wildlife species requirements for food sources, home range, breeding requirements, and cover were examined and compared to covertype characteristics. Additional information used in the evaluation of habitat quality included: the nature, extent and diversity of observed wildlife; the availability of similar habitats in the immediate vicinity; the size of the habitat; adjacent land use patterns.

Former 004 Outfall Site

The Site (Former 004 Outfall) consists of a flat narrow bank (*unpaved road/path* covertype) along the eastern edge of the Hudson River that serves as a gravel access road to reach monitoring wells associated with investigations in the area of the Former 004 Outfall. Immediately to the east, the shale bluff rises to approximately 130 ft above river level up to a *beech-maple mesic forest* community. Directly downstream of the Site on the same side of the Hudson River, is Site 3 of the Fort Edward PCB Remnants Deposits , which is an approximately 17-acre sediment consolidation area of maintained, vegetated, engineered clay cover. This area is characterized as *mowed lawn* covertype. The open mowed grass, gravel access road, and 130 ft cliff areas provide little cover or food sources for wildlife. However, tree species in the adjacent forested area provide food for various birds and mammals species.

Off-Site Study Area

Beech-maple Mesic Forest/Floodplain Forest
The forested covertypes in the study area represent important habitats for a variety of wildlife species including species that may utilize the Hudson River. The forested covertypes' existence amidst an urban/suburban area and their combined relatively large size makes them a refuge for forest wildlife forced out of nearby developed habitats. The canopy tree species provide abundant food sources for birds as well as mammals such as squirrels and white-tailed deer. Other terrestrial mammals such as rabbit, raccoon, fox, and small rodents would find suitable food and cover in these covertypes. Inundated areas of the floodplain provide suitable habitat for aquatic furbearers and may serve as migratory stopovers and wintering areas for waterfowl.

Successional Old Field
The *successional old field* covertype is represented by a relatively small area within the study area. Despite its size, this covertype provides habitat for various birds and small to medium sized mammals. However, due to its proximity to an urban/suburban area, this covertype's value as a local resource is likely limited.

Shrub Swamp
Similar to the *successional old field* covertype, the *shrub swamp* covertype represents a small portion of the overall Site study area. However, this covertype may provide habitat for a variety of wildlife species, including small mammals, birds and amphibians.

Unconfined River/ Marsh Headwater Stream/ Intermittent Stream
The Hudson River provides aquatic habitat in the study area. However, the presence of commercial development present along its eastern banks decreases its habitat value. Nevertheless, the Hudson River provides the physical requirements of aquatic vegetation, macroinvertebrates, fish and cover sources for other aquatic wildlife. The Hudson River's two unnamed tributaries also contribute aquatic habitat as they drain to the Hudson River on its western bank from within a *beech-maple mesic forest* community. These streams are isolated from the commercial development along the eastern banks of the river and provide the physical requirements mentioned above to support aquatic wildlife.

Fish in the Hudson River and the *marsh headwater stream* tributary potentially provide a food source for piscivorous wildlife, such as great blue heron, green heron (*Butorides virescens*), and mink. These piscivores may find the shoreline cover afforded by the forested habitat along the Hudson River's western shoreline in the off-Site study area attractive for isolation from predators and humans and for hunting.

Other Cultural Covertypes
Urban and industrial areas, with their mowed lawns, ornamental trees, and building exteriors provide habitat for urbanized bird and mammal species. As natural habitat communities diminish in size and quality, wildlife are forced to adapt to the more urban environment. However, urbanization limits utilization of the area by most wildlife species.

2.3.2 Value of Resources to Humans

In general, fish and wildlife resources are valuable to the people of New York State for recreational and aesthetic uses. Many sportsmen hunt, fish and consume their catches. Wildlife resources are also enjoyed by naturalists who enjoy observations of wildlife during hiking and camping. Within the study area, the Hudson River provides opportunities for fishing and recreational canoeing/kayaking within the study area. However, as mandated by the NYSDEC, there is a catch and release fishing policy from Bakers Falls to Troy Dam. Further, the steep banks, limited property access to the river shoreline and developed nature of much of the remainder of the study area restricts the value of natural resources for humans in the vicinity of the Site.

2.4 POTENTIALLY APPLICABLE FISH AND WILDLIFE REGULATORY CRITERIA

In accordance with the guidance (NYSDEC 2010, 1994), potentially applicable Fish and Wildlife Regulatory Criteria (FWRC) were identified for this analysis and are described below. FWRC are classified as either site-specific or chemical-specific. Site-specific FWRC apply to features such as wetlands or streams potentially impacted by the Site. Chemical-specific FWRC are medium-specific regulatory contaminant concentration thresholds, for example, the NYS Ambient Water Quality Standards and sediment criteria, described below.

2.4.1 Site-specific FWRC

Site-specific FWRC are regulations that apply to freshwater wetlands; tidal wetlands; regulated streams; navigable waterbodies; coastal zones; significant fish and wildlife habitats; wild, scenic and recreational rivers; and RTE plant and animal species. The Coastal Zone Management and the tidal wetland FWRC are not addressed herein because the Site and the Site study area are not located within a Coastal Zone.

Freshwater wetlands were identified through a review of available NYSDEC and USFWS mapping. Regulated streams and navigable water bodies were identified through a review of 6 NYCRR Part 701. The potential presence of RTE plant and animal species as well as significant habitats was identified through a records search by the NYNHP performed at the request of O'Brien & Gere and a review of available information from the USFWS. The presence of these resources is discussed in Section 2.2.5. As described previously, wetlands were identified for a distance of one-half mile surrounding the Site perimeter.

NYSDEC Freshwater Wetlands. The New York State Freshwater Wetlands Act (Article 24 of New York State Conservation Law) was promulgated in 1975 by the State of New York to preserve, protect, and conserve freshwater wetlands. Under the Act, NYSDEC was required to map the boundaries of wetlands greater than five hectares (12.4 acres) in size and to regulate the activities that can be conducted in these areas. Activities are also regulated within a 100-ft buffer zone around each wetland boundary depicted on the wetland map. The discharge of contaminants into NYS wetlands is a regulated activity under NYS Wetlands Laws.

The state regulated wetland boundaries are presented on NYSDEC Freshwater Wetlands Maps for most of the topographic quadrangles in the state. Based on a review of the wetland maps, no state-regulated wetlands are located within the study area.

Federal Wetlands. The U.S. Environmental Protection Agency (USEPA) and USACE have joint jurisdiction for federal wetlands under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. A qualitative evaluation of wetland presence in the vicinity of the Site was performed through a review of NWI Maps that include the Site. NWI maps are prepared by the USFWS as an indication of waterfowl habitat in the U.S. Although the wetlands depicted on these maps are not regulated unless they also meet state or federal criteria, the NWI maps provide an indication of potential wetland presence in the vicinity of the Site. Table 3 provides a list of NWI wetlands identified in the Site vicinity and Figure 4 presents their locations.

Regulated Streams. Disturbances to streams are regulated based on the classification of the stream. Stream classifications are presented in 6 NYCRR Section 941. According to NYCRR, the portion of Hudson River within the study area is a class “C” surface water. Class "C" waters support fisheries and are suitable for non-contact activities. Class "C" streams are protected by the permit system under 6 NYCRR Section 608, which regulates physical modifications or disturbances to protected streams, its bed, or banks. The unnamed tributary northwest of the Site (*marsh headwater stream*) is identified as a class “C(T)” surface water. The “T” designation indicates that this portion of stream contains trout habitat. The *intermittent stream* southwest of the Site is not classified in 6 NYCRR Section 941.

Navigable Waterbodies. According to New York State Conservation Law, activities affecting navigable waterbodies are governed by 6 NYCRR Part 608. As defined by this Part, a navigable waterbody is one "upon which vessels with a capacity of one or more persons can be operated." The Hudson River qualifies as a navigable waterbody according to this definition.

2.4.2 Chemical-specific FWRC

Criteria and guidance values that are potentially applicable to the evaluation of possible impacts to fish and wildlife resources as a result of exposures to chemicals in environmental media are identified. For example, the following FWRC are listed in the guidance as potentially applicable: NYS Water Quality Standards (NYSDEC 1998) and the federal chemical-specific USEPA Ambient Water Quality Criteria (USEPA 2009). These FWRC are described in this section.

Additional references can be utilized for the identification of numeric chemical criteria (*e.g.*, ecological screening levels). The sources of screening levels chosen for a specific project or Site are based primarily on NYSDEC and USEPA direction and guidance. Media selected for screening are based on potential receptors and exposure scenarios existing at the Site. Table 4 presents a list of potential chemical-specific FWRC. Applicable state and federal regulatory criteria utilized in this assessment for comparison to Site media data are described below. Results of the screening of Site media samples to the FWRC are discussed in Section 3.

Surface Water Screening References

Technical and Operational Guidance Series Number 1.1.1. New York State Ambient Water Quality Standards and Guidance Values (NYSDEC 1998). The NYSDEC surface water quality standards and guidance values are specific to each “class” of water identified by the state. Standards and guidance values are ambient water quality values derived according to procedures that are in regulation (6 NYCRR Part 702). Standards are values that have been promulgated and placed into regulation. Guidance values may be considered where a standard for a substance or group of substances has not been established for a particular water class and type, but do not have the regulatory implications of the standards. When available, the freshwater values for the protection of aquatic life from chronic effects (A-C) and protection of wildlife (W) were utilized for this assessment.

National Recommended Ambient Water Quality Criteria (USEPA 2009). The water quality criteria developed by USEPA under section 304(a) of the Clean Water Act are based on data and scientific and regulatory judgments about the relationship between chemical concentrations and environmental and human health effects, with provision of conservative scaling, or safety factors, to provide an additional margin of safety. These criteria do not reflect site-specific factors, background or consideration of economic impacts of attempting to meet the criteria within the design of the wastewater facilities or the technological feasibility of meeting the chemical concentrations in ambient water. National recommended water quality criteria have been developed for approximately 150 constituents. Criteria were also developed for an additional 12 constituents, but these criteria are solely for organoleptic effects (aesthetic consideration such as odor, appearance, taste, *etc.*). When available, the aquatic life Criterion Continuous Concentration (CCC) was utilized for this assessment. The CCC is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect.

3. CONTAMINANT-SPECIFIC IMPACT ASSESSMENT

In accordance with the NYSDEC (1994) guidance, the Pathway Analysis is the first step of the Contaminant-specific Impact Assessment, where Site-related constituents and potential pathways of contaminant migration to ecological receptors in the vicinity of the Site are evaluated. If no resources or pathways exist at the Site, or if impact is considered minimal, then no further analysis is required. If complete pathways between constituents and resources are identified, a Criteria-specific Analysis is performed. These analyses are discussed in this section.

3.1 POTENTIAL PATHWAYS

The following sections consider the primary potential exposure pathways and receptors identified in this FWRIA. An exposure pathway is a mechanism by which a receptor may be exposed to a chemical or physical agent at, or originating from, a source. The three primary routes of organism exposure are inhalation, ingestion, and dermal contact. Exposure pathways are classified as being complete or incomplete. An exposure pathway is complete when receptors exist that could contact a physical or chemical agent under specified conditions. The pathway is incomplete if there are no receptors or no exposures could occur under the specified conditions. Presented below is a discussion of the potential ecological pathways at the Former 004 Outfall Site under current conditions.

3.1.1 Terrestrial Exposure Pathway

The terrestrial exposure pathway is considered incomplete for the Site. The Site consists of DNAPL in bedrock in the vicinity of the Former 004 Outfall; therefore the contaminant is present below the ground surface where ecological receptors are not present. As described previously in Section 2, little or no viable habitat for wildlife exists on the surface of the Site. As shown in the Photo log (Appendix A), the Site surface consists primarily of a gravel road where a sparse vegetative community exists, offering little to no habitat for wildlife except for transient individuals potentially migrating between the river and the adjacent bluff. The Site is also subject to periodic flooding during high river flows.

3.1.2 Groundwater Exposure Pathway

Ecological exposures, if any, to Site-related constituents in groundwater are typically limited to direct contact exposures from shallow groundwater to soil invertebrates, plant roots, and/or burrowing animals. However, wildlife potentially inhabiting or utilizing the Site are not likely to contact groundwater since dens or burrows are not excavated or inhabited below the water table and wildlife food sources occur above ground or in shallow soil.

Groundwater flow in the shallow bedrock in the vicinity of the Former 004 Outfall is generally westerly toward the Hudson River, and in close proximity to the river there are upward hydraulic gradients between the shallow bedrock and the Hudson River. In addition, there is a potential for migration of DNAPL in the shallow bedrock at or above the elevation of the bottom of the river to surface water. Although the inaccessibility of potential on-Site receptors to groundwater and DNAPL in bedrock indicates that the exposure pathway is incomplete for the Site, the groundwater exposure pathway is *potentially complete* for off-Site receptors due to potential exposure to Site constituents via groundwater migration from shallow bedrock to the Hudson River surface water. In addition, as described below, surface water concentrations indicated that groundwater/DNAPL contributions from the Site, if any, are minimal. Once discharged to surface water, aquatic receptors, including water column organisms, benthic invertebrates and upper trophic level receptors, may become exposed to groundwater constituents via direct contact, incidental ingestion, and ingestion of affected prey items.

3.1.3 Aquatic Habitat - Surface Water Exposure Pathway

No aquatic habitat is present on the Former 004 Outfall Site; however, the Hudson River is located immediately adjacent to the Site and is the primary natural resource present in the vicinity of the Site. Ecological receptors associated with the river include aquatic plants, benthic invertebrates, fish, amphibians, reptiles and semi-aquatic birds and mammals that may forage from or otherwise utilize the river.

Since PCBs were detected in both DNAPL and groundwater samples collected from bedrock wells located adjacent to the river, and were also detected in Hudson River surface water samples collected adjacent to the Site, there is a *potentially complete* exposure pathway for Site-related constituents to reach the Hudson River. The Hudson River surface water is readily available to wildlife receptors; however, infrequent detections of PCBs in surface water samples from the river are an indication that migration of groundwater and/or DNAPL containing PCBs in the shallow bedrock, if any, to the Hudson River is minimal. The analytical results of the surface water samples are discussed further in Section 3.2.1., below.

3.2 CRITERIA SPECIFIC ANALYSIS

Based on the results of the Pathway Analysis, the only pathway warranting further evaluation is the surface water exposure pathway. Therefore, a comparison of surface water data collected near the Former 004 Outfall to ecologically-based screening values and criteria was performed. This analysis uses the FWRC identified in Section 2.4.2. for comparison to the media-specific data discussed in Section 3.1 as an assessment of potential impact to ecological receptors.

The surface water samples collected near the Former 004 Outfall Site were collected periodically from three locations in the Hudson River. These three locations are representative of the conditions upstream (Location -004-HR-N), adjacent to (Location -004-HR-A) and downstream (Location -004-HR-S) of the Former 004 Outfall in 2010 through 2013. Figure 2 presents the surface water sample locations. Tables 5A, 5B, 5C, and 6 present a summary of the surface water data collected between 2010 and 2013. The results of the surface water screening evaluation are also presented on Tables 5A, 5B, 5C and 6 and are discussed further below.

3.2.1 Surface Water Screening Results (2010-2012)

From June into mid December, a total of 53 surface water weekly sampling events were conducted as part of Former 004 Outfall RI activities at three locations in the Hudson River between 2010 and 2012; upstream (north) of the Former 004 Outfall location, at the Former 004 Outfall location, and downstream (south) of the Former 004 Outfall location (Tetra Tech Geo and JG Environmental 2012).

Of the 53 samples collected at the upstream location (Table 5A), two samples had PCB detections above detection limits (4%). These detections were collected on September 19, 2011 (8.36 nanograms per liter (ng/L)) and November 14, 2011 (8.37 ng/L) (Tetra Tech Geo and JG Environmental 2012) and are above the NYSDEC aquatic life standard (protection of wildlife) of 0.12 ng/L (NYSDEC 1998) for PCBs, as presented on Table 5A.

Of the 53 samples collected at the Former 004 Outfall location (Table 5B), 19 samples had PCB concentrations above detection limits (36%). Detected PCB concentrations ranged from 12.6 ng/L to 153 ng/L (Tetra Tech 2012 and JG Environmental 2012). Each of these 19 detections are above the NYSDEC aquatic life standard of 0.12 ng/L (NYSDEC 1998) and 17 of the detections are above the USEPA criterion (freshwater-chronic) of 14.0 ng/L (USEPA 2009) for PCBs, as presented on Table 5B.

Of the 53 samples collected at the downstream location (Table 5C), 15 samples had PCB detections above the detection limit (28%). Detected PCB concentrations in samples from the downstream sampling station range from 7.88 ng/L to 97.8 ng/L (Tetra Tech Geo and JG Environmental 2012). These 15 detections are above NYSDEC aquatic life (protection of wildlife) standard of 0.12 ng/L (NYSDEC 1998) for PCBs; however, only four of the detections are above the USEPA criterion of 14 ng/L (USEPA 2009) for PCBs, as presented on Table 5C.

3.2.2 Surface Water Sampling Results (2013)

Subsequent to the RI activities, monthly surface water samples were collected from three sample locations in the Hudson River between May and November 2013. These surface water grab samples were collected from approximately the same locations used for the RI. Of the 21 surface water samples collected in 2013, only two samples (9.5%), both located at the Former 004 Outfall location, exhibited concentrations above the detection limit with concentrations ranging from 8.91 to 14.1 ng/L. Both of these detections are above NYSDEC aquatic life (protection of wildlife) standard of 0.12 ng/L (NYSDEC 1998) and only one is above USEPA criteria of 14.0 ng/L (USEPA 2009) for PCBs, as presented on Table 6. Detections in 2013 represent a decline in concentrations relative to detections in previous years sampled.

4. SUMMARY AND CONCLUSIONS

This FWRIA report was completed for the GE Fort Edward Plant – OU-05 (Former 004 Outfall) in accordance with NYSDEC's DER-10 Section 3.10.1 (Part 1 – Resource Characterization; NYSDEC 2010) and Step IIB (Contaminant-Specific Impact Assessment) of their FWIA guidance document (NYSDEC 1994).

The Site, which includes DNAPL and dissolved phase PCBs in bedrock with a gravel access road at the surface, provides poor habitat value for wildlife. However, the Hudson River is immediately adjacent to the Site and is the primary natural resource present in the vicinity of the Site. Ecological receptors of the river include aquatic plants, benthic invertebrates, fish, amphibians, reptiles and semi-aquatic birds and mammals that may forage from or otherwise utilize the river. The potential exists for PCB exposure to these receptors based on the potential migration of PCB contaminated groundwater and DNAPL in bedrock from the Site to the river.

The results of surface water samples collected from locations upstream, downstream and adjacent to the Site show that PCBs have been detected in some surface water samples in exceedance of NYSDEC and USEPA criteria. Of the 53 samples collected at each of these locations between 2010 and 2012, detection frequencies for PCBs of 4%, 36% and 28% have been observed upstream, adjacent and downstream of the Site, respectively. Each of these detections was above the NYSDEC aquatic life (protection of wildlife) standard of 0.12 ng/L (NYSDEC 1998) and several are above the USEPA criteria of 14.0 ng/L (USEPA 2009) for PCBs. However, only 2 of 21 samples (9.5%) had detections of PCBs in the most recently collected samples (May through November of 2013). Both of these detections were above the NYSDEC aquatic life (protection of wildlife) standard of 0.12 ng/L (NYSDEC 1998) and only one was marginally above USEPA criteria of 14.0 ng/L (USEPA 2009) for PCBs. The magnitude and frequency of the latest surface water detections suggest that potential impacts to ecological receptors in Hudson River from Site-related constituents, if any, are *de minimis*.

It should be noted that although PCBs have been detected in surface water samples collected in the vicinity of the Site, the relative contribution PCBs from the Former Outfall 004 to the river is uncertain. That is, additional potential sources of PCBs such as the existing river sediments, Hudson Falls Plant Site (currently being remediated under a state order) and residual contributions from the nearby remnant sites, likely play some role on the sampling results and data evaluated for this assessment.

Based on the relatively low magnitude of exceedances and low detection frequency of PCBs in surface water in the vicinity of the Site (particularly in recent years), a *Part II - Ecological Impact Assessment*, is not deemed necessary for this Site.

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Table 1
General Electric Company
Fort Edward Plant OU-5, Former 004 Outfall
Fish and Wildlife Resources Impact Analysis
Potential Wildlife Associated with Study Area Covertypes

Common Name	Scientific Name
Amphibians and Reptiles[1]	
Blue-spotted salamander	*Ambystoma laterale*
Bullfrog	*Rana catesbeiana*
Common garter snake	*Thamnophis sirtalis*
Common mudpuppy	*Necturus maculosus*
Common snapping turtle	*Chelydra serpentina*
Eastern American toad	*Bufo a. americanus*
Eastern milk snake	*Lampropeltis triangulum triangulum*
Fowler's toad	*Bufo fowleri*
Gray tree frog	*Hyla versicolor*
Green frog	*Rana clamitans melanota*
Jefferson salamander	*Ambystoma jeffersonianum*
Northern brown snake	*Storeria dekayi dekayi*
Northern leopard frog	*Rana pipiens*
Northern redback salamander	*Plethodon c. cinereus*
Northern redbelly snake	*Storeria o. occipitomaculata*
Northern spring peeper	*Pseudacris c. crucifer*
Northern two-lined salamander	*Eurycea bislineata*
Painted turtle	*Chrysemys picta*
Pickerel frog	*Rana palustris*
Red-spotted newt	*Notophthalmus v. viridescens*
Spotted salamander	*Ambystoma maculatum*
Spotted turtle	*Clemmys guttata*
Wood frog	*Rana sylvatica*
Wood turtle	*Clemmys insculpta*
Birds[2, 3]	
American crow	*Corvus brachyrhynchos*
American robin	*Turdus migratorius*
Barn swallow	*Hirundo rustica*
Belted kingfisher	*Ceryle alcyon*
American woodcock	*Scolopax minor*
Blue Jay	*Cyanocitta cristata*
Brown thrasher	*Toxostoma rufum*
Common yellowthroat	*Geothlypis trichas*
Eastern towhee	*Pipilo erythrophthalmus*
Field sparrow	*Spizella pusilla*
Great bule heron	*Ardea herodias*
House sparrow	*Passer domesticus*
Indigo Bunting	*Passerina cyanea*
Mourning dove	*Zenaida macroura*
Northern flicker	*Colaptes auratus*
Northern mockingbird	*Mimus polyglottus*
Pileated woodpecker	*Dryocopus pileatus*
Red-bellied woodpecker	*Melanerpes carolinus*
Red-tailed hawk	*Buteo jamaicensis*
Rock dove	*Columba livia*
Song sparrow	*Melospiza melodia*
Tree swallow	*Tachycineta bicolor*
Tufted titmouse	*Parus bicolor*
Yellow-throated vireo	*Vireo flavifrons*

Table 1
General Electric Company
Fort Edward Plant OU-5, Former 004 Outfall
Fish and Wildlife Resources Impact Analysis
Potential Wildlife Associated with Study Area Covertypes

Common Name	Scientific Name
Fish[2]	
Bluntnose minnow	*Pimephales notatus*
Brook trout	*Salvelinus fontinalis*
Brown bullhead	*Ameriurus nebulosus*
Central mudminnow	*Umbra limi*
Fathead minnow	*Pimephales promelas*
Golden shiner	*Notemigonus crysoleucas*
Largemouth bass	*Microterus salmoides*
Longnose dace	*Rhinichthys cataractae*
Longnose sucker	*Catostomus catastomus*
Northern pike	*Esox lucius*
Northern redbelly dace	*Phoxinus eos*
Pickerel	*Esox americanus*
Pumpkinseed	*Lepomis gibbosus*
Redhorse species	*Moxostoma spp.*
Smallmouth bass	*Micropterus dolomieui*
Sturgeon species	*Acipenser spp.*
White sucker	*Catostomus commersoni*
Mammals[3]	
Beaver	*Castor canadensis*
Big brown bat	*Eptesicus fuscus*
Black bear	*Ursus americanus*
Coyote	*Canis latrans*
Deer mouse	*Peromyscus maniculatus*
Eastern chipmunk	*Tamias striatus*
Eastern cottontail	*Sylvilagus floridanus*
Eastern gray squirrel	*Sciurus carolinensis*
Eastern pipistrelle	*Pipistrellus subflavus*
Fox squirrel	*Sciurus niger*
Gray fox	*Urocyon cinereoargenteus*
Hairytail mole	*Parascalops breweri*
Hoary bat	*Lasiurus cinereus*
Keen myotis	*Myotis keeni*
Least shrew	*Cryptotis parva*
Little brown bat	*Myotis lucifugus*
Longtail weasel	*Mustela frenata*
Masked shrew	*Sorex cinerus*
Meadow jumping mouse	*Zapus hudsonius*
Meadow vole	*Microtus pennsylvanicus*
Mink	*Mustela vison*
New England cottontail	*Sylvilagus transitionalis*
Northern flying squirrel	*Glaucomys sabrinus*
Opossum	*Didelphia virginiana*
Pine vole	*Microtus pinetorum*
Porcupine	*Erethizon dorsatum*
Raccoon	*Procyon lotor*
Red bat	*Lasiurus borealis*
Red fox	*Vulpes fulva*
Red squirrel	*Tamiasciurus hudsonicus*
Shorttail shrew	*Blarina brevicauda*

Table 1
General Electric Company
Fort Edward Plant OU-5, Former 004 Outfall
Fish and Wildlife Resources Impact Analysis
Potential Wildlife Associated with Study Area Covertypes

Common Name	Scientific Name
Shorttail weasel	*Mustela erminea*
Silver haired bat	*Lasionycteris noctivagans*
Smoky shrew	*Sorex fumeus*
Snowshoe hare	*Lepus americanus*
Striped skunk	*Mephitis mephitis*
White footed mouse	*Peromyscus leucopus*
White-tailed deer	*Odocoileus virginianus*
Woodchuck	*Marmota monax*
Woodland jumping mouse	*Napaeozapus insignis*

Sources:

1 = New York State Herp Atlas Project (http://www.dec.ny.gov/animals/7140.html); Hudson Falls USGS Quadrangle/Block

2 = Edigner *et al* . 2002

3 = Chambers 1983

Table 2
General Electric Company
Fort Edward Plant OU-5, Former 004 Outfall
Fish and Wildlife Resources Impact Analysis
NYS Breeding Bird Atlas Information[1]
for Survey Blocks 6079D and 6179C

Common Name	Scientific Name	NY Legal Status	BBA Blocks
Alder Flycatcher	*Empidonax alnorum*	Protected	6179C
American Black Duck	*Anas rubripes*	Game Species	6079D, 6179C
American Crow	*Corvus brachyrhynchos*	Game Species	6079D, 6179C
American Goldfinch	*Spinus tristis*	Protected	6079D, 6179C
American Redstart	*Setophaga ruticilla*	Protected	6079D, 6179C
American Robin	*Turdus migratorius*	Protected	6079D, 6179C
Baltimore Oriole	*Icterus galbula*	Protected	6079D, 6179C
Bank Swallow	*Riparia riparia*	Protected	6079D
Barn Swallow	*Hirundo rustica*	Protected	6079D, 6179C
Belted Kingfisher	*Megaceryle alcyon*	Protected	6079D, 6179C
Black-and-white Warbler	*Poecile atricapillus*	Protected	6079D
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Protected	6179C
Black-capped Chickadee	*Poecile atricapillus*	Protected	6079D, 6179C
Blue Jay	*Cyanocitta cristata*	Protected	6079D, 6179C
Blue-gray Gnatcatcher	*Polioptila caerulea*	Protected	6079D, 6179C
Blue-winged Warbler	*Vermivora pinus*	Protected	6079D
Bobolink	*Dolichonyx oryzivorus*	Protected	6179C
Brown Thrasher	*Toxostoma rufum*	Protected	6179C
Brown-headed Cowbird	*Molothrus ater*	Protected	6079D, 6179C
Canada Goose	*Branta canadensis*	Game Species	6079D, 6179C
Carolina Wren	*Thryothorus ludovicianus*	Protected	6179C
Cedar Waxwing	*Bombycilla cedrorum*	Protected	6079D, 6179C
Chimney Swift	*Chaetura pelagica*	Protected	6079D
Chipping Sparrow	*Spizella passerina*	Protected	6079D, 6179C
Common Grackle	*Quiscalus quiscula*	Protected	6079D, 6179C
Common Merganser	*Mergus merganser*	Game Species	6079D
Common Yellowthroat	*Geothlypis trichas*	Protected	6079D, 6179C
Double-crested Cormorant	*Phalacrocorax auritus*	Protected	6079D
Downy Woodpecker	*Picoides pubescens*	Protected	6079D, 6179C
Eastern Bluebird	*Sialia sialis*	Protected	6079D, 6179C
Eastern Kingbird	*Tyrannus tyrannus*	Protected	6079D, 6179C
Eastern Phoebe	*Sayornis phoebe*	Protected	6079D, 6179C
Eastern Screech-Owl	*Megascops asio*	Protected	6079D
Eastern Towhee	*Pipilo erythrophthalmus*	Protected	6079D
Eastern Wood-Pewee	*Contopus virens*	Protected	6079D, 6179C
European Starling	*Sturnus vulgaris*	Unprotected	6079D, 6179C
Field Sparrow	*Spizella pusilla*	Protected	6179C
Grasshopper Sparrow	*Ammodramus savannarum*	Protected-Special Concern	6179C
Gray Catbird	*Dumetella carolinensis*	Protected	6079D, 6179C
Great Blue Heron	*Ardea herodias*	Protected	6079D
Great Crested Flycatcher	*Myiarchus crinitus*	Protected	6079D, 6179C
Green Heron	*Butorides virescens*	Protected	6079D, 6179C
Hairy Woodpecker	*Picoides villosus*	Protected	6179C
Henslow's Sparrow	*Ammodramus henslowii*	Threatened	6179C

Table 2
General Electric Company
Fort Edward Plant OU-5, Former 004 Outfall
Fish and Wildlife Resources Impact Analysis
NYS Breeding Bird Atlas Information[1]
for Survey Blocks 6079D and 6179C

Common Name	Scientific Name	NY Legal Status	BBA Blocks
Hooded Merganser	*Lophodytes cucullatus*	Game Species	6179C
Horned Lark	*Eremophila alpestris*	Protected-Special Concern	6179C
House Finch	*Carpodacus mexicanus*	Protected	6079D, 6179C
House Sparrow	*Passer domesticus*	Unprotected	6079D, 6179C
House Wren	*Troglodytes aedon*	Protected	6079D, 6179C
Indigo Bunting	*Passerina cyanea*	Protected	6179C
Killdeer	*Charadrius vociferus*	Protected	6079D, 6179C
Mallard	*Anas platyrhynchos*	Game Species	6079D, 6179C
Mourning Dove	*Zenaida macroura*	Protected	6079D, 6179C
Northern Cardinal	*Cardinalis cardinalis*	Protected	6079D, 6179C
Northern Flicker	*Colaptes auratus*	Protected	6079D, 6179C
Northern Harrier	*Circus cyaneus*	Threatened	6179C
Northern Mockingbird	*Mimus polyglottos*	Protected	6079D, 6179C
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Protected	6079D, 6179C
Pileated Woodpecker	*Dryocopus pileatus*	Protected	6079D, 6179C
Red-bellied Woodpecker	*Melanerpes carolinus*	Protected	6179C
Red-breasted Nuthatch	*Sitta canadensis*	Protected	6079D
Red-eyed Vireo	*Vireo olivaceus*	Protected	6079D, 6179C
Red-tailed Hawk	*Buteo jamaicensis*	Protected	6079D, 6179C
Red-winged Blackbird	*Agelaius phoeniceus*	Protected	6079D, 6179C
Rock Pigeon	*Columba livia*	Unprotected	6079D, 6179C
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Protected	6079D, 6179C
Ruby-throated Hummingbird	*Archilochus colubris*	Protected	6079D, 6179C
Ruffed Grouse	*Bonasa umbellus*	Game Species	6179C
Savannah Sparrow	*Passerculus sandwichensis*	Protected	6179C
Scarlet Tanager	*Piranga olivacea*	Protected	6079D, 6179C
Sedge Wren	*Cistothorus platensis*	Threatened	6179C
Song Sparrow	*Melospiza melodia*	Protected	6079D, 6179C
Spotted Sandpiper	*Actitis macularius*	Protected	6079D
Swamp Sparrow	*Melospiza georgiana*	Protected	6179C
Tree Swallow	*Tachycineta bicolor*	Protected	6079D, 6179C
Tufted Titmouse	*Baeolophus bicolor*	Protected	6079D, 6179C
Turkey Vulture	*Cathartes aura*	Protected	6079D, 6179C
Upland Sandpiper	*Bartramia longicauda*	Threatened	6179C
Warbling Vireo	*Vireo gilvus*	Protected	6079D, 6179C
White-breasted Nuthatch	*Sitta carolinensis*	Protected	6079D, 6179C
White-throated Sparrow	*Zonotrichia albicollis*	Protected	6079D
Willow Flycatcher	*Empidonax traillii*	Protected	6179C
Wood Duck	*Aix sponsa*	Game Species	6079D, 6179C
Wood Thrush	*Hylocichla mustelina*	Protected	6079D, 6179C
Yellow Warbler	*Dendroica petechia*	Protected	6079D, 6179C
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Protected	6079D
Yellow-rumped Warbler	*Dendroica coronata*	Protected	6079D
Yellow-throated Vireo	*Vireo flavifrons*	Protected	6079D

1 = Source: 2000 New York State Department of Environmental Conservation Breeding Bird Atlas (2000-2005) - Blocks 6079D (Site) and 6179C (east). http://www.dec.ny.gov/cfmx/extapps/bba/

Table 3
General Electric Company
Fort Edward Plant OU-5, Former 004 Outfall
Fish and Wildlife Resources Impact Analysis
Characteristics of Wetlands within 0.5-Mile Site Radius

Wetland Identification Code	Number of Polygons within 0.5-mile Radius	Total Area (Acres)	Description
State Wetlands[1]			
None	NA	NA	NA
NWI Habitats[2]			
PABF	1	0.84	Palustrine; Aquatic bed; Persistent; Semipermanently flooded
PEM1C	1	4.97	Palustrine; Emergent; Persistent; Seasonally flooded
PEM1E	4	3.11	Palustrine; Emergent; Persistent; Seasonally flooded/saturated
PFO1C	2	11.89	Palustrine; Forested; Broad-leaved deciduous; Seasonally flooded
PFO1E	3	3.50	Palustrine; Forested; Broad-leaved deciduous; Seasonally flooded/saturated
PSS1A	1	0.35	Palustrine; Scrub-shrub; Broad-leaved deciduous; Temporarily flooded
PSS1C	3	1.89	Palustrine; Scrub-shrub; Broad-leaved deciduous; Seasonally flooded
PUBFh	1	0.15	Palustrine; Unconsolidated bottom; Semipermanently flooded; Diked/Impounded
PUBHh	1	0.46	Palustrine; Unconsolidated bottom; Permanently flooded; Diked/Impounded
PUBHx	1	0.26	Palustrine; Unconsolidated bottom; Permanently flooded; Excavated
R2UBH	1	*100.00	Riverine; Lower perennial; Unconsolidated bottom, Permanently flooded
R3USA	1	17.39	Riverine; Lower perennial; Unconsolidated shore, Temporarily flooded

Notes:

1 = NYSDEC. 1999b. New York State Regulatory Freshwater Wetlands For Washington County Outside the Adirondack Park (ARC Export : 1999). Digital Data. http://cugir.mannlib.cornell.edu/bucketinfo.jsp?id=494

NYSDEC. 1999c. New York State Regulatory Freshwater Wetlands For Saratoga County (ARC Export : 1999). Digital Data. http://cugir.mannlib.cornell.edu/bucketinfo.jsp?id=483

NYSDEC. 2001. New York State Regulatory Freshwater Wetlands For Warren County Outside the Adirondack Park (ARC Export : 2001). Digital Data. http://cugir.mannlib.cornell.edu/bucketinfo.jsp?id=493

2 = USFWS. 2012b. Digital Data (ContinentalUSScannedMaps.shp). Based on *Classification of Wetlands and Deepwater Habitats of the United States.* (Cowardin *et al* . 1979). http://www.fws.gov/wetlands/

* = This acreage is approximately the amount of the wetland polygon located within 0.5-mile radius, but may not represent the entire acreage of this wetland polygon.

Table 4
General Electric Company
Fort Edward Plant OU-5, Former 004 Outfall
Fish and Wildlife Resources Impact Analysis
Potentially Applicable Fish and Wildlife Regulatory Criteria

New York State Laws and Regulations

Environmental Media	Potentially Applicable Regulations, Criteria, and/or Standards
Surface Water	• 6 NYCRR Part 608 (Use and Protection of Waters) • 6 NYCRR Part 700-706 (Water Quality Standards) • 6 NYCRR Part 750-758 (Water Resource Law) • ECL Article 15 (Water Resources) • ECL Article 17 (Water Pollution Control)
Wetlands	• NY Freshwater Wetlands Act (NYS 1985; NYS 1980; 6 NYCRR Parts 663, 664) • ECL Article 24 (Freshwater wetlands)
Fish and Wildlife	• 6 NYCRR Part 182 (Endangered and Threatened Species) • ECL Article 11 (Endangered and Threatened Species)
Miscellaneous	• 6 NYCRR Part 375 (Inactive Hazardous Waste Disposal Sites) • ECL Article 27 (Inactive Hazardous Waste Disposal Sites)

Federal Laws and Regulations

Environmental Media	Potentially Applicable Regulations, Criteria, and/or Standards
Surface Water	• National Recommended Water Quality Criteria-Fresh Water (USEPA 2009)
Wetlands	• USEPA Clean Water Act - Section 404
Fish and Wildlife	• Endangered Species Act - 16 USC 1531 *et seq*; 50 CFR Parts 17, Subpart I and 50 CFR Part 402

State and Federal Guidance

Environmental Media	Potentially Applicable Regulations, Criteria, and/or Standards
Surface Water	• *TOGS 1.1.1 New York State Ambient Water Quality Standards and Guidance Values* (NYSDEC 1998) • *USEPA Region 3 Biological Technical Assistance Group (BTAG) Freshwater Screening Benchmarks* (USEPA 2006) • *ECO Update: Ecotox Thresholds* (USEPA 1996)
Wetlands	• *Freshwater Wetlands Delineation Manual*. New York State Department of Environmental Conservation, Albany, NY (NYSDEC 1995) • *U.S. Army Corps of Engineers Wetlands Delineation Manual* (USACE 1987)
Miscellaneous	• *Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites*. New York State Department of Environmental Conservation, Division of Fish and Wildlife, Albany, NY (NYSDEC 1994) • *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*. *Interim Final*. United States Environmental Protection Agency Environmental Response Team. EPA 540-R-97-006. Edison, New Jersey (USEPA 1997)

Table 5A
General Electric Company
Fort Edward Plant OU-5, Former 004 Outfall
Fish and Wildlife Resources Impact Analysis
Hudson River 2010-2012 Surface Water PCB Concentration Results
Upstream of Former 004 Outfall (Location-004_HR_N)

Date Sampled	Units	PQL	Total PCB Results
6/2/2010	ng/L	7.25	ND
6/9/2010	ng/L	8.84	ND
6/16/2010	ng/L	9.38	ND
6/23/2010	ng/L	7.6	ND
6/30/2010	ng/L	7.6	ND
7/7/2010	ng/L	8.94	ND
7/14/2010	ng/L	7.6	ND
7/21/2010	ng/L	7.6	ND
7/28/2010	ng/L	7.25	ND
8/11/2010	ng/L	7.6	ND
8/18/2010	ng/L	7.25	ND
8/25/2010	ng/L	9.93	ND
9/1/2010	ng/L	7.6	ND
9/8/2010	ng/L	7.6	ND
9/15/2010	ng/L	7.6	ND
9/23/2010	ng/L	7.6	ND
9/29/2010	ng/L	7.6	ND
10/6/2010	ng/L	7.6	ND
10/13/2010	ng/L	7.6	ND
10/20/2010	ng/L	7.6	ND
10/29/2010	ng/L	7.6	ND
11/3/2010	ng/L	7.6	ND
11/10/2010	ng/L	7.6	ND
11/17/2010	ng/L	7.6	ND
6/29/2011	ng/L	7.52	ND
7/6/2011	ng/L	7.52	ND
7/13/2011	ng/L	7.52	ND
7/20/2011	ng/L	7.52	ND
7/27/2011	ng/L	7.52	ND
8/3/2011	ng/L	7.52	ND
8/10/2011	ng/L	7.52	ND
8/17/2011	ng/L	7.52	ND
8/24/2011	ng/L	7.52	ND
9/1/2011	ng/L	7.52	ND
9/15/2011	ng/L	7.52	ND
9/19/2011	ng/L	7.52	**8.36**
9/28/2011	ng/L	7.52	ND
10/6/2011	ng/L	7.52	ND
10/6/2011	ng/L	7.52	ND

Table 5A
General Electric Company
Fort Edward Plant OU-5, Former 004 Outfall
Fish and Wildlife Resources Impact Analysis
Hudson River 2010-2012 Surface Water PCB Concentration Results
Upstream of Former 004 Outfall (Location-004_HR_N)

Date Sampled	Units	PQL	Total PCB Results
10/7/2011	ng/L	7.52	ND
10/12/2011	ng/L	7.52	ND
10/20/2011	ng/L	7.52	ND
10/26/2011	ng/L	7.52	ND
4/18/2012	ng/L	7.52	ND
6/13/2012	ng/L	7.52	ND
7/3/2012	ng/L	7.52	ND
7/3/2012	ng/L	7.52	ND
7/18/2012	ng/L	7.52	ND
8/15/2012	ng/L	7.52	ND
9/20/2012	ng/L	7.52	ND
10/17/2012	ng/L	7.52	ND
11/14/2012	ng/L	7.52	**8.37**
12/12/2012	ng/L	7.52	ND

Notes:

- Results reported in ng/L.

Bold = exceeds screening value (either NYSDEC 1998 and/or USEPA 2009 below).

- 0.12 ng/L = Screening value for Total PCBs from NYSDEC Technical & Operational Guidance Series 1.1.1., New York State Ambient Water Quality Standards and Guidance Values (NYSDEC 1998). PCB value is for wildlife protection.
- 14.00 ng/L = Screening values for Total PCBs from National Recommended Ambient Water Quality Criteria (USEPA 2009).

ND = non-detect.

PQL= practical quantification limit

Source: Tetra Tech Geo. 2012. *Remedial Investigation Report-Former 004 Outfall-OU-5* . General Electric Company. Fort Edward, NY. December 21, 2012.

Table 5B
General Electric Company
Fort Edward Plant OU-5, Former 004 Outfall
Fish and Wildlife Resources Impact Analysis
Hudson River 2010-2012 Surface Water PCB Concentration Results
At the Former 004 Outfall (Location-004_HR_A)

Date Sampled	Units	PQL	Total PCB Results
6/2/2010	ng/L	7.25	ND
6/9/2010	ng/L	7.25	ND
6/16/2010	ng/L	7.6	ND
6/23/2010	ng/L	7.6	ND
6/30/2010	ng/L	7.6	**24.6**
7/7/2010	ng/L	7.6	ND
7/14/2010	ng/L	7.6	ND
7/21/2010	ng/L	7.6	ND
7/28/2010	ng/L	7.25	ND
8/11/2010	ng/L	7.6	ND
8/18/2010	ng/L	7.25	**20.5**
8/25/2010	ng/L	9.93	**61.8**
9/1/2010	ng/L	7.6	ND
9/8/2010	ng/L	7.6	ND
9/15/2010	ng/L	7.6	ND
9/23/2010	ng/L	7.6	ND
9/29/2010	ng/L	7.6	ND
10/6/2010	ng/L	7.6	**19**
10/13/2010	ng/L	7.6	**44.5**
10/20/2010	ng/L	7.6	**67.8**
10/29/2010	ng/L	7.6	**54.9**
11/3/2010	ng/L	7.6	**51.9**
11/10/2010	ng/L	7.6	**83.5**
11/17/2010	ng/L	7.68	**153**
6/29/2011	ng/L	7.52	ND
7/6/2011	ng/L	7.52	ND
7/13/2011	ng/L	7.52	ND
7/20/2011	ng/L	7.52	ND
7/27/2011	ng/L	7.52	ND
8/3/2011	ng/L	7.52	ND
8/10/2011	ng/L	7.52	ND
8/17/2011	ng/L	7.52	ND
8/24/2011	ng/L	7.52	ND
9/1/2011	ng/L	7.52	**14.5**
9/15/2011	ng/L	10.3	**24.5**
9/19/2011	ng/L	7.52	**15.5**
9/28/2011	ng/L	7.52	ND
10/6/2011	ng/L	7.52	**12.8**
10/6/2011	ng/L	7.52	**12.6**

Table 5B
General Electric Company
Fort Edward Plant OU-5, Former 004 Outfall
Fish and Wildlife Resources Impact Analysis
Hudson River 2010-2012 Surface Water PCB Concentration Results
At the Former 004 Outfall (Location-004_HR_A)

Date Sampled	Units	PQL	Total PCB Results
10/7/2011	ng/L	7.52	ND
10/12/2011	ng/L	7.52	ND
10/20/2011	ng/L	7.52	**15.5**
10/26/2011	ng/L	7.52	**32.9**
4/18/2012	ng/L	7.52	ND
6/13/2012	ng/L	7.52	ND
7/3/2012	ng/L	7.52	ND
7/3/2012	ng/L	7.52	**15**
7/18/2012	ng/L	7.52	ND
8/15/2012	ng/L	7.52	ND
9/20/2012	ng/L	7.52	ND
10/17/2012	ng/L	7.52	ND
11/14/2012	ng/L	7.52	**22.8**
12/12/2012	ng/L	7.52	ND

Notes:

- Results reported in ng/L.

Bold = exceeds screening value (either NYSDEC 1998 and/or USEPA 2009 below).

- 0.12 ng/L = Screening value for Total PCBs from NYSDEC Technical & Operational Guidance Series 1.1.1., New York State Ambient Water Quality Standards and Guidance Values (NYSDEC 1998). PCB value is for wildlife protection.
- 14.00 ng/L = Screening values for Total PCBs from National Recommended Ambient Water Quality Criteria (USEPA 2009).

ND = non-detect.

PQL= practical quantification limit

Source: Tetra Tech Geo. 2012. *Remedial Investigation Report-Former 004 Outfall-OU-5* . General Electric Company. Fort Edward, NY. December 21, 2012.

Table 5C
General Electric Company
Fort Edward Plant OU-5, Former 004 Outfall
Fish and Wildlife Resources Impact Analysis
Hudson River 2010-2012 Surface Water PCB Concentration Results
Downstream of Former 004 Outfall (Location-004_HR_S)

Date	Units	PQL	Total PCB Results
6/2/2010	ng/L	7.55	ND
6/9/2010	ng/L	7.25	ND
6/16/2010	ng/L	7.6	ND
6/23/2010	ng/L	7.6	ND
6/30/2010	ng/L	7.6	ND
7/7/2010	ng/L	7.6	ND
7/14/2010	ng/L	7.6	**8.35**
7/21/2010	ng/L	7.6	ND
7/28/2010	ng/L	7.25	ND
8/11/2010	ng/L	7.6	ND
8/18/2010	ng/L	7.25	**15.7**
8/25/2010	ng/L	9.93	ND
9/1/2010	ng/L	7.6	ND
9/8/2010	ng/L	7.6	ND
9/15/2010	ng/L	7.6	ND
9/23/2010	ng/L	7.6	ND
9/29/2010	ng/L	7.6	ND
10/6/2010	ng/L	7.6	ND
10/13/2010	ng/L	7.6	ND
10/20/2010	ng/L	7.6	ND
10/29/2010	ng/L	7.6	ND
11/3/2010	ng/L	7.6	**8.82**
11/10/2010	ng/L	7.6	ND
11/17/2010	ng/L	7.6	**8.5**
6/29/2011	ng/L	7.52	ND
7/6/2011	ng/L	7.52	ND
7/13/2011	ng/L	7.67	ND
7/20/2011	ng/L	7.52	ND
7/27/2011	ng/L	7.52	ND
8/3/2011	ng/L	7.52	ND
8/10/2011	ng/L	7.52	ND
8/17/2011	ng/L	7.52	ND
8/24/2011	ng/L	7.52	**26.1**
9/1/2011	ng/L	7.52	ND
9/15/2011	ng/L	7.52	ND
9/19/2011	ng/L	7.67	**9.87**
9/28/2011	ng/L	7.52	ND
10/6/2011	ng/L	7.52	**8.14**
10/6/2011	ng/L	7.52	ND

Table 5C
General Electric Company
Fort Edward Plant OU-5, Former 004 Outfall
Fish and Wildlife Resources Impact Analysis
Hudson River 2010-2012 Surface Water PCB Concentration Results
Downstream of Former 004 Outfall (Location-004_HR_S)

Date	Units	PQL	Total PCB Results
10/7/2011	ng/L	7.52	ND
10/12/2011	ng/L	7.52	ND
10/20/2011	ng/L	7.52	**7.88**
10/26/2011	ng/L	7.52	ND
4/18/2012	ng/L	7.52	ND
6/13/2012	ng/L	7.52	**7.93**
7/3/2012	ng/L	7.52	ND
7/3/2012	ng/L	7.52	**33.2**
7/18/2012	ng/L	7.52	**7.91**
8/15/2012	ng/L	7.52	**10.8**
9/20/2012	ng/L	7.52	**10.3**
10/17/2012	ng/L	7.52	ND
11/14/2012	ng/L	7.52	**97.8**
12/12/2012	ng/L	7.52	**10**

Notes:
- Results reported in ng/L.
Bold = exceeds screening value (either NYSDEC 1998 and/or USEPA 2009 below).
- 0.12 ng/L = Screening value for Total PCBs from NYSDEC Technical & Operational Guidance Series 1.1.1., New York State Ambient Water Quality Standards and Guidance Values (NYSDEC 1998). PCB value is for wildlife protection.
- 14.00 ng/L = Screening values for Total PCBs from National Recommended Ambient Water Quality Criteria (USEPA 2009).
ND = non-detect.
PQL= practical quantification limit
Source: Tetra Tech Geo. 2012. *Remedial Investigation Report-Former 004 Outfall-OU-5* . General Electric Company. Fort Edward, NY. December 21, 2012.

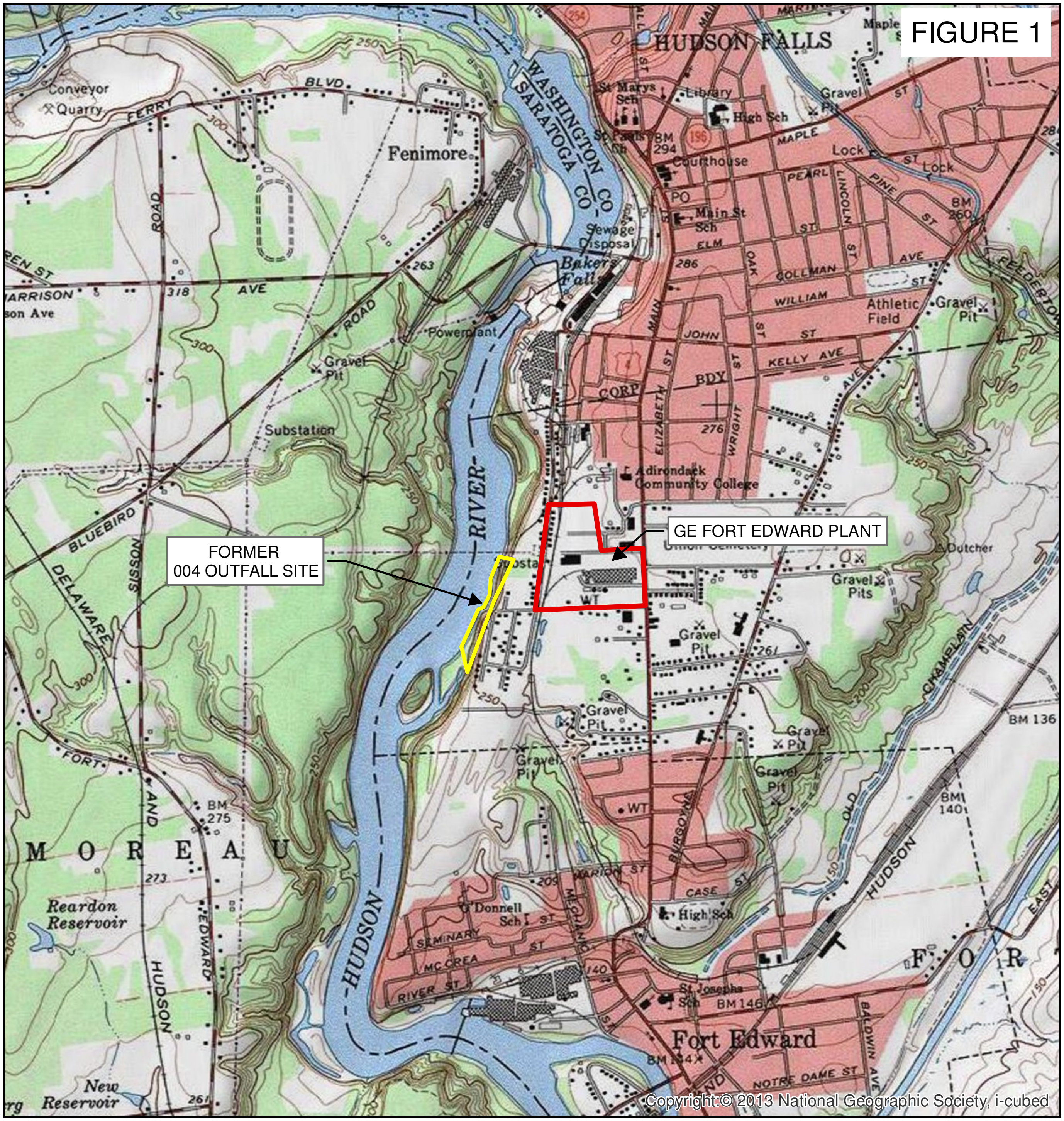
Table 6
General Electric Company
Fort Edward Plant OU-5, Former 004 Outfall
Fish and Wildlife Resources Impact Analysis
2013 Surface Water Sample Results[1] and Screening for Total PCBs

Location ID	November 2013	October 2013	September 2013	August 2013	July 2013	June 2013	May 2013	NYSDEC Ambient Water Quality Standards and Guidance Values[2]	USEPA National Recommended Water Quality Criteria Freshwater-CCC[3]
Upstream of Former 004 Outfall (004_HR_N)	< 7.91	< 7.91	< 8.99	< 7.91	< 8.99	< 7.91	< 7.52	0.12	14.00
At the Former 004 Outfall (004_HR_A)	< 7.91	**8.91 J**	< 7.91	< 7.91	**14.1 J**	< 8.24	< 7.52		
Downstream of Former 004 Outfall (004_HR_S)	< 7.91	< 7.91	< 7.91	< 7.91	< 7.91	< 7.91	< 7.52		

Notes:
1= Analytical results from monthly sampling conducted between May 2013 and November 2013. Results reported in ng/L. (Screening criteria was converted from ug/L to ng/L.)
2= Screening values are from NYSDEC Technical & Operational Guidance Series 1.1.1., New York State Ambient Water Quality Standards and Guidance Values (NYSDEC 1998). PCB value is for wildlife protection.
3= Screening values are from National Recommended Ambient Water Quality Criteria (USEPA 2009).
< = Denotes non-detect.
J = Denotes an estimated concentration. The concentration result is greater than or equal to the Method Detection Limit (MDL) but less than the PQL.
CCC = Criterion Continuous Concentration
BOLD = exceeds screening value.

I:\Ge-Cep.612\51119.Former-004-Outf\Docs\DWG\MXD\FIG1_site loc.mxd

PLOTDATE: 01/15/14 5:09:10 PM MortonAK



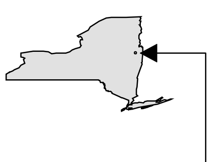
ADAPTED FROM: HUDSON FALLS USGS QUADRANGLE

LEGEND

- SITE BOUNDARY
- GE PLANT BOUNDARY

GENERAL ELECTRIC COMPANY
FISH AND WILDLIFE
RESOURCES IMPACT ANALYSIS
FORT EDWARD PLANT OU-5,
FORMER 004 OUTFALL
FORT EDWARD, NEW YORK

SITE LOCATION



MAP LOCATION

N

0 1,000 2,000 4,000 6,000 8,000

Feet

1:24,000

JANUARY 2014
612.51119

O'BRIEN & GERE

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Dec 11, 2013 - 4:45pm

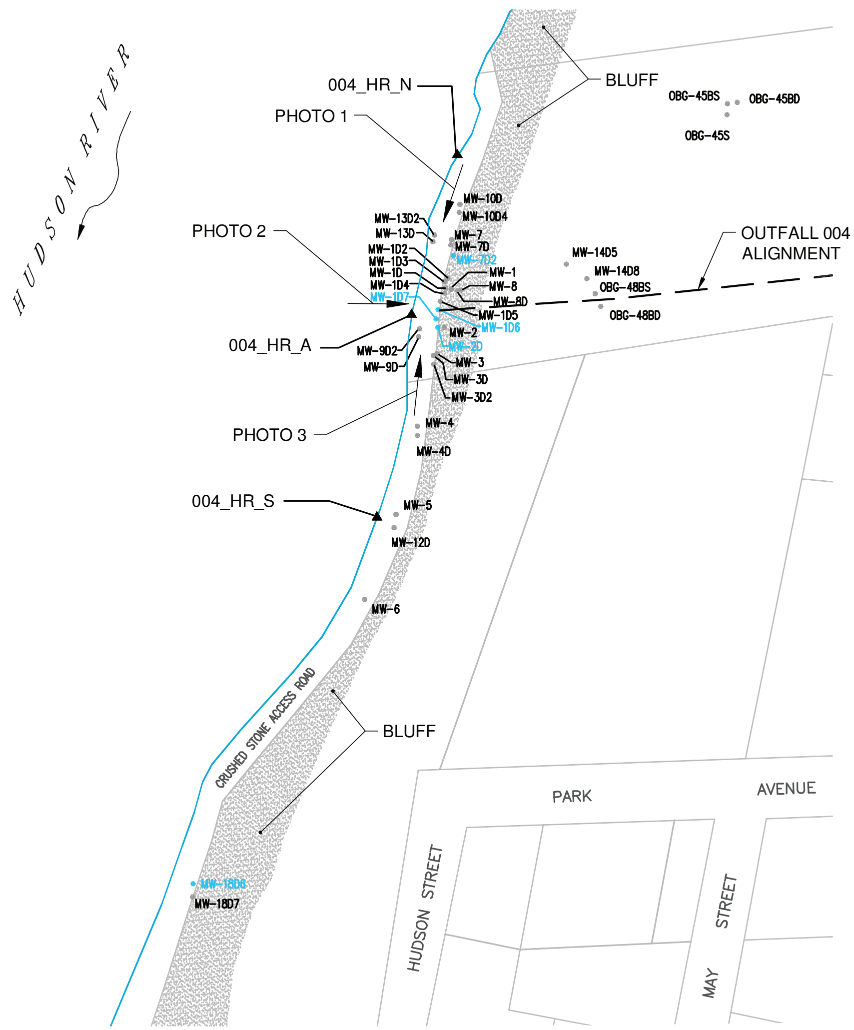


PHOTO 1 - ACCESS ROAD VIEWING SOUTH

PHOTO 2 - FORMER 004 OUTFALL

PHOTO 3 - ACCESS ROAD VIEWING NORTH

FIGURE 2

LEGEND

MW-18D7 •	MONITORING WELL LOCATION
MW-1D7 •	DNAPL COLLECTION WELL (2013)
004_HR_A ▲	SURFACE WATER SAMPLING LOCATION

THIS FIGURE DEVELOPED IN COLOR. REPRODUCTION IN BLACK AND WHITE MAY NOT REPRESENT DATA AS INTENDED.

GENERAL ELECTRIC COMPANY
FISH AND WILDLIFE
RESOURCES IMPACT ANALYSIS
FORT EDWARD PLANT OU-5,
FORMER 004 OUTFALL
FORT EDWARD, NEW YORK

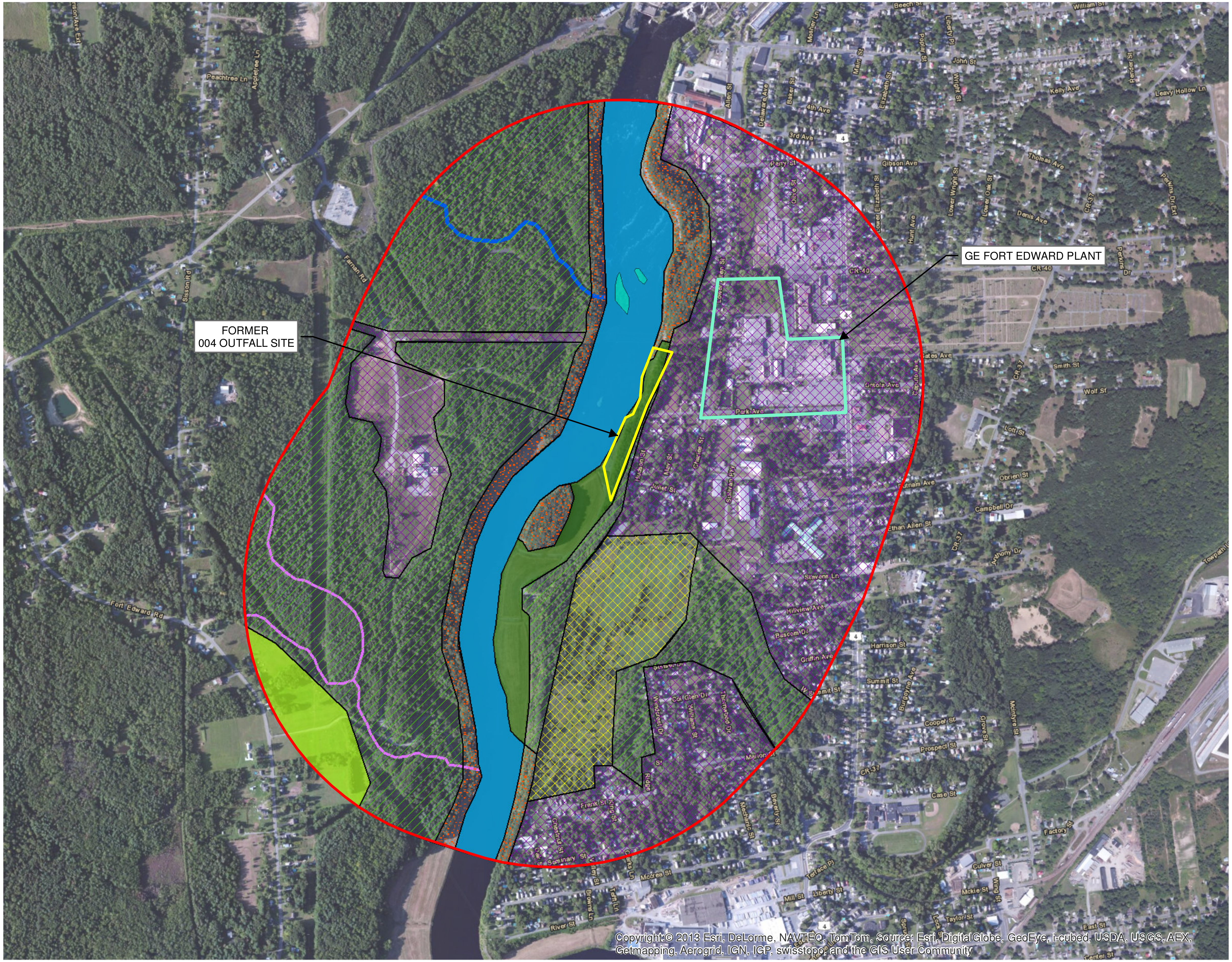
SITE PLAN

1"=120' 120 0 120

FILE NO. 612.51119-FIG1-2
JANUARY 2014

O'BRIEN & GERE

FIGURE 3



This document was developed in color. Reproduction in B/W may not represent the data as intended.

N

LEGEND

- SITE BOUNDARY
- GE PLANT BOUNDARY
- 0.5-MILE RADIUS
- BEECH-MAPLE MESIC FOREST
- SUCCESSIONAL OLD FIELD
- UNCONFINED RIVER
- MARSH HEADWATER STREAM
- INTERMITTENT STREAM
- FLOODPLAIN FOREST
- SHRUB SWAMP
- URBAN STRUCTURE EXTERIOR AND MOWED LAWN WITH TREES
- MOWED LAWN AND UNPAVED ROAD/PATH
- MOWED LAWN WITH TREES AND UNPAVED ROAD/PATH

NOTE: BOUNDARIES ARE APPROXIMATE.

GENERAL ELECTRIC COMPANY
FISH AND WILDLIFE
RESOURCES IMPACT ANALYSIS
FORT EDWARD PLANT OU-5,
FORMER 004 OUTFALL
FORT EDWARD, NEW YORK

STUDY AREA COVERTYPES

0 500 1,000 2,000
Feet

JANUARY 2014
612.51119

O'BRIEN & GERE

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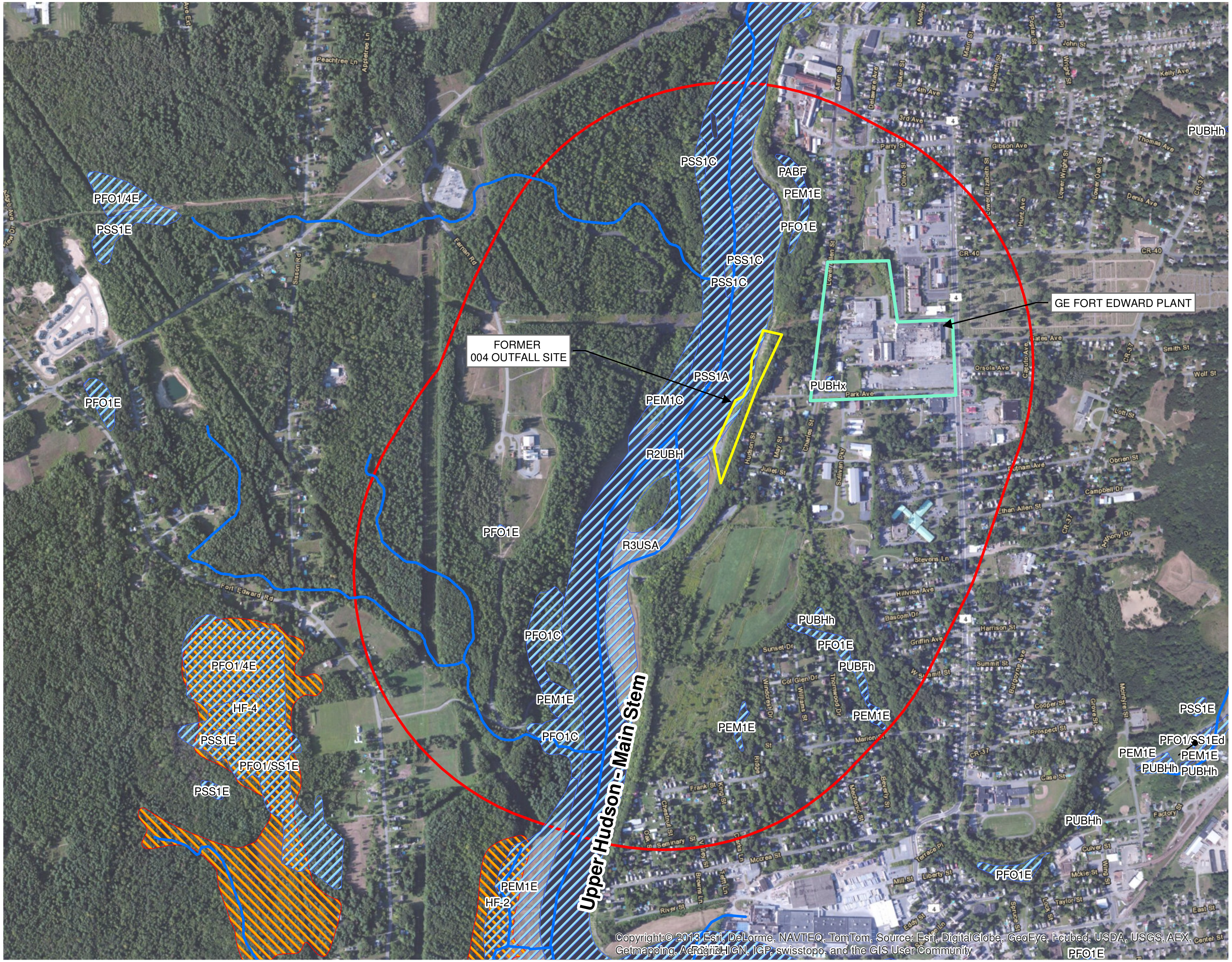
PLOTDATE: 01/15/14 5:12:41 PM MortonAK

FIGURE 4

N

LEGEND

- SITE BOUNDARY
- GE PLANT BOUNDARY
- 0.5-MILE RADIUS
- NWI WETLANDS
- STATE WETLANDS
- STREAMS AND RIVERS



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GENERAL ELECTRIC COMPANY
FISH AND WILDLIFE
RESOURCES IMPACT ANALYSIS
FORT EDWARD PLANT OU-5,
FORMER 004 OUTFALL
FORT EDWARD, NEW YORK

NATURAL RESOURCES

0 500 1,000 2,000
Feet

JANUARY 2014
612.51119

O'BRIEN & GERE

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Photograph Log

Photo 1. Looking east from the shoreline at a cliff and the former 004 Outfall pipe routing.
October 28, 2013

Photo 2. Looking west at river from the approximate former Outfall 004 location.
October 28, 2013

Photo 3. Looking south at Site and river from approximate former Outfall 004 location.
October 28, 2013

Photo 4. Looking upstream at eastern shoreline of river from northern portion of Site.
October 28, 2013

New York Natural Heritage Program Correspondence

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Division of Fish, Wildlife & Marine Resources
New York Natural Heritage Program
625 Broadway, 5th Floor, Albany, New York 12233-4757
Phone: (518) 402-8935 • **Fax:** (518) 402-8925
Website: www.dec.ny.gov

Joe Martens
Commissioner

November 20, 2013

Abby K. Morton
O'Brien & Gere
PO Box 4873
Syracuse, NY 13221

Re: General Electric Company - Fort Edward Former Outfall 004 Site, FILE: 612\51119\Corres
Town/City: Fort Edward. County: Washington.

Dear Abby K. Morton :

In response to your recent request, we have reviewed the New York Natural Heritage Program database with respect to the above project

Enclosed is a report of rare or state-listed animals and plants, and significant natural communities, which our databases indicate occur, or may occur, on your site or in the immediate vicinity of your site.

For most sites, comprehensive field surveys have not been conducted; the enclosed report only includes records from our databases. We cannot provide a definitive statement as to the presence or absence of all rare or state-listed species or significant natural communities. This information should not be substituted for on-site surveys that may be required for environmental impact assessment.

Our databases are continually growing as records are added and updated. If this proposed project is still under development one year from now, we recommend that you contact us again so that we may update this response with the most current information.

The presence of the plants and animals identified in the enclosed report may result in this project requiring additional review or permit conditions. For further guidance, and for information regarding other permits that may be required under state law for regulated areas or activities (e.g., regulated wetlands), please contact the appropriate NYS DEC Regional Office, Division of Environmental Permits, as listed at www.dec.ny.gov/about/39381.html.

Sincerely,

Nancy A. Davis

Nancy Davis-Ricci
Environmental Review Specialist
New York Natural Heritage Program

1043

The following rare plants and rare animals have historical records at your project site, or in its vicinity.

The following rare plants and animals were documented in the vicinity of the project site at one time, but have not been documented there since 1979 or earlier, and/or there is uncertainty regarding their continued presence. There is no recent information on these plants and animals in the vicinity of the project site and their current status there is unknown. In most cases the precise location of the plant or animal in this vicinity at the time it was last documented is also unknown.

If suitable habitat for these plants or animals is present in the vicinity of the project site, it is possible that they may still occur there. We recommend that any field surveys to the site include a search for these species, particularly at sites that are currently undeveloped and may still contain suitable habitat.

COMMON NAME	*SCIENTIFIC NAME*	*NYS LISTING*	*HERITAGE CONSERVATION STATUS*	
Vascular Plants				
Small Whorled Pogonia	*Isotria medeoloides*	Endangered *and Federally Listed as Threatened*	Critically Imperiled in NYS and Globally Rare	
1875-06-12: Specimen label: Beneath second growth chestnut in rich and rather moist ground and well-shaded.				5432
Hooker's Orchid	*Platanthera hookeri*	Endangered	Critically Imperiled in NYS	
1912-08-30: Swamp woods.				1023

This report only includes records from the NY Natural Heritage databases. For most sites, comprehensive field surveys have not been conducted, and we cannot provide a definitive statement as to the presence or absence of all rare or state-listed species. This information should not be substituted for on-site surveys that may be required for environmental impact assessment.

If any rare plants or animals are documented during site visits, we request that information on the observations be provided to the New York Natural Heritage Program so that we may update our database.

Information about many of the rare animals and plants in New York, including habitat, biology, identification, conservation, and management, are available online in Natural Heritage's Conservation Guides at www.guides.nynhp.org, from NatureServe Explorer at http://www.natureserve.org/explorer, and from USDA's Plants Database at http://plants.usda.gov/index.html (for plants).

November 5, 2013

Ms. Tara Salerno
NYSDEC-DFWMR
NY Natural Heritage Program
625 Broadway, 5th Floor
Albany, NY 12233-4757

RE: General Electric Company - Fort Edward Former Outfall 004 Site; Biological Information Request

FILE: 612\51119\Corres

Dear Ms. Salerno:

On behalf of the General Electric Company (GE), O'Brien & Gere is performing a Fish and Wildlife Resource Impact Analysis (FWRIA) for the Fort Edward Plant - Former Outfall 004Site (#5-58-004) as part of ongoing Site remedial activities. The Site is located off of Hudson Street, Fort Edward, Washington County, New York. The Site area is roughly 30 acres and is situated along the eastern bank of the Hudson River. The Site is bound by the Hudson River (west), a nearly vertical rocky slope to the east with residential and commercial properties on top of the slope to the north and east, and wooded and open grass areas to the south along the river shoreline.

In accordance with the FWRIA process, O'Brien & Gere requests information regarding the potential presence of sensitive resources including rare, threatened, or endangered animal and plant species, natural communities, and/or significant wildlife habitats at or within a 0.5-mile radius of the Site. Additional information regarding other significant ecological resources, such as wild and scenic rivers, wildlife species of special concern, and records of wildlife mortality would also be greatly appreciated. Please find enclosed a site location map (Figure 1) depicting the Site area.

Thank you for your attention to this matter. If you have any question, please call me at (315) 956- 6229.

Very truly yours,
O'BRIEN & GERE ENGINEERS, INC.

Abby K. Morton

Abby K. Morton
Project Scientist

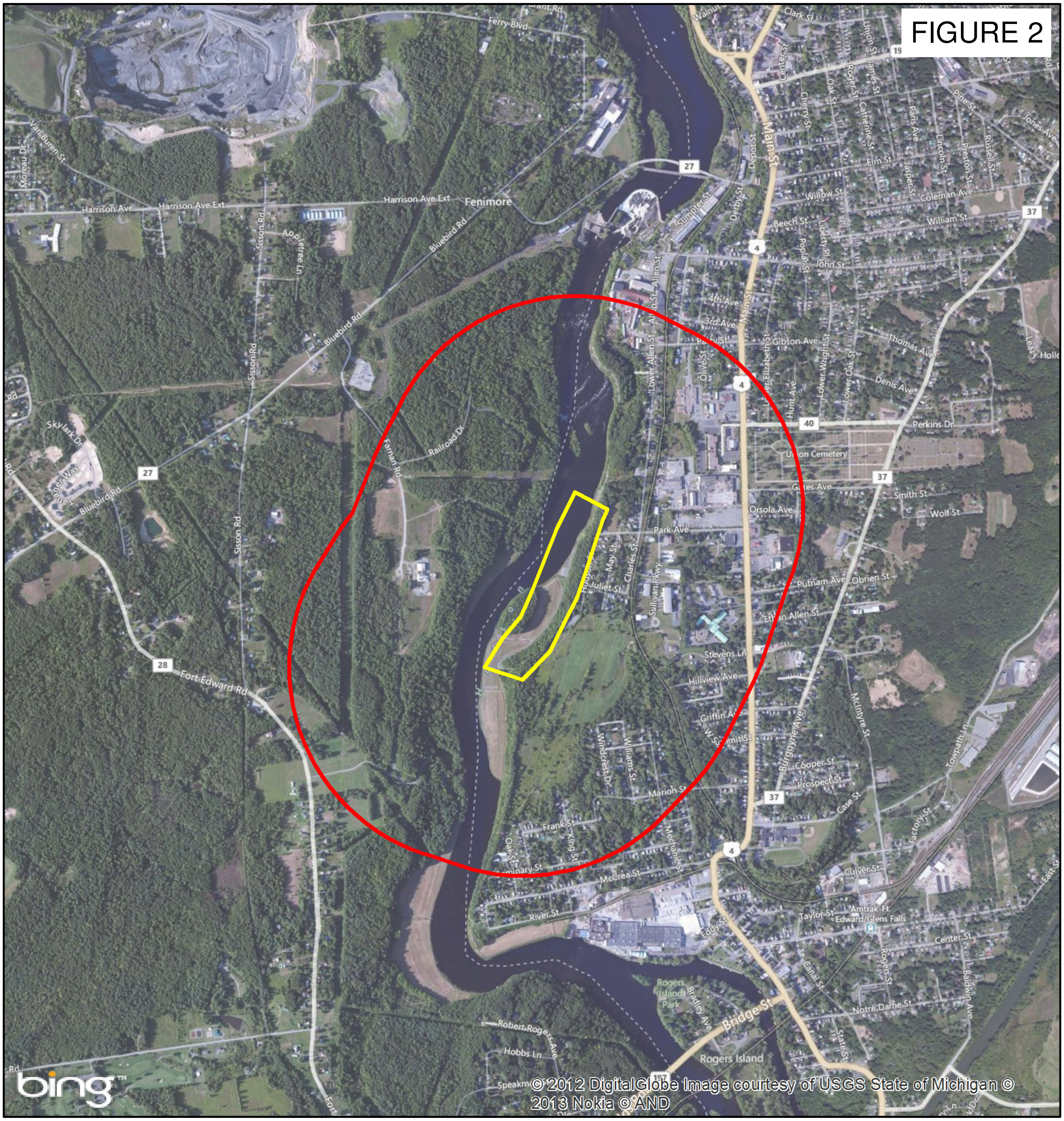
Enclosure (1)

ec: Clare Leary – O'Brien & Gere
Steve Mooney – O'Brien & Gere

I:\Ge-Cep.612\51119.Former-004-Outf\Docs\DWG\MXD\site loc.mxd

PLOTDATE: 11/04/13 2:40:31 PM MortonAK

FIGURE 2



This document was developed in color. Reproduction in B/W may not represent the data as intended.

ADAPTED FROM: HUDSON FALLS USGS QUADRANGLE

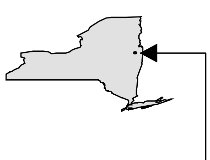
LEGEND

APPROXIMATE SITE BOUNDARY

0.5-MILE RADIUS

GENERAL ELECTRIC COMPANY
FISH AND WILDLIFE
RESOURCE IMPACT ANALYSIS
FORT EDWARD - FORMER OUTFALL 004
FORT EDWARD, NEW YORK

SITE LOCATION



MAP LOCATION

N

0 1,000 2,000 4,000 6,000 8,000

Feet

NOVEMBER 2013
612.51119

1:24,000

O'BRIEN & GERE

U.S. Fish & Wildlife Service Endangered Species Data

U.S. Fish and Wildlife Service

Natural Resources of Concern

This resource list is to be used for planning purposes only — it is not an official species list.

Endangered Species Act species list information for your project is available online and listed below for the following FWS Field Offices:

NEW YORK ECOLOGICAL SERVICES FIELD OFFICE
3817 LUKER ROAD
CORTLAND, NY 13045
(607) 753-9334
http://www.fws.gov/northeast/nyfo/es/section7.htm

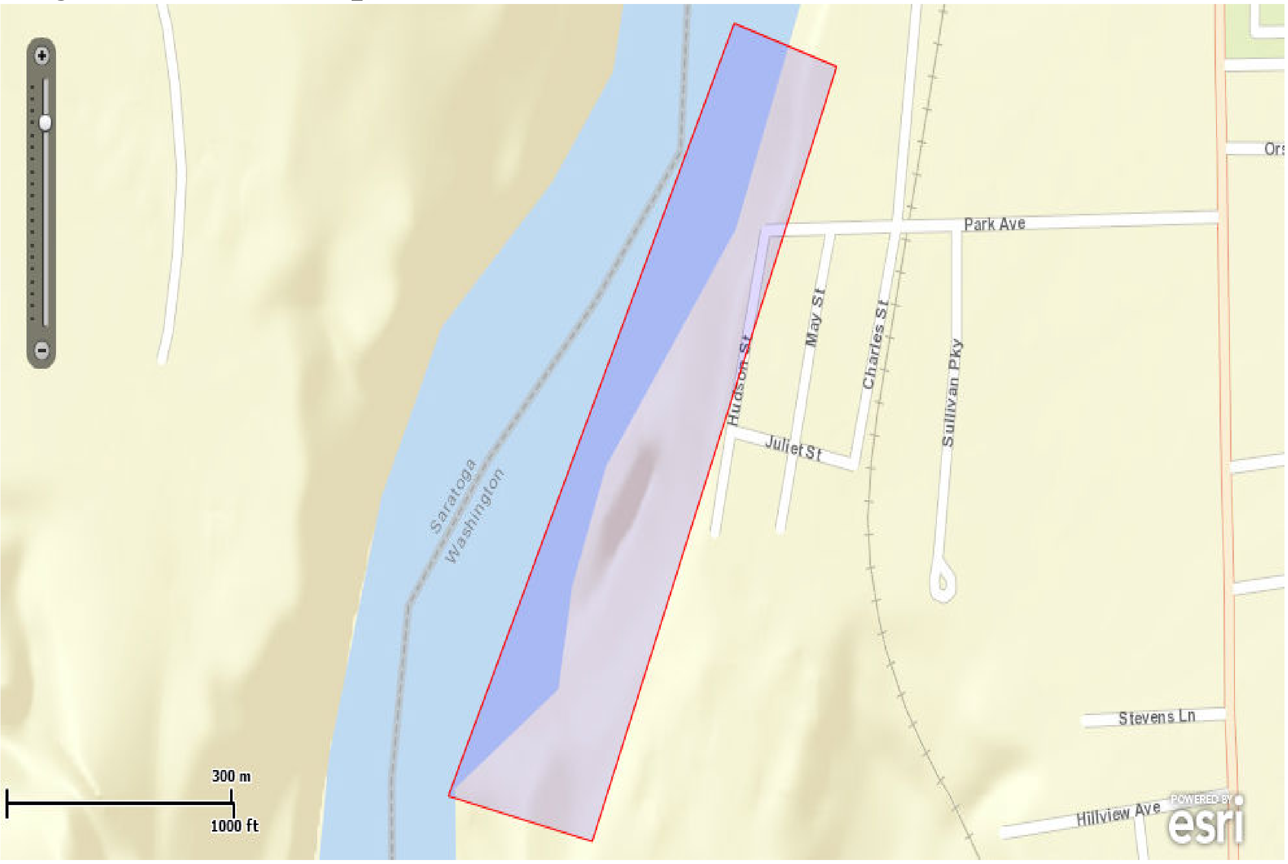
Project Name:

GE-FORT EDWARD

U.S. Fish and Wildlife Service

Natural Resources of Concern

Project Location Map:



Project Location Measurements:

Area : 37.0 ac.

Length : 1.3 mi.

Project Counties:

Washington, NY

Geographic coordinates (Open Geospatial Consortium Well-Known Text, NAD83):

MULTIPOLYGON (((-73.5993447 43.2789074, -73.5946155 43.2861539, -73.5929182 43.2857494, -73.5969651 43.278481, -73.5993447 43.2789074)))

U.S. Fish and Wildlife Service

Natural Resources of Concern

Project Type:

** Other **

Endangered Species Act Species List (USFWS Endangered Species Program).

There are a total of **2** threatened, endangered, or candidate species, and/or designated critical habitat on your species list. Species on this list are the species that may be affected by your project and could include species that exist in another geographic area. For example, certain fishes may appear on the species list because a project could cause downstream effects on the species. Please contact the designated FWS office if you have questions.

Species that may be affected by your project:

Mammals	Status	Species Profile		Contact
Indiana bat (*Myotis sodalis*) Population: Entire	Endangered	species info		New York Ecological Services Field Office
northern long-eared Bat (*Myotis septentrionalis*) Population:	Proposed Endangered	species info		New York Ecological Services Field Office

FWS National Wildlife Refuges (USFWS National Wildlife Refuges Program).

There are no refuges found within the vicinity of your project.

FWS Migratory Birds (USFWS Migratory Bird Program).

Most species of birds, including eagles and other raptors, are protected under the Migratory Bird Treaty Act (16 U.S.C. 703). Bald eagles and golden eagles receive additional protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668). The Service's Birds of Conservation Concern (2008) report identifies species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become listed under the Endangered Species Act as amended (16 U.S.C 1531 et seq.).

Natural Resources of Concern

NWI Wetlands (USFWS National Wetlands Inventory).

The U.S. Fish and Wildlife Service is the principal Federal agency that provides information on the extent and status of wetlands in the U.S., via the National Wetlands Inventory Program (NWI). In addition to impacts to wetlands within your immediate project area, wetlands outside of your project area may need to be considered in any evaluation of project impacts, due to the hydrologic nature of wetlands (for example, project activities may affect local hydrology within, and outside of, your immediate project area). It may be helpful to refer to the USFWS National Wetland Inventory website. The designated FWS office can also assist you. Impacts to wetlands and other aquatic habitats from your project may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal Statutes. Project Proponents should discuss the relationship of these requirements to their project with the Regulatory Program of the appropriate U.S. Army Corps of Engineers District.

The following wetlands intersect your project area:

Wetland Types	NWI Classification Code	Approximate Acres
Riverine	R3USA	17.387183
Riverine	R2UBH	645.920616

Species Conclusions Table

Project Name: GE- Fort Edward (Former 004 Outfall) Fish and Wildlife Impact Analysis – Remedial Investigation

Date: 11/15/13

Species Name/Critical Habitat	Potential Habitat Present?	Species Present?	Critical Habitat Present?	ESA / Eagle Act Determination	Notes / Documentation Summary (include full rationale in your report)
Indiana bat (endangered)	No		No		Potential habitat within forested areas of the study area based on habitat description in USFWS 2007, but habitat is not present within the mowed grass and unpaved road/path covertypes of the Former 004 Outfall location.
northern long-eared bat (proposed endangered)	No		No		Potential habitat within forested areas of the study area based on habitat description in USFWS 2013b, but habitat is not present the mowed grass and unpaved road/path covertypes of the Former 004 Outfall location.
Bald eagle	No		No	Unlikely to disturb nesting bald eagles.	

IPaC - Information, Planning, and Conservation System

Environmental Conservation Online System

[(http://www.fws.gov)](http://www.fws.gov)

IPaC Home Page (/ipac/) **Initial Project Scoping** (/ipac/wizard/chooseLocation!prepare.action)

Project Builder () **FAQs** (/ipac/faqs.jsp)

Step 1 (/ipac/wizard/chooseLocation!prepare.action)
Location

Step 2 (/ipac/wizard/chooseActivities!prepare.action)
Activities

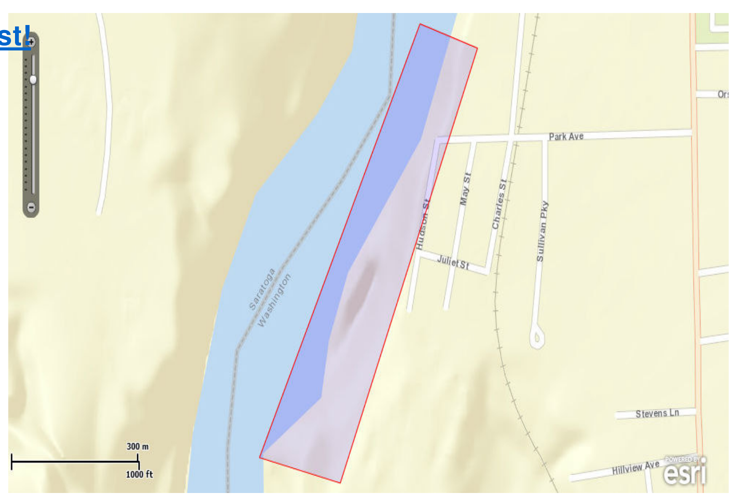
Step 3 (/ipac/wizard/trustResourceList!prepare.action)
Trust resources list

Step 4
Conservation measures

Conservation Measures (CM) Report

Caution!
This portion of the IPaC system is still under development and testing by the U.S. Fish & Wildlife Service. Conservation Measures obtained at this time should not be used as authoritative recommendations for your project.

Project Location Map:



Note: The map reflects the map layers selected on the Step 1 Location page. To change what appears on this map, return

Project Location Measurements:

Area : 37.0 ac.

Length : 1.3 mi.

Project Counties:

Washington, NY

Project type: ** Other **

Conservation Measures (Grouped by Category)

FWS Endangered Species conservation measures are not available for your project online.

Last updated: November 15, 2013

ECOS Home (/ecos/indexPublic.do) | **Contact Us (/ecos/helpdesk.do)**

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O'BRIEN & GERE

A – Remedial Investigation Figures

B – GE Fort Edward Plant Site OU-4

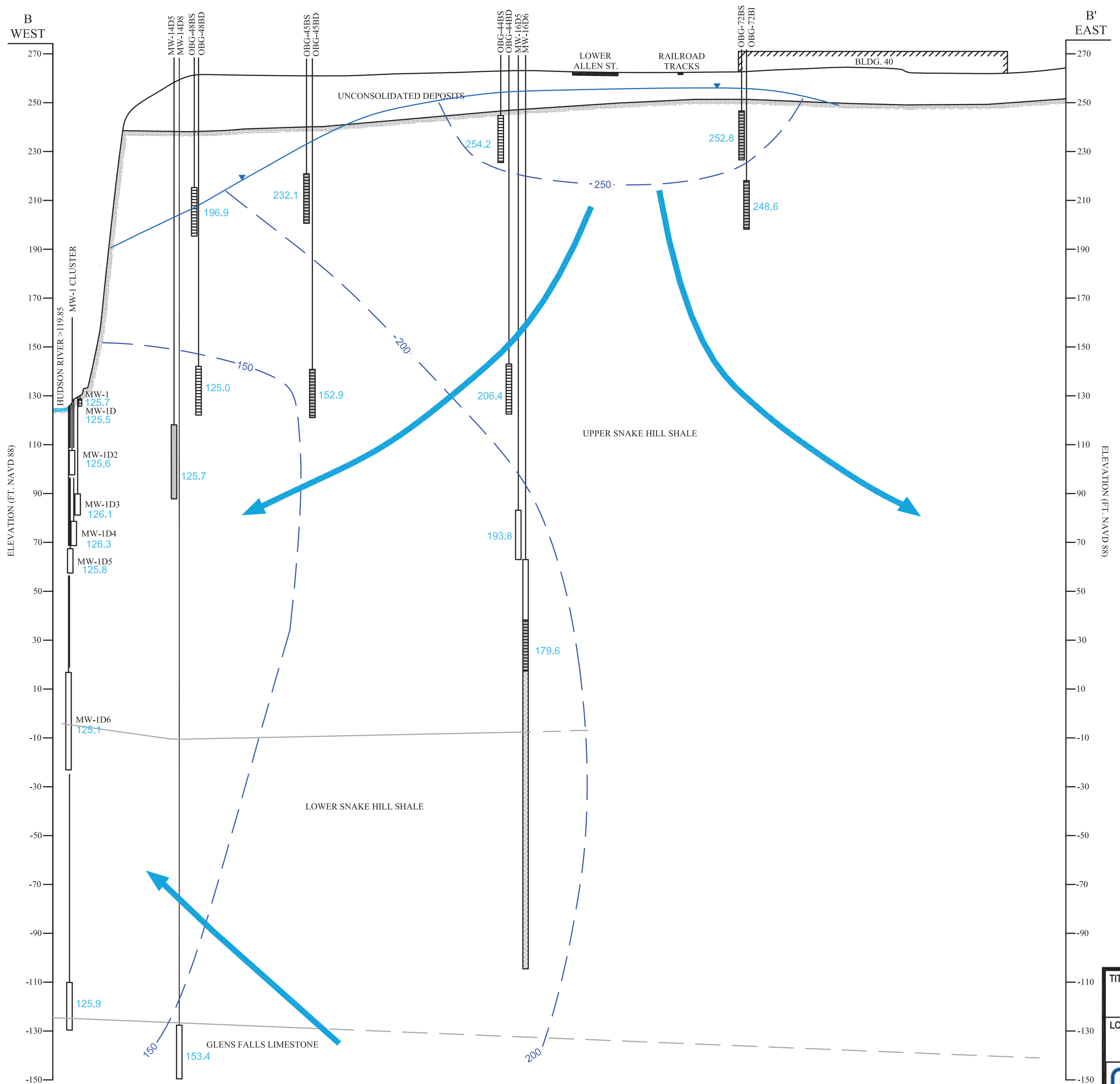
Remedial Investigation Report Figures

A-1 Potentiometric Section B-B' – November 13, 2012 (RI Report Figure 7-9)

A-2 Potentiometric Section C-C' – November 13, 2012 (RI Report Figure 7-10)

A-3 Conceptual Block Diagram (RI Report 8-2)

Figure A-1



EXPLANATION

- MW-13D — WELL DESIGNATION AND APPROXIMATE LOCATION
- GENERALIZED GROUND SURFACE
- OPEN HOLE INTERVAL
- SCREENED INTERVAL
- WELL PROJECTED ONTO SECTION
- GROUTED COREHOLE
- GEOLOGIC CONTACT (DASHED WHERE INFERRED)
- BEDROCK - UPPER SNAKE HILL SHALE
- 203.7 WATER LEVEL ELEVATION MEASURED NOV. 13, 2012
- APPROXIMATE WATER TABLE
- 150 POTENTIOMETRIC CONTOUR
- GENERALIZED GROUNDWATER FLOW DIRECTION

NOTES:

1. REFER TO FIGURE 7-2 FOR THE ORIENTATION OF THE LINE OF SECTION
2. REFER TO BORING AND CORE LOGS FOR DETAILED LITHOLOGIC DESCRIPTION
3. APPROXIMATE LOCATION FOR MW-14D8

0 40
SCALE IN FEET
VERTICAL EXAGGERATION = 2x

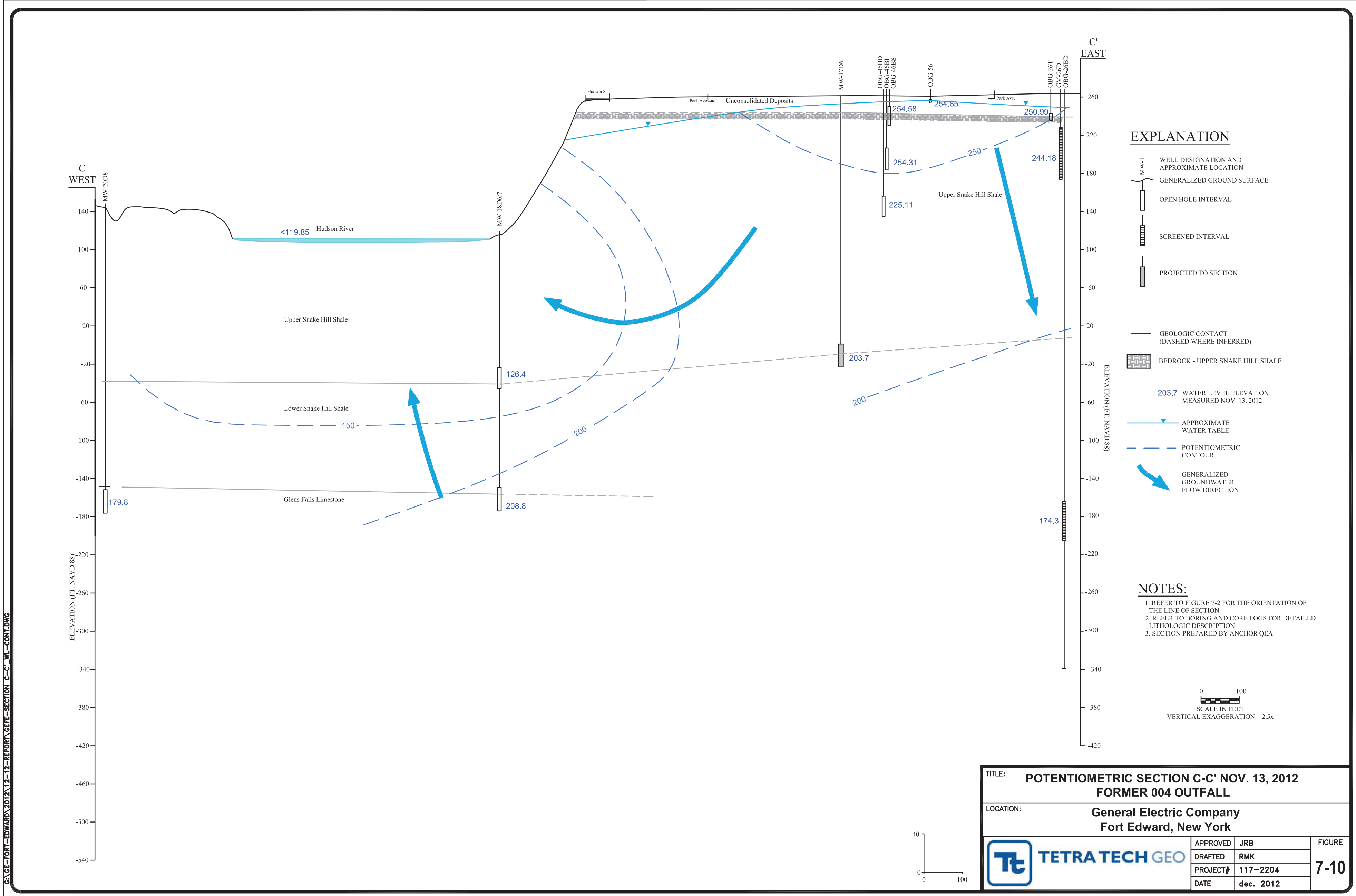
TITLE:	POTENTIOMETRIC SECTION B-B' NOV. 13,2012 FORMER 004 OUTFALL
LOCATION:	General Electric Company Fort Edward, New York

TETRA TECH GEO

APPROVED	JRB	FIGURE
DRAFTED	RMK	7-9
PROJECT#	117–2204	
DATE	DEC. 2012	

G:\GE-FORT-EDWARD\2012\12-12-REPORT\GEFE-SECTION B-B' WL-CONT.DWG

Figure A-2



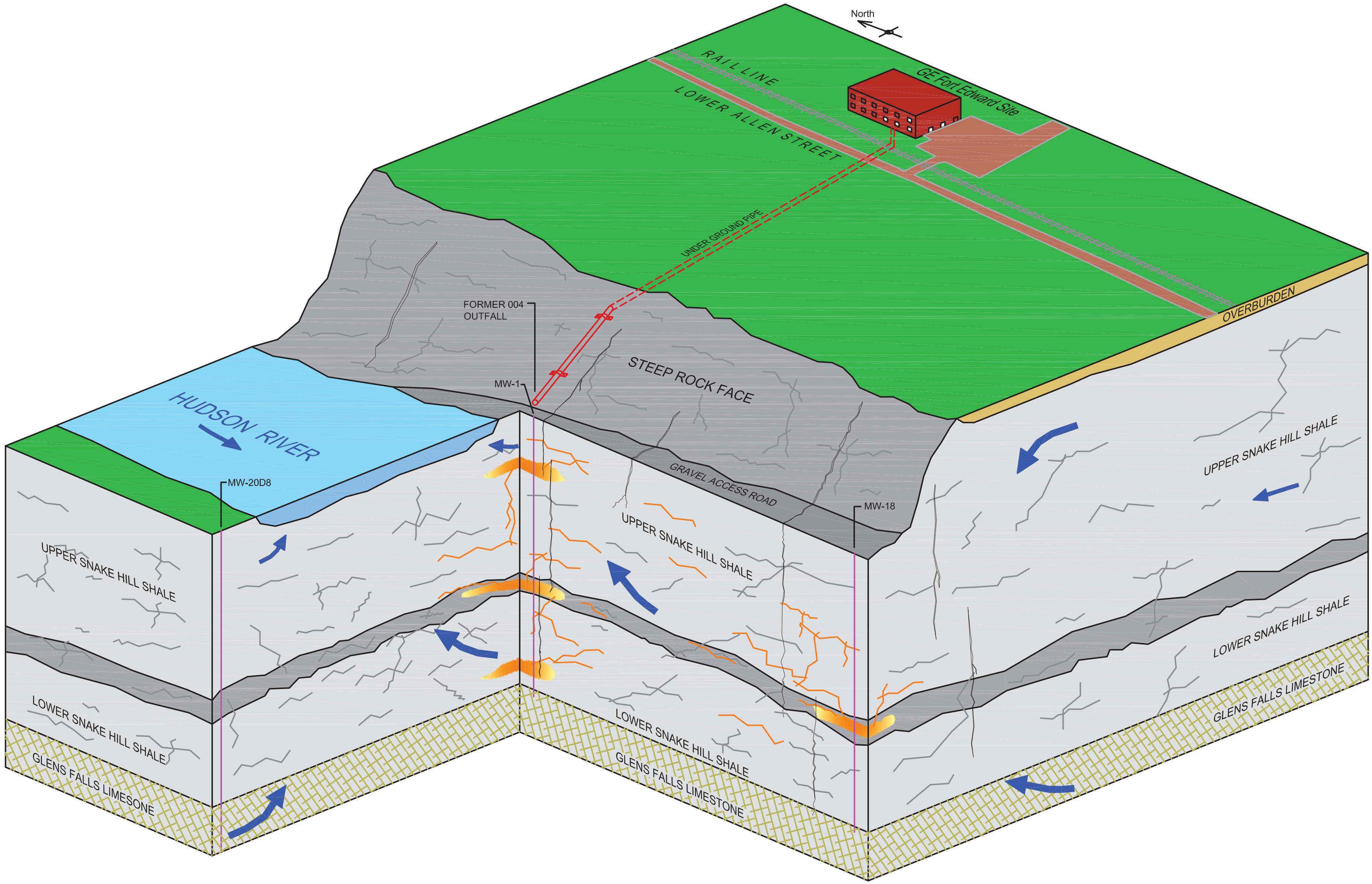
TITLE:	POTENTIOMETRIC SECTION C-C' NOV. 13, 2012 FORMER 004 OUTFALL
LOCATION:	General Electric Company Fort Edward, New York

TETRA TECH GEO

APPROVED	JRB	FIGURE
DRAFTED	RMK	7-10
PROJECT#	117-2204	
DATE	dec. 2012	

Figure A-3

G:\GE-FORT-EDWARD\2012\12-12-REPORT\GE-FE-3D-DIA.DWG



EXPLANATION

- FRACTURE
- OPEN VERTICAL FRACTURE
- FRACTURE WITH DNAPL
- LOCALIZED REGION OF RECOVERABLE DNAPL
- GENERALIZED DIRECTION OF GROUNDWATER FLOW

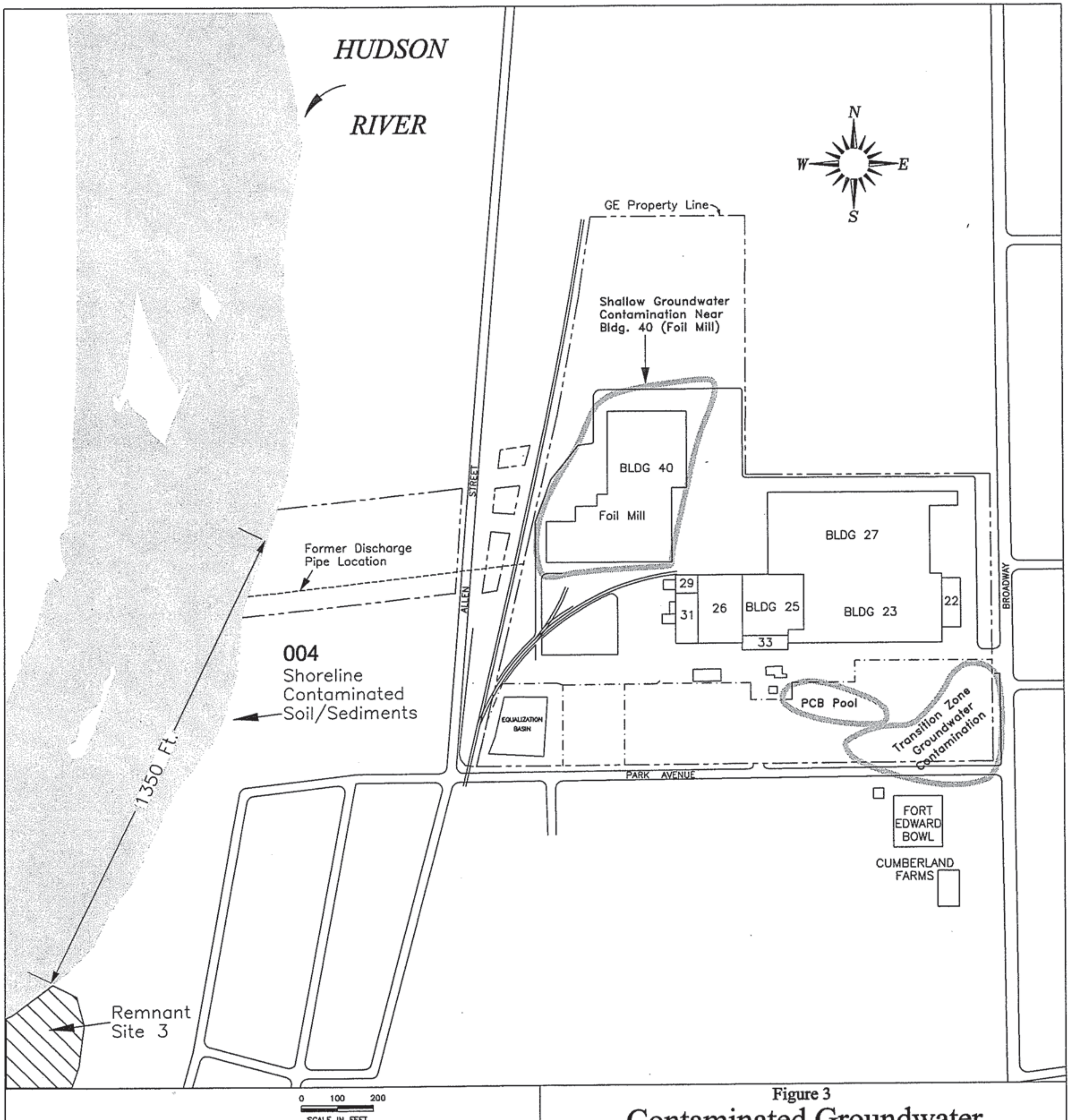
NOT TO SCALE

TETRA TECH GEO

FIGURE 8-2 CONCEPTUAL BLOCK DIAGRAM

GE Fort Edward Plant Site
Operable Unit 4

B-1 OU-4 Site Layout Map from NYSDEC 2000 Record of Decision for OU-3 and OU-4



ports4.dwg, WBW, 10/13/98

Figure 3

Contaminated Groundwater For Operable Unit 03

G.E. Capacitor Prod. Div. (Fort Edward) Site ID No. 558004

Department of Environmental Conservation
Division of Environmental Remediation

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