SAMPLING and ANALYSIS PLAN

1997 Hydro Facility Operations and Thompson Island Pool Monitoring Hudson River Project

General Electric
Corporate Environmental Programs
Albany, New York

March 1997

O'BRIEN & GERE
ENGINEERS, INC.

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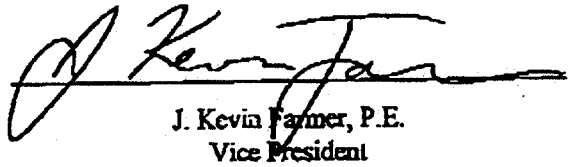

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March 1997

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1. Overview

This sampling and analysis plan (SAP) has been developed by O'Brien & Gere Engineers, Inc. (O'Brien & Gere) in association with HydroQual, Inc. on behalf of the General Electric Company (General Electric). This SAP describes the hydro facility operations and Thompson Island Pool (TIP) monitoring activities to be performed during 1997 on the upper Hudson River (Figure 1).

1.2. Background

General Electric is conducting an extensive investigation during 1997 to evaluate potential causes for the anomalous PCB loading in the TIP (HydroQual, 1995). PCB loading attributable to diffusive flux based on principles of equilibrium partitioning is not sufficiently high to account for the water column PCB concentrations measured at Thompson Island Dam. The Hydro Facility Maintenance Operations and TIP Monitoring Program is one component of a larger study, the Water Column Monitoring Study, to be conducted by General Electric during 1997. The Water Column Monitoring Study will also include the High Flow Monitoring Program (HydroQual, 1997a) and the Ground Water Seepage Investigation (HydroQual, 1997b).

Several hypotheses have been developed to account for the anomalous PCB loading (HydroQual, 1997a). These hypotheses are as follows:

- The mass and concentration of PCBs entering the TIP are greater than the mass and concentration measured at the Rogers Island monitoring station due to pulsed loadings from the Bakers Falls area or due to PCB transport in the bedload; either of which is undetected by water column monitoring.
- PCB concentrations measured at the Thompson Island Dam monitoring station are greater than the PCB concentrations present throughout the total river flow as it passes over the dam.
- Ground water inflow to the TIP is transporting PCBs from buried sediment to the water column.

- PCB concentrations in surficial sediment are greater than surface sediment data as a result of a release of PCBs from the Allen Mill (O'Brien & Gere, 1994a).

- Significant quantities of PCBs are entering the TIP between Rogers Island and the TIP from areas such as dredge spoil sites .

- Resuspension of surficial sediment contributes a significant quantity of PCBs into the TIP water column.

Several sampling and analysis programs have been performed, or are being performed, to evaluate these hypotheses (O'Brien & Gere, 1996a; O'Brien & Gere, 1997a; HydroQual, 1996a; HydroQual, 1996b). This SAP has been developed to evaluate the potential for pulsed loadings of PCBs to enter the river undetected, and to assess whether the Thompson Island Dam monitoring station is representative of the entire water column or whether the PCB concentrations measured at Thompson Island Dam may be resulting in an overestimation of PCB loading attributable to the TIP.

Pulsed loadings from the Bakers Falls area are possible due to the known migration of PCBs in dense non-aqueous phase liquid (DNAPL) form through fractures in bedrock from the General Electric Hudson Falls facility to the Hudson River. DNAPL seeps have been identified in Bakers Falls and the plunge pool located at the base of the falls. It is possible that accumulations of DNAPL on the falls and in the plunge pool may be mobilized during periods of elevated flow over the falls and/or through the plunge pool.

Under normal flow conditions (approximately 8,000 cfs or less), Bakers Falls is dewatered due to diversion of flow through the Adirondack Hydro Development Corporation (AHDC) hydro facility at Bakers Falls, which began operation in December 1995. Pulsed loadings of PCBs to the river may result from routine maintenance activities performed at the hydro facility. These maintenance activities involve short-term (approximately 20 minutes) shut-down of the facility, with temporary diversion of flow through a bypass that discharges directly into the plunge pool. Short-term flows over the falls are also typical during the maintenance activities. These flows may mobilize DNAPL that has accumulated on the falls or within the plunge pool. As the routine river monitoring is conducted once per week, and the hydro facility maintenance activities are typically conducted at approximately three- to four-day intervals, it is possible that pulsed loadings of PCBs are entering the river and are not detected by the routine river monitoring. During high flow and the fall season, hydro facility maintenance operations are conducted more frequently, as much as once per day.

To evaluate the representativeness of data collected at the Thompson Island Dam sampling station, water column monitoring activities have been performed along a transect located just upstream of the Thompson Island Dam (Figure 2, Transect 18) in conjunction with the collection of samples at the monitoring station on the west wing wall of the dam (HydroQual and O'Brien & Gere, 1996a; O'Brien & Gere, 1997a). The results of this monitoring suggest that PCB concentrations at the routine monitoring station are elevated above the concentrations measured across the channel at the transect location. For two time-of-travel sampling events conducted in 1996, the PCB loading estimated at the monitoring station averaged approximately two times higher than the PCB loading estimated at Transect 18 (O'Brien & Gere, 1997a).

1.2. Objectives

The objectives of this SAP are:

- to identify the impact that pulsed loadings of PCBs from the Bakers Falls area may be having on PCB concentrations in the TIP
- to assess whether PCB concentrations measured at the Thompson Island Dam monitoring station are representative of the total river flow as it passes over Thompson Island Dam.

2. Sampling program

To accomplish the objectives of this SAP, the following water column monitoring activities will be conducted:

- Hydro facility operations sampling
- Plunge pool dye study and TIP time-of-travel survey
- TIP sampling.

Hydro facility operations sampling, and the plunge pool dye study and TIP survey will be performed as time-of-travel sampling events. For these events, the flow rate of the Hudson River will be monitored by obtaining instantaneous water levels from the United States Geological Survey (USGS) gaging station in Fort Edward during each sampling event. Time-of-travel sampling will utilize estimates developed from field experience obtained during the transect sampling conducted during the 1995 River Monitoring Test (O'Brien & Gere, 1996a), the 1996 Water Column Monitoring Study (O'Brien & Gere, 1997a), float surveys conducted for the Post-Construction Remnant Deposits Monitoring Program (PCRDMP) (O'Brien & Gere, 1993a, 1993b, 1994b), and time-of-travel studies by others (Tofflemire, 1984; USGS, 1969). The timing of sampling will be based on the instantaneous flow readings obtained from the USGS gaging station at Fort Edward prior to sampling and on the time-of-travel estimates for a parcel of water.

Details of these sampling events are provided below.

2.1. Hydro facility operations sampling

Hydro facility operations sampling will be conducted to evaluate the potential relationship between short-term increases in flow through the plunge pool (and inundation of Bakers Falls), pulsed loadings of PCBs to the river, and water column PCB transport downstream.

2.1.1. Field activities

The hydro facility operations sampling frequency will be biweekly during the summer low flow period in 1997. Ten hydro facility operations sampling events will be performed. This sampling will be coordinated with AHDC.

It is anticipated that water column samples will be obtained from four stations on the river, as outlined in Table 1.

Table 1. Sample locations and collection procedures

Site Location	Sampling Responsibility	Location Description	River Mile	Sample Collection
County Route 27 (Fenimore Bridge)	O'Brien & Gere	Adjacent to Bakers Falls, upstream of remnant deposits	HRM 197.0	Depth-integrated composite sample collected at middle of river from bridge
Plunge Pool/ Boat Launch	Dames & Moore	Below Bakers Falls	HRM 196.9	Depth sample collected approximately 3 feet from bottom.
Fort Edward, Route 197	O'Brien & Gere	Downstream of Remnant deposits	HRM 194.2	Composite sample collected from bridges. Composite composed of depth-integrated samples collected separately from east and west channels
Thompson Island Dam	O'Brien & Gere	Downstream of Thompson Island Pool	HRM 188.5	Grab sample collected from edge of west dam abutment

Note: HRM = Hudson River Mile. Mile 0.0 is located at the Battery in New York City

Source: O'Brien & Gere Engineers, Inc.

During low flow periods (less than approximately 8,000 cfs), hydro facility maintenance operations typically cause short-term flows to the plunge pool and over Bakers Falls lasting approximately 20 minutes. Otherwise, there is minimal current in the plunge pool, and the falls are generally dewatered. It is assumed that one round of time-of-travel samples will be collected for the routine PCRDMP samples approximately two hours before the hydro facility maintenance activities (before). An additional round of sampling will be performed after hydro facility maintenance operations are completed (after), at which time the discharge to the plunge pool will have stopped and the falls will be inactive. Sample collection times for downstream sampling stations will be based on time-of-travel estimates and instantaneous flow measurements obtained from the USGS. For Thompson Island Dam sampling, two rounds will be collected after hydro facility maintenance operations due to the accuracy limitations of instantaneous flow measurements.

2.1.2. Analytical testing

Water samples collected for the water column characterization will be analyzed for PCB congeners using method NEA608CAP. A subset of samples may be analyzed for PCBs by method NEA608CAP modified to include an independent separation and quantification of congeners contained in method NEA608CAP peaks 5, 8 and 14 (BZ4 and BZ10, BZ5 and BZ8, and BZ18 and BZ15, respectively) on a CP-SIL5-C18 capillary column. Total suspended solids (TSS) will be analyzed by USEPA Method 160.2. Both analyses will be performed by Northeast Analytical, Inc. It is assumed that quality assurance/quality control (QA/QC) samples collected for the routine PCRDMP will be sufficient for evaluation of data quality of the hydro facility samples.

2.1.3. Sampling and analytical procedures

Specific sample collection, handling, and analytical procedures for the water column characterization are consistent with those presented in the PCRDMP field sampling plan (FSP; O'Brien & Gere, 1992a), PCRDMP quality assurance project plan (QAPP; O'Brien & Gere, 1992b) and the PCRDMP Health and Safety Plan (HASP; O'Brien & Gere, 1992c), as addended for the 1995 River Monitoring Test (O'Brien & Gere, 1996a). Additional details of the field sampling program were provided in an addendum to the FSP included in the 1995 PCRDMP report (O'Brien & Gere, 1996b).

It is assumed that PCB data generated for the hydro facility monitoring will be packaged as standard analytical test results and that a completely data validatable package (*i.e.*, Contract Laboratory Program [CLP] type) will not be required. The laboratory will maintain complete data records should complete validation of the hydro facility operations data be desired in the future.

2.2. Plunge pool dye study and TIP time-of-travel survey

This field event is intended to monitor a single parcel of water originating from the plunge pool at the base of Bakers Falls as it travels through the TIP. The time-of-travel survey through the TIP will be coordinated with a round of hydro facility operations sampling. Therefore, if a pulsed loading of PCBs occurs during hydro facility maintenance operations, sampling of the parcel of water to be monitored will be timed to coincide with this pulse. As previously discussed, generally, Bakers Falls is inactive due to diversion of flow through the hydro facility; however, hydro facility maintenance activities result in short-term discharges to the plunge pool and inundation of the falls. This task

is designed to investigate the potential relationship of hydro facility maintenance activities to water column transport of PCBs through the TIP. To accomplish this task, dye will be released in the plunge pool before hydro facility maintenance operations are initiated. Subsequently, a hydro facility maintenance event will be performed (as described in Section 2.1). Dye concentrations in river water downstream of the plunge pool will be measured in the field to monitor the position of the parcel of water impacted by the hydro facility maintenance operations as it travels downstream. The timing of water sampling will be calibrated to the time of travel indicated by the concentration of the dye.

2.2.1. Field activities

The plunge pool dye study and TIP time-of-travel survey will be performed as soon as the spring high flow period has subsided. Typically, the highest PCB loading measured at Thompson Island Dam is experienced immediately after the spring high flow subsides. For this study, dye will be released to the plunge pool of Bakers Falls when the falls is inactive. The first round of hydro facility operations sampling (before inundation of the falls) will be collected prior to hydro facility maintenance operations start-up to obtain an estimate of the initial dye concentration/mass. Then, hydro facility maintenance operations will be performed, causing flow through the plunge pool and inundation of the falls. After completion of the hydro facility operations, the parcel of water originating from the plunge pool will be monitored as it progresses downstream through the TIP. The time-of-travel survey will be initiated upon identification of dye in the water column at Rogers Island.

The time-of-travel survey through the TIP will be performed using procedures developed for the 1996 Water Column Monitoring Study (HydroQual and O'Brien & Gere, 1996b). Specifically, eighteen transects will be located along the length of the pool with three stations across the river perpendicular to flow at each transect (*e.g.*, west, center and east portions of the river). Samples will be collected from three boats simultaneously. Samples will be collected at each station as depth-integrated composite samples consisting of surface, mid, and deep aliquots.

The procedures used for the 1997 TIP time-of-travel survey will differ from the 1996 study in two ways. First, sampling will be based on results of real-time dye analyses that will be used to confirm the time of travel of the subject parcel of water. Second, time-of-travel samples will be collected from the TIP dam abutments for comparison with the TIP sampling results.

One or two weeks before this sampling event occurs, a preliminary dye test will be performed to evaluate the hydrodynamics of the plunge pool. It is

anticipated that dye concentrations may be detectable after inundation of the falls and that additional hydro facility maintenance events may be simulated on the same day to obtain an estimate of dye mass release rates from the pool. This preliminary dye sampling will allow an assessment of the water turnover rate in the plunge pool and refinement of time-of-travel estimates of water originating from the plunge pool for the TIP time-of-travel survey. It is anticipated that dye samples will be collected and analyzed in the field as required for this preliminary dye test.

2.2.2. Analytical testing

Water samples collected for the water column characterization will be analyzed for PCB congeners using method NEA608CAP. A subset of samples may be analyzed for PCBs by method NEA608CAP modified to include an independent separation and quantification of congeners contained in method NEA608CAP peaks 5, 8 and 14 (BZ4 and BZ10, BZ5 and BZ8, and BZ18 and BZ15, respectively) on a CP-SIL5-C18 capillary column. Total suspended solids (TSS) will be analyzed by USEPA Method 160.2. Both analyses will be performed by Northeast Analytical, Inc. Three sets of QA/QC samples consisting of matrix spike, duplicate and equipment blank samples will be collected to maintain a 5% ratio with the field samples collected.

Dye samples will be analyzed in the field using a field fluorometer in accordance with the procedures specified in the addendum to the PCRDMP QAPP prepared for the 1995 River Monitoring Test (O'Brien & Gere, 1996a).

2.2.3. Sampling and analytical procedures

Specific sample collection, handling, and analytical procedures for the water column characterization are consistent with those presented in the FSP (O'Brien & Gere, 1992a), QAPP (O'Brien & Gere, 1992b), and HASP (O'Brien & Gere, 1992c), as addended for the 1995 River Monitoring Test (O'Brien & Gere, 1995, 1996a). Additional details of the field sampling program were provided in an addendum to the FSP included in the 1995 PCRDMP report (O'Brien & Gere, 1996b). for the PCRDMP.

It is assumed that PCB data generated for the TIP time-of-travel survey will be packaged as standard analytical test results and a completely data validatable package (*i.e.*, CLP type) will not be required. The laboratory will maintain complete data records should complete validation of the data be desired in the future.

2.3. TIP sampling

The TIP sampling will be conducted to compare PCB concentrations measured at the routine sampling station at the west abutment of Thompson Island Dam with PCB concentrations measured near the center of the channel. These data will be used to assess whether the routine sampling location is representative of overall water column concentrations discharged from the TIP.

2.3.1. Field activities

It is anticipated that water column samples will be obtained from the center of the river in the vicinity of the TIP transect area established in 1995 and 1996 (Transect 18; Figure 2). For each sampling round, a depth-integrated sample will be collected using a Kemmerer sampler. It is assumed that approximately eight rounds of sampling will be conducted. The sampling frequency is assumed to be weekly beginning at the end of the high flow period, typically the beginning of May.

2.3.2. Analytical testing

Water samples collected for the water column characterization will be analyzed for PCB congeners using method NEA608CAP. A subset of samples may be analyzed for PCBs by method NEA608CAP modified to include an independent separation and quantification of congeners contained in method NEA608CAP peaks 5, 8 and 14 (BZ4 and BZ10, BZ5 and BZ8, and BZ18 and BZ15, respectively) on a CP-SIL5-C18 capillary column. Total suspended solids (TSS) will be analyzed by USEPA Method 160.2. Both analyses will be performed by Northeast Analytical, Inc. It is assumed that QA/QC samples collected for the routine PCRDMP will be sufficient for evaluation of the data quality of the TIP samples.

2.3.3. Sampling and analytical procedures

Specific sample collection, handling, and analytical procedures for the water column characterization are consistent with those presented in the FSP (O'Brien & Gere, 1992a), QAPP (O'Brien & Gere, 1992b), and HASP (O'Brien & Gere, 1992c), as addended for the 1995 River Monitoring Test (O'Brien & Gere, 1995, 1996a). Additional details of the field sampling program were provided in an addendum to the FSP included in the 1995 report (O'Brien & Gere, 1996b) for the PCRDMP.

It is assumed that PCB data generated for the TIP sampling will be included with the PCRDMP samples as a completely data validatable deliverable package.

3. Deliverables

A non-interpretive data summary report will be prepared that will include a description of the objectives, methods, and data associated with the completion of the 1997 hydro facility operations and Thompson Island Pool monitoring.

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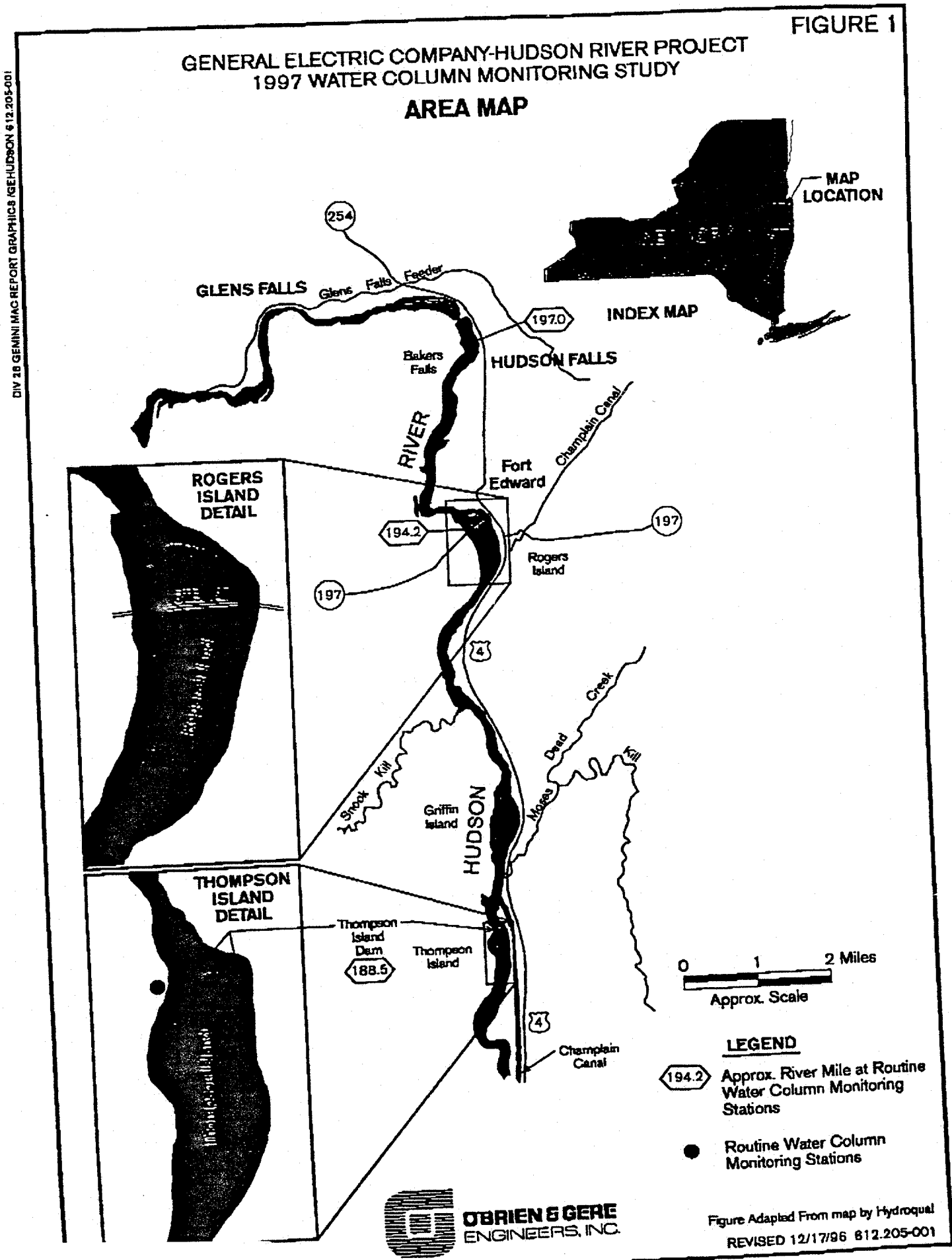
Figures

FIGURE 1

GENERAL ELECTRIC COMPANY-HUDSON RIVER PROJECT
1997 WATER COLUMN MONITORING STUDY
AREA MAP



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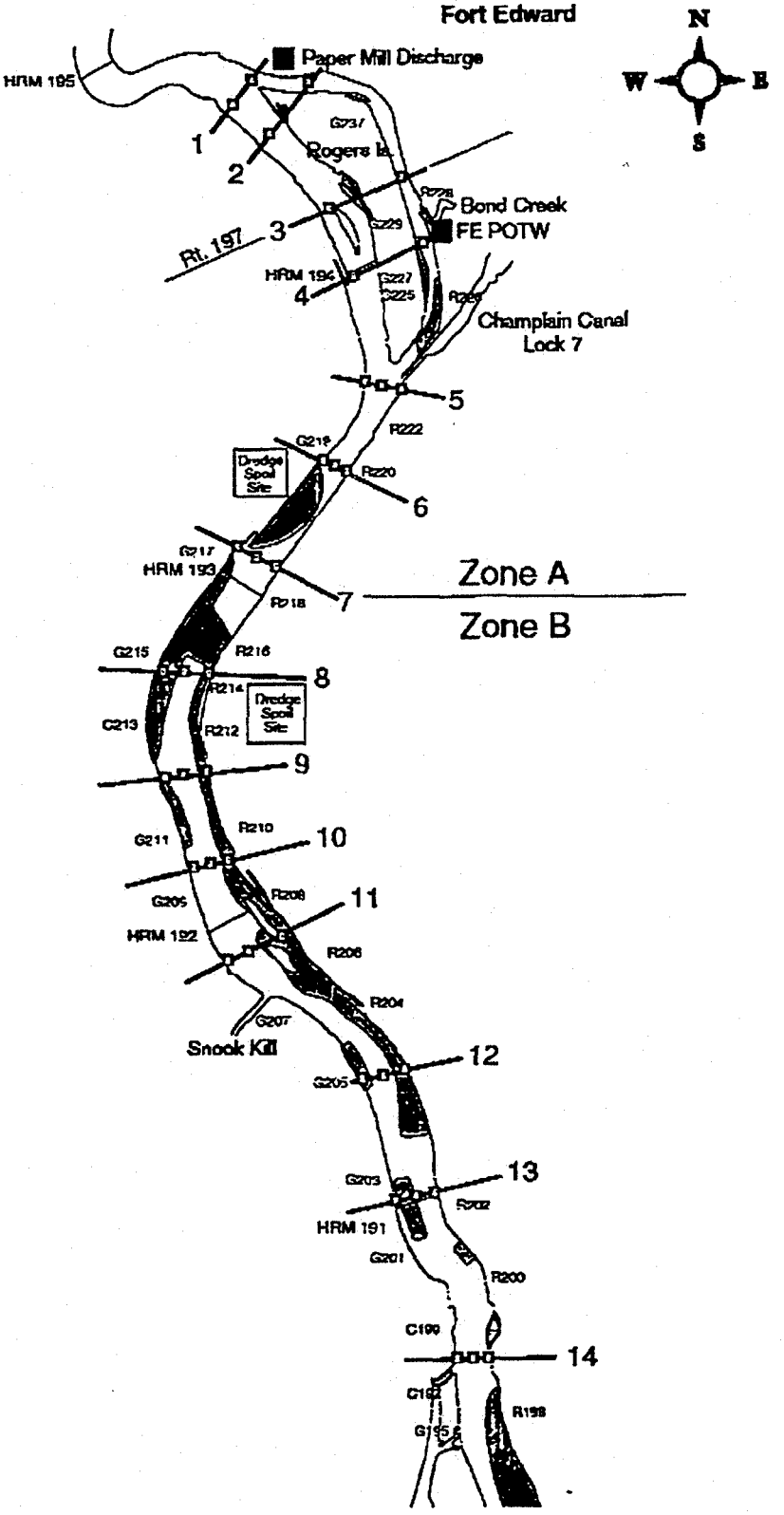
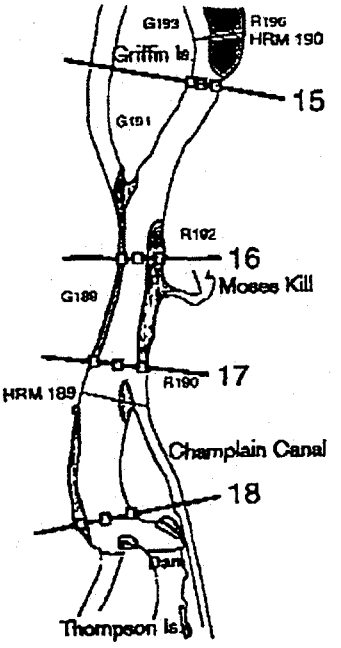
GENERAL ELECTRIC COMPANY-HUDSON RIVER PROJECT
1997 WATER COLUMN MONITORING STUDY

TIP TIME OF TRAVEL SURVEY LOCATIONS





0 1.0 2.0 Miles

Approximate Scale

Legend

18 Transect

HRM 189 Mile mar

Sample

G237 Green M

R228 Red NO

Hotspot

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