PROPOSED REMEDIAL ACTION PLAN
Nyack Gas Plant

Operable Unit No.1
Former Plant Site
Nyack (V), Rockland County, New York
Site No. 3-44-046

February 2004

Prepared by:

Division of Environmental Remediation
New York State Department of Environmental Conservation

PROPOSED REMEDIAL ACTION PLAN

Nyack Gas Plant
Operable Unit No. 1 - Former Plant Site
Nyack (V), Rockland County, New York
Site No. 3-44-046
February 2004

SECTION 1: SUMMARY AND PURPOSE OF THE PROPOSED PLAN

The New York State Department of Environmental Conservation (NYSDEC), in consultation with the New York State Department of Health (NYSDOH), is proposing a remedy for the Nyack Gas Plant, Operable Unit No. 1 (OU1) - Former Plant Site. The presence of hazardous waste has created significant threats to human health and/or the environment that are addressed by this proposed remedy. As more fully described in Sections 3 and 5 of this document, operations at the former manufactured gas plant (MGP) have resulted in the disposal of hazardous wastes, including coal carbonization and water gas tars. These coal tars contain chemicals including polycyclic aromatic hydrocarbons (PAHs) and benzene, toluene, ethylbenzene, and xylene (BTEX). These wastes have contaminated the soils, groundwater and soil gas at the site, and have resulted in:

- a threat to human health associated with potential exposure to groundwater, surface soil, subsurface soil and soil gas vapors; and
- an environmental threat associated with the impacts of contaminants to groundwater, surface soil, and subsurface soils.

To eliminate or mitigate these threats, the NYSDEC proposes the following remedy:

- Impacted soils and subsurface structures in the upper terrace would be excavated to bedrock and transported to an off-site permitted treatment/disposal facility.
- Remaining MGP subsurface structures and other obstructions in the lower terrace would be excavated. Gross contamination in and immediately adjacent to subsurface structures would be excavated to the extent practicable.
- Flowable coal tar in the overburden in the lower terrace remaining after excavation would be extracted by recovery wells.
- Impacted soils in the lower terrace would be augured and mixed with cement. This process, in-situ solidification, would produce a stable, low permeability monolithic mass.
- Flowable coal tar would be removed from the shallow bedrock by recovery wells and/or trenches. Remaining contamination would be treated using in-situ chemical oxidation.
- In-situ chemical oxidation would be used to treat MGP contamination on the adjoining Hudson Vista Associates property.

- Final grading would include placement of a minimum of two feet of clean soil, asphalt paving, or other appropriate cover.

- A site management plan would be developed to: (a) address residual contaminated soils that may be excavated from the site during future redevelopment. (b) ensure that appropriate barriers (soil, paving or buildings) remain in place between the ground surface and residual contaminated soils; (c) evaluate the potential for vapor intrusion for any buildings developed on the site; and (d) identify use restrictions for development of groundwater.

- The property owner would provide an annual certification that the institutional and engineering controls remain in place and effective.

- An institutional control would be imposed in the form of an environmental easement that would: (a) require compliance with the approved site management plan, (b) restrict use of groundwater; and, (c) require the property owner to complete and submit to the NYSDEC an annual certification.

The proposed remedy, discussed in detail in Section 8, is intended to attain the remediation goals identified for this site in Section 6. The remedy must conform with officially promulgated standards and criteria that are directly applicable, or that are relevant and appropriate. The selection of a remedy must also take into consideration guidance, as appropriate. Standards, criteria and guidance are hereafter called SCGs.

This Proposed Remedial Action Plan (PRAP) identifies the preferred remedy, summarizes the other alternatives considered, and discusses the reasons for this preference. The NYSDEC will select a final remedy for the site only after careful consideration of all comments received during the public comment period.

The NYSDEC has issued this PRAP as a component of the Citizen Participation Plan developed pursuant to the New York State Environmental Conservation Law and Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York (6 NYCRR) Part 375. This document is a summary of the information that can be found in greater detail in the January 2002 "Remedial Investigation (RI) Report", the January 2004 "Feasibility Study" (FS), and other relevant documents. The public is encouraged to review the project documents, which are available at the following repositories:

The Nyack Library
59 South Broadway,
Nyack, NY 10960
(845) 358-3370,

M-R	10:00 AM - 9:00 PM
F	10:00 AM -- 6:00 PM
Sat.	10:00 AM - 5:00 PM
Sun.	12:00 PM -- 5:00 PM

New York State Department of Environmental Conservation
21 South Putt Corners
New Paltz, NY 12561
Attn: Ram Pergadia
845-256-3146

New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, New York 12233-7013
Attn.: Mr. William Ottaway, P.E.
Phone: (518) 402-9662
Monday - Friday, 8 a.m. - 4:30 p.m.

The NYSDEC seeks input from the community on all PRAPs. A public comment period has been set from February 10 to March 12, 2004 to provide an opportunity for public participation in the remedy selection process. A public meeting is scheduled for February 25, 2004 at the Hilltop Auditorium at Nyack College, beginning at 7:00 pm.

At the meeting, the results of the RI/FS will be presented along with a summary of the proposed remedy. After the presentation, a question-and-answer period will be held, during which verbal or written comments may be submitted on the PRAP. Written comments may also be sent to Mr. William Ottaway at the above address through {date comment period ends}.

The NYSDEC may modify the preferred alternative or select another of the alternatives presented in this PRAP, based on new information or public comments. Therefore, the public is encouraged to review and comment on all of the alternatives identified here.

Comments will be summarized and addressed in the responsiveness summary section of the Record of Decision (ROD). The ROD is the NYSDEC's final selection of the remedy for this site.

SECTION 2: SITE LOCATION AND DESCRIPTION

The Nyack Gas Plant site is located on Gedney Street in the Village of Nyack in the Town of Orangetown, Rockland County, NY. The site covers a total land area of approximately 4 acres.

The site is divided into a number of areas. The western parcel is on the west side of Gedney Street between Lydecker Street and High Avenue and is currently used as a paved parking lot. The eastern parcel (i.e., former plant area) is across Gedney Street from the western parcel, extending from Gedney Street to the Hudson River. The former plant area, which is currently vacant, is divided into the upper terrace, along Gedney Street, and the lower terrace, along the Hudson River. Pedestrian and vehicle access to the Eastern Parcel is restricted by a low chain link fence. Also referenced in this document is an area of off-site contamination directly south of the lower terrace, which is referred to as the "Hudson Vista Associates Property." The site is in an urban setting, with adjacent properties used for a mix of commercial and residential purposes. The site location is shown on Figure 1.

Operable Unit No. 1 (OU1), which is the subject of this PRAP, consists of the MGP related wastes on the former MGP site located on the west bank of the Hudson River (i.e., the eastern and western parcels, excluding the sediments in the Hudson River), and the adjacent Hudson Vista Associates property. An operable unit represents a portion of the site remedy that for technical or administrative reasons can be addressed separately to eliminate or mitigate a release, threat of release or exposure pathway resulting from the site contamination.

The remaining operable unit (i.e., Operable Unit No. 2) for this site will address sediments in the Hudson River which have been impacted by MGP related wastes. The investigation of this area is currently under review by the NYSDEC.

SECTION 3: SITE HISTORY

3.1: Operational/Disposal History

An MGP operated at this site from 1852 until 1965. The location of historic MGP structures is show on Figure 2. It is believed that gas was made from the coal carbonization process from 1852 until 1887. From 1887 until 1889 the plant used oil instead of coal, and from 1890 until 1938 the plant used both coal and oil as feedstock for the carburetted water gas (CWG) process. From 1938 until 1965, the site was used as an oil gas facility only during times of peak demand, a practice known as "peak shaving."

The coal carbonization process heated coal in retorts or beehive ovens, carbonizing the coal in the absence of air. The carburetted water gas process involved the passage of steam through burning coal. This formed a gaseous mixture (water gas or blue gas) which was then passed through a super heater which had an oil spray.

The oil spray would generate additional gas, enhancing the heat and light capacity of the overall gas mixture. In each process, the gas produced was purified prior to distribution. Coal tar was formed as a condensate as the gas cooled, and was a by-product of the gas production.

3.2: Remedial History

There were no previous environmental investigations of this site prior to the start of the RI/FS process. The properties to the south and west of this site were previously investigated for unrelated reasons. All buildings on the site were razed by 1974. Very little information is available regarding the site from 1974 until the remedial investigation commenced in 1999.

SECTION 4: ENFORCEMENT STATUS

Potentially Responsible Parties (PRPs) are those who may be legally liable for contamination at a site. This may include past or present owners and operators, waste generators, and haulers.

The NYSDEC and Orange and Rockland Utilities Inc. (O&R) entered into a Consent Order on January 2,1996. The Order obligates O&R to investigate the former MGP sites in their service area. This order was superceded by an second order dated March 5, 1999, which further clarified the obligation to investigate, and as necessary, remediate the Nyack Gas Plant Site.

SECTION 5: SITE CONTAMINATION

A remedial investigation/feasibility study (RI/FS) has been conducted to evaluate the alternatives for addressing the significant threats to human health and the environment.

5.1: Summary of the Remedial Investigation

The purpose of the RI was to define the nature and extent of any contamination resulting from previous activities at the site. The RI was conducted between October 1999 and January 2002. The field activities and findings of the investigation are described in the RI report.

The following activities were conducted during the RI:

- Research of historical information;
- Collection of nine surface soil samples;
- Excavation of 21 test pits;
- Installation of 31 soil borings and 14 monitoring wells for analysis of soils and groundwater as well as physical properties of soil and hydrogeologic conditions;
- Sampling of 14 new and existing monitoring wells; and
- Collection of six soil gas samples.

To determine whether the surface soil, subsurface soil and groundwater contain contamination at levels of concern, data from the investigation were compared to the following SCGs:

- Groundwater SCGs are based on NYSDEC "Ambient Water Quality Standards and Guidance Values" and Part 5 of the New York State Sanitary Code; and
- Soil SCGs are based on the NYSDEC "Technical and Administrative Guidance Memorandum (TAGM) 4046; Determination of Soil Cleanup Objectives and Cleanup Levels."

Based on the RI results, in comparison to the SCGs and potential public health and environmental exposure routes, certain media and areas of the site require remediation. These are summarized below. More complete information can be found in the RI report.

5.1.1: Site Geology and Hydrogeology

The site is covered with a varying thickness of fill. The jetty area which protrudes into the Hudson River has the thickest layer of fill (13 feet). A second significant area of fill is the slope between the upper and lower terraces, which was apparently placed after plant operations had ended. A layer of native silty sand generally underlies the fill material. A layer of glacial till was noted in one boring on the upper terrace. Underlying the silty sand is sandstone bedrock.

The bedrock is a productive aquifer with the groundwater flowing upward through the bedrock. The overburden in the upper terrace is entirely above groundwater. In the lower terrace, groundwater is found in the overburden, and is seen to fluctuate with the tide, indicating some hydraulic communication between the river and the groundwater.

5.1.2: Nature of Contamination

As described in the RI report, many soil and groundwater samples were collected to characterize the nature and extent of contamination. As summarized in Table 1, the main categories of contaminants which exceed their SCGs are volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs).

Specific volatile organic compounds of concern are benzene, toluene, ethylbenzene and xylenes. These are referred to collectively as BTEX in this document.

The specific semivolatile organic compounds of concern in soil and groundwater are the following polycyclic aromatic hydrocarbons (PAHs):

acenaphthene	acenaphthylene
anthracene	*benzo(a)anthracene*
benzo(a)pyrene	*benzo(b)fluoranthene*
benzo(g,h,i)perylene	*benzo(k)fluoranthene*
dibenzo(a,h)anthracene	*chrysene*
fluoranthene	fluorene
indeno(1,2,3-cd) pyrene	2-methylnaphthalene
naphthalene	phenanthrene
pyrene	

PAH concentrations referred to in this plan are the summation of the individual PAHs listed above (i.e., total PAHs or tPAHs). The italicized PAHs are probable human carcinogens. The summation of the italicized PAHs are referred to in this document as cPAHs.

As reported in Section 5.1.3, coal tars are present at this site in the form of a dense oily liquid which does not readily dissolve in water. Materials such as this are typically found at MGP sites, and are referred to as non-aqueous phase liquids or NAPL. Since this NAPL is more dense than water, it is also referred to as a dense NAPL or DNAPL. Analysis of the NAPL reveals that it contains BTEX and PAHs several orders of magnitude greater than the SCGs for these compounds. The NAPL was found to saturate the unconsolidated deposits and/or exist in scattered, discontinuous globules. Any of these conditions could coincide with high BTEX and PAH concentrations in soil, groundwater and soil gas.

5.1.3: Extent of Contamination

This section describes the findings of the investigation for all environmental media that were investigated.

Chemical concentrations are reported in parts per billion (ppb) for water, parts per million (ppm) for soil and micrograms per cubic meter ($\mu g/m^3$) for soil gas samples. For comparison purposes, where applicable, SCGs are provided for each medium.

Table 1 summarizes the degree of contamination for the contaminants of concern in surface and subsurface soil, groundwater and soil gas and compares the data with the SCGs for the site. The following are the media which were investigated and a summary of the findings of the investigation.

Waste Materials

Coal tar was found in the subsurface in both the upper and lower terrace areas. The sources of the coal tar wastes appear to be the former MGP structures. Coal tar deposits have not migrated a significant distance horizontally from these sources (approximately 20 feet, maximum). Coal tar has migrated vertically into the bedrock underlying the site to a depth of over 40 feet below ground surface.

Surface Soil

Surface soil samples (0-6 inches) contained elevated levels of PAHs. Total PAH levels ranged from 6 ppm to 836 ppm. Total cPAHs were detected at levels of 3 to 158 ppm. No BTEX were detected in the surface soil. Cyanide levels ranged from non-detect to 14 ppm. Cyanide detections were co-located with areas of elevated PAHs. One sample showed lead to be present at a level of 1,200 ppm, which is above the typical background level, but within the range which would be expected in an urban environment.

Subsurface Soil

Subsurface soil in direct contact with and in the vicinity of MGP structures or related coal tar deposits has been impacted by PAHs, BTEX, and cyanide. Total PAHs levels in subsurface soils ranged from non-detect to 19,388 ppm, with total cPAH values of non-detect to 1,936 ppm. BTEX levels in subsurface soils ranged from non-detect to 2,860 ppm. Cyanide levels ranged from non-detect to 56 ppm. All samples with elevated BTEX and cyanide levels also had elevated total PAHs, so total PAH levels are used to delineate subsurface soil impacts. The extent of PAH and visible coal tar contamination are shown on Figure 3.

Groundwater

Groundwater in the vicinity of the coal tar and the contaminated subsurface soil has also been impacted by PAHs and BTEX. BTEX levels in groundwater ranged from non-detect to 199,500 ppb. These results are two to three orders of magnitude above SCGs. Total PAH levels in groundwater ranged from non-detect to 11,450 ppb. Carcinogenic PAHs were detected in only one sample, at a level of 717 ppb. Total cyanide levels ranged from non-detect to 495 ppm. All wells with elevated levels of PAHs and cyanide also had elevated levels of BTEX, so BTEX levels are used to delineate groundwater impacts. The extent of groundwater BTEX contamination is shown on Figure 4.

Soil Gas

Soil gas on-site did have BTEX at levels above typical background. Benzene levels ranged from non-detect to 61 Fg/m^3 (micrograms per cubic meter), toluene from 4 to 68 Fg/m^3, ethylbenzene from non-detect to 23 Fg/m^3, and xylene from 13 to 130 Fg/m^3. These chemicals appear to be from a combination of sources, some site related and some not related to the MGP.

5.2: Interim Remedial Measures

An interim remedial measure (IRM) is conducted at a site when a source of contamination or exposure pathway can be effectively addressed before completion of the RI/FS.

There were no IRMs performed at this site during the RI/FS.

5.3: Summary of Human Exposure Pathways:

This section describes the types of human exposures that may present added health risks to persons at or around the site. A more detailed discussion of the human exposure pathways can be found in Section 6.1.3 of the RI report.

An exposure pathway describes the means by which an individual may be exposed to contaminants originating from a site. An exposure pathway has five elements: [1] a contaminant source, [2] contaminant release and transport mechanisms, [3] a point of exposure, [4] a route of exposure, and [5] a receptor population.

The source of contamination is the location where contaminants were released to the environment (any waste disposal area or point of discharge). Contaminant release and transport mechanisms carry contaminants from the source to a point where people may be exposed. The exposure point is a location where actual or potential human contact with a contaminated medium may occur. The route of exposure is the manner in which a contaminant actually enters or contacts the body (e.g., ingestion, inhalation, or direct contact). The receptor population is the people who are, or may be, exposed to contaminants at a point of exposure.

An exposure pathway is complete when all five elements of an exposure pathway exist. An exposure pathway is considered a potential pathway when one or more of the elements currently does not exist, but could in the future.

Pathways which are known to or may exist at the site include:

- Dermal contact with and incidental ingestion of contaminated surface soil in the Eastern Parcel by trespassers and site workers;

- Dermal contact, inhalation or incidental ingestion with contaminated subsurface soils in the Eastern Parcel by construction and utility workers; and

- Potential for inhalation of volatile organic compounds in the form of vapors from the intrusion of contaminated soil gas into buildings constructed on the Eastern Parcel in the future.

The analyses of soil samples collected from the Western Parcel did not indicate the presence of any significant subsurface contamination that would represent an exposure concern. In addition, the parcel is paved and landscaped further diminishing the potential for contact with any residual MGP-related soil contamination. The analyses of surface soil samples from the Eastern Parcel indicates the presence of PAHs and lead at levels which could present an exposure concern. However, a chain link fence is installed around the perimeter of the parcel so as to control access by trespassers. Authorized access to the parcel is provided to site workers, and the potential for their exposure is minimal based on the vegetated cover present.

The presence of MGP-related contamination at depth presents an exposure concern to construction and utility workers who may excavate into contaminated soils on the Eastern Parcel. The potential exposures to these workers may be minimized by the use of personal protective equipment in areas known to be impacted by MGP contamination.

The presence of any MGP-related contamination remaining at depth following remediation of the Eastern Parcel presents a potential exposure concern should buildings be constructed at a future date. Of concern is the potential for the intrusion of contaminated soil gas into the basements or foundations of newly constructed buildings resulting in discernable impacts to indoor air quality.

5.4: <u>Summary of Environmental Impacts</u>

This section summarizes the existing and potential future environmental impacts presented by the site. Environmental impacts include existing and potential future exposure pathways to fish and wildlife receptors, as well as damage to natural resources such as aquifers and wetlands.

The Fish and Wildlife Impact Analysis, which is included in the RI report, presents a detailed discussion of the existing and potential impacts from the site to fish and wildlife receptors. The following environmental exposure pathways and ecological risks have been identified:

- NAPL has impacted the groundwater resource in the shallow and bedrock aquifers at the site, and contamination is migrating off-site as NAPL and as dissolved phase;
- The potential for direct contact by fauna and flora with NAPL and contaminated subsurface soils; and
- MGP contamination has migrated into the Hudson River. Impacts from this contamination will be addressed in Operable Unit 2.

SECTION 6: <u>SUMMARY OF THE REMEDIATION GOALS</u>

Goals for the remedial program have been established through the remedy selection process stated in 6 NYCRR Part 375-1.10. At a minimum, the remedy selected must eliminate or mitigate all significant threats to public health and/or the environment presented by the hazardous waste disposed at the site through the proper application of scientific and engineering principles.

The remediation goals for this site are to eliminate or reduce to the extent practicable:

- the presence of NAPL and MGP-related contaminants as the sources of soil, groundwater and soil gas contamination;
- migration of NAPL and MGP-related contaminants that would result in soil, groundwater or soil gas contamination;
- the release of contaminants from NAPL in on-site soil into groundwater that result in exceedances of groundwater quality standards;
- the potential for ingestion of groundwater with contaminant levels exceeding drinking water standards;
- the potential for ingestion/direct contact with contaminated soil;
- impacts to biota from ingestion/direct contact with soil; and
- the release of contaminants from subsurface soil under buildings into indoor air through soil gas migration and intrusion.

Further, the remediation goals for the site include attaining to the extent practicable:

- recommended soil cleanup objectives in TAGM 4046; and
- ambient groundwater quality standards.

SECTION 7: <u>SUMMARY OF THE EVALUATION OF ALTERNATIVES</u>

The selected remedy must be protective of human health and the environment, be cost-effective, comply with other statutory requirements, and utilize permanent solutions, alternative technologies or resource recovery technologies to the maximum extent practicable. Potential remedial alternatives for the Nyack Gas Plant Site, were identified, screened and evaluated in the FS report which is available at the document repositories identified in Section 1.

A summary of the remedial alternatives that were considered for this site are discussed below. The present worth represents the amount of money invested in the current year that would be sufficient to cover all present and future costs associated with the alternative. This enables the costs of remedial alternatives to be compared on a common basis. As a convention, a time frame of 30 years is used to evaluate present worth costs for alternatives with an indefinite duration. This does not imply that operation, maintenance, or monitoring would cease after 30 years if remediation goals are not achieved.

7.1: Description of Remedial Alternatives

The following potential remedies were considered to address the contaminated subsurface soils, groundwater and soil gas at the site.

Alternative 1: No Action

Present Worth: *$1,070,000*
Capital Cost: *$0*
Annual OM&M:
(Years 1-30): *$60,000*

The No Action Alternative is evaluated as a procedural requirement and as a basis for comparison. It requires continued monitoring only, allowing the site to remain in an unremediated state. This alternative would leave the site in its present condition and would not provide any additional protection to human health or the environment.

Alternatives S-1 through GW-4

No single technology would be effective in addressing both soil and groundwater impacts at this site, so the remedy for this site will require a combination of a number of different technologies. In analyzing the remaining remedial alternatives, solutions to the groundwater and soil contamination are evaluated separately.

None of the remedial alternatives evaluated would be capable of addressing contamination in the bedrock underlying the Eastern Parcel completely enough to provide unrestricted use of that property. Even with the most aggressive treatment, restrictions would still be required to address groundwater contamination and the potential for re-contamination of subsurface soil from the bedrock. As such, the soil alternatives (S-1 through S-5) do not include any remedies which would remediate the site to unrestricted criteria. In the following soil alternatives, impacted soil are defined as those containing PAHs at levels above the TAGM 4046 objective of 500 ppm total PAHs. Since residential development of this site is contemplated following remediation, and since all remedial alternatives would leave soil behind with individual PAHs above TAGM 4046 levels, all remedial alternatives include institutional and engineering controls to prevent human exposure to these soils.

As previously indicated, other contaminants of concern in soils are co-located with areas of elevated PAHs, so total PAHs are used to delineate impacted soils. Similarly, other contaminants of concern in groundwater are co-located with areas of elevated BTEX, so BTEX are used to delineate groundwater impacts.

Chemical Oxidation of Offsite Area
A small area to the south of the lower terrace, on the Hudson Vista Associates property, is impacted by both MGP wastes and petroleum sources apparently unrelated to this site. The MGP impacts are generally concentrated in the three feet of soil overlying bedrock, approximately ten feet below ground surface. Orange and Rockland has proposed to address this contamination by in-situ chemical oxidation (oxidation). The goal of oxidation would be to oxidize the residual coal tar soils to reduce leaching of coal tar related chemicals to groundwater. The specific performance standard for the oxidation of the Hudson Vista Associates property would be determined during treatability testing. If

treatability testing does not demonstrate that oxidation would be effective in eliminating these impacts as a continuing source of contamination, this area would be addressed by the technology selected to address on-site soil contamination on the lower terrace.

Alternative S-1:In-situ Solidification of Upper and Lower Terraces

Present Worth: *$8,072,000*
Capital Cost: *$8,072,000*
Annual OM&M:
(Years 1-30): *$0*

Alternative S-1 would occur in three phases. In the preparation phase, major obstructions such as rip rap, concrete debris and remaining MGP substructures including piping would be removed by conventional excavation. This excavation would also remove gross contamination in and immediately adjacent to subsurface structures and piping to the extent practicable. Where excavation is not practicable, principally in the lower terrace, flowable DNAPL would be extracted by recovery wells. The excavation would be conducted in a manner which controls the emission of dust, odors, and VOCs.

In the second phase, impacted soils in the Upper and lower terrace would be augered and mixed with pozzolanic agents (typically Portland cement). This process would produce overlapping columns of solidified soil, resulting in a low permeability monolith. The result would eliminate the mobility of the contamination and greatly reduce or eliminate the contamination as a continuing source of groundwater contamination. Approximately 19,000 cubic yards of soils would be solidified.

In the third phase, site restoration would occur, with final slope stabilization and grading, and placement of appropriate cover to prevent exposure of the stabilized soil at the ground surface (two feet of seeded, clean soil; asphalt paving; or structure). An environmental easement would be placed on the property which would: 1)describe the location and characteristics of the solidified material, 2)restrict groundwater usage, 3)require that any future on-site building construction address the potential for soil gas intrusion and implement any necessary engineering controls, 4)require a soil management plan to control subsurface exploration or excavation, and 5)require annual certification that the institutional and engineering controls remain in place and are effective in controlling exposures.

Alternative S-2:In-situ Solidification of Lower Terrace / Excavation and Ex-situ Solidification of Upper Terrace

Present Worth: *$8,282,000*
Capital Cost: *$8,282,000*
Annual OM&M:
(Years 1-30): *$0*

This remedial action would occur in four phases. The preparation phase would be identical to that of Alternative S-1 and would involve removal of flowable DNAPL and impacted subsurface structures.

In the second phase, in-situ solidification (ISS) would be conducted as in Alternative S-1, but in the lower terrace only.

In the third phase, impacted soils in the upper terrace would be excavated to bedrock and mixed with pozzolanic agents in a temporary processing facility located on site. This ex-situ solidification (ESS) process would produce a concrete-like thick slurry, which would be placed into forms within the lower terrace. Excavation and ESS activities would occur in a manner which would control emissions of odors, dust, and VOCs. Initial estimates indicate that not all of the volume could be accommodated in the lower terrace, and a few feet of material would need to be placed in the upper terrace area as well. This additional material represents 4,000 to 8,000 cubic yards of soil that would otherwise require off-site transport and disposal.

In the fourth phase, site restoration would occur, with final slope stabilization, grading, and placement and seeding of two feet of clean soil or other appropriate surfacing material. An environmental easement would be placed on the property which would: 1)describe the location and characteristics of the solidified material, 2)restrict groundwater usage, 3)require that any future on-site building construction address the potential for soil gas intrusion and implement any necessary engineering controls, 4)require a soil management plan to control subsurface exploration or excavation, and 5)require annual certification that the institutional and engineering controls remain in place and are effective in controlling exposures.

It is estimated that approximately 8,000 cubic yards of impacted soil would be ex-situ solidified and 11,000 cubic yards of soil would be solidified by ISS techniques during this remedial alternative.

Alternative S-3:In-situ Solidification of Lower Terrace / Excavation and Off-site Transport of Upper Terrace

Present Worth: *$8,426,000*
Capital Cost: *$8,426,000*
Annual OM&M:
(Years 1-30): *$0*

This remedial action would occur in four phases. The preparation phase for the lower terrace would be the same as that of Alternatives S-1 and S-2. Additional construction would be performed to facilitate loading and off-site transport of excavated soil.

In the second phase, impacted soils and subsurface structures in the upper terrace would be excavated to bedrock and transported to an off-site permitted treatment/disposal facility. The excavation would occur in a manner which would control emissions of odors, dust, and VOCs.

In the third phase, ISS would be conducted as in Alternatives S-1 and S-2, but in the lower terrace only.

In the fourth phase, site restoration would occur, with final slope stabilization, grading, and placement and seeding of two feet of clean soil or other appropriate cover materials such as asphalt pavement. An environmental easement would be placed on the property which would: 1)describe the location and characteristics of the solidified material, 2)restrict groundwater usage, 3)require any future on-site building construction to address the potential for soil gas intrusion and implement any necessary engineering controls, 4)require a soil management plan to control subsurface exploration or excavation, and 5)require annual certification that the institutional and engineering controls remain in place and are effective in controlling exposures.

Approximately 8,000 cubic yards of impacted material would be excavated and transported off site from the upper terrace while approximately 11,000 cubic yards would be mixed using ISS techniques in the lower terrace.

Alternative S-4:Partial Excavation of Lower Terrace, In Situ Chemical Oxidation of Soil, and Excavation of Upper Terrace with Off-site Transport

Present Worth: *$6,936,000*
Capital Cost: *$6,936,000*
Annual OM&M:
(Years 1-30): *$0*

This remedial action would occur in five phases. The preparation phase would prepare the site to accommodate loading of excavated soil and importing of clean fill. DNAPL recovery wells would be installed in the northern portion of the lower terrace to collect any flowable DNAPL present where excavation would not be performed.

In the second phase, impacted, unsaturated soils and impacted structures would be excavated from the upper terrace. Partial excavation of the lower terrace would first involve removal of the small quantity of unsaturated soils exceeding the RAO action levels. The primary remedial action for the lower terrace would be the removal of grossly impacted saturated soils located at the former drainage pits. This excavation is currently estimated to be a 130-foot by 70-foot area of grossly impacted soil. Grossly impacted soil consists of soil which has at least a six-inch thick lens of waste material distributed throughout. The excavation activities in the upper and lower terrace would occur in a manner that would control emissions of odors, dust, and VOCs. Impacted materials would be transported to an off-site permitted treatment/disposal facility.

In the third phase, the upper terrace and lower terrace excavation areas would be backfilled to the extent required to accommodate possible future site development.

In the fourth phase, in situ chemical oxidation would be used to treat impacted saturated soil in the south and north areas of the lower terrace. During chemical oxidation, contaminants are converted to less toxic compounds that are more stable, less mobile, and/or inert through the action of oxidizing agents. To implement the oxidation process, an aqueous solution of the oxidizing agent would be placed in contact with the saturated, impacted soils, usually by a grid of temporary injection points. The process would be repeated several times until the remedial goals are achieved. The process would be monitored before and after treatment. Long-term trends in groundwater quality would also be monitored.

The northern area consists of a 150-foot x 40-foot zone along the toe of the bank, between the excavation area and the northern property line, while the southern area is comprised of a 35-foot x 70-foot area on the southern part of the lower terrace including an area within the Hudson Vista property. These soils, while not constituting gross contamination, contain impacts above 500 ppm total PAHs and cPAHs above 1 ppm as benzo(a)pyrene, and could possibly be a source of continuing impact to groundwater quality in the long term, and therefore should be addressed by remedial action. These soils appear to be amenable to oxidation technology because they are sands and gravels with sheens and small pinhead globules of NAPL that could be contacted by a grid of oxidation injection points. The performance standard to be used for the chemical oxidation would be determined in a bench-scale treatability study conducted during the pre-design investigation.

In the fifth phase, site restoration would occur, with final slope stabilization, grading, placement and seeding of 2 feet of clean soil or other appropriate surfacing material. An environmental easement would be placed on the property which would: 1)describe the location and characteristics of the remaining residual contamination, 2)restrict groundwater usage, 3)require that any future on-site building construction address the potential for soil gas intrusion and implement any necessary engineering controls, 4)require a soil management plan to control subsurface exploration or excavation, and 5)require annual certification that the institutional and engineering controls remain in place and are effective in controlling exposures.

In this alternative, approximately 14,000 cubic yards of impacted soil would be excavated and transported off site for treatment/disposal.

Alternative S-5:Excavation with Off-site Transport of All Soils

Present Worth: *$10,095,000*
Capital Cost: *$10,095,000*
Annual OM&M:
(Years 1-30): *$0*

This remedial action would occur in four phases, the first being preparation of the site for excavation and transport, including shoring and dewatering systems in the lower terrace, and accommodations for loading of excavated soil and unloading backfill.

In the second phase, all impacted soils in the upper terrace and lower terrace would be excavated. Excavation of deep saturated soils immediately adjacent to the Hudson River in the lower terrace would require a substantial dewatering system, a water treatment system, and discharge to the Hudson River. A large shoring structure consisting of steel sheeting, pilings, and bracing would be required. All excavation activities would occur in a manner which would control emissions of odors, dust, and VOCs.

In the third phase, the upper terrace would be backfilled to the extent required to accommodate site development. The lower terrace would be backfilled to its original grade. Large quantities of backfill material would be required for the lower terrace.

In the fourth phase, site restoration would occur, with final slope stabilization, grading, addition of two feet of clean soil, and seeding or other appropriate surfacing. An environmental easement would be placed on the property which would: 1)describe the location and characteristics of the remaining residual contamination, 2)restrict groundwater usage, 3)require that any future on-site building construction address the potential for soil gas intrusion and implement any necessary engineering controls, 4)require a soil management plan to control subsurface exploration or excavation, and 5)require annual certification that the institutional controls remain in place and are effective in controlling exposures.

In this alternative, approximately 19,000 cubic yards of impacted soil would be excavated and transported off site for treatment/disposal.

Alternative GW-1: In-situ Biotreatment and NAPL Recovery

Present Worth: $4,822,000
Capital Cost: $2,776,000
Annual OM&M:
(Years 1-10): $180,000
(Years 10-30): $60,000

In-situ biotreament enhances the biodegradation of organic contaminants in the subsurface by microorganisms by providing additional oxygen and/or nutrients. Common methods of adding oxygen include placement of oxygen releasing compounds (ORC), injection of low concentration hydrogen peroxide, or air sparging. Addition of nutrients would also be considered to support the biodegradation process. The system would be expected to operate for many years until the groundwater quality would meet the remedial action objectives.

Cost estimates for this alternative are based on the system being active for a period of 10 years and then monitored for an additional 20 years.

Alternative GW-2: Groundwater/NAPL Recovery and Treatment

Present Worth: $6,067,000
Capital Cost: $4,389,000
Annual OM&M:
(Years 1-10): $135,000
(Years 1-30): $60,000

In this alternative, groundwater and NAPL would be recovered from a system of downgradient wells or trenches located in the shoreline area of the lower terrace. A barrier wall would be required to provide hydraulic control so that the system would not be recovering clean river water. Above-ground treatment of the water would be conducted using granular activated carbon (GAC) or other appropriate treatment technologies. The system would be expected to operate for many years until groundwater quality meets the remedial action objectives. Elements of the in-situ biological treatment could be added to further increase the system's effectiveness.

Alternative GW-3: Rapid NAPL Recovery Followed by Bedrock Isolation

Present Worth: *$6,939,000*
Capital Cost: *$5,876,000*
Annual OM&M:
(Years 1-30): *$60,000*

This remedial action would be conducted in three phases. In the first phase, the site would be prepared by conducting initial NAPL recovery and clearing obstructions to the drilling activities. These activities would overlap substantially with many of the site preparation activities described in the soil alternatives.

In the second phase, the grouting of the fractured bedrock matrix would proceed in a designed, controlled procedure. A series of borings would be completed, typically ten borings in a staggered pattern of five-foot spacings, each followed immediately by pumping out the contents of the borings to remove grossly impacted groundwater/NAPL. Controlled pressure grouting would proceed in an outward to inward sequence. The spacings of the borings and characteristics of the grout would be adjusted in response to grout pressure and volume data collected during the initial portion of the program, to ensure that the bedrock matrix has been substantially grouted.

In the third phase, the site would be restored in conjunction with the soil remedial actions.

Alternative GW-4: NAPL Recovery and Chemical Oxidation

Present Worth: *$4,178,000*
Capital Cost: *$2,936,000*
Annual OM&M:
(Years 1-30): *$70,000*

Wells and/or trenches would be used to recover flowable NAPL in the bedrock to the extent practicable. The extent of bedrock contamination would be verified during pre-design investigation, and the construction and distribution of recovery wells and/trenches would be determined during the remedial design. NAPL removal actions would continue until the volume of NAPL recovered is no longer significant.

After the NAPL is removed, the chemical oxidation of MGP contaminants would be implemented using active means, including strategic placement of oxidizing agents or other methods of introducing oxidants to the groundwater. The chemical oxidation process would proceed over a period of several months of intensive oxidant addition. Due to the difficulty of measuring before and after conditions in the hidden fractures of the bedrock, no other performance standard would be applicable for this action in the upper terrace.

7.2 Evaluation of Remedial Alternatives

The criteria to which potential remedial alternatives are compared are defined in 6 NYCRR Part 375, which governs the remediation of inactive hazardous waste disposal sites in New York State. A detailed discussion of the evaluation criteria and comparative analysis is included in the FS report.

The first two evaluation criteria are termed "threshold criteria" and must be satisfied in order for an alternative to be considered for selection.

1. Protection of Human Health and the Environment. This criterion is an overall evaluation of each alternative's ability to protect public health and the environment.

2. Compliance with New York State Standards, Criteria, and Guidance (SCGs). Compliance with SCGs addresses whether a remedy will meet environmental laws, regulations, and other standards and criteria. In addition, this criterion includes the consideration of guidance which the NYSDEC has determined to be applicable on a case-specific basis.

The next five "primary balancing criteria" are used to compare the positive and negative aspects of each of the remedial strategies.

3. Short-term Effectiveness. The potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment during the construction and/or implementation are evaluated. The length of time needed to achieve the remedial objectives is also estimated and compared against the other alternatives.

4. Long-term Effectiveness and Permanence. This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. If wastes or treated residuals remain on-site after the selected remedy has been implemented, the following items are evaluated: 1) the magnitude of the remaining risks, 2) the adequacy of the engineering and/or institutional controls intended to limit the risk, and 3) the reliability of these controls.

5. Reduction of Toxicity, Mobility or Volume. Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility or volume of the wastes at the site.

6. Implementability. The technical and administrative feasibility of implementing each alternative are evaluated. Technical feasibility includes the difficulties associated with the construction of the remedy and the ability to monitor its effectiveness. For administrative feasibility, the availability of the necessary personnel and materials is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, institutional controls, and so forth.

7. Cost-Effectivness. Capital costs and operation, maintenance, and monitoring costs are estimated for each alternative and compared on a present worth basis. Although cost-effectiveness is the last balancing criterion evaluated, where two or more alternatives have met the requirements of the other criteria, it can be used as the basis for the final decision. The costs for each alternative are presented in Table 2.

This final criterion is considered a "modifying criterion" and is taken into account after evaluating those above. It is evaluated after public comments on the Proposed Remedial Action Plan have been received.

8. Community Acceptance - Concerns of the community regarding the RI/FS reports and the PRAP are evaluated. A responsiveness summary will be prepared that describes public comments received and the manner in which the NYSDEC will address the concerns raised. If the selected remedy differs significantly from the proposed remedy, notices to the public will be issued describing the differences and reasons for the changes.

SECTION 8: SUMMARY OF THE PROPOSED REMEDY

The NYSDEC is proposing Alternative Soil Alternative S-3, Excavation of upper terrace with In-Situ Solidification of the lower terrace for addressing the impacts in soil, and GW-4, Chemical Oxidation and NAPL Recovery to address groundwater/NAPL impacts as the remedy for this site. The areal extent of the groundwater treatment system is shown on Figure 4 and the areal extent of the soil remedy is shown on Figure 5. The elements of this remedy are described at the end of this section.

The proposed remedy is based on the results of the RI and the evaluation of alternatives presented in the FS. In selecting the remedy for this site, each of the distinct site areas were evaluated separately to select the optimum solution for each area. While this approach increases the complexity of the remedy selection process, it is warranted in this instance due to the distinct characteristics in each of the evaluated areas.

In the upper terrace, all soils are above groundwater, which would make excavation less complicated. As a result, excavation of the upper terrace could be completed for a similar or lower cost, when compared to other remedies while providing a preferred solution by permanently removing impacted materials from this portion of the site.

In the lower terrace, the increased cost and complexity associated with operating below the groundwater table in close proximity to the Hudson River would make excavation much more difficult to implement, and more costly. In addition, the complexity of this excavation would be expected to lead to a much longer construction period, resulting in increased disruption to the community. The ability of solidification to meet the remedial goals with less short term impacts and less cost than excavation would make this the preferred remedy for the lower terrace.

Chemical oxidation of the lower terrace (Alternative S-4) would be more cost effective than Alternative S-3, and would result in the permanent destruction of the hazardous waste. However, the site's location along the Hudson River would make it especially difficult to establishing hydraulic control over the injected chemical and it would be difficult to establish a performance criteria. In comparing these two alternatives, there was greater confidence that Alternative S-3 could be effectively implemented at this site.

All four of the groundwater remedies would be expected to have similar levels of reliability and effectiveness. Alternatives GW1 and GW-4 are significantly less expensive than GW-2 and GW-3, and would be similar in there ability to meet remedial objectives. Groundwater alternatives GW-1 and GW-2 would require extended operation periods to be effective. Alternative GW-4 would address contamination effectively, quickly and at a reasonable cost.

The estimated present worth cost to implement the combined groundwater and soil remedy is $11,806,000. The cost to construct the combined remedy is estimated to be $9,835,000 and the estimated average annual operation, maintenance, and monitoring costs for 30 years is $70,000.

The elements of the proposed remedy are as follows:

1. A remedial design program would be implemented to provide the details necessary for the construction, operation, maintenance, and monitoring of the remedial program. This would include treatability studies to allow the design of in-situ chemical oxidation of the bedrock and Hudson Vista Associates property.

2. In the upper terrace, all MGP structures, including piping, and soils which contain total PAHs over 500 ppm or which are visibly impacted by coal tar would be excavated and transported to an off-site permitted treatment/disposal facility. The excavation would occur in a manner which would control emissions of odors, dust, and VOCs. Following excavation, slopes would be stabilized using on-site material meeting the cleanup criteria.

3. Wells and/or trenches would be used to recover flowable NAPL in the bedrock in both the upper and lower terrace to the extent practicable. NAPL removal actions would continue until the volume of NAPL recovered is no longer significant.

4. In the lower terrace, major obstructions such as rip rap, concrete debris, piping and remaining MGP structures would be removed by conventional excavation. This excavation would also remove gross contamination in and immediately adjacent to subsurface structures and piping would be removed to the extent practicable. Where excavation is not practicable, flowable NAPL would be extracted by recovery wells. The excavation would be conducted in a

manner which controls the emission of dust, odors, and VOCs.

5. Soils in the lower terrace which contain total PAHs over 500 ppm or which are visibly impacted by coal tar would be augered and mixed with pozzolanic agents (typically Portland cement). This process, in-situ solidification, would produce overlapping columns of solidified soil, resulting in a low permeability, solidified mass.

6. In the steeply sloped area between the upper and lower terraces, all soils which contain total PAHs over 500 ppm or which are visibly impacted by coal tar which are above the groundwater table would be excavated and transported off-site. All soils which contain total PAHs over 500 ppm or which are visibly impacted by coal tar which are below the groundwater would either be excavated or solidified using in-situ solidification.

7. Residual contamination in the bedrock would be treated using in-situ chemical oxidation.

8. MGP related contamination on the Hudson Vista property would be treated using in-situ chemical oxidation. In-situ solidification (ISS) may be used if it is determined during the design program that ISS would be preferable to oxidation in this location.

9. Since the remedy results in MGP waste remaining at the site, a long term monitoring program would be instituted. A monitoring plan would be developed which would include installing monitoring wells and sampling them on an annual basis. Analysis would include BTEX and PAHs. This monitoring program and the effectiveness of the remedy would periodically be re-evaluated. If site groundwater conditions improve and the site remedy remains physically secure, the monitoring interval could be extended.

10. Since the remedy would result in soil remaining on site with PAHs above individual TAGM 4046 soil cleanup objectives, the entire site would be covered with two feet of clean fill, pavement, or buildings.

11. A site management plan would be developed to: (a) address residual contaminated soils that may be excavated from the site during future redevelopment. The plan would require soil characterization and, where applicable, disposal/reuse in accordance with NYSDEC regulations; (b) ensure that appropriate barriers (soil, paving or buildings) remain in place between the ground surface and residual contaminated soils; (c) evaluate the potential for vapor intrusion for any buildings developed on the site, including provision for mitigation of any impacts identified; and (d) identify use restrictions for development of groundwater.

12. The property owner would provide an annual certification, prepared and submitted by a professional engineer or environmental professional acceptable to the Department, which would certify that the institutional controls and engineering controls put in place, are unchanged from the previous certification and nothing has occurred that would impair the ability of the control to protect public health or the environment or constitute a violation or failure to comply with any operation an maintenance or soil management plan.

13. An institutional control would be imposed in the form of an environmental easement that would: (a) require compliance with the approved site management plan, (b)

restrict use of groundwater as a source of potable or process water, without necessary water quality treatment as determined by the Rockland County Department of Health; and, (c) require the property owner to complete and submit to the NYSDEC an annual certification as indicated above.

14. Since no significant contamination has been observed on the western (holder) parcel, no active remediation would be undertaken on this parcel as part of this remedy. If ongoing testing detects residual contamination which could present a potential human health risk to workers who may excavate the site in the future, the site management plan would include appropriate safety measure to be in place and would require appropriate handling and disposal of all excavated soils.

TABLE 1
Nature and Extent of Contamination
Sampling performed September 1999 through January 2002

SURFACE SOIL	Contaminants of Concern	Concentration Range Detected (ppm)[a]	SCG[b] (ppm)[a]	Frequency of Exceeding SCG
Semivolatile Organic Compounds (SVOCs)	Total PAHs	6-836	NA	NA
Individual cPAHs	Benzo(a)anthracene	0.55-37	0.224	9 of 9
	Chrysene	0.59-30	0.4	9 of 9
	Benzo(b)fluoranthene	0.52-16	1.1	8 of 9
	Benzo(k)fluoranthene	0.51-23	1.1	8 of 9
	Benzo(a)pyrene	0.52-40	0.061	9 of 9
	Indeno(1,2,3-cd)anthracene	0.36-16	3.2	7 of 9
	Dibenzo(a,h)anthracene	0.15-6	0.014	9 of 9
	Total cPAHs*	3-158	NA	NA
Inorganic Compounds	Cyanide	ND-14	NA	NA

*Total cPAHs values are calculated from discreet samples and are less than the sum of the individual maximum values listed.

TABLE 1 (Cont.)
Nature and Extent of Contamination
Sampling performed September 1999 through January 2002

SUBSURFACE SOIL	Contaminants of Concern	Concentration Range Detected (ppm)[a]	SCG[b] (ppm)[a]	Frequency of Exceeding SCG
Volatile Organic Compounds (VOCs)	Benzene	ND-270	0.060	13 of 55
	Toluene	ND-780	1.5	7 of 55
	Ethylbenzene	ND-1,000	5.5	15 of 55
	Xylene	ND-1,000	1.2	19 of 55
	Total BTEX*	ND-2,860	10	17 of 55
Semivolatile Organic Compounds (SVOCs)	Total PAHs	ND-19,388	500	21 of 55
Individual cPAHs	Benzo(a)anthracene	ND - 450	0.224	48 of 55
	Chrysene	ND - 410	0.4	44 of 55
	Benzo(b)fluoranthene	ND - 280	1.1	36 of 55
	Benzo(k)fluoranthene	ND - 240	1.1	35 of 55
	Benzo(a)pyrene	ND - 430	0.061	49 of 55
	Indeno(1,2,3-cd)anthracene	ND - 150	3.2	31 of 55
	Dibenzo(a,h)anthracene	ND - 58	0.014	46 of 55
	Total cPAHs	ND-1,936	NA	NA
Inorganic Compounds	Cyanide	ND-56	NA	NA

*Total cPAHs and BTEX values are calculated from discreet samples and are less than the sum of the individual maximum values listed.

TABLE 1 (Cont.)
Nature and Extent of Contamination
Sampling performed September 1999 through January 2002

GROUNDWATER	Contaminants of Concern	Concentration Range Detected (ppb)[a]	SCG[b] (ppb)[a]	Frequency of Exceeding SCG
Volatile Organic Compounds (VOCs)	Benzene	ND-47,000	1	19 of 30
	Toluene	ND-4,500	5	6 of 30
	Ethylbenzene	ND-62,000	5	14 of 30
	Xylene	ND-86,000	5	15 of 30
Semivolatile Organic Compounds (SVOCs)	Total PAHs	ND-11,450	NA	NA
	Total cPAHs	ND-717	NA	NA
Inorganic Compounds	Cyanide	ND-495	200	1 of 30

SOIL GAS	Contaminants of Concern	Concentration Range Detected ($\mu g/m^3$)[a]	SCG[b] ($\mu g/m^3$)[a]	Frequency of Exceeding SCG
Volatile Organic Compounds (VOCs)	Benzene	ND - 61	NA	NA
	Toluene	4 - 68	NA	NA
	Ethylbenzene	ND - 23	NA	NA
	Xylene	13 - 130	NA	NA

[a] ppb = parts per billion, which is equivalent to micrograms per liter, ug/L, in water;
ppm = parts per million, which is equivalent to milligrams per kilogram, mg/kg, in soil;
ug/m^3 = micrograms per cubic meter

[b] SCG = standards, criteria, and guidance values;
Coal Tar - N/A
Surface and Subsurface Soil - NYSDEC TAGM 4046 Remedial Cleanup Objectives
Groundwater - NYS DEC Groundwater Standards
ND=No detection above the laboratory method detection limit.
NA=No applicable SCG.

Table 2
Remedial Alternative Costs

Remedial Alternative		Capital Cost	Annual OM&M	Total Present Worth
SOIL ALTERNATIVES		**Capital Cost**	**O&M NPV**	**Total NPV**
S-1	ISS of Upper and Lower Terraces	$8,072,000		$8,072,000
S-2	ISS of Lower Terrace/ Excavation and Ex-situ Solidification of Upper Terrace	$8,282,000		$8,282,000
S-3	ISS of Lower Terrace/ Excavation and Offsite Transport of Upper Terrace	$8,426,000		$8,426,000
S-4	Excavation of Upper Terrace with Offsite Transport/ Partial Excavation of Lower Terrace and In-situ Chemical Oxidation of NAPL in Soils	$6,936,000		$6,936,000
S-5	Excavation with Offsite Transport of All Soils	$10,095,000		$10,095,000
GROUNDWATER/NAPL ALTERNATIVES		**Capital Cost**	**O&M NPV**	**Total NPV**
GW-1	In-situ Biotreatment and NAPL Recovery	$2,776,000	$2,046,000	$4,822,000
GW-2	Groundwater/NAPL Recovery and Treatment	$4,389,000	$1,678,000	$6,067,000
GW-3	Rapid NAPL Recovery followed by Bedrock Isolation	$5,876,000	$1,063,000	$6,939,000
GW4	In-situ Chemical Oxidation and NAPL Recovery	$2,938,000	$1,971,000	$4,178,000

Nyack Gas Plant Site No. 3-44-046
Proposed Remedial Action Plan

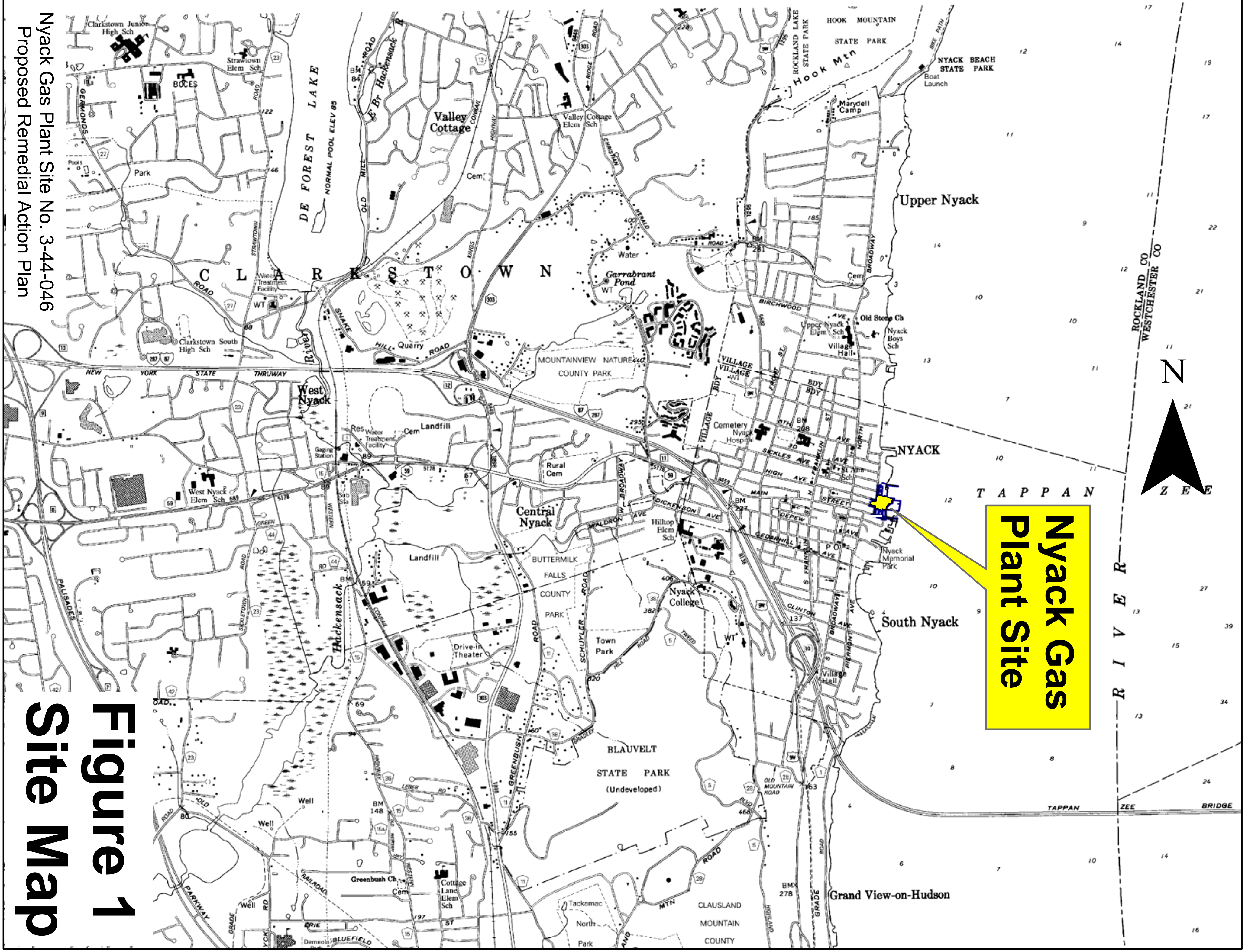


Figure 1
Site Map

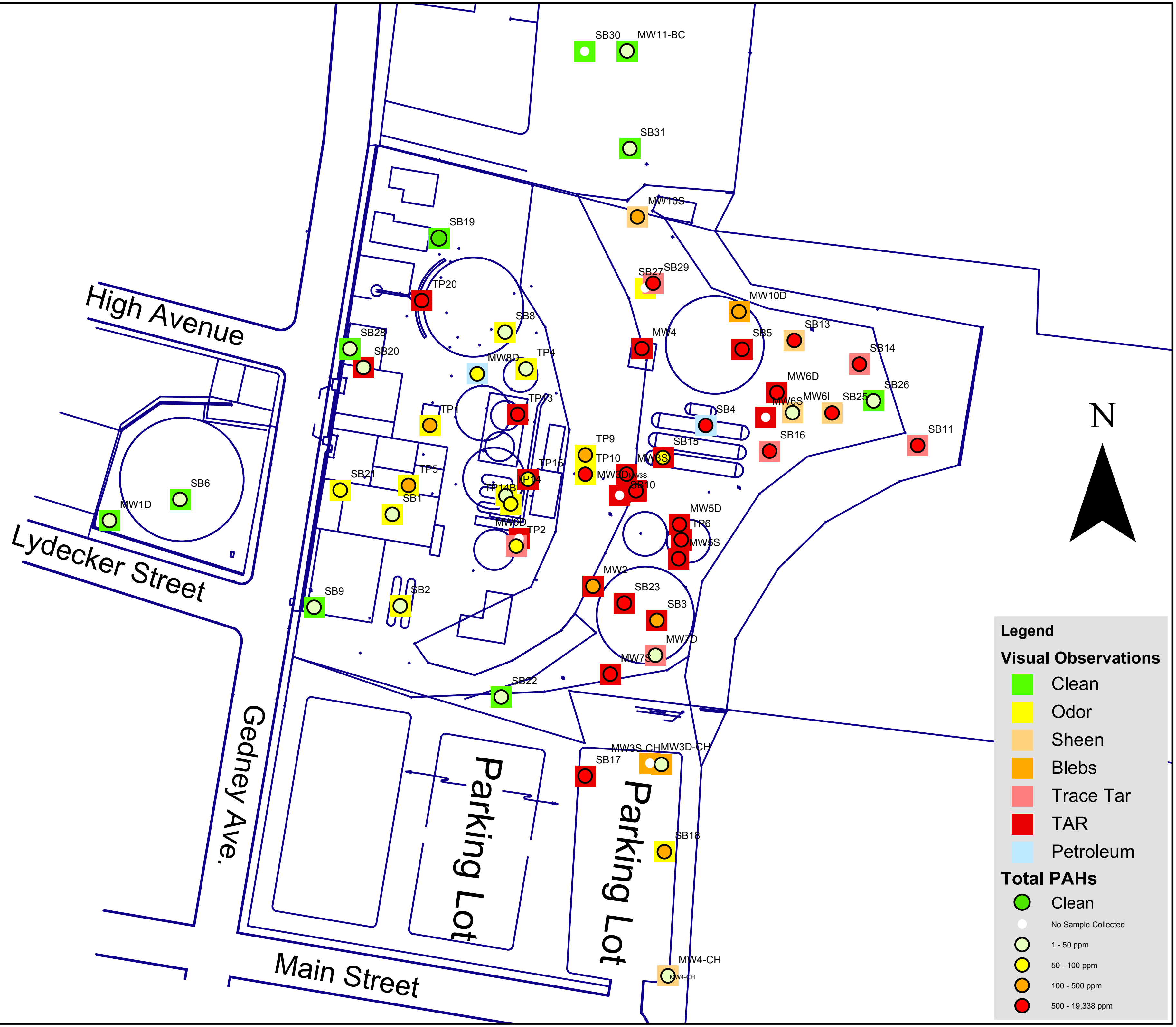
NYACK GAS PLANT SITE (OU-I)
NYACK (C), ROCKLAND COUNTY, NEW YORK
SITE NO. 3-44-046

HISTORIC STRUCTURES

FIGURE 2

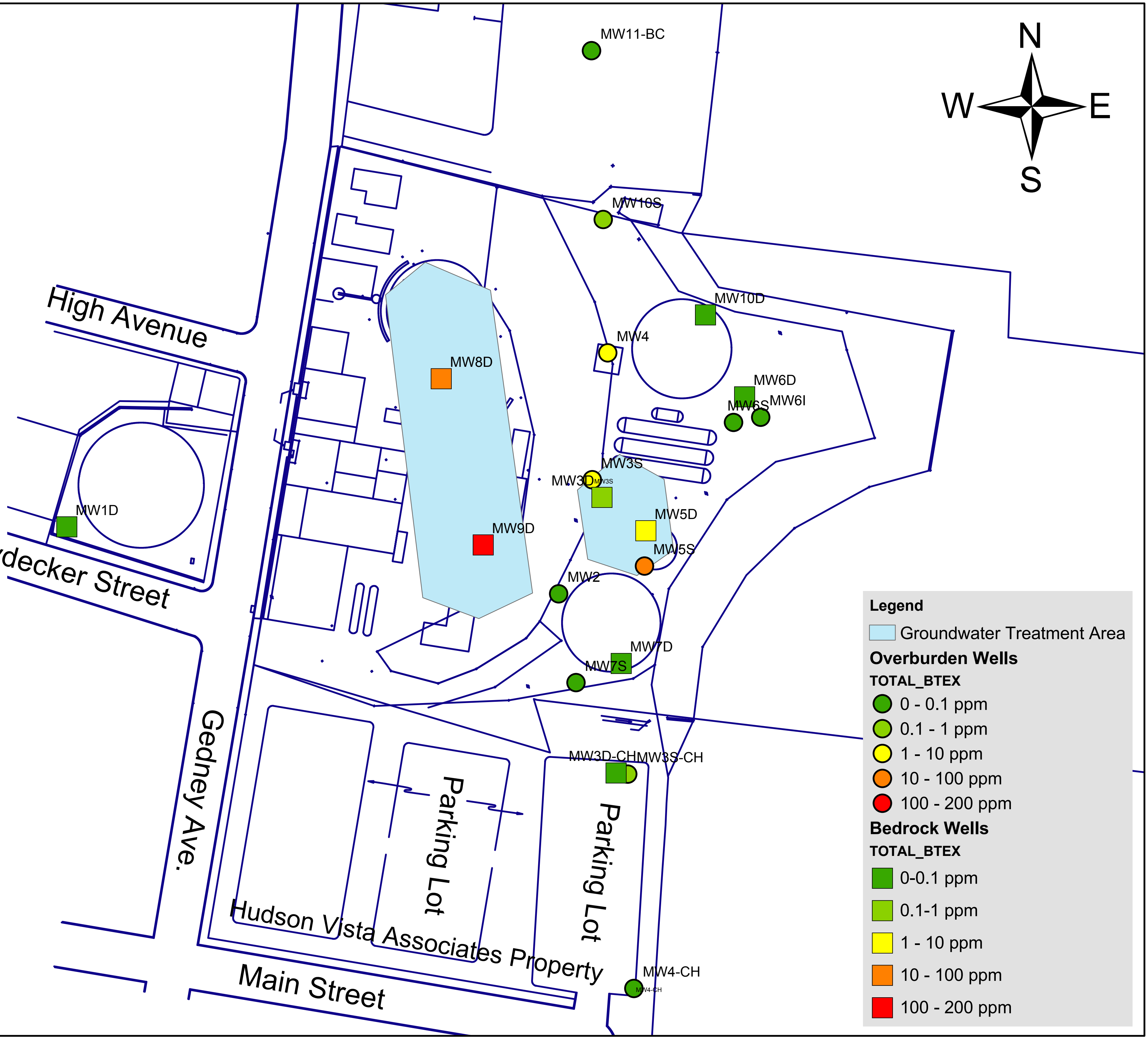
Figure 3
Extent of Contamination

Nyack Gas Plant Site, No. 3-44-046
Proposed Remedial Action Plan



Nyack Gas Plant Site, No. 3-44-046
Proposed Remedial Action Plan

Figure 4
Groundwater Contamination and Remedy



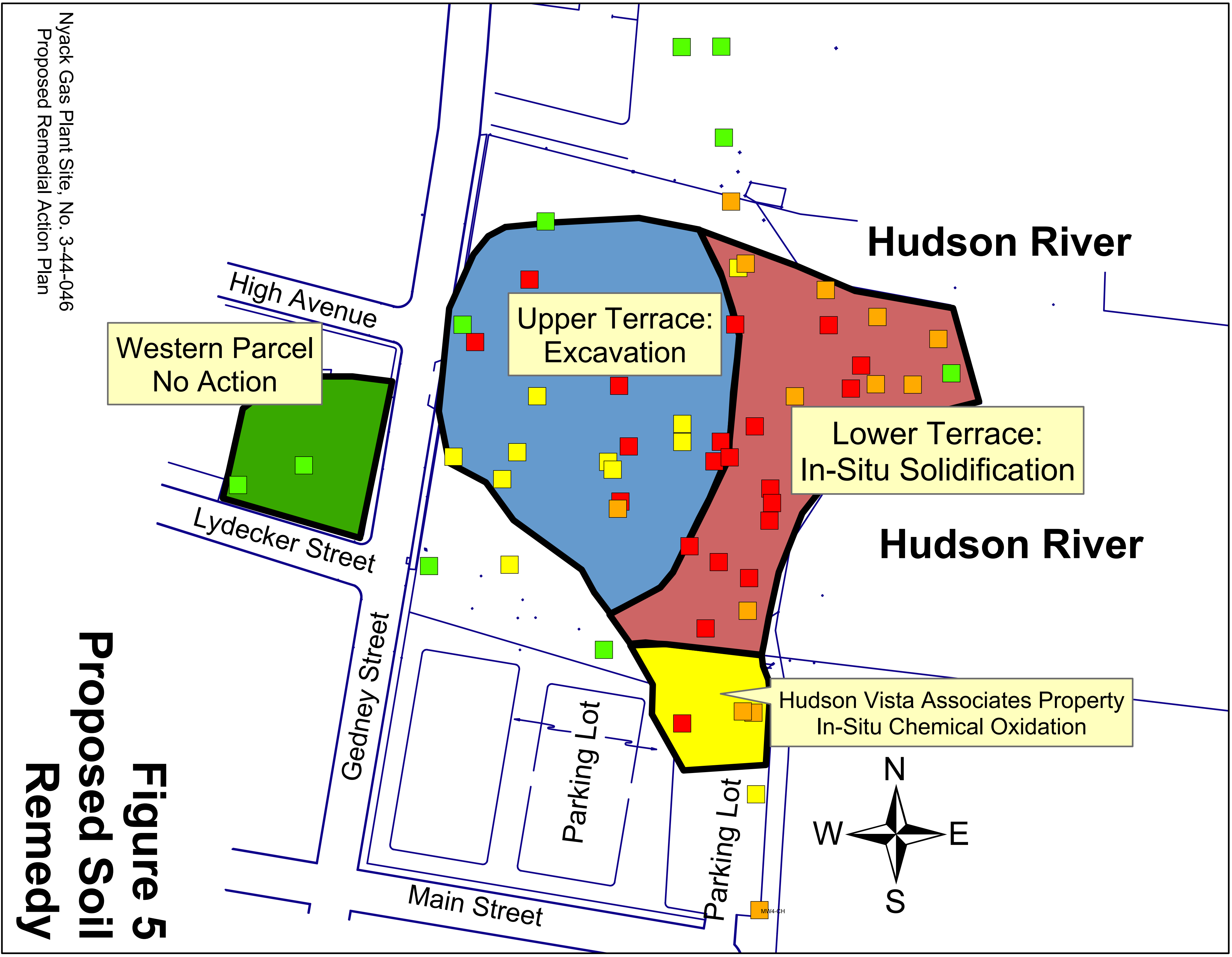


Figure 5
Proposed Soil Remedy

Nyack Gas Plant Site, No. 3-44-046
Proposed Remedial Action Plan