Field Measurements of Unauthorized FM Band Radio Signals In New York, NY Metropolitan Area

PHASE 4

A Report Prepared for

New York State

Broadcasters Association, Inc.

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I. EXECUTIVE SUMMARY

The purpose of this analysis is to report to the New York State Broadcasters Association, Inc. (NYSBA) the results of a multi-day field measurement project to determine the number of unauthorized transmissions ("Pirates") in the FM Radio Band in the New York City metropolitan area. While there may be unauthorized stations operating on AM frequencies, the survey focuses exclusively on the FM band. We have expanded our measurements to cover northern New Jersey because these unauthorized stations interfere with stations that are licensed to and operating in New York.

Interference from unauthorized pirate station has a significant impact on a listener's ability to receive a quality signal from licensed FM stations. The FM broadcast radio service is governed by a table of allocations, with power and height requirements established by the FCC in order to maximize the number of radio stations that may be authorized without causing interference. Inserting a large number of illegal operations in the FM Broadcast band that operate without regard to the FCC's engineering rules creates significant interference in the band.

Unauthorized Radio Operations Are Significant: This Report focuses on the number of illegal FM pirate stations operating in the Bronx, Brooklyn, Newark, NJ, and Paterson, NJ. Based on measurements taken over a four-day period in late February and March 2016, this report finds:

- **76** unauthorized radio stations were received on FM frequencies at these locations.
- We estimate that there may be more than **100** unauthorized stations operating in the New York City Metropolitan Area.
- Unauthorized stations appear to be increasing with a **58% increase** (from 12 to 29) in the number of unauthorized stations operating in Brooklyn between 2015 and 2016.

A comparison to our previous surveys in 2012, 2014 and 2015 indicates that the total number of pirate radio stations operating on FM radio frequencies is becoming even more problematic.

We note that this analysis likely underestimates the total number of unauthorized stations. First, the analysis was conducted in March. But, the number of illegal stations increases during the summer months. Second, the analysis was conducted during the day and the number illegal operations tend to increase during the evening hours. Third, the analysis is based on surveying illegal operations at four specific locations. Because there are significant variances in the signal strength of pirate operations, moving our receiving equipment to different locations would yield additional and different illegal operations.

A conservative estimate of the total number of illegal pirate operations in the five boroughs of New York City and Northern New Jersey could well exceed **100** stations. In short, there are more illegal unauthorized "pirate" stations operating in the FM band in the New York City metropolitan area than legal FM Broadcast facilities licensed by the FCC.

EAS Alerts May be Jeopardized: As noted in previous reports, interference from illegal pirate radio operations pose a threat to the Emergency Alert System. Interference to a licensed station's signal not only affects regular programming, but EAS alert tones, as well. This may create significant problems on several levels. First, consumers listening to licensed stations will be unable to hear the alert due to interference. Second, the interference may affect the EAS alert "daisy chain" relay system where stations rely on receiving EAS alerts from other stations in the market which are then retransmitted onward to additional stations. Interference to this daisy chain may have consequences throughout the EAS system. Finally, because unauthorized pirate stations do not participate in sending EAS alerts, consumers listening to these stations will not hear an alert and may not be informed to take action during an emergency.

RF Radiation Exposure: For the first time, we provide an analysis regarding the RF Radiation Emissions from the unauthorized FM pirate radio stations. We found that transmissions may be in excess of the NEPA limits for RF radiation exposure as determined by Maximum Permissible Exposure (MPE) standards. The FCC does not examine the RF emissions from pirate operations. Many of these pirate operations are found on roofs of businesses and residential buildings. Some pirate stations transmit from balconies and fire escapes. In short, these unauthorized transmissions emanate in very close proximity to apartments, houses, stores and office buildings. The failure to meet federal Radio Frequency Radiation (RFR) standards may raise significant public health and safety issues. Our preliminary results indicate this should be a cause for concern in those areas with a significant number of unauthorized pirate radio operations. And, this should raise particular concerns about pirate transmitting antennas operating in close proximity to the general public.

Interference to FAA Frequencies: While this report did not specifically examine interference to aeronautical and Federal Aviation Administration (FAA) frequencies, the FCC has taken action against pirate radio stations in the past because of interference to FAA communications systems. FAA frequencies occupy a position in the VHF Band (108-137 MHz[1]) that is adjacent to commercial FM broadcast frequencies. Our survey found at least two unauthorized pirate stations operating on frequencies that were adjacent to FAA frequencies. Because unauthorized pirate stations frequently over modulate their signals and spill over to adjacent channels, this may be a cause of concern.

Furthermore, pirate stations may cause intermodulation products that interfere with aeronautical and FAA frequencies. Intermodulation is a commonly known interference mechanism caused by strong local signals overloading or overpowering the tuner in a receiver. Typically, this non-linear effect will produce interfering signals on multiple frequencies at the front end of the aeronautical radio. More details regarding the interference mechanisms caused by intermodulation are detailed later in the report. However, it is important to note that the potential for this type of interference increases as the number of pirate operations grows. Given the significant number of pirate stations in the New York City metropolitan area and the close proximity to several airports, intermodulation should be of significant concern.

Interference to New Technologies: As noted in previous reports, pirate radio stations often operate on channels that are directly adjacent to licensed channels. The interference from illegal operations on an adjacent channel has a direct negative impact on HD radio, which is home to many unique and diverse programs.

[1] The VHF aeronautical band uses the frequencies between 108-137 MHz. The lowest 10 MHz of the band, from 108–117.95 MHz, is split into 200 narrow-band channels of 50 kHz. These are reserved for navigational aids such as VOR beacons, and precision approach systems such as ILS localizers. The upper 19 MHz is divided into 760 channels for amplitude modulation voice transmissions on frequencies from 118–136.975 MHz in steps of 25 kHz.

II. BACKGROUND AND TEST PROCEDURES

The NYSBA retained the firm of Meintel, Sgrignoli, & Wallace, LLC (MSW) to conduct a follow-up survey of "pirate" radio stations within the New York City (NYC) area. A particular emphasis was placed on determining the extent of these unauthorized transmissions and general locations to aid law enforcement and Federal Communications Commission (FCC) officials in assessing the problem.

This is the fourth engineering analysis of pirate radio operations that we have conducted in the New York City area. Tests were previously conducted in August 2012, February 2014, and January 2015, to determine the number of potential unlicensed radio stations in operation within the New York City metropolitan area. This testing was conducted in the same locations using the same methods and equipment to determine the number of unlicensed radio station operations that continue to operate in close proximity to the three test locations.

For this Phase 4 testing, in addition to Bronx, Brooklyn, and Newark locations an additional testing location was added in Paterson NJ. Furthermore, an assessment of the potential RF Radiation Exposure was conducted to determine the potential for public health and safety impacts from unauthorized transmitters that exceed the NEPA limits for Maximum Permissible Exposure (MPE) for General Public[2] that may be in close proximity to the "Pirate" transmitting antennas. As noted herein, pirate transmitting antennas are generally located in uncontrolled environments as defined by FCC rules.

To achieve these goals, MSW conducted a spectrum survey of the FM Broadcast Band at the measurement locations in the New York City metropolitan area to aid in estimating the number of unauthorized "pirate" stations in operation.

A. Field Test Vehicle Description:

In this survey we used the same test vehicle as in previous tests. **Appendix A Figure A1-1** contains a picture of the MSW test van**.** The van's electronic block diagram of the test equipment is illustrated in **Figure A1-2**. The test antenna is mounted on the pneumatic mast of the truck and is capable of being raised to 30' AGL and rotated remotely from within the truck. A mast-mounted compass allows a direct readout of the antenna pointing angle, and a mast-mounted camera provides a view of the surrounding area that the antenna "looks" through. A GPS unit inside the truck is used to determine the exact location of each test site, as well as its distance and bearing back to the transmitter site. The GPS coordinates also provide accurate location information for a computer mapping program in order to identify and plot exact test site locations for this written report. The GPS unit coordinates are also utilized to identify the locations of pirate broadcast stations.

The field test vehicle's system gain for the 30' AGL system was measured for calibration purposes before the start of each of the test days. The field test truck also housed the FM band receivers, spectrum analyzer, test equipment and laptop computer.

[2] See Federal Communications Commission Office of Engineering Technology Bulletin #65. https://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf

B. Field Test Set Up

For the testing conducted in this project, it was desirable to use a consumer FM receiver which would result in measurements that would approximate a consumer experience. Automobile receivers were used in this particular case since they have higher adjacent-channel and taboo-channel interference rejection that allowed the test team to listen to stations in the presence of large adjacent channel signals. Two consumer automobile receivers were used for the spectrum survey portion of the testing.

An FSH-3 portable spectrum analyzer from Rohde & Schwarz provided a robust measurement platform and provided accurate results in measuring the channels. For the spectrum survey phase, the spectrum analyzer was used to make measurements of the FM signals on each channel within the FM band.

For the spectrum survey portion of the test, a 5 element Yagi antenna manufactured by Winegard was used for the measurements of each channel, as well as direction finding determinations from the test location to the signal of interest.

In addition, a calibrated dipole antenna manufactured by A.H. Systems was utilized to make field strength and power level measurements to facilitate radiated power estimates for several of the sites.

C. Measurement Overview:

The data was taken from the same testing locations that were surveyed previously. Test location #1 was located in Bronx, New York, testing location #2 was located in Brooklyn, New York, and testing location #3 was located in Newark, NJ. For this Phase 4 project, additional test locations were added in Paterson, NJ. The spreadsheet with the data collected at each test location is contained in Appendix D.

D. Measurement Procedures

After deploying the 30 ft. mast with the FM Band Yagi antenna at the test location, a consumer FM receiver (Pioneer and Kenwood automobile receivers) was set to each frequency starting below the FM band at 87.7 MHz and stepped through each channel in the FM band up to 107.9 MHz. At the same time, a Rohde & Schwarz FSH-3 Spectrum Analyzer was used to determine the signal frequency and amplitude for each channel tested.

The received signal was identified as an authorized or unauthorized user by comparing a current FCC database listing (CDBS) for all stations within a 60KM culling distance from the ESB facility to those received at the testing location. Frequencies that were not authorized were found to be pirate stations if, after listening to the broadcast, they identified themselves as a station that was not listed in the database or were not listed as a potential co-channel station from another market. FCC licensed stations are required to identify themselves at the top of each hour with their call sign.

Furthermore, by listening to the programming and characteristics of the radio signal, additional verification of authorized and unauthorized users was achieved. For example, severely over-modulated or under-modulated signals would be indicative of an unauthorized user, as commercial broadcasters tend to have very precise modulation signatures (100% modulation with limited dynamic range). Pirate stations tend to use significant audio processing with echo and other effects that licensed broadcasters do not typically use. In addition, stations broadcasting a "top of the hour ID" (Call Sign), which is not typically announced for "pirate" stations, were identified as authorized stations.

The results of these tests were recorded in the spreadsheet developed for each test location.

E. Measurement Time and Date

The data was collected over several measurement days during the period of February 26 – March 14, 2016. Specifically, measurements were conducted on the following dates:

Bronx:	**Saturday, February 27, 2016 starting @ 11:32AM**
Brooklyn:	**Sunday February 28, 2016 starting @ 11:09 AM**
Newark:	**Monday, February 29, 2016 starting @ 11:10 AM**
Paterson:	**Saturday March 12, 2016 starting @ 10:45 AM**

The survey constitutes a snap shot of the number of unauthorized pirate FM station operations at these time periods at the measurement locations.

F. Measurement Locations

The initial test site locations were the same testing locations utilized in the previous three measurement projects with the addition of the new testing locations Paterson, NJ.

Test location #1 is in Bronx, NY at Tracy Towers, which is located at the intersection of Paul Ave and 205th St. This is the same location used in previous tests. This site is located approximately 10.1 miles from the Empire State Building (ESB) transmission facility utilized by most of the New York City FM radio stations. As such, signals in this location from ESB should be of a moderate level.

Test location #2 was in Brooklyn, NY on Flatbush Avenue at Prospect Park. This was the same location used in previous tests. This site is located approximately 5.5 miles from the ESB facility to the South of Manhattan. Again, signals from the ESB facility should be of a moderate level in this location.

Test Location # 3 was located in Newark, NJ, near the Branch Brook Park. This is near the intersection of Park Avenue and Lake Street. This is the same location used in previous tests. This site is located approximately 10.2 miles from the ESB facility to the West of Manhattan (275°). The signals from the ESB facility should be of a moderate level in this location. Note that data for Newark includes pirate stations that can be received in Newark, but may be transmitting from cities within the immediate vicinity of Newark such as East Orange.

Test Location # 4 was located in Paterson, NJ, near the intersection of Oak Street and Martin Street. This is next to a high school football field and athletic complex. This is a new test site not used

previously. This site is located approximately 14.5 miles from the ESB facility to the Northwest of Manhattan (321°). This location included pirate stations that could be received in Paterson, but were transmitting from the surrounding areas such as Clifton and other locations. The signals from the ESB facility should be of a moderate level in this location.

Appendix E contains the locations and pictures of some of the pirate transmitting locations that were identified during the spectrum survey project. To aid in locating these facilities, street addresses, GPS coordinates, and pictures of the transmitting antennas are provided.

III. RESULTS

A. 2016 Survey

The spectrum survey revealed that there are at least **76 unauthorized broadcast stations** in the FM band operating during the spectrum survey period[3].The results from the specific locations mentioned above are listed in the following chart.

Location #	Test Location Name	Test Location Description	Latitude N	Longitude W	Pirates #
1	Bronx / Tracey Towers	Paul Ave. @ 205th St.	40-52-34.4 N	73-53-26.6 W	19
2	Brooklyn / Prospect Park	Flatbush Ave. at Prospect Park	40-40-16.5 N	73-58-07.1 W	29
3	Newark, NJ	Lake Street @ Park	40-45-36.4N	074-10-47.0W	13
4	Paterson, NJ	Football Field 100 Oak Street	40-54-41.9N	074-09-39.4W	15

Site #1 – Bronx – Tracey Towers – Paul Ave at 205th Street: Measurements at this location indicated that at least **19 unauthorized broadcasts** could be received by the test setup.

Site # 2 – Brooklyn – Prospect Park: Flatbush Avenue: Measurements in this location indicated that at least **29 unauthorized broadcasts** were active during the testing period.

Site # 3 – Newark, New Jersey –Lake Street at Park Avenue: Measurements in this location indicated that at least **13 unauthorized broadcasts** were active during the testing period.

Site # 4 – Paterson, New Jersey – Oak Street at Martin Street: Measurements in this location indicated that at least **15 unauthorized broadcasts** were active during the testing period.

[3] Pirate stations operate at varying power levels. Consequently, it is theoretically possible that one could receive the same pirate station at different locations. Nonetheless, the distances between the receive sites in this study would indicate that the unauthorized stations operating on the same frequencies at the four locations are different pirate operations. See page 10 for further explanation.

Despite limited resources, we were able to determine the exact location of 14 pirates. The locations, including pictures of these operations can be found in Appendix E of this report and are labeled as locations A – N. We were able to locate these operations within survey periods. Our results demonstrate that finding the locations of unauthorized pirate operations is not terribly difficult.

B. Comparison to Prior Spectrum Survey Results

Beginning in 2012, we conducted several sweeps on the New York City metropolitan area. While originally confined to Brooklyn and Bronx, the analysis was expanded to Newark, New Jersey, in 2015. The 2016 survey added Paterson, New Jersey. To ensure consistency in our results, we monitored from the same locations in Bronx, Brooklyn and Newark. The results of these previous spectrum surveys are detailed below.

PHASE 1 FIELD TEST RESULTS AUGUST 2012

Location #	Test Location Name	Test Location Description	Latitude N	Longitude W	Pirates #
1	Bronx / Tracey Towers	Paul Ave. @ 205th St.	40-52-32.6 N	73-53-25.8 W	19
2	Brooklyn / Prospect Park	Flatbush Ave. at Prospect Park	40-40-10.8 N	73-58-01.6 W	30

PHASE 2 FIELD TEST RESULTS FEBRUARY 2014

Location #	Test Location Name	Test Location Description	Latitude N	Longitude W	Pirates #
1	Bronx / Tracey Towers	Paul Ave. @ 205th St.	40-52-34.4 N	73-53-26.6 W	22
2	Brooklyn / Prospect Park	Flatbush Ave. at Prospect Park	40-40-16.5 N	73-58-07.1 W	12

PHASE 3 FIELD TEST RESULTS DECEMBER 2014/ JANUARY 2015

Location #	Test Location Name	Test Location Description	Latitude N	Longitude W	Pirates #
1	Bronx / Tracey Towers	Paul Ave. @ 205th St.	40-52-34.4 N	73-53-26.6 W	17
2	Brooklyn / Prospect Park	Flatbush Ave. at Prospect Park	40-40-16.5 N	73-58-07.1 W	17
3	Newark, NJ	Lake Street @ Park	40-45-36.4N	074-10-47.0W	15

The data indicate that the number of unauthorized operations in the FM band remains a significant problem and appears to be increasing. For example, in 2012 we were able to receive 30 unauthorized stations at the same location in Brooklyn. The 2012 survey was taken during the summer, when the overall number of pirate operations tends to increase. The survey conducted in February 2014 revealed 12 pirate stations and the analysis in December/January 2015 revealed 17 pirate stations receivable at this location. **Our most recent measurement in late February 2016 found 29 unauthorized stations that could be received at this location, representing a 58% increase from the number surveyed in 2015.**

Our 2012 survey was taken in August, when we expect to have a significant number of pirate stations in operation. To have 29 pirate stations operating in late February in Brooklyn raises some concerns. Based on our experience, it is safe to assume that number will increase significantly in Brooklyn during the summer.

IV. ANALYSIS OF RESULTS

A. Data Underestimate the Number of Pirate Operations

The results demonstrated above must be analyzed in context. The number of unauthorized radio operations reported above may significantly underestimate the actual number of pirate radio stations in the New York City metropolitan area. As will be discussed below, the number of unauthorized operations in New York City exceeds the number of radio stations operating with an FCC license. In fact, there may be more than 100 unauthorized stations operating in the New York City metropolitan area. There are several reasons to believe that we have underestimated the total number of unauthorized stations.

1. Time of Day Surveyed Leads to an Underestimation:

As noted above, the most recent survey was conducted during daytime hours from approximately 11:00AM to 2:00PM. These times were selected due to schedule limitations as well as logistical and safety considerations. Our experience from prior surveys indicates that pirate radio operations tend to increase in number at night and on weekend evenings. One theory is that illegal operators tend to wait until FCC field office closes to commence operations. For example, our survey of Bronx, NY and Paterson, NJ, took place on Saturday morning. Brooklyn was surveyed on Sunday morning and Newark, NJ, on Monday morning. Historically, these have not been times which attract the most unauthorized transmissions. Had we surveyed at night, we would expect the number of unauthorized pirate operations to have increased substantially.

2. Measurement methodology underestimates the number of unauthorized operations.

As noted above, measurements were taken at only four specific locations in Brooklyn, Bronx, Paterson, NJ and Newark, NJ. To ensure consistency, we took measurements at the same locations in Bronx, Brooklyn, and Newark that were used in previous years. Thus, the analysis measures only the number of unauthorized radio stations that can be received at those specific locations.

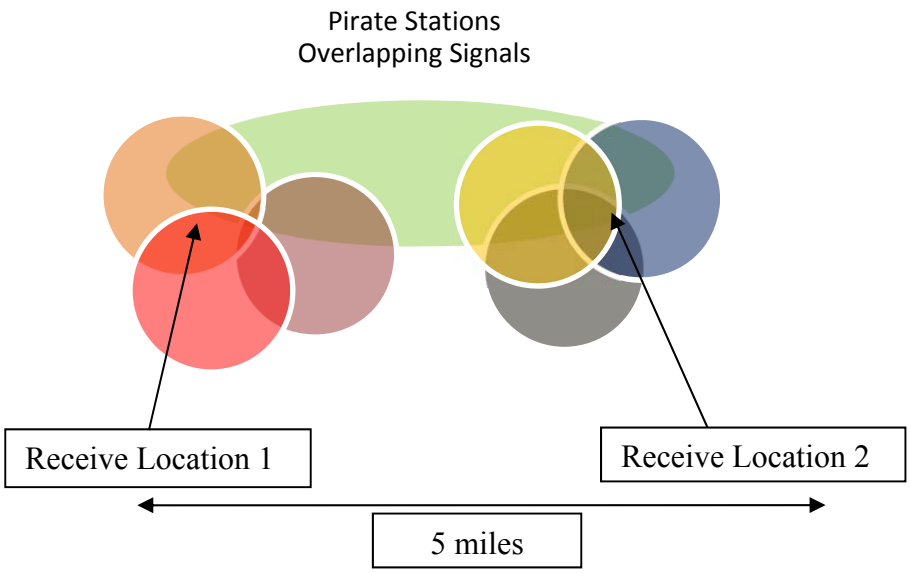
The power levels of pirate operations vary considerably. Our experience from surveying unauthorized operations since 2012 indicates that pirate stations operate at power levels ranging from a

low of 10 Watts to a high of ~3,000 Watts. Moreover, the reach of these stations will vary depending on the height of the antenna with which the pirates operate. The higher the antenna (typically a building roof-top) the greater the geographic reach of the pirate's signal.

Consequently, at any one particular location such as Brooklyn, one can receive 29 different unauthorized signals. However, if one were to move 5 miles in either direction, one would likely receive a similar number of pirate signals. While some of the higher powered pirate signals may be the same, many will be different operators operating on some of the same frequencies. In other words, one may have a number of different lower powered pirate stations operating on the same frequency (co-channel) throughout the New York City area. This situation is illustrated in Figure 1 below. The green oval represents the signal of a high powered pirate that has a coverage area of many miles. The smaller multicolored circles represent multiple lower powered pirates.

Figure 1

Description of Pirate Location Reception



As Figure 1 demonstrates, one will be able to receive multiple and different, unauthorized pirate stations throughout the New York City metropolitan area. At any one particular location, one may be able to receive only a small portion of the overall number of pirates operating throughout the New York City metropolitan area. Thus, by surveying only four locations, we will be able to identify the higher power illegal pirate operations, but there may be scores of lowered powered pirate stations throughout NY that simply cannot be received at the locations we have selected. Because of these limitations, we believe our analysis underestimates the total number of unauthorized pirate radio operations.

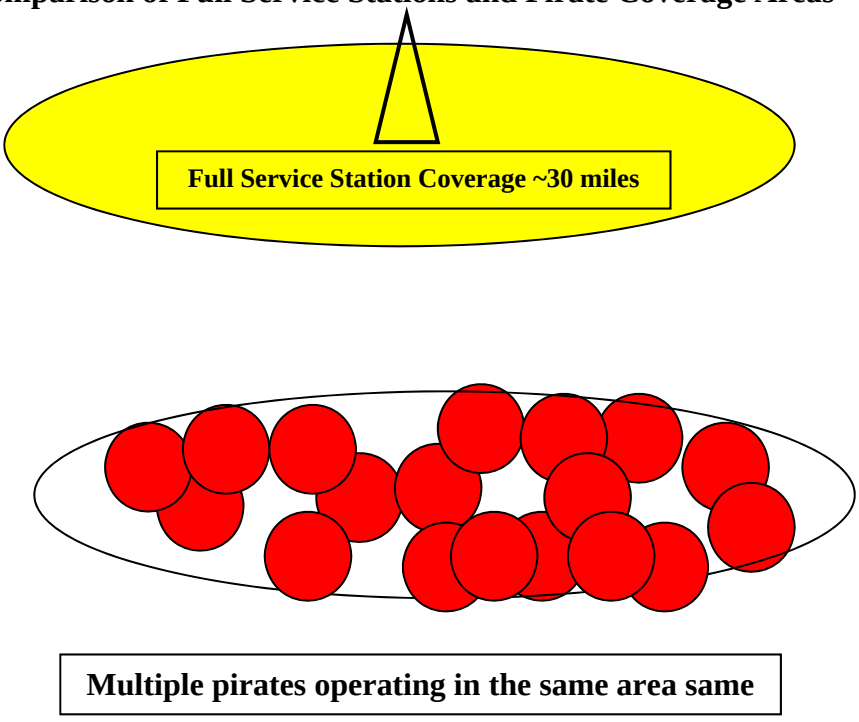
V. NATURE OF UNAUTHORIZED TRANSMISSIONS AND INTERFERENCE

A. Interference is Pervasive

It is important to understand the nature of the interference caused by the 76 unauthorized pirate operations that were discovered. The power levels of pirate stations tend to vary ranging from a low of 10 watts to a high of up to ~3,000 watts (3KW).[4] While many occupy channels that are directly adjacent to existing broadcast radio stations (adjacent channel interference), some operate on the same channels (co-channel interference) as licensed broadcast radio facilities.

Our experience with surveying indicates that it is common to find multiple lower powered pirates operating simultaneously on the same frequencies throughout the city. Thus, even though each individual pirate station may have a small coverage area, they are in aggregate covering areas as large as a full service facility. When taken together multiple pirate stations on the same frequencies create an interference zone that may be equivalent to a higher powered facility. In many cases, these pirate stations operate on the same frequencies as well as those that are directly adjacent to licensed facilities causing "co-channel" and "adjacent channel" interference (discussed below). This situation is illustrated in Figure 2 below.

Figure 2
Comparison of Full Service Stations and Pirate Coverage Areas



[4] As noted in Section V(C), we estimated the power level of pirate stations using the measured field strength, observed distance from the monitoring location to the pirate transmitter, as well as the appropriate antenna calibration factors.

Power alone does not determine the reach and interference potential of an illegal station. Antenna height plays an important role. A 10 watt transmitter on a twenty story building will send a 40dBu signal out to 8.86 miles. The same 10 watt transmitter on a three story building will send a 40dBu signal out 6.3miles. Thus, interference from even a low powered facility may cause significant interference to surrounding licensed facilities. And for pirate stations operating at high power the interference area can cover huge geographic areas. For example, a 2,000 watt transmitter on a twenty story building will send a 40dBu signal out to 37.8 miles.[5] This is why pirates located in Northern New Jersey can cause interference to stations that are licensed to and transmit from New York City. Such interference may occur many miles from the pirate transmitter.

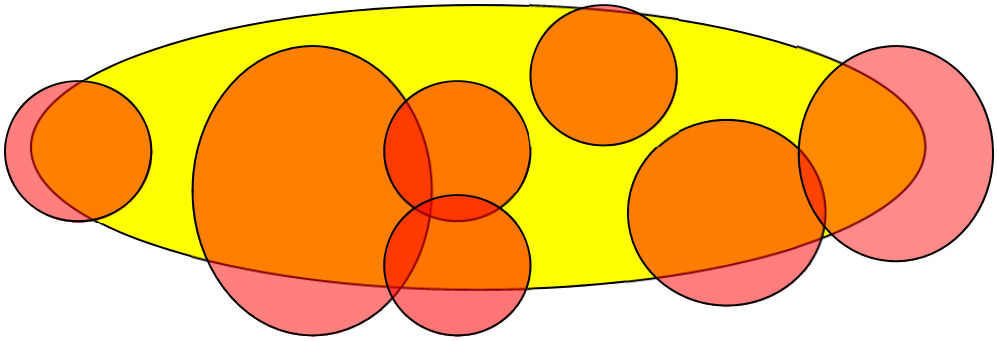
Of course, licensed facilities generally operate at significantly higher power levels than most pirate stations. For example, a Class A FM station has a maximum power of 6 KW with a HAAT (Height Above Average Terrain) of 100 meters and an interference protection zone of 28.3 kilometers. The highest powered Class C FM station has a maximum power level of 100 KW with a HAAT of 600 meters and a protected interference zone of 91.8 kilometers.

As noted above, unauthorized pirate stations generally range from 10 watts to 3,000 watts. Because they do not follow any regulations, some may operate at even higher power. Some may operate at power levels well above licensed FM facilities, and most operate at power levels above those established by the FCC for LPFM facilities. In this regard, it is noted that the FCC's own engineering analysis limits the number of LPFM stations that may be located in the New York City metropolitan area. In fact, the Commission has found that there are essentially no open frequencies that can accommodate even lower powered LPFM stations. Stated another way, illegal pirate radio operations are causing interference under the FCC's own engineering and interference analysis.

From an engineering perspective, the key issue is the relationship and distance between a consumer's radio receiver and the pirate transmitter. While licensed FM stations may have significantly large coverage areas, large portions of that coverage area may not receive the station's signal due to unauthorized pirate operations. As a consumer's radio receiver gets closer to the illegal pirate transmitting antenna it will, at some point, lose the ability to receive a signal from the licensed facility. This is due to a number of interference mechanisms at work in the consumer's radio. When a receiver is in very close proximity to the pirate transmitting antenna it will become overwhelmed by the RF signal and start receiving the illegal pirate signal (AGC reduction Blanketing, and front-end overload). A lower power pirate radio station may interfere with a licensed FM Radio facility for several kilometers. Moreover, because there are multiple pirates operating, the licensed facility's coverage area may be reduced significantly with multiple portions of the coverage area impaired by interference. This is illustrated in Figure 3.

[5] The FCC Rules Section 73.215 requires that short-spaced co-channels stations maintain a 20dB D/U (Desired/Undesired) ratio. Hence, for a 60dBu signal, the interfering signal must not exceed 40dBu for the interfering co-channel station under the FCC Rules.

Figure 3
Interference Impact of Multiple Pirate Stations



Referring to Figure 3, assume that the coverage area of a licensed facility operating from the Empire State Building is represented by the area in yellow. For this example, the coverage area could constitute a distance of 30-40 kilometers. In this example, there are a number of unauthorized pirate radio stations operating on either a co-channel or a first-adjacent channel, represented by the smaller red circles. The interference from these pirate stations is illustrated as the orange area. Our survey found a number of illegal pirate stations operating throughout a licensed station's coverage area as indicated by multiple red circles. In the illustration above, any FM radio receiver attempting to listen to the licensed station (yellow) would receive interference in the areas where it is in close proximity to the illegal pirate transmitter (orange). Also, because there is no adherence to the regulations, pirate signals may also interfere with each other (overlapping red).

As a result, the radio receiver tuned into the licensed station will receive unacceptable interference. When the pirate signal becomes very strong, it will overwhelm the receiver and cause the pirate signal to be heard on the consumer's receiver instead of the desired licensed station. The zone of interference is represented by the orange overlap areas in the example above. Depending on the power used by the pirate and the height of the illegal transmitting tower, these interference zones may range for miles and cover entire local communities. Thus, the aggregate impact of the pirate stations in the New York Metropolitan area will have a significant impact on reception of licensed stations even though each individual pirate radio station may operate at low power as compared to a licensed facility.

The example provided in Figure 3 illustrates both co-channel and adjacent-channel interference. Co-channel interference is easily understood. Two stations operating on the same frequency at the same time cannot be separated by the FM radio receiver, and interference or intermodulation that occurs will result in audio that is impaired. Nonetheless, our surveys have indicated that a number of pirate stations operate on the same frequencies as licensed facilities. They simply overpower the signal of the licensed facility in the areas in which they operate. The pirate signal needs only be a few decibels stronger than the licensed signal in that location for the radio to demodulate the pirate station audio instead of the licensed station audio.

There is a similar issue with unauthorized stations operating on so called "adjacent channels". Interference from adjacent channels is well documented. The reason the FCC does not assign stations to operate on these frequencies is because they will cause interference to licensed stations that are operating on adjacent frequencies. Every radio receiver is built with internal filters (IF filters) that allow the radio to select among channels that are operating in any specific area. They are designed to receive the signal from the selected radio stations, while at the same time ignoring all other stations. A key to this selection process is that in the FM band, stations are not assigned to frequencies that are directly adjacent to licensed radio stations in the same geographic area, since the internal filters are not able to filter out the interfering (adjacent) signals. Operating unauthorized stations on these adjacent channels within the coverage area undermines the ability of a radio receiver to perform this selection process.

In the case of unauthorized pirate stations operating on adjacent channels, interference problems are compounded because pirate stations seldom comply with any engineering standards. In our experience, it is quite common for unauthorized pirate stations to over modulate their transmitters. The result is interference from spurious emissions that spill over onto adjacent frequencies occupied by licensed stations. As noted in figure 2 above, multiple pirate stations may create considerable interference area throughout a licensed station's coverage area.

B. Unauthorized Stations Jeopardizes the Emergency Alert System

Interference caused by unauthorized radio operations is not limited to news and entertainment content. A radio station's Emergency Alert System (EAS)[6] signal is transmitted over the same frequency as its music or news content. The same interference mechanism, described above, will impair a licensed station's EAS messages. Interference from co-channel and adjacent-channel pirate operations limits the ability of the public to receive emergency information, news, and EAS messages during times of emergency.

The EAS system is based upon a relay system. It has national primary stations (NP), which receive emergency information directly from the federal government and start the relaying of information to additional stations. The same is true for state primary stations (SR), which receive and start the process for state emergency messages. These stations are monitored by, and send information to LP1 stations. LP1 stations are critical because they are the primary source of EAS alerts and messages in each local market and they retransmit federal and state alerts to the remaining stations in a market. These LP1stations broadcast the EAS alert, which in turn is received by other stations that are monitoring the primary stations. These stations in turn broadcast the EAS message, which is picked up by additional stations. The message is then relayed by additional stations and "daisy chains" across the state.

Our survey not only found unauthorized pirate operations on adjacent frequencies to key EAS LP1 and SR stations, we discovered that a number of pirates were operating on the same frequencies as key EAS stations. Based on our most recent survey results, the following table indicates unauthorized operations in relation to the designated LP1 FM stations in New York City, Long Island, and northern New Jersey. With respect to New Jersey, we included LP1 stations from the Northeast region (Bergen,

[6] https://www.fcc.gov/consumers/guides/emergency-alert-system-eas

Essex, Hudson, Morris, Passaic and Union counties); Northwest Region (Sussex and Warren counties) and the North Coastal Region (Monmouth, Ocean and Toms River North). The survey results appear in Figure 4.

Figure 4
EAS LP1 Stations in New York City, Long Island, and New Jersey
Unauthorized Operations on Co-Channel and Adjacent-Channels

FM LP1 Stations NYC, Long Island & New Jersey	Unauthorized Bronx Station Frequencies	Unauthorized Brooklyn Stations Frequencies	Unauthorized Newark Stations Frequencies	Unauthorized Paterson Stations Frequencies
WNYC-FM 93.9 (New York City)		94.1 (adj.channel)		93.7 (adj.channel)
WHFM –FM 95.3 (Long Island)	95.3 (co-channel)	95.1 (adj.channel) 95.3 (co-channel)		
WALK-FM 97.5 (Long Island)		97.5 (co-channel)	97.5 (co-channel)	97.5 (co-channel)
WBAB-FM 102.3 (Long Island)	102.1 (adj. channel) 102.3 (co channel)	102.3 (co-channel)	102.3 (co-channel)	
WBLI-FM 106.1 (Long Island)	106.1 (co-channel)	106.3 (adj.channel)		
WFME-FM 94.7 (New Jersey NE)				94.5 (adj.channel)
WRAT-FM 95.9 (New Jersey North Costal)		95.9 (adj.channel)	95.9 (co-channel) 96.1 (adj.channel)	96.1 (adj.channel)
WNNJ-FM 103.7 (New Jersey NW)	103.7 (co-channel)			

The potential threat to the New York and New Jersey Emergency Alert System is substantial. For example, our data indicates there is still a co-channel pirate radio station operating in Brooklyn on FM frequency 97.5 MHz. As we noted in our last spectrum survey, this is the same frequency that is used by WALK-FM 97.5 MHz, which is an important LP1 station in the EAS plan for Long Island. During our observation period, WALK-FM was rendered completely unlistenable by the interference from the pirate station. Had the EAS system been activated during this time, it is highly unlikely that any other stations in close proximity would have been able to receive the EAS messages sent from WALK-FM. We note that it has been over a year since the last spectrum survey in the Bronx area, yet the operation of pirates on 97.5MHz in Bronx, NY remains unabated. Similar situations of co-channel problems were found for Long Island stations WBAB, WBLI, and WHFN, which have co-channel pirate operations in Bronx, also remain in operation. In fact, WBAB has co-channel pirate stations operating not only in Bronx, but Brooklyn and Newark, NJ, as well. WRAT, the LPI station in North Costal, NJ, has a co-channel pirate operation in Newark.

As explained above, however, there is also significant interference from pirates operating on adjacent channels. For example, public radio station WNYC-FM receives interference from pirates operating on adjacent channels in Brooklyn, NY and Paterson, NJ. Both areas are well within the licensed coverage area of WNYC-FM. WFME in Northeastern NJ has an adjacent channel issue with a

pirate station located in Paterson, NJ. Consumers listening to these stations may not hear an EAS alert when they are activated due to the adjacent-channel interference from pirate stations.

Apart from direct interference which prevents listeners in New York City and Northern New Jersey from hearing EAS alerts, interference from unauthorized pirate operations may have significant ramifications for the entire EAS system. For example, WNYC-FM is an LP1 station operating on 93.9 MHz. In 2015, a licensed station WWRV-AM 1330, which is assigned in the New York EAS plan to monitor EAS alerts from WNYC-FM, filed a complaint with the FCC regarding pirate radio interference. WWRV AM 1330 serves New York City and Northern New Jersey. The concern was that an unauthorized pirate station operating on 93.7 FM was interfering with WWRV's ability to monitor WNYC-FM. Our recent survey indicates that there is still a pirate operating on 93.7 in Paterson, NJ. This interference results in WWRV's inability to consistently monitor the WNYC-FM signal as it is assigned in the EAS Plan. A picture of the location of this apparently unauthorized station can be found in Appendix "E" at location "M."

The concerns with regard to the EAS system appear to be substantial[7]. Because the power levels of pirate stations vary, it is not certain that a pirate station operating in New Jersey will necessarily interfere with a station operating in Long Island. Nonetheless, interference from pirate stations may occur over significant distances where the pirate station uses higher power, or locates on top of a tall building or mountain. We have found that New York City licensees receive significant interference from pirate stations located throughout northern New Jersey. As noted above, Long Island stations receive significant interference from pirate stations located in Bronx and Brooklyn. Because the EAS system is so important, a high priority must be given to eliminating interference from pirate operations.

Finally, our experience has been that when confronted with interference, consumers are more likely to switch channels than to report interference to the FCC. Consequently, many pirate stations go unreported for some period of time before they are reported to the FCC.

C. Analysis of Potential RF Radiation Exposure

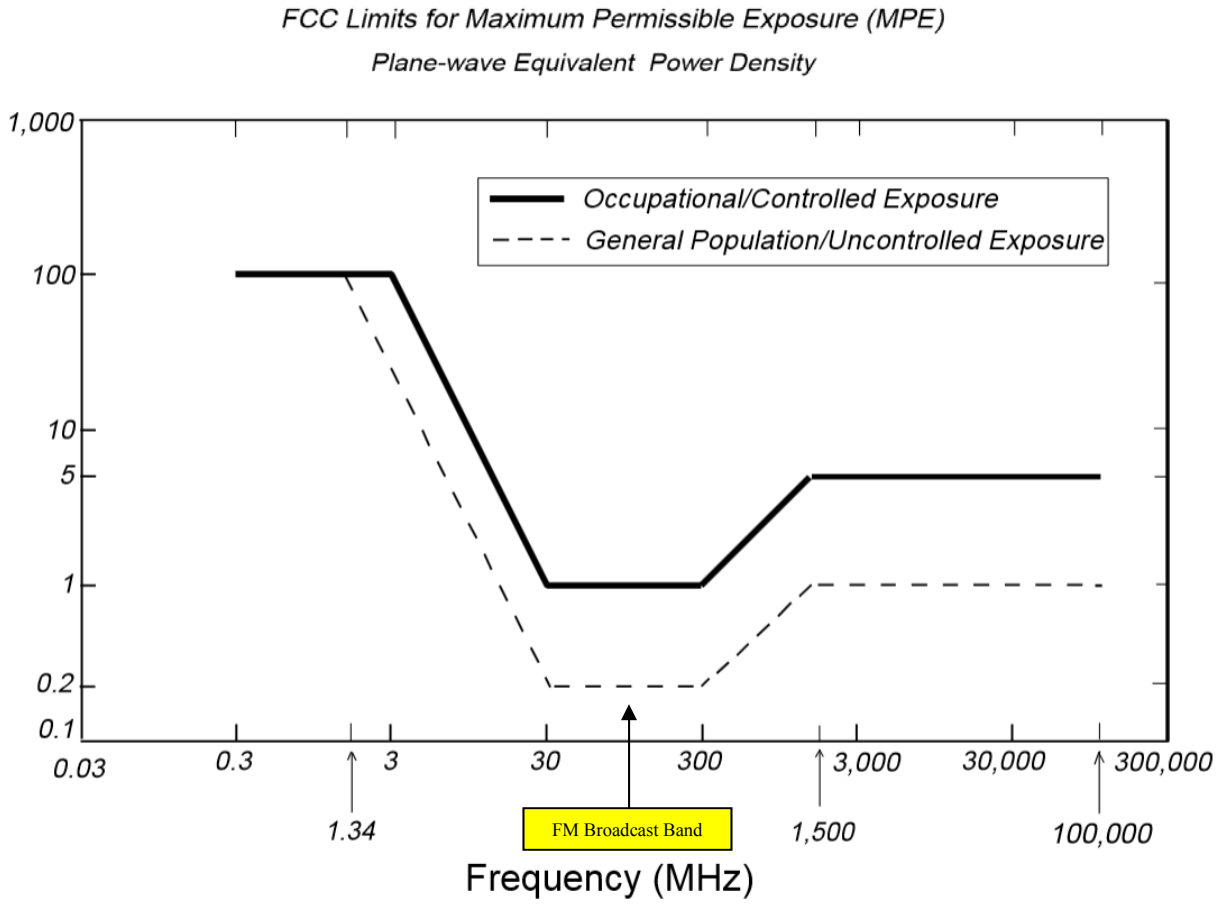
Licensed radio stations, including Low Power FM (LPFM) stations, must meet very strict RF radiation guidelines which are included in the FCC rules. Broadcast licensees are required to ensure that persons are not exposed to higher than permitted exposure levels and they take great care to ensure appropriate training and that warning signs are posted in areas where they are required by law. Unfortunately, unauthorized pirate stations do not comply with existing RF radiation standards and rules. Many of these unauthorized operations are on the roofs of residential buildings, on apartment balconies and on office and other commercial buildings. As a result, unauthorized operations may pose a

[7] There may be additional public safety concerns. Because pirate stations can be located anywhere, they sometimes get too close to other public safety facilities. As shown in Appendix E, Site J, a pirate transmitting antenna was constructed and operating in very close proximity (next door) to the public safety radio transmitting and receiving antennas of the East Orange, New Jersey Police Station. It is possible for a very strong signal from the pirate transmitter to cause a number of impairments to the East Orange Public Safety Radio system including Intermodulation, Receiver De-sensitization, and other impairments. (The East Orange Police were informed of the pirate station's location during the survey.) Clearly, the public safety operations should be a paramount concern, and unauthorized operations such as this one need to be eliminated as quickly as possible before the potential public safety radio system impairment jeopardizes the safety and operation of law enforcement officials in the local area.

health hazard to individuals living or working in close proximity to these illegal transmitters. The significance of this harm will depend on the power level of the unauthorized operation and its proximity to the public.

The standards defining exposure limits to RFR (radio frequency radiation) are governed by NCRP's (National Council on Radiation Protection and Measurements) Maximum Permissible Exposure (MPE) limits[8]. To evaluate the potential problem, several identified, unauthorized transmitter locations were analyzed to determine the potential Radio Frequency Radiation (RFR) exposure risks (non-ionizing radiation) and Maximum Permissible Exposure (MPE) limits. Given that the FM Broadcast band of 88-108MHz falls within the most sensitive part of the exposure limits (see Figure 5), it would seem prudent to ensure that the general public is not exposed to potentially harmful levels of RFR from unauthorized "pirate" stations that may not be educated or may not care about the potential health risks that can come from exposure to RFR levels in excess of the MPE limits.

Figure 5



From FCC OET Bulletin 65

[8] On August 1, 1996, the Commission adopted the NCRP's recommended Maximum Permissible Exposure limits for field strength and power density for the transmitters operating at frequencies of 300 kHz to 100 GHz. In addition, the Commission adopted the specific absorption rate (SAR) limits for devices operating within close proximity to the body as specified within the ANSI/IEEE C95.1-1992 guidelines. (See Report and Order, FCC96-326) https://www.fcc.gov/general/radio-frequency-safety-0

It is our experience that unauthorized broadcast transmitting antennas are typically installed on rooftops, balconies, fire-escape stairs, and other locations that do not limit access to the transmitting antenna while it is energized. Consequently, potential exposure to radiation in excess of the NCRP and FCC MPE limits is certainly possible.

Furthermore, it is unlikely that any person entering the high RF radiation field would know that they are close to an emitting antenna. And, obviously, required warning signs are not present at any of these locations. Furthermore, the operators of these illegal transmitters are not likely to participate in RFR training or certification programs to educate the operators or those in close proximity that may be potentially exposed to excessive RF energy levels. Moreover, as illegal operators, they simply may not care about the potential health hazard from RFR exposure. This matter should be of particular concern to building owners and their maintenance workers who are likely to work on the roofs of these buildings, and other persons who may come within close proximity to the radiating antennas, such as residents of an apartment building with an antenna on its roof or other nearby structures.

According to the FCC's OET Bulletin 65 (as shown in Figure 5) the MPE limit for the general population or uncontrolled environments is 200μW/cm² in the FM broadcast frequency band. Using the following formula from FCC OET Bulletin 65 a distance to the 200μW/cm² limit contour from the pirate transmitting antenna can be calculated.

$$S = \frac{33.4\ ERP}{R^2}$$

where: S = power density in $\mu W/cm^2$
ERP = power in watts
R = distance in meters

From FCC OET Bulletin 65

For the purposes of this analysis, the equation is simplified to:

$$200\mu W/cm^2 = \frac{33.4 \times ERP}{R^2}$$

Or

$$R^2 = \frac{33.4 \times ERP}{200\mu W/cm^2}$$

In the following analysis, the ERP (effective radiated power) of the pirate transmitting antenna was estimated using measured field strength with a calibrated dipole antenna (oriented in the same plane as the pirate antenna) and the measured signal level on the FSH-3 spectrum analyzer. Additional losses for cables and antenna factors were also taken into account. Finally, the observed distance from the pirate antenna to measurement antenna was utilized to calculate the estimated free-space path loss which was also used to derive the estimated ERP value used for each location.

$$\text{Free Space Path Loss} = \left(\frac{4\pi d}{\lambda}\right)^2$$

or

$$\text{Free Space Path Loss} = \left(\frac{4\pi d f}{c}\right)^2$$

Where:

FSPL is the Free space path loss
d is the distance of the receiver from the transmitter (metres)
λ is the signal wavelength (metres)
f is the signal frequency (Hertz)
c is the speed of light in a vacuum (metres per second)

The speed of light is 2.99792458 x 10^8 metres per second, although for most practical purposes, this is taken to be 3 x 10^8 metres per second.

The following figures 6, 7, and 8 and also Appendix D contain several examples of unauthorized transmitter locations that may pose some risk of exposing the general public to excessive RF radiation levels since these locations do not limit access to the energized antenna, post warning signs, or otherwise inform persons to stay away from the energized antenna.

The potential for an uninformed person to come in close contact with the energized antenna or within the area of the General Population MPE level of 200µW/cm² (the MPE limit for operation in the FM Broadcast Band) of an active transmitting antenna is high.

FIGURE 6



FIGURE 6

An analysis was conducted on Location A to estimate the approximate ERP and then to determine the approximate distance of the 200µW/cm² MPE limit for the General Population (Uncontrolled Environment) using the FCC OET 65 methodology. Based upon the received signal level, free-space path loss, cable losses, and antenna factors it is estimated that the transmitter at Location A is operating with approximately 288.4 watts of Effective Radiated Power (ERP).
Received Signal Level = -15.0dBm
Distance to Transmitting Antenna from Measurement Antenna = Approx. 700 Ft.
Total Loss = 69.6dB + -15.0dBm = +54.6dBm = 288.4 watts Estimated ERP
Using the OET65 method, the distance to the 200µW/cm2 MPE limit is approximately 22.76 Feet from the antenna.

$$48.168 = R^2 = \frac{33.4 \times 288.4}{200\ \mu W/cm^2}$$

$$\sqrt{48.168} = \quad R = 6.94 \text{ meters} = \ 22.76 \ \text{ feet}$$

From the picture in Figure 6 it can be seen that any persons on the roof top as well as people living on the top floor of the apartment building would be potentially exposed to RFR exposure levels in excess of the FCC MPE limits.

FIGURE 7



FIGURE 7

An analysis was conducted on Location L to estimate the approximate ERP and then to determine the approximate distance of the 200µW/cm² MPE limit for the General Population (Uncontrolled Environment) using the FCC OET 65 methodology. Based upon the received signal level, free-space path loss, cable losses, and antenna factors it is estimated that the transmitter at Location L is operating with approximately 2,576.3 watts of Effective Radiated Power (ERP).

Received Signal Level = -0.5dBm

Observed Distance from Measurement Antenna to Transmitting antenna = 500 Ft Approx.

Total Loss = 64.61dB + -0.5dBm = +64.11dBm = 2,576.3 watts Estimated ERP

Using the OET65 method, the distance to the 200µW/cm2 MPE limit is approximately 68.03 Feet from the antenna.

$$430.24 = R^2 = \frac{33.4 \times 2576.3}{200\ \mu W/cm^2}$$

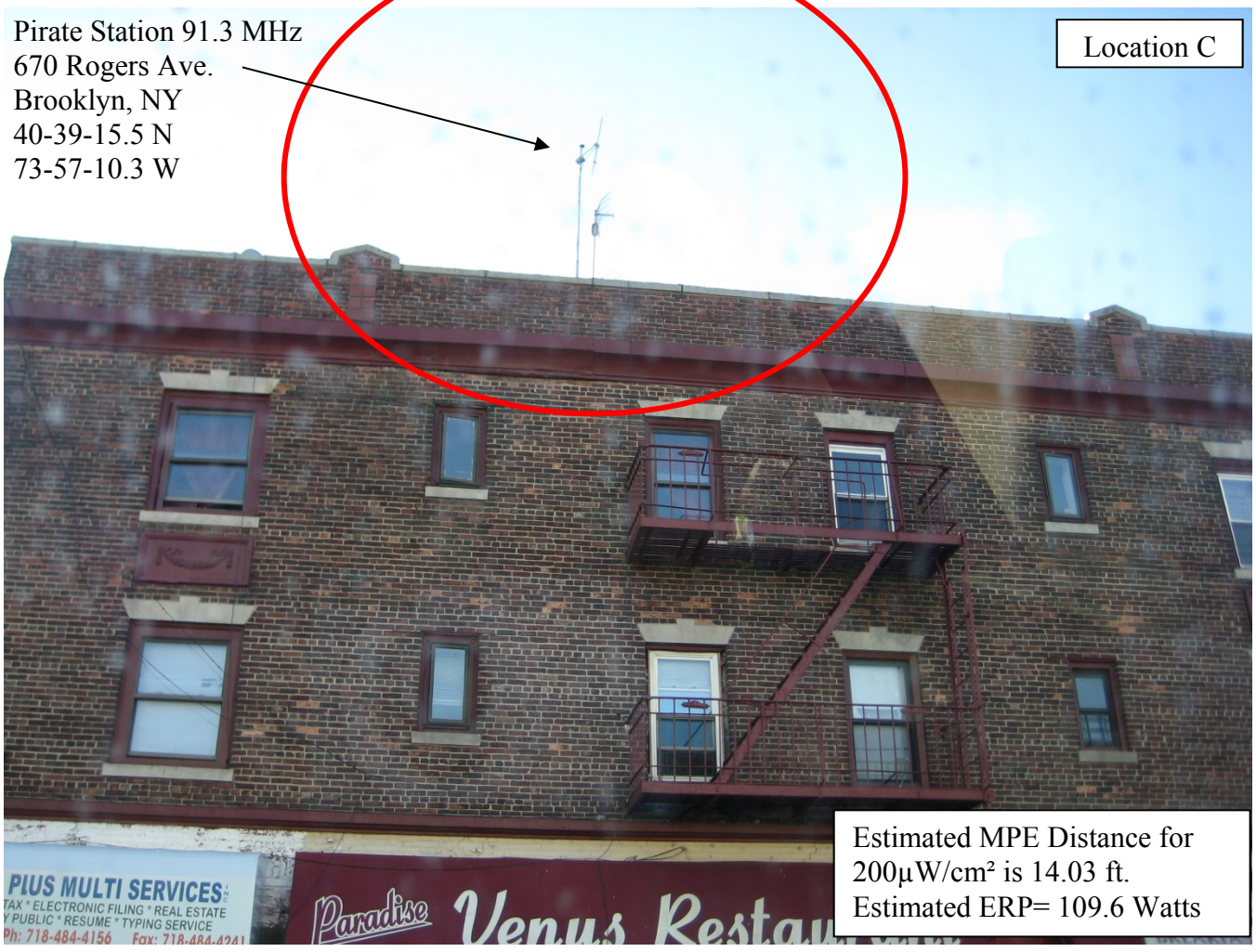
$$\sqrt{430.24} = R = 20.74 \text{ meters} = 69.03 \text{ feet}$$

While it is difficult to see from the picture in Figure 7, the MPE distance of 68.03ft encompasses a rather large area of the roof of the house and adjacent properties. This particular antenna is mounted in

the rear of the home so as to obstruct its visibility from the street. It is believed that the roof structure of this building is wood and therefore would provide little attenuation to the RF emissions from the antenna mounted just above the roof.

Figure 8 is a photograph of the pirate transmitter at Location C, the antenna is mounted on the roof of an apartment building. This roof is in close proximity to adjacent building rooftops, balconies, fire escapes and other locations easily accessible by the general public. The measured signal level was utilized to calculate an estimated ERP from the pirate antenna. Then an analysis was conducted using this estimated ERP to determine the distance from the antenna to which the MPE level extends. In this instance, a person would need to maintain a distance of not less than 14 feet from the energized antenna in order to stay below the FCC General Public (Uncontrolled Environment) Maximum Permissible Exposure level.

Figure 8



An analysis was conducted on Location C to estimate the approximate ERP and then to determine the approximate distance of the 200µW/cm² MPE limit for the General Population (Uncontrolled Environment) using the FCC OET 65 methodology. Based upon the received signal level, free-space path loss, cable losses, and antenna factors it is estimated that the transmitter at Location C is operating with approximately 109.6 watts of Effective Radiated Power (ERP).

Received Signal Level = -10.0 dBm
Observed Distance from Measurement Antenna to Transmitting Antenna Approximately 350 Ft
Total Loss = 60.41dB + -10.0dBm = +50.41 dBm = 109.6 watts Estimated ERP
Using the OET65 method, the distance to the 200µW/cm2 MPE limit is approximately 14.03 Feet from the antenna.

$$18.3 = R^2 = \frac{33.4 \times 109.6}{200\ \mu W/cm^2}$$

R = 4.27 Meters = 14.03 Feet

From the picture it can be seen that any persons in close proximity to the transmitting antenna would potentially be exposed to RFR levels in excess of the FCC MPE limits.

Looking at the example in Figure 8, it appears that there may possibly be some exposure risk for individuals living or working on the top floor of the building. Of course, it is difficult to fully assess the impact because radio waves dissipate at different rates depending on building materials. For example, a brick wall will provide higher signal attenuation than wood or wallboard. For the purposes of this analysis, we did not go inside the building to examine the building materials. Nonetheless, there may be some risk to those working or living on the top floor and it should be examined further and appropriate measures undertaken.

The examples presented above illustrate the problem with regard to potential RFR exposure. Time limitations prevented a more in depth analysis at all unauthorized pirate stations listed in this survey. It is clear, however, that exposure to greater than allowed MPE levels is possible and no attempt has been made to warn people in the proximity of pirate transmitting antennas of the potential health risks. This is an extremely important issue, and we would urge the FCC to fully examine the potential RFR harm from unauthorized pirate transmissions. We believe the risk is particularly high for pirate stations operating at substantial power levels in close proximity to residential and uncontrolled areas.

D. Interference with Aeronautical and FAA Frequencies

This survey did not examine incidents of interference from unauthorized radio stations to aeronautical band and FAA (Federal Aviation Administration) frequencies at JFK Airport and LaGuardia Airport. Nonetheless, it is worth noting that unauthorized pirate radio stations operating in the FM band have been known to cause interference to FAA frequencies. For example, in 2013, the FCC and the Department of Justice shut down an unauthorized radio station operating on 91.7 MHz in Boston, MA. According to the Department of Justice's Press Release, the FAA complained about pirate radio interference:

> "According to an affidavit filed with the civil complaint, the unlicensed FM radio station was causing interference to Federal Aviation Administration (FAA) frequency 120.6 MHz, which is one of the primary frequencies used by pilots to communicate with FAA controllers when flying in the Boston metropolitan area. The FCC issued verbal and written warnings to the residents of 9 Rutland Street on several occasions, but the radio station continued to broadcast." [9]

[9] Source DOJ Press release at https://www.justice.gov/usao-ma/pr/radio-equipment-seized-pirate-radio-station

Similar actions have been taken by the FCC in a number of cities over the years. The potential for interference is significant. The FM broadcast band is adjacent to aeronautical frequencies (108-137MHz) including those used by the FAA for a variety of systems. Interference from pirate stations could cause errors in navigational guidance, interference to pilot to ground communications, as well as other aeronautical systems. As the above case demonstrates, unauthorized pirate stations tend to over modulate, transmit spurious signals, and create intermodulation, and these interfering signals do not stay wholly within the FM broadcast band.

While this survey did not examine interference with aeronautical and FAA frequencies, these interference issues remain one of our top concerns. For example, our Newark, NJ, survey found a pirate station operating on 107.7 MHz, which is only one channel away from being directly adjacent to the FAA frequencies that start at 108 MHz. Newark has an extremely busy airport. In addition, our survey found an unauthorized pirate station in Brooklyn operating on 107.9, which is directly adjacent to FAA frequencies. This station could potentially affect communications at JFK airport. Importantly, our survey did not find that these unauthorized pirate stations were directly causing interference to FAA systems. Nonetheless, the sheer number of unauthorized FM radio stations found in this survey, raises important questions. We urge the FCC to address such potential interference concerns in a timely manner. Additional resources may be needed in order to safeguard against harmful interference to aeronautical communications systems.

Furthermore, pirate stations may cause intermodulation products that interfere with aeronautical or FAA frequencies. Intermodulation is a commonly known interference mechanism caused by strong local signals overloading or overpowering the tuner in a receiver. Typically, this non-linear effect will produce interfering signals on multiple frequencies at the front end of the aeronautical radio. For example, a strong pirate signal on 105.1 MHz may mix with an aeronautical signal on 115.05 MHz (Δ= 9.95 MHz +115.05MHz) and produce an intermodulation product at 125.0 MHz potentially causing interference to the voice communications of aircraft. The potential for this type of interference increases as the number of pirate operations grows. We note that pirate radio stations appear to be operating in proximity to major airports including LaGuardia, John F. Kennedy, and Newark. However, smaller business airports such as Teterboro and Linden airports in New Jersey are located in in close proximity to identified unauthorized operations. Given the significant number of pirate stations in the New York City metropolitan area and the close proximity to these airports, intermodulation should be of significant concern to the FCC.

E. Interference to New Technologies: HD Radio Interference

It is noted that “pirate” stations tend to operate on channels that are either upper or lower adjacent from full power analog FM Broadcast stations. When listening with an analog radio, these channels would sound like “noise” and therefore be presumed to be unoccupied by pirate operators. However, most FM stations in the New York metropolitan area are operating in HD Radio mode. In this case, the “noise” that is heard by a pirate looking for an open channel on which to operate is actually the “noise-like” digital carrier of the HD Radio signal on the Upper and Lower adjacent channels from the analog FM Station.

It is clear that many pirates don't understand that they are operating essentially "co-channel" with the HD Radio carriers (OFDM Carriers). Due to the noise-like interference from the HD Radio carriers, additional power (ERP) is required to overcome the HD Radio Carriers to cover the area in which they desire to broadcast.

As a consequence, HD Radios in automobiles and other HD Radio devices are receiving what is essentially co-channel interference from the pirate station. And, since the HD Radio carriers are relatively high power, when compared to some pirate stations, many pirates will find that they need to increase their station's power to overcome the HD Radio signal and to achieve coverage of the area in which they desire to broadcast. Increasing the power of the pirate station in order to overcome the HD Radio carriers to be received successfully on an analog FM Radio, will lead to potentially increased RF Radiation exposure as well as other interference issues.

This co-channel interference from pirate stations leads to very unreliable HD Radio service due to the interference. Uninformed persons may wrongly draw the conclusion that the HD Radio signal is unreliable. But, in fact, the HD Radio signal in the New York City area is being interfered with by the pirate radio stations. It is the co-channel interference from the pirate station that is causing the HD Radio reception failures in many cases within the New York City metropolitan area.

VI: CONCLUSIONS

Based upon the field tests and resultant data, the measurement of the unauthorized stations in three test locations within the New York City metropolitan area documented at least 76 instances of unlicensed operation. Indeed, the number of unauthorized stations in Brooklyn nearly doubled since our survey in December of 2014. Based upon these observations we feel that our estimate of far more than 100 unlicensed operations is still valid and may be somewhat conservative.

The total number of unauthorized stations is likely to be much larger, perhaps more than 100. It is noted that this fourth testing survey was conducted during weekend hours during the late winter / early spring time frame and not during the summer when pirate stations are generally more active. We believe that the itinerant operations of the unauthorized station will be more active during the summer and fall time periods, and therefore our survey results are conservative. Moreover, due to safety and security considerations the survey was conducted during the day and many unauthorized pirate stations operate at night.

Interference in the FM broadcast and other bands is significant. Not only did we find co-channel operations, we also confirmed that many of the pirate stations are on adjacent-channel frequencies to licensed radio stations. It is important to recognize that the operation of these adjacent channels will cause interference to licensed operations. Under the FCC's rules, FM radio stations are not allowed to operate on these first adjacent channels because they will cause interference to licensed stations operating on adjacent authorized frequencies. The cumulative impact of multiple stations operating on adjacent channels will have a wide ranging interference impact. Accordingly, harmful interference will occur even if unlicensed radio stations are not operating on the exact same frequencies as licensed operations.

Interference is harmful to the public in several ways. First, both co-channel and adjacent-channel interference places the Emergency Alert Service (EAS) system, and the people that rely upon the EAS system warnings, at risk. Consumers listening to unauthorized pirate radio stations will never hear an EAS alert because unauthorized stations do not broadcast the EAS alerts. New Yorkers listening to licensed stations may be unable to hear the EAS alerts due to interference to their radios from unauthorized pirate stations. Finally, interference from unauthorized pirate stations prevents licensed stations from monitoring critically important LP1 stations. These LP1 stations begin the EAS relay daisy-chain. A break in that chain due to interference can prevent thousands, if not potentially millions, from hearing a life-saving EAS message.

Second, we must begin to examine the potential harm of RF radiation exposure. Because these pirate stations operate on rooftops, balconies and fire escapes, there is significant concern with RF radiation exposure. As shown in Appendix D, the potential for exposure to RF Radiation levels in excess of the FCC MPE limits is high since no precautions are taken by pirate operators to limit access by the general public to their active and energized antennas, nor are the operators likely to have safety training related to RFR exposure and the appropriate MPE limit signage posted near their transmitting antennas, as required by law.

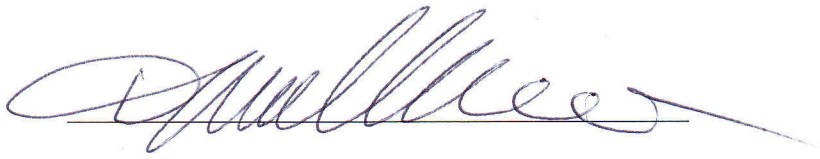
Third, because of the significant number of unauthorized radio stations, there is an increasing risk to interference to aeronautical radio frequencies (FAA operations). The FCC has recognized these problems in the past, and has acted swiftly to resolve these problems. However, given the large number of pirate operations and the proximity to several major airports, this potential issue deserves considerable attention by the FCC and other law enforcement officials.

Fourth, we note that several unauthorized stations were found to be interfering with the reception of authorized HD Radio operations from licensed stations. In this regard, some HD Radio reception failures in the New York City area are erroneous attributed to the HD Radio technology or system when in fact the problem is co-channel interference from unauthorized “pirate” stations.

On balance, this most recent survey indicates that the problem of unauthorized radio operations in the FM broadcast band has not abated since our first survey in 2012. In some respects the pirate problem appears to be increasing.

While it is beyond the scope of this analysis to make policy recommendations, it appears more resources and a new enforcement strategy is necessary to address this growing problem since current efforts do not appear to be effective.

Submitted this 19th Day of May, 2016



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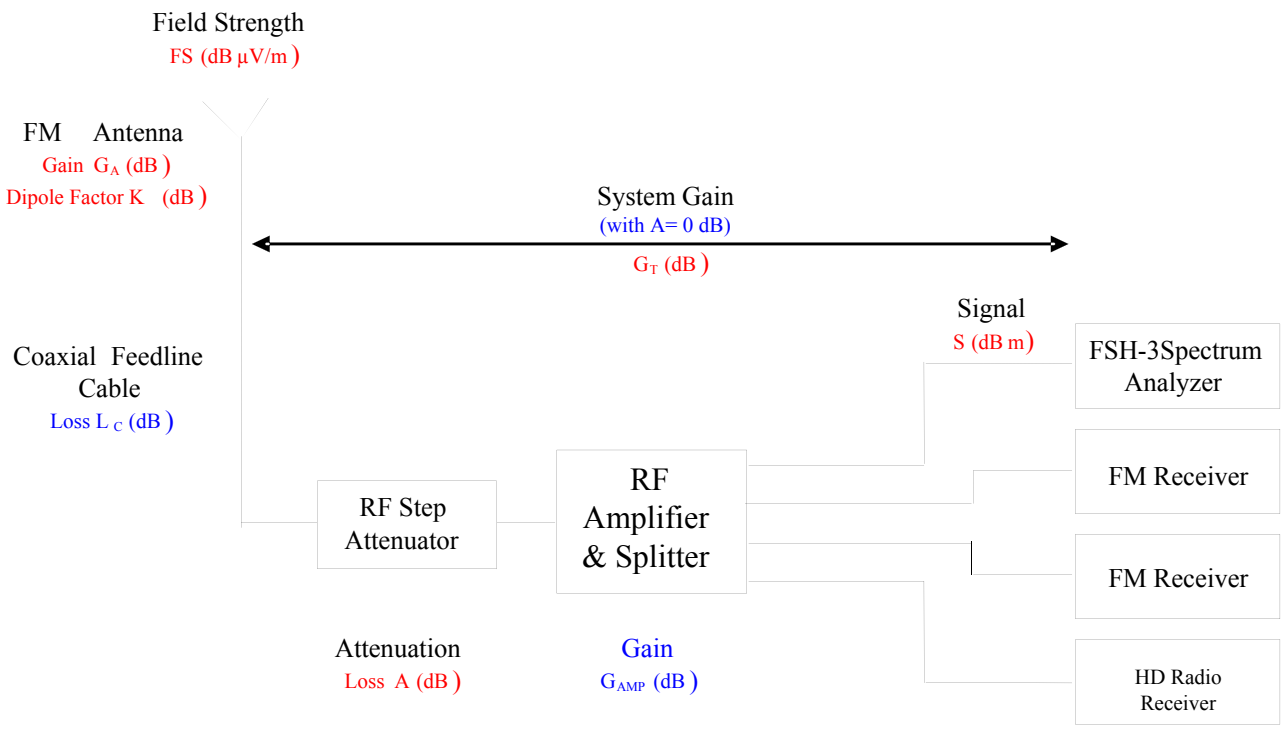
APPENDIX A

Field Test Vehicle Description

One field test truck was employed in these field tests. A pneumatic mast with 30' AGL mast extension was utilized, as well as a 5.5 kW AC power generator. A picture of the test van and its system block diagram are shown.



Figure A1-1 MSW field test truck photo



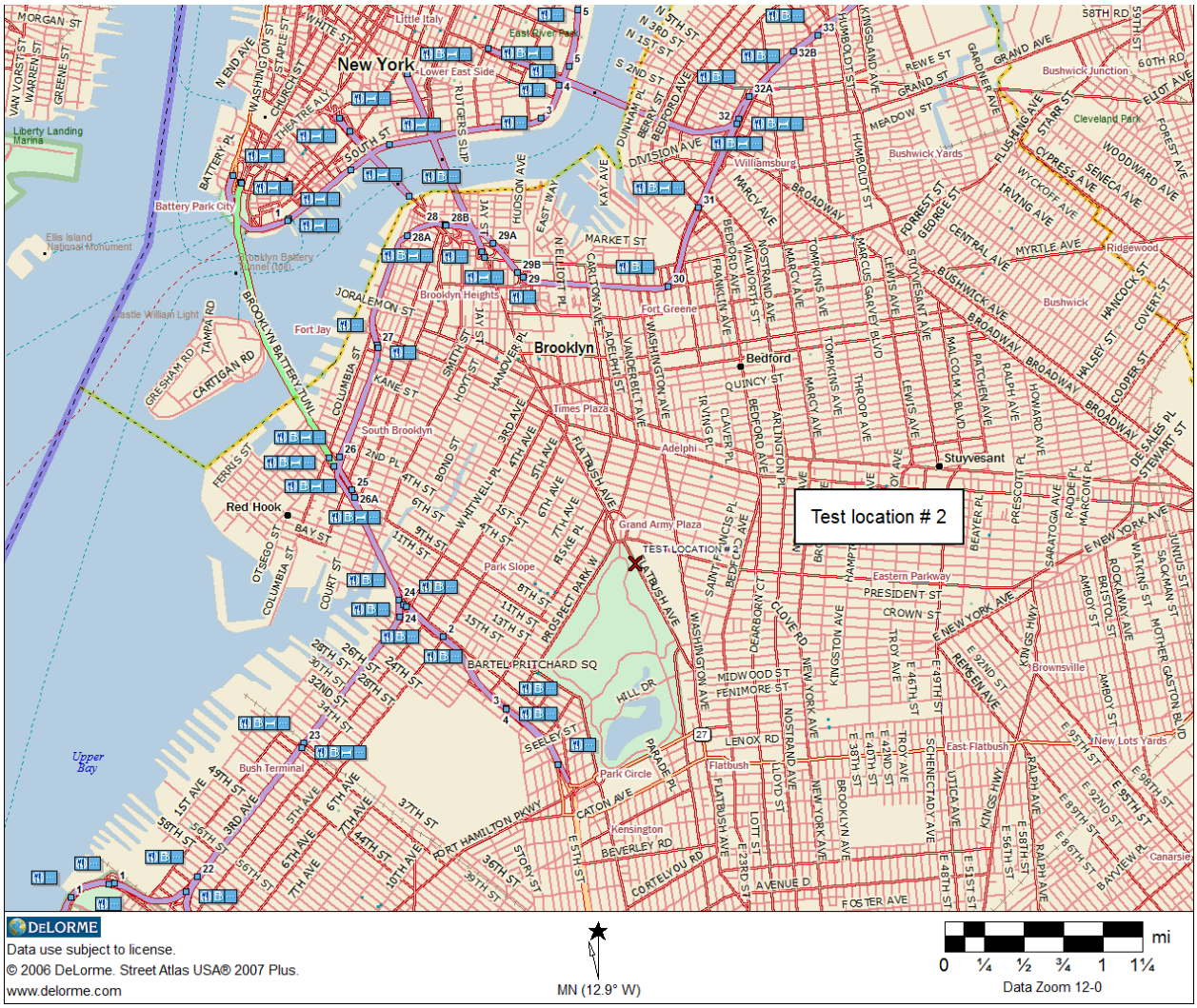
$$\mathbf{FS\ (dB\mu V/m) = S - G_T + A + K - G_A}$$

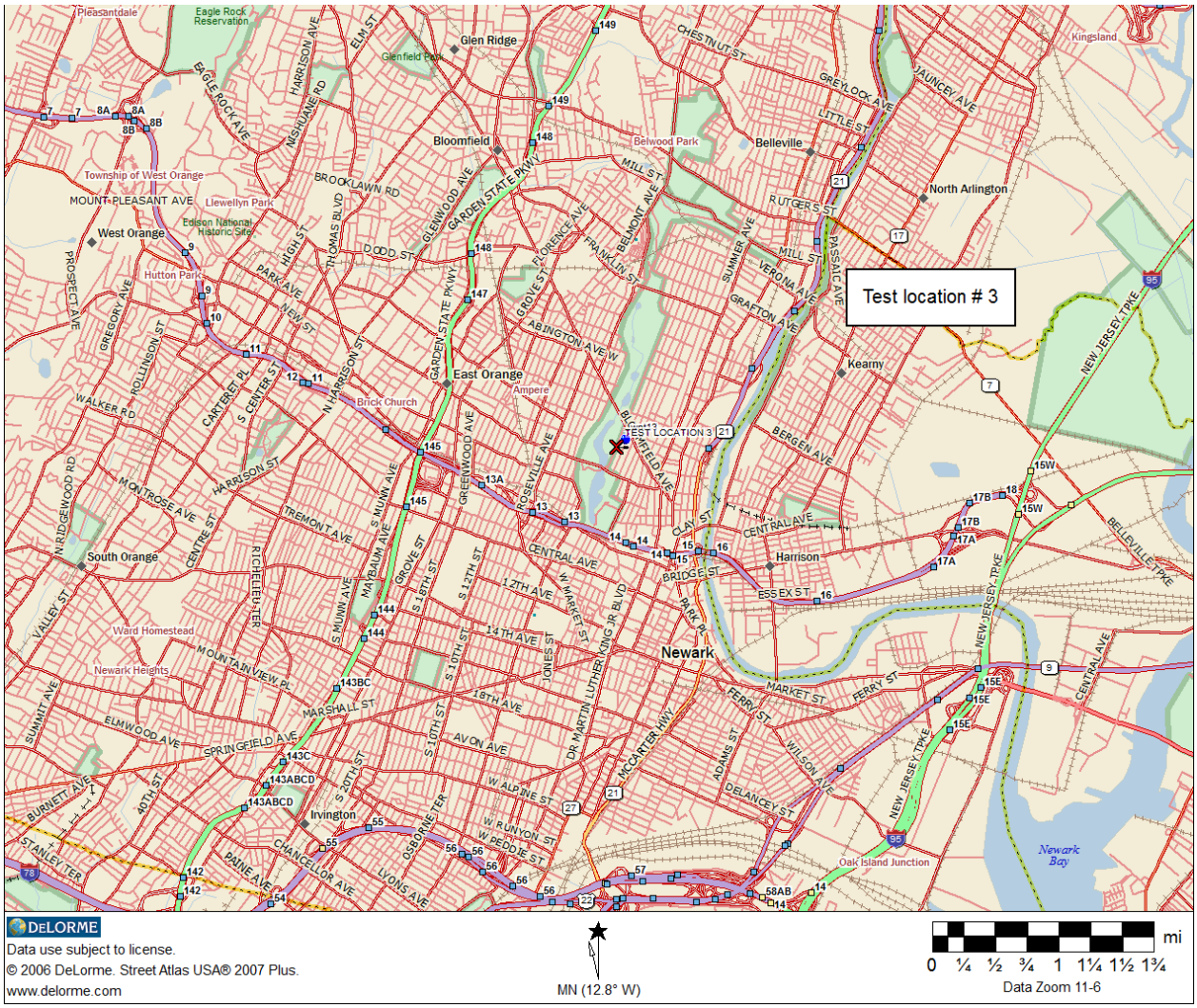
Field Test Truck Block Diagram

APPENDIX B

Map of Measurement Locations




Test location # 2
TEST LOCATION
New York
Brooklyn
Bedford
Stuyvesant
Red Hook
Fort Greene
Brooklyn Heights
Park Slope
Williamsburg
Bushwick
Flatbush
Kensington
Bush Terminal
Upper Bay
Liberty Landing Marina
Ellis Island National Monument
Battery Park City
Grand Army Plaza
Prospect Park
Eastern Parkway
DeLORME
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www.delorme.com
MN (12.9° W)
mi
0 ¼ ½ ¾ 1 1¼
Data Zoom 12-0


Test location # 3
TEST LOCATION 3
Newark
Bloomfield
Glen Ridge
Belleville
Nutley
Kearny
Harrison
East Orange
West Orange
South Orange
Irvington
North Arlington
Kingsland
Belwood Park
Oak Island Junction
Newark Bay
DeLORME
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www.delorme.com
MN (12.8° W)
mi
0 ¼ ½ ¾ 1 1¼ 1½ 1¾
Data Zoom 11-6


Test Location #4
Paterson
Totowa
Elmwood Park
Passaic Junction
Garret Mountain Reservation
Highland Lake
Lake View
Boonstra Park
Memorial Park
Warren Point
DeLORME
Data use subject to license.
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www.delorme.com
MN (12.8° W)
0 800 1600 2400 3200 4000 ft
Data Zoom 12-7

APPENDIX C

DATA SPREADSHEET

NYC Pirate Project "= PIRATE FREQUE **4th Visit 02/27/16**

SITE #1 Paul Ave. At Athletic Fields Bronx At W. 205th St 40.87625 11:32AM

Dipole Antenna Length = 30 5/8" Antenna Factor= 6.73dB/m Gain= 3.08dBi Gain=2.03X 19 Pirate Stations

Spectrum Analzy Calculated

FREQUENCY	STATION CALL	ERP	Station Class	Attenuator	SIGNAL LEVEL	RECVD POWER	Antenna Orientation	Licensee	Spectrum Notes:
87.7			LPTV	20	-57.6	-37.6			"Franken-FM" Station LPTV Ch. 6 Aura
87.9	Pirate			20	-66.5	-46.5	NE/SW		Multiple pirates co-channel
88.1				0	-79	-79			Weak Station -
88.3	WBGO	2.5 KW	B1	10	-68.5	-58.5	SSW	Newark Public Rac	Newark Public Radio
88.5	WPOB?			10	-51.7	-41.7	SE/NW		Unmodulated Carrier
88.7	WRHU			0	-69.5	-69.5	SE/NW	Hoffstra Univ.	Mod Signal
88.9				20	-75.6	-55.6	SSE	WFDU?	HD Carriers for 89.1MHz
89.1	WFDU / WNYU	0.55 KW	A / B1	20	-53.2	-33.2	SSE	Fairleigh Dickinsor	Analog Carrier for Full Power
89.3				20	-76.5	-56.5	SSE	WFDU?	HD Carriers for 89.1MHz
89.5	WSOU	2.4KW	A	10	-65.5	-55.5	SW	Seton Hall Univ.	Mod Signal
89.7	Pirate			10	-72.5	-62.5	SSE/NNW		Pirate Co-Ch w/ HD Carriers of WKCR
89.9	WKCR	1.35KW	B	10	-49.6	-39.6	S	Columbia Universi	Analog Carrier for Full Power
90.1				10	-72	-62	S		HD Carriers WKCR
90.3	/WMSC/WHCR/WKRB		D	10	-79.8	-69.8		Kean Univ/Montcl	Very Weak Signal
90.5				40	-67.8	-27.8	E		HD CARRIERS FROM WFUV
90.7	WFUV	47 KW	B	40	-44.8	-4.8	E	Fordham Univ	STRONG
90.9				40	-69.1	-29.1	E		HD CARRIERS FROM WFUV
91.1	WFMU	1.25KW	A	10	-78.5	-68.5	SSE	Auricle Communic	Noisy Carrier
91.3	Pirate			10	-59.6	-49.6	SSE		Unmodulated Carrier - Strong level
91.5	WNYE	2.0KW	B1	10	-47.6	-37.6	S	New York City	WNYE
91.7	Pirate			10	-72.2	-62.2	S		Moderate Signal Level analog pirate
91.9	Pirate			10	-81.5	-71.5	S		Unmodulated Carrier
92.1				10	-66.9	-56.9	S	HD Carrier	HD CARRIERS
92.3	WXRK	6.0 KW	B	20	-58.5	-38.5	S	CBS Radio	WXRK
92.5				10	-70.8	-60.8	S	HD Carrier	HD Carriers
92.7	WQBU	2.0 KW	A	10	-57.7	-47.7	S	Univision Radio	Analog Carrier for Full Power
92.9				20	-81.6	-61.6	S		HD Carriers
93.1	WPAT	6.0 KW	B	20	-56.5	-36.5	S	WPAT License Inc.	Analog Carrier for Full Power
93.3				20	-44.5	-24.5	N/S	HD Carrier	HD Carriers
93.5	WVIP	1.75KW	A	30	-30.5	-0.5	N/S	Westchester - Hud	Analog Carrier for Full Power
93.7				30	-54.4	-24.4	N/S	HD Carrier	HD Carriers
93.9	WNYC	5.2KW	B	30	-63.4	-33.4	N/S	New York Public R	Analog Carrier for Full Power
94.1				3	-83.9	-80.9	E/W	Nothing	Clear
94.3	Pirate			3	-57.4	-54.4	E/W		Pirate Analog

94.5				10	-77.2	-67.2	NNE/SSW	HD Carrier	HD Carriers
94.7	WFME	23.5KW	B	10	-65.4	-55.4	NNE/SSW	Cumulus - NASH F	Analog Carrier for Full Power
94.9				10	-77.1	-67.1	NNE/SSW	HD Carrier	HD Carriers
95.1				0	-71.2	-71.2	N/S	Full Power Station	Distant Full Power Analog Station
95.3	Pirate			10	-68.3	-58.3	E/W	Pirate & HD Carrie	Pirate Analog FM/Co-Channel w/ HD C
95.5	WPLJ	7 KW	B	10	-49.9	-39.9	N/S	WPLJ	Analog Carrier for Full Power
95.7				10	-72.8	-62.8	N/S	HD Carrier	HD Carriers
95.9				10	-76.7	-66.7	SW	Distant Full Power	"The Frog"?
96.1				10	-88	-78	S	Distant Full Power	Distant Full Power Analog Station
96.3	WXNY	26 KW	B	10	-49.6	-39.6	S	WADO License Inc	Analog Carrier for Full Power
96.5				10	-89	-79	S		Clear
96.7	WKLV	3.1KW	A	10	-53.4	-43.4	SW	Educational Media	Analog Carrier for Full Power
96.9				10	-73.5	-63.5	S		HD Carriers for 97.1
97.1	WQHT	7KW	B	20	-58.2	-38.2	S	Emmis	Analog Carrier for Full Power
97.3				20	-83.9	-63.9	S		HD Carrier for 97.1
97.5	WALK			3	-78.8	-75.8	SE/NW	WALK ?	Analog Carrier for Full Power
97.7				3	-88	-85		Clear	Clear
97.9	WSKQ	7KW	B	10	-55.6	-45.6	S	WSKQ License	Analog Carrier for Full Power
98.1				3	-86	-83	S		Clear
98.3	WKJY			10	-80.7	-70.7	E		Analog Carrier for Full Power
98.5				10	-88	-78	S		Clear
98.7	WEPN	4.6 KW	B	10	-52.3	-42.3	S	EMMIS	WEPN
98.9	Pirate			10	-71.5	-61.5	N/S		Pirate
99.1				10	-82.5	-72.5	SE/NW	Distant Full Power	Analog Carrier for Full Power
99.3	Pirate			10	-69.5	-59.5	N/S		Pirate
99.5	WBAI	4.3 KW	B	10	-59.8	-49.8	S	Pacifica	Analog Carrier for Full Power
99.7				10	-91.2	-81.2	S		Clear
99.9				10	-82.6	-72.6	N	CT Full Power Stat	Analog Carrier for Full Power
100.1				10	-71.2	-61.2	S		HD Carriers
100.3	WHTZ	6KW	B	10	-55.8	-45.8	S	Clear Channel	Analog Carrier for Full Power
100.5				10	-74.5	-64.5	S		HD Carriers
100.7	WHUD			10	-65.8	-55.8	N		Analog Carrier for Full Power
100.9				10	-65.4	-55.4	S		HD Carriers
101.1	WCBS	6.7KW	B	10	-50.7	-40.7	S	CBS	Analog Carrier for Full Power
101.3				10	-66.9	-56.9	S		HD Carriers
101.5	Pirate			0	-72.4	-72.4	S	NJ 101.5	Pirate and Analog Full Power
101.7	Pirate			10	-61.8	-51.8	S		Pirate Station
101.9	WRXP	4.6KW	B	10	-49.8	-39.8	S	Merlin Media	Analog Carrier for Full Power
102.1	Pirate			10	-79.2	-69.2	E/W		Pirate
102.3	Pirate			10	-71.2	-61.2	S		Unmodulated Carrier - Pirate

102.5				0	-61.6	-61.6	S		HD Carriers
102.7	WWFS	6KW	B	10	-46.5	-36.5	S	CBS Radio	Analog Carrier for Full Power
102.9				10	-71.2	-61.2	S		HD Carriers
103.1	W275AQ	0.035 KW	D	10	-81.6	-71.6	SW	Translator / Bridg	Translator
103.3	Pirate			10	-63.4	-53.4	E/W	Pirate & HD Carrie	HD Carriers
103.5	WKTU	6KW	B	10	-48.9	-38.9	S	Clear Channel	Analog Carrier for Full Power
103.7	Pirate			10	-67.8	-57.8	S		Pirate and HD Carriers Co-channel
103.9	WFAS	1.3kW	A	20	-34.7	-14.7	SW	Cumulus	Analog Carrier for Full Power
104.1				20	-79.9	-59.9	S		HD Carriers
104.3	WAXQ	6KW	B	20	-61.5	-41.5	S	Clear Channel	Analog Carrier for Full Power
104.5	Pirate			20	-44.7	-24.7	SSE	Analog Pirate and	VERY Strong Pirate Signal
104.7	Q1047			10	-82.9	-72.9	NW		Analog Carrier for Full Power
104.9				10	-79.8	-69.8	S		HD Carriers
105.1	WWPR	6KW	B	10	-54.8	-44.8	S	Clear Channel	Analog Carrier for Full Power
105.3				10	-74.9	-64.9	S		HD Carriers
105.5	Pirate			10	-71.8	-61.8	SW/NE		Strong Pirate
105.7	Pirate			10	-73.5	-63.5	S		Pirate and HD Carriers Co-channel
105.9	WQXR	0.7KW	B1	10	-59.7	-49.7	S	New York Public R	Analog Carrier for Full Power
106.1	Pirate			10	-54.8	-44.8	E/W		Pirate and HD Carriers Co-channel
106.3	W292DV	0.099KW	D	10	-79.7	-69.7	SE/NW	Translator / Apple	Translator
106.5				10	-71.9	-61.9	S		HD Radio
106.7	WLTW	4.7KW	B	10	-53.5	-43.5	S	Clear Channel	Analog Carrier for Full Power
106.9				10	-72.2	-62.2	S		HD Radio
107.1	The Peak Westchester			10	-80.2	-70.2	N/S		Analog Carrier for Full Power
107.3				10	-77.6	-67.6	N/S		HD Radio
107.5	WBLS	4.2KW	B	10	-58.8	-48.8	N/S	URBAN Licenses	Analog Carrier for Full Power
107.7				10	-75.8	-65.8	N/S		HD Carriers
107.9	WEBE			10	-73.9	-63.9	N		Analog Carrier for Full Power

NYC Pirate Project "= PIRATE FREQUENCIES" **4th Visit 02/28/16**

SITE # 2 Flatbush Ave. at Prospect Park N40.67072 W73.96823 11:09AM

Dipole Antenna Length = 30 5/8" Antenna Factor= 6.73dB/m Gain= 3.08dBi Gain=2.03X

Spectrum Analzy Calculated

FREQUENCY	STATION CALL	ERP	Station Class	Attenuator	SIGNAL LEVEL	RECVD POWER	Antenna Orientation	Licensee	TX Location	Spectrum Notes:
87.7			LPTV	10	-70.9	-60.9	NW/SE		Citi Bldg - Lo	"Franken-FM" Station LPTV Ch. 6 Aura
87.9				10	-104.3	-94.3	NNW			Very Noisy -
88.1				10	-72.7	-62.7	W/E	HD Carriers		HD Carriers for WBGO
88.3	WBGO	2.5 KW	B1	10	-45.7	-35.7	W/E	Newark Public Radio		Analog Carrier for Full Power
88.5	Pirate			10	-71.3	-61.3	W/E	HD Carriers		HD Carriers for WBGO// Pirate Co-Cha
88.7	Pirate			10	-68.9	-58.9	SW/NE	Hoffstra Univ. // Pirate Co.ch		Pirate Co-ch w/ WRHU
88.9	Pirate			10	-73.5	-63.5	E/W	Pirate // Co-Ch w/ HD Carriers		Pirate - co-channel w/ HD Carriers
89.1	WFDU / WNYU	0.55 KW	A / B1	10	-75.6	-65.6	N/S	Fairleigh Dickinson University /		Analog Carrier for Full Power
89.3				10	-67.9	-57.9	N/S	Pirate Co-CH. w/ HD Carriers		Pirate Co-Ch w/ HD Carriers
89.5	WSOU	2.4KW	A	10	-59.5	-49.5	N/S	Seton Hall Univ.		Analog Carrier for Full Power
89.7	Pirate			10	-63.9	-53.9	N/S	Pirate Co-CH. w/ HD Carriers		Pirate Co-Ch w/ HD Carriers of WKCR
89.9	WKCR	1.35KW	B	10	-42.9	-32.9	N/S	Columbia University		Analog Carrier for Full Power
90.1	Pirate			10	-65	-55	E/W	Pirate Co-CH. w/ HD Carriers		Pirate CO-Channel w/ HD Carriers
90.3	WMSC/WHCR/WKRB		D	10	-77.6	-67.6	SW/NE	Kean Univ/Montclair / City Coll		Very Weak Signal
90.5	Pirate			10	-67.4	-57.4	SW/NE	Pirate - French		Pirate Co-Ch w/ HD Carriers
90.7	WFUV	47 KW	B	10	-60.2	-50.2	N/S	Fordham Univ		Analog Carrier for Full Power
90.9	Pirate			10	-65.4	-55.4	N/S			Very strong Pirate co-ch w/ HD Carrier
91.1	WFMU	1.25KW	A	10	-70.2	-60.2	NW/SE	Auricle Communications		Noisy Carrier
91.3	Pirate			10	-60.4	-50.4	N/S	Pirate		Very Strong Pirate
91.5	WNYE	2.0KW	B1	10	-51.5	-41.5	N/S	New York City		WNYE
91.7	Pirate			10	-60.4	-50.4	NE/SW	Pirate		Moderate Signal Level analog pirate
91.9	Pirate			10	-69.8	-59.8	E/W	Pirate		Pirate
92.1				10	-67	-57	N/S	HD Carrier		HD CARRIERS
92.3	WXRK	6.0 KW	B	10	-48.6	-38.6	N/S	CBS Radio	ESB	WXRK
92.5	Pirate			10	-60.9	-50.9	N/S	Pirate Co-CH. w/ HD Carriers		Pirate CO-Channel w/ HD Carriers
92.7	WQBU	2.0 KW	A	10	-76.3	-66.3	E/W	Univision Radio		Analog Carrier for Full Power
92.9	pirate			10	-64.8	-54.8	NNE/SSW	Pirate Co-CH. w/ HD Carriers		Pirate CO-Channel w/ HD Carriers
93.1	WPAT	6.0 KW	B	10	-48.8	-38.8	N/S	WPAT License Inc.		Analog Carrier for Full Power
93.3				10	-68.8	-58.8	N/S	HD Carrier		HD Carriers
93.5	WVIP	1.75KW	A	10	-64.5	-54.5	N/S	Westchester - Hud WVIP		Analog Carrier for Full Power
93.7				10	-79.5	-69.5	N/S	HD Carrier		HD Carriers
93.9	WNYC	5.2KW	B	10	-42.3	-32.3	N/S	New York Public Radio		Analog Carrier for Full Power
94.1				10	-78.7	-68.7	N/S	Pirate		Weak Signal - Pirate - very noisy

94.3	Pirate			10	-68.7	-58.7	E/W	Pirate		Pirate - Very Noisy - unmod carrier
94.5				10	-74.6	-64.6	N/S	HD Carrier		HD Carriers
94.7	WFME	23.5KW	B	10	-59.6	-49.6	N/S	Cumulus - NASH Fm		Analog Carrier for Full Power
94.9				10	-74.7	-64.7	N/S	HD Carrier		HD Carriers
95.1	Pirate			10	-62.3	-52.3	NE/SW	Pirate		Unmodulated Carrier - Pirate
95.3	Pirate			10	-64.8	-54.8	NW/SE	Pirate & HD Carrier		Pirate Analog FM/Co-Channel w/ HD C
95.5	WPLJ	7 KW	B	10	-54.8	-44.8	N/S	WPLJ		Analog Carrier for Full Power
95.7				10	-68.9	-58.9	N/S	HD Carrier		HD Carriers
95.9	Pirate			10	-71.5	-61.5	SE/NW	pirate		Pirate
96.1	Pirate			10	-77.5	-67.5	W/E	Pirate		Pirate
96.3	WXNY	26 KW	B	10	-41.3	-31.3	SW/NE	WADO License Inc.		Analog Carrier for Full Power
96.5				10	-90	-80	N/S			Clear
96.7	WKLV	3.1KW	A	10	-68.8	-58.8	SW/NE	Educational Media		Analog Carrier for Full Power
96.9				10	-68.9	-58.9	N/S			HD Carriers for 97.1
97.1	WQHT	7KW	B	10	-58.7	-48.7	N/S	Emmis	ESB	Analog Carrier for Full Power
97.3				10	-71.2	-61.2	N/S			HD Carrier for 97.1
97.5	Pirate/WALK			10	-72.9	-62.9	E/W	Pirate - co-channel	Long Island	Pirate Co-Channel w/ Analog Station
97.7				10	-67.1	-57.1	N/S	HD Carrier		HD Carrier
97.9	WSKQ	7KW	B	10	-48.7	-38.7	N/S	WSKQ License	ESB	Analog Carrier for Full Power
98.1				10	-68.8	-58.8	N/S	HD Carrier		HD Carrier
98.3	WKJY			10	-71.5	-61.5	E/W		Long Island	Analog Carrier for Full Power
98.5				10	-96.6	-86.6	N/S			Clear
98.7	WEPN	4.6 KW	B	10	-48.5	-38.5	N/S	EMMIS	ESB	WEPN
98.9				10	-88.3	-78.3	NNE/SSW			HD Carriers
99.1				10	-62.8	-52.8	NNE/SSW	Full Power Station		Analog Carrier for Full Power
99.3	Pirate			10	-63.5	-53.5	E/W	Pirate		Pirate CO-Channel w/ HD Carriers
99.5	WBAI	4.3 KW	B	10	-48.2	-38.2	N/S	Pacifica	ESB	Analog Carrier for Full Power
99.7				10	-93.6	-83.6	E/W	Distant Station - noisy		Analog Carrier for Full Power
99.9	Pirate			10	-81.4	-71.4	N/S	Pirate		Weak Signal - Pirate - very noisy
100.1				10	-77.3	-67.3	N/S			HD Carriers
100.3	WHTZ	6KW	B	10	-54.3	-44.3	N/S	Clear Channel	ESB	Analog Carrier for Full Power
100.5				10	-77.4	-67.4	N/S			HD Carriers
100.7	Pirate			10	-65.3	-55.3	S	Pirate		Pirate
100.9				10	-71.8	-61.8	N/S			HD Carriers
101.1	WCBS	6.7KW	B	10	-45.8	-35.8	N/S	CBS	ESB	Analog Carrier for Full Power
101.3				10	-67.6	-57.6	N/S			HD Carriers
101.5	NJ 101.5			10	-75.6	-65.6	SW/NE	NJ 101.5	Trenton	Pirate and Analog Full Power
101.7	Pirate			10	-84.5	-74.5	SE/NW	Pirate		Pirate Station
101.9	WRXP	4.6KW	B	10	-49.5	-39.5	N/S	Merlin Media	ESB	Analog Carrier for Full Power
102.1				10	-90	-80	N/S			Clear

102.3	Pirate			10	-75.4	-65.4	E/W			Pirate Analog
102.5				10	-74.8	-64.8	N/S			HD Carriers
102.7	WWFS	6KW	B	10	-55.7	-45.7	N/S	CBS Radio	ESB	Analog Carrier for Full Power
102.9				10	-74.1	-64.1	N/S			HD Carriers
103.1	Pirate	0.035 K	D	10	-77.6	-67.6	N/S	Pirate - co-channel		Pirate
103.3				10	-71.6	-61.6	N/S	HD Carrier		HD Carriers
103.5	WKTU	6KW	B	10	-52.8	-42.8	N/S	Clear Channel	ESB	Analog Carrier for Full Power
103.7				10	-69.7	-59.7	N/S			HD Carriers
103.9	WFAS	1.3kW	A	10	-70.9	-60.9	NNE/SSW	Cumulus	Bronxville	Analog Carrier for Full Power
104.1				10	-70.3	-60.3	N/S			HD Carriers
104.3	WAXQ	6KW	B	10	-47.7	-37.7	N/S	Clear Channel	ESB	Analog Carrier for Full Power
104.5				10	-74.8	-64.8	N/S	HD Carrier		HD Carriers
104.7	Pirate			10	-76.9	-66.9	N/S		Pirate	Pirate
104.9				10	-72.3	-62.3	N/S			HD Carriers
105.1	WWPR	6KW	B	10	-53.5	-43.5	N/S	Clear Channel	ESB	Analog Carrier for Full Power
105.3				10	-74.4	-64.4	N/S			HD Carriers
105.5	Pirate			10	-74.5	-64.5	N/S	Pirate		Pirate
105.7				10	-78.8	-68.8	NNE/SSW			HD Carriers
105.9	WQXR	0.7KW	B1	10	-56.1	-46.1	N/S	New York Public Ra	ESB	Analog Carrier for Full Power
106.1				10	-80.1	-70.1	N/S			HD Carriers
106.3	Pirate	0.099K\	D	10	-67.3	-57.3	SW/NE	Pirate - co-channel	Long Island (	Priate co-channel w/ Translator
106.5				10	-68.9	-58.9	N/S			HD Radio
106.7	WLTW	4.7KW	B	10	-51.4	-41.4	N/S	Clear Channel	ESB	Analog Carrier for Full Power
106.9				10	-73.8	-63.8	N/S			HD Radio
107.1	The Peak Westchester			10	-72.7	-62.7	NNE/SSW			Analog Carrier for Full Power
107.3				10	-69.5	-59.5	N/S			HD Radio
107.5	WBLS	4.2KW	B	10	-54.2	-44.2	N/S	URBAN Licenses	ESB	Analog Carrier for Full Power
107.7				10	-72.5	-62.5	N/S			HD Carriers
107.9	Pirate			10	-67.6	-57.6	NNE/SSW	Pirate		Priate - Very Strong

NYC Pirate Project "= PIRATE FREQUENCIES" **4th Visit 02/29/16**

SITE # 3 Newark, NJ - 303 Lake Street - Next Ballpark N40.76116 W74.179 11:09AM

Dipole Antenna Length = 30 5/8" Antenna Factor= 6.73dB/m Gain= 3.08dBi Gain=2.03X

Spectrum Analzy Calculated

FREQUENCY	STATION CALL	ERP	Station Class	Attenuator	SIGNAL LEVEL	RECVD POWER	Antenna Orientation	Licensee	Location	Spectrum Notes:
87.7			LPTV	10	-86.8	-76.8	E/W		Citi Bldg	"Franken-FM" Station LPTV Ch. 6 Aural
87.9				10	-98.9	-88.9	E/W	Clear		Clear
88.1				10	-81.5	-71.5	E/W	HD Carriers		HD Carriers for WBGO
88.3	WBGO	2.5 KW	B1	10	-57.5	-47.5	E/W	Newark Public Radio		Analog Carrier for Full Power
88.5				10	-82.8	-72.8	E/W	HD Carriers		HD Carriers
88.7				10	-73.5	-63.5	N/S	WPSC		Analog Carrier for Full Power
88.9	WSIA			10	-78.9	-68.9	NNW/SSE	WSIA		Analog Carrier for Full Power
89.1	WFDU	0.55 KW	A / B1	10	-74.5	-64.5	NE/SW	Fairleigh Dickinson University / N		Analog Carrier for Full Power
89.3				10	-62.5	-52.5	NE/SW	HD Carriers		HD Carriers
89.5	WSOU	2.4KW	A	10	-38.2	-28.2	NE/SW	Seton Hall Univ.		Analog Carrier for Full Power
89.7				10	-62.3	-52.3	NE/SW	HD Carriers		HD Carriers
89.9	WKCR	1.35KW	B	10	-73.4	-63.4	N/S	Columbia University		Analog Carrier for Full Power
90.1	Pirate			10	-56	-46	N/S	Pirate		Pirate
90.3	/WMSC/WHCR/WKRB		D	10	-75.5	-65.5	N/S	Kean Univ/Montclair / City Colleg		Analog Carrier for Full Power
90.5				10	-88.5	-78.5	N/S	Distant Station - noisy		Distant Station - Very Noisy
90.7	WFUV	47 KW	B	10	-76.5	-66.5	E/W	Fordham Univ		Analog Carrier for Full Power
90.9	Pirate			10	-75.2	-65.2	NE/SW	Noisy Signal - Not Identifiable		Weak Signal - Pirate - very noisy
91.1	WFMU	1.25KW	A	10	-46.5	-36.5	E/W	Auricle Communications		Analog Carrier for Full Power
91.3	Pirate			10	-67.5	-57.5	NW/SE	Pirate		Pirate Station
91.5	WNYE	2.0KW	B1	10	-67.5	-57.5	NW/SE	New York City		WNYE
91.7	Pirate			10	-98	-88	E/W	Noisy Signal - Not Identifiable		noisy signal not identifiable
91.9				10	-79.9	-69.9	E/W	Identified at "XPN" ?		Analog Carrier for Full Power
92.1				10	-73.5	-63.5	NE/SW	HD Carrier		HD CARRIERS
92.3	WXRK	6.0 KW	B	10	-54.8	-44.8	NE/SW	CBS Radio	ESB	WXRK
92.5				10	-72.6	-62.6	NE/SW	HD Carriers		HD Carriers
92.7	WQBU	2.0 KW	A	10	-85.5	-75.5	N/S	Univision Radio		Analog Carrier for Full Power
92.9				10	-85.8	-75.8	NE/SW	HD Carriers		HD Carriers
93.1	WPAT	6.0 KW	B	10	-63.4	-53.4	NE/SW	WPAT License Inc.		Analog Carrier for Full Power
93.3				10	-81.1	-71.1	NE/SW	HD Carrier		HD Carriers
93.5	Pirate	1.75KW	A	10	-65.2	-55.2	NE/SW	Pirate	Pirate	Pirate
93.7				10	-94.5	-84.5	NE/SW	HD Carrier		HD Carriers
93.9	WNYC	5.2KW	B	10	-57.7	-47.7	NE/SW	New York Public Radio		Analog Carrier for Full Power
94.1				10	-89.5	-79.5	NE/SW	Philly Station WIP		Analog Carrier for Full Power
94.3	Pirate			10	-68.8	-58.8	N/S	Pirate		Strong Pirate Signal
94.5				10	-46.5	-36.5	E/W	HD Carrier		HD Carriers
94.7	WFME	23.5KW	B	10	-30.8	-20.8	E/W	Cumulus - NASH Fm		Analog Carrier for Full Power
94.9				10	-45.5	-35.5	E/W	HD Carrier		HD Carriers

95.1				10	-87.8	-77.8	NE/SW	Clear		Clear
95.3				10	-78.9	-68.9	NE/SW	HD Carriers		HD Carriers
95.5	WPLJ	7 KW	B	10	-51.8	-41.8	NE/SW	WPLJ		Analog Carrier for Full Power
95.7				10	-82.5	-72.5	NE/SW	HD Carrier		HD Carriers
95.9	Pirate			10	-69.9	-59.9	NE/SW	pirate		Pirate
96.1	Pirate			10	-63.5	-53.5	E/W	Pirate		Pirate
96.3	WXNY	26 KW	B	10	-57.1	-47.1	NE/SW	WADO License Inc.		Analog Carrier for Full Power
96.5				10	-93.9	-83.9	N/S	Distant Station - noisy		noisy signal not identifiable
96.7	WKLV	3.1KW	A	10	-79.9	-69.9	N/S	Educational Media		Analog Carrier for Full Power
96.9				10	-82.3	-72.3	NE/SW	HD Carriers		HD Carriers for 97.1
97.1	WQHT	7KW	B	10	-58.9	-48.9	NE/SW	Emmis	ESB	Analog Carrier for Full Power
97.3				10	-82.9	-72.9	NE/SW	HD Carriers		HD Carrier for 97.1
97.5	Pirate			10	-69.9	-59.9	E/W	Pirate		Pirate
97.7				10	-77.7	-67.7	NE/SW	HD Carrier		HD Carrier
97.9	WSKQ	7KW	B	10	-54.3	-44.3	NE/SW	WSKQ License	ESB	Analog Carrier for Full Power
98.1				10	-80.7	-70.7	NE/SW	HD Carrier		HD Carrier
98.3	Magic 98.3			10	-76.5	-66.5	N/S		Central N	Analog Carrier for Full Power
98.5				10	-98	-88	E/W	Clear		Clear
98.7	WEPN	4.6 KW	B	10	-51.8	-41.8	NE/SW	EMMIS	ESB	WEPN
98.9				10	-88.9	-78.9	N/S	HD Carriers		HD Carriers
99.1	Star 99.1			10	-71.3	-61.3	N/S	Full Power Station		Analog Carrier for Full Power
99.3				10	-91.5	-81.5	N/S	HD Carrier		HD Carriers
99.5	WBAI	4.3 KW	B	10	-59.8	-49.8	NE/SW	Pacifica	ESB	Analog Carrier for Full Power
99.7				10	-97.9	-87.9	N/S	Distant Station - noisy		Distant Station - Very Noisy
99.9				10	-89.9	-79.9	N/S	Distant Station - noisy		Weak Signal - Very Noisy - Full Power
100.1				10	-76.3	-66.3	NE/SW			HD Carriers
100.3	WHTZ	6KW	B	10	-56.5	-46.5	NE/SW	Clear Channel	ESB	Analog Carrier for Full Power
100.5				10	-76.6	-66.6	NE/SW			HD Carriers
100.7	WHUD			10	-78.9	-68.9	NW/SE	Full Power Station	Hudson \	Analog Carrier for Full Power
100.9				10	-74.7	-64.7	NE/SW	HD Carriers		HD Carriers
101.1	WCBS	6.7KW	B	10	-56.3	-46.3	NE/SW	CBS	ESB	Analog Carrier for Full Power
101.3				10	-77.6	-67.6	NE/SW			HD Carriers
101.5	NJ 101.5			10	-76.3	-66.3	N/S	NJ 101.5	Trenton	Pirate and Analog Full Power
101.7				10	-95.3	-85.3	N/S	HD Carrier		HD Carrier
101.9	WRXP	4.6KW	B	10	-63.3	-53.3	E/W	Merlin Media	ESB	Analog Carrier for Full Power
102.1				10	-96.9	-86.9	E/W	Clear		Clear
102.3	Pirate			10	-83.6	-73.6	NE/SW	Pirate		Pirate Analog
102.5				10	-82.3	-72.3	NE/SW	HD Carriers		HD Carriers
102.7	WWFS	6KW	B	10	-63.5	-53.5	NE/SW	CBS Radio	ESB	Analog Carrier for Full Power
102.9				10	-82.9	-72.9	NE/SW			HD Carriers
103.1		0.035 KW	D	10	-93.2	-83.2	N/S	HD Carrier - Weak		Weak HD Carrier
103.3				10	-73.7	-63.7	NE/SW	HD Carrier		HD Carriers
103.5	WKTU	6KW	B	10	-57.3	-47.3	NE/SW	Clear Channel	ESB	Analog Carrier for Full Power

103.7				10	-75.8	-65.8	NE/SW			HD Carriers
103.9	WFAS	1.3kW	A	10	-89.8	-79.8	E/W	Cumulus	Bronxvill	Analog Carrier for Full Power
104.1				10	-78.8	-68.8	NE/SW			HD Carriers
104.3	WAXQ	6KW	B	10	-54.9	-44.9	NE/SW	Clear Channel	ESB	Analog Carrier for Full Power
104.5				10	-78.7	-68.7	NE/SW	HD Carrier		HD Carriers
104.7	K104			10	-89.5	-79.5	N/S	Distant Station - weak		Distant Station - Weak Signal
104.9				10	-75.1	-65.1	NE/SW	HD Carriers		HD Carriers
105.1	WWPR	6KW	B	10	-64.3	-54.3	NE/SW	Clear Channel	ESB	Analog Carrier for Full Power
105.3				10	-79.9	-69.9	NE/SW	HD Carriers		HD Carriers
105.5	WDHA			10	-78.4	-68.4	E/W	Full Power Station		Analog Carrier for Full Power
105.7	**Pirate**			10	-64.5	-54.5	E/W	Pirate		Very Strong Pirate
105.9	WQXR	0.7KW	B1	10	-62.2	-52.2	NE/SW	New York Public Radio	ESB	Analog Carrier for Full Power
106.1				10	-89.9	-79.9	NE/SW	HD Carriers		HD Carriers
106.3		0.099KW	D	10	-94.4	-84.4	N/S	Distant Signal		Distant Station - Noisy
106.5				10	-85.1	-75.1	NE/SW	HD Carriers		HD Radio
106.7	WLTW	4.7KW	B	10	-62.2	-52.2	NE/SW	Clear Channel	ESB	Analog Carrier for Full Power
106.9				10	-85.4	-75.4	NE/SW	HD Carriers		HD Radio
107.1	Pirate			10	-65.5	-55.5	NW/SE	Pirate	Strong Si	Unmodulated Carrier
107.3				10	-78.7	-68.7	NE/SW	HD Carriers		HD Radio
107.5	WBLS	4.2KW	B	10	-59.7	-49.7	NE/SW	URBAN Licenses	ESB	Analog Carrier for Full Power
107.7	Pirate			10	-72.6	-62.6	NE/SW			Priate Co Channel w/ HD Carriers
107.9				10	-95.2	-85.2	N/S	Distant Station		Analog Carrier for Full Power

NYC Pirate Project "= PIRATE FREQUENCIES" **1st Visit 3/12/16**

SITE # 4 Paterson NJ Next to Football Field 100 Oak Street N40.91165 W74.16095 10:45AM

FM Antenna Yagi **13 Pirate Stations**

Spectrum Analzy Calculated

FREQUENCY	STATION CALL	ERP	Station Class	Attenuator	SIGNAL LEVEL	RECVD POWER	Antenna Orientation	Licensee	TX Location	Spectrum Notes:
87.7			LPTV	10	-68.5	-58.5	East		Citi Bldg - Lo	"Franken-FM" Station LPTV Cl
87.9				10	-100.2	-90.2	East	Clear		Clear
88.1				10	-75.1	-65.1	East	HD Carriers		HD Carriers for WBGO
88.3	WBGO	2.5 KW	B1	10	-52.1	-42.1	SE	Newark Public Radio		Analog Carrier for Full Power
88.5				10	-70.1	-60.1	SE	HD Carriers		HD Carriers
88.7				10	-97.7	-87.7	East	WPSC		Analog Carrier for Full Power
88.9				10	-88.1	-78.1	East	HD Carriers		HD Carriers
89.1	WFDU	0.55 KW	A / B1	10	-58.6	-48.6	East	Fairleigh Dickinson University / N		Analog Carrier for Full Power
89.3				10	-80.6	-70.6	East	HD Carriers		HD Carriers
89.5	WSOU	2.4KW	A	10	-74.3	-64.3	East	Seton Hall Univ.		Analog Carrier for Full Power
89.7	Pirate			10	-58.9	-48.9	North	Pirate co-channel w/ HD Carriers		Priate Co Channel w/ HD Carr
89.9	WKCR	1.35KW	B	10	-60.3	-50.3	SE	Columbia University		Analog Carrier for Full Power
90.1	Pirate			10	-56.5	-46.5	East	Pirate		Pirate
90.3	/WMSC/WHCR/WKRB		D	10	-68.8	-58.8	ENE	Kean Univ/Montclair / City Colle		Analog Carrier for Full Power
90.5	Pirate			10	-48.9	-38.9	ESE	Pirate		Pirate Station
90.7	WFUV	47 KW	B	10	-68.9	-58.9	ESE	Fordham Univ		Analog Carrier for Full Power
90.9	Pirate			10	-55.3	-45.3	East	Pirate Station		Very Strong Pirate
91.1	WFMU	1.25KW	A	10	-79.5	-69.5	NE	Auricle Communications		Analog Carrier for Full Power
91.3	Pirate			10	-96.8	-86.8	NW	Pirate - Very Weak		Weak Pirate Station
91.5	WNYE	2.0KW	B1	10	-52.5	-42.5	ESE	New York City		WNYE
91.7				10	-64.8	-54.8	NE	Not Identifiable		signal not identifiable
91.9	Pirate			10	-78.2	-68.2	East	Pirate Noisy		Pirate
92.1				10	-68.8	-58.8	East	HD Carrier		HD CARRIERS
92.3	WXRK	6.0 KW	B	10	-43.2	-33.2	ESE	CBS Radio	ESB	WXRK
92.5				10	-58.7	-48.7	ESE	HD Carriers		HD Carriers
92.7	WQBU	2.0 KW	A	10	-74.5	-64.5	ESE	Univision Radio		Analog Carrier for Full Power
92.9				10	-74.8	-64.8	ESE	HD Carriers		HD Carriers
93.1	WPAT	6.0 KW	B	10	-44.9	-34.9	ESE	WPAT License Inc.		Analog Carrier for Full Power
93.3				10	-66.4	-56.4	ESE	HD Carrier		HD Carriers
93.5	WVIP	1.75KW	A	10	-61.5	-51.5	ESE	WVIP FM	WVIP	Analog Carrier for Full Power
93.7	Pirate			10	-65.5	-55.5	East	Pirate co-channel w/ HD Carriers		Pirate cochannel w/ HD Carrie
93.9	WNYC	5.2KW	B	10	-43.5	-33.5	East	New York Public Radio		Analog Carrier for Full Power
94.1				10	-94.3	-84.3	East	Clear		Clear
94.3	WSBP			10	-66.5	-56.5	East	WSBP	Woodridge I	LPFM Station

94.5	Pirate			10	-68.9	-58.9	ESE	Pirate co-channel w/ HD Carriers		Pirate cochannel w/ HD Carrie
94.7	WFME	23.5KW	B	10	-57.5	-47.5	SE	Cumulus - NASH Fm		Analog Carrier for Full Power
94.9				10	-68.8	-58.8	SE	HD Carrier		HD Carriers
95.1				10	-81.1	-71.1	NE	Weak Full Power Station		Weak Signal - Very Noisy - Ful
95.3				10	-72.5	-62.5	ESE	HD Carriers		HD Carriers
95.5	WPLJ	7 KW	B	10	-47.5	-37.5	ESE	WPLJ		Analog Carrier for Full Power
95.7				10	-66.4	-56.4	ESE	HD Carrier		HD Carriers
95.9				10	-88.9	-78.9	W	Weak Full Power Station		Distant Weak Station
96.1	Pirate			10	-73.4	-63.4	North	Pirate		Pirate
96.3	WXNY	26 KW	B	10	-44.7	-34.7	ESE	WADO License Inc.		Analog Carrier for Full Power
96.5				10	-93.9	-83.9	SE	Distant Station - noisy		noisy signal not identifiable
96.7	WKLV	3.1KW	A	10	-77.1	-67.1	ESE	Educational Media		Analog Carrier for Full Power
96.9				10	-71.7	-61.7	ESE	HD Carriers		HD Carriers for 97.1
97.1	WQHT	7KW	B	10	-47.5	-37.5	ESE	Emmis	ESB	Analog Carrier for Full Power
97.3				10	-67.7	-57.7	ESE	HD Carriers		HD Carrier for 97.1
97.5	Pirate			10	-43.4	-33.4	NE	VERY STRONG Pirate		Pirate
97.7				10	-71.5	-61.5	ESE	HD Carrier		HD Carrier
97.9	WSKQ	7KW	B	10	-48.9	-38.9	ESE	WSKQ License	ESB	Analog Carrier for Full Power
98.1				10	-66.4	-56.4	ESE	HD Carrier		HD Carrier
98.3	Magic 98.3			10	-78.9	-68.9	SE	Full Power Station	Central NJ	Analog Carrier for Full Power
98.5				10	-95.8	-85.8	SE	Clear		Clear
98.7	WEPN	4.6 KW	B	10	-36.8	-26.8	ESE	EMMIS	ESB	WEPN
98.9				10	-92.1	-82.1	ESE	Clear		Clear
99.1	Star 99.1			10	-82.7	-72.7	SE	Full Power Station		Analog Carrier for Full Power
99.3	Pirate			10	-34.9	-24.9	N	Pirate		Pirate Station VERY STRONG
99.5	WBAI	4.3 KW	B	10	-37.8	-27.8	ESE	Pacifica	ESB	Analog Carrier for Full Power
99.7				10	-93.5	-83.5	ESE	Clear		Clear
99.9	Pirate			10	-80.2	-70.2	SW	Pirate		Pirate - noisy
100.1				10	-65.2	-55.2	ESE			HD Carriers
100.3	WHTZ	6KW	B	10	-44.8	-34.8	ESE	Clear Channel	ESB	Analog Carrier for Full Power
100.5				10	-60.3	-50.3	ESE			HD Carriers
100.7	WHUD			10	-69.7	-59.7	N	Full Power Station	Hudson Vall	Analog Carrier for Full Power
100.9				10	-62.5	-52.5	ESE	HD Carriers		HD Carriers
101.1	WCBS	6.7KW	B	10	-45.8	-35.8	ESE	CBS	ESB	Analog Carrier for Full Power
101.3				10	-57.8	-47.8	ESE			HD Carriers
101.5	NJ 101.5			10	-90.8	-80.8	S	NJ 101.5	Trenton	Pirate and Analog Full Power
101.7				10	-91.5	-81.5	SE	Noisy Signals		noisy signal not identifiable
101.9	WRXP	4.6KW	B	10	-43.5	-33.5	ESE	Merlin Media	ESB	Analog Carrier for Full Power
102.1				10	-96.5	-86.5	S	Clear		Clear
102.3	WSUS			10	-82.5	-72.5	S	WSUS Distant Signal		Distant Signal

102.5				10	-69.3	-59.3	ESE	HD Carriers		HD Carriers
102.7	WWFS	6KW	B	10	-47.4	-37.4	ESE	CBS Radio	ESB	Analog Carrier for Full Power
102.9				10	-60.8	-50.8	ESE			HD Carriers
103.1	W275AQ	0.035 KW	D	10	-77.5	-67.5	E	Translator?	Ft. Lee?	Translator ?
103.3				10	-67.4	-57.4	ESE	HD Carrier		HD Carriers
103.5	WKTU	6KW	B	10	-46.3	-36.3	ESE	Clear Channel	ESB	Analog Carrier for Full Power
103.7				10	-61.3	-51.3	ESE			HD Carriers
103.9	WFAS	1.3kW	A	10	-64.5	-54.5	ESE	Cumulus	Bronxville	Analog Carrier for Full Power
104.1				10	-68.5	-58.5	ESE			HD Carriers
104.3	WAXQ	6KW	B	10	-44.5	-34.5	ESE	Clear Channel	ESB	Analog Carrier for Full Power
104.5				10	-63.4	-53.4	ESE	HD Carrier		HD Carriers
104.7	K104			10	-83.2	-73.2	N	Full Power Station		Analog Carrier for Full Power
104.9				10	-65.4	-55.4	ESE	HD Carriers		HD Carriers
105.1	WWPR	6KW	B	10	-46.3	-36.3	ESE	Clear Channel	ESB	Analog Carrier for Full Power
105.3				10	-61.4	-51.4	ESE	HD Carriers		HD Carriers
105.5	WDHA			10	-85.2	-75.2	SE	Full Power Station		Analog Carrier for Full Power
105.7				10	-77.8	-67.8	ESE	HD Carriers		HD Carriers
105.9	WQXR	0.7KW	B1	10	-47.3	-37.3	ESE	New York Public Ra	ESB	Analog Carrier for Full Power
106.1				10	-72.5	-62.5	ESE	HD Carriers		HD Carriers
106.3	Thunder 106	0.099KW	D	10	-84.5	-74.5	SE	Distant Signal		Distant Station - Noisy
106.5				10	-68.7	-58.7	ESE	HD Carriers		HD Radio
106.7	WLTW	4.7KW	B	10	-46.5	-36.5	ESE	Clear Channel	ESB	Analog Carrier for Full Power
106.9				10	-63.4	-53.4	ESE	HD Carriers		HD Radio
107.1	The Peak			10	-72.5	-62.5	S	Full Power Station	The Peak	Analog Carrier for Full Power
107.3				10	-68.3	-58.3	ESE	HD Carriers		HD Radio
107.5	WBLS	4.2KW	B	10	-46.5	-36.5	ESE	URBAN Licenses	ESB	Analog Carrier for Full Power
107.7				10	-62.8	-52.8	ESE			Priate Co Channel w/ HD Carr
107.9	Pirate			10	-78.5	-68.5	S	Pirate		Priate

APPENDIX D

RF RADIATION EXPOSURE ANALYSIS

LOCATION A



An analysis was conducted on Location A to estimate the approximate ERP and then to determine the approximate distance of the 200µW/cm² MPE limit for the General Population (Uncontrolled Environment) using the FCC OET 65 methodology. Based upon the received signal level, free-space path loss, cable losses, and antenna factors it is estimated that the transmitter at Location A is operating with approximately 288.4 watts of Effective Radiated Power (ERP).

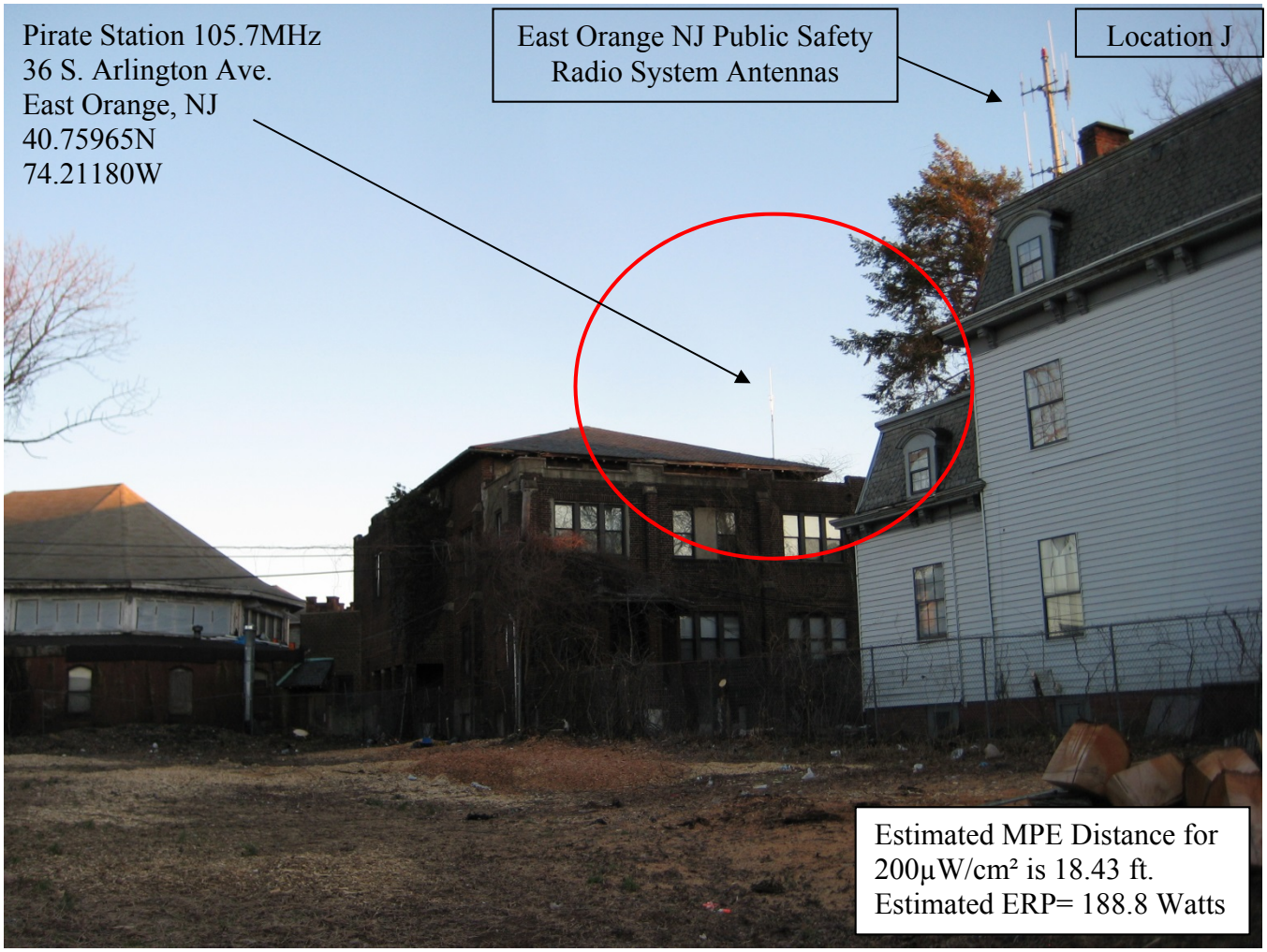
Received Signal Level = -15.0dBm
Observed Distance from Measurement Antenna to Transmitting Antenna Approximately 700 Ft
Total Loss = 69.6dB + -15.0dBm = +54.6dBm = 288.4 watts Estimated ERP
Using the OET65 method, the distance to the 200µW/cm2 MPE limit is approximately 22.76 Feet from the antenna.

$$48.168 = R^2 = \frac{33.4 \times 288.4}{200\ \mu W/cm^2}$$

$$\sqrt{48.168} = R = 6.94 \text{ meters} = 22.76 \text{ feet}$$

From the picture it can be seen that any persons on the roof top of the apartment building would be potentially exposed to RFR exposure levels in excess of the FCC MPE limits.

LOCATION J



An analysis was conducted on Location J to estimate the approximate ERP and then to determine the approximate distance of the 200µW/cm² MPE limit for the General Population (Uncontrolled Environment) using the FCC OET 65 methodology. Based upon the received signal level, free-space path loss, cable losses, and antenna factors it is estimated that the transmitter at Location J is operating with approximately 188.8 watts of Effective Radiated Power (ERP).

Received Signal Level = -8.0dBm
Observed Distance from Measurement Antenna to Transmitting antenna is approximately 250 Ft
Total Loss = 60.76dB + -8.0dBm = +52.76dBm = 188.8 watts Estimated ERP
Using the OET65 method, the distance to the 200µW/cm2 MPE limit is approximately 18.43 Feet from the antenna.

$$31.53 = R^2 = \frac{33.4 \times 188.8}{200\ \mu W/cm^2}$$

$$\sqrt{31.53} = R = 5.62 \text{ meters} = 18.43 \text{ feet}$$

While it is difficult to see from this picture, the MPE distance of 18.43ft encompasses a rather large area of the roof of the building and adjacent properties. It is believed that the roof structure of this building is wood and therefore would provide little attenuation to the RF emissions from the antenna mounted just above the roof on the pipe.

LOCATION L



An analysis was conducted on Location L to estimate the approximate ERP and then to determine the approximate distance of the 200µW/cm² MPE limit for the General Population (Uncontrolled Environment) using the FCC OET 65 methodology. Based upon the received signal level, free-space path loss, cable losses, and antenna factors it is estimated that the transmitter at Location L is operating with approximately 2,576.3 watts of Effective Radiated Power (ERP).

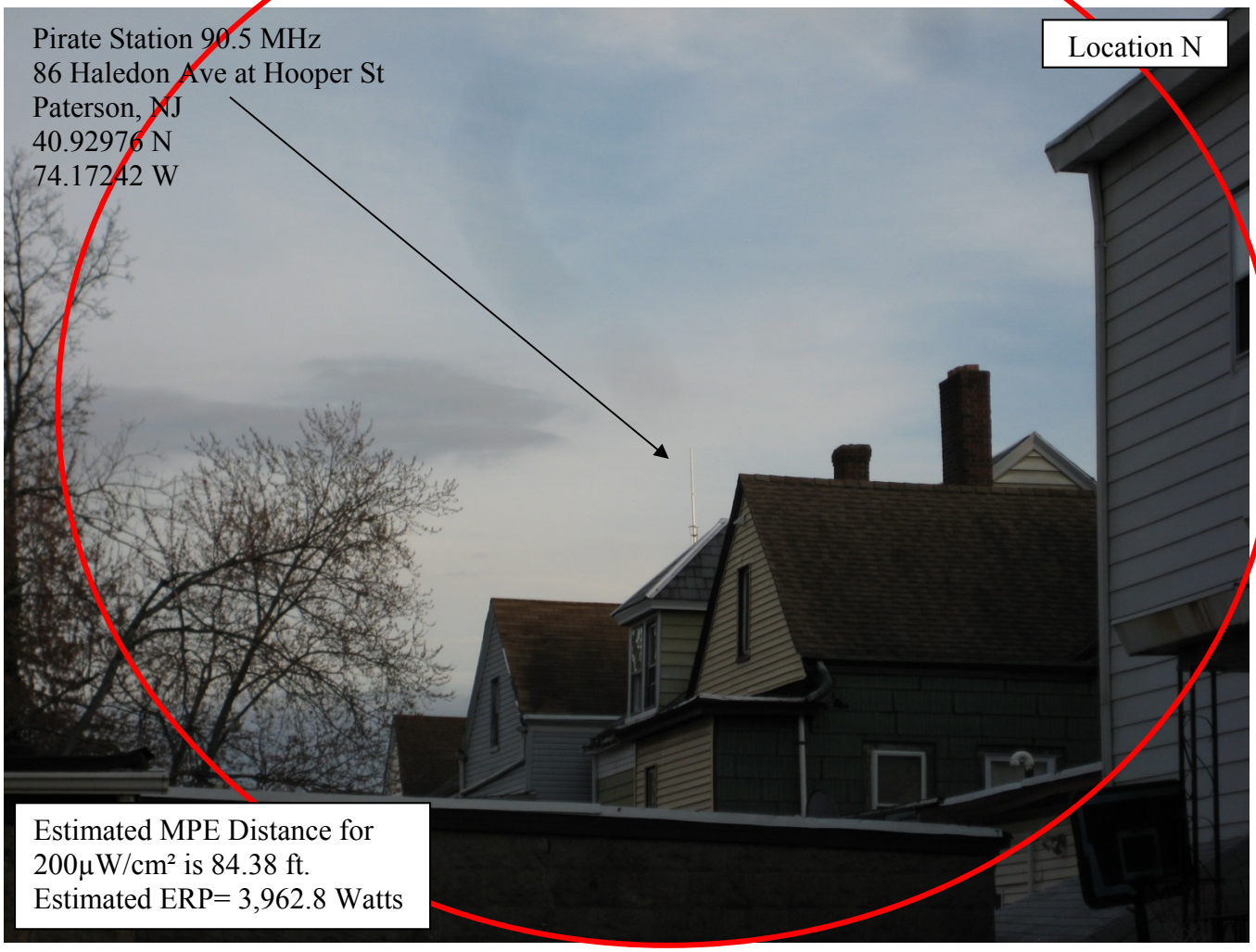
Received Signal Level = -0.5dBm
Observed Distance from Measurement antenna to transmitting antenna approximately 500 Ft
Total Loss = 64.61dB + -0.5dBm = +64.11dBm = 2,576.3 watts Estimated ERP
Using the OET65 method, the distance to the 200µW/cm2 MPE limit is approximately 68.03 Feet from the antenna.

$$430.24 = R^2 = \frac{33.4 \times 2576.3}{200\ \mu W/cm^2}$$

$$\sqrt{430.24} = R = 20.74 \text{ meters} = 69.03 \text{ feet}$$

While it is difficult to see from this picture, the MPE distance of 68.03ft encompasses a rather large area of the roof of the house and adjacent properties. This particular antenna is mounted in the rear of the home so as to obstruct its visibility from the street. It is believed that the roof structure of this building is wood and therefore would provide little attenuation to the RF emissions from the antenna mounted just above the roof.

LOCATION N



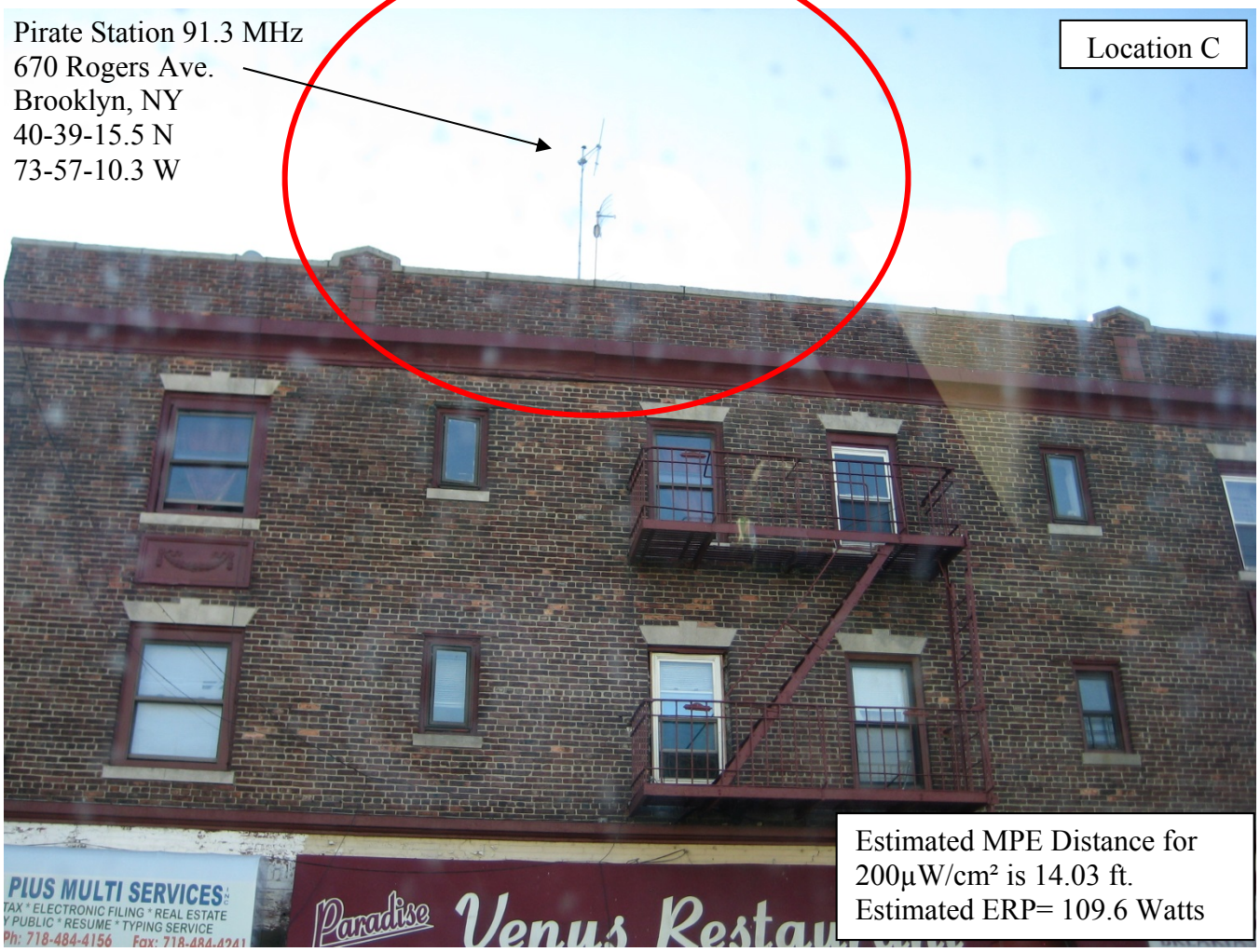
An analysis was conducted on Location N to estimate the approximate ERP and then to determine the approximate distance of the 200µW/cm² MPE limit for the General Population (Uncontrolled Environment) using the FCC OET 65 methodology. Based upon the received signal level, free-space path loss, cable losses, and antenna factors it is estimated that the transmitter at Location N is operating with approximately 3,962.8 watts of Effective Radiated Power (ERP).

Received Signal Level = +13.0dBm
Observed Distance from Measurement Antenna to Transmitting antenna 150 Ft Approx.
Total Loss = 52.98dB + 13.0dBm = +65.98dBm = 3,962.8 watts Estimated ERP
Using the OET65 method, the distance to the 200µW/cm2 MPE limit is approximately 84.38 Feet from the antenna.

$$661.79 = R^2 = \frac{33.4 \times 3962.8}{200\ \mu W/cm^2}$$

$$\sqrt{661.79} = R = 25.73 \text{ meters} = 84.38 \text{ feet}$$

While it is difficult to see from this picture, the MPE distance of 84.38ft encompasses a very large area including the adjacent properties. This particular antenna is mounted in the rear of the home so as to obstruct its visibility from the street. It is believed that the roof structure of this building is wood and therefore would provide little attenuation to the RF emissions from the antenna mounted just above the roof. The neighboring structures are also believed to be of wood construction which would limit the amount of attenuation of the RF signal entering neighboring structures.



An analysis was conducted on Location C to estimate the approximate ERP and then to determine the approximate distance of the 200µW/cm² MPE limit for the General Population (Uncontrolled Environment) using the FCC OET 65 methodology. Based upon the received signal level, free-space path loss, cable losses, and antenna factors it is estimated that the transmitter at Location C is operating with approximately 109.6 watts of Effective Radiated Power (ERP).

Received Signal Level = -10.0 dBm
Observed Distance from Measurement Antenna to Transmitting antenna 350 Ft Approx.
Total Loss = 60.41dB + -10.0dBm = +50.41 dBm = 109.6 watts Estimated ERP
Using the OET65 method, the distance to the 200µW/cm2 MPE limit is approximately 14.03 Feet from the antenna.

$$18.3 = R^2 = \frac{33.4 \times 109.6}{200\ \mu W/cm^2}$$

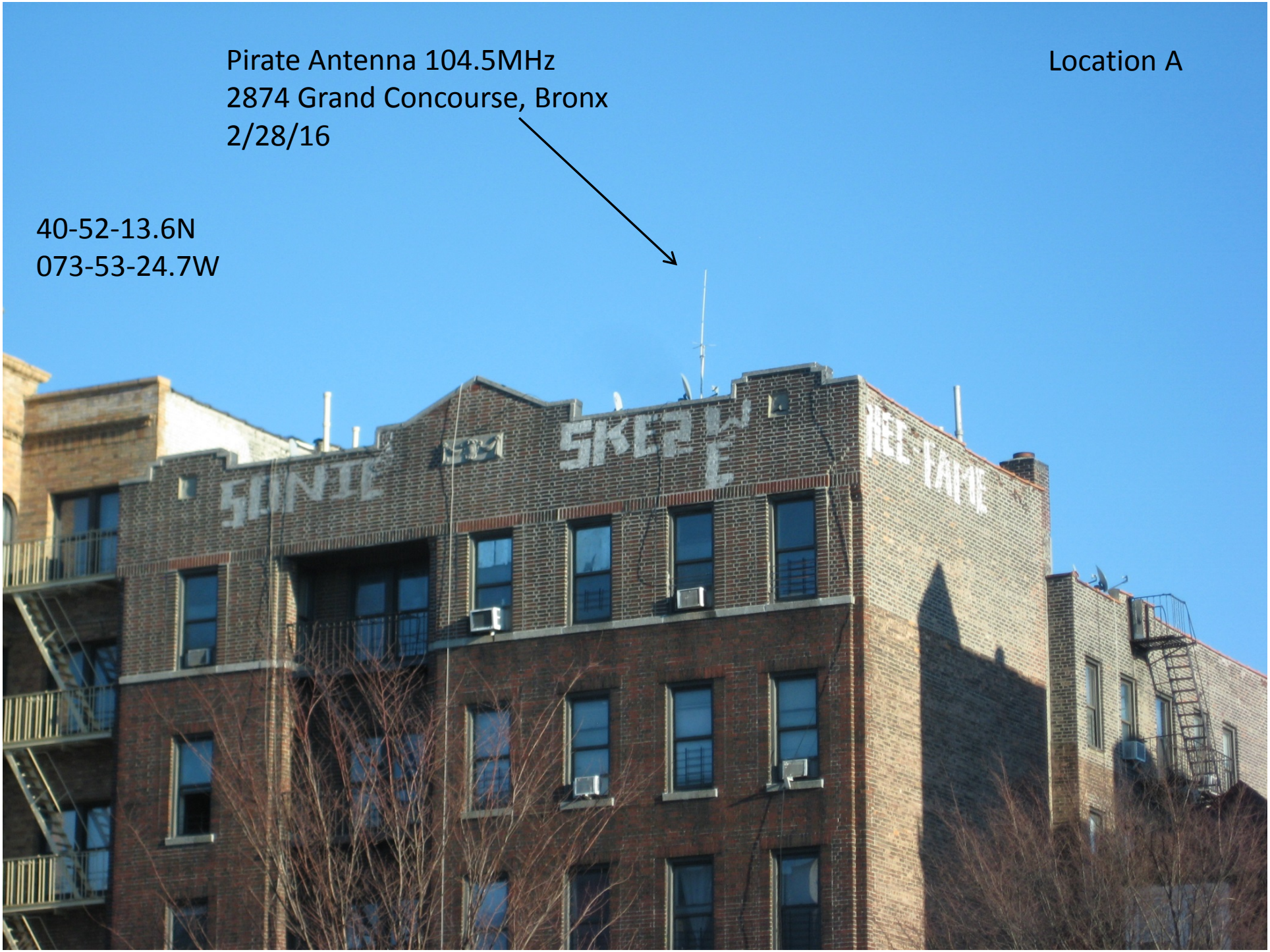
R = 4.27 Meters = 14.03 Feet

From the picture it can be seen that any persons in close proximity to the transmitting antenna would potentially be exposed to RFR levels in excess of the FCC MPE limits.

APPENDIX E

IDENTIFIED PIRATE RADIO TRANSMITTER LOCATIONS

APPENDIX E
PIRATE OPERATION LOCATIONS


Pirate Antenna 104.5MHz
2874 Grand Concourse, Bronx
2/28/16
Location A
40-52-13.6N
073-53-24.7W


Pirate Antenna 104.5MHz
2874 Grand Concourse, Bronx
2/28/16
40-52-13.6N
073-53-24.7W
Location A
ONE WAY
Grand Concourse
ONE WAY


Location A
Pirate Antenna 104.5MHz
2874 Grand Concourse, Bronx
2/28/16
2874
Daycare
Little Derek's
718-887-3704
646-464-0431
AA
40-52-13.6N
073-53-24.7W

LOCATION B

Pirate Operation on 89.3 MHz
2/29/16
747 Rogers Ave.
Brooklyn, NY
40-39-10N
073-57-09.7W



LOCATION B

Pirate Operation on 89.3 MHz
2/29/16
747 Rogers Ave.
Brooklyn, NY
40-39-10N
073-57-09.7W



LOCATION B

Pirate Operation on 89.3 MHz
2/29/16
747 Rogers Ave.
Brooklyn, NY
40-39-10N
073-57-09.7W



LOCATION B

Pirate Operation on 89.3 MHz
2/29/16
747 Rogers Ave.
Brooklyn, NY
40-39-10N
073-57-09.7W



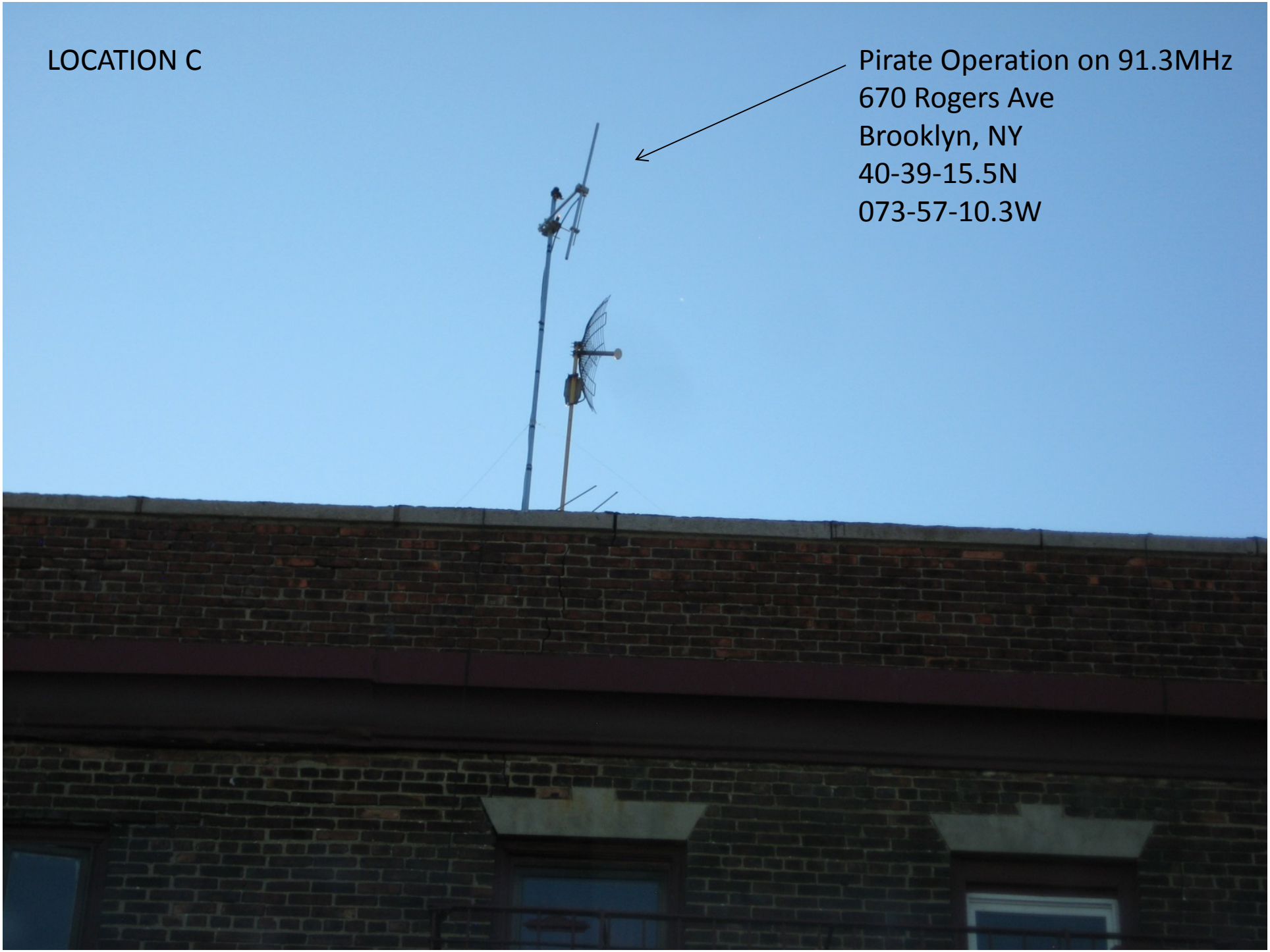

LOCATION C
Pirate Operation on 91.3MHz
670 Rogers Ave
Brooklyn, NY
40-39-15.5N
073-57-10.3W


LOCATION C
Pirate Operation on 91.3MHz
670 Rogers Ave
Brooklyn, NY
40-39-15.5N
073-57-10.3W


VISION PLUS MULTI SERVICES
INCOME TAX * ELECTRONIC FILING * REAL ESTATE
NOTARY PUBLIC * RESUME * TYPING SERVICE
674 Rogers Ave.
Ph: 718-484-4156
Fax: 718-484-4241
NOTARY PUBLIC
Paradise Venus Restaurant
670 ROGERS AVE.
HAITIAN–AMERICAN–CARIBBEAN CUISINE
TEL: 718 287-4949
VENUS L'ENDROIT IDEAL
BREAKFAST-LUNCH-DINER
EXOTIC JUICES-CATERING
FREE DELIVERY
ATM 99¢
VENUS SE LAHMOU IS LIFE THE BEST IN TOWN
WIN $2,000 EVERY WEEK
Pirate Operation on 91.3MHz
670 Rogers Ave
Brooklyn, NY
40-39-15.5N
073-57-10.3W
LOCATION C

LOCATION C


Pirate Operation on 91.3MHz
670 Rogers Ave
Brooklyn, NY
40-39-15.5N
073-57-10.3W
PLUS MULTI SERVICES INC
TAX * ELECTRONIC FILING * REAL ESTATE
Y PUBLIC * RESUME * TYPING SERVICE
Ph: 718-484-4156
Paradise
Venus Restaurant
VENUS


LOCATION C
Pirate Operation on 91.3MHz
670 Rogers Ave
Brooklyn, NY
40-39-15.5N
073-57-10.3W

LOCATION D

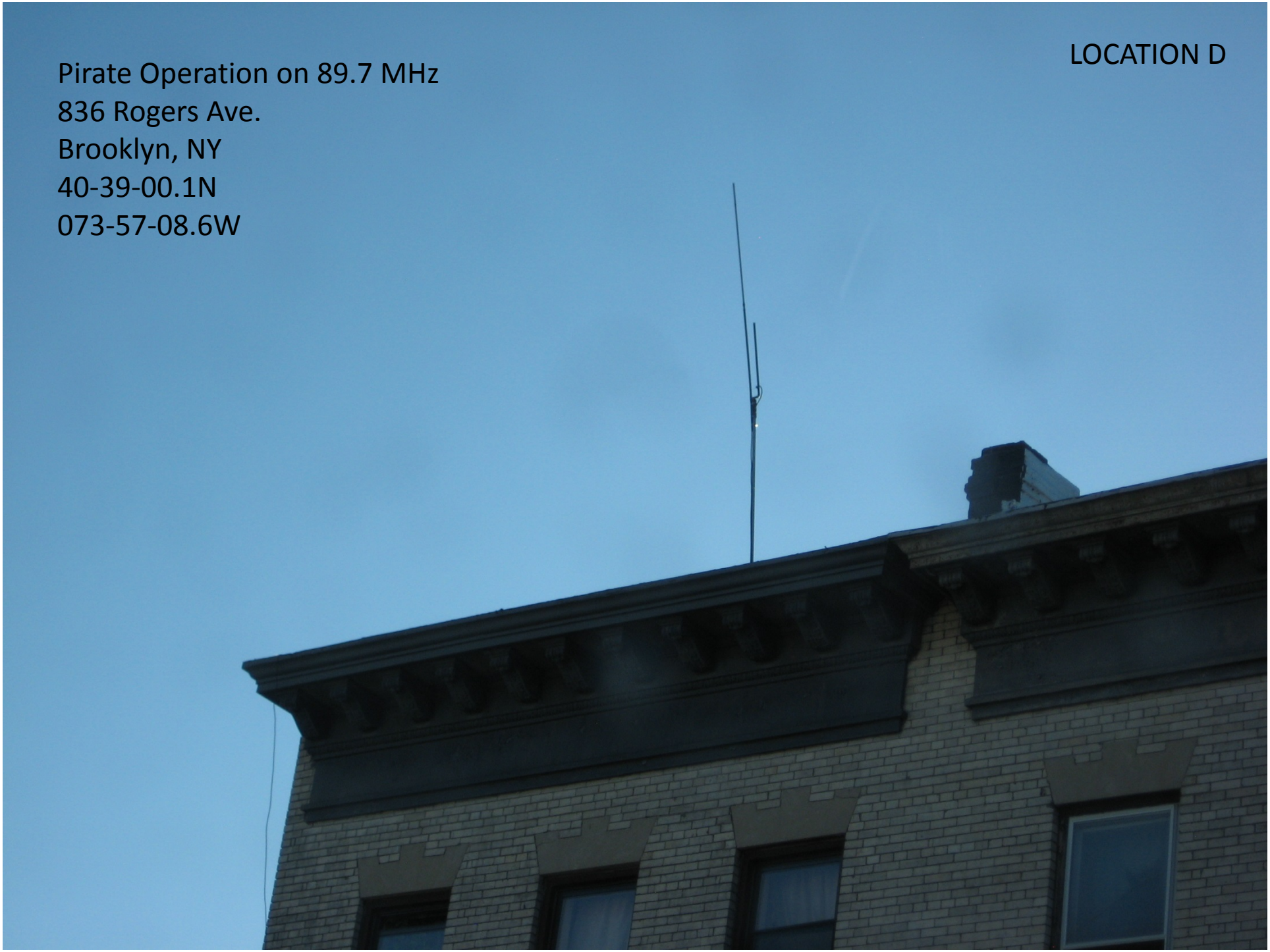
Pirate Operation on 89.7 MHz
836 Rogers Ave.
Brooklyn, NY
40-39-00.1N
073-57-08.6W




Pirate Operation on 89.7 MHz
836 Rogers Ave.
Brooklyn, NY
40-39-00.1N
073-57-08.6W
LOCATION D
PARTS FOR ALL MAJOR BRANDS
347-305-3950
Urban
AUTO REPAIR
LEARN DRIVE

LOCATION D

Pirate Operation on 89.7 MHz
836 Rogers Ave.
Brooklyn, NY
40-39-00.1N
073-57-08.6W




Location E
Pirate Operation on 91.7 MHz
3116 Clarendon Road
Brooklyn, NY
40-38-35.9N
073-56-51.0W
11AM TO
12:30PM
MON
& THURS
3116


Location E
Pirate Operation on 91.7 MHz
3116 Clarendon Road
Brooklyn, NY
40-38-35.9N
073-56-51.0W

Location E

Pirate Operation on 91.7 MHz
3116 Clarendon Road
Brooklyn, NY
40-38-35.9N
073-56-51.0W



Location E

Pirate Operation on 91.7 MHz
3116 Clarendon Road
Brooklyn, NY
40-38-35.9N
073-56-51.0W




Pirate Operation on 91.7 MHz
3116 Clarendon Road
Brooklyn, NY
40-38-35.9N
073-56-51.0W
Location E
11AM TO
12:30PM
MON
& THURS
3116


LOCATION F
Pirate Operation on 103.1 MHz
2900 Courtyou Road
Brooklyn, NY
40-38-39.7N
73-57-02.1W

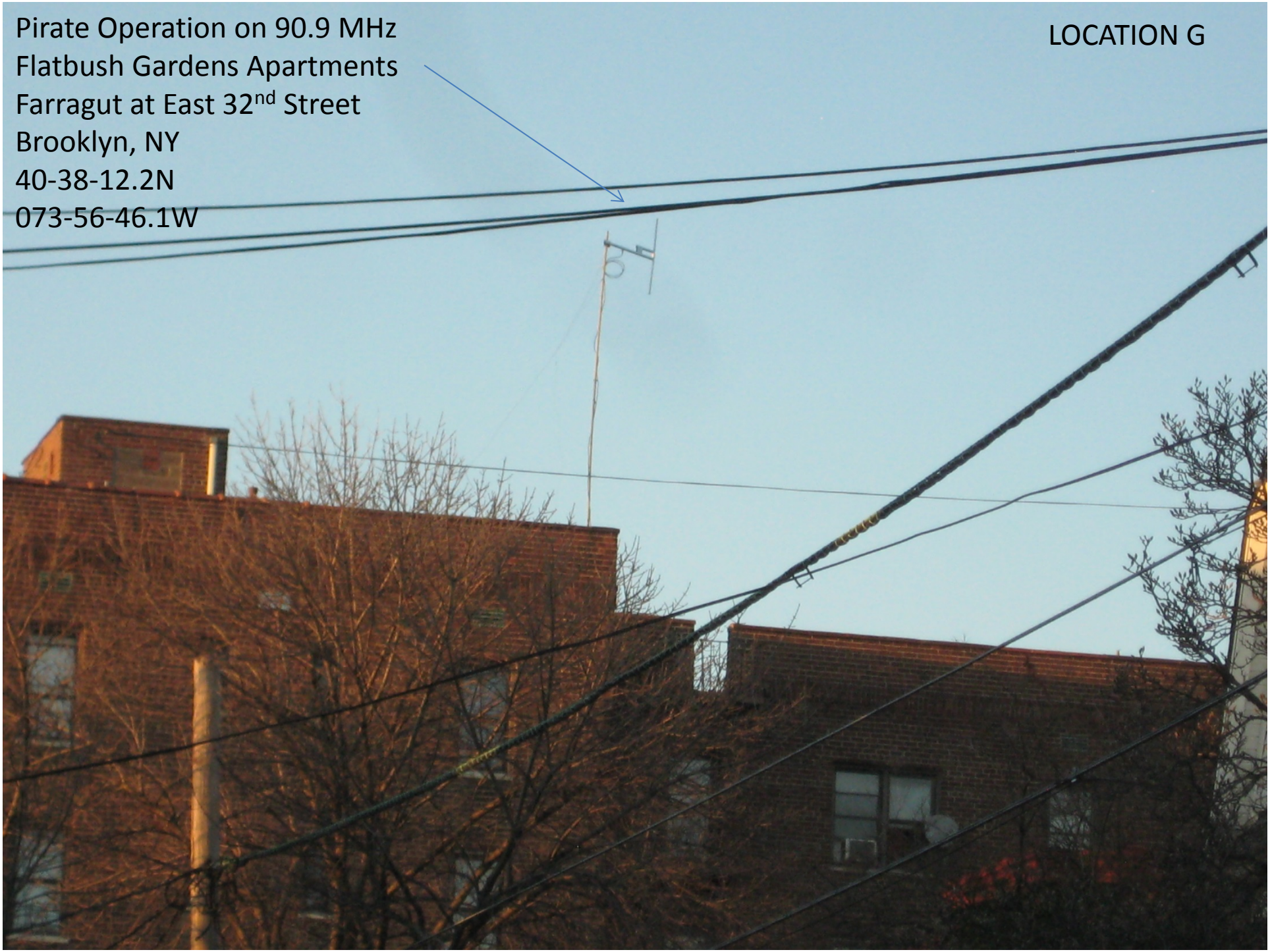
LOCATION F

Pirate Operation on 103.1 MHz
2900 Courtyou Road
Brooklyn, NY
40-38-39.7N
73-57-02.1W




Pirate Operation on 103.1 MHz
2900 Courtyou Road
Brooklyn, NY
40-38-39.7N
73-57-02.1W
LOCATION F


Pirate Operation on 90.9 MHz
Flatbush Gardens Apartments
Farragut at East 32nd Street
Brooklyn, NY
40-38-12.2N
073-56-46.1W
LOCATION G


Pirate Operation on 90.9 MHz
Flatbush Gardens Apartments
Farragut at East 32nd Street
Brooklyn, NY
40-38-12.2N
073-56-46.1W
LOCATION G


Pirate Operation on 90.9 MHz
Flatbush Gardens Apartments
Farragut at East 32nd Street
Brooklyn, NY
40-38-12.2N
073-56-46.1W
LOCATION G


Pirate Operation on 90.9 MHz
Flatbush Gardens Apartments
Farragut at East 32nd Street
Brooklyn, NY
40-38-12.2N
073-56-46.1W
LOCATION G

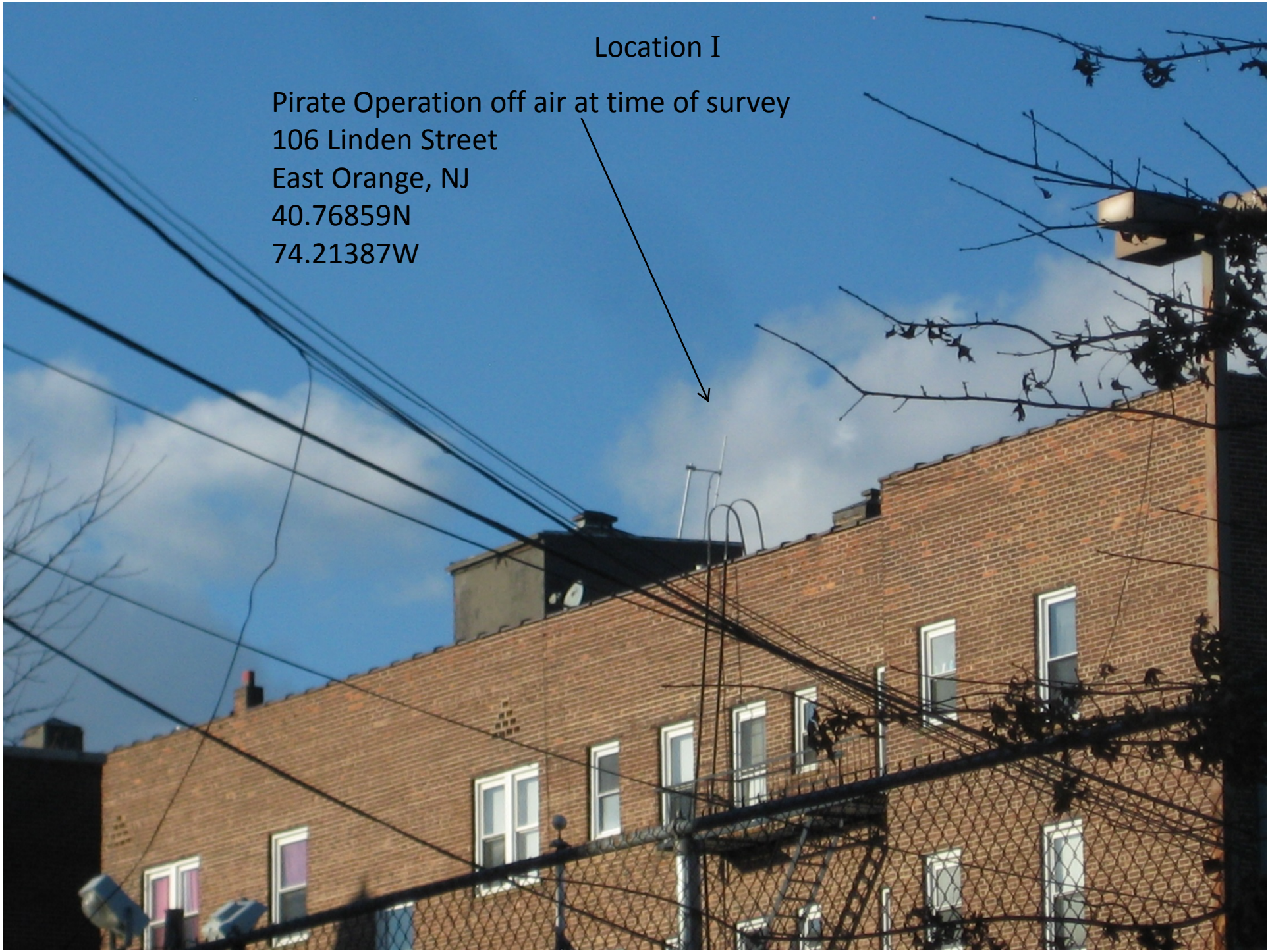

Pirate Operation on 95.9 MHz
41 Washington Street
East Orange, NJ
40.76990N
074.21890W
Location H
OFFICE SPACE FOR
973-440-9111
AMBULANCE
888-874-4496

Location H

Pirate Operation on 95.9 MHz
41 Washington Street
East Orange, NJ
40.76990N
074.21890W




Location H
Pirate Operation on 95.9 MHz
41 Washington Street
East Orange, NJ
40.76990N
074.21890W


Location I
Pirate Operation off air at time of survey
106 Linden Street
East Orange, NJ
40.76859N
74.21387W

Location J

40.75965N
74.21180W




East Orange Police Tower
Location J
Pirate Antenna 105.7 MHz
Back of Brick Building


Location J
Pirate Radio Station Antenna
On 105.7 MHz on 2/29/16


Location K
Pirate Operation on 107.7 MHz
Central Ave. @ Center St.
East Orange, NJ
On Top of Billboards
40.76534N
74.23233W
MEXICO


Location L
Pirate Operation on 94.5 MHz
114 Fenner Ave.
Clifton, NJ
40.89431N
74.17285W
Back Roof of House
Only visible from street behind house


Location L
Pirate Operation on 94.5 MHz
114 Fenner Ave.
Clifton, NJ
40.89431N
74.17285W
Only visible from street behind house


Pirate Operation on 94.5 MHz
114 Fenner Ave.
Clifton, NJ
40.89431N
74.17285W
Location L


Location L
114
Pirate Operation on 94.5 MHz
114 Fenner Ave.
Clifton, NJ
40.89431N
74.17285W


Location L
Pirate Operation on 94.5 MHz
114 Fenner Ave.
Clifton, NJ
40.89431N
74.17285W
Empire State Bldg
Four Time Square


Location L
Pirate Operation on 94.5 MHz
114 Fenner Ave.
Clifton, NJ
40.89431N
74.17285W

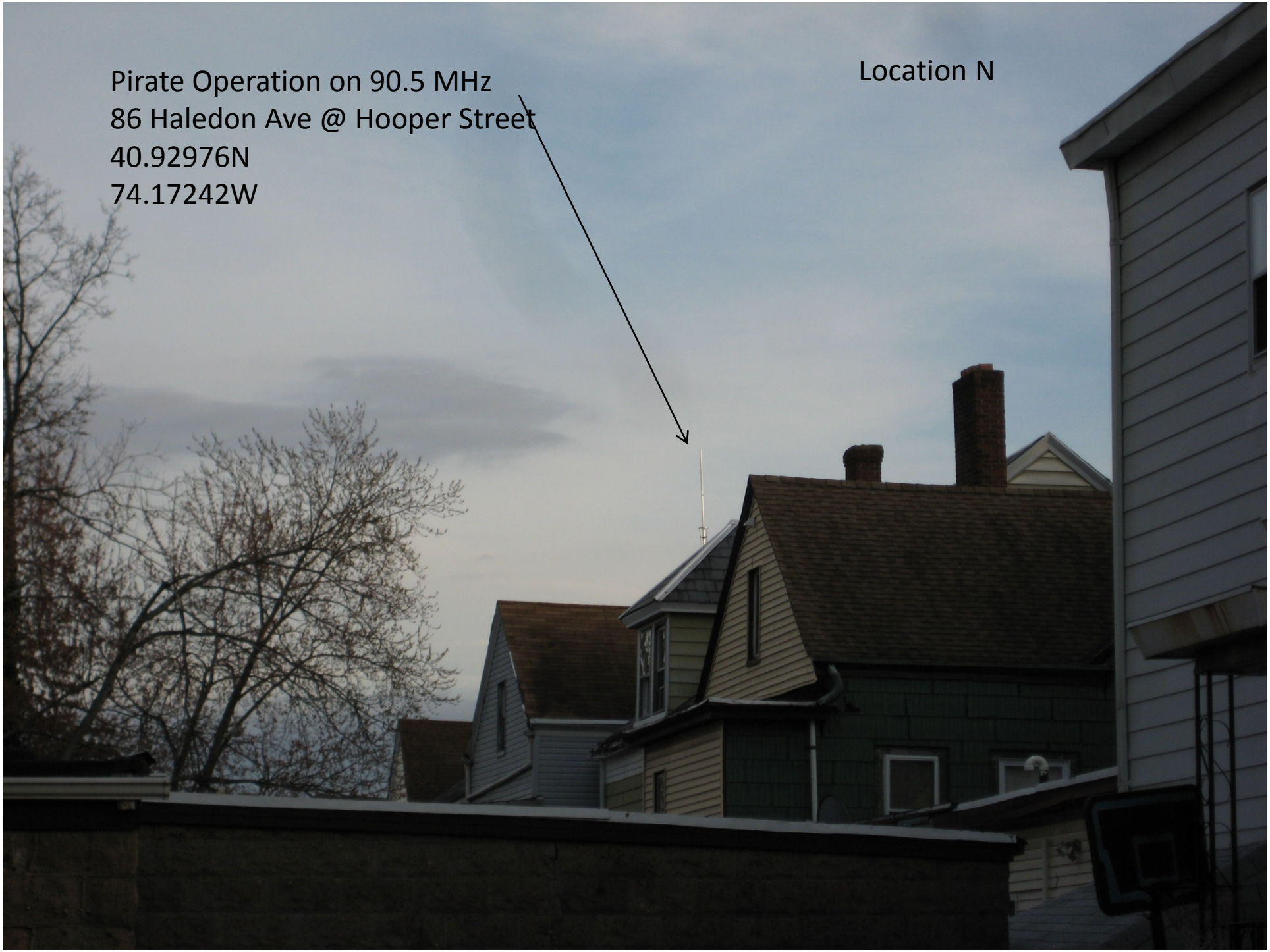

Location L
Pirate Operation on 94.5 MHz
114 Fenner Ave.
Clifton, NJ
40.89431N
74.17285W
View from Dunkin Donuts Parking Lot


Location M
Pirate Operation on 93.7 MHz
323 East 30th Street
Paterson, NJ
40.91550N
74.14434W
(Close to 33rd & Broadway)
Only visible on back of house – street behind house


Location M
Pirate Operation on 93.7 MHz
323 East 30th Street
Paterson, NJ
40.91550N
74.14434W
(Close to 33rd & Broadway)


Pirate Operation on 93.7 MHz
323 East 30th Street
Paterson, NJ
40.91550N
74.14434W
(Close to 33rd & Broadway)
Location M


Location M
Pirate Operation on 93.7 MHz
323 East 30th Street
Paterson, NJ
40.91550N
74.14434W
(Close to 33rd & Broadway)
WED
TOW AWAY ZONE
Only visible on back of house – street behind house


Pirate Operation on 90.5 MHz
86 Haledon Ave @ Hooper Street
40.92976N
74.17242W
Location N


Location N
Pirate Operation on 90.5 MHz
86 Haledon Ave @ Hooper Street
40.92976N
74.17242W


Location N
Pirate Operation on 90.5 MHz
86 Haledon Ave @ Hooper Street
40.92976N
74.17242W