Feasibility Study Addendum
Operable Unit 2
Former Unisys Facility
Great Neck, New York
Site No. 130045

Prepared for:
Lockheed Martin Corporation

Prepared by:
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Acronyms and Abbreviations

ARCADIS	ARCADIS of New York, Inc.
CFR	Code of Federal Regulations
COC	constituent of concern
CWA	Clean Water Act
DER-10	*Division of Environmental Remediation (DER)-10 Technical Guidance for Site Investigation and Remediation*
DER-31	*DER-31 Green Remediation*
FMCC	Fresh Meadow Country Club
FS Addendum	*Draft Feasibility Study Addendum, Operable Unit 2*
FS Report	*Draft Feasibility Study, Operable Unit 2*
gpm	gallons per minute
MLWD	Manhasset-Lakeville Water District
µg/L	microgram(s) per liter
NCDPW	Nassau County Department of Public Works
NPV	net present value
NSLIJH	North Shore Long Island Jewish Hospital
NYSDEC	New York State Department of Environmental Conservation
NYSDOT	New York State Department of Transportation
OU-1	Operable Unit 1
OU-2	Operable Unit 2

RAA	remedial action alternative
RAO	remedial action objective
ROD	Record of Decision
RSL	Regional Screening Level
SCGs	standards, criteria, and guidance
site	former Unisys Corporation Facility located at 1111 Marcus Avenue (formerly 365 Lakeville Road) in Great Neck, Long Island, New York
TVOC	total volatile organic compound
VLS	Village of Lake Success
VLSGC	Village of Lake Success Golf Course
VPGAC	vapor-phase granular activated carbon

Section 1
Introduction

ARCADIS of New York, Inc. (ARCADIS) has prepared this *Feasibility Study Addendum, Operable Unit 2* (FS Addendum) on behalf of Lockheed Martin Corporation for the off-site groundwater plume located near the former Unisys Corporation Facility located at 1111 Marcus Avenue (formerly 365 Lakeville Road) in Great Neck, New York (site; a Site Layout Map is provided as Figure 1. The FS Addendum was prepared pursuant to a request by the New York State Department of Environmental Conservation (NYSDEC) to evaluate three remedial action alternatives (RAAs) in addition to those proposed in the *Feasibility Study, Operable Unit 2* (FS Report) (ARCADIS, 2012) to address the off-site plume of volatile organic compounds in groundwater (Operable Unit 2 or OU-2).

On April 8, 2011, ARCADIS and NYSDEC met to view off-site locations where infrastructure for some of the 16 RAAs presented in the FS Report could potentially be installed. At the meeting, NYSDEC requested that three additional RAAs be evaluated consistent with the process and criteria used in the FS Report. This FS Addendum presents the results of that evaluation. Background information was previously detailed in the FS Report, so it is not repeated herein. As described in the FS Report, the remedial action objectives (RAOs) developed for OU-2 are:

1. Continue to protect public health by further mitigating exposure to site-related constituents of concern (COCs) in groundwater at concentrations in excess of standards, criteria, and guidance (SCGs).

    a. Treat as necessary to ensure that site-related COC concentrations are below SCGs in potable water supplies.

    b. Treat as necessary to ensure that site-related COC concentrations pose no unacceptable risk to the public or the environment at irrigation wells.

2. Attain SCGs for site-related COCs in the groundwater to the extent practicable.

    a. Control site-related COC plumes in the OU-2 area to minimize impacts to additional water purveyors.

    b. Restore groundwater quality to the point at which site-related COCs are below SCGs in OU-2.

Section 2
Description of New Remedial Action Alternatives

Three additional RAAs proposed by NYSDEC have been evaluated based on their potential to meet standards, criteria, and guidance (SCGs), remedial action objectives (RAOs), and preliminary remediation goals, as presented in the FS Report. These RAAs are modifications of the targeted hydraulic control RAAs presented in the FS Report (RAA-4a through RAA-4h) and are hereby referred to as RAA-4i, RAA-4j, and RAA-4k.

Each new RAA includes institutional controls, outpost groundwater monitoring, continued operation of the existing OU-2 interim remedial measure, installation of a new on-site (Operable Unit 1 [OU-1]) extraction well, and potentially deed restrictions. Consistent with the FS Report and as required by the *Division of Environmental Remediation (DER)-10 Technical Guidance for Site Investigation and Remediation* (DER-10; NYSDEC 2010a), each of the RAAs is evaluated according to seven required criteria. In addition, an eighth criterion—consistency with green remediation principles, in particular *DER-31 Green Remediation* (NYSDEC 2010b)—has been included. The subsections below contain a summary of each RAA. Full evaluation of the three new alternatives is presented in the remainder of this FS Addendum and its supporting tables, figures, and appendices.

2.1 ALTERNATIVE 4I—TARGETED HYDRAULIC CONTROL

The first new alternative, RAA-4i, combines all the elements of RAA-4a and RAA-3b as presented in the FS Report (ARCADIS 2012). As shown in Figure 2, it would include installation of the following:

- Four new remedial recovery wells
    - One 120-gallon-per-minute (gpm) on-site well (EW1D)

  - Single 500- and a 700-gpm wells (RW400MM and RW400BM) within the Manhasset-Lakeville Water District [MLWD] facility located on Community Drive

  - One 500-gpm well (RW300) near the northeastern corner of the Village of Lake Success Golf Course (VLSGC)

- Four new diffusion wells (DW400, DW401, DW402, and DW402a) along the west side of Fresh Meadow Country Club (FMCC)

- Two new diffusion wells (DW300 and DW301) near the northwestern portion of VLSGC

- Two new groundwater treatment systems near the northeastern corner of VLSGC and within the MLWD facility near the new extraction wells.

The new VLSGC diffusion wells would be connected to the proposed treatment system at VLSGC via piping installed along the northern and western golf course boundaries. The new FMCC diffusion wells would be connected to the proposed treatment system at MLWD via piping installed along Community Drive, the southern perimeter of FMCC, and Lakeville Road. RAA-4i would include continued pumping at MLWD well N5099 with treatment beginning in year six

2.2 ALTERNATIVE 4J—TARGETED HYDRAULIC CONTROL

The second new alternative, RAA-4j (Figure 3), is identical to RAA-4i as presented above with the exception that MLWD supply well N5099 would cease operation in year one for a period of 5 years (it was assumed that MLWD would obtain water from other wells within their system during this period) while the necessary remedial infrastructure is installed. The evaluation was prepared with the assumption that the well is returned to service in year 6 of the 30-year simulation period (treatment would not be required for MLWD supply well N5099 after it is restarted).

2.3 ALTERNATIVE 4K—TARGETED HYDRAULIC CONTROL

The third new alternative, RAA-4k, is similar to RAA-4h as presented in the FS Report (ARCADIS 2012) with a modification to the location of diffusion wells. Along with the

conversion of MLWD well N5099 to a remedial well, it would include installation of the following (Figure 4):

- One new 120-gpm on site remedial well (EW1D)
- One new 500-gpm remedial well (RW300) near the northeastern corner of VLSGC
- Four new diffusion wells (DW413, DW413a, DW414, and DW414a) east of North Shore Long Island Jewish Hospital (NSLIJH)
- Two new diffusion wells (DW300 and DW301) located near the northwest corner of VLSGC
- One new 1,200-gpm treatment system north of FMCC to treat water from MLWD well N5099
- One new 500-gpm treatment system near the extraction well on VLSGC.

Since MLWD well N5099 would be converted to a remedial well, a new supply well and treatment system would be provided to MLWD to replace well N5099 at another location within the MLWD service area. It is assumed that the new production well and treatment system would be installed at the Chatham site and groundwater, treated using air stripping, and would be pumped into the MLWD distribution system at IU Willets (near well N13704). Piping runs along Community Drive would be required to connect the new diffusion wells to the proposed MLWD treatment system. The new VLSGC diffusion wells and treatment system would be connected via piping installed along the northern and western boundaries of the golf course.

Section 3
Analysis of New Remedial Action Alternatives

This section presents an evaluation of the three new RAAs that have been developed to address OU-2 groundwater. Each would include institutional controls, outpost groundwater monitoring, and operation of the existing OU-2 groundwater treatment system. Also, while not considered part of the groundwater remedy, baseline conditions would include continued operation of (and potential future addition to) local water purveyors' groundwater supply well systems and golf course irrigation water supply systems that may or may not include ancillary wellhead treatment.

3.1 ALTERNATIVE 4I—TARGETED HYDRAULIC CONTROL

Alternative 4i would include institutional controls, continued operation of the existing OU-2 groundwater treatment system, installation of four new remedial and six new diffusion wells, and construction of two new groundwater treatment systems (see detailed description of system components in Section 2.1). The existing OU-2 groundwater treatment system includes the extraction of groundwater from extraction well RW100, treatment with an air stripper, and subsurface injection into diffusion wells DW100, DW101, and DW102 at a flow rate of approximately 500 gpm. Alternative 4i would extend the capture zone downgradient of well RW100 to more fully contain the plume. The analysis of RAA-4i is summarized in Tables 1 through 5, and Figure 2 shows the locations of the remedial wells, diffusion wells, the new groundwater treatment systems, and the existing OU-2 groundwater treatment system.

3.1.1 Overall Protectiveness of Public Health and the Environment

Alternative 4i would be protective of public health concerning the exposure to groundwater because wellhead treatment has already been implemented at supply wells currently affected by site-related COCs, and institutional controls would be implemented at wells that may become

affected in the future. Additionally, the OU-2 groundwater treatment system has reduced the downgradient migration of the site-related, COC-affected groundwater: thus, RAA-4i would meet the protection of public health RAO.

3.1.2 Conformance with SCGs

This section describes how RAA-4i complies with SCGs.

3.1.2.1 Chemical-Specific SCGs

Alternative 4i would comply with all chemical-specific SCGs, except those that relate to ambient water quality. This RAA would not comply with the following:

- Clean Water Act (CWA) Ambient Water Quality Criteria (40 Code of Federal Regulations [CFR] Part 131; EPA – 440/5-86/001 Quality Criteria for Water – 1986, superseded by EPA-822-R-02-047 National Recommended Water Quality Criteria: 2002)

- NYSDEC Ambient Water Quality Standards and Guidance Values (Division of Water TOGS 1.1.1 [1998, revised 2000])

If downgradient water purveyors are affected by site-related COCs, institutional controls would be provided to ensure compliance with drinking water standards.

3.1.2.2 Action-Specific SCGs

Alternative 4i would be designed, constructed, and implemented to comply with all action-specific SCGs.

3.1.2.3 Location-Specific SCGs

Alternative 4i would be constructed and implemented with all of the appropriate local building permits and would comply with Section 14.09 of the New York Preservation of Historic Structures or Artifacts location-specific SCGs. RAA-4i would comply with location-specific SCGs.

3.1.3 Long-Term Effectiveness and Permanence

Alternative 4i would meet RAOs in the long-term because institutional controls would be provided to site-related, COC-affected purveyor wells. This RAA would not protect purveyor well N5099 from being affected by site-related COCs, and there would be residual risk of affecting other downgradient water purveyors.

3.1.4 Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment

Alternative 4i would not reduce the toxicity or mobility of site-related, COC-affected groundwater throughout OU-2; however, as shown in Table 5, RAA-4i would reduce the volume of site-related, COC-affected groundwater after 30 years from approximately 73,700 acre-feet to approximately 20,900 acre-feet by the continued operation of the Operable Unit 1 (OU-1) groundwater treatment system with the new remediation well (EW1D) in the basal portion of the Magothy aquifer, continued operation of the OU-2 groundwater treatment system, and operation of the two new groundwater treatment systems at VLSGC and MLWD. Figure 2 illustrates the 30-year groundwater model-predicted 5-microgram-per-liter (µg/L) total volatile organic compound (TVOC) concentration contour, Table 5 and Appendix A provide the RAA-4i mass removal information.

3.1.5 Short-Term Impact and Effectiveness

The OU-2 groundwater treatment system is already constructed and is operational. Four new groundwater monitoring well clusters in RAA-4i would be installed, and outpost groundwater conditions would be monitored. It is expected that monitoring, extraction, and diffusion well installation; installation of the new groundwater treatment systems; and operation of the OU-2 groundwater treatment system would have a high impact on the public, the workers, and the environment, but adverse short-term effects associated with implementing RAA-4i would be minimized as much as possible. The length of time required to achieve RAOs in OU-2 groundwater would be approximately 22, 28, and 27 years for the golf course, remedial, and public supply wells, respectively (based on current pumping and modeling) (Table 1).

3.1.6 Implementability

Treatment systems are already installed at site-related, COC-affected purveyor wells, and the OU-2 groundwater treatment system is already constructed. This RAA would require the installation of remedial wells RW300, RW400BM, RW400MM, and EW1D, two additional groundwater treatment systems at VLSGC and within the MLWD facility, six new diffusion wells (DW300, DW301, DW400 through DW402, and DW402a), and four new monitoring well clusters, which would require access agreements and permits.

A technical implementability score of 3 was assigned to RAA-4i. There are no road crossings required for RAA-4i, but piping would be installed along the northern and western VLSGC boundaries, Community Drive, the southern perimeter of FMCC, and Lakeville Road, which would require access agreements from the Village of Lake Success (VLS), FMCC, MLWD, and the Nassau County Department of Public Works (NCDPW). To date, FMCC has declined to provide access for the installation of any proposed remediation-related infrastructure; therefore, an administrative implementability score of 9 was assigned to RAA-4i. As a result, the overall implementability score for this RAA is 12 (Table 2), and the RAA is, therefore, not implementable.

3.1.7 Cost-Effectiveness

The capital cost for RAA-4i would be approximately $32,000,000, and the 30-year net present value (NPV) cost would be approximately $85,000,000 (Table 4). The cost for providing wellhead treatment on MLWD well N5099 is included. The cost model is included in Appendix B.

3.1.8 Consistency with Green Remediation Principles

Although RAA-4i would consist of the installation of four new extraction wells, six new diffusion wells, and two new treatment systems at VLSGC and within the MLWD facility, the associated energy and water requirements, air emissions, impacts to land, health and safety concerns, and environmental impacts associated with the surrounding community would be expected to be minimal. The required routine vapor-phase granular activated carbon (VPGAC) change-outs would result in moderate material use and waste generation and the associated impacts from transportation of treatment materials. Reinjecting the treated groundwater pumped from the

four new extraction wells back into the subsurface would create an aquifer water balance and would reduce water discharge, thereby lowering water impacts associated with this RAA.

Air emissions would be minimized by using local suppliers for infrastructure construction materials and using trucks and heavy machinery that run on biofuels, if available, to haul construction and treatment (VPGAC) materials to the site and generated wastes off site for disposal. RAA-4i would affect land use because it involves the installation of ten new wells and two new treatment systems at VLSGC and within the MLWD facility. However, the effect on land use would be minimal because all piping would be installed underground and the treatment system would be installed at or adjacent to a golf course. Minimizing work activities on public roadways would minimize impacts to the surrounding community (e.g., reduced vehicle traffic during construction) and associated health and safety concerns.

3.2 ALTERNATIVE 4J—TARGETED HYDRAULIC CONTROL

Alternative 4j is identical to RAA-4i, above, except that RAA-4j includes the cessation of pumping at MLWD N5099 for a period of 5 years. Alternative 4j would include institutional controls, continued operation of the existing OU-2 groundwater treatment system, installation of four new remedial wells and six new diffusion wells, construction of two new groundwater treatment systems, and the cessation of pumping at MLWD N5099 for a period of five years (it was assumed that MLWD would obtain water from other wells within their system during this time, see detailed description of system components in Section 2.2). The existing OU-2 groundwater treatment system includes the extraction of groundwater from extraction well RW100, treatment with an air stripper, and subsurface injection into diffusion wells DW100, DW101, and DW102 at a flow rate of approximately 500 gpm. Alternative 4j would extend the capture zone downgradient of well RW100 to more fully contain the plume. The analysis of RAA4j is summarized in Tables 1 through 5, and Figure 3 shows the locations of the remedial wells, diffusion wells, the new groundwater treatment systems, and the existing OU-2 groundwater treatment system.

3.2.1 Overall Protectiveness of Public Health and the Environment

Alternative 4j would be protective of public health concerning the exposure to groundwater because wellhead treatment has already been implemented at supply wells currently affected by

site-related COCs, and institutional controls would be implemented at wells that may become affected in the future. Additionally, the OU-2 groundwater treatment system has reduced the downgradient migration of the site-related, COC-affected groundwater; thus, RAA-4j would meet the protection of public health RAO.

3.2.2 Conformance with SCGs

This section describes how RAA-4j complies with SCGs.

3.2.2.1 Chemical-Specific SCGs

Alternative 4j would comply with all chemical-specific SCGs, except those that relate to ambient water quality. This RAA would not comply with the following:

- CWA Ambient Water Quality Criteria (40 CFR Part 131; EPA – 440/5-86/001 Quality Criteria for Water – 1986, superseded by EPA-822-R-02-047 National Recommended Water Quality Criteria: 2002)

- NYSDEC Ambient Water Quality Standards and Guidance Values (Division of Water TOGS 1.1.1 [1998, revised 2000])

If downgradient water purveyors become affected by site-related COCs, institutional controls would be provided to ensure compliance with drinking water standards.

3.2.2.2 Action-Specific SCGs

Alternative 4j would be designed, constructed, and implemented to comply with all action-specific SCGs.

3.2.2.3 Location-Specific SCGs

Alternative 4j would be constructed and implemented with all of the appropriate local building permits and would comply with Section 14.09 of the New York Preservation of Historic Structures or Artifacts location-specific SCGs. RAA-4j would comply with location-specific SCGs.

3.2.3 Long-Term Effectiveness and Permanence

Alternative 4j would meet RAOs in the long-term because institutional controls would be provided to site-related, COC-affected purveyor wells. This RAA would protect purveyor well N5099 from being affected by site-related COCs, but there would be future risk of affecting other downgradient water purveyors.

3.2.4 Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment

Alternative 4j would not reduce the toxicity or mobility of site-related, COC-affected groundwater throughout OU-2; however, as shown in Table 5, RAA-4j would reduce the volume of site-related, COC-affected groundwater after 30 years from approximately 73,700 acre-feet to approximately 20,500 acre-feet by the continued operation of the OU-1 groundwater treatment system with the new remediation well (EW1D) in the basal portion of the Magothy aquifer, continued operation of the OU-2 groundwater treatment system, and operation of the two new groundwater treatment systems at VLSGC and MLWD. Figure 3 illustrates the 30-year groundwater model-predicted 5 µg/L TVOC concentration contour, Table 5 and Appendix A provides the RAA-4j mass removal information.

3.2.5 Short-Term Impact and Effectiveness

The OU-2 groundwater treatment system is already constructed and is operational. Four new groundwater monitoring well clusters would be installed, and outpost groundwater conditions would be monitored. It is expected that monitoring, extraction, and diffusion well installation; installation of the new groundwater treatment systems; and operation of the OU-2 groundwater treatment system would have a high impact on the public, the workers, and the environment, but adverse short-term effects associated with implementing RAA-4j would be minimized as much as possible. The length of time required to achieve RAOs in OU-2 groundwater would be approximately 22, 28, and 27 years for the golf course, remedial, and public supply wells, respectively (based on current pumping and modeling) (Table 1).

3.2.6 Implementability

Treatment systems are already installed at site-related, COC-affected purveyor wells, and the OU-2 groundwater treatment system is already constructed. This RAA would require the installation of remedial wells RW300, RW400BM, RW400MM, and EW1D; two additional groundwater treatment systems at VLSGC and within the MLWD facility; six new diffusion wells (DW300, DW301, DW400 through DW402, and DW402a); and four new monitoring well clusters, which would require access agreements and permits.

A technical implementability score of 3 was given to RAA-4j. There are no road crossings required for RAA-4j, but piping would be installed along the northern and western VLSGC boundaries, Community Drive, the southern perimeter of FMCC, and Lakeville Road, which would require access agreements from VLS, FMCC, MLWD, and NCDPW. To date, FMCC has declined to provide access for the installation of any proposed remediation-related infrastructure; therefore, an administrative implementability score of 9 was assigned to RAA-4j. As a result, the overall implementability score for this RAA is 12 (Table 2), and the RAA is, therefore, not implementable.

3.2.7 Cost Effectiveness

The capital cost for RAA-4j would be approximately $31,000,000, and the 30-year NPV cost would be approximately $83,000,000 (Table 4). Wellhead treatment on MLWD well N5099 is not needed since RAA-4j would protect this well from being affected by site-related COCs. The cost model is included in Appendix B.

3.2.8 Consistency with Green Remediation Principles

Although RAA-4j would consist of the installation of four new extraction wells, six new diffusion wells, and two new treatment systems at VLSGC and within the MLWD facility, the associated energy and water requirements, air emissions, impacts to land, health and safety concerns, and environmental impacts associated with the surrounding community would be expected to be minimal. The required routine VPGAC change-outs would result in moderate material use and waste generation and the associated impacts from transportation of treatment materials. Reinjecting the treated groundwater pumped from the four new extraction wells back into the

subsurface would create an aquifer water balance and would reduce water discharge, thereby lowering water impacts associated with this RAA.

Air emissions would be minimized by using local suppliers for infrastructure construction materials and using trucks and heavy machinery that run on biofuels, if available, to haul construction and treatment (VPGAC) materials to the site and generated wastes off site for disposal. RAA-4j would affect land use because it involves the installation of ten new wells and two new treatment systems at VLSGC and within the MLWD facility. However, the effect on land use would be minimal because all piping would be installed underground and the treatment system would be installed at or adjacent to a golf course. Minimizing work activities on public roadways would minimize impacts to the surrounding community (e.g., reduced vehicle traffic during construction) and associated health and safety concerns.

3.3 ALTERNATIVE 4K—TARGETED HYDRAULIC CONTROL

Alternative 4k would include institutional controls, continued operation of the existing OU-2 groundwater treatment system, installation of two new remedial wells and six new diffusion wells, and construction of two new groundwater treatment systems. Well N5099 would be converted to a remedial extraction well and the new treatment system would treat the water, which would then be reinjected into diffusion wells located at NSLIJH. A new production well and treatment system would be provided to replace water from well N5099. It is assumed that the new production well and treatment system would be installed at the Chatham site and groundwater, treated using air stripping, and would be pumped into the MLWD distribution system at IU Willets (near well N13704) (see detailed description of system components in Section 2.3). The existing OU-2 groundwater treatment system includes the extraction of groundwater from extraction well RW100, treatment with an air stripper, and subsurface injection into diffusion wells DW100, DW101, and DW102 at a flow rate of approximately 500 gpm. Alternative 4k would extend the capture zone to attempt to fully contain the plume. The analysis of RAA-4k is summarized in Tables 1 through 5, and Figure 4 shows the locations of the remedial wells, diffusion wells, the new groundwater treatment systems, and the existing OU-2 groundwater treatment system.

3.3.1 Overall Protectiveness of Public Health and the Environment

Alternative 4k would be protective of public health concerning the exposure to groundwater because wellhead treatment has already been implemented at supply wells that are currently affected by site-related COCs, and institutional controls would be implemented at wells that may become affected in the future. Additionally, the OU-2 groundwater treatment system has reduced the downgradient migration of site-related, COC-affected groundwater. Alternative 4k would meet the protection of public health RAO.

3.3.2 Conformance with SCGs

This section describes how RAA-4k complies with SCGs.

3.3.2.1 Chemical-Specific SCGs

Alternative 4k would comply with all chemical-specific SCGs, except those that relate to ambient water quality. This RAA would not comply with the following:

- CWA – Ambient Water Quality Criteria (40 CFR Part 131; EPA – 440/5-86/001 Quality Criteria for Water – 1986, superseded by EPA-822-R-02-047 National Recommended Water Quality Criteria: 2002)

- NYSDEC Ambient Water Quality Standards and Guidance Values (Division of Water TOGS 1.1.1 [1998, revised 2000])

If downgradient water purveyors become affected by site-related COCs, institutional controls would be provided to ensure compliance with drinking water standards.

3.3.2.2 Action-Specific SCGs

Alternative 4k would be designed, constructed, and implemented to comply with all action-specific SCGs.

3.3.2.3 Location-Specific SCGs

Alternative 4k would be constructed and implemented with all of the appropriate local building permits and would comply with Section 14.09 of the New York Preservation of Historic

Structures or Artifacts location-specific SCGs. RAA-4k would comply with location-specific SCGs.

3.3.3 Long-Term Effectiveness and Permanence

Alternative 4k would meet RAOs in the long-term because institutional controls would be provided to site-related, COC-affected purveyor wells. As part of this RAA, supply well N5099 would be converted to a remedial well, but there would be a residual risk of affecting other downgradient water purveyors.

3.3.4 Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment

Alternative 4k would not reduce the toxicity or mobility of site-related, COC-affected groundwater throughout OU-2; however, as shown in Table 5, RAA-4k would reduce the volume of site-related, COC-affected groundwater after 30 years from approximately 73,700 acre-feet to approximately 21,600 acre-feet by the continued operation of the OU-1 groundwater treatment system with the new remediation well (EW1D) in the basal portion of the Magothy aquifer, continued operation of the OU-2 groundwater treatment system, operation of N5099 as a remedial well, and operation of the two new groundwater treatment systems. Figure 4 illustrates the 30-year groundwater model-predicted 5 µg/L TVOC concentration contour, Table 5 and Appendix A provides the RAA-4k mass removal information.

3.3.5 Short-Term Impact and Effectiveness

The OU-2 groundwater treatment system is already constructed and operational. Four new groundwater monitoring well clusters would be installed, and outpost groundwater conditions would be monitored. Monitoring, extraction, and diffusion well installation; implementation of groundwater monitoring; installation of the new groundwater treatment systems; installation of a new production well and treatment system (assumed to be installed at the Chatham site to replace water from well N5099); and operation of the OU-2 groundwater treatment system would be expected to have a high impact on the public, the workers, and the environment, but adverse short-term effects associated with implementing RAA-4k would be minimized as much as possible. The length of time required to achieve RAOs in OU-2 groundwater would be approximately 20, more

than 30, and approximately 25 years for golf course, remedial, and public supply wells, respectively (based on current pumping and modeling) (Table 1).

3.3.6 Implementability

Treatment systems are already installed at site-related, COC-affected purveyor wells, and the OU2 groundwater treatment system is already constructed. This RAA would require the installation of two new remediation wells (at VLSGC and on site), two new groundwater treatment systems (at MLWD well N5099 and northeast of VLSGC), six new diffusion wells (two at the western portion of VLSGC and four at NSLIJH), a new production well and treatment system (assumed to be installed at the Chatham site to replace water from well N5099), infrastructure to discharge to the MLWD distribution system at IU Willets (near well N13704), and four new monitoring well clusters, which would require access agreements and permits. Piping runs along Community Drive would be required to connect the new diffusion wells to the proposed MLWD treatment system. The new VLSGC diffusion wells and treatment system would be connected via piping installed along the northern and western boundaries of the golf course.

A technical implementability score of 3 was given to RAA-4k. Installing these wells and treatment systems would require obtaining access agreements from NSLIJH, MLWD, VLS, Nassau County, and NCDPW. Currently, only VLS, MLWD, and NSLIJH have indicated a willingness to negotiate access to their properties to install remedial system infrastructure. Accordingly, an administrative implementability score of 6 was assigned to this RAA. The overall implementability score for RAA-4k is 9 (Table 2); therefore, this alternative is potentially implementable.

3.3.7 Cost Effectiveness

The capital cost for RAA-4k would be approximately $35,000,000, and the 30-year NPV cost would be approximately $89,000,000 (Table 4). The cost of a replacement for MLWD well N5099 is included. The cost model is included in Appendix B.

3.3.8 Consistency with Green Remediation Principles

RAA-4k would consist of the installation of two new extraction wells, six new diffusion wells, two new treatment systems at VLSGC and near MLWD well N5099 north of FMCC, and a new

production well and treatment system at the Chatham site to replace water from well N5099. However, the associated energy and water requirements, air emissions, impacts to land, health and safety concerns, and environmental impacts associated with the surrounding community would be expected to be minimal. The required routine VPGAC change-outs would result in moderate material use and waste generation and the associated impacts from transportation of treatment materials. Reinjecting the treated groundwater pumped from the two new extraction wells back into the subsurface would create an aquifer water balance and would reduce water discharge, thereby lowering water impacts associated with this RAA.

Air emissions would be minimized by using local suppliers for infrastructure construction materials and using trucks and heavy machinery that run on biofuels, if available, to haul construction and treatment (VPGAC) materials to the site and generated wastes off site for disposal. RAA-4k would affect land use because it would involve the installation of eight new wells and two new treatment systems at VLSGC and north of FMCC. However, the effect on land use would be minimal because all the piping would be installed underground and the treatment systems would be installed at or adjacent to a golf course. Minimizing work activities on public roadways would minimize impacts to the surrounding community (e.g., reduced vehicle traffic during construction) and associated health and safety concerns.

3.4 SUMMARY OF REMEDIAL ACTION ALTERNATIVES EVALUATION

After performing the above detailed analysis of the three new RAAs, only one (RAA-4k) appears to be potentially implementable for OU-2. All three RAAs were found to be protective of public health because institutional controls have already and will continue to include providing wellhead treatment (where necessary) at purveyor wells. The RAAs are also equally protective of the environment because each removes approximately 31,000 pounds of COC mass in the 30-year evaluation period (Table 5).

All three RAAs comply with action-, location-, and chemical-specific SCGs. The RAAs are all effective in the long-term. However, the alternatives are not projected to achieve the water quality RAO throughout OU-2 within 30 years. None of the RAAs reduce the toxicity (the COCs are not made less toxic in groundwater because their chemical compositions are not altered by the

remediation processes) or mobility (the physical parameters of the aquifer are not affected by remediation) of site-related, COC-affected groundwater throughout OU-2 within 30 years. All of the RAAs reduce the volume of site-related, COC-affected groundwater throughout OU-2 from approximately 73,000 acre-feet to a maximum residual volume of approximately 25,500 acre-feet for RAA-4i and RAA-4j and a minimum residual volume of approximately 21,500 acre-feet for RAA-4k. All three RAAs would be expected to have high short-term impacts to the public, the workers, and the environment if implemented.

For the potentially implementable RAA-4k option, the time to achieve the RAOs is expected to range from approximately 20 to more than 30 years. The 30-year NPV cost per pound of COC removed is estimated to be on the order of $2,900.

Section 4
Conclusions

Consistent with the analysis conducted in the FS Report (ARCADIS 2012), the primary discriminators used to evaluate the three RAAs considered in this FS Addendum are implementability and cost-effectiveness. Although RAA-4k has the highest 30-year NPV cost per-pound of COC removed of the three alternatives evaluated, it has the lowest (most favorable) implementability score (9 vs. 12 for the other two alternatives). Based on the evaluation, RAA-4k would be considered implementable while the other two are not likely to be implementable.

Section 5
References

1. ARCADIS. 2012. *Feasibility Study, Operable Unit 2, Former Unisys Facility, Great Neck, New York, Site No. 130045*. Prepared for Lockheed Martin Corporation. ARCADIS of New York, Inc. May.

2. New York State Department of Environmental Conservation. 2010a. DER-10, Technical Guidance for Site Investigation and Remediation. Division of Environmental Remediation.

3. New York State Department of Environmental Conservation. 2010b. DER-31, Green Remediation.

Tables

Table 1
Detailed Evaluation of Remedial Action Alternatives
Feasibility Study Addendum, Operable Unit 2
Former Unisys Facility, Great Neck, New York

Criteria / Alternatives	RAA-1	RAA-2a	RAA-2b	RAA-2c	RAA-3a	RAA-3b	RAA-4a	RAA-4b	RAA-4c	RAA-4d
	No Action/Institutional Controls and Operation of OU-1 Treatment System	**Conversion of the IRM to the Final Remedy—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems**	**Conversion of the IRM to the Final Remedy—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of One New Remediation Well On-Site in the Basal Magothy Aquifer (EW1D)**	**Conversion of the IRM to the Final Remedy—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of One New Remediation Well On-site (EW1D), Installation of a New 1,200-gallons per minute (gpm) Treatment System at MLWD N5099.**	**Capture Additional Constituent of Concern (COC) Mass—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Two New Remediation Wells On-Site and at Village of Lake Success Golf Course (VLSGC) (EW1D and RW300), Installation of Two New Diffusion Wells at OU-2 (DW103 and DW104). Treatment with IRM System.**	**Capture Additional COC Mass—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Two New Remediation Wells On-Site and at VLSGC (EW1D and RW300), Installation of Two New Diffusion Wells at VLSGC (DW300 and DW301), Installation of a New 500-gpm Treatment System Near RW300 at VLSGC.**	**Targeted Hydraulic Control—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Three New Remediation Wells On-Site and at the Manhasset-Lakeville Water District (MLWD) (EW1D, RW400MM, and RW400BM), Installation of Four New Diffusion Wells at Fresh Meadow Country Club (FMCC) (DW400, DW401, DW402, and DW402a), Installation of a New 1,200-gpm Treatment System at MLWD.**	**Targeted Hydraulic Control—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Three New Remediation Wells On-Site and at the North Shore Long Island Jewish Hospital (NSLIJH) (EW1D, RW401MM, and RW401BM), Installation of Four New Diffusion Wells South of NSLIJH (DW404, DW404a, DW405, and DW406), Installation of a New 1,000-gpm Treatment System at NSLIJH.**	**Modified Hydraulic Containment—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Three New Remediation Wells On-Site, at VLSGC, and at MLWD South (EW1D, RW300, and RW402), and Four New Diffusion Wells South of NSLIJH and North of MLWD (DW404, DW405, DW407, DW408), Installation of a New 1,600-gpm Treatment System East of FMCC.**	**Minimized Impact to Public Supply Wells—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Five New Remediation Wells On-Site, at MLWD, at the Village of Lake Success Park (VLSP), and at the Korean Church (KC) (EW1D, RW400BM, RW400MM, RW403, and RW404), Installation of Eight New Diffusion Wells North and South of NSLIJH (DW404-, DW406, DW405a, and DW409-DW412), Installation of a New 3,000-gpm Treatment System at KC.**
Remedial Action Objectives (RAOs)										
Protect Public Health and the Environment from Exposure to COCs	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.
Remove COC Mass	Removes approximately **29,000** pounds of site-related COCs (OU-1 system).	Actively removes COC mass in the RW100 capture zone. Removes approximately **29,000** pounds of site-related COCs.	Actively removes COC mass in the RW100 capture zone and in the RW1RS, EW1, and EW1D capture zone (north of the OU-1 treatment area). Removes approximately **30,000** pounds of site-related COCs.	Actively removes COC mass in the RW100 capture zone; in the RW1RS, EW1, and EW1D capture zone (north of the OU-1 treatment area); and in the MLWD N5099 capture zone (north of FMCC). Removes approximately **31,000** pounds of site-related COCs.	Actively removes COC mass in the expanded RW100 and RW300 capture zone (west of RW100 between the Northern State Parkway [NSP] to the south and the LIE to the north). Removes approximately **31,000** pounds of site-related COCs.	Actively removes COC mass in the expanded RW100 and RW300 capture zone (west of RW100 between the NSP to the south and the LIE to the north). Removes approximately **31,000** pounds of site-related COCs.	Actively removes COC mass in the capture zone of each remediation well throughout OU-2 (north/northwest of Deepdale Golf Club, FMCC, and VLSGC). Removes approximately **30,000** pounds of site-related COCs.	Actively removes COC mass in the capture zone of each remediation well throughout OU-2 (north/northwest of Deepdale Golf Club). Removes approximately **30,000** pounds of site-related COCs.	Actively removes COC mass throughout OU-2. Removes approximately **31,000** pounds of site-related COCs.	Actively removes COC mass throughout OU-2. Removes approximately **32,000** pounds of site-related COCs.
Conformance with Standards, Criteria, and Guidance (SCGs)										
Complies with Chemical-Specific SCGs?	Complies with several chemical-specific SCGs, but not with the Clean Water Act (CWA) and New York State Department of Environmental Conservation (NYSDEC) ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.
Complies with Action-Specific SCGs?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Complies with Location-Specific SCGs?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Evaluation Criteria										
Long-Term Effectiveness and Permanence	Effective in the long term because institutional controls will be provided to site-related COC-affected purveyor wells. Will not comply with groundwater quality RAO.	Will be effective in the long term in the RW100 capture zone, but may not comply with the groundwater quality RAO.	Will be effective in the long term in the RW100 capture zone, but may not comply with the groundwater quality RAO.	Will be effective in the long term in the RW100 and N5099 capture zones, but may not comply with the groundwater quality RAO. Does not protect purveyor well N5099; however, wellhead treatment prior to discharge to the distribution system will protect public health. Other downgradient wells are also expected to be impacted.	Will be effective in the long term in the expanded RW100 and RW300 capture zone, but may not comply with the groundwater quality RAO. Does not protect downgradient water purveyor well N5099. Other downgradient wells are also expected to be impacted.	Will be effective in the long term in the expanded RW100 and RW300 capture zone, but may not comply with the groundwater quality RAO. Does not protect downgradient water purveyor well N5099. Other downgradient wells are also expected to be impacted.	Will be effective in the long term in the expanded RW400MM and RW400BM capture zone, but may not comply with the groundwater quality RAO. Reduces further impacts to nearest downgradient water purveyor well N5099. Other downgradient wells are expected to be impacted.	Will be effective in the long term in the expanded RW401MM and RW401BM capture zone, but may not comply with the groundwater quality RAO. Does not protect downgradient water purveyor well N5099. Other downgradient wells are also expected to be impacted.	Will be effective in the long term throughout OU-2. Does not protect downgradient water purveyor well N5099. Other downgradient wells are also expected to be impacted.	Complies with RAOs. Will be effective in the long term throughout OU-2. Reduces further impacts to downgradient water purveyor well N5099 and is protective of Water Authority of Great Neck North (WAGNN) wells N4388 and N12796. Other downgradient wells are expected to be impacted.
Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment	Will not actively reduce toxicity, mobility, or volume.	Will not actively reduce toxicity, mobility, or volume.	Will not actively reduce toxicity, mobility, or volume.	Will not actively reduce toxicity, mobility, or volume.	Will not actively reduce toxicity, mobility, or volume.	Will not actively reduce toxicity, mobility, or volume.	Will not actively reduce toxicity or mobility, but reduces volume of impacted groundwater throughout OU-2.	Will not actively reduce toxicity or mobility, but reduces volume of impacted groundwater throughout OU-2.	Will not actively reduce toxicity or mobility, but reduces volume of impacted groundwater throughout OU-2.	Will not actively reduce toxicity or mobility, but reduces volume of impacted groundwater throughout OU-2.
Short-Term Impact and Effectiveness	Will be effective in the short term with **minimal** impact to the public, the workers, and the environment. Time to meet RAOs is indeterminate.	Will be effective in the short term with **minimal** impact to the public, the workers, and the environment. Will meet RAOs in approximately 17 years, approximately 27 years, and more than 30 years for the golf course, remedial, and public supply wells, respectively.	Will be effective in the short term with **minimal** impact to the public, the workers, and the environment. Will meet RAOs in approximately 18 years for the golf course wells and more than 30 years for the public and remedial supply wells.	Will be effective in the short term with **minimal** impact to the public, the workers, and the environment. Will meet RAOs in approximately 19 years for the golf course and remedial wells and more than 30 years for the public supply wells.	Will be effective in the short term with **minimal** impact to the public, the workers, and the environment. But installing new infrastructure will impact the public more than RAA-2a and RAA-2b. Will meet RAOs in approximately 19 years, approximately 27 years, and approximately 28 years for the golf course, remedial, and public supply wells, respectively.	Will be effective in the short term with **some** impact to the public, the workers, and the environment. Installing new infrastructure will impact the public more than RAA-2a and RAA-2b. Will meet RAOs in approximately 20 years, approximately 25 years, and more than 30 years for the golf course, remedial, and public supply wells, respectively.	Will be effective in the short term with **high** impact to the public, the workers, and the environment. Installing new infrastructure will impact the public more than RAA-3a and RAA-3b. Will meet RAOs in approximately 16 years, more than 30 years, and approximately 25 years for the golf course, remedial, and public supply wells, respectively.	Will be effective in the short term with **high** impact to the public, the workers, and the environment. Installing new infrastructure will impact the public more than RAA-4a. Will meet RAOs in approximately 17 years, more than 30 years, and approximately 25 years for the golf course, remedial, and public supply wells, respectively.	Will be effective in the short term with **high** impact to the public, the workers, and the environment. Installing new infrastructure, including a pipeline that crosses the LIE, will impact the public more than RAA-4b. Will meet RAOs in approximately 16 years for the golf course wells and approximately 25 years for the remedial and public supply wells.	Will be effective in the short term with **high** impact to the public, the workers, and the environment. Installing new infrastructure will impact the public more than RAA-4b. Will meet RAOs in approximately 15 years, approximately 25 years, and approximately 7 years for the golf course, remedial, and public supply wells, respectively.

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Criteria / Alternatives	RAA-1	RAA-2a	RAA-2b	RAA-2c	RAA-3a	RAA-3b	RAA-4a	RAA-4b	RAA-4c	RAA-4d
	No Action/Institutional Controls and Operation of OU-1 Treatment System	**Conversion of the IRM to the Final Remedy—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems**	**Conversion of the IRM to the Final Remedy—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of One New Remediation Well On-Site in the Basal Magothy Aquifer (EW1D)**	**Conversion of the IRM to the Final Remedy—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of One New Remediation Well On-site (EW1D), Installation of a New 1,200-gallons per minute (gpm) Treatment System at MLWD N5099.**	**Capture Additional Constituent of Concern (COC) Mass—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Two New Remediation Wells On-Site and at Village of Lake Success Golf Course (VLSGC) (EW1D and RW300), Installation of Two New Diffusion Wells at OU-2 (DW103 and DW104). Treatment with IRM System.**	**Capture Additional COC Mass—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Two New Remediation Wells On-Site and at VLSGC (EW1D and RW300), Installation of Two New Diffusion Wells at VLSGC (DW300 and DW301), Installation of a New 500-gpm Treatment System Near RW300 at VLSGC.**	**Targeted Hydraulic Control—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Three New Remediation Wells On-Site and at the Manhasset-Lakeville Water District (MLWD) (EW1D, RW400MM, and RW400BM), Installation of Four New Diffusion Wells at Fresh Meadow Country Club (FMCC) (DW400, DW401, DW402, and DW402a), Installation of a New 1,200-gpm Treatment System at MLWD.**	**Targeted Hydraulic Control—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Three New Remediation Wells On-Site and at the North Shore Long Island Jewish Hospital (NSLIJH) (EW1D, RW401MM, and RW401BM), Installation of Four New Diffusion Wells South of NSLIJH (DW404, DW404a, DW405, and DW406), Installation of a New 1,000-gpm Treatment System at NSLIJH.**	**Modified Hydraulic Containment—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Three New Remediation Wells On-Site, at VLSGC, and at MLWD South (EW1D, RW300, and RW402), and Four New Diffusion Wells South of NSLIJH and North of MLWD (DW404, DW405, DW407, DW408), Installation of a New 1,600-gpm Treatment System East of FMCC.**	**Minimized Impact to Public Supply Wells—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Five New Remediation Wells On-Site, at MLWD, at the Village of Lake Success Park (VLSP), and at the Korean Church (KC) (EW1D, RW400BM, RW400MM, RW403, and RW404), Installation of Eight New Diffusion Wells North and South of NSLIJH (DW404-, DW406, DW405a, and DW409-DW412), Installation of a New 3,000-gpm Treatment System at KC.**
Implementability	Implementable; overall implementability score is **4**. OU-1 treatment system is already constructed and operational; hence this RAA was given a technical implementability score of 1. Access agreements will be needed for the installation and sampling of new groundwater monitoring wells; therefore, RAA-1 was given an administrative implementability score of 3.	Implementable; overall implementability score is **4**. IRM and wellhead treatment systems are already constructed and operational; hence, this RAA was given a technical implementability score of 1. Access agreements will be needed for the installation and sampling of new groundwater monitoring wells; therefore, RAA-2a was given an administrative implementability score of 3.	More difficult to implement than RAA-1 and RAA-2a; overall implementability score is **5**. IRM and wellhead treatment systems are already constructed and operational; hence, this RAA was given a technical implementability score of 1. Access agreements will be needed for the installation and sampling of new groundwater monitoring wells and installation of one new remediation well; therefore, RAA-2b was given an administrative implementability score of 4.	More difficult to implement than RAA-2b; overall implementability score is 6. IRM and wellhead treatment systems are already constructed and operational; however, a new treatment system and associated infrastructure are proposed. Accordingly, this RAA was given a technical implementability score of 2. Access agreements will also be needed for the installation of the new treatment system, new remediation well, and new groundwater monitoring wells; therefore, RAA-2c was given an administrative implementability score of 4.	More difficult to implement than RAA-2b; overall implementability score is **10**. Although this RAA does not involve the installation of any new treatment systems besides IRM and wellhead treatment systems which are already constructed and operational, access agreements will still be required to install remediation wells and associated infrastructure. Accordingly, RAA-3a was given a technical implementability score of 3 and an administrative implementability score of 7.	Less difficult to implement than RAA-3a; overall implementability score is **6**. A technical implementability score of 2 was given to this RAA. Although RAA-3b includes the installation of a new treatment system, a new remediation well, and new diffusion wells at VLSGC property, Village of Lake Success (VLS) has indicated willingness to discuss access to implement this RAA. Therefore, an administrative implementability score of 4 was assigned to RAA-3b.	Less implementable than RAA-3a; overall implementability score is **12**. IRM and wellhead treatment systems are already constructed and operational; however, a new treatment system, new remediation wells, new diffusion wells, and associated infrastructure are proposed. Accordingly, this RAA was given a technical implementability score of 3. Access agreements will be needed for the installation of the components of this RAA. FMCC declined to provide access to install remediation infrastructure; therefore, an administrative implementability score of 9 was given to RAA-4a.	Less difficult to implement than RAA-4a; overall implementability score is **6**. A technical implementability score of 2 was given to this RAA. Although RAA-4b includes the installation of a new treatment system, new remediation wells, and new diffusion wells at the NSLIJH property, NSLIJH indicated willingness to negotiate access to install these components. Therefore, an administrative implementability score of 4 was assigned to RAA-4b.	Less implementable than RAA-4b; overall implementability score is **11**. A technical implementability score of 3 was given to this RAA. RAA-4c may not be implementable because proposed pipelines will cross Lakeville Road, the LIE, and possibly Little Neck Parkway, which will require obtaining access agreements from numerous stakeholders; including Nassau County and New York State Department of Transportation (NYSDOT). The installation of this RAA's components will also require access to MLWD, VLS, FMCC, and NSLIJH. As a result, RAA-4c was given an administrative implementability score of 8.	Less implementable than RAA-4b; overall implementability score is **11**. A technical implementability score of 3 was given to this RAA. RAA-4d may not be implementable because proposed pipelines will cross Lakeville Road, Community Drive, and possibly Little Neck Parkway, which will require obtaining access agreements from numerous stakeholders; including Nassau County and NYSDOT. Access agreements will also be required to install a new treatment system at KC as well as several remediation and diffusion wells at NSLIJH, MLWD, and VLSP. As a result, RAA-4d was given an administrative implementability score of 8.
Consistency with Green Remediation Principles	No additional infrastructure required; therefore, minimal energy and water requirements, air emissions, impact to land, material consumption, waste generation, health and safety concerns, or impacts on the sustainability of the surrounding community.	No additional infrastructure required; therefore, minimal energy and water requirements, air emissions, impact to land, material consumption, waste generation, health and safety concerns, or impacts on the sustainability of the surrounding community.	One new remediation well to be installed; therefore, minimal energy and water requirements, air emissions, impact to land, material consumption, waste generation, health and safety concerns, or impacts on the sustainability of the surrounding community.	One new treatment system and one new remediation well to be installed; extracted groundwater to be treated and discharged to distribution system for beneficial use. Minimal energy requirements, air emissions, impact to land, material consumption, waste generation, health and safety concerns, or impacts on the sustainability of the surrounding community.	Two new remediation wells, two new diffusion wells, and associated piping to be installed; additional groundwater flow to be re-injected into the subsurface; therefore, lowering water impacts. Generally, minimal energy and water requirements, air emissions, impact to land, material consumption, waste generation, health and safety concerns, or impacts on the sustainability of the surrounding community.	Four new remediation and diffusion wells and one treatment system to be installed on-site and at a golf course. Low water impacts because of subsurface re-injection of treated groundwater; moderate material use and waste generation and associated impacts from transportation of treatment materials on- and off-site as part of routine vapor-phase granular activated carbon (VPGAC) changeouts; low air emissions by using local suppliers for construction materials and utilizing trucks and heavy machinery that run on biofuels to haul construction and treatment materials and wastes; minimal effect on land use because all piping will be installed underground and treatment system will be installed on a golf course; minimal energy requirements and health and safety concerns.	Seven new remediation and diffusion wells and one new treatment system to be installed on-site and adjacent to a golf course. Low water impacts because of subsurface re-injection of treated groundwater; moderate material use and waste generation, and associated impacts from transportation of treatment materials on- and off-site as part of routine VPGAC changeouts; low air emissions by using local suppliers for construction materials and utilizing trucks and heavy machinery that run on biofuels to haul construction and treatment materials and wastes; minimal effect on land use because all piping will be installed underground and the treatment system will be installed adjacent to a golf course; minimal energy requirements and health and safety concerns.	Seven new remediation and diffusion wells and one new treatment system to be installed on-site and south of NSLIJH. Low water impacts because of subsurface re-injection of treated groundwater; moderate material use and waste generation and associated impacts from transportation of treatment materials on- and off-site as part of routine VPGAC changeouts; low air emissions by using local suppliers for construction materials and utilizing trucks and heavy machinery that run on biofuels to haul construction and treatment materials and wastes; minimal effect on land use because all piping will be installed underground and the treatment system will be installed at the edge of a parking lot; minimal energy requirements and health and safety concerns.	Seven new remediation and diffusion wells and one new treatment system to be installed on-site and at a golf course. Low water impacts because of subsurface re-injection of treated groundwater; moderate material use and waste generation and associated impacts from transportation of treatment materials on- and off-site as part of routine VPGAC changeouts; low air emissions by using local suppliers for construction materials and utilizing trucks and heavy machinery that run on biofuels to haul construction and treatment materials and wastes; minimal effect on land use because all piping will be installed underground and the treatment system will be installed on a golf course; minimal energy requirements and health and safety concerns.	Thirteen new remediation and diffusion wells and one new treatment system to be installed on-site and at KC. Low water impacts because of subsurface re-injection of treated groundwater; moderate material use and waste generation and associated impacts from transportation of treatment materials on- and off-site as part of routine VPGAC changeouts; low air emissions by using local suppliers for construction materials and utilizing trucks and heavy machinery that run on biofuels to haul construction and treatment materials and wastes; minimal effect on land use because all piping will be installed underground and the treatment system will be installed in a parking lot; minimal energy requirements and health and safety concerns.
Costs										
Cost Effectiveness	**$9,000,000**	**$32,000,000**	**$38,000,000**	**$39,000,000**	**$42,000,000**	**$55,000,000**	**$63,000,000**	**$60,000,000**	**$69,000,000**	**$89,000,000**

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Former Unisys Facility, Great Neck, New York

Alternatives Criteria	RAA-4e	RAA-4f	RAA-4g	RAA-4h	RAA-4i	RAA-4j	RAA-4k	RAA-5a	RAA-5b
	Minimized Impact to Public Supply Wells—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Four New Remediation Wells On-Site, at VLSGC, and at NSLIJH (EW1D, RW300, RW400MM, and RW400MM), Installation of Six New Diffusion Wells at VLSGC and South of NSLIJH (DW300, DW301, DW404, DW404a, DW405, and DW405a), Installation of Two New 800-gpm Treatment Systems at NSLIJH and VLSGC.	**Minimized Impact to Public Supply Wells—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Two New Remediation Wells On-Site and at KC (EW1D and RW404), Installation of Four New Diffusion Wells North and South of NSLIJH (DW404, DW405, DW409, and DW410), Installation of a New 1,600-gpm Treatment System at KC.**	**Targeted Hydraulic Control—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of One New Remediation Well On-Site (EW1D), Installation of Four New Diffusion Wells North and South of NSLIJH (DW411-DW414), Installation of a New 1,200-gpm Treatment System at MLWD N5099.**	**Modified Hydraulic Containment—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Two New Remediation Wells On-Site and at VLSGC (EW1D and RW300), Installation of Six New Diffusion Wells at VLSGC and North and South of NSLIJH (DW300, DW301, and DW411-DW-414), Installation of Two New Treatment Systems at VLSGC (500 gpm) and at MLWD N5099 (1,200 gpm).**	**Targeted Hydraulic Control—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Four New Remediation Wells On-Site, at VLSGC, and at the Manhasset-Lakeville Water District (MLWD) (EW1D, RW300, RW400MM, and RW400BM), Installation of Six New Diffusion Wells at VLSGC and Fresh Meadow Country Club (FMCC) (DW300, DW301, DW400, DW401, DW402, and DW402a), Installation of Two New Treatment Systems at VLSGC (500 gpm) and at MLWD (1,200 gpm).**	**Targeted Hydraulic Control—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Pumping of Purveyor Well N5099 Stopped in Year 1 and Resumed in Year 6, Installation of Four New Remediation Wells On-Site, at VLSGC, and at the Manhasset-Lakeville Water District (MLWD) (EW1D, RW300, RW400MM, and RW400BM), Installation of Six New Diffusion Wells at VLSGC and Fresh Meadow Country Club (FMCC) (DW300, DW301, DW400, DW401, DW402, and DW402a), Installation of Two New Treatment Systems at VLSGC (500 gpm) and at MLWD (1,200 gpm).**	**Modified Hydraulic Containment—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Two New Remediation Wells On-Site and at VLSGC (EW1D and RW300), Installation of Six New Diffusion Wells at VLSGC and South of NSLIJH (DW300, DW301, DW413, DW413a, DW414, and DW414a), Installation of Two New Treatment Systems at VLSGC (500 gpm) and at MLWD N5099 (1,200 gpm).**	**Modified Hydraulic Containment—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Five New Remediation Wells On-Site, at VLSGC, VLSP, and MLWD (EW1D, RW300, RW403, RW400BM, and RW400MM), Installation of Nine New Diffusion Wells at FMCC and South of NSLIJH (DW401-DW406 and DW415-DW417), Installation of Two New Treatment Systems at VLSGC (1,700 gpm) and East of FMCC (1,500 gpm).**	**Hydraulic Containment—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Five New Remediation Wells On-Site and North of Long Island Expressway (LIE) (EW1D and RW501-RW504) and Nine New Diffusion Wells (DW501-DW509) North of LIE, Installation of Two New Treatment Systems in the Northeast Corner of VLSGC (1,300 gpm) and South of NSLIJH (2,000-gpm).**
Remedial Action Objectives (RAOs)									
Protect Public Health and the Environment from Exposure to COCs	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.	Protective of public health and the environment. Achieves public health protection RAO.
Remove COC Mass	Actively removes COC mass throughout OU-2. Removes approximately **31,000** pounds of site-related COCs.	Actively removes COC mass throughout OU-2. Removes approximately **31,000** pounds of site-related COCs.	Actively removes COC mass in the MLWD N5099 capture zone (north of FMCC). Removes approximately **29,000** pounds of site-related COCs.	Actively removes COC mass throughout OU-2. Removes approximately **31,000** pounds of site-related COCs.	Actively removes COC mass in the capture zone of each remediation well throughout OU-2 (north/northwest of Deepdale Golf Club, northeast of VLSGC, and FMCC). Removes approximately **31,000** pounds of site-related COCs.	Actively removes COC mass in the capture zone of each remediation well throughout OU-2 (north/northwest of Deepdale Golf Club, northeast of VLSGC, and FMCC). Removes approximately **31,000** pounds of site-related COCs.	Actively removes COC mass throughout OU-2. Removes approximately **31,000** pounds of site-related COCs.	Actively removes COC mass throughout OU-2. Removes approximately **32,000** pounds of site-related COCs.	Actively removes COC mass throughout OU-2. Removes approximately **32,000** pounds of site-related COCs.
Conformance with Standards, Criteria, and Guidance (SCGs)									
Complies with Chemical-Specific SCGs?	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.	Complies with several chemical-specific SCGs, but not with the CWA and NYSDEC ambient water quality standards.
Complies with Action-Specific SCGs?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Complies with Location-Specific SCGs?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Evaluation Criteria									
Long-Term Effectiveness and Permanence	Will be effective in the long term throughout OU-2. Does not protect downgradient water purveyor well N5099. Other downgradient wells are also expected to be impacted.	Will be effective in the long term throughout OU-2. Does not protect downgradient water purveyor well N5099. Other downgradient wells are also expected to be impacted.	Will be effective in the long term throughout OU-2. Does not protect downgradient water purveyor well N5099. Other downgradient wells are also expected to be impacted.	Will be effective in the long term throughout OU-2. Does not protect downgradient water purveyor well N5099. Other downgradient wells are also expected to be impacted.	Will be effective in the long term in the expanded RW300, RW400MM, and RW400BM capture zone, but may not comply with the groundwater quality RAO. Reduces further impacts to nearest downgradient water purveyor well N5099. Other downgradient wells are expected to be impacted.	Will be effective in the long term in the expanded RW300, RW400MM, and RW400BM capture zone, but may not comply with the groundwater quality RAO. Protects downgradient water purveyor well N5099. Other downgradient wells are expected to be impacted.	Will be effective in the long term throughout OU-2. Does not protect downgradient water purveyor well N5099. Other downgradient wells are also expected to be impacted.	Will be effective in the long term throughout OU-2 and is protective of WAGNN well N12796. Will be effective in reducing downgradient impacts to public supply wells.	Will be effective in the long term throughout OU-2 and is protective of N5099 and WAGNN wells N4388 and N12796; however, other downgradient wells are expected to be impacted.
Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment	Will not actively reduce toxicity or mobility, but reduces volume of impacted groundwater throughout OU-2.	Will not actively reduce toxicity or mobility, but reduces volume of impacted groundwater throughout OU-2.	Will not actively reduce toxicity or mobility, but reduces volume of impacted groundwater throughout OU-2.	Will not actively reduce toxicity or mobility, but reduces volume of impacted groundwater throughout OU-2.	Will not actively reduce toxicity or mobility, but reduces volume of impacted groundwater throughout OU-2.	Will not actively reduce toxicity or mobility, but reduces volume of impacted groundwater throughout OU-2.	Will not actively reduce toxicity or mobility, but reduces volume of impacted groundwater throughout OU-2.	Will not actively reduce toxicity or mobility, but reduces volume of impacted groundwater throughout OU-2.	Will not actively reduce toxicity or mobility, but reduces volume of impacted groundwater throughout OU-2.
Short-Term Impact and Effectiveness	Will be effective in the short term with **high** impact to the public, the workers, and the environment. Installing new infrastructure will impact the public more than RAA-4b. Will meet RAOs in approximately 19 years, more than 30 years, and approximately 25 years for the golf course, remedial, and public supply wells, respectively.	Will be effective in the short term with **high** impact to the public, the workers, and the environment. Installing new infrastructure will impact the public more than RAA-4b. Will meet RAOs in approximately 16 years for the golf course wells and approximately 25 years for the remedial and public supply wells.	Will be effective in the short term with **high** impact to the public, the workers, and the environment. Installing new infrastructure will impact the public more than RAA-4b. Will meet RAOs in approximately 18 years, approximately 19 years, and approximately 25 years for the golf course, remedial, and public supply wells, respectively.	Will be effective in the short term with **high** impact to the public, the workers, and the environment. Installing new infrastructure will impact the public more than RAA-4b. Will meet RAOs in approximately 19 years, approximately 30 years, and approximately 25 years for the golf course, remedial, and public supply wells, respectively.	Will be effective in the short term with **high** impact to the public, the workers, and the environment. Installing new infrastructure will impact the public more than RAA-4b. Will meet RAOs in approximately 22 years, approximately 28 years, and approximately 27 years for the golf course, remedial, and public supply wells, respectively.	Will be effective in the short term with **high** impact to the public, the workers, and the environment. Installing new infrastructure will impact the public more than RAA-4b. Will meet RAOs in approximately 22 years, approximately 28 years, and approximately 27 years for the golf course, remedial, and public supply wells, respectively.	Will be effective in the short term with **high** impact to the public, the workers, and the environment. Installing new infrastructure will impact the public more than RAA-4b. Will meet RAOs in approximately 20 years, more than 30 years, and approximately 25 years for the golf course, remedial, and public supply wells, respectively.	Will be effective in the short term with **high** impact to the public, the workers, and the environment. Installing new infrastructure, including a pipeline that crosses the LIE, will impact the public more than all RAA-4 alternatives. Will meet RAOs in approximately 17 years, approximately 28 years, and approximately 7 years for the golf course, remedial, and public supply wells, respectively.	Will be effective in the short term with **high** impact to the public, the workers, and the environment. Installing new infrastructure, including a pipeline that crosses the LIE, will impact the public more than RAA-5a. Will meet RAOs in approximately 16 years, approximately 26 years, and approximately 7 years for the golf course, remedial, and public supply wells, respectively.

Table 1
Detailed Evaluation of Remedial Action Alternatives
Feasibility Study Addendum, Operable Unit 2
Former Unisys Facility, Great Neck, New York

Criteria \ Alternatives	RAA-4e	RAA-4f	RAA-4g	RAA-4h	RAA-4i	RAA-4j	RAA-4k	RAA-5a	RAA-5b
	Minimized Impact to Public Supply Wells—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Four New Remediation Wells On-Site, at VLSGC, and at NSLIJH (EW1D, RW300, RW400MM, and RW400MM), Installation of Six New Diffusion Wells at VLSGC and South of NSLIJH (DW300, DW301, DW404, DW404a, DW405, and DW405a), Installation of Two New 800-gpm Treatment Systems at NSLIJH and VLSGC.	**Minimized Impact to Public Supply Wells—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Two New Remediation Wells On-Site and at KC (EW1D and RW404), Installation of Four New Diffusion Wells North and South of NSLIJH (DW404, DW405, DW409, and DW410), Installation of a New 1,600-gpm Treatment System at KC.**	**Targeted Hydraulic Control—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of One New Remediation Well On-Site (EW1D), Installation of Four New Diffusion Wells North and South of NSLIJH (DW411-DW414), Installation of a New 1,200-gpm Treatment System at MLWD N5099.**	**Modified Hydraulic Containment—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Two New Remediation Wells On-Site and at VLSGC (EW1D and RW300), Installation of Six New Diffusion Wells at VLSGC and North and South of NSLIJH (DW300, DW301, and DW411-DW-414), Installation of Two New Treatment Systems at VLSGC (500 gpm) and at MLWD N5099 (1,200 gpm).**	**Targeted Hydraulic Control—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Four New Remediation Wells On-Site, at VLSGC, and at the Manhasset-Lakeville Water District (MLWD) (EW1D, RW300, RW400MM, and RW400BM), Installation of Six New Diffusion Wells at VLSGC and Fresh Meadow Country Club (FMCC) (DW300, DW301, DW400, DW401, DW402, and DW402a), Installation of Two New Treatment Systems at VLSGC (500 gpm) and at MLWD (1,200 gpm).**	**Targeted Hydraulic Control—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Pumping of Purveyor Well N5099 Stopped in Year 1 and Resumed in Year 6, Installation of Four New Remediation Wells On-Site, at VLSGC, and at the Manhasset-Lakeville Water District (MLWD) (EW1D, RW300, RW400MM, and RW400BM), Installation of Six New Diffusion Wells at VLSGC and Fresh Meadow Country Club (FMCC) (DW300, DW301, DW400, DW401, DW402, and DW402a), Installation of Two New Treatment Systems at VLSGC (500 gpm) and at MLWD (1,200 gpm).**	**Modified Hydraulic Containment—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Two New Remediation Wells On-Site and at VLSGC (EW1D and RW300), Installation of Six New Diffusion Wells at VLSGC and South of NSLIJH (DW300, DW301, DW413, DW413a, DW414, and DW414a), Installation of Two New Treatment Systems at VLSGC (500 gpm) and at MLWD N5099 (1,200 gpm).**	**Modified Hydraulic Containment—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Five New Remediation Wells On-Site, at VLSGC, VLSP, and MLWD (EW1D, RW300, RW403, RW400BM, and RW400MM), Installation of Nine New Diffusion Wells at FMCC and South of NSLIJH (DW401-DW406 and DW415-DW417), Installation of Two New Treatment Systems at VLSGC (1,700 gpm) and East of FMCC (1,500 gpm).**	**Hydraulic Containment—Institutional Controls, Operation of the OU-1 and OU-2 Treatment Systems, Installation of Five New Remediation Wells On-Site and North of Long Island Expressway (LIE) (EW1D and RW501-RW504) and Nine New Diffusion Wells (DW501-DW509) North of LIE, Installation of Two New Treatment Systems in the Northeast Corner of VLSGC (1,300 gpm) and South of NSLIJH (2,000-gpm).**
Implementability	Less implementable than RAA-4b; overall implementability score is **7**. A technical implementability score of 3 was given to this RAA. Although RAA-4e includes the installation of two new treatment systems, new remediation wells, and new diffusion wells at VLSGC and NSLIJH, both stakeholders have indicated willingness to negotiate access to install remediation infrastructure. Therefore, an administrative implementability score of 4 was assigned to RAA-4e.	Less implementable than RAA-4b; overall implementability score is **9**. A technical implementability score of 3 was given to this RAA. Installing this RAA's components will require obtaining access agreements from numerous stakeholders, including NSLIJH, KC, Nassau County, Hebrew Academy, MLWD, VLS, and the NYSDOT. To date, only VLS and NSLIJH have agreed to negotiate access to their properties. Consequently, an administrative implementability score of 6 was assigned to this RAA.	Less implementable than RAA-4b; overall implementability score is 9. A technical implementability score of 3 was given to this RAA. Implementing this RAA will require obtaining access agreements from NSLIJH, Nassau County, NYSDOT, and MLWD for the installation of a new treatment system at MLWD N5099 and diffusion wells north and south of NSLIJH. To date, only NSLIJH has agreed to negotiate access to install remediation infrastructure. Accordingly, an administrative implementability score of 6 was given to RAA-4g.	Less implementable than RAA-4b; overall implementability score is 9. A technical implementability score of 3 was given to this RAA. Implementing this RAA will require obtaining access agreements from NSLIJH, Nassau County, VLS, NYSDOT, MLWD, and commercial properties for the installation of new treatment systems at MLWD N5099 and VLSGC and diffusion wells at VLSGC and north and south of NSLIJH. To date, only VLS and NSLIJH have agreed to negotiate access to install remediation infrastructure. Accordingly, an administrative implementability score of 6 was given to RAA-4h.	Less implementable than RAA-4b; overall implementability score is **12**. IRM and wellhead treatment systems are already constructed and operational; however, new treatment systems, new remediation wells, new diffusion wells, and associated infrastructure are proposed. Accordingly, this RAA was given a technical implementability score of 3. Access agreements will be needed for the installation of the components of this RAA. FMCC declined to provide access to install remediation infrastructure; therefore, an administrative implementability score of 9 was given to RAA-4i.	Less implementable than RAA-4b; overall implementability score is **12**. IRM and wellhead treatment systems are already constructed and operational; however, new treatment systems, new remediation wells, new diffusion wells, and associated infrastructure are proposed. Accordingly, this RAA was given a technical implementability score of 3. Access agreements will be needed for the installation of the components of this RAA. FMCC declined to provide access to install remediation infrastructure; therefore, an administrative implementability score of 9 was given to RAA-4j.	Less implementable than RAA-4b; overall implementability score is **9**. A technical implementability score of 3 was given to this RAA. Implementing this RAA will require obtaining access agreements from NSLIJH, Nassau County, VLS, NYSDOT, and MLWD for the installation of new treatment systems at MLWD N5099 and VLSGC and diffusion wells at VLSGC and south of NSLIJH. To date, only VLS and NSLIJH have agreed to negotiate access to install remediation infrastructure. Accordingly, an administrative implementability score of 6 was given to RAA-4k.	Less implementable than all RAA-4 alternatives; overall implementability score is **12**. A technical implementability score of 3 was given to this RAA. RAA-5a may not be implementable because proposed pipelines will cross Lakeville Road, the LIE, and Community Drive, which will require obtaining access agreements from numerous stakeholders; including Nassau County and NYSDOT. Access agreements will also be required to install the new treatment systems, remediation wells, diffusion wells, and associated infrastructure at NSLIJH, FMCC, MLWD, VLSP, and VLSGC. As a result, RAA-5a was given an administrative implementability score of 9.	Not implementable; overall implementability score is **14**, the highest of all RAAs. A technical implementability score of 4 was given to this RAA. The implementation of RAA-5b will require obtaining access agreements from numerous stakeholders; including VLSGC, NSLIJH, KC, and residential neighborhoods. The difficulty of obtaining access agreements from area neighborhoods is the main reason that RAA-5b is not implementable since residents have showed significant reluctance to allow the installation of treatment systems and pipelines. Additionally, pipelines will cross Lakeville Road, the LIE, and Community Drive, which will require obtaining access agreements from Nassau County and NYSDOT. RAA-5b was given the highest administrative implementability score, i.e., most difficult to implement, of 10.
Consistency with Green Remediation Principles	Ten new remediation and diffusion wells and two new treatment systems to be installed on-site and at VLSGC and NSLIJH. Low water impacts because of subsurface re-injection of treated groundwater; moderate material use and waste generation and associated impacts from transportation of treatment materials on- and off-site as part of routine VPGAC changeouts; low air emissions by using local suppliers for construction materials and utilizing trucks and heavy machinery that run on biofuels to haul construction and treatment materials and wastes; minimal effect on land use because all piping will be installed underground and treatment systems will be installed on a golf course or in a parking lot; minimal energy requirements and health and safety concerns.	Six new remediation and diffusion wells and one new treatment system to be installed on-site and at KC. Low water impacts because of subsurface re-injection of treated groundwater; moderate material use and waste generation and associated impacts from transportation of treatment materials on- and off-site as part of routine VPGAC changeouts; low air emissions by using local suppliers for construction materials and utilizing trucks and heavy machinery that run on biofuels to haul construction and treatment materials and wastes; minimal effect on land use because all piping will be installed underground and the treatment system will be installed in a parking lot; minimal energy requirements and health and safety concerns.	Five new remediation and diffusion wells and one new treatment system to be installed on-site and at MLWD N5099 north of FMCC. Low water impacts because of subsurface re-injection of treated groundwater; moderate material use and waste generation and associated impacts from transportation of treatment materials on- and off-site as part of routine VPGAC changeouts; low air emissions by using local suppliers for construction materials and utilizing trucks and heavy machinery that run on biofuels to haul construction and treatment materials and wastes; minimal effect on land use because all piping will be installed underground and the treatment system will be installed adjacent to a golf course; minimal energy requirements and health and safety concerns.	Eight new remediation and diffusion wells and two new treatment systems to be installed on-site and at VLSGC and MLWD N5099. Low water impacts because of subsurface re-injection of treated groundwater; moderate material use and waste generation and associated impacts from transportation of treatment materials on- and off-site as part of routine VPGAC changeouts; low air emissions by using local suppliers for construction materials and utilizing trucks and heavy machinery that run on biofuels to haul construction and treatment materials and wastes; minimal effect on land use because all piping will be installed underground and treatment systems will be installed at or adjacent to a golf course; minimal energy requirements and health and safety concerns.	Ten new remediation and diffusion wells and two new treatment systems to be installed on-site, at VLSGC, and adjacent to FMCC. Low water impacts because of subsurface re-injection of treated groundwater; moderate material use and waste generation, and associated impacts from transportation of treatment materials on- and off-site as part of routine VPGAC changeouts; low air emissions by using local suppliers for construction materials and utilizing trucks and heavy machinery that run on biofuels to haul construction and treatment materials and wastes; minimal effect on land use because all piping will be installed underground and the treatment systems will be installed at or adjacent to a golf course; minimal energy requirements and health and safety concerns.	Ten new remediation and diffusion wells and two new treatment systems to be installed on-site, at VLSGC, and adjacent to FMCC. Low water impacts because of subsurface re-injection of treated groundwater; moderate material use and waste generation, and associated impacts from transportation of treatment materials on- and off-site as part of routine VPGAC changeouts; low air emissions by using local suppliers for construction materials and utilizing trucks and heavy machinery that run on biofuels to haul construction and treatment materials and wastes; minimal effect on land use because all piping will be installed underground and the treatment systems will be installed at or adjacent to a golf course; minimal energy requirements and health and safety concerns.	Eight new remediation and diffusion wells and two new treatment systems to be installed on-site and at VLSGC and MLWD N5099. Low water impacts because of subsurface re-injection of treated groundwater; moderate material use and waste generation and associated impacts from transportation of treatment materials on- and off-site as part of routine VPGAC changeouts; low air emissions by using local suppliers for construction materials and utilizing trucks and heavy machinery that run on biofuels to haul construction and treatment materials and wastes; minimal effect on land use because all piping will be installed underground and the treatment systems will be installed at or adjacent to a golf course; minimal energy requirements and health and safety concerns.	Fourteen new remediation and diffusion wells and two new treatment systems to be installed on-site and at VLSGC, VLSP, MLWD, NSLIJH, and FMCC. Low water impacts because of subsurface re-injection of treated groundwater; moderate material use and waste generation and associated impacts from transportation of treatment materials on- and off-site as part of routine VPGAC changeouts; low air emissions by using local suppliers for construction materials and utilizing trucks and heavy machinery that run on biofuels to haul construction and treatment materials and wastes; minimal effect on land use because all piping will be installed underground and treatment systems will be installed at golf courses; minimal energy requirements and health and safety concerns.	Fourteen new remediation and diffusion wells and two new treatment systems to be installed on-site and at VLSGC, NSLIJH, and several residential neighborhoods. Low water impacts because of subsurface re-injection of treated groundwater; moderate material use and waste generation and associated impacts from transportation of treatment materials on- and off-site as part of routine VPGAC changeouts; low air emissions by using local suppliers for construction materials and utilizing trucks and heavy machinery that run on biofuels to haul construction and treatment materials and wastes; minimal effect on land use because all piping will be installed underground and treatment systems will be installed at or adjacent to golf courses; minimal energy requirements and health and safety concerns.
Costs									
Cost Effectiveness	**$80,000,000**	**$64,000,000**	**$66,000,000**	**$91,000,000**	**$85,000,000**	**$83,000,000**	**$89,000,000**	**$102,000,000**	**$97,000,000**

Notes:

COC - Contaminant of concern.
CWA - Clean Water Act.
FMCC - Fresh Meadow Country Club
IRM - Interim remedial measure.
KC - Korean Church
LIE - Long Island Expressway.
MLWD - Manhasset-Lakeville Water District
NSP - North Shore Parkway
NSLIJH - North Shore Long Island Jewish Hospital
NYSDEC - New York State Department of Environmental Conservation.
NYSDOT - New York State Department of Transportation
OU - Operable Unit.
RAO - Remedial action objective.
SCG - Standards, Criteria, and Guidance.
VLSGC - Village of Lake Success Golf Course
VLS - Village of Lake Success
VLSP - Village of Lake Success Park
VPGAC - Vapor-phase granular activated carbon
WAGNN - Water Authority of Great Neck North.

Table 2
Technical and Administrative Implementability Evaluation of Remedial Action Alternatives
Feasibility Study, Operable Unit 2
Former Unisys Facility, Great Neck, New York

FS Scenario	Description	New Remedial System Flow Rate (gpm)[3]	Remedial Action Objectives				Prevents/Minimizes Impacts to Purveyor Wells[1]				Access Status					Costs			
							Year of Impact (Duration of Impact [years])[2]									NPV			NPV/lb
			Achieve SCGs (Y/N)	Mass Removal via Remedial Wells (lbs)	Mass Removal via Remedial, Supply, and Golf Course Wells (lbs)	Significant Reduction to Purveyor Well Impacts[4] (Y/N)	MLWD N5099	WAGNN Wells 12999,13000, and 13821 (13000b)	WAGNN 12796	WAGNN 4388	Implementability[5]	Access Required[6]	Number of Additional Treatment Systems	Number of Remediation Wells	Number of Diffusion Wells	Capital	O&M	Total	$/lb
RAA-1	**OU-1 Only**	**0**	**N**	**5,600**	**29,200**	**N**	**2016 (25)**	**2011 (30)**	**2035 (4)**	**2028 (13)**	**4**	**None**	**None**	**None**	**None**	**$ 5,100,000**	**$ 3,500,000**	**$ 8,600,000**	**$ 300**
RAA-2a	**OU-1 and OU-2**	**0**	**N**	**10,200**	**29,300**	**N**	**2016 (25)**	**2011 (30)**	**2035 (4)**	**2028 (12)**	**4**	**Review and update existing agreements**	**None**	**None**	**None**	**$ 8,600,000**	**$ 23,000,000**	**$ 32,000,000**	**$ 1,100**
RAA-2b	**OU-1,OU-2, Additional Deep Well at OU-1**	**120**	**N**	**11,700**	**29,600**	**N**	**2016 (25)**	**2011 (30)**	**2037 (4)**	**2029 (12)**	**5**	**Review and update existing agreements (GN School, NYSDOT, MLWD)**	**None**	**1**	**None**	**$ 9,800,000**	**$ 28,000,000**	**$ 38,000,000**	**$ 1,300**
RAA-2c	**OU-1,OU-2, Additional Deep Well at OU-1, Extraction at N5099 at 1,200 gpm**	**1,320**	**N**	**11,600**	**30,800**	**N**	**2013 (26)**	**2011 (30)**	**2039 (1)**	**2031 (7)**	**5**	**Review and update existing agreements (GN School, NYSDOT, MLWD)**	**1**	**1**	**None**	**$ 14,000,000**	**$ 25,000,000**	**$ 39,000,000**	**$ 1,300**
RAA-3a	**OU-1, OU-2, Additional Deep Well at OU-1, Extraction at VLSGC, and Diffusion at OU-2**	**620**	**N**	**19,800**	**30,600**	**N**	**2016 (25)**	**2011 (28)**	**2038 (3)**	**2030 (11)**	**10**	**County, VLSGC, GN School, NYSDOT**	**None**	**2**	**2**	**$ 14,000,000**	**$ 28,000,000**	**$ 42,000,000**	**$ 1,400**
RAA-3b	**OU-1, OU-2, Additional Deep Well at OU-1, Extraction and Diffusion at VLSGC**	**620**	**N**	**18,300**	**30,900**	**N**	**2016 (25)**	**2011 (30)**	**2033 (8)**	**2028 (13)**	**6**	**VLSGC**	**1**	**2**	**2**	**$ 20,000,000**	**$ 35,000,000**	**$ 55,000,000**	**$ 1,800**
RAA-4a	OU-1, OU-2, Additional Deep Well at OU-1, Extraction at MLWD, and Diffusion at FMCC	1,320	N	25,300	30,100	N	2016 (1)	2011 (25)	2032 (9)	2027 (14)	12	*FMCC* , **MLWD**, NYSDOT	1	3	4	$ 23,000,000	$ 42,000,000	$ 65,000,000	$ 2,200
RAA-4b	OU-1, OU-2, Additional Deep Well at OU-1, Extraction and Diffusion at NSLIJH South	1,120	N	25,000	30,300	N	2016 (25)	2011 (7)	2038 (3)	2029 (12)	7	**NSLIJH**	1	3	4	$ 23,000,000	$ 38,000,000	$ 61,000,000	$ 2,000
RAA-4c	OU-1, OU-2, Additional Deep Well at OU-1, Extraction at VLSGC and MLWD South, and Diffusion at MLWD and NSLIJH South	1,720	N	26,900	30,900	N	2016 (25)	2011 (8)	2039 (2)	2029 (12)	11	**VLSGC**, NYSDOT, County, **NSLIJH**, **MLWD**	1	3	4	$ 27,000,000	$ 42,000,000	$ 69,000,000	$ 2,200
RAA-4d	OU-1, OU-2, Additional Deep Well at OU-1, Extraction at MLWD, VLSP, and Korean Church, and Diffusion at NSLIJH North and South	3,120	N	29,900	31,600	Y	2016 (5)	2011 (7)	Not Impacted	Not Impacted	11	**VLSGC**, NYSDOT, County, **NSLIJH**, **MLWD**, Korean Church, Hebrew Academy	1	5	8	$ 35,000,000	$ 54,000,000	$ 89,000,000	$ 2,800
RAA-4e	OU-1, OU-2, Additional Deep Well at OU-1, Extraction at VLSGC and NSLIJH, and Diffusion at VLSGC and NSLIJH South	1,720	N	27,300	31,200	N	2016 (25)	2011 (7)	2033 (8)	2028 (13)	7	**VLSGC, NSLIJH**	2	4	6	$ 31,000,000	$ 49,000,000	$ 80,000,000	$ 2,600
RAA-4f	OU-1, OU-2, Additional Deep Well at OU-1, Extraction at Korean Church, and Diffusion at NSLIJH North and South	1,720	N	27,700	31,100	N	2016 (25)	2011 (8)	2040 (1)	2030 (11)	9	NYSDOT, County, **NSLIJH,** Korean Church, Hebrew Academy	1	2	4	$ 23,000,000	$ 41,000,000	$ 64,000,000	$ 2,100
RAA-4g	OU-1, OU-2, Additional Deep Well at OU-1, Extraction at N5099, and Diffusion at Macy's Parking Lot and NSLIJH South	1,320	N	26,400	29,000	N	2016 (25)	2011 (12)	2035 (6)	2028 (13)	9	NYSDOT, County, **NSLIJH**	2	2	4	$ 22,000,000	$ 44,000,000	$ 66,000,000	$ 2,300
RAA-4h	OU-1, OU-2, Additional Deep Well at OU-1, Extraction at N5099, and Diffusion at Macy's Parking Lot and NSLIJH South, VLSGC - Pump, Treat, and Diffuse at 500 gpm	1,820	N	28,400	30,800	N	2016 (25)	2011 (10)	2032 (9)	2027 (14)	9	NYSDOT, County, **NSLIJH,** Commercial Property, VLSGC	3	3	6	$ 35,000,000	$ 56,000,000	$ 91,000,000	$ 3,000

Table 2
Technical and Administrative Implementability Evaluation of Remedial Action Alternatives
Feasibility Study, Operable Unit 2
Former Unisys Facility, Great Neck, New York

FS Scenario	Description	New Remedial System Flow Rate (gpm)[3]	Remedial Action Objectives				Prevents/Minimizes Impacts to Purveyor Wells[1]				Access Status					Costs			
							Year of Impact (Duration of Impact [years])[2]									NPV			NPV/lb
			Achieve SCGs (Y/N)	Mass Removal via Remedial Wells (lbs)	Mass Removal via Remedial, Supply, and Golf Course Wells (lbs)	Significant Reduction to Purveyor Well Impacts[4] (Y/N)	MLWD N5099	WAGNN Wells 12999,13000, and 13821 (13000b)	WAGNN 12796	WAGNN 4388	Implementability[5]	Access Required[6]	Number of Additional Treatment Systems	Number of Remediation Wells	Number of Diffusion Wells	Capital	O&M	Total	$/lb
RAA-4i	OU-1, OU-2, Additional Deep Well at OU-1, Extraction and Diffusion at VLSGC, Extraction at MLWD and Diffusion at FMCC	1,820	N	27,200	31,000	N	2016 (1)	2011 (19)	2032 (9)	2027 (14)	12	*FMCC*, **MLWD**, NYSDOT, **VLSGC**	2	4	6	$ 32,000,000	$ 53,000,000	$ 85,000,000	$ 2,700
RAA-4j	OU-1, OU-2, Additional Deep Well at OU-1, Extraction and Diffusion at VLSGC, Extraction at MLWD and Diffusion at FMCC	1,820	N	27,200	31,000	N	Not Impacted	2011 (19)	2031 (10)	2027 (14)	12	*FMCC*, **MLWD**, NYSDOT, **VLSGC**	2	4	6	$ 31,000,000	$ 52,000,000	$ 83,000,000	$ 2,700
RAA-4k	OU-1, OU-2, Additional Deep Well at OU-1, Extraction and Diffusion at VLSGC, Extraction at N5099 and Diffusion at NSLIJ South	1,820	N	28,700	31,000	N	2016 (25)	2011 (9)	2033 (8)	2028 (13)	9	NYSDOT, **MLWD**, County, **NSLIJH, VLSGC**	2	2	6	$ 35,000,000	$ 54,000,000	$ 89,000,000	$ 2,900
RAA-5a	OU-1, OU-2, Additional Deep Well at OU-1, Extraction at VLSGC, VLSP, and MLWD, and Diffusion at FMCC and NSLIJH South	3,320	N	30,500	32,100	Y	2016 (1)	2011 (6)	Not Impacted	2034 (7)	12	**VLSGC**, NYSDOT, County, *FMCC*, **NSLIJH, MLWD**	2	5	9	$ 42,000,000	$ 60,000,000	$ 102,000,000	$ 3,200
RAA-5b	OU-1, OU-2, Additional Deep Well at OU-1, and Extraction and Diffusion at NSLIJH South, FMCC, and Residential Area North of LIE	3,420	N	30,900	32,400	Y	Not Impacted	2011 (7)	Not Impacted	Not Impacted	14	**MLWD**, County, NYSDOT, *FMCC*, and extensive neighborhood access	2	5	9	$ 34,000,000	$ 63,000,000	$ 97,000,000	$ 3,000

Abbreviations:

FMCC - Fresh Meadow Country Club
FS - Feasibility Study
gpm - gallons per minute
lb - Pound
LIE - Long Island Expressway
µg/L - Micrograms per liter
MLWD - Manhasset Lakeville Water District
N - No
NPV - Net Present Value (include purveyor well costs)
NYSDEC - New York State Department of Environmental Conservation
NYSDOT - New York State Department of Transportation
NSLIJH - North Shore Long Island Jewish Health System
OU-1 - Operable Unit 1
OU-2 - Operable Unit 2
SCGs - Standards, Criteria, and Guidelines
TVOC - Total Volatile Organic Carbon
VLS - Village of Lake Success
VLSGC - Village of Lake Success Golf Course
VLSP - Village of Lake Success Park
WAGNN - Water Authority of Great Neck North
County - Nassau County
WAWNC - Water Authority of Western Nassau County
Y - Yes

Notes:

[1] - IU Willet well is not impacted, WAWNC Well N7445 is not impacted.

[2] - Impact defined as TVOC concentration greater than 5 µg/L based on 30-year analysis. Duration of impact includes the first year of impact.

[3] - The OU-1 treatment system flow rate is currently 730 gpm, and the OU-2 treatment system flow rate is 500 gpm.

[4] - Reduces Duration of Impact to N12999, N13000, N13000b, and N5099 wells by 10 or more years

[5] - The implementability score is the sum of an Administrative Implementability score (1 to 10) and a Technical Implementability Score (1 to 4) that was determined from the following scales:

Administrative Implementability

1	No new access agreements needed
2	Updating existing access agreements
3	New monitoring access agreements
4	Access anticipated for all components with major stakeholders
5	Access anticipated for major components with major stakeholders, public right-of-way and community acceptance, minor construction disruption
6	Access anticipated for some major components, public right-of-way and community acceptance, major construction disruption
7	Unknown access for major components - public right-of-way and community acceptance, minor construction disruption
8	Unknown access for major components - public right-of-way and community acceptance, major construction disruption
9	Access denied for major components - public right-of-way and community acceptance, major construction disruption
10	No known mechanism for gaining access - significant major equipment in residential areas, multiple stakeholders and major disruptions

Technical Implementability

1	Implementable
2	Potentially Implementable
3	Difficult to Implement
4	Not Implementable

The lower the aggregate number, the more implementable the alternative is.
Yellow highlight indicates that the RAA is implementable.

[6] - Current status of property access for each entity is denoted as follows:

Bold - Written notice of intent to negotiate access.
Italics - Verbal notice of denial for installation of any or all parts of treatment system.
Underline - Verbal commitment from NYSDEC for public right-of-way access (NYSDOT).

Table 3
Time to Achieve Total Volatile Organic Compound Concentration of Less than 5 µg/L
Feasibility Study Addendum, Operable Unit 2
Former Unisys Facility, Great Neck, New York

Feasibility Study Scenario Category	Year Well is Impacted by Simulated TVOC Plume >5 µg/L		Year Simulated TVOC Concentrations Decrease <5 µg/L	
	Water Supply Wells	Golf Course Wells	Water Supply Wells	Golf Course Wells
RAA-1	2010	2010	>30	16
RAA-2a	2010	2010	>30	17
RAA-2b	2010	2010	>30	18
RAA-2c	2010	2010	>30	19
RAA-3a	2010	2010	28	19
RAA-3b	2010	2010	>30	20
RAA-4a	2010	2010	25	16
RAA-4b	2010	2010	25	17
RAA-4c	2010	2010	25	16
RAA-4d	2010	2010	7	15
RAA-4e	2010	2010	25	19
RAA-4f	2010	2010	25	16
RAA-4g	2010	2010	25	18
RAA-4h	2010	2010	25	19
RAA-4i	2010	2010	27	22
RAA-4j	2010	2010	27	22
RAA-4k	2010	2010	25	20
RAA-5a	2010	2010	7	17
RAA-5b	2010	2010	7	16

Notes:

µg/L - Micrograms per liter

TVOC - Total volatile organic compounds

Table 4
Remedial Action Alternatives Cost Estimate Summary
Feasibility Study Addendum, Operable Unit 2
Lockheed Martin Corporation, Great Neck, New York

Alternative	Capital	Operation and Maintenance	Total
	30-Year Net Present Value Cost		
RAA-1	$ 5,100,000	$ 3,500,000	$ 8,600,000
RAA-2a	$ 8,600,000	$ 23,000,000	$ 32,000,000
RAA-2b	$ 9,800,000	$ 28,000,000	$ 38,000,000
RAA-2c	$ 14,000,000	$ 25,000,000	$ 39,000,000
RAA-3a	$ 14,000,000	$ 28,000,000	$ 42,000,000
RAA-3b	$ 20,000,000	$ 35,000,000	$ 55,000,000
RAA-4a	$ 23,000,000	$ 40,000,000	$ 63,000,000
RAA-4b	$ 23,000,000	$ 37,000,000	$ 60,000,000
RAA-4c	$ 27,000,000	$ 42,000,000	$ 69,000,000
RAA-4d	$ 35,000,000	$ 54,000,000	$ 89,000,000
RAA-4e	$ 31,000,000	$ 49,000,000	$ 80,000,000
RAA-4f	$ 23,000,000	$ 41,000,000	$ 64,000,000
RAA-4g	$ 22,000,000	$ 44,000,000	$ 66,000,000
RAA-4h	$ 35,000,000	$ 54,000,000	$ 89,000,000
RAA-4i	**$ 32,000,000**	**$ 53,000,000**	**$ 85,000,000**
RAA-4j	**$ 31,000,000**	**$ 52,000,000**	**$ 83,000,000**
RAA-4k	**$ 35,000,000**	**$ 54,000,000**	**$ 89,000,000**
RAA-5a	$ 42,000,000	$ 60,000,000	$ 102,000,000
RAA-5b	$ 34,000,000	$ 63,000,000	$ 97,000,000

Note:
Costs are escalated at 3.5% and discounted at 8%.

Table 5
Volume of Affected Groundwater and Residual COC Mass After 30 Years of Remediation
Feasibility Study Addendum, Operable Unit 2
Lockheed Martin Corporation, Great Neck, New York

Scenario Name	Initial Volume of Affected Groundwater (Acre-Feet) [1]	Volume of Affected Groundwater After 30 Years of Remediation (Acre-Feet) [2]	Volume Reduction After 30 Years or Remediation (%)	Initial Off-Site COC Mass (Pounds)	Initial On-Site COC Mass (Pounds)	Total COC Mass Removed by Remedial, Supply, and Golf Course Wells (Pounds)	Total Estimated Residual On Site and Off-Site COC Mass After 30 Years of Remediation (Pounds)
1	73,700	36,200	51%	26,000	7,000	29,200	3,800
2a	73,700	31,900	57%	26,000	7,000	29,300	3,700
2b	73,700	30,400	59%	26,000	7,000	29,600	3,400
2c	73,700	22,400	70%	26,000	7,000	30,800	2,200
3a	73,700	23,900	68%	26,000	7,000	30,600	2,400
3b	73,700	23,900	68%	26,000	7,000	30,900	2,100
4a	73,700	25,500	65%	26,000	7,000	30,100	2,900
4b	73,700	25,500	65%	26,000	7,000	30,300	2,700
4c	73,700	19,000	74%	26,000	7,000	30,900	2,100
4d	73,700	12,300	83%	26,000	7,000	31,600	1,400
4e	73,700	17,800	76%	26,000	7,000	31,200	1,800
4f	73,700	16,900	77%	26,000	7,000	31,100	1,900
4g	73,700	31,300	58%	26,000	7,000	29,000	4,000
4h	73,700	21,500	71%	26,000	7,000	30,800	2,200
4i	73,700	20,900	72%	26,000	7,000	31,000	2,000
4j	73,700	20,600	72%	26,000	7,000	31,000	2,000
4k	73,700	21,500	71%	26,000	7,000	31,000	2,000
5a	73,700	6,400	91%	26,000	7,000	32,100	900
5b	73,700	4,000	95%	26,000	7,000	32,400	600

Notes:

[1] - Represents volume of affected groundwater with total volatile organic compound concentration greater than 5 µg/L.

Figures

NOTE

1. THE FOLLOWING ON-SITE EXTRACTION AND RECOVERY WELLS WITHDRAW FROM THE INDICATED AQUIFERS:
   - UPPER GLACIAL AND UPPER PORTION OF THE MAGOTHY - RW1RS
   - UPPER AND MIDDLE PORTION OF THE MAGOTHY - RW1RD
   - UPPER PORTION OF THE MAGOTHY - EW1
   - UPPER AND MIDDLE PORTION OF THE MAGOTHY - RW100

LEGEND:

- BODY OF WATER
- SITE EXTRACTION AND RECOVERY WELLS
- REMEDIATION SYSTEM DIFFUSION WELL
- MUNICIPAL SUPPLY WELL
- NON-MUNICIPAL SUPPLY WELL
- NON-MUNICIPAL IRRIGATION WELL
- NON-MUNICIPAL DIFFUSION WELL
- LLOYD AQUIFER MUNICIPAL SUPPLY WELL
- LLOYD AQUIFER NON-MUNICIPAL SUPPLY WELL
- LLOYD AQUIFER NON-MUNICIPAL DIFFUSION WELL
- EXISTING OU-1 TREATMENT SYSTEM AREA AND COMPOUND LOCATION

0 1600' 3200'

SCALE IN FEET

LOCKHEED MARTIN CORPORATION
FORMER UNISYS FACILITY
FEASIBILITY STUDY ADDENDUM

SITE LAYOUT MAP

ARCADIS

FIGURE
1

CTTY:(Reqd) DIV/GROUP:(Reqd) DB:(Reqd) LD:(Opt) PIC:(Opt) PW:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
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XREFS:
Xref 2.5mile
PROJECTNAME: ----

NOTE

1. THE FOLLOWING ON-SITE EXTRACTION AND RECOVERY WELLS WITHDRAW FROM THE INDICATED AQUIFERS:
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   UPPER AND MIDDLE PORTION OF THE MAGOTHY - RW100

LEGEND:

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- PROPOSED DIFFUSION WELL
- PROPOSED RECOVERY WELL
- EXISTING IRM TREATMENT SYSTEM AND COMPOUND
- NEW TREATMENT SYSTEM AND COMPOUND
- EXISTING OU-1 TREATMENT SYSTEM AREA AND COMPOUND LOCATION
- GROUNDWATER 30 YEARS MODEL PREDICTED 5 ug/L TVOC CONCENTRATION CONTOUR LINE
- CURRENT 5 ug/L TVOC CONCENTRATION CONTOUR LINE
- EXISTING SYSTEM PIPING LAYOUT
- PROPOSED SYSTEM PIPING LAYOUT

0 1600' 3200'
SCALE IN FEET

LOCKHEED MARTIN CORPORATION
FORMER UNISYS FACILITY
FEASIBILITY STUDY ADDENDUM

ALTERNATIVE 4i

ARCADIS

FIGURE
2

CITY:(Reqd) DIV/GROUP:(Reqd) DB:(Reqd) LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\Melville-NY\ACT\FS Scenarios\FS Addendum\Addendum_Fig 01_07-15 Alt4i.dwg LAYOUT: 2 SAVED: 5/30/2012 3:43 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 5/30/2012 5:22 PM BY: SANCHEZ, ADRIAN
XREFS: Xref_2.5mile PROJECTNAME: ----

NOTES

1. THE FOLLOWING ON-SITE EXTRACTION AND RECOVERY WELLS WITHDRAW FROM THE INDICATED AQUIFERS:
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   - UPPER AND MIDDLE PORTION OF THE MAGOTHY - RW1RD
   - UPPER PORTION OF THE MAGOTHY - EW1
   - UPPER AND MIDDLE PORTION OF THE MAGOTHY - RW100
2. MLWD WELL N5099 WILL BE SHUT OFF IN YEAR 1 AND WILL RESUME NORMAL OPERATION IN YEAR 6.

LEGEND:

- BODY OF WATER
- SITE EXTRACTION AND RECOVERY WELLS
- REMEDIATION SYSTEM DIFFUSION WELL
- MUNICIPAL SUPPLY WELL
- NON-MUNICIPAL SUPPLY WELL
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- CURRENT 5 ug/L TVOC CONCENTRATION CONTOUR LINE
- EXISTING SYSTEM PIPING LAYOUT
- PROPOSED SYSTEM PIPING LAYOUT

0 1600’ 3200’

SCALE IN FEET

LOCKHEED MARTIN CORPORATION
FORMER UNISYS FACILITY
FEASIBILITY STUDY ADDENDUM

ALTERNATIVE 4j

ARCADIS

FIGURE **3**

NOTE

1. THE FOLLOWING ON-SITE EXTRACTION AND RECOVERY WELLS WITHDRAW FROM THE INDICATED AQUIFERS:
   - UPPER GLACIAL AND UPPER PORTION OF THE MAGOTHY - RW1RS
   - UPPER AND MIDDLE PORTION OF THE MAGOTHY - RW1RD
   - UPPER PORTION OF THE MAGOTHY - EW1
   - UPPER AND MIDDLE PORTION OF THE MAGOTHY - RW100

LEGEND:

- BODY OF WATER
- SITE EXTRACTION AND RECOVERY WELLS
- REMEDIATION SYSTEM DIFFUSION WELL
- MUNICIPAL SUPPLY WELL
- NON-MUNICIPAL SUPPLY WELL
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0 1600’ 3200’

SCALE IN FEET

LOCKHEED MARTIN CORPORATION
FORMER UNISYS FACILITY
FEASIBILITY STUDY ADDENDUM

ALTERNATIVE 4k

ARCADIS

FIGURE
4

Appendix A – Groundwater Model Documentation Report

REPORT

OU-2 Feasibility Study Groundwater Remediation Simulation Report Addendum

Feasibility Study Report
Operable Unit No. 2 for the Unisys Site,
Great Neck, NY

May 2012

CDM Smith

Table of Contents

List of Figures

List of Tables

Section 1
Introduction

This summary is an addendum to the *OU-2 Feasibility Study Groundwater Remediation Simulation Report* prepared by CDM Smith for Lockheed Martin Corporation (Lockheed Martin) (CDM Smith, May 2012). The work described herein was conducted as part of the OU-2 Remediation Investigation and Feasibility Study Scope of Work for the former Unisys site located in Great Neck, New York on Long Island. This report describes three additional feasibility study scenarios. These alternatives were simulated using the groundwater flow model developed for the OU-2 Remediation Investigation (RI) and Feasibility Study (FS). A summary of the groundwater flow model development and calibration is presented in the *Remedial Investigation Report Operable Unit No. 2 for the Unisys Site, Great Neck, NY (ARCADIS, 2012).*

Section 2

Additional OU-2 FS Alternatives

The groundwater flow model was used to simulate three additional OU-2 FS scenarios. Pumping and diffusion details for all the FS scenarios, including the three new alternatives, are presented in **Table 1.**

The three additional scenarios fall into the "Scenario 4 Series" category. Scenario 4 alternatives focus on hydraulic capture of the higher concentration portion of the offsite total volatile organic compound (TVOC) plume, and reducing impacts to nearby water supply wells. Some Scenario 4 alternatives include strategic placement of diffusion wells to reduce TVOC plume impacts at nearby water supply wells.

The additional OU-2 FS scenarios are described below:

- Scenario 4I: Scenario 4A in combination with Scenario 3B.
- Scenario 4J: Scenario 4A in combination with Scenario 3B with no pumping at Manhasset Lakeville Water District (MLWD) well N-5099 during the initial five year period. Well N-5099 resumes operation after five years.
- Scenario 4K: Scenario 4H with all the treated water from N-5099, which operates as a remediation well in this alternative, discharged to diffusion wells on the eastern side of NSLIJ property upgradient of the Water Authority of Great Neck North (WAGNN) wells N-12999, N-13000 and N-13821.

The simulated groundwater flow fields for the new OU-2 FS alternatives were used to simulate potential future groundwater plume migration to evaluate the effect of remediation pumping on the site related TVOC plume. The initial TVOC plume distribution for the solute transport simulations was based on 2009/2010 sampling data and historical data. The initial TVOC plume distribution used in the simulations is consistent with that presented in the OU-2 Remediation Investigation and Feasibility Study main reports.

Section 3
Results

Solute transport simulation results for the additional OU-2 FS alternatives are presented below. **Table 2** lists the mass removal by the OU-1 remediation system, OU-2 IRM, proposed remediation wells and receptors wells for all the OU-2 FS alternatives including the three additional alternatives.

The maximum simulated TVOC concentrations after 30 years for the Scenario 4I, Scenario 4J and Scenario 4K alternatives are presented in plan view in **Figure 1 to Figure 3. Figure 4 to Figure 6** show the simulated concentration time histories at receptor and remediation pumping wells for Scenario 4I, Scenario 4J and Scenario 4K.

Scenarios were compared on the basis of mass removal and limiting or reducing impacts to receptors. **Figure 7** shows the simulated mass removal by remediation wells and receptors wells for each OU-2 FS alternative. **Table 3** lists the duration of TVOC plume impact, defined by simulated concentrations greater than or equal to 5µg/L, for potential groundwater receptors, which are comprised of water supply and golf course wells.

Table 1
Simulated Scenarios for OU2 Feasibility Study

FS Scenario	*OU-1 Pumping (gpm)*	*OU-2 IRM Pumping (gpm)*	*Proposed New Remediation Wells and Pumping*					
			Simulation ID	*Pumping Location*	*FS Well ID (For reference with main FS report text)*	*New Remediation Well Pumping (gpm)*	*Discharge ID*	*Discharge Location*
Scenario 1	730	-	-	-	-	-	-	-
Scenario 2A	730	500	-	-	-	-	-	-
Scenario 2B	850	500	EW-1D	onsite	EW-1D	-	OU-1	OU-1
Scenario 2C	850	500	EW-1D	onsite	EW-1D	-	OU-1	OU-1
Scenario 3A	850	500	RW300	Village of Lake Success Golf Course	RW300	500	DW103, DW104	OU-2 IRM Diffusion Wells
Scenario 3B	850	500	RW300	Village of Lake Success Golf Course	RW300	500	DW300, DW301	Village of Lake Success Golf Course
Scenario 4A	850	500	RW400	Manhasset-Lakeville Water District N-12802 Parcel	RW400BM RW400MM	1,200	DW400, DW401, DW402, DW402a	Fresh Meadow Golf Course Parking Lot
Scenario 4B	850	500	RW401	North Shore Hospital LIJ	RW401BM RW401MM	1,000	DW404, DW404a, DW405, DW406	North Shore Hospital - South
Scenario 4C	850	500	RW300	Village of Lake Success Golf Course	RW300	1,600	DW407, DW408	Manhasset-Lakeville Water District N-12802 Parcel
			RW402	Manhasset-Lakeville Water District South Parcel	RW402		DW404, DW405	North Shore Hospital - South
Scenario 4D	850	500	RW400	Manhasset-Lakeville Water District N-12802 Parcel	RW400BM RW400MM	3,000	DW404, DW405, DW405a, DW406	North Shore Hospital - South
			RW403	Village of Lake Success Ball Fields	RW403		DW409 - DW414	North Shore Hospital - North
			RW404	Korean Church	RW404			
Scenario 4E	850	500	RW300	Village of Lake Success Golf Course	RW300	1,600	DW300, DW301	Village of Lake Success Golf Course
			RW401	North Shore Hospital LIJ	RW401BM RW401MM		DW404, DW404a, DW405, DW405a	North Shore Hospital - South
Scenario 4F	850	500	RW404	Korean Church	RW404	1,600	DW404, DW405	North Shore Hospital - South
							DW409, DW410	North Shore Hospital - North
Scenario 4G	850	500	RW5099	MLWD N-5099 parcel	RW-5099	1,200	DW413, DW414	North Shore Hospital - South
							DW411, DW412	Macy's Parking Lot
Scenario 4H	850	500	RW5099	MLWD N-5099 parcel	RW5099	1,700	DW413, DW414	North Shore Hospital - South
			RW300	Village of Lake Success Golf Course	RW300		DW411, DW412	Macy's Parking Lot
							DW300, DW301	Village of Lake Success Golf Course

Table 1
Simulated Scenarios for OU2 Feasibility Study

FS Scenario	*OU-1 Pumping (gpm)*	*OU-2 IRM Pumping (gpm)*	*Proposed New Remediation Wells and Pumping*					
			Simulation ID	*Pumping Location*	*FS Well ID (For reference with main FS report text)*	*New Remediation Well Pumping (gpm)*	*Discharge ID*	*Discharge Location*
Scenario 4I	850	500	RW300	Village of Lake Success Golf Course	RW300	500	DW300, DW301	Village of Lake Success Golf Course
			RW400	Manhasset-Lakeville Water District N-12802 Parcel	RW400BM RW400MM	1,200	DW400, DW401, DW402, DW402a	Fresh Meadow Golf Course Parking Lot
Scenario 4J (N-5099 not operating during 5 year lag period)	850	500	RW300	Village of Lake Success Golf Course	RW300	500	DW300, DW301	Village of Lake Success Golf Course
			RW400	Manhasset-Lakeville Water District N-12802 Parcel	RW400BM RW400MM	1,200	DW400, DW401, DW402, DW402a	Fresh Meadow Golf Course Parking Lot
Scenario 4K	850	500	RW5099	MLWD N-5099 parcel	RW5099	1,700	DW413, DW413a, DW414, DW414a	North Shore Hospital - South
			RW300	Village of Lake Success Golf Course	RW300		DW300, DW301	Village of Lake Success Golf Course
Scenario 5A	850	500	RW300	Village of Lake Success Golf Course	RW300	3,200	DW401, DW402, DW403, DW415, DW416, DW417	Fresh Meadow Golf Course Parking Lot
			RW400	Manhasset-Lakeville Water District N-12802 Parcel	RW400BM RW400MM			
			RW403	Village of Lake Success Ball Fields	RW403		DW404, DW405, DW406	North Shore Hospital - South
Scenario 5B	850	500	RW501 -504	Neighborhood Parcels North of Long Island Expressway	RW501 -504	3,300	DW501 -509	Neighborhood Parcels North of Long Island Expressway

Note:
For Scenarios 2B, 3, 4 and 5, increased OU-1 pumping is not included in "New Remediation Well Pumping".
In Scenario 2C, N-5099 is pumped at 1,200 gpm with the assumption that the water will be treated and distributed.
In Scenario 4G, 4H and 4K, N-5099 is used as a remediation well with the assumption that water will be treated and reinjected to groundwater.
The proposed remediation wells pump from middle and/or basal Magothy aquifer.
Remediation pumping and diffusion were simulated from a single location in the model. In reality some scenarios require multiple extraction or diffusion locations depending on the volume of flow.

Table 2
Simulated Mass Removal Over 30 Years for OU-2 Feasibility Study Scenarios

FS Scenario	*New Off-Site Remediation Well Pumping (gpm)**	*Simulated Delay Associated with Design and Implementation (years)*	*OU2 Remediation Pumping Operation Period (years)***	*Simulated Total Mass Removed by Well Group During 30-year Simulation Period, lb*					
				OU-1	*OU-2 IRM*	*Water Supply Wells*	*Golf Course Wells*	*Proposed Remediation Wells*	*Total Removal*
Scenario 1	0	0	30	5,600	0	23,300	300	0	29,200
Scenario 2A	0	0	30	5,400	4,800	18,900	200	0	29,300
Scenario 2B	0	1	30	8,700	3,000	17,700	200	0	29,600
Scenario 2C	0	1	30	8,700	2,900	19,000	200	0	30,800
Scenario 3A	500	3	27	8,500	2,500	10,600	200	8,800	30,600
Scenario 3B	500	3	27	8,600	2,800	12,400	200	6,900	30,900
Scenario 4A	1,200	5	25	8,700	3,000	4,600	200	13,600	30,100
Scenario 4B	1,000	5	25	8,700	3,000	5,100	200	13,300	30,300
Scenario 4C	1,600	5	25	8,500	2,700	3,800	200	15,700	30,900
Scenario 4D	3,000	5	25	8,500	2,600	1,500	200	18,800	31,600
Scenario 4E	1,600	5	25	8,600	2,800	3,700	200	15,900	31,200
Scenario 4F	1,600	5	25	8,500	2,600	3,200	200	16,600	31,100
Scenario 4G	1,200	5	25	8,900	3,100	2,500	200	14,300	29,000
Scenario 4H	1,700	5	25	8,700	2,900	2,200	200	16,800	30,800
Scenario 4I	1,700	5	25	8,600	2,800	3,600	200	15,800	31,000
Scenario 4J	1,700	5	25	8,700	2,900	3,600	200	15,600	31,000
Scenario 4K	1,700	5	25	8,800	2,900	2,000	300	17,000	31,000
Scenario 5A	3,200	5	25	8,600	2,700	1,400	200	19,200	32,100
Scenario 5B	3,300	5	25	8,500	2,700	1,300	200	19,700	32,400

* Does not include increased OU-1 pumping
** OU1 and OU2 IRM operate during delay period

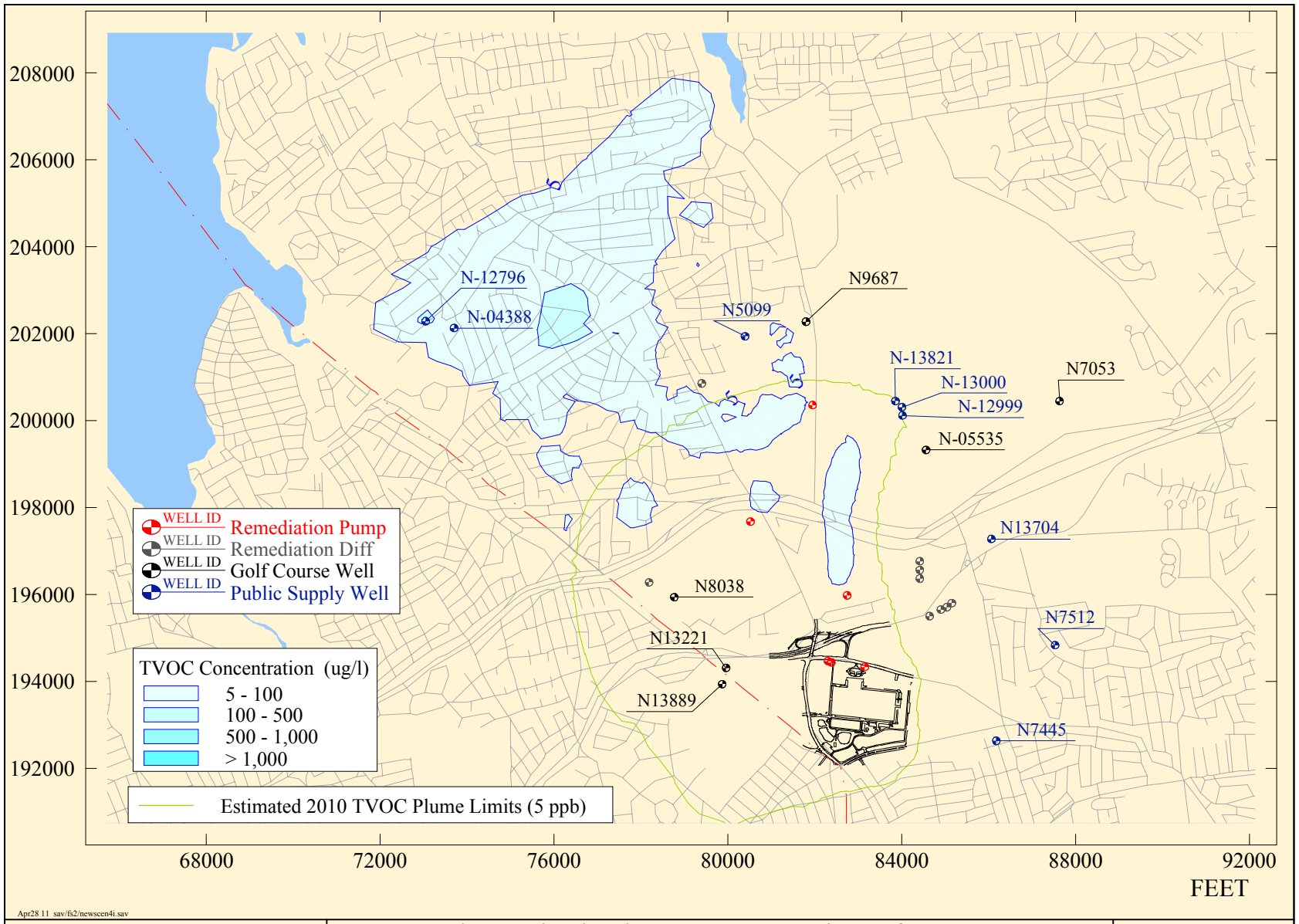
Table 3

Summary of Simulated TVOC Plume Impacts to Receptor Wells

Number of Years During 30 Year Simulation Period That Receptor Wells Are Impacted By Concentrations Greater Than 5 ppb

FS Scenario Category	*New Off-Site Remediation Well Pumping (gpm) (Does not include new OU-1 pumping)*	*Number of impacted years*												
		Public Supply Wells							*Golf Course Wells*					
		N-7445 WAWNC	*N-12796 WAGNN*	*N-4388 WAGNN*	*N-12999 N-13000 N-13821 Average*	*N-5099 MLWD*	*N-7512 GCP*	*N13704 MWLD*	*N-13221 North Shore Towers*	*N13889 North Shore Towers*	*N-5535 Deepdale*	*N-9687 Fresh Meadows*	*N-8038 Lake Success*	*N-7053 North Hills*
Scenario 1	0	Not Impacted	4	13	30	25	Not Impacted	Not Impacted	4	16	Not Impacted	Not Impacted	14	Not Impacted
Scenario 2A	0	Not Impacted	4	12	30	25	Not Impacted	Not Impacted	5	17	Not Impacted	Not Impacted	12	Not Impacted
Scenario 2B	0	Not Impacted	4	12	30	25	Not Impacted	Not Impacted	5	18	Not Impacted	Not Impacted	11	Not Impacted
Scenario 2C	0	Not Impacted	1	7	30	26	Not Impacted	Not Impacted	5	19	Not Impacted	Not Impacted	12	Not Impacted
Scenario 3A	500	Not Impacted	3	11	28	25	Not Impacted	Not Impacted	4	19	Not Impacted	Not Impacted	12	Not Impacted
Scenario 3B	500	Not Impacted	8	13	30	25	Not Impacted	Not Impacted	4	17	Not Impacted	Not Impacted	20	Not Impacted
Scenario 4A	1,200	Not Impacted	9	14	25	1	Not Impacted	Not Impacted	5	16	Not Impacted	Not Impacted	12	Not Impacted
Scenario 4B	1,000	Not Impacted	3	12	7	25	Not Impacted	Not Impacted	5	17	Not Impacted	Not Impacted	12	Not Impacted
Scenario 4C	1,600	Not Impacted	2	12	8	25	Not Impacted	Not Impacted	5	16	Not Impacted	3	11	Not Impacted
Scenario 4D	3,000	Not Impacted	Not Impacted	Not Impacted	7	5	Not Impacted	Not Impacted	5	15	Not Impacted	Not Impacted	11	Not Impacted
Scenario 4E	1,600	Not Impacted	8	13	7	25	Not Impacted	Not Impacted	5	17	Not Impacted	Not Impacted	19	Not Impacted
Scenario 4F	1,600	Not Impacted	1	11	8	25	Not Impacted	Not Impacted	5	16	Not Impacted	Not Impacted	12	Not Impacted
Scenario 4G	1,200	Not Impacted	6	13	12	25*	Not Impacted	Not Impacted	5	18	Not Impacted	Not Impacted	12	Not Impacted
Scenario 4H	1,700	Not Impacted	9	14	10	25*	Not Impacted	Not Impacted	4	17	Not Impacted	Not Impacted	19	Not Impacted
Scenario 4I	1,700	Not Impacted	9	14	19	1	Not Impacted	Not Impacted	5	17	Not Impacted	Not Impacted	22	Not Impacted
Scenario 4J	1,700	Not Impacted	10	14	19	Not Impacted	Not Impacted	Not Impacted	5	17	Not Impacted	Not Impacted	22	Not Impacted
Scenario 4K	1,700	Not Impacted	8	13	9	25*	Not Impacted	Not Impacted	5	18	Not Impacted	13	20	Not Impacted
Scenario 5A	3,200	Not Impacted	Not Impacted	7	6	1	Not Impacted	Not Impacted	5	17	Not Impacted	1	10	Not Impacted
Scenario 5B	3,300	Not Impacted	Not Impacted	Not Impacted	7	Not Impacted	Not Impacted	Not Impacted	5	16	Not Impacted	Not Impacted	10	Not Impacted

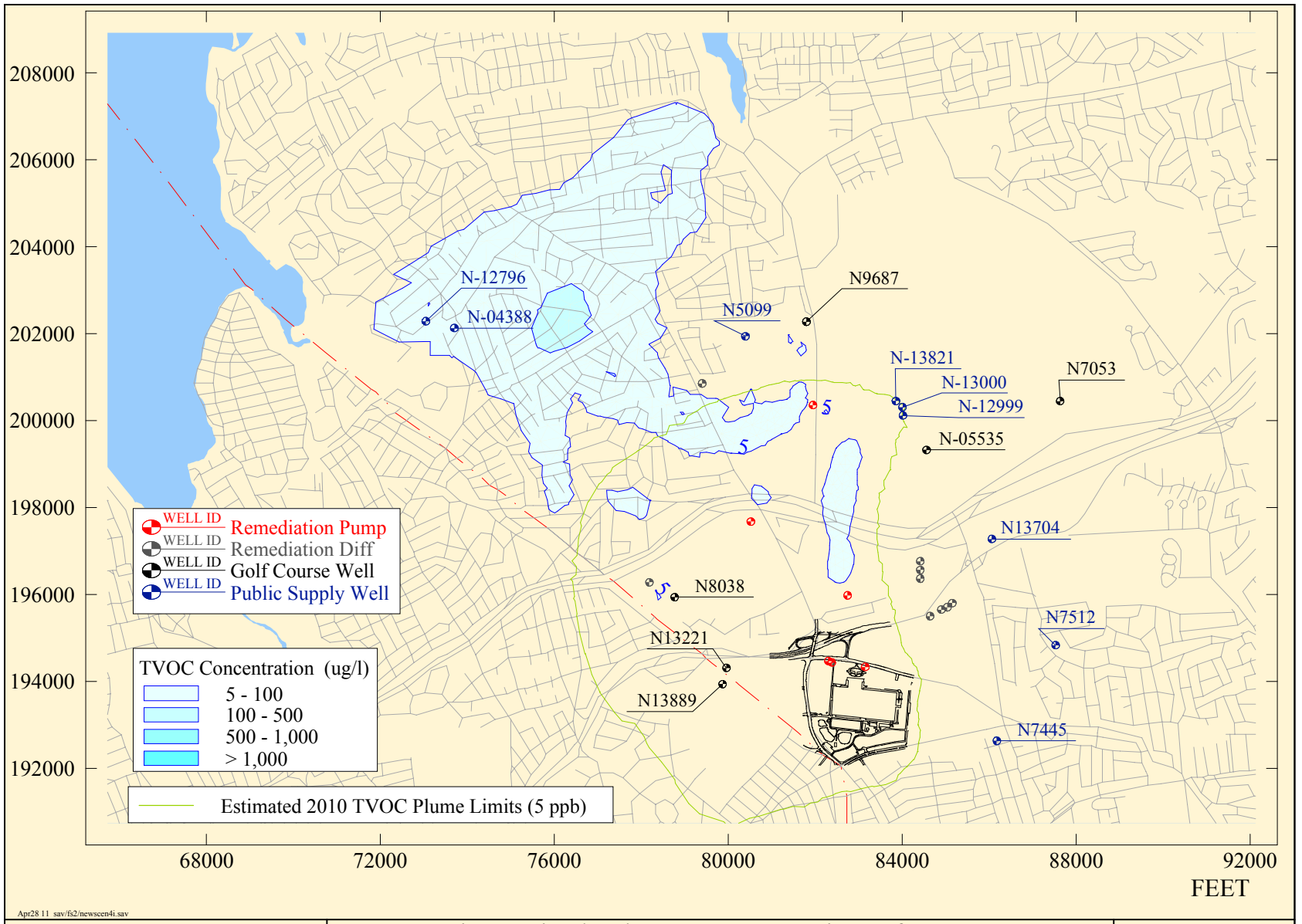
* In Scenario 4G, 4H and 4K, N-5099 is used as a remediation well with the assumption that water will be treated and reinjected to groundwater.



CDM Smith

Maximum Simulated TVOC Concentrations After 30 Years
Scenario 4I
Former Unisys Site, Great Neck, NY
Groundwater Model Documentation

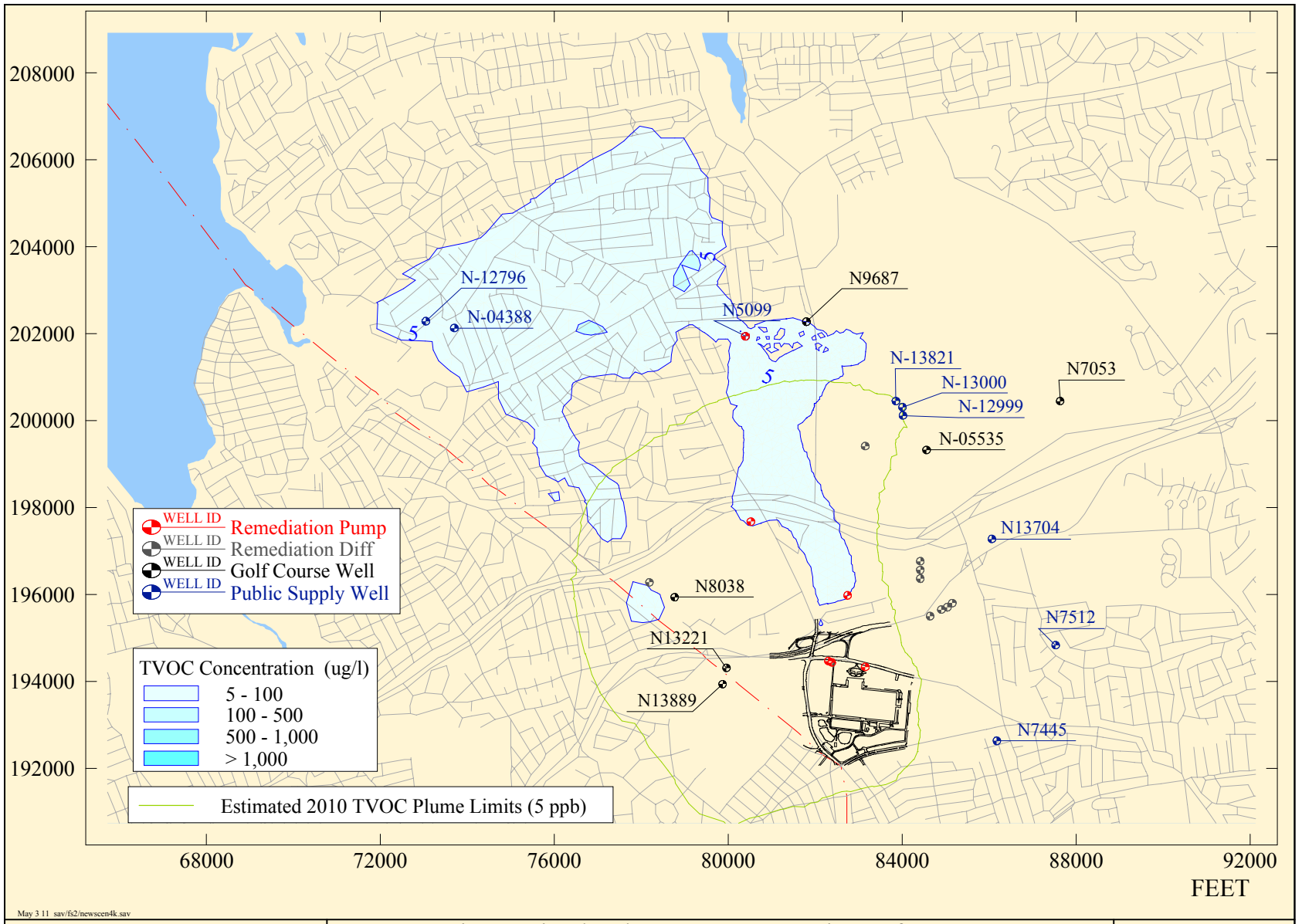
FIGURE
1



CDM Smith

Maximum Simulated TVOC Concentrations After 30 Years
Scenario 4J
Former Unisys Site, Great Neck, NY
Groundwater Model Documentation

FIGURE
2

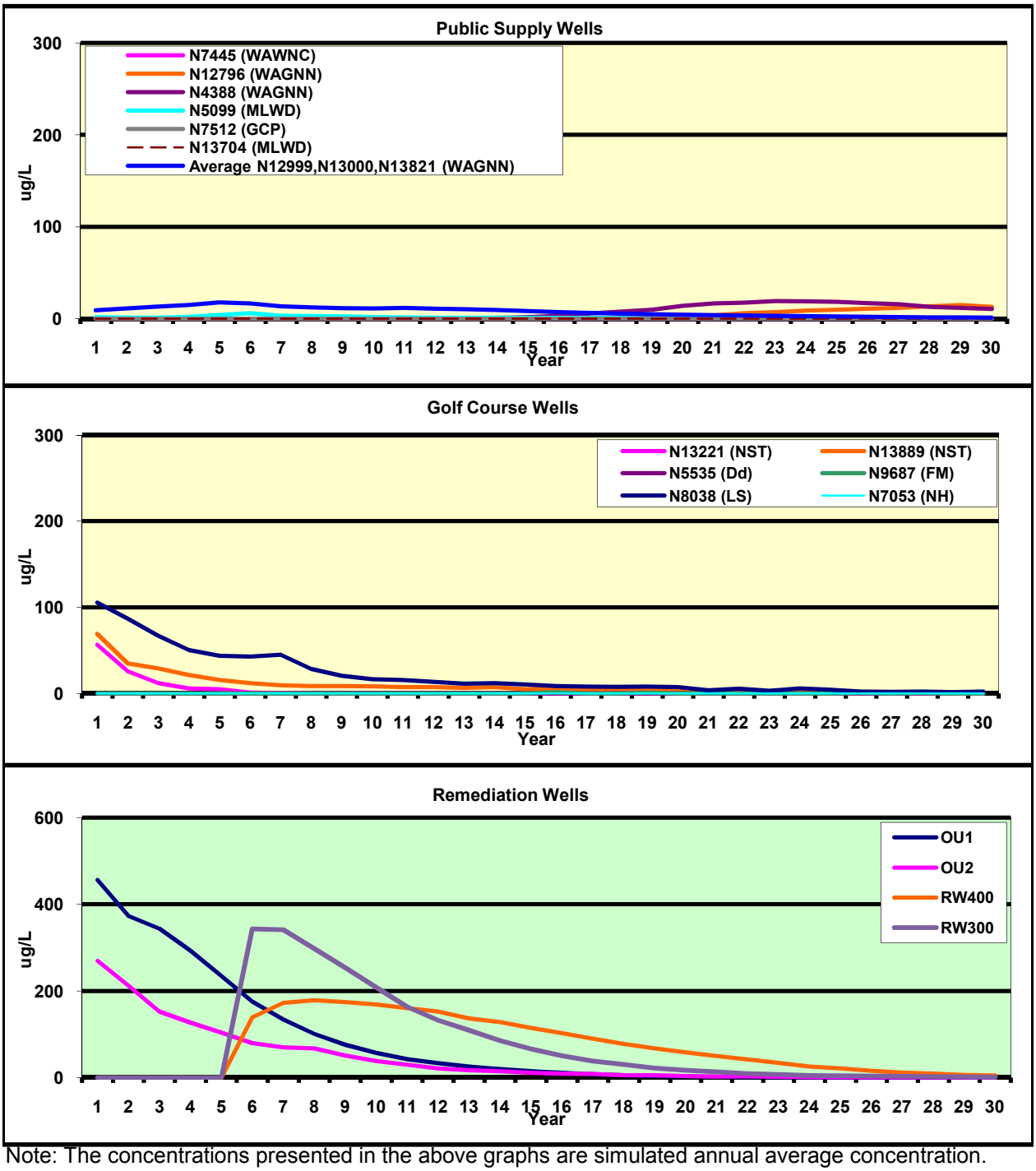


CDM Smith

Maximum Simulated TVOC Concentrations After 30 Years
Scenario 4K
MLWD N5099 pumps 1,200 gpm for remediation
Treated water is discharged upgradient of WAGNN (1,200)

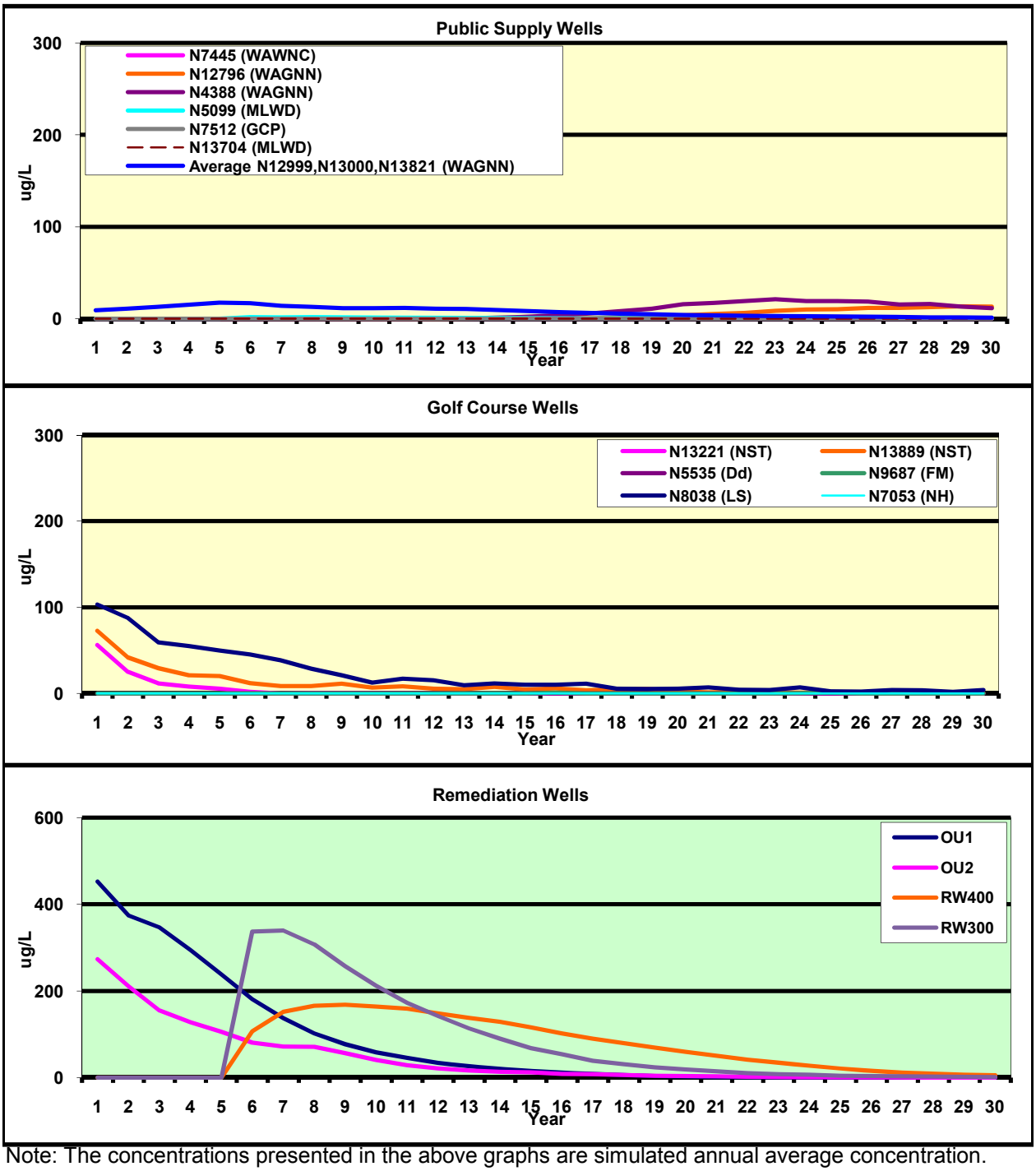
FIGURE 3

Figure 4
Simulated TVOC Concentration Time Histories at Receptor and Remediation Wells
Scenario 4I



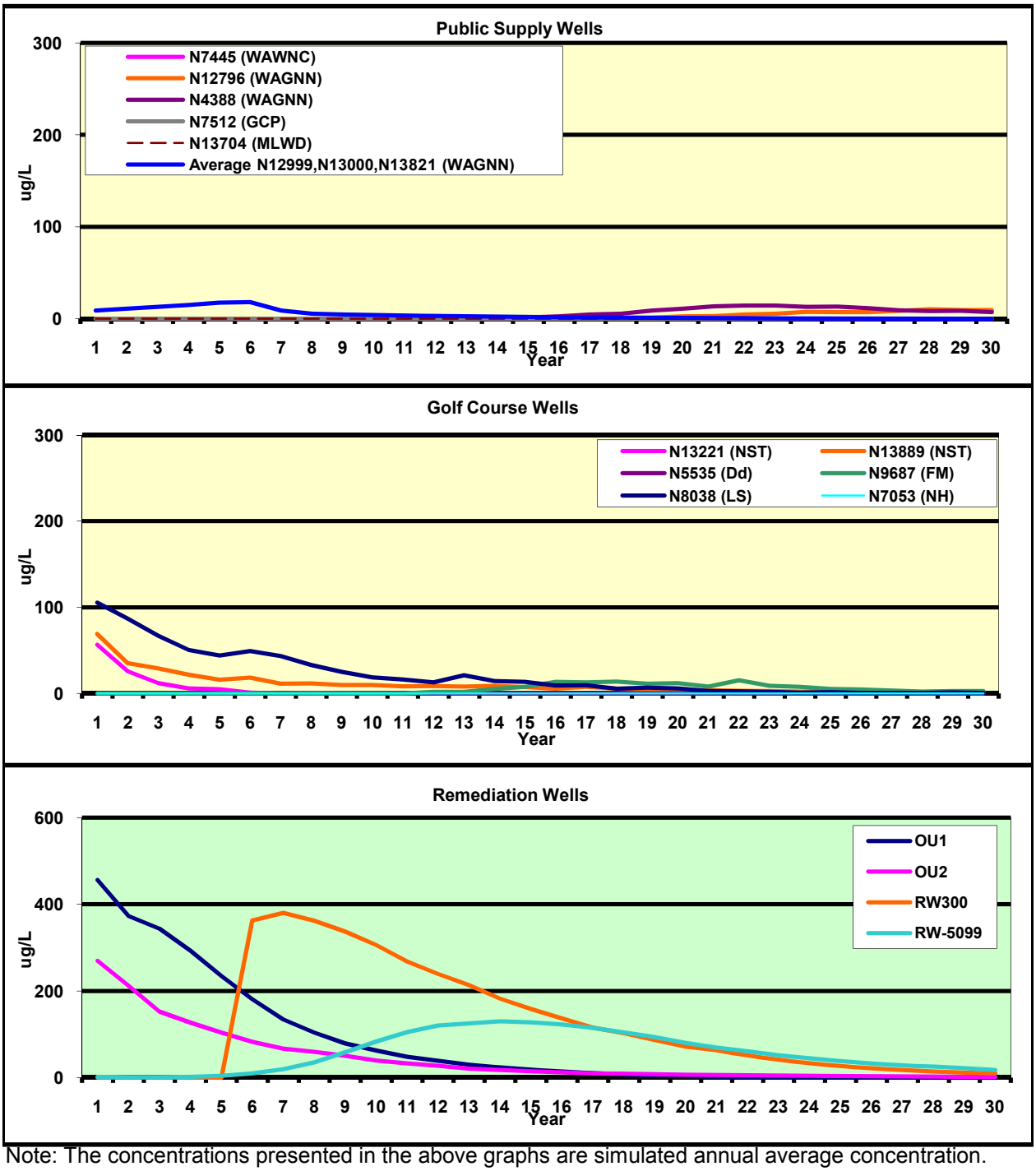
Note: The concentrations presented in the above graphs are simulated annual average concentration.

Figure 5
Simulated TVOC Concentration Time Histories at Receptor and Remediation Wells
Scenario 4J



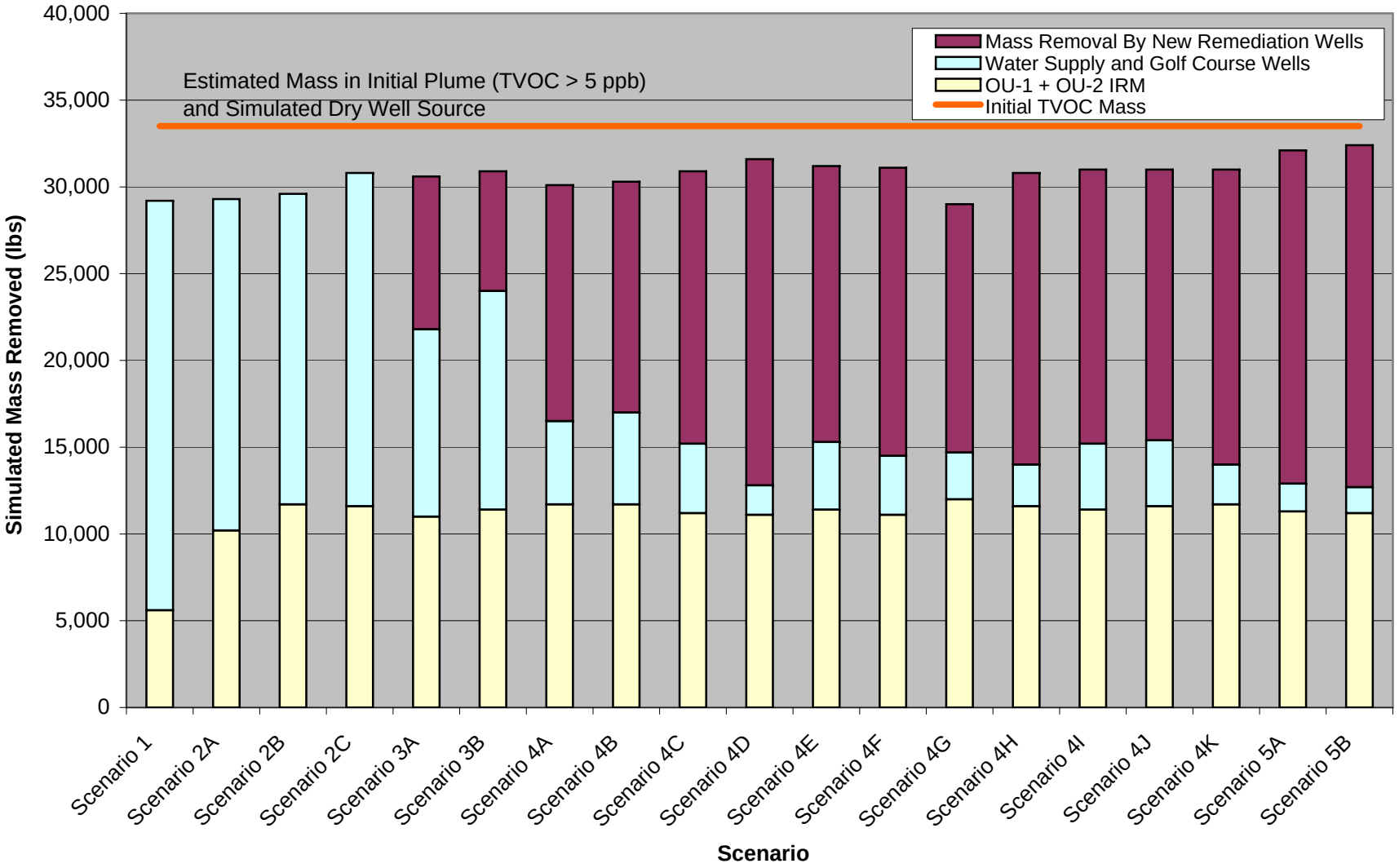
Note: The concentrations presented in the above graphs are simulated annual average concentration.

Figure 6
Simulated TVOC Concentration Time Histories at Receptor and Remediation Wells
Scenario 4K



Note: The concentrations presented in the above graphs are simulated annual average concentration.

Figure 7. Simulated Mass Removal Over 30 Year Simulation Period



Appendix B – Cost Model

Escalation Rate:	**3.5%**	
Discount Rate:	**8.0%**	
Full Sampling Frequency:	**3**	Years
Number of wells monitored in years 1 and 2:	**35**	Wells
Number of wells monitored in years 3 - 30:	**45**	Wells
Number of wells monitored during OU-2 event:	**135**	Wells
Frequency of OU-2 monitoring event:	**3**	Years
Standard monitoring event:	**2**	Weeks
OU-2 Monitoring Event:	**5**	Weeks
EPA 8260 Analysis:	**$120**	
Gloves:	**$20**	per box
PPE:	**$50**	per week
Tubing:	**$2.50**	per foot
Bladders:	**$10**	each
PDBs:	**$18**	each
PDB Harnesses:	**$50**	each
Initial Event Supplies:	**$100**	per week
Non-Initial Event Supplies:	**$150**	per week
Engineering Percentage of Capital Cost:	**5%**	
Construction Management Percentage of Capital Cost	**7%**	
Project Management Percentage of Capital Cost	**10%**	
Construction Contingency (Union Labor)	**15%**	
New York State Tax	**8.625%**	
Total Capital Adder	**45.625%**	
Mechanical Installation Percentage of Capital Cost	**100%**	
Electrical Installation Percentage of Capital Cost	**25%**	
Treatment System Access Fee	**$100,000**	per treatment system
Treatment System Building Cost	**$250**	per square feet
Well Access Fee	**$50,000**	per EW & DW pair
Well Permitting Fee	**$20,000**	per well
Capital Improvement Factor	**5%**	percent of capital
Capital Improvement Frequency	**5**	years
Treatment System Capital Improvement Fee	**$300,000**	per treatment system
O&M Efficiency Reduction Percentage	**2%**	per year
Wellhead O&M Efficiency Reduction Percentage	**1%**	per year
Electricity Cost	**$0.13**	per kW-hour
N5099 Flow Rate	**1,000**	GPM
N5099 Flow Rate_Remedial	**1,200**	GPM
N12796 and N4388 Flow Rate	**2,000**	GPM
Blower Efficiency	**80%**	
Air:Water Ratio	**50**	
Air Stripper Blower Pressure	**0.8**	psig
Pump Efficiency	**75%**	
Motor Efficiency	**90%**	
N5099 System Pressure	**0**	psig
N5099 System Pressure_Remedial	**75**	psig
N12796 and N4388 System Pressure	**0**	psig

Table 4
Remedial Action Alternatives Cost Estimate Summary
Feasibility Study Addendum, Operable Unit 2
Lockheed Martin Corporation, Great Neck, New York

Alternative	Capital	Operation and Maintenance	Total
	30-Year Net Present Value Cost		
RAA-1	$ 5,100,000	$ 3,500,000	$ 8,600,000
RAA-2a	$ 8,600,000	$ 23,000,000	$ 32,000,000
RAA-2b	$ 9,800,000	$ 28,000,000	$ 38,000,000
RAA-2c	$ 14,000,000	$ 25,000,000	$ 39,000,000
RAA-3a	$ 14,000,000	$ 28,000,000	$ 42,000,000
RAA-3b	$ 20,000,000	$ 35,000,000	$ 55,000,000
RAA-4a	$ 23,000,000	$ 40,000,000	$ 63,000,000
RAA-4b	$ 23,000,000	$ 37,000,000	$ 60,000,000
RAA-4c	$ 27,000,000	$ 42,000,000	$ 69,000,000
RAA-4d	$ 35,000,000	$ 54,000,000	$ 89,000,000
RAA-4e	$ 31,000,000	$ 49,000,000	$ 80,000,000
RAA-4f	$ 23,000,000	$ 41,000,000	$ 64,000,000
RAA-4g	$ 22,000,000	$ 44,000,000	$ 66,000,000
RAA-4h	$ 35,000,000	$ 54,000,000	$ 89,000,000
RAA-4i	**$ 32,000,000**	**$ 53,000,000**	**$ 85,000,000**
RAA-4j	**$ 31,000,000**	**$ 52,000,000**	**$ 83,000,000**
RAA-4k	**$ 35,000,000**	**$ 54,000,000**	**$ 89,000,000**
RAA-5a	$ 42,000,000	$ 60,000,000	$ 102,000,000
RAA-5b	$ 34,000,000	$ 63,000,000	$ 97,000,000

Note:
Costs are escalated at 3.5% and discounted at 8%.

Table C-5 Cost Estimate for OU-2 Alternative 4i, LMC, Great Neck.

Outpost Monitoring
OU-2 IRM O&M
Install 4 New Extraction Wells at VLSGC, MLWD, and in OU-1 (RW300, RW400BM, RW400BM, and EW1D)
Install 6 New Diffusion Wells at VLSGC, FMCC (DW300, DW301, DW400 through DW402, and DW402a)
Install a New 500-gpm Treatment Plant at VLSGC
Install a New 1,200-gpm Treatment Plant at MLWD
30 Years of O&M of New Treatment Plants
Install 4 New Groundwater Monitoring Wells into Basal Magothy

Description	Quantity	Units	Unit Cost ($)	Total Cost ($)	Descriptions
Install 4 Groundwater Monitoring Well Clusters (250-350 ft)				**$ 2,000,000**	
Install New Extraction Wells					
(VLSGC and EW1D Extraction Wells)					
1. RW300 and EW1D	2	ea	$ 875,000	$ 1,750,000	Typ. diffusion well cost x 25% Includes: 60 Hp pump, leads, and installation Piping work in vault: main, cla-valve, gate valve, fittings, flow meter. Below-grade Concrete Vault Hatches, Coatings, Heater Site Preparation, Site Restoration and Waste Removal Well Development and Testing
2. Well Access Fee	1	ea	$ 50,000	$ 50,000	Well access fee not required for EW1D
3. Well Permitting Fee	2	ea	$ 20,000	$ 40,000	
Subtotal				**$ 1,840,000**	
(MLWD Extraction Wells)					
1. RW400BM and RW400MM	2	ea	$ 875,000	$ 1,750,000	
2. Well Access Fee	1	ea	$ 50,000	$ 50,000	
3. Well Permitting Fee	2	ea	$ 20,000	$ 40,000	
4. Discharge Piping from RW400 to Treatment Plant	800	ft	$ 175	$ 140,000	
Subtotal				**$ 1,980,000**	
Install New Diffusion Wells (6)					
(Two [2] Wells at VLSGC)					
1. Drill and install diffusion wells	2	ea	$ 700,000	$ 1,400,000	ARCADIS Proposal to Lockheed dated 6/28/07; Delta Well & Pump. Bid to ARCADIS (11/07)
2. Discharge Piping from Plant to DW300 and DW301	5,000	ft	$ 85	$ 425,000	Single-wall, 8" Blue Brute HDPE piping, trenching, and restoration. Est. from pervious ARCADIS FS cost estimates with inflation.
3. Piping Appurtenances	1	ls	$ 30,000	$ 30,000	Valves, piping between diffusion wells. Basis: prev. ARCADIS FS cost estimates.
4. Additional Design & Permitting	1	ea	$ 50,000	$ 50,000	Basis: ARCADIS Cost Proposal to Lockheed dated 6/28/07
5. Well Access Fee	1	ea	$ 50,000	$ 50,000	
Subtotal				**$ 1,955,000**	
(Four [4] Wells at FMCC)					
1. Drill and install diffusion wells	4	ea	$ 700,000	$ 2,800,000	
2. Discharge Piping from Plant to Diffusion Wells	6,000	ft	$ 85	$ 510,000	
3. Piping Appurtenances	1	ls	$ 30,000	$ 30,000	
4. Additional Design & Permitting	1	ea	$ 50,000	$ 50,000	
5. Well Access Fee	1	ea	$ 50,000	$ 50,000	
Subtotal				**$ 3,440,000**	
Install New Treatment Plants					*Note: Basis of Below Costs, except as noted*
(500-gpm plant at VLSGC for RW300)					
1. General Site Preparation	1	ls	$ 150,000	$ 150,000	Clearing, grading, mobilization and foundation preparation
2. Treatment Building					
Concrete Work	1	ea	$ 75,000	$ 75,000	Foundation (incl. clearwells)
Building	3,000	lf	$ 250	$ 750,000	Cost based on RTKL architect's estimate
HVAC	1	ea	$ 20,000	$ 20,000	
Soil transport.	1,000	cy	$ 6.62	$ 6,623	On-site haul. Spread in basins.
Final Grading, Fencing, and Landscape	1	ls	$ 50,000	$ 50,000	
3. Major Process Equipment Items					
Air Stripping Tower	1	ea	$ 226,000	$ 226,000	
Off-gas Treatment Vessels, filled with media	1	ls	$ 372,000	$ 372,000	Estimate from Tigg Corp. to ARCADIS dated 8/3/07 ($500k capital cost for 5 vessels in same config. As IRM); 56,000 lb PPZ x $1.10lb; 60,000 lb VPGAC x $1.20/lb est. from experience
Horizontal Mist Eliminator and Knock-Out Tank	1	ea	$ 11,000	$ 11,000	
Duct Heater	1	ea	$ 24,000	$ 24,000	Assumes 50 hp unit. Est. from experience.
Clearwell Pumps	2	ea	$ 21,000	$ 42,000	Assumes two 20 hp variable speed drive pumps. Est. from experience.
Filtration System	1	ls	$ 75,000	$ 75,000	Bag Filter System.
Ducting	1	ls	$ 169,000	$ 169,000	Duct and insulation/controls installed. Est. from experience with IRM installation.
Discharge Pump	2	ea	$ 27,000	$ 54,000	50 Hp pump. Est. from experience.
Blower	1	ea	$ 32,000	$ 32,000	100 hp blower. Per quote from Northern Blower to ARCADIS dated 12/9/05 (plus inflation) plus
4. Mechanical Components					
Piping from Extraction Well to Treatment Plant	300	ft	$ 175	$ 52,500	Includes double-walled 8" HDPE piping, trenching and restoration.
Extraction Well Piping Leak Detection System	300	ft	$ 25	$ 7,500	
Process Piping	1	ls	$ 115,000	$ 115,000	Includes labor and piping (building interior)/process equipment installation
Piping Appurtanances	1	ls	$ 75,000	$ 75,000	Includes valves, gauges, controls, sensors, flowmeters, diffusion line flush.
5. Electrical Components					
Electrical Service Conduits, Transformer	1	ea	$ 90,000	$ 90,000	800 amp service
Power to Treatment Structure	100	ft	$ 100	$ 10,000	From source to treatment building
Conduit/Conductors to Well Vaults	300	ft	$ 35	$ 10,500	
Building Controls and Distribution	1	ea	$ 95,000	$ 95,000	Includes MCC, disconnect, lights, power to HVAC
Process Controls	1	ea	$ 95,000	$ 95,000	Includes PLC and interlocks, alarms, etc.
6. Building Security System	1	ls	$ 25,000	$ 25,000	Alarm system.
7. Mechanical Installation	100%	of	$ 1,255,000	$ 1,260,000	
8. Electrical Installation	25%	of	$ 325,500	$ 81,000	
9. Treatment System Operational Testing and Startup	1	ls	$ 10,000	$ 10,000	Includes laboratory sample analysis.
10. Treatment System Access Fee	1	ea	$ 100,000	$ 100,000	
Subtotal				**$ 4,083,000**	

Table C-5 Cost Estimate for OU-2 Alternative 4i, LMC, Great Neck.

Outpost Monitoring
OU-2 IRM O&M
Install 4 New Extraction Wells at VLSGC, MLWD, and in OU-1 (RW300, RW400BM, RW400BM, and EW1D)
Install 6 New Diffusion Wells at VLSGC, FMCC (DW300, DW301, DW400 through DW402, and DW402a)
Install a New 500-gpm Treatment Plant at VLSGC
Install a New 1,200-gpm Treatment Plant at MLWD
30 Years of O&M of New Treatment Plants
Install 4 New Groundwater Monitoring Wells into Basal Magothy

Description	Quantity	Units	Unit Cost ($)	Total Cost ($)	Descriptions
(1,200-gpm plant at MLWD for RW400BM and RW400MM)					*Note: Basis of Below Costs, except as noted*
1. General Site Preparation	0.25	ea	$ 200,000	$ 50,000	Clearing, grading, mobilization and foundation preparation
2. Treatment Building					
Concrete Work	0.5	ea	$ 100,000	$ 50,000	Foundation (incl. clearwells)
Building	4,600	sf	$ 250	$ 1,150,000	Cost based on RTKL architect's estimate
HVAC	1	ea	$ 25,000	$ 25,000	
Soil transport.	625	cy	$ 6.62	$ 4,139	On-site haul. Spread in basins.
Final Grading, Fencing, and Landscape	1	ls	$ 65,000	$ 65,000	
3. Major Process Equipment Items					
Air Stripping Tower	1	ea	$ 350,000	$ 350,000	
Off-gas Treatment Vessels, filled with media	1	ls	$ 372,000	$ 372,000	Estimate from Tigg Corp. to ARCADIS dated 8/3/07 ($500k capital cost for 5 vessels in same config. As IRM); 56,000 lb PPZ x $1.10lb; 60,000 lb VPGAC x $1.20/lb est. from experience
Horizontal Mist Eliminator and Knock-Out Tank	1	ea	$ 11,000	$ 11,000	
Duct Heater	1	ea	$ 37,000	$ 37,000	Assumes 50 hp unit. Est. from experience.
Clearwell Pumps	2	ea	$ 27,000	$ 54,000	Assumes two 50 hp variable speed drive pumps. Est. from experience.
Filtration System	1	ls	$ 116,000	$ 116,000	Bag Filter System.
Ducting	1	ls	$ 225,000	$ 225,000	Duct and insulation/controls installed. Est. from experience with IRM installation.
Discharge Pump	2	ea	$ 27,000	$ 54,000	50 Hp pump. Est. from experience.
Blower	1	ea	$ 50,000	$ 50,000	100 hp blower. Per quote from Northern Blower to ARCADIS dated 12/9/05 (plus inflation) plus
4. Mechanical Components					
Extraction Well Piping Leak Detection System	800	ft	$ 25	$ 20,000	
Process Piping	1	ls	$ 175,000	$ 175,000	Includes labor and piping (building interior)/process equipment installation
Piping Appurtanances	1	ls	$ 120,000	$ 120,000	Includes valves, gauges, controls, sensors, flowmeters, diffusion line flush.
5. Electrical Components					
Electrical Service Conduits, Transformer	0.5	ea	$ 90,000	$ 45,000	800 amp service
Power to Treatment Structure	100	ft	$ 100	$ 10,000	From source to treatment building
Conduit/Conductors to Well Vaults	800	ft	$ 35	$ 28,000	
Building Controls and Distribution	1	ea	$ 115,000	$ 115,000	Includes MCC, disconnect, lights, power to HVAC
Process Controls	1	ea	$ 115,000	$ 115,000	Includes PLC and interlocks, alarms, etc.
6. Building Security System	1	ls	$ 25,000	$ 25,000	Alarm system.
7. Mechanical Installation	100%	of	$ 1,584,000	$ 1,580,000	
8. Electrical Installation	25%	of	$ 338,000	$ 85,000	
9. Treatment System Operational Testing and Startup	1	ls	$ 15,000	$ 15,000	Includes laboratory sample analysis.
10. Treatment System Access Fee	1	ea	$ 100,000	$ 100,000	
Subtotal				**$ 5,047,000**	
Subtotal of Capital Costs				**$ 20,345,000**	
Engineering/Project Management					
1. Engineering (5% of capital cost)	5%	of	$ 20,345,000	$ 1,017,250	
2. Construction Management (7% of capital cost)	7%	of	$ 20,345,000	$ 1,424,150	
3. Project Management (10% of capital cost)	10%	of	$ 20,345,000	$ 2,034,500	
4. Construction Contingency (Union Labor; 15% of capital cost)	15%	of	$ 20,345,000	$ 3,051,750	
5. New York State Sales Tax (8.625% of capital cost)	8.625%	of	$ 20,345,000	$ 1,754,756	
Subtotal				$ 9,282,000	
TOTAL CAPITAL COST				**$ 29,600,000**	
Treatment Plant/Equipment Annual O&M					
(OU-2 IRM P&T System Cost)					
GWTS Operations, Checklist and Inspections	1	ls	$ 256,000	$ 256,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Monthly Compliance Sampling/Analysis and Alarm Testing	1	ls	$ 56,000	$ 56,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Quarterly O&M Activities - Preventative Maintenance	1	ls	$ 80,000	$ 80,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Extraction Well Cleaning and Redevelopment	0.33	ls	$ 190,000	$ 62,700	2010 budget estimate to clean one well (performed every 3 years)
Diffusion Well Cleaning and Redevelopment	0.33	ls	$ 210,000	$ 69,300	2010 budget estimate to clean one well with carbon dioxide (performed every 3 years)
Monthly Utility Expenses, including electric	1	ls	$ 180,000	$ 180,000	From RAA-2a costing
Monthly Service Contractors (e.g., electrical, controls)	1	ls	$ 120,000	$ 120,000	2010 spend plus 20%
Vapor Phase Carbon Replacement	1	ls	$ 100,000	$ 100,000	2010 spend
Zeolite/Pot Perm Media Cost (VC removal)	1	ls	$ 26,250	$ 26,250	Annualized based on change-out every 4 years
Quarterly Progress Reports to NYSDEC	1	ls	$ 28,000	$ 28,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Unscheduled O&M and System Repair	1	ls	$ 120,000	$ 120,000	2010 spend, reduced by 20% for treatment system duplication efficiency
OM&M Plan Revisions and As-Builts	1	ls	$ 32,000	$ 32,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Annual GWTS Performance Analysis	1	ls	$ 28,800	$ 28,800	2010 spend, reduced by 20% for treatment system duplication efficiency
Project Management	1	ls	$ 44,000	$ 44,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Subtotal				**$ 1,200,000**	
(New 500-gpm RW300 Treatment System)					
GWTS Operations, Checklist and Inspections	1	ls	$ 256,000	$ 256,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Monthly Compliance Sampling/Analysis and Alarm Testing	1	ls	$ 56,000	$ 56,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Quarterly O&M Activities - Preventative Maintenance	1	ls	$ 80,000	$ 80,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Extraction Well Cleaning and Redevelopment	0.33	ls	$ 190,000	$ 62,700	2010 budget estimate to clean one well (performed every 3 years)
Diffusion Well Cleaning and Redevelopment	0.33	ls	$ 210,000	$ 69,300	2010 budget estimate to clean one well with carbon dioxide (performed every 3 years)
Monthly Utility Expenses, including electric	1	ls	$ 180,000	$ 180,000	From RAA-2a estiimate
Monthly Service Contractors (e.g., electrical, controls)	1	ls	$ 120,000	$ 120,000	2010 spend plus 20%
Vapor Phase Carbon Replacement	1	ls	$ 100,000	$ 100,000	2010 spend
Zeolite/Pot Perm Media Cost (VC removal)	0	ls	$ 26,250	$ -	
Quarterly Progress Reports to NYSDEC	1	ls	$ 28,000	$ 28,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Unscheduled O&M and System Repair	1	ls	$ 120,000	$ 120,000	2010 spend, reduced by 20% for treatment system duplication efficiency
OM&M Plan Revisions and As-Builts	1	ls	$ 32,000	$ 32,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Annual GWTS Performance Analysis	1	ls	$ 28,800	$ 28,800	2010 spend, reduced by 20% for treatment system duplication efficiency
Project Management	1	ls	$ 44,000	$ 44,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Subtotal				**$ 1,180,000**	
(New 1,200-gpm RW400 Treatment System)					
GWTS Operations, Checklist and Inspections	1	ls	$ 256,000	$ 256,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Monthly Compliance Sampling/Analysis and Alarm Testing	1	ls	$ 56,000	$ 56,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Quarterly O&M Activities - Preventative Maintenance	1	ls	$ 80,000	$ 80,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Extraction Well Cleaning and Redevelopment	0.67	ls	$ 190,000	$ 127,300	2010 budget estimate to clean one well (performed every 3 years)
Diffusion Well Cleaning and Redevelopment	0.67	ls	$ 210,000	$ 140,700	2010 budget estimate to clean one well with carbon dioxide (performed every 3 years)
Monthly Utility Expenses, including electric	1	ls	$ 432,000	$ 432,000	Flow rate adjusted from RAA-2a costing
Monthly Service Contractors (e.g., electrical, controls)	1	ls	$ 120,000	$ 120,000	2010 spend plus 20%
Vapor Phase Carbon Replacement	1	ls	$ 240,000	$ 240,000	Flow rate adjusted from RAA-2a costing
Zeolite/Pot Perm Media Cost (VC removal)	0	ls	$ 26,250	$ -	
Quarterly Progress Reports to NYSDEC	1	ls	$ 28,000	$ 28,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Unscheduled O&M and System Repair	1	ls	$ 217,500	$ 217,500	2010 spend for OU-2, increased by 45% for 1,200-gpm system vs. 500-gpm system
OM&M Plan Revisions and As-Builts	1	ls	$ 32,000	$ 32,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Annual GWTS Performance Analysis	1	ls	$ 28,800	$ 28,800	2010 spend, reduced by 20% for treatment system duplication efficiency
Project Management	1	ls	$ 44,000	$ 44,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Subtotal				**$ 1,800,000**	
TOTAL ANNUAL O&M COST				**$ 4,180,000**	

NPV Operation & Maintenance Costs Escalated over a 30-Year Period
Discount Rate: 8%
Escalation Rate: 3.5%

Year	Capital Cost [1]	Monitoring Cost	OU-2 O&M Cost	OU-2 Capital Improvements	Pre-Escalated Cost	Escalated Cost (FV)	OU-2 PV (Cost)	OU-2 Capital FV	OU-2 O&M FV	OU-2 Capital PV	OU-2 O&M NPV	Year	N12796 & N4388 Capital Cost	N12796 & N4388 O&M	N5099 Capital Cost	N5099 O&M	N13000b Capital Cost	N13000b O&M	Welhead Pre-Escalated Cost	Grand Total Pre-Escalated Cost	Grand Total Escalated Cost (FV)	Grand Total PV (Cost)
1	$ 6,364,000	$ 41,000	$ 1,364,000		$ 7,769,000	$ 8,040,915	$ 7,445,292	$ 6,586,740	$ 1,454,175	$ 6,098,833	$ 1,346,458	2011	1				$ 1,515,500		$ 1,515,500	$ 9,284,500	$ 9,609,458	$ 8,897,646
2	$ 5,048,000	$ 41,000	$ 1,364,000		$ 6,453,000	$ 6,912,615	$ 5,926,453	$ 5,407,544	$ 1,505,071	$ 4,636,097	$ 1,290,356	2012	2				$ 1,515,500		$ 1,515,500	$ 7,968,500	$ 8,536,056	$ 7,318,293
3	$ 5,973,000	$ 96,000	$ 1,364,000		$ 7,433,000	$ 8,241,100	$ 6,542,051	$ 6,622,372	$ 1,618,728	$ 5,257,052	$ 1,284,999	2013	3				$ -	$ 160,000	$ 160,000	$ 7,593,000	$ 8,418,495	$ 6,682,873
4	$ 8,095,000	$ 36,000	$ 2,380,000		$ 10,511,000	$ 12,061,614	$ 8,865,647	$ 9,289,199	$ 2,772,416	$ 6,827,838	$ 2,037,808	2014	4		$ 939,500		$ -	$ 160,000	$ 1,099,500	$ 11,610,500	$ 13,323,316	$ 9,793,035
5	$ 4,148,000	$ 36,000	$ 2,332,400		$ 6,516,400	$ 7,739,439	$ 5,267,332	$ 4,926,523	$ 2,812,916	$ 3,352,909	$ 1,914,424	2015	5		$ 939,500		$ 31,807	$ 160,000	$ 1,131,307	$ 7,647,707	$ 9,083,077	$ 6,181,789
6		$ 96,000	$ 4,085,752	$ -	$ 4,181,752	$ 5,140,441	$ 3,239,350	$ -	$ 5,140,441	$ -	$ 3,239,350	2016	6		$ -	$ 71,000	$ -	$ 160,000	$ 231,000	$ 4,412,752	$ 5,424,399	$ 3,418,291
7		$ 36,000	$ 4,004,037	$ -	$ 4,040,037	$ 5,140,055	$ 2,999,173	$ -	$ 5,140,055	$ -	$ 2,999,173	2017	7				$ -	$ 160,000	$ 160,000	$ 4,200,037	$ 5,343,620	$ 3,117,951
8		$ 36,000	$ 3,923,956	$ -	$ 3,959,956	$ 5,214,506	$ 2,817,235	$ -	$ 5,214,506	$ -	$ 2,817,235	2018	8				$ -	$ 160,000	$ 160,000	$ 4,119,956	$ 5,425,196	$ 2,931,064
9		$ 96,000	$ 3,845,477	$ -	$ 3,941,477	$ 5,371,829	$ 2,687,252	$ -	$ 5,371,829	$ -	$ 2,687,252	2019	9				$ -	$ 160,000	$ 160,000	$ 4,101,477	$ 5,589,892	$ 2,796,338
10		$ 36,000	$ 3,768,568	$ 600,000	$ 4,404,568	$ 6,213,078	$ 2,877,857	$ 846,359	$ 5,366,718	$ 392,028	$ 2,485,829	2020	10				$ 31,807	$ 160,000	$ 191,807	$ 4,596,374	$ 6,483,640	$ 3,003,180
11		$ 36,000	$ 3,693,196	$ -	$ 3,729,196	$ 5,444,514	$ 2,335,059	$ -	$ 5,444,514	$ -	$ 2,335,059	2021	11				$ -	$ 160,000	$ 160,000	$ 3,889,196	$ 5,678,109	$ 2,435,243
12		$ 96,000	$ 3,619,332	$ -	$ 3,715,332	$ 5,614,122	$ 2,229,445	$ -	$ 5,614,122	$ -	$ 2,229,445	2022	12				$ -	$ 160,000	$ 160,000	$ 3,875,332	$ 5,855,893	$ 2,325,456
13		$ 36,000	$ 3,546,946	$ -	$ 3,582,946	$ 5,603,570	$ 2,060,421	$ -	$ 5,603,570	$ -	$ 2,060,421	2023	13				$ -	$ 160,000	$ 160,000	$ 3,742,946	$ 5,853,803	$ 2,152,431
14		$ 36,000	$ 3,476,007	$ -	$ 3,512,007	$ 5,684,866	$ 1,935,475	$ -	$ 5,684,866	$ -	$ 1,935,475	2024	14				$ -	$ 160,000	$ 160,000	$ 3,672,007	$ 5,943,857	$ 2,023,652
15		$ 96,000	$ 3,406,487	$ 600,000	$ 4,102,487	$ 6,873,096	$ 2,166,687	$ 1,005,209	$ 5,867,887	$ 316,884	$ 1,849,803	2025	15				$ 31,807	$ 160,000	$ 191,807	$ 4,294,293	$ 7,194,439	$ 2,267,987
16		$ 36,000	$ 3,338,357	$ -	$ 3,374,357	$ 5,851,088	$ 1,707,877	$ -	$ 5,851,088	$ -	$ 1,707,877	2026	16	$ 739,000			$ -	$ 160,000	$ 899,000	$ 4,273,357	$ 7,409,941	$ 2,162,891
17		$ 36,000	$ 3,271,590	$ -	$ 3,307,590	$ 5,936,050	$ 1,604,330	$ -	$ 5,936,050	$ -	$ 1,604,330	2027	17	$ -	$ 100,000		$ -	$ 160,000	$ 260,000	$ 3,567,590	$ 6,402,666	$ 1,730,442
18		$ 96,000	$ 3,206,158	$ -	$ 3,302,158	$ 6,133,723	$ 1,534,958	$ -	$ 6,133,723	$ -	$ 1,534,958	2028	18	$ -	$ 98,000		$ -	$ 160,000	$ 258,000	$ 3,560,158	$ 6,612,955	$ 1,654,886
19		$ 36,000	$ 3,142,035	$ -	$ 3,178,035	$ 6,109,776	$ 1,415,709	$ -	$ 6,109,776	$ -	$ 1,415,709	2029	19	$ -	$ 96,040		$ -	$ 160,000	$ 256,040	$ 3,434,075	$ 6,602,013	$ 1,529,766
20		$ 36,000	$ 3,079,194	$ 600,000	$ 3,715,194	$ 7,392,452	$ 1,586,037	$ 1,193,873	$ 6,198,578	$ 256,143	$ 1,329,894	2030	20	$ 36,950	$ 94,119		$ 31,807	$ 160,000	$ 322,876	$ 4,038,070	$ 8,034,907	$ 1,723,875
21		$ 96,000	$ 3,017,610	$ -	$ 3,113,610	$ 6,412,267	$ 1,273,834	$ -	$ 6,412,267	$ -	$ 1,273,834	2031	21	$ -	$ 92,237		$ -	$ 160,000	$ 252,237	$ 3,365,847	$ 6,931,731	$ 1,377,028
22		$ 36,000	$ 2,957,258	$ -	$ 2,993,258	$ 6,380,164	$ 1,173,571	$ -	$ 6,380,164	$ -	$ 1,173,571	2032	22	$ -	$ 90,392		$ -	$ 160,000	$ 250,392	$ 3,243,650	$ 6,913,878	$ 1,271,742
23		$ 36,000	$ 2,898,113	$ -	$ 2,934,113	$ 6,472,989	$ 1,102,449	$ -	$ 6,472,989	$ -	$ 1,102,449	2033	23	$ -	$ 88,584		$ -	$ 160,000	$ 248,584	$ 3,182,697	$ 7,021,394	$ 1,195,851
24		$ 96,000	$ 2,840,151	$ -	$ 2,936,151	$ 6,704,196	$ 1,057,247	$ -	$ 6,704,196	$ -	$ 1,057,247	2034	24	$ -	$ 86,813		$ -	$ 160,000	$ 246,813	$ 3,182,963	$ 7,267,750	$ 1,146,119
25		$ 36,000	$ 2,783,348	$ 600,000	$ 3,419,348	$ 8,080,756	$ 1,179,935	$ 1,417,947	$ 6,662,809	$ 207,046	$ 972,889	2035	25	$ 36,950	$ 85,076		$ 31,807	$ 160,000	$ 313,833	$ 3,733,181	$ 8,822,420	$ 1,288,231
26		$ 36,000	$ 2,727,681	$ -	$ 2,763,681	$ 6,759,848	$ 913,943	$ -	$ 6,759,848	$ -	$ 913,943	2036	26	$ -	$ 83,375		$ -	$ 160,000	$ 243,375	$ 3,007,055	$ 7,355,133	$ 994,427
27		$ 96,000	$ 2,673,127	$ -	$ 2,769,127	$ 7,010,231	$ 877,588	$ -	$ 7,010,231	$ -	$ 877,588	2037	27	$ -	$ 81,707		$ -	$ 160,000	$ 241,707	$ 3,010,834	$ 7,622,129	$ 954,190
28		$ 36,000	$ 2,619,664	$ -	$ 2,655,664	$ 6,958,298	$ 806,562	$ -	$ 6,958,298	$ -	$ 806,562	2038	28	$ -	$ 80,073				$ 80,073	$ 2,735,738	$ 7,168,103	$ 830,881
29		$ 36,000	$ 2,567,271	$ -	$ 2,603,271	$ 7,059,754	$ 757,706	$ -	$ 7,059,754	$ -	$ 757,706	2039	29	$ -	$ 78,472				$ 78,472	$ 2,681,743	$ 7,272,559	$ 780,546
30		$ 96,000	$ 2,515,926	$ -	$ 2,611,926	$ 7,331,137	$ 728,549	$ -	$ 7,331,137	$ -	$ 728,549	2040	30	$ -	$ 76,902				$ 76,902	$ 2,688,828	$ 7,546,985	$ 749,999
	$ 29,628,000	$ 1,690,000	$ 89,811,639	$ 2,400,000	$ 123,529,639	$ 199,888,487	**$ 77,116,000**	$ 37,296,000	$ 162,593,000	$ 27,300,000	$ 49,800,000		$ 812,900	$ 1,231,790	$ 1,879,000	$ 71,000	$ 3,190,034	$ 4,000,000	$ 11,185,000	$ 134,715,000	$ 216,748,000	**$ 84,736,000**

Major Assumptions in the Cost Estimate

1. Annual sampling is required for 45 wells (following installation of additional wells)
2. Every 3 years, annual sampling is required for 135 wells (includes public supply wells)
3. First two sampling rounds: sampling will be conducting using low flow pumps (not dedicated)
4. Following first two sampling rounds, sampling will be conducted using PDBs
5. Pump sampling: 4 wells per day
6. PDB sampling: ~5 wells/day
7. Laboratory analysis for VOCs by EPA 8260B (chlorinated VOCs)
8. 30 years O&M for OU2 IRM
9. 30 years O&M for RW-400/-502 Plant
10. 4 diffusion wells for RW-400/RW-502 Plant located at the west end of VLSGC
11. O&M Costs for RW-400/-502 Plant, Use 2008 IRM Costs and Update as Follows:
* Scale Electrical Costs based on ratio of new higher hp to old hp
* Assume Media Costs are increased by 100% (since flow rate will roughly triple and
new flow will conservatively have the same removal rate)
* Increase labor costs by 15%
12. VC offgas treatment media (PZ) will be required every 5 years in the IRM system
and every 7.5 years in the RW-400/-502 system
13. Capital Costs
Years 1 and 2 - Install Groundwater Monitoring Wells, Extraction Wells, Diffusion Wells, and Piping
Years 2 - Install Treatment Plant at RW-400 (1/2)
Year 3 - Install Treatment Plant at RW-400 (1/2)

		Wellhead	Wellhead			Wellhead	Wellhead												
		Total	Total			Total	Total			Total	Total	Grand Total				Total	Total	Grand Total	
	Year	Capital FV	O&M FV			Capital PV	O&M PV			Capital FV	O&M FV	FV				Capital PV	O&M PV	PV	
2011	1	$ 1,568,543	$ -			$ 1,452,354	$ -			$ 8,155,283	$ 1,454,175	$ 9,609,458				$ 7,551,188	$ 1,346,458	$ 8,897,646	
2012	2	$ 1,623,441	$ -			$ 1,391,839	$ -			$ 7,030,985	$ 1,505,071	$ 8,536,056				$ 6,027,937	$ 1,290,356	$ 7,318,293	
2013	3	$ -	$ 177,395			$ -	$ 140,822			$ 6,622,372	$ 1,796,123	$ 8,418,495				$ 5,257,052	$ 1,425,820	$ 6,682,873	
2014	4	$ 1,078,098	$ 183,604			$ 792,434	$ 134,954			$ 10,367,297	$ 2,956,019	$ 13,323,316				$ 7,620,272	$ 2,172,762	$ 9,793,035	
2015	5	$ 1,153,608	$ 190,030			$ 785,126	$ 129,331			$ 6,080,131	$ 3,002,946	$ 9,083,077				$ 4,138,035	$ 2,043,755	$ 6,181,789	
2016	6	$ -	$ 283,958			$ -	$ 178,942			$ -	$ 5,424,399	$ 5,424,399				$ -	$ 3,418,291	$ 3,418,291	
2017	7	$ -	$ 203,565			$ -	$ 118,778			$ -	$ 5,343,620	$ 5,343,620				$ -	$ 3,117,951	$ 3,117,951	
2018	8	$ -	$ 210,689			$ -	$ 113,829			$ -	$ 5,425,196	$ 5,425,196				$ -	$ 2,931,064	$ 2,931,064	
2019	9	$ -	$ 218,064			$ -	$ 109,086			$ -	$ 5,589,892	$ 5,589,892				$ -	$ 2,796,338	$ 2,796,338	
2020	10	$ 44,867	$ 225,696			$ 20,782	$ 104,541			$ 891,226	$ 5,592,414	$ 6,483,640				$ 412,810	$ 2,590,370	$ 3,003,180	
2021	11	$ -	$ 233,595			$ -	$ 100,185			$ -	$ 5,678,109	$ 5,678,109				$ -	$ 2,435,243	$ 2,435,243	
2022	12	$ -	$ 241,771			$ -	$ 96,011			$ -	$ 5,855,893	$ 5,855,893				$ -	$ 2,325,456	$ 2,325,456	
2023	13	$ -	$ 250,233			$ -	$ 92,010			$ -	$ 5,853,803	$ 5,853,803				$ -	$ 2,152,431	$ 2,152,431	
2024	14	$ -	$ 258,991			$ -	$ 88,176			$ -	$ 5,943,857	$ 5,943,857				$ -	$ 2,023,652	$ 2,023,652	
2025	15	$ 53,288	$ 268,056			$ 16,798	$ 84,502			$ 1,058,497	$ 6,135,943	$ 7,194,439				$ 333,682	$ 1,934,305	$ 2,267,987	
2026	16	$ 1,281,416	$ 277,438			$ 374,033	$ 80,981			$ 1,281,416	$ 6,128,525	$ 7,409,941				$ 374,033	$ 1,788,858	$ 2,162,891	
2027	17	$ -	$ 466,616			$ -	$ 126,112			$ -	$ 6,402,666	$ 6,402,666				$ -	$ 1,730,442	$ 1,730,442	
2028	18	$ -	$ 479,232	***Capital***	***O&M***	$ -	$ 119,927	***Capital***	***O&M***	$ -	$ 6,612,955	$ 6,612,955	***Capital***	***O&M***		$ -	$ 1,654,886	$ 1,654,886	***Capital***	***O&M***
2029	19	$ -	$ 492,237	***20 yr FV***	***20 yr FV***	$ -	$ 114,057	***20 yr PV***	***20 yr PV***	$ -	$ 6,602,013	$ 6,602,013	***20 yr FV***	***20 yr FV***		$ -	$ 1,529,766	$ 1,529,766	***20 yr PV***	***20 yr PV***
2030	20	$ 136,812	$ 505,644	***$ 6,940,000***	***$ 5,167,000***	$ 29,353	$ 108,485	***$ 4,863,000***	***$ 2,041,000***	$ 1,330,685	$ 6,704,222	$ 8,034,907	***$ 42,818,000***	***$ 100,008,000***		$ 285,496	$ 1,438,379	$ 1,723,875	***$ 32,001,000***	***$ 42,147,000***
2031	21	$ -	$ 519,464			$ -	$ 103,195			$ -	$ 6,931,731	$ 6,931,731				$ -	$ 1,377,028	$ 1,377,028		
2032	22	$ -	$ 533,714			$ -	$ 98,172			$ -	$ 6,913,878	$ 6,913,878				$ -	$ 1,271,742	$ 1,271,742		
2033	23	$ -	$ 548,405			$ -	$ 93,402			$ -	$ 7,021,394	$ 7,021,394				$ -	$ 1,195,851	$ 1,195,851		
2034	24	$ -	$ 563,554			$ -	$ 88,872			$ -	$ 7,267,750	$ 7,267,750				$ -	$ 1,146,119	$ 1,146,119		
2035	25	$ 162,489	$ 579,175			$ 23,726	$ 84,570			$ 1,580,436	$ 7,241,984	$ 8,822,420				$ 230,772	$ 1,057,459	$ 1,288,231		
2036	26	$ -	$ 595,285			$ -	$ 80,484			$ -	$ 7,355,133	$ 7,355,133				$ -	$ 994,427	$ 994,427		
2037	27	$ -	$ 611,898			$ -	$ 76,602			$ -	$ 7,622,129	$ 7,622,129				$ -	$ 954,190	$ 954,190		
2038	28	$ -	$ 209,805			$ -	$ 24,319			$ -	$ 7,168,103	$ 7,168,103				$ -	$ 830,881	$ 830,881		
2039	29	$ -	$ 212,806			$ -	$ 22,840			$ -	$ 7,272,559	$ 7,272,559				$ -	$ 780,546	$ 780,546		
2040	30	$ -	$ 215,849			$ -	$ 21,450			$ -	$ 7,546,985	$ 7,546,985				$ -	$ 749,999	$ 749,999		
		$ 7,103,000	**$ 9,757,000**			**$ 4,886,000**	**$ 2,735,000**			**$ 44,398,000**	**$ 172,349,000**	**$ 216,748,000**				**$ 32,231,000**	**$ 52,505,000**	**$ 84,736,000**		

Table C-5 Cost Estimate for OU-2 Alternative 4j, LMC, Great Neck.

Outpost Monitoring
OU-2 IRM O&M
Install 4 New Extraction Wells at VLSGC, MLWD, and in OU-1 (RW300, RW400BM, RW400BM, and EW1D)
Install 6 New Diffusion Wells at VLSGC, FMCC (DW300, DW301, DW400 through DW402, and DW402a)
Install a New 500-gpm Treatment Plant at VLSGC
Install a New 1,200-gpm Treatment Plant at MLWD
30 Years of O&M of New Treatment Plants
Install 4 New Groundwater Monitoring Wells into Basal Magothy

Description	Quantity	Units	Unit Cost ($)	Total Cost ($)	Descriptions
Install 4 Groundwater Monitoring Well Clusters (250-350 ft)				**$ 2,000,000**	
Install New Extraction Wells					
(VLSGC and EW1D Extraction Wells)					
1. RW300 and EW1D	2	ea	$ 875,000	$ 1,750,000	Typ. diffusion well cost x 25% Includes: 60 Hp pump, leads, and installation Piping work in vault: main, cla-valve, gate valve, fittings, flow meter. Below-grade Concrete Vault Hatches, Coatings, Heater Site Preparation, Site Restoration and Waste Removal Well Development and Testing
2. Well Access Fee	1	ea	$ 50,000	$ 50,000	Well access fee not required for EW-1D
3. Well Permitting Fee	2	ea	$ 20,000	$ 40,000	
Subtotal				**$ 1,840,000**	
(MLWD Extraction Wells)					
1. RW400BM and RW400MM	2	ea	$ 875,000	$ 1,750,000	
2. Well Access Fee	1	ea	$ 50,000	$ 50,000	
3. Well Permitting Fee	2	ea	$ 20,000	$ 40,000	
4. Discharge Piping from RW400 to Treatment Plant	800	ft	$ 175	$ 140,000	Includes double-walled 8" PVC piping, trenching and restoration.
Subtotal				**$ 1,980,000**	
Install New Diffusion Wells (6)					
(Two [2] Wells at VLSGC)					
1. Drill and install diffusion wells	2	ea	$ 700,000	$ 1,400,000	ARCADIS Proposal to Lockheed dated 6/28/07; Delta Well & Pum. Bid to ARCADIS (11/07)
2. Discharge Piping from Plant to DW300 and DW301	5,000	ft	$ 85	$ 425,000	Single-wall, 8" Blue Brute HDPE piping, trenching, and restoration. Est. from pervious ARCADIS FS cost estimates with inflation.
3. Piping Appurtenances	1	ls	$ 30,000	$ 30,000	Valves, piping between diffusion wells. Basis: prev. ARCADIS FS cost estimates.
4. Additional Design & Permitting	1	ea	$ 50,000	$ 50,000	Basis: ARCADIS Cost Proposal to Lockheed dated 6/28/07
5. Well Access Fee	1	ea	$ 50,000	$ 50,000	
Subtotal				**$ 1,955,000**	
(Four [4] Wells at FMCC)					
1. Drill and install diffusion wells	4	ea	$ 700,000	$ 2,800,000	
2. Discharge Piping from Plant to Diffusion Wells	6,000	ft	$ 85	$ 510,000	
3. Piping Appurtenances	1	ls	$ 30,000	$ 30,000	
4. Additional Design & Permitting	1	ea	$ 50,000	$ 50,000	
5. Well Access Fee	1	ea	$ 50,000	$ 50,000	
Subtotal				**$ 3,440,000**	
Install New Treatment Plants					*Note: Basis of Below Costs, except as noted*
(500-gpm plant at VLSGC for RW300)					
1. General Site Preparation	1	ls	$ 150,000	$ 150,000	Clearing, grading, mobilization and foundation preparation
2. Treatment Building					
Concrete Work	1	ea	$ 75,000	$ 75,000	Foundation (incl. clearwells)
Building	3,000	lf	$ 250	$ 750,000	Cost based on RTKL architect's estimate
HVAC	1	ea	$ 20,000	$ 20,000	
Soil transport.	1,000	cy	$ 6.62	$ 6,623	On-site haul. Spread in basins.
Final Grading, Fencing, and Landscape	1	ls	$ 50,000	$ 50,000	
3. Major Process Equipment Items					
Air Stripping Tower	1	ea	$ 226,000	$ 226,000	
Off-gas Treatment Vessels, filled with media	1	ls	$ 372,000	$ 372,000	Estimate from Tigg Corp. to ARCADIS dated 8/3/07 ($500k capital cost for 5 vessels in same config. As IRM); 56,000 lb PPZ x $1.10lb; 60,000 lb VPGAC x $1.20/lb est. from experience
Horizontal Mist Eliminator and Knock-Out Tank	1	ea	$ 11,000	$ 11,000	
Duct Heater	1	ea	$ 24,000	$ 24,000	Assumes 50 hp unit. Est. from experience.
Clearwell Pumps	2	ea	$ 21,000	$ 42,000	Assumes two 20 hp variable speed drive pumps. Est. from experience.
Filtration System	1	ls	$ 75,000	$ 75,000	Bag Filter System.
Ducting	1	ls	$ 169,000	$ 169,000	Duct and insulation/controls installed. Est. from experience with IRM installation.
Discharge Pump	2	ea	$ 27,000	$ 54,000	50 Hp pump. Est. from experience.
Blower	1	ea	$ 32,000	$ 32,000	100 hp blower. Per quote from Northern Blower to ARCADIS dated 12/9/05 (plus inflation) plus
4. Mechanical Components					
Piping from Extraction Well to Treatment Plant	300	ft	$ 175	$ 52,500	Includes double-walled 8" HDPE piping, trenching and restoration.
Extraction Well Piping Leak Detection System	300	ft	$ 25	$ 7,500	
Process Piping	1	ls	$ 115,000	$ 115,000	Includes labor and piping (building interior)/process equipment installation
Piping Appurtanances	1	ls	$ 75,000	$ 75,000	Includes valves, gauges, controls, sensors, flowmeters, diffusion line flush.
5. Electrical Components					
Electrical Service Conduits, Transformer	1	ea	$ 90,000	$ 90,000	800 amp service
Power to Treatment Structure	100	ft	$ 100	$ 10,000	From source to treatment building
Conduit/Conductors to Well Vaults	300	ft	$ 35	$ 10,500	
Building Controls and Distribution	1	ea	$ 95,000	$ 95,000	Includes MCC, disconnect, lights, power to HVAC
Process Controls	1	ea	$ 95,000	$ 95,000	Includes PLC and interlocks, alarms, etc.
6. Building Security System	1	ls	$ 25,000	$ 25,000	Alarm system.
7. Mechanical Installation	100%	of	$ 1,255,000	$ 1,260,000	
8. Electrical Installation	25%	of	$ 325,500	$ 81,000	
9. Treatment System Operational Testing and Startup	1	ls	$ 10,000	$ 10,000	Includes laboratory sample analysis.
10. Treatment System Access Fee	1	ea	$ 100,000	$ 100,000	
Subtotal				**$ 4,083,000**	

Table C-5 Cost Estimate for OU-2 Alternative 4j, LMC, Great Neck.

Outpost Monitoring
OU-2 IRM O&M
Install 4 New Extraction Wells at VLSGC, MLWD, and in OU-1 (RW300, RW400BM, RW400BM, and EW1D)
Install 6 New Diffusion Wells at VLSGC, FMCC (DW300, DW301, DW400 through DW402, and DW402a)
Install a New 500-gpm Treatment Plant at VLSGC
Install a New 1,200-gpm Treatment Plant at MLWD
30 Years of O&M of New Treatment Plants
Install 4 New Groundwater Monitoring Wells into Basal Magothy

Description	Quantity	Units	Unit Cost ($)	Total Cost ($)	Descriptions
(1,200-gpm plant at MLWD for RW400BM and RW400MM)					*Note: Basis of Below Costs, except as noted*
1. General Site Preparation	0.25	ea	$ 200,000	$ 50,000	Clearing, grading, mobilization and foundation preparation
2. Treatment Building					
Concrete Work	0.5	ea	$ 100,000	$ 50,000	Foundation (incl. clearwells)
Building	4,600	sf	$ 250	$ 1,150,000	Cost based on RTKL architect's estimate
HVAC	1	ea	$ 25,000	$ 25,000	
Soil transport.	625	cy	$ 6.62	$ 4,139	On-site haul. Spread in basins.
Final Grading, Fencing, and Landscape	1	ls	$ 65,000	$ 65,000	
3. Major Process Equipment Items					
Air Stripping Tower	1	ea	$ 350,000	$ 350,000	
Off-gas Treatment Vessels, filled with media	1	ls	$ 372,000	$ 372,000	Estimate from Tigg Corp. to ARCADIS dated 8/3/07 ($500k capital cost for 5 vessels in same config. As IRM); 56,000 lb PPZ x $1.10lb; 60,000 lb VPGAC x $1.20/lb est. from experience
Horizontal Mist Eliminator and Knock-Out Tank	1	ea	$ 11,000	$ 11,000	
Duct Heater	1	ea	$ 37,000	$ 37,000	Assumes 50 hp unit. Est. from experience.
Clearwell Pumps	2	ea	$ 27,000	$ 54,000	Assumes two 50 hp variable speed drive pumps. Est. from experience.
Filtration System	1	ls	$ 116,000	$ 116,000	Bag Filter System.
Ducting	1	ls	$ 225,000	$ 225,000	Duct and insulation/controls installed. Est. from experience with IRM installation.
Discharge Pump	2	ea	$ 27,000	$ 54,000	50 Hp pump. Est. from experience.
Blower	1	ea	$ 50,000	$ 50,000	100 hp blower. Per quote from Northern Blower to ARCADIS dated 12/9/05 (plus inflation) plus
4. Mechanical Components					
Extraction Well Piping Leak Detection System	800	ft	$ 25	$ 20,000	
Process Piping	1	ls	$ 175,000	$ 175,000	Includes labor and piping (building interior)/process equipment installation
Piping Appurtanances	1	ls	$ 120,000	$ 120,000	Includes valves, gauges, controls, sensors, flowmeters, diffusion line flush.
5. Electrical Components					
Electrical Service Conduits, Transformer	0.5	ea	$ 90,000	$ 45,000	800 amp service
Power to Treatment Structure	100	ft	$ 100	$ 10,000	From source to treatment building
Conduit/Conductors to Well Vaults	800	ft	$ 35	$ 28,000	
Building Controls and Distribution	1	ea	$ 115,000	$ 115,000	Includes MCC, disconnect, lights, power to HVAC
Process Controls	1	ea	$ 115,000	$ 115,000	Includes PLC and interlocks, alarms, etc.
6. Building Security System	1	ls	$ 25,000	$ 25,000	Alarm system.
7. Mechanical Installation	100%	of	$ 1,584,000	$ 1,580,000	
8. Electrical Installation	25%	of	$ 338,000	$ 85,000	
9. Treatment System Operational Testing and Startup	1	ls	$ 15,000	$ 15,000	Includes laboratory sample analysis.
10. Treatment System Access Fee	1	ea	$ 100,000	$ 100,000	
Subtotal				**$ 5,047,000**	
Subtotal of Capital Costs				**$ 20,345,000**	
Engineering/Project Management					
1. Engineering (5% of capital cost)	5%	of	$ 20,345,000	$ 1,017,250	
2. Construction Management (7% of capital cost)	7%	of	$ 20,345,000	$ 1,424,150	
3. Project Management (10% of capital cost)	10%	of	$ 20,345,000	$ 2,034,500	
4. Construction Contingency (Union Labor; 15% of capital cost)	15%	of	$ 20,345,000	$ 3,051,750	
5. New York State Sales Tax (8.625% of capital cost)	8.625%	of	$ 20,345,000	$ 1,754,756	
Subtotal				$ 9,282,000	
TOTAL CAPITAL COST				**$ 29,600,000**	
Treatment Plant/Equipment Annual O&M					
(OU-2 IRM P&T System Cost)					
GWTS Operations, Checklist and Inspections	1	ls	$ 256,000	$ 256,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Monthly Compliance Sampling/Analysis and Alarm Testing	1	ls	$ 56,000	$ 56,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Quarterly O&M Activities - Preventative Maintenance	1	ls	$ 80,000	$ 80,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Extraction Well Cleaning and Redevelopment	0.33	ls	$ 190,000	$ 62,700	2010 budget estimate to clean one well (performed every 3 years)
Diffusion Well Cleaning and Redevelopment	0.33	ls	$ 210,000	$ 69,300	2010 budget estimate to clean one well with carbon dioxide (performed every 3 years)
Monthly Utility Expenses, including electric	1	ls	$ 180,000	$ 180,000	From RAA-2a costing
Monthly Service Contractors (e.g., electrical, controls)	1	ls	$ 120,000	$ 120,000	2010 spend plus 20%
Vapor Phase Carbon Replacement	1	ls	$ 100,000	$ 100,000	2010 spend
Zeolite/Pot Perm Media Cost (VC removal)	1	ls	$ 26,250	$ 26,250	Annualized based on change-out every 4 years
Quarterly Progress Reports to NYSDEC	1	ls	$ 28,000	$ 28,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Unscheduled O&M and System Repair	1	ls	$ 120,000	$ 120,000	2010 spend, reduced by 20% for treatment system duplication efficiency
OM&M Plan Revisions and As-Builts	1	ls	$ 32,000	$ 32,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Annual GWTS Performance Analysis	1	ls	$ 28,800	$ 28,800	2010 spend, reduced by 20% for treatment system duplication efficiency
Project Management	1	ls	$ 44,000	$ 44,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Subtotal				**$ 1,200,000**	
(New 500-gpm RW300 Treatment System)					
GWTS Operations, Checklist and Inspections	1	ls	$ 256,000	$ 256,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Monthly Compliance Sampling/Analysis and Alarm Testing	1	ls	$ 56,000	$ 56,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Quarterly O&M Activities - Preventative Maintenance	1	ls	$ 80,000	$ 80,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Extraction Well Cleaning and Redevelopment	0.33	ls	$ 190,000	$ 62,700	2010 budget estimate to clean one well (performed every 3 years)
Diffusion Well Cleaning and Redevelopment	0.33	ls	$ 210,000	$ 69,300	2010 budget estimate to clean one well with carbon dioxide (performed every 3 years)
Monthly Utility Expenses, including electric	1	ls	$ 180,000	$ 180,000	From RAA-2a estiimate
Monthly Service Contractors (e.g., electrical, controls)	1	ls	$ 120,000	$ 120,000	2010 spend plus 20%
Vapor Phase Carbon Replacement	1	ls	$ 100,000	$ 100,000	2010 spend
Zeolite/Pot Perm Media Cost (VC removal)	0	ls	$ 26,250	$ -	
Quarterly Progress Reports to NYSDEC	1	ls	$ 28,000	$ 28,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Unscheduled O&M and System Repair	1	ls	$ 120,000	$ 120,000	2010 spend, reduced by 20% for treatment system duplication efficiency
OM&M Plan Revisions and As-Builts	1	ls	$ 32,000	$ 32,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Annual GWTS Performance Analysis	1	ls	$ 28,800	$ 28,800	2010 spend, reduced by 20% for treatment system duplication efficiency
Project Management	1	ls	$ 44,000	$ 44,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Subtotal				**$ 1,180,000**	
(New 1,200-gpm RW400 Treatment System)					
GWTS Operations, Checklist and Inspections	1	ls	$ 256,000	$ 256,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Monthly Compliance Sampling/Analysis and Alarm Testing	1	ls	$ 56,000	$ 56,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Quarterly O&M Activities - Preventative Maintenance	1	ls	$ 80,000	$ 80,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Extraction Well Cleaning and Redevelopment	0.67	ls	$ 190,000	$ 127,300	2010 budget estimate to clean one well (performed every 3 years)
Diffusion Well Cleaning and Redevelopment	0.67	ls	$ 210,000	$ 140,700	2010 budget estimate to clean one well with carbon dioxide (performed every 3 years)
Monthly Utility Expenses, including electric	1	ls	$ 432,000	$ 432,000	Flow rate adjusted from RAA-2a costing
Monthly Service Contractors (e.g., electrical, controls)	1	ls	$ 120,000	$ 120,000	2010 spend plus 20%
Vapor Phase Carbon Replacement	1	ls	$ 240,000	$ 240,000	Flow rate adjusted from RAA-2a costing
Zeolite/Pot Perm Media Cost (VC removal)	0	ls	$ 26,250	$ -	
Quarterly Progress Reports to NYSDEC	1	ls	$ 28,000	$ 28,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Unscheduled O&M and System Repair	1	ls	$ 217,500	$ 217,500	2010 spend for OU-2, increased by 45% for 1,200-gpm system vs. 500-gpm system
OM&M Plan Revisions and As-Builts	1	ls	$ 32,000	$ 32,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Annual GWTS Performance Analysis	1	ls	$ 28,800	$ 28,800	2010 spend, reduced by 20% for treatment system duplication efficiency
Project Management	1	ls	$ 44,000	$ 44,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Subtotal				**$ 1,800,000**	
TOTAL ANNUAL O&M COST				**$ 4,180,000**	

NPV Operation & Maintenance Costs Escalated over a 30-Year Period
Discount Rate: 8%
Escalation Rate: 3.5%

Year	Capital Cost [1]	Monitoring Cost	OU-2 O&M Cost	OU-2 Capital Improvements	Pre-Escalated Cost	Escalated Cost (FV)	OU-2 PV (Cost)	OU-2 Capital FV	OU-2 O&M FV	OU-2 Capital PV	OU-2 O&M NPV	Year	N12796 & N4388 Capital Cost	N12796 & N4388 O&M	N5099 Capital Cost	N5099 O&M	N13000b Capital Cost	N13000b O&M	Welhead Pre-Escalated Cost	Grand Total Pre-Escalated Cost	Grand Total Escalated Cost (FV)	Grand Total PV (Cost)
1	$ 6,364,000	$ 41,000	$ 1,364,000		$ 7,769,000	$ 8,040,915	$ 7,445,292	$ 6,586,740	$ 1,454,175	$ 6,098,833	$ 1,346,458	2011	1				$ 1,515,500		$ 1,515,500	$ 9,284,500	$ 9,609,458	$ 8,897,646
2	$ 5,048,000	$ 41,000	$ 1,364,000		$ 6,453,000	$ 6,912,615	$ 5,926,453	$ 5,407,544	$ 1,505,071	$ 4,636,097	$ 1,290,356	2012	2				$ 1,515,500		$ 1,515,500	$ 7,968,500	$ 8,536,056	$ 7,318,293
3	$ 5,973,000	$ 96,000	$ 1,364,000		$ 7,433,000	$ 8,241,100	$ 6,542,051	$ 6,622,372	$ 1,618,728	$ 5,257,052	$ 1,284,999	2013	3				$ -	$ 160,000	$ 160,000	$ 7,593,000	$ 8,418,495	$ 6,682,873
4	$ 8,095,000	$ 36,000	$ 2,380,000		$ 10,511,000	$ 12,061,614	$ 8,865,647	$ 9,289,199	$ 2,772,416	$ 6,827,838	$ 2,037,808	2014	4				$ -	$ 160,000	$ 160,000	$ 10,671,000	$ 12,245,218	$ 9,000,601
5	$ 4,148,000	$ 36,000	$ 2,332,400		$ 6,516,400	$ 7,739,439	$ 5,267,332	$ 4,926,523	$ 2,812,916	$ 3,352,909	$ 1,914,424	2015	5				$ 31,807	$ 160,000	$ 191,807	$ 6,708,207	$ 7,967,245	$ 5,422,373
6		$ 96,000	$ 4,085,752	$ -	$ 4,181,752	$ 5,140,441	$ 3,239,350	$ -	$ 5,140,441	$ -	$ 3,239,350	2016	6				$ -	$ 160,000	$ 160,000	$ 4,341,752	$ 5,337,122	$ 3,363,292
7		$ 36,000	$ 4,004,037	$ -	$ 4,040,037	$ 5,140,055	$ 2,999,173	$ -	$ 5,140,055	$ -	$ 2,999,173	2017	7				$ -	$ 160,000	$ 160,000	$ 4,200,037	$ 5,343,620	$ 3,117,951
8		$ 36,000	$ 3,923,956	$ -	$ 3,959,956	$ 5,214,506	$ 2,817,235	$ -	$ 5,214,506	$ -	$ 2,817,235	2018	8				$ -	$ 160,000	$ 160,000	$ 4,119,956	$ 5,425,196	$ 2,931,064
9		$ 96,000	$ 3,845,477	$ -	$ 3,941,477	$ 5,371,829	$ 2,687,252	$ -	$ 5,371,829	$ -	$ 2,687,252	2019	9				$ -	$ 160,000	$ 160,000	$ 4,101,477	$ 5,589,892	$ 2,796,338
10		$ 36,000	$ 3,768,568	$ 600,000	$ 4,404,568	$ 6,213,078	$ 2,877,857	$ 846,359	$ 5,366,718	$ 392,028	$ 2,485,829	2020	10				$ 31,807	$ 160,000	$ 191,807	$ 4,596,374	$ 6,483,640	$ 3,003,180
11		$ 36,000	$ 3,693,196	$ -	$ 3,729,196	$ 5,444,514	$ 2,335,059	$ -	$ 5,444,514	$ -	$ 2,335,059	2021	11				$ -	$ 160,000	$ 160,000	$ 3,889,196	$ 5,678,109	$ 2,435,243
12		$ 96,000	$ 3,619,332	$ -	$ 3,715,332	$ 5,614,122	$ 2,229,445	$ -	$ 5,614,122	$ -	$ 2,229,445	2022	12				$ -	$ 160,000	$ 160,000	$ 3,875,332	$ 5,855,893	$ 2,325,456
13		$ 36,000	$ 3,546,946	$ -	$ 3,582,946	$ 5,603,570	$ 2,060,421	$ -	$ 5,603,570	$ -	$ 2,060,421	2023	13				$ -	$ 160,000	$ 160,000	$ 3,742,946	$ 5,853,803	$ 2,152,431
14		$ 36,000	$ 3,476,007	$ -	$ 3,512,007	$ 5,684,866	$ 1,935,475	$ -	$ 5,684,866	$ -	$ 1,935,475	2024	14				$ -	$ 160,000	$ 160,000	$ 3,672,007	$ 5,943,857	$ 2,023,652
15		$ 96,000	$ 3,406,487	$ 600,000	$ 4,102,487	$ 6,873,096	$ 2,166,687	$ 1,005,209	$ 5,867,887	$ 316,884	$ 1,849,803	2025	15				$ 31,807	$ 160,000	$ 191,807	$ 4,294,293	$ 7,194,439	$ 2,267,987
16		$ 36,000	$ 3,338,357	$ -	$ 3,374,357	$ 5,851,088	$ 1,707,877	$ -	$ 5,851,088	$ -	$ 1,707,877	2026	16	$ 739,000				$ -	$ 160,000	$ 899,000	$ 4,273,357	$ 7,409,941	$ 2,162,891
17		$ 36,000	$ 3,271,590	$ -	$ 3,307,590	$ 5,936,050	$ 1,604,330	$ -	$ 5,936,050	$ -	$ 1,604,330	2027	17	$ -	$ 100,000			$ -	$ 160,000	$ 260,000	$ 3,567,590	$ 6,402,666	$ 1,730,442
18		$ 96,000	$ 3,206,158	$ -	$ 3,302,158	$ 6,133,723	$ 1,534,958	$ -	$ 6,133,723	$ -	$ 1,534,958	2028	18	$ -	$ 98,000			$ -	$ 160,000	$ 258,000	$ 3,560,158	$ 6,612,955	$ 1,654,886
19		$ 36,000	$ 3,142,035	$ -	$ 3,178,035	$ 6,109,776	$ 1,415,709	$ -	$ 6,109,776	$ -	$ 1,415,709	2029	19	$ -	$ 96,040			$ -	$ 160,000	$ 256,040	$ 3,434,075	$ 6,602,013	$ 1,529,766
20		$ 36,000	$ 3,079,194	$ 600,000	$ 3,715,194	$ 7,392,452	$ 1,586,037	$ 1,193,873	$ 6,198,578	$ 256,143	$ 1,329,894	2030	20	$ 36,950	$ 94,119			$ 31,807	$ 160,000	$ 322,876	$ 4,038,070	$ 8,034,907	$ 1,723,875
21		$ 96,000	$ 3,017,610	$ -	$ 3,113,610	$ 6,412,267	$ 1,273,834	$ -	$ 6,412,267	$ -	$ 1,273,834	2031	21	$ -	$ 92,237			$ -	$ 160,000	$ 252,237	$ 3,365,847	$ 6,931,731	$ 1,377,028
22		$ 36,000	$ 2,957,258	$ -	$ 2,993,258	$ 6,380,164	$ 1,173,571	$ -	$ 6,380,164	$ -	$ 1,173,571	2032	22	$ -	$ 90,392			$ -	$ 160,000	$ 250,392	$ 3,243,650	$ 6,913,878	$ 1,271,742
23		$ 36,000	$ 2,898,113	$ -	$ 2,934,113	$ 6,472,989	$ 1,102,449	$ -	$ 6,472,989	$ -	$ 1,102,449	2033	23	$ -	$ 88,584			$ -	$ 160,000	$ 248,584	$ 3,182,697	$ 7,021,394	$ 1,195,851
24		$ 96,000	$ 2,840,151	$ -	$ 2,936,151	$ 6,704,196	$ 1,057,247	$ -	$ 6,704,196	$ -	$ 1,057,247	2034	24	$ -	$ 86,813			$ -	$ 160,000	$ 246,813	$ 3,182,963	$ 7,267,750	$ 1,146,119
25		$ 36,000	$ 2,783,348	$ 600,000	$ 3,419,348	$ 8,080,756	$ 1,179,935	$ 1,417,947	$ 6,662,809	$ 207,046	$ 972,889	2035	25	$ 36,950	$ 85,076			$ 31,807	$ 160,000	$ 313,833	$ 3,733,181	$ 8,822,420	$ 1,288,231
26		$ 36,000	$ 2,727,681	$ -	$ 2,763,681	$ 6,759,848	$ 913,943	$ -	$ 6,759,848	$ -	$ 913,943	2036	26	$ -	$ 83,375			$ -	$ 160,000	$ 243,375	$ 3,007,055	$ 7,355,133	$ 994,427
27		$ 96,000	$ 2,673,127	$ -	$ 2,769,127	$ 7,010,231	$ 877,588	$ -	$ 7,010,231	$ -	$ 877,588	2037	27	$ -	$ 81,707			$ -	$ 160,000	$ 241,707	$ 3,010,834	$ 7,622,129	$ 954,190
28		$ 36,000	$ 2,619,664	$ -	$ 2,655,664	$ 6,958,298	$ 806,562	$ -	$ 6,958,298	$ -	$ 806,562	2038	28	$ -	$ 80,073					$ 80,073	$ 2,735,738	$ 7,168,103	$ 830,881
29		$ 36,000	$ 2,567,271	$ -	$ 2,603,271	$ 7,059,754	$ 757,706	$ -	$ 7,059,754	$ -	$ 757,706	2039	29	$ -	$ 78,472					$ 78,472	$ 2,681,743	$ 7,272,559	$ 780,546
30		$ 96,000	$ 2,515,926	$ -	$ 2,611,926	$ 7,331,137	$ 728,549	$ -	$ 7,331,137	$ -	$ 728,549	2040	30	$ -	$ 76,902					$ 76,902	$ 2,688,828	$ 7,546,985	$ 749,999
	$ 29,628,000			$ 2,400,000	$ 123,529,639	$ 199,888,487	**$ 77,116,000**	$ 37,296,000	$ 162,593,000	$ 27,300,000	$ 49,800,000		**$ 812,900**	$ 1,231,790	$ -	$ -	$ 3,190,034	$ 4,000,000	$ 9,235,000	$ 132,765,000	$ 214,467,000	**$ 83,129,000**

Major Assumptions in the Cost Estimate

1. Annual sampling is required for 45 wells (following installation of additional wells)
2. Every 3 years, annual sampling is required for 135 wells (includes public supply wells)
3. First two sampling rounds: sampling will be conducting using low flow pumps (not dedicated)
4. Following first two sampling rounds, sampling will be conducted using PDBs
5. Pump sampling: 4 wells per day
6. PDB sampling: ~5 wells/day
7. Laboratory analysis for VOCs by EPA 8260B (chlorinated VOCs)
8. 30 years O&M for OU2 IRM
9. 30 years O&M for RW-400/-502 Plant
10. 4 diffusion wells for RW-400/RW-502 Plant located at the west end of VLSGC
11. O&M Costs for RW-400/-502 Plant, Use 2008 IRM Costs and Update as Follows:
* Scale Electrical Costs based on ratio of new higher hp to old hp
* Assume Media Costs are increased by 100% (since flow rate will roughly triple and new flow will conservatively have the same removal rate)
* Increase labor costs by 15%
12. VC offgas treatment media (PZ) will be required every 5 years in the IRM system and every 7.5 years in the RW-400/-502 system
13. Capital Costs
Years 1 and 2 - Install Groundwater Monitoring Wells, Extraction Wells, Diffusion Wells, and Piping
Years 2 - Install Treatment Plant at RW-400 (1/2)
Year 3 - Install Treatment Plant at RW-400 (1/2)

		Wellhead	Wellhead				Wellhead	Wellhead														
		Total	Total				Total	Total				Total	Total	Grand Total			Total	Total	Grand Total			
	Year	Capital FV	O&M FV				Capital PV	O&M PV				Capital FV	O&M FV	FV			Capital PV	O&M PV	PV			
2011	1	$ 1,568,543	$ -				$ 1,452,354	$ -				$ 8,155,283	$ 1,454,175	$ 9,609,458			$ 7,551,188	$ 1,346,458	$ 8,897,646			
2012	2	$ 1,623,441	$ -				$ 1,391,839	$ -				$ 7,030,985	$ 1,505,071	$ 8,536,056			$ 6,027,937	$ 1,290,356	$ 7,318,293			
2013	3	$ -	$ 177,395				$ -	$ 140,822				$ 6,622,372	$ 1,796,123	$ 8,418,495			$ 5,257,052	$ 1,425,820	$ 6,682,873			
2014	4	$ -	$ 183,604				$ -	$ 134,954				$ 9,289,199	$ 2,956,019	$ 12,245,218			$ 6,827,838	$ 2,172,762	$ 9,000,601			
2015	5	$ 37,777	$ 190,030				$ 25,710	$ 129,331				$ 4,964,299	$ 3,002,946	$ 7,967,245			$ 3,378,619	$ 2,043,755	$ 5,422,373			
2016	6	$ -	$ 196,681				$ -	$ 123,942				$ -	$ 5,337,122	$ 5,337,122			$ -	$ 3,363,292	$ 3,363,292			
2017	7	$ -	$ 203,565				$ -	$ 118,778				$ -	$ 5,343,620	$ 5,343,620			$ -	$ 3,117,951	$ 3,117,951			
2018	8	$ -	$ 210,689				$ -	$ 113,829				$ -	$ 5,425,196	$ 5,425,196			$ -	$ 2,931,064	$ 2,931,064			
2019	9	$ -	$ 218,064				$ -	$ 109,086				$ -	$ 5,589,892	$ 5,589,892			$ -	$ 2,796,338	$ 2,796,338			
2020	10	$ 44,867	$ 225,696				$ 20,782	$ 104,541				$ 891,226	$ 5,592,414	$ 6,483,640			$ 412,810	$ 2,590,370	$ 3,003,180			
2021	11	$ -	$ 233,595				$ -	$ 100,185				$ -	$ 5,678,109	$ 5,678,109			$ -	$ 2,435,243	$ 2,435,243			
2022	12	$ -	$ 241,771				$ -	$ 96,011				$ -	$ 5,855,893	$ 5,855,893			$ -	$ 2,325,456	$ 2,325,456			
2023	13	$ -	$ 250,233				$ -	$ 92,010				$ -	$ 5,853,803	$ 5,853,803			$ -	$ 2,152,431	$ 2,152,431			
2024	14	$ -	$ 258,991				$ -	$ 88,176				$ -	$ 5,943,857	$ 5,943,857			$ -	$ 2,023,652	$ 2,023,652			
2025	15	$ 53,288	$ 268,056				$ 16,798	$ 84,502				$ 1,058,497	$ 6,135,943	$ 7,194,439			$ 333,682	$ 1,934,305	$ 2,267,987			
2026	16	$ 1,281,416	$ 277,438				$ 374,033	$ 80,981				$ 1,281,416	$ 6,128,525	$ 7,409,941			$ 374,033	$ 1,788,858	$ 2,162,891			
2027	17	$ -	$ 466,616				$ -	$ 126,112				$ -	$ 6,402,666	$ 6,402,666			$ -	$ 1,730,442	$ 1,730,442			
2028	18	$ -	$ 479,232	***Capital***	***O&M***		$ -	$ 119,927	***Capital***	***O&M***		$ -	$ 6,612,955	$ 6,612,955	***Capital***	***O&M***	$ -	$ 1,654,886	$ 1,654,886	***Capital***	***O&M***	
2029	19	$ -	$ 492,237	***20 yr FV***	***20 yr FV***		$ -	$ 114,057	***20 yr PV***	***20 yr PV***		$ -	$ 6,602,013	$ 6,602,013	***20 yr FV***	***20 yr FV***	$ -	$ 1,529,766	$ 1,529,766	***20 yr PV***	***20 yr PV***	
2030	20	$ 136,812	$ 505,644	***$ 4,746,000***	***$ 5,080,000***		$ 29,353	$ 108,485	***$ 3,311,000***	***$ 1,986,000***		$ 1,330,685	$ 6,704,222	$ 8,034,907	***$ 40,624,000***	***$ 99,921,000***	$ 285,496	$ 1,438,379	$ 1,723,875	***$ 30,449,000***	***$ 42,092,000***	
2031	21	$ -	$ 519,464				$ -	$ 103,195				$ -	$ 6,931,731	$ 6,931,731			$ -	$ 1,377,028	$ 1,377,028			
2032	22	$ -	$ 533,714				$ -	$ 98,172				$ -	$ 6,913,878	$ 6,913,878			$ -	$ 1,271,742	$ 1,271,742			
2033	23	$ -	$ 548,405				$ -	$ 93,402				$ -	$ 7,021,394	$ 7,021,394			$ -	$ 1,195,851	$ 1,195,851			
2034	24	$ -	$ 563,554				$ -	$ 88,872				$ -	$ 7,267,750	$ 7,267,750			$ -	$ 1,146,119	$ 1,146,119			
2035	25	$ 162,489	$ 579,175				$ 23,726	$ 84,570				$ 1,580,436	$ 7,241,984	$ 8,822,420			$ 230,772	$ 1,057,459	$ 1,288,231			
2036	26	$ -	$ 595,285				$ -	$ 80,484				$ -	$ 7,355,133	$ 7,355,133			$ -	$ 994,427	$ 994,427			
2037	27	$ -	$ 611,898				$ -	$ 76,602				$ -	$ 7,622,129	$ 7,622,129			$ -	$ 954,190	$ 954,190			
2038	28	$ -	$ 209,805				$ -	$ 24,319				$ -	$ 7,168,103	$ 7,168,103			$ -	$ 830,881	$ 830,881			
2039	29	$ -	$ 212,806				$ -	$ 22,840				$ -	$ 7,272,559	$ 7,272,559			$ -	$ 780,546	$ 780,546			
2040	30	$ -	$ 215,849				$ -	$ 21,450				$ -	$ 7,546,985	$ 7,546,985			$ -	$ 749,999	$ 749,999			
		$ 4,909,000	**$ 9,669,000**				**$ 3,335,000**	**$ 2,680,000**				**$ 42,204,000**	**$ 172,262,000**	**$ 214,467,000**			**$ 30,679,000**	**$ 52,450,000**	**$ 83,129,000**			

Table C-4 Cost Estimate for OU-2 Alternative 4k, LMC, Great Neck.

Outpost Monitoring
OU-2 IRM O&M (30 years)
Install 2 New Extraction Wells at VLSGC (near Lakeview Road) and in OU-1 (RW300 and EW1D)
Install 6 New Diffusion Wells in VLSGC and NSLIJH
Install New 500-gpm Treatment Plant near RW300
New 500-gpm Treatment Plant O&M
Install 4 New Groundwater Monitoring Wells into Basal Magothy
Install Replacement Well for N5099 and Pay for Operation of the System
Install New Remediation Well at N5099
Install New 1,200 gpm Treatment System at N5099
Operate N5099 at 1,200 gpm

Description	Quantity	Units	Unit Cost ($)	Total Cost ($)	Descriptions
Install 4 Groundwater Monitoring Well Clusters (250-350 ft)				**$ 2,000,000**	
Install New Extraction Wells (RW300 and EW1D)					
1. RW300 and EW1D	2	ea	$ 875,000	$ 1,750,000	Typ. diffusion well cost x 25% Includes: 60 Hp pump, leads, and installation Piping work in vault: main, cla-valve, gate valve, fittings, flow meter. Below-grade Concrete Vault Hatches, Coatings, Heater Site Preparation, Site Restoration and Waste Removal Well Development and Testing Basis: Diffusion Well Installation Costs per ARCADIS Principal Sci. rec'd
2. Well Access Fee	1	ea	$ 50,000	$ 50,000	Well access fee not required for EW1D
3. Well Permitting Fee	2	ea	$ 20,000	$ 40,000	
Subtotal				**$ 1,840,000**	
Install New Diffusion Wells (DW300, DW301, and NSLIJH)					
1. Drill and install 400-gpm Diffusion Wells	6	ea	$ 700,000	$ 4,200,000	Basis: ARCADIS Cost Proposal to Lockheed dated 6/28/07; Delta Well & Pump Co., Inc. Bid to ARCADIS (11/07)
2. Discharge Piping from VLSGC System to DW300 and DW301	5,000	ft	$ 85	$ 425,000	Single-wall, 8" Blue Brute HDPE piping, trenching, and restoration. Est. from previous ARCADIS FS cost estimates with inflation.
2a. Discharge Piping from Treatment System to Communty Drive	6,000	ft	$ 85	$ 510,000	
3. Piping Appurtenances	2	ls	$ 30,000	$ 60,000	Valves, piping between diffusion wells. Basis: prev. ARCADIS FS cost estimates.
4. Additional Design & Permitting	2	ea	$ 50,000	$ 100,000	Basis: ARCADIS Cost Proposal to Lockheed dated 6/28/07
5. Well Access Fee	2	ea	$ 50,000	$ 100,000	
Subtotal				**$ 5,395,000**	
Install 500 gpm Treatment Plant for RW300					*Note: Basis of Below Costs, except as noted*
1. General Site Preparation	1	ls	$ 150,000	$ 150,000	Clearing, grading, mobilization and foundation preparation
2. Treatment Building					
Concrete Work	1	ea	$ 75,000	$ 75,000	Foundation (incl. clearwells)
Building	3,000	lf	$ 250	$ 750,000	Cost based on RTKL architect's estimate
HVAC	1	ea	$ 20,000	$ 20,000	
Soil transport.	1,000	cy	$ 6.62	$ 6,623	On-site haul. Spread in basins.
Final Grading, Fencing, and Landscape	1	ls	$ 50,000	$ 50,000	
3. Major Process Equipment Items					
Air Stripping Tower	1	ea	$ 226,000	$ 226,000	
Off-gas Treatment Vessels, filled with media	1	ls	$ 372,000	$ 372,000	Estimate from Tigg Corp. to ARCADIS dated 8/3/07 ($500k capital cost for 5 vessels in same config. As IRM); 56,000 lb PPZ x $1.10lb; 60,000 lb VPGAC x $1.20/lb est. from experience
Horizontal Mist Eliminator and Knock-Out Tank	1	ea	$ 11,000	$ 11,000	
Duct Heater	1	ea	$ 24,000	$ 24,000	Assumes 50 hp unit. Est. from experience.
Clearwell Pumps	2	ea	$ 21,000	$ 42,000	Assumes two 20 hp variable speed drive pumps. Est. from experience.
Filtration System	1	ls	$ 75,000	$ 75,000	Bag Filter System.
Ducting	1	ls	$ 169,000	$ 169,000	Duct and insulation/controls installed. Est. from experience with IRM installation.
Discharge Pump	2	ea	$ 27,000	$ 54,000	50 Hp pump. Est. from experience.
Blower	1	ea	$ 32,000	$ 32,000	100 hp blower. Per quote from Northern Blower to ARCADIS dated 12/9/05 (plus inflation) plus
4. Mechanical Components					
Piping from Extraction Well to Treatment Plant	300	ft	$ 175	$ 52,500	Includes double-walled 8" HDPE piping, trenching and restoration.
Extraction Well Piping Leak Detection System	300	ft	$ 25	$ 7,500	
Process Piping	1	ls	$ 115,000	$ 115,000	Includes labor and piping (building interior)/process equipment installation
Piping Appurtanances	1	ls	$ 75,000	$ 75,000	Includes valves, gauges, controls, sensors, flowmeters, diffusion line flush.
5. Electrical Components					
Electrical Service Conduits, Transformer	1	ea	$ 90,000	$ 90,000	800 amp service
Power to Treatment Structure	100	ft	$ 100	$ 10,000	From source to treatment building
Conduit/Conductors to Well Vaults	300	ft	$ 35	$ 10,500	
Building Controls and Distribution	1	ea	$ 95,000	$ 95,000	Includes MCC, disconnect, lights, power to HVAC
Process Controls	1	ea	$ 95,000	$ 95,000	Includes PLC and interlocks, alarms, etc.
6. Building Security System	1	ls	$ 25,000	$ 25,000	Alarm system.
7. Mechanical Installation	100%	of	$ 1,255,000	$ 1,260,000	
8. Electrical Installation	25%	of	$ 325,500	$ 81,000	
9. Treatment System Operational Testing and Startup	1	ls	$ 10,000	$ 10,000	Includes laboratory sample analysis.
10. Treatment System Access Fee	0	ea	$ 100,000	$ -	
Subtotal				**$ 3,983,000**	
Subtotal of Capital Cost				**$ 13,218,000**	
Engineering/Project Management					
1. Engineering (5% of capital cost)	5%	of	$ 13,218,000	$ 660,900	
2. Construction Management (7% of capital cost)	7%	of	$ 13,218,000	$ 925,260	
3. Project Management (10% of capital cost)	10%	of	$ 13,218,000	$ 1,321,800	
4. Construction Contingency (Union Labor; 15% of capital cost)	15%	of	$ 13,218,000	$ 1,982,700	
5. New York State Sales Tax (8.625% of capital cost)	8.625%	of	$ 13,218,000	$ 1,140,053	
Subtotal				**$ 6,031,000**	
TOTAL CAPITAL COST				**$ 19,200,000**	

Table C-4 Cost Estimate for OU-2 Alternative 4k, LMC, Great Neck.

Outpost Monitoring
OU-2 IRM O&M (30 years)
Install 2 New Extraction Wells at VLSGC (near Lakeview Road) and in OU-1 (RW300 and EW1D)
Install 6 New Diffusion Wells in VLSGC and NSLIJH
Install New 500-gpm Treatment Plant near RW300
New 500-gpm Treatment Plant O&M
Install 4 New Groundwater Monitoring Wells into Basal Magothy
Install Replacement Well for N5099 and Pay for Operation of the System
Install New Remediation Well at N5099
Install New 1,200 gpm Treatment System at N5099
Operate N5099 at 1,200 gpm

Description	Quantity	Units	Unit Cost ($)	Total Cost ($)	Descriptions
Treatment Plant/Equipment Annual O&M					
(OU-2 IRM P&T System Cost)					
GWTS Operations, Checklist and Inspections	1	ls	$ 256,000	$ 256,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Monthly Compliance Sampling/Analysis and Alarm Testing	1	ls	$ 56,000	$ 56,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Quarterly O&M Activities - Preventative Maintenance	1	ls	$ 80,000	$ 80,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Extraction Well Cleaning and Redevelopment	0.33	ls	$ 190,000	$ 62,700	2010 budget estimate to clean one well (performed every 3 years)
Diffusion Well Cleaning and Redevelopment	0.33	ls	$ 210,000	$ 69,300	2010 budget estimate to clean one well with carbon dioxide (performed every 3 years)
Monthly Utility Expenses, including electric	1	ls	$ 180,000	$ 180,000	From RAA-2a estiimate
Monthly Service Contractors (e.g., electrical, controls)	1	ls	$ 120,000	$ 120,000	2010 spend plus 20%
Vapor Phase Carbon Replacement	1	ls	$ 100,000	$ 100,000	2010 spend
Zeolite/Pot Perm Media Cost (VC removal)	1	ls	$ 26,250	$ 26,250	Annualized based on change-out every 4 years
Quarterly Progress Reports to NYSDEC	1	ls	$ 28,000	$ 28,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Unscheduled O&M and System Repair	1	ls	$ 120,000	$ 120,000	2010 spend, reduced by 20% for treatment system duplication efficiency
OM&M Plan Revisions and As-Builts	1	ls	$ 32,000	$ 32,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Annual GWTS Performance Analysis	1	ls	$ 28,800	$ 28,800	2010 spend, reduced by 20% for treatment system duplication efficiency
Project Management	1	ls	$ 44,000	$ 44,000	2010 spend, reduced by 20% for treatment system duplication efficiency
(New 500-gpm RW300 Treatment System)					
GWTS Operations, Checklist and Inspections	1	ls	$ 256,000	$ 256,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Monthly Compliance Sampling/Analysis and Alarm Testing	1	ls	$ 56,000	$ 56,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Quarterly O&M Activities - Preventative Maintenance	1	ls	$ 80,000	$ 80,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Extraction Well Cleaning and Redevelopment	0.33	ls	$ 190,000	$ 62,700	2010 budget estimate to clean one well (performed every 3 years)
Diffusion Well Cleaning and Redevelopment	0.33	ls	$ 210,000	$ 69,300	2010 budget estimate to clean one well with carbon dioxide (performed every 3 years)
Monthly Utility Expenses, including electric	1	ls	$ 180,000	$ 180,000	From RAA-2a estiimate
Monthly Service Contractors (e.g., electrical, controls)	1	ls	$ 120,000	$ 120,000	2010 spend plus 20%
Vapor Phase Carbon Replacement	1	ls	$ 100,000	$ 100,000	2010 spend
Zeolite/Pot Perm Media Cost (VC removal)	0	ls	$ 26,250	$ -	
Quarterly Progress Reports to NYSDEC	1	ls	$ 28,000	$ 28,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Unscheduled O&M and System Repair	1	ls	$ 120,000	$ 120,000	2010 spend, reduced by 20% for treatment system duplication efficiency
OM&M Plan Revisions and As-Builts	1	ls	$ 32,000	$ 32,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Annual GWTS Performance Analysis	1	ls	$ 28,800	$ 28,800	2010 spend, reduced by 20% for treatment system duplication efficiency
Project Management	1	ls	$ 44,000	$ 44,000	2010 spend, reduced by 20% for treatment system duplication efficiency
(New 1,200-gpm N5099 Treatment System)					
GWTS Operations, Checklist and Inspections	1	ls	$ 256,000	$ 256,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Monthly Compliance Sampling/Analysis and Alarm Testing	1	ls	$ 56,000	$ 56,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Quarterly O&M Activities - Preventative Maintenance	1	ls	$ 80,000	$ 80,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Extraction Well Cleaning and Redevelopment	0.67	ls	$ 190,000	$ 127,300	2010 budget estimate to clean one well (performed every 3 years)
Diffusion Well Cleaning and Redevelopment	0.67	ls	$ 210,000	$ 140,700	2010 budget estimate to clean one well with carbon dioxide (performed every 3 years)
Monthly Utility Expenses, including electric	1	ls	$ 432,000	$ 432,000	Flow rate adjusted from RAA-2a costing
Monthly Service Contractors (e.g., electrical, controls)	1	ls	$ 120,000	$ 120,000	2010 spend plus 20%
Vapor Phase Carbon Replacement	1	ls	$ 240,000	$ 240,000	Flow rate adjusted from RAA-2a costing
Zeolite/Pot Perm Media Cost (VC removal)	0	ls	$ 26,250	$ -	
Quarterly Progress Reports to NYSDEC	1	ls	$ 28,000	$ 28,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Unscheduled O&M and System Repair	1	ls	$ 217,500	$ 217,500	2010 spend for OU-2, increased by 45% for 1,200-gpm system vs. 500-gpm system
OM&M Plan Revisions and As-Builts	1	ls	$ 32,000	$ 32,000	2010 spend, reduced by 20% for treatment system duplication efficiency
Annual GWTS Performance Analysis	1	ls	$ 28,800	$ 28,800	2010 spend, reduced by 20% for treatment system duplication efficiency
Project Management	1	ls	$ 44,000	$ 44,000	2010 spend, reduced by 20% for treatment system duplication efficiency
TOTAL ANNUAL O&M COST				**$ 4,180,000**	

NPV Operation & Maintenance Costs Escalated over a 30-Year Period
Discount Rate: 8%
Escalation Rate: 3.5%

Year	Capital Cost	Monitoring Cost	OU-2 O&M Cost	OU-2 Capital Improvements	OU-2 Pre-Escalated Cost	OU-2 Escalated Cost (FV)	OU-2 PV (Cost)	OU-2 Total Capital FV	OU-2 Total O&M FV	OU-2 Total Capital PV	OU-2 Total O&M PV		Year	N12796 & N4388 Capital Cost	N4388 O&M	N5099 Capital Cost	N5099 O&M	N13000b Capital Cost	N13000b O&M	Welhead Pre-Escalated Cost	Total Pre-Escalated Cost	Total Escalated Cost (FV)	Total PV (Cost)
1	$ 11,373,000	$ 41,000	$ 1,364,000		$ 12,778,000	$ 13,225,230	$ 12,245,583	$ 11,771,055	$ 1,454,175	$ 10,899,125	$ 1,346,458		2011	1				$ 1,515,500		$ 1,515,500	$ 14,293,500	$ 14,793,773	$ 13,697,938
2	$ 4,976,000	$ 41,000	$ 1,364,000		$ 6,381,000	$ 6,835,487	$ 5,860,328	$ 5,330,416	$ 1,505,071	$ 4,569,972	$ 1,290,356		2012	2				$ 1,515,500		$ 1,515,500	$ 7,896,500	$ 8,458,928	$ 7,252,168
3	$ 2,901,000	$ 96,000	$ 1,364,000		$ 4,361,000	$ 4,835,119	$ 3,838,273	$ 3,216,391	$ 1,618,728	$ 2,553,275	$ 1,284,999		2013	3				$ -	$ 160,000	$ 160,000	$ 4,521,000	$ 5,012,514	$ 3,979,095
4		$ 36,000	$ 2,380,000	$ -	$ 2,416,000	$ 2,772,416	$ 2,037,808	$ -	$ 2,772,416	$ -	$ 2,037,808		2014	4		$ 6,809,000		$ -	$ 160,000	$ 6,969,000	$ 9,385,000	$ 10,769,503	$ 7,915,906
5		$ 36,000	$ 2,332,400	$ -	$ 2,368,400	$ 2,812,916	$ 1,914,424	$ -	$ 2,812,916	$ -	$ 1,914,424		2015	5		$ 6,809,000		$ 31,807	$ 160,000	$ 7,000,807	$ 9,369,207	$ 11,127,679	$ 7,573,311
6		$ 96,000	$ 4,085,752	$ -	$ 4,181,752	$ 5,140,441	$ 3,239,350	$ -	$ 5,140,441	$ -	$ 3,239,350		2016	6		$ -	$ 200,000	$ -	$ 160,000	$ 360,000	$ 4,541,752	$ 5,582,973	$ 3,518,220
7		$ 36,000	$ 4,004,037	$ -	$ 4,040,037	$ 5,140,055	$ 2,999,173	$ -	$ 5,140,055	$ -	$ 2,999,173		2017	7		$ -	$ 200,000	$ -	$ 160,000	$ 360,000	$ 4,400,037	$ 5,598,076	$ 3,266,423
8		$ 36,000	$ 3,923,956	$ 600,000	$ 4,559,956	$ 6,004,592	$ 3,244,094	$ 790,085	$ 5,214,506	$ 426,859	$ 2,817,235		2018	8		$ 275,900	$ 200,000	$ -	$ 160,000	$ 635,900	$ 5,195,856	$ 6,841,950	$ 3,696,493
9		$ 96,000	$ 3,845,477	$ -	$ 3,941,477	$ 5,371,829	$ 2,687,252	$ -	$ 5,371,829	$ -	$ 2,687,252		2019	9		$ -	$ 200,000	$ -	$ 160,000	$ 360,000	$ 4,301,477	$ 5,862,472	$ 2,932,695
10		$ 36,000	$ 3,768,568	$ -	$ 3,804,568	$ 5,366,718	$ 2,485,829	$ -	$ 5,366,718	$ -	$ 2,485,829		2020	10		$ -	$ 200,000	$ 31,807	$ 160,000	$ 391,807	$ 4,196,374	$ 5,919,400	$ 2,741,828
11		$ 36,000	$ 3,693,196	$ -	$ 3,729,196	$ 5,444,514	$ 2,335,059	$ -	$ 5,444,514	$ -	$ 2,335,059		2021	11		$ -	$ 200,000	$ -	$ 160,000	$ 360,000	$ 4,089,196	$ 5,970,103	$ 2,560,475
12		$ 96,000	$ 3,619,332	$ -	$ 3,715,332	$ 5,614,122	$ 2,229,445	$ -	$ 5,614,122	$ -	$ 2,229,445		2022	12		$ -	$ 200,000	$ -	$ 160,000	$ 360,000	$ 4,075,332	$ 6,158,107	$ 2,445,469
13		$ 36,000	$ 3,546,946	$ 600,000	$ 4,182,946	$ 6,541,943	$ 2,405,459	$ 938,374	$ 5,603,570	$ 345,038	$ 2,060,421		2023	13		$ 275,900	$ 200,000	$ -	$ 160,000	$ 635,900	$ 4,818,846	$ 7,536,463	$ 2,771,142
14		$ 36,000	$ 3,476,007	$ -	$ 3,512,007	$ 5,684,866	$ 1,935,475	$ -	$ 5,684,866	$ -	$ 1,935,475		2024	14		$ -	$ 200,000	$ -	$ 160,000	$ 360,000	$ 3,872,007	$ 6,267,596	$ 2,133,872
15		$ 96,000	$ 3,406,487	$ -	$ 3,502,487	$ 5,867,887	$ 1,849,803	$ -	$ 5,867,887	$ -	$ 1,849,803		2025	15		$ -	$ 200,000			$ 200,000	$ 3,702,487	$ 6,202,957	$ 1,955,431
16		$ 36,000	$ 3,338,357	$ -	$ 3,374,357	$ 5,851,088	$ 1,707,877	$ -	$ 5,851,088	$ -	$ 1,707,877		2026	16		$ -	$ 200,000			$ 200,000	$ 3,574,357	$ 6,197,885	$ 1,809,104
17		$ 36,000	$ 3,271,590	$ -	$ 3,307,590	$ 5,936,050	$ 1,604,330	$ -	$ 5,936,050	$ -	$ 1,604,330		2027	17	$ 739,000	$ -	$ 200,000			$ 939,000	$ 4,246,590	$ 7,621,251	$ 2,059,787
18		$ 96,000	$ 3,206,158	$ 600,000	$ 3,902,158	$ 7,248,216	$ 1,813,859	$ 1,114,494	$ 6,133,723	***Capital***	***O&M***		2028	18	$ -	$ 100,000	$ 275,900	$ 200,000		$ 575,900	$ 4,478,058	$ 8,317,944	$ 2,081,557
19		$ 36,000	$ 3,142,035	$ -	$ 3,178,035	$ 6,109,776	$ 1,415,709	$ -	$ 6,109,776	***20 yr FV***	***20 yr FV***		2029	19	$ -	$ 99,000	$ -	$ 200,000		$ 299,000	$ 3,477,035	$ 6,684,604	$ 1,548,903
20		$ 36,000	$ 3,079,194	$ -	$ 3,115,194	$ 6,198,578	$ 1,329,894	$ -	$ 6,198,578	***$ 23,161,000***	***$ 94,841,000***		2030	20	$ -	$ 98,010	$ -	$ 200,000		$ 298,010	$ 3,413,204	$ 6,791,555	$ 1,457,116
21		$ 96,000	$ 3,017,610	$ -	$ 3,113,610	$ 6,412,267	$ 1,273,834	$ -	$ 6,412,267	$ -	$ 1,273,834		2031	21	$ 36,950	$ 97,030	$ -	$ 200,000		$ 333,980	$ 3,447,590	$ 7,100,076	$ 1,410,471
22		$ 36,000	$ 2,957,258	$ -	$ 2,993,258	$ 6,380,164	$ 1,173,571	$ -	$ 6,380,164	$ -	$ 1,173,571		2032	22	$ -	$ 96,060	$ -	$ 200,000		$ 296,060	$ 3,289,318	$ 7,011,219	$ 1,289,647
23		$ 36,000	$ 2,898,113	$ 600,000	$ 3,534,113	$ 7,796,657	$ 1,327,890	$ 1,323,669	$ 6,472,989	$ 225,441	$ 1,102,449		2033	23	$ -	$ 95,099	$ 275,900	$ 200,000		$ 570,999	$ 4,105,112	$ 9,056,347	$ 1,542,434
24		$ 96,000	$ 2,840,151	$ -	$ 2,936,151	$ 6,704,196	$ 1,057,247	$ -	$ 6,704,196	$ -	$ 1,057,247		2034	24	$ -	$ 94,148	$ -	$ 200,000		$ 294,148	$ 3,230,299	$ 7,375,833	$ 1,163,164
25		$ 36,000	$ 2,783,348	$ -	$ 2,819,348	$ 6,662,809	$ 972,889	$ -	$ 6,662,809	$ -	$ 972,889		2035	25	$ -	$ 93,207	$ -	$ 200,000		$ 293,207	$ 3,112,554	$ 7,355,728	$ 1,074,068
26		$ 36,000	$ 2,727,681	$ -	$ 2,763,681	$ 6,759,848	$ 913,943	$ -	$ 6,759,848	$ -	$ 913,943		2036	26	$ 36,950	$ 92,274	$ -	$ 200,000		$ 329,224	$ 3,092,905	$ 7,565,118	$ 1,022,817
27		$ 96,000	$ 2,673,127	$ -	$ 2,769,127	$ 7,010,231	$ 877,588	$ -	$ 7,010,231	$ -	$ 877,588		2037	27	$ -	$ 91,352	$ -	$ 200,000		$ 291,352	$ 3,060,479	$ 7,747,807	$ 969,923
28		$ 36,000	$ 2,619,664	$ 600,000	$ 3,255,664	$ 8,530,401	$ 988,790	$ 1,572,103	$ 6,958,298	$ 182,228	$ 806,562		2038	28	$ -	$ 90,438	$ 275,900	$ 200,000		$ 566,338	$ 3,822,003	$ 10,014,304	$ 1,160,795
29		$ 36,000	$ 2,567,271	$ -	$ 2,603,271	$ 7,059,754	$ 757,706	$ -	$ 7,059,754	$ -	$ 757,706		2039	29	$ -	$ 89,534	$ -	$ 200,000		$ 289,534	$ 2,892,805	$ 7,844,934	$ 841,977
30		$ 96,000	$ 2,515,926	$ -	$ 2,611,926	$ 7,331,137	$ 728,549	$ -	$ 7,331,137	$ -	$ 728,549		2040	30	$ -	$ 88,638	$ -	$ 200,000		$ 288,638	$ 2,900,564	$ 8,141,285	$ 809,059
	$ 19,250,000			$ 3,000,000	$ 113,751,639	$ 188,649,306	**$ 69,251,000**	$ 26,057,000	$ 162,593,000	$ 19,481,000	$ 49,770,000				$ 812,900	$ 1,224,790	$ 14,997,500	$ 5,000,000	$ 3,094,614	$ 1,920,000	$ 27,050,000	$ 140,802,000	**$ 226,928,000**	**$ 88,681,000**

Major Assumptions in the Cost Estimate

1. Annual sampling is required for 45 wells (after 5 additional wells are installed)
2. Every 3 years, annual sampling is required for 135 wells (includes public supply wells)
3. First two sampling rounds: sampling will be conducting using low flow pumps (not dedicated)
4. Following first two sampling rounds: sampling will be conducted using PDBs
5. Pump sampling: 4 wells per day
6. PDB sampling: ~5 wells/day
7. Laboratory analysis for VOCs by EPA 8260B (chlorinated VOCs)
8. 30 years O&M for OU-2 IRM
9. 30 years O&M for RW-400 Plant (O&M costs are equivalent to 2008 OU2 IRM budgeted costs)
10. 2 diffusion wells for RW-400 Plant located at west end of VLSGC
11. Extraction well located at east side of VLSGC
12. Fresh VC offgas treatment media (PPZ) will be required every 5 years in the IRM system and every 10 years in the RW-300/-400 system
13. Capital Costs:
Years 1 and 2 - Install New Groundwater Monitoring, Extraction and Diffusion Wells
Year 2 - Install Piping and Begin Treatment Plant Installation (Design will be performed during year 1)
Year 3 - Complete Treatment Plant Installation

NOTE:
If substituting installation of RW-300 for RW-400, a double-walled PVC pipe will need to be run across the VLSGC.
This pipe would be approximately 3,200 feet. The cost for this pipe would be $560,000 in today's dollars.
O&M costs (e.g., power) may increase slightly due to the increased transport distance of the water.

		Wellhead	Wellhead			Wellhead	Wellhead	Wellhead			Total	Total	Total			Total	Total	Total		
	Year	Total Capital FV	Total O&M FV			Total Capital PV	Total O&M PV	Total PV			Capital FV	O&M FV	FV			Capital NPV	O&M NPV	NPV		
2011	1	$ 1,568,543	$ -			$ 1,452,354	$ -	$ 1,452,354			$ 13,339,598	$ 1,454,175	$ 14,793,773			$ 12,351,479	$ 1,346,458	$ 13,697,938		
2012	2	$ 1,623,441	$ -			$ 1,391,839	$ -	$ 1,391,839			$ 6,953,857	$ 1,505,071	$ 8,458,928			$ 5,961,812	$ 1,290,356	$ 7,252,168		
2013	3	$ -	$ 177,395			$ -	$ 140,822	$ 140,822			$ 3,216,391	$ 1,796,123	$ 5,012,514			$ 2,553,275	$ 1,425,820	$ 3,979,095		
2014	4	$ 7,813,484	$ 183,604			$ 5,743,144	$ 134,954	$ 5,878,098			$ 7,813,484	$ 2,956,019	$ 10,769,503			$ 5,743,144	$ 2,172,762	$ 7,915,906		
2015	5	$ 8,124,733	$ 190,030			$ 5,529,556	$ 129,331	$ 5,658,888			$ 8,124,733	$ 3,002,946	$ 11,127,679			$ 5,529,556	$ 2,043,755	$ 7,573,311		
2016	6	$ -	$ 442,532			$ -	$ 278,870	$ 278,870			$ -	$ 5,582,973	$ 5,582,973			$ -	$ 3,518,220	$ 3,518,220		
2017	7	$ -	$ 458,021			$ -	$ 267,251	$ 267,251			$ -	$ 5,598,076	$ 5,598,076			$ -	$ 3,266,423	$ 3,266,423		
2018	8	$ 363,308	$ 474,051			$ 196,284	$ 256,115	$ 452,399			$ 1,153,393	$ 5,688,557	$ 6,841,950			$ 623,142	$ 3,073,351	$ 3,696,493		
2019	9	$ -	$ 490,643			$ -	$ 245,444	$ 245,444			$ -	$ 5,862,472	$ 5,862,472			$ -	$ 2,932,695	$ 2,932,695		
2020	10	$ 44,867	$ 507,816			$ 20,782	$ 235,217	$ 255,999			$ 44,867	$ 5,874,534	$ 5,919,400			$ 20,782	$ 2,721,046	$ 2,741,828		
2021	11	$ -	$ 525,589			$ -	$ 225,416	$ 225,416			$ -	$ 5,970,103	$ 5,970,103			$ -	$ 2,560,475	$ 2,560,475		
2022	12	$ -	$ 543,985			$ -	$ 216,024	$ 216,024			$ -	$ 6,158,107	$ 6,158,107			$ -	$ 2,445,469	$ 2,445,469		
2023	13	$ 431,495	$ 563,024			$ 158,660	$ 207,023	$ 365,683			$ 1,369,869	$ 6,166,594	$ 7,536,463			$ 503,698	$ 2,267,444	$ 2,771,142		
2024	14	$ -	$ 582,730			$ -	$ 198,397	$ 198,397			$ -	$ 6,267,596	$ 6,267,596			$ -	$ 2,133,872	$ 2,133,872		
2025	15	$ -	$ 335,070			$ -	$ 105,628	$ 105,628			$ -	$ 6,202,957	$ 6,202,957			$ -	$ 1,955,431	$ 1,955,431		
2026	16	$ -	$ 346,797			$ -	$ 101,227	$ 101,227			$ -	$ 6,197,885	$ 6,197,885			$ -	$ 1,809,104	$ 1,809,104		
2027	17	$ 1,326,265	$ 358,935			$ 358,448	$ 97,009	$ 455,457			$ 1,326,265	$ 6,294,986	$ 7,621,251			$ 358,448	$ 1,701,339	$ 2,059,787		
2028	18	$ 512,481	$ 557,247	***Capital***	***O&M***	$ 128,248	$ 139,450	$ 267,698	***Capital***	***O&M***	$ 1,626,975	$ 6,690,969	$ 8,317,944	***Capital***	***O&M***	$ 407,149	$ 1,674,409	$ 2,081,557	***Capital***	***O&M***
2029	19	$ -	$ 574,828	***20 yr FV***	***20 yr FV***	$ -	$ 133,195	$ 133,195	***20 yr PV***	***20 yr PV***	$ -	$ 6,684,604	$ 6,684,604	***20 yr FV***	***20 yr FV***	$ -	$ 1,548,903	$ 1,548,903	***20 yr PV***	***20 yr PV***
2030	20	$ -	$ 592,977	***$ 21,809,000***	***$ 7,905,000***	$ -	$ 127,222	$ 127,222	***$ 14,979,000***	***$ 3,239,000***	$ -	$ 6,791,555	$ 6,791,555	***$ 44,969,000***	***$ 102,746,000***	$ -	$ 1,457,116	$ 1,457,116	***$ 34,052,000***	***$ 43,344,000***
2031	21	$ 76,096	$ 611,713			$ 15,117	$ 121,520	$ 136,637			$ 76,096	$ 7,023,980	$ 7,100,076			$ 15,117	$ 1,395,354	$ 1,410,471		
2032	22	$ -	$ 631,054			$ -	$ 116,076	$ 116,076			$ -	$ 7,011,219	$ 7,011,219			$ -	$ 1,289,647	$ 1,289,647		
2033	23	$ 608,667	$ 651,022			$ 103,665	$ 110,879	$ 214,544			$ 1,932,336	$ 7,124,011	$ 9,056,347			$ 329,106	$ 1,213,328	$ 1,542,434		
2034	24	$ -	$ 671,637			$ -	$ 105,917	$ 105,917			$ -	$ 7,375,833	$ 7,375,833			$ -	$ 1,163,164	$ 1,163,164		
2035	25	$ -	$ 692,919			$ -	$ 101,179	$ 101,179			$ -	$ 7,355,728	$ 7,355,728			$ -	$ 1,074,068	$ 1,074,068		
2036	26	$ 90,378	$ 714,891			$ 12,219	$ 96,655	$ 108,874			$ 90,378	$ 7,474,739	$ 7,565,118			$ 12,219	$ 1,010,598	$ 1,022,817		
2037	27	$ -	$ 737,576			$ -	$ 92,335	$ 92,335			$ -	$ 7,747,807	$ 7,747,807			$ -	$ 969,923	$ 969,923		
2038	28	$ 722,905	$ 760,998			$ 83,795	$ 88,210	$ 172,005			$ 2,295,009	$ 7,719,296	$ 10,014,304			$ 266,023	$ 894,772	$ 1,160,795		
2039	29	$ -	$ 785,180			$ -	$ 84,271	$ 84,271			$ -	$ 7,844,934	$ 7,844,934			$ -	$ 841,977	$ 841,977		
2040	30	$ -	$ 810,149			$ -	$ 80,510	$ 80,510			$ -	$ 8,141,285	$ 8,141,285			$ -	$ 809,059	$ 809,059		
		$ 23,307,000	$ 14,972,000			$ 15,194,000	$ 4,236,000	$ 19,430,000			$ 49,363,000	$ 177,565,000	**$ 226,928,000**			$ 34,675,000	$ 54,006,000	**$ 88,681,000**		