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April 8, 2003

Mr. William Ottaway, P.E.
MGP Remedial Section
Bureau of Western Remedial Action
Division of Environmental Remediation
New York State Department of Environmental Conservation
625 Broadway
Albany, New York 12233-7017

RE: Supplemental Sediment RI
Former Nyack (Gedney Street) MGP Site
Site Number 3-44-046

Dear Mr. Ottaway:

The purpose of this letter is to present to you the results of the re-evaluation of sediment data for the former Nyack MGP site. This re-evaluation was performed to address comments from NYSDEC on the final Remedial Investigation (RI) Report (dated January 11, 2002) for the site. The overall objective of this re-evaluation was to further analyze the distribution of PAHs in the river, and to attempt to determine the extent of impact from the former MGP site.

Scope of Work

The re-evaluation of sediment data consisted of three main tasks: re-analysis of the raw mass spectrometer data generated by the laboratories from the sediment analyses, hydrocarbon pattern ("fingerprint") evaluation based on this re-analysis, and a series of statistical evaluations of sediment chemical characteristics.

META Environmental, Inc. of Watertown, Massachusetts (META) was contracted to work with the analytical data from the RI, and to perform the statistical analysis of the results. RETEC provided META with the Category B data packages which were generated for the sediment samples, and the analytical laboratories which performed the sediment analyses provided META with the electronic raw data files which were generated by their analytical instrumentation. META then re-analyzed the raw data files in order to extract information on compounds beyond those on the standard list of semi-volatile compounds. The additional compounds evaluated were considered to be diagnostic of MGP and petroleum sources.

META used the results of the data re-analysis to produce total ion chromatograms (TICs), and to produce plots of diagnostic ratios of PAHs. Statistical analysis using multivariate factor techniques was then performed in an attempt to find characteristics of the source materials in the sediment data.

META found that the data quality for the sediments and other samples analyzed by STL was good, and that they were able to perform the data manipulations requested by NYSDEC. The details of META's work and their results are described in their report entitled *Investigation of Hydrocarbon Sources at the Former Manufactured Gas Plant (MGP) Site in Nyack New York*, dated February 19, 2003. The report also addresses the specific questions and requests posed in the NYSDEC letter dated March 11, 2002 commenting on the RI.

Results

On the basis of the total ion chromatogram (TIC) analysis META defined four general classes of sediment impact for the samples from Nyack:

- Natural background
- Urban background
- Coal tar/MGP source-derived
- Mixed petrogenic (petroleum-derived) and pyrogenic (combustion-derived)

Tables 1 and 2 of the META report provides the breakdown for the sediment samples into these classifications. As shown in Table 2, the largest group of sediments are those which exhibit a mixture of pyrogenic and petrogenic characteristics, which is to say that they exhibit both combustion (including, but not limited to, MGP-derived sources) and petroleum influences.

META found that some of the samples from the pyrogenic/petrogenic group could be assigned to the MGP group by combining the results of the TIC analysis with diagnostic ratios of compounds. These samples are listed on page 3-8 of the META report.

Figure 1 (attached) shows the location of all the sediment samples at the Nyack site, along with the depth range of the sample interval and the total PAH concentration (as reported by the STL Laboratories using the standard list of 17 PAHs). (Note that Figure 1 includes data from a false-color infra-red aerial image, in which on-shore vegetation appears as red rather than green.) Figure 2 presents this data with a color-coding according to META's classification in order to display the spatial distribution of the sediment influences. Figure 3 presents the same information, with the total carcinogenic PAH concentration in place of the total PAH data.

Discussion of Results

The hydrocarbon source analysis is discussed below along with geographic and spatial information as part of a "weight-of-evidence" evaluation of the river conditions. This evaluation is presented as the final component of the RI for the Nyack site, and will serve as the foundation for future discussions on the management of impacted river sediments as Operable Unit 2 (OU-2) during the sediment feasibility study.

Distribution of Source-Identified Samples

The META report groups the sediment samples by their TIC chromatogram fingerprints, and by patterns observed in diagnostic PAH ratios. Four groups are defined: natural background, urban background, coal tar/MGP residual, and mixed pyrogenic/petrogenic. The sampling points shown on Figures 2 and 3 are color-coded according to this classification. From this coding several patterns can be seen in the data:

- The samples which are identified as having a coal tar/MGP influence are found immediately adjacent to the shoreline of the MGP site, and up to approximately 400 feet offshore of the site. One sample is located to the north, approximately 350 feet offshore of the Nyack Boat Club (a sub-bottom sample 2.6 to 3.6 below the sediment surface); one sample is found south of the MGP site near the Clermont Condominium pier (a sub-bottom sample 4.9 to 6.0 feet below the sediment surface).

- Only one of the fourteen sediment samples (from seven sediment sample locations) between the MGP site and the Clermont Condominium pier, and one of the ten samples (from five locations) offshore of the Nyack Boat Club show an MGP impact. Most of the samples in this area show pyrogenic/petrogenic diagnostic features, with two of the deeper samples showing natural background features. These data are consistent with the site uses in these areas (such as current and historic boat yards and boat docking, and urban storm water discharge).

- Eight of the thirteen background samples obtained east and north of the MGP site are classified as exhibiting natural background characteristics. These eight samples each contain less than 1 ppm total PAH. Two of the three near-shore background samples in this area exhibit higher PAH concentrations. The northernmost sample, obtained approximately 200 feet from shore, had a total PAH concentration of 4 ppm. A sample obtained approximately 150 feet offshore of a former petroleum storage terminal had a total PAH concentration of 37 ppm. Based on the chemical characterization of the PAHs, the upper limit of background PAH concentration is therefore 37 ppm.

- Seven background samples were obtained south of the MGP site. The total PAH concentration in these samples ranged from 3 to 19 ppm. These samples were classified as exhibiting urban background characteristics.

Total PAH Concentrations

Total PAH concentration of sediment samples is shown on Figure 2. The amount of variation from point-to-point does not make a coherent pattern which can be contoured; however, the following general observations can be made:

- The areas with sediment concentrations which exceed 4 and 50 ppm total PAH are demarcated on Figure 2. All surface and subsurface sampling points with total PAH concentrations which exceed 50 ppm are found within an area that extends out from the shoreline of the MGP site to the east, and slightly to the south at the offshore end. The area which exceeds 4 ppm extends north and south of the site, extending from approximately 300 feet offshore at the north at BSD1, to an estimated distance of up to 500 feet offshore in the vicinity of BSD17.

- The surface sediments with the highest concentration of total PAHs are located along the shoreline of the MGP site. Total PAH concentrations range up to 441 ppm in this area.

- The sample with the highest total PAH concentration found during the RI was obtained from sediment core SD12 (1,238 ppm total PAH at 4.4 to 4.7 feet below the sediment surface). Total PAH concentrations at all other locations and depths were not more than 441 ppm.

The total PAH concentration in the sediment cores varies greatly with depth. Cores with low surface PAH sediments over high PAH sediments were found in close proximity to cores with the opposite pattern. The concentration of PAHs in the surface sediments is likely to be controlled by several factors all working at the same time. These include:

1. Surface water runoff and the in-washing of impacted soils from the site;
2. transport of PAHs in groundwater to river sediments;
3. deposition of PAHs from storm water (outfall pipe located at the southern side of the MGP site) or other upland sources of PAHs; and
4. the reworking of sediments by waves and currents.

The subsurface sediments observed in the sediment cores exhibited far more uniformity than the surface sediments. Most of the subsurface sediments consist of generally uniform unimpacted marine silts, with the MGP impacts localized in thin (one to three-inch thick) beds or zones. Note that the analytical samples obtained from the sediment cores were biased samples, obtained from zones which exhibited NAPL impacts, staining, or odors. These samples do not represent the great majority of the buried sediment.

The total carcinogenic PAH (cPAH) concentration is shown on Figure 3. In general, the cPAH concentration in the sediment samples is approximately a third to a half of the total PAH concentration.

Visual Observations of MGP Impact

Visual impacts were noted in site sediments by direct and indirect methods. Indirect observations were made during a probing study. This study found that hydrocarbon sheens could be raised from limited areas of the near-shore zone at the site (RI, Figure 4-

10). Direct observations were made of surface sediment grab samples and of sediment cores. The direct observations found that that hydrocarbon-impacted sediments or NAPL were found in thin bands (one to three inches thick) in some of the cores obtained from the area close to the MGP site (within the 50 ppm zone shown on Figure 1).

The vertical variation in PAH impact is likely to be the result of several factors:

- Variations in the deposition of PAHs during the gas production period
- Redistribution of impacted sediments due to wave action
- Human redistribution of sediments due to construction of structures and scour and redeposition associated with these structures
- Variations in the modern discharge of PAHs to the sediments

The fact that the sediments offshore of the MGP site are not uniformly impacted implies that discharges from the MGP were not a constant occurrence. Intervals of PAH-impacted sediment may be the remnants of discrete discharge events from the MGP which were deposited on the river bottom and buried by newer sediment. It may also be the case, especially with the sediment intervals in cores immediately adjacent to the shoreline, that impacts in the more permeable sediment layers represent modern migration of PAHs from the site with the groundwater.

Sources of Impact

The large number of samples which exhibit a mixture of influences is a result of the range of sources of PAHs. A number of these sources are identified on Figures 2 and 3, which include:

- The former MGP site (containing coal carbonization and water gas residuals, and petroleum feedstocks)
- Former petroleum storage and distribution terminals (located north and south of the MGP site)
- Current and historic boatyards, boat docks, and boat anchoring/mooring facilities north and south of the MGP site
- Storm sewer outfalls (note that a 12-inch diameter storm sewer outfall is located at southern side of site)
- Sanitary sewer outfalls (two current or historic treatment plants located south of the site)
- Nyack Brook, which enters the river at Memorial Park (approximately 1,500 feet south of the site)
- Non-point source urban runoff

All of these sources would produce a chemical signature consisting of mixed pyrogenic and petrogenic PAHs.

Of particular note is the area between the river portion of the MGP site and the Clermont Condominium pier. Although this area is in the area presumed to be downstream of the MGP site, only one sediment sample exhibits an MGP fingerprint. All other samples in this area (except for a natural background sample at approximately six feet deep) exhibit an unresolvable pyrogenic/petrogenic chemical signature. This is likely to be due to the discharge of stormwater into this area from a Village of Nyack storm sewer outfall, the discharge of petroleum from the former oil storage and distribution terminal on the onshore Hudson Vista property, and the long-time use of this area for construction and mooring. The remediation of the MGP impacts on the Hudson Vista property will be performed in conjunction with the remediation of the upgradient petroleum terminal impacts; however, the ongoing discharge from the storm sewer outfall will continue to impact the sediments following the completion of onshore remediation.

Note that other storm sewer outfalls are presumed to be present north and south of the site to drain areas in the Village of Nyack. The Village pubic works department and engineer were contacted in an attempt to obtain a map of the locations of these outfalls; however, none of the Village officials could provide this information. The Division of Water in Region 3 of NYSDEC was also contacted for information on the location of pipeline outfalls in this region of the river. NYSDEC indicated that they do not have records on the locations of stormwater outfalls along the river. NYSDEC did provide a list of SPDES permits for Rockland County; however, the locations of outfalls were not indicated on the list. According to the Rockland County Health Department the Village is required by state regulations to file a storm water management plan in March of 2003; therefore it is likely that further information on storm water discharges to the river will be developed in the near-term.

Sediment Impact Model

Using all of the observations obtained during the RI, the following presents a model of sediment and contaminant behavior at the site.

Physical Setting

The former Nyack MGP site is located on the western shore of the Hudson River in a region of the river known as the Tappen Zee. This area is characterized by a widening of the river, with a three-mile distance across the river between Nyack and Tarrytown. The river bottom offshore of Nyack is relatively shallow between the shore and the river channel, located two miles east. The average water depth across this shelf area is generally nine to twelve feet below Mean Sea Level (MSL). At about the twelve-foot bathymetric contour the river bottom begins to slope downward, reaching a maximum depth of about 41 feet in the channel.

The Hudson River at Nyack has a semidiurnal tidal environment, with a typical tide range of 3 to 3.5 feet. These typical tide stages can be influenced by weather events, such as wind tides and storm surges. This places the entire lower terrace area of the site within the 100-year flood plain of the river.

Off-shore tidal and littoral currents in the river at the site move both to the north and south; however, the net flow direction for both off-shore and littoral currents is to the south, as directed by the freshwater flow in the river and the prevailing wind direction. The net sediment transport direction is also to the south, with an off-shore component to the east towards the river channel.

The wide stretch of open water at the Nyack site allows for the generation of waves during wind events. The waves are limited in height by the three-mile fetch, and by the shallow offshore river bottom which attenuates larger waves. Waves moving towards the site are also influenced by the jetties and man-made headlands which extend into the river along the Nyack shorefront. The result is that the erosion potential along the site is low, and the beach area along the shore of the MGP site is relatively narrow.

Contaminant Fate and Transport

PAH impacts in sediments at the former Nyack MGP site are presumed to have occurred by one of several mechanisms:

- Erosion of PAH-impacted soil and subsequent deposition in the river
- Discharge of MGP-residuals (such as tar or tar-water emulsions) to the river via overland flow or direct discharge
- Subsurface migration of NAPL under gravity flow or with groundwater

The direct discharge mechanism is likely to have dominated sediment and water quality impacts during the period of MGP operation, and is likely to be responsible for the thin buried NAPL-rich lenses observed in some of the sediment cores. For example, the most impacted sediment sample at the site was obtained at 4.4 to 4.7 feet below the river bottom in core SD12. This depth is below the influence of typical wave and current erosion, and is therefore likely to be a relic of the time of MGP operations.

Erosion and overland runoff of MGP residuals are also likely to have been most active during the time of MGP operation. Photographs of the MGP show little vegetation on the site, which is densely covered by gas producing facilities. Vegetation and stabilization of the site soils would have occurred following the end of MGP operations in the 1940s, and following the removal of the last of the site structures in the 1970s. Erosion of impacted soils and overland runoff of MGP residuals are not a significant process today: the site is fully vegetated, no residuals are observed at the ground surface, and surface soils show a relatively low PAH impact.

Subsurface migration of NAPL or transport of NAPL in groundwater may have been active both during MGP operations and at the present time. Flowable DNAPL was observed to be associated with the drainage pits located on the lower terrace of the MGP site. This DNAPL may have migrated towards the river through course-grained lenses of sediment, such as buried beach sand deposits. For example, NAPL was observed in a sand layer observed in core SD3 at a depth of 2.6 to 2.8 feet. The sediment above and below this layer was comprised of marine silt. Note that the amount of sand in the river sediment column is at its greatest close to the shoreline, and decreases rapidly with distance from the shore. In general, the thickness and frequency of sand layers or sand nodules in the cores decrease with distance and depth from the shoreline, thus the marine silt and clay deposits have served to act as a natural cap, limiting the distance of eastern migration of impacts. These sediments have also served to protect the buried impacted layers or lenses of MGP residuals from erosion and reworking, and from biological contact.

The migration of groundwater from beneath the site to the nearshore zone of the river may have also acted to transport MGP residuals, either in solution or as free NAPL droplets in suspension. Like the direct migration of DNAPL, the groundwater transport mechanism is limited by the fine-grained marine sediment deposits in the river. These low-permeability silt and clay deposits cap the bedrock beneath the river, and therefore prevent upward migration of groundwater in the off-shore areas of the river. Except for a small seep of water observed in the beach area at low tide (sample location SB11/SS9) groundwater is not observed to reach the ground surface at the site. Groundwater migrating to the river from the site and the upland area to the west must therefore move from the lower terrace area of the site to the nearshore zone through the submerged portion of the beachface and/or the shallow nearshore zone. This correlates with the limited area of impact seen in the sediment cores.

Other Sources of Impact

There are a large number of modern and historic sources of impacts to the river in the immediate vicinity of the MGP site. These sources include both point source and non-point source features which are typical of an urban waterfront. The waterfront area of Nyack has a long history of commercial occupation, dating to the Colonial era. It is likely that both modern and historical shorefront uses at the site have mixed with MGP impacts, thus limiting the area in which MGP chemical patterns are exhibited.

It is anticipated that there will be no significant migration of MGP residuals to the Hudson River sediments following the completion of remediation for OU-1. This will allow natural attenuation of PAHs in sediments to occur until they reach a level in equilibrium with the continuing discharge of PAHs from on-shore sources.

Conclusions

This letter report, along with the attached figures and hydrocarbon characterization report, present the findings of the additional sediment evaluation performed as part of the RI for the former Nyack MGP site. This document concludes the RI activities for the site. Although the Consent Order for the site specifies that a feasibility study must be submitted within 120 days of approval of the RI, we recommend that the FS for OU-2 be delayed until the implementation of the remedy for OU-1. As noted above, the implementation of the on-shore remediation is expected to change the off-shore conditions; therefore, the FS for OU-2 should be prepared after the effects of on-shore remediation on the river sediments can be assessed.

Sincerely,

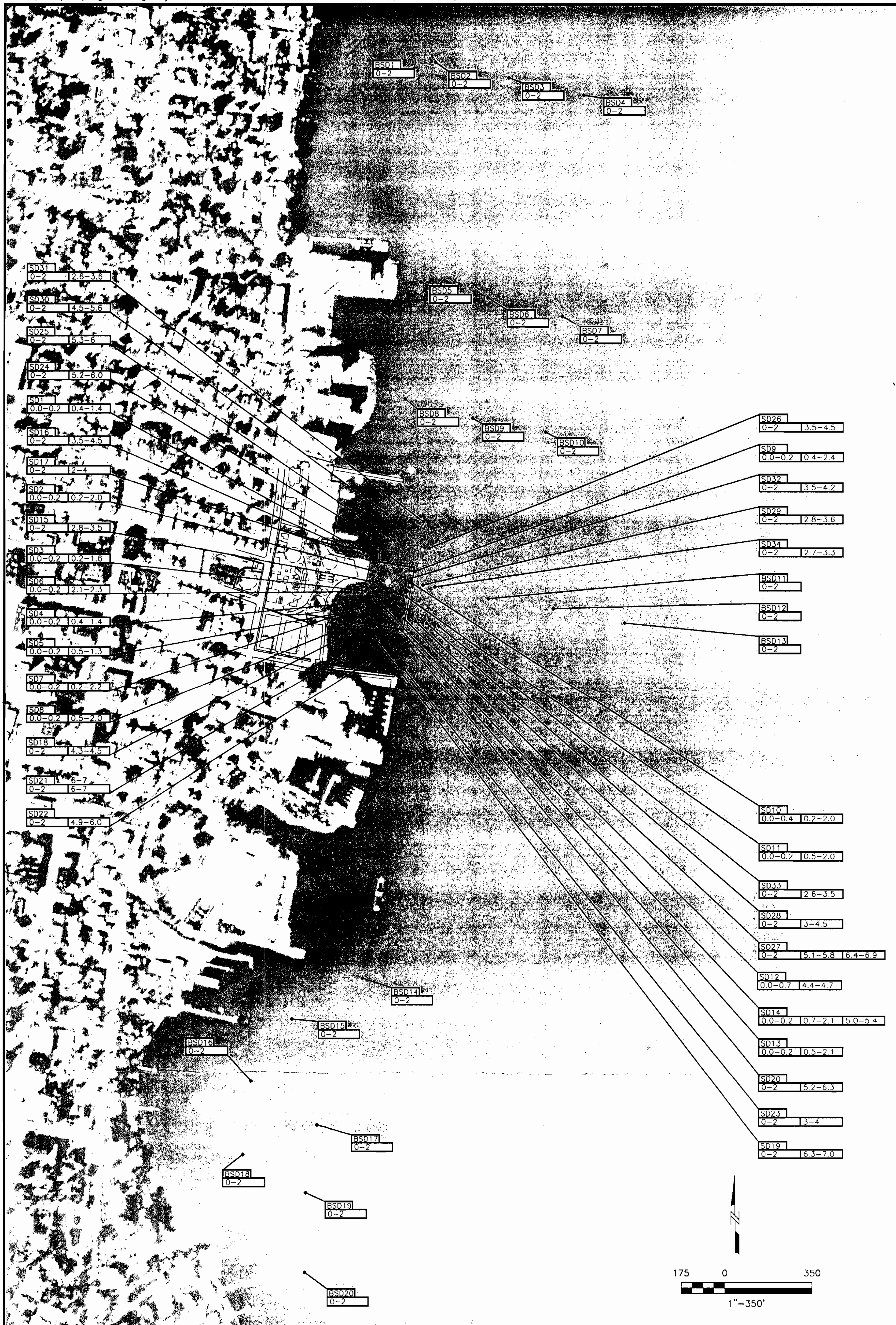
The RETEC Group, Inc.

Bruce Coulombe, P.G.

BC:mlr

Attachments:
- Figure 1 – RI Sediment Sample Locations
- Figure 2 – Sediment Sample Locations and Total PAH Concentrations
- Figure 3 – Sediment Sample Locations and Total CPAH Concentrations
- Report: *Investigation of Hydrocarbon Sources at the Former Manufactured Gas Plant (MGP) Site in Nyack, New York*

cc: Ms. Maribeth McCormick – Orange and Rockland Utilities (with report)
David S. Yudelson Esq. – Sive, Paget & Reisel, P.C. (w/o report)
Thomas Knight, Esq., Jerome Johnson – Presidential Life Insurance (w/o report)
John Conrad – Conrad Geoscience (with report)
Gary Litwin, NYSDOH (w/o report)
Krista Anders – NYSDOH (w/o report)
Catherine M. Quinn, – Rockland County DOH (w/o report)
Robert Schick – NYSDEC (w/o report)
File: ORAN2-04301



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SAMPLE LOCATION MAP

DATE: 3/04/03 DRWN: MAW/BIL

FIGURE 1

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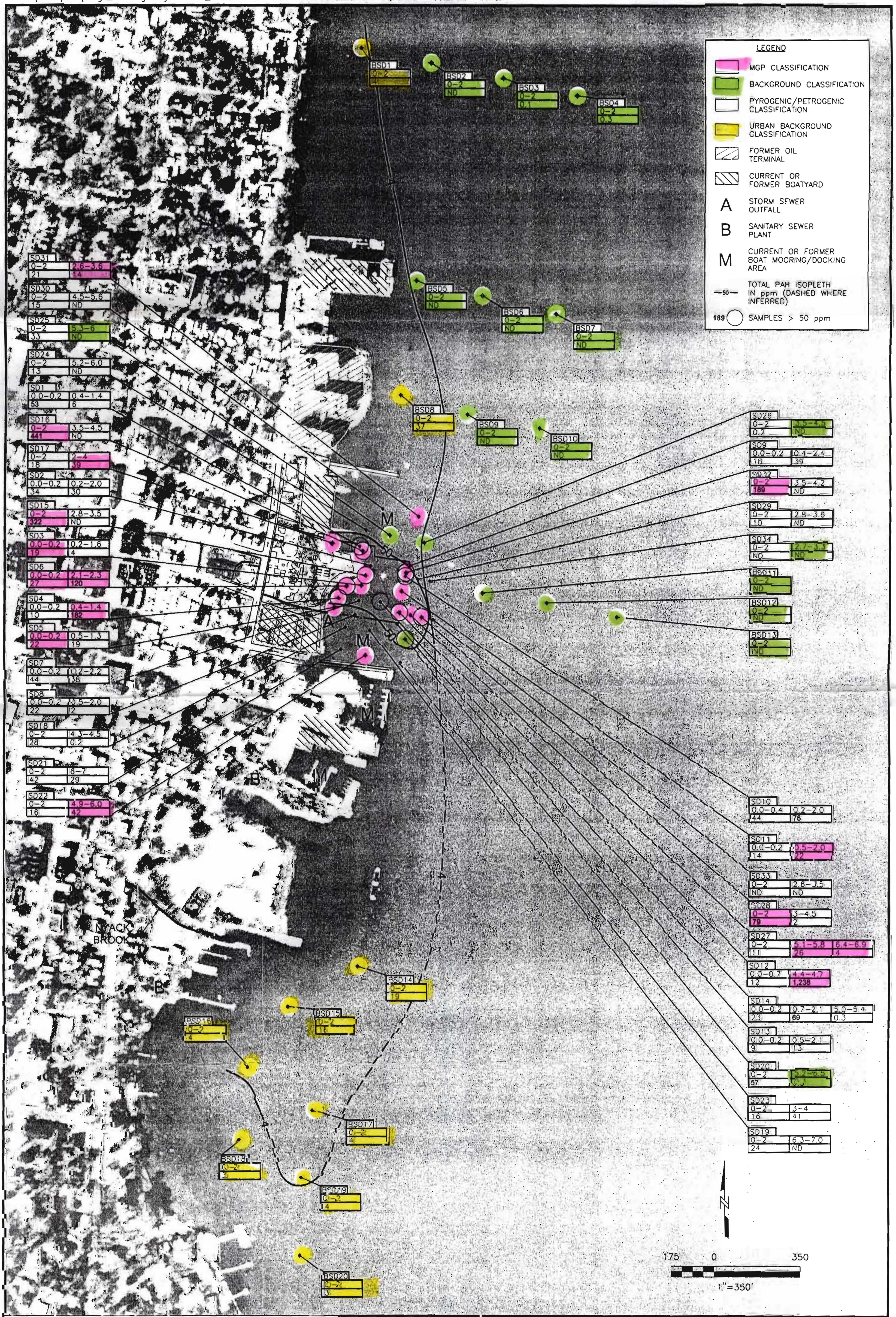

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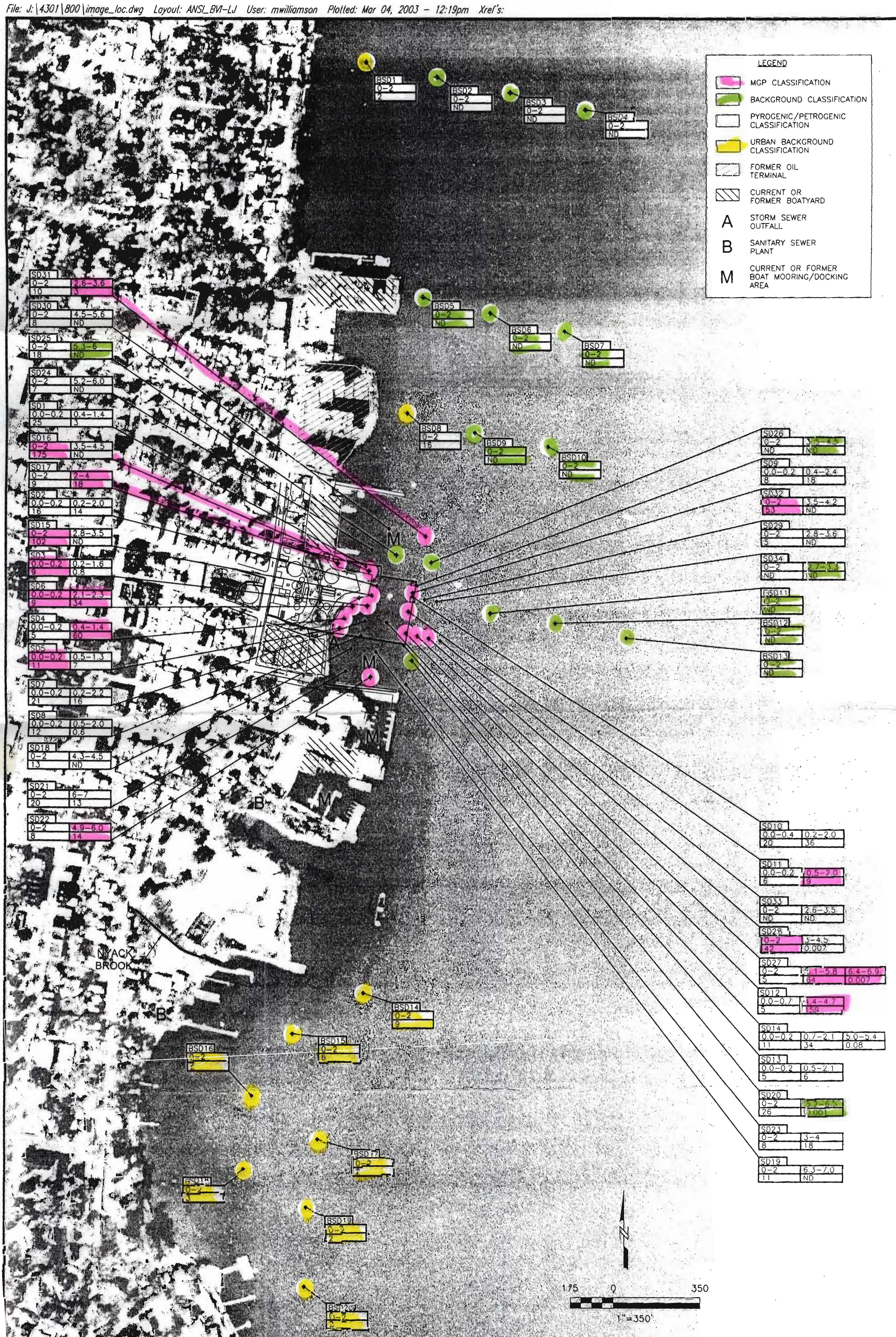
DATE: 3/04/03 | DRWN: MAW

RI SEDIMENT AND BACKGROUND SEDIMENT SAMPLE LOCATIONS AND TOTAL PAH CONCENTRATIONS (mg/Kg)

FIGURE 2

File: J:\4301\800\image_loc.dwg Layout: ANSI_BVI-LJ User: mwilliamson Plotted: Mar 04, 2003 - 12:19pm Xref's:



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RI SEDIMENT AND BACKGROUND SEDIMENT SAMPLE LOCATIONS AND TOTAL CPAH CONCENTRATIONS (mg/Kg)

FIGURE 3