

**FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR THE
CROTON WATER TREATMENT PLANT
METHODOLOGIES**

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4.17. ELECTRIC AND MAGNETIC FIELDS (EMF) AND EXTREMELY LOW FREQUENCY FIELDS (ELF) ANALYSIS

Numerous studies have been conducted in an attempt to determine whether there is a direct link between electric/magnetic field exposure and adverse biological effects. (Most recent research has focused on the potential human health effects of magnetic fields.) This issue is still being debated, although no consensus on scientific conclusions has been reached. Advancing a definitive determination on this issue is beyond the scope of this Supplemental Environmental Impact Statement (SEIS). In order to avoid this debate in the context of this proposal, New York City Department of Environmental Protection (NYCDEP) has committed to design the proposed project in such a manner that there would be no discernable Electric and Magnetic Fields and Extremely Low Frequency Fields (EMF/ELF) emissions beyond background levels. The methodology described below has been developed with that goal in mind.

4.17.1. Introduction

Electric and Magnetic Fields (EMF) surround any electrical devices that carry an electrical charge and/or current. The electricity used in the United States consists of voltages and currents that alternate at a frequency of 60 cycles per second or 60 Hertz (Hz). Such fields are categorized as Extremely Low Frequency (ELF). People are periodically exposed to these 60 Hz fields to varying degrees from a variety of sources. Examples of EMF sources include:

- Outdoor power lines
- Lighting and transformers
- Trains and automobiles
- Indoor lighting systems
- Heating, ventilation, and air conditioning systems
- Computers, copiers, telephones, and fax machines
- Industrial motors, generators, and miscellaneous electrical equipment
- Indoor wiring
- Household appliances such as refrigerators, televisions, radios, washers, microwaves, toasters and clocks
- Electric blankets and shavers
- Cellular telephones

Electric fields exist near electric equipment like that proposed for the proposed Croton Water Treatment Plant (WTP), as well as near home appliances that are plugged into electrical outlets. They are present even when the equipment is turned off, as long as it remains connected to the source of electric power. Electric fields increase in strength as the rated voltage increases. The electric field strength is measured in units of volts per meter (V/m).

Magnetic fields result from the flow of current through wires or electrical devices and increase in strength as the current increases. Magnetic fields or magnetic flux density is measured in units of gauss (G) or tesla (T).

While electric fields are easily shielded or weakened by conducting objects (e.g. trees, buildings, human skin), magnetic fields are not. Magnetic fields pass through most materials and are more difficult to shield. Both electric and magnetic fields, however, weaken with distance from the source. Line sources of magnetic fields, such as power lines, decay with distance based on the formula:

$$1/(\text{distance from the source})^2$$

Point sources of magnetic fields, such as stationary equipment, decay with distance based on the formula:

$$1/(\text{distance from the source})^3$$

4.17.2. Baseline Conditions

4.17.2.1. Existing Conditions

Electric and magnetic fields were measured at the northern boundary of the Eastview Site (Town of Mt. Pleasant, NY), around the Mosholu Site (the Bronx, NY), and around the Harlem River Site (the Bronx, NY), along the Consolidated Edison Company of New York's (Con Edison) proposed feeder lines, and at the off-site facilities. The purpose of these measurements was to establish baseline data used for comparison with the projected water treatment plant's operational levels.

4.17.2.1.1. Measurement Protocols

A formal protocol (by manufacturers or legislation) for conducting electric and magnetic field surveys has not yet been established for several reasons:

- Federal and state standards have not been established for public and occupational exposure to electric and magnetic fields.
- Implementation of formal standards could require years of research and technical and public debate.

- Every site has unique characteristics that make generalized sampling programs difficult to establish.
- Liability issues have prevented many consultants, manufacturers, and regulatory agencies from establishing a formal sampling protocol.

However, standards for measuring the strength of electric magnetic fields have been developed by the National EMF Measurement Protocol Group (NEMPG). NEMPG represents a wide variety of utilities and trade associations. The protocol was designed by trade associations including American Public Power Association, Edison Electric Institute, and National Rural Electric Cooperative Association. NEMPG also incorporated measurement criteria developed by the Institute for Electrical and Electronics and the Electrical Power Research Institute. The protocol was primarily intended to respond to the needs and concerns of residential utility customers.

4.17.2.1.2. Field Measurement Locations and Times

EMF baseline measurements were taken at the three potential water treatment plant sites and at the off-site facilities following the NEMPG protocol. At each of the water treatment plant study locations, approximately ten points were chosen to measure the electric and magnetic fields. The measurements were performed along the proposed limits of construction on the sides that face the sensitive receptor, i.e. the public access locations.

To measure the line sources, three sample spots per mile were chosen along each of the Con Edison feeder routes: from the Con Edison substation adjacent to the southeast corner of the Eastview Site north of Grasslands Road to the Eastview Site, from the Washington Street substation in Mt. Vernon to the Moshulu Site in the Bronx and from East 179th Street-Con Edison substation on 3rd Avenue in the Bronx to the Harlem River Site. Site maps were prepared to identify the sampling points. These appear in the specific analysis for each site.

4.17.2.1.3. Equipment

A Holaday meter, which is recommended by the National EMF Measurement Protocol Group, was used in the survey of electric and magnetic fields at the three proposed sites.

The Holaday meter model HI-3604 is a single axis Faraday induction coil probe. The signal from the induction coil probe is transferred and processed through a detector circuit, which produces an output in units of magnetic flux density. It uses an average sensing root-mean-square (rms) detector. The rms detectors accurately measure fields that have various waveforms. The Holaday meter uses a single coil that measures the vector component of each field one at a time; the resultant field is then calculated manually. Magnetic flux density measurements are shown in units of milligauss (mG).

Electric fields are measured by a displacement current sensor. In this device, the charge induced on a pair of conducting plates by the electric field is sensed and converted by the meter into a digital readout in V/m.

In accordance with the NEMPG protocol, the meter has a direct numerical output in units of mG and V/m. Meters with direct numerical output are recommended for accuracy. The Holaday meter has an auto-ranging feature and an out-of-range detector.

The Holaday meter is designed to evaluate electric and magnetic fields associated with 50/60 Hz power lines and electrically operated equipment and appliances. In addition, the meter is designed to measure electric and magnetic field strengths at discrete locations. The meter was last calibrated in May 2002 by a certified manufacturer according to the National Institute of Standards and Technology (NIST) Standard No. IR 86-3330. Prior to measurements done at the Mosholu Site, the most recent calibration was in February 1998. Mosholu Site field measurements were conducted in March and July 1998.

All EMF measurements were made at a height of three feet above the ground (waist high), with the exception of measurements near certain electrical equipment. Electric and magnetic readings collected with the Holaday meter were obtained with the operator holding the meter probe approximately three feet away from his or her body. All methods were based on the NEMPG recommended protocol.

4.17.2.1.4. Holaday Meter Measurement Methods

The following procedures were used when conducting magnetic field measurements with a single axis meter, such as the Holaday meter:

1. As each spot measurement was made, the probe was rotated until a maximum magnetic field was indicated. This value was recorded as "Bmax."
2. The probe was pivoted from the same spot, oriented so that its axis was placed in a horizontal position. This value was recorded as "Bx." The direction in the horizontal plane was consistently chosen to be perpendicular to the source being measured.
3. The probe was pivoted from the same spot to a position orthogonal (90 degrees) to the chosen "x" direction, still in the horizontal plane. This value was recorded as "By." The "x" direction was perpendicular to the source; the "y" direction was parallel to the source.
4. The probe was pivoted upward from the same spot so that it was in a vertical position, and orthogonal to both the "x" and "y" positions chosen previously. This value was recorded as "Bz."
5. The resultant field (Bres) was calculated as shown below:

$$B_{res} = (B_x^2 + B_y^2 + B_z^2)^{\frac{1}{2}}$$

This calculation was done after the field survey was completed using the Bx, By, and Bz values measured in the field.

Electric and magnetic field measurements obtained with the Holaday meter were entered into a field log. The field log included the location, date, time, temperature, weather conditions, personnel, and the instrument's operating voltage.

4.17.2.1.5. Guidelines

International Radiation Protection Association (IRPA) issued interim standards for electric and magnetic field exposure limits for the general public in 1990 based upon the 1984 World Health Organization Guidelines. The general public limit for electric field strengths is 5,000 V/m. In addition, New York State (NYS) uses informal guidelines to limit electric and magnetic field strengths along rights-of-way (ROW) for overhead power transmission lines (Table 4.17-1). This standard was based on the maximum fields that existing lines in New York State produce under maximum load-carrying conditions. Its purpose is to ensure that future lines do not exceed current EMF levels. Two organizations have also developed guidelines for 60-Hz EMF exposure, which are also shown in Table 4.17-1. This set of guidelines is based on established effects of EMFs, such as nerve stimulation, and are much higher than EMF levels found typically in occupational and residential environments.

TABLE 4.17-1. ELECTRIC AND MAGNETIC FIELD PUBLISHED GUIDELINES⁽⁴⁾

Guidelines	Electric Field On R.O.W.⁽¹⁾	Magnetic Field On R.O.W.
NYS Transmission Line EMF Standards and Guidelines	<ul style="list-style-type: none"> • 11.8 kV/m • 7 kV/m (maximum for highway crossing) 	<ul style="list-style-type: none"> • 200 mG (maximum load)
International Commission on Non-Ionizing Radiation Protection (IRPA/INIRC) Guideline (source IRPA/INIRC 1990)	Occupational: <ul style="list-style-type: none"> • Whole working day = 10 kV/m • Short term = 30 kV/m⁽²⁾ General Public: <ul style="list-style-type: none"> • Up to 24 hours per day = 5 kV/m • Few hours per day = 10 kV/m 	Occupational: <ul style="list-style-type: none"> • Whole working day = 5 G⁽³⁾ • Short term = 50 G • For limbs = 250 G General Public: <ul style="list-style-type: none"> • Up to 24 hours per day = 1 G • Few hours per day = 10 G

Notes:

1. R.O.W = Right Of Way
2. For electric load of 10-30 kV/m, field strength (kV/m) x hours of exposure should not exceed 8G for the whole working day. Whole-body exposure to magnetic fields up to 2 hours per day should not exceed 50G
3. G = 1000 mG
4. Note that there is not enough evidence for these guidelines to be used for distinguishing a “safe” from an “unsafe” EMF levels.

4.17.2.2. Future Without the Project

Any new significant sources of electric and magnetic fields proposed in the vicinity of the project site, such as electrical equipment and feeder lines, were identified where possible. Otherwise, electric and magnetic fields would be anticipated to remain constant at the established conditions.

4.17.3. Potential Impacts

4.17.3.1. Potential Project Impacts

Electric and magnetic field levels from the proposed water treatment plant were projected using decay equations for point and line sources and EMF data collected from two existing City-owned facilities having similar electrical equipment and load capacities. These two facilities are the Wards Island and the North River Water Pollution Control Plants (WPCPs). Based on comparisons of projected field strengths to the guidelines, a determination was made if there would be any significant increases in electric and magnetic fields.

The same procedures for collecting electric and magnetic field measurements were used at the three proposed sites. This methodology is described above under “Existing Conditions.” The methodology of the EMF collection at the two WPCPs is described in detail in the *Draft Report on Electric and Magnetic Field Measurements at the Site of the North River Water Pollution Control Plant* (NYCDEP, 1994d) and the *Draft Report of Electric and Field Measurements at the Site of the Wards Island Water Pollution Control Plant* (NYCDEP, 1994d).

4.17.3.2. Potential Construction Impacts

Electric and magnetic fields from the proposed temporary on-site substation were assessed to determine the contribution to the existing fields.

4.17.4. Mitigation

The mitigation goal is to avoid any significant measurable increase in public exposure. The use of buried triplex cable and equipment shielding was investigated if necessary to insure magnetic fields at ambient levels. Additional shielding is applied if projected levels of 60-Hz electric and magnetic fields exceed pre-construction levels (baseline conditions) at the site boundaries.