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**New York State Department of Environmental
Conservation Brownfield Cleanup Program**

Draft

REMEDIAL INVESTIGATION WORK PLAN

Bethpage Community Park Ice Rink Area

**Stewart Avenue
Bethpage
Nassau, New York**

NYSDEC Site No. C130212

October 18, 2013

Prepared for:

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REMEDIAL INVESTIGATION WORK PLAN
BETHPAGE COMMUNITY PARK ICE RINK AREA
TOWN OF OYSTER BAY
BETHPAGE, NASSAU COUNTY, NEW YORK
NYSDEC SITE NO. C130212

OCTOBER 2013

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**REMEDIAL INVESTIGATION WORK PLAN
BETHPAGE COMMUNITY PARK ICE RINK AREA
TOWN OF OYSTER BAY
BETHPAGE, NASSAU COUNTY, NEW YORK
NYSDEC SITE NO. C130212**

OCTOBER 2013

1.0 INTRODUCTION

On behalf of the Town of Oyster Bay (TOB) Office of the Town Attorney (OTA), Holzmacher, McLendon & Murrell, P.C. (H2M) has prepared this Remedial Investigation Work Plan (RIWP) for the Bethpage Community Park Ice Rink Area in the Hamlet of Bethpage, TOB, Nassau County, New York (Site). The approximately 0.4-acre Site is situated within the northeast portion of the approximately 18-acre Bethpage Community Park (Park) and encompasses the footprint of two former ice skating rinks, now demolished and replaced by the current indoor ice skating center. United States Geological Survey (USGS) 7.5-minute topographic quadrangles including the Site and the surrounding area (within a minimum radius of 0.5 miles) are provided as Figure 1. A map showing the Park features and Site outline is provided as Figure 2.

1.1. SITE BACKGROUND

To date, a number of environmental investigations have been conducted at the Site and general area by various entities including the United States Navy (U.S. Navy), USGS, New York State Department of Environmental Conservation (NYSDEC), New York State Department of Health (NYSDOH), Grumman Aircraft Engineering Corporation (Grumman), Northrop Grumman Corporation (NGC), Rogers, Golden & Halpern of Philadelphia, Pennsylvania (RGH), Geraghty & Miller, Inc. of Plainview, New York (G & M), Halliburton NUS Environmental Corporation of Wayne, Pennsylvania (Halliburton), Dvirka and Bartilucci Consulting Engineers of Woodbury, New York (D & B), ARCADIS, Inc. of Melville, New York (ARCADIS), EA Engineering P.C. and its Affiliate EA Science and Technology (EAE & ST), and H2M. A Freon™ compound identified as chlorodifluoromethane (Freon-22™) was detected in the groundwater down-gradient of the Site. Based on an NYSDEC letter dated September 17, 2008, "NYSDEC has concluded that the former ice rinks" at the Bethpage Community Park "were the source of the dichlorodifluoromethane (Freon-22)". In a NYSDEC letter to ARCADIS, dated May 26, 2010, the NYSDEC indicates that a "review of groundwater analytical data shows that Freon-22 groundwater contamination has been identified as a sub-plume within the overall OU3 Grumman groundwater contamination plume."

In the BCP application prepared by the TOB (also known as the Participant) and submitted to the NYSDEC on July 26, 2011, the TOB proposed to investigate the extent of Freon-22™ impacts from the Site to the groundwater and, if necessary, develop and implement mitigating measures (Project). The NYSDEC accepted the Site into the Brownfield Cleanup Program (BCP) in a letter dated January 19, 2012 and executed / entered into a Brownfield Cleanup Agreement (BCA) with the TOB on March 16, 2012. In the NYSDEC letter dated April 10, 2013 (April 2013 NYSDEC Comment Letter), the TOB was additionally tasked with "investigating volatile organic compounds (VOCs) that include Freon 12, Freon 22 and any other VOC impacts from the Brownfield site to groundwater and soil vapor". The April 2013 NYSDEC Comment Letter further clarified that the RIWP must include sampling and analysis for "all VOCs and tentatively identified compounds (TICs)".

According to the Remedial Investigation Report (Site Area) prepared by ARCADIS for Operable Unit 3 (OU3) and dated February 1, 2008 (February 2008 ARCADIS RIR [Site Area]), the southwest portion of the Park ("Areas 'B', 'C', 'D', and 'I'", as defined by ARCADIS) "appear to be continuing sources of VOCs to groundwater." Based on the Record of Decision (ROD) for Northrop Grumman Bethpage Facility – Operable Unit Number: 03 – State Superfund Project – Bethpage, Nassau County- Site No. 130003A, dated March 2013 and issued by the NYSDEC (March 2013 NYSDEC OU3 ROD), the "approximately one-acre VOC rag pit area" is the source area(s) for VOCs.

Considering the above, this RIWP has been prepared to include groundwater and soil vapor sampling for VOCs, Freon-12™, Freon-22™, plus VOC TICs analysis. It is understood that the contaminant of concern associated with the subject Site is limited to Freon™, and that non-Freon™ VOC analytical data, that may be generated as part of the Remedial Investigation, will be utilized for information purposes regarding the Site setting and not for consideration as contaminants of concern associated with the Site.

1.2. PROJECT OBJECTIVES

The objective of the Project is to investigate the extent of contaminant impacts from the Site to groundwater and to soil vapor. Based on the findings of the Remedial Investigation (RI), a determination will be made as to whether there are any potential threats to human health and/or the environment due to the above-listed compounds of concern. Specific project objectives are defined further in Section 4.1.

2.0 SITE AND AREA DESCRIPTION

2.1. LOCATION AND USE

Site

The Site is located on Stewart Avenue in the Hamlet of Bethpage, TOB, Nassau County, New York. The Site location map is provided as Figures 1 and 2. The approximately 0.4-acre Site is situated within the northeast portion of the Park. The Site encompasses the footprint of two former ice skating rinks, now demolished and replaced by the current indoor ice skating center. The Site is currently utilized for recreational purposes.

Bethpage Community Park

Surrounding the Site is the approximately 18-acre Park containing additional recreational facilities. The Park is bordered by Cherry Avenue Extension to the north; Stewart Avenue to the east; Former NGC Plant 24 Access Road to the south; and the former NGC Plant 24 building and other NGC properties to the west. Bethpage High School (BHS) is located east of the Park, across Stewart Avenue and residential properties are located south of the Park, across the Former NGC Plant 24 Access Road. A portion of the Park and the Former NGC Plant 24 Access Road are collectively referred to by NYSDEC as OU3. The Park is currently owned and operated by the TOB and contains a swimming pool, basketball court, baseball field, tennis courts, playgrounds, picnic areas, a parking lot, and an indoor ice skating center. A site plan depicting the Park features and Former NGC Plant 24 Access Road is provided in Figure 2 of the 2010 Annual Summary Operation, Maintenance, and Monitoring (OM&M) Report for the Groundwater Interim Remedial Measure (IRM) prepared by ARCADIS for OU3 and dated April 7, 2011 (April 2011 ARCADIS Annual Summary OM&M Report for 2010). The area hydraulically down-gradient of the Park and Sycamore Avenue is defined by ARCADIS as the "Study Area".

Construction Area

Surrounding the Site and within the Park is an approximately 7-acre area identified in the Investigation Report and Remedial Action Plan prepared by H2M and dated November 2005 (November 2005 H2M IR and RAP) as the Construction Area. The Construction Area extends from the north border of the Park, in a southerly direction to the approximate center of the Park. A site plan depicting the Construction Area is provided in Figure 2 of the Final Engineering Report (FER) prepared by H2M for the Construction Area IRM and dated March 2008 (March 2008 H2M FER).

Former Grumman Property

The former Grumman Property (Grumman Property) was approximately 500 acres in size and was located to the north, west and south of the Site. The Grumman Property was owned and operated by Grumman, now known as NGC. A site plan depicting the Grumman Property is provided as Figure 1 of the Remedial Investigation Report (Study Area Groundwater) prepared by ARCADIS for OU3 and revision dated February 7, 2011 (February 2011 ARCADIS RIR [Study Area]).

Former United States Naval Weapons Industrial Reserve Plant

The former United States Naval Weapons Industrial Reserve Plant (NWIRP) occupied approximately 105 acres of the north-central portion of the Grumman Property. A site plan depicting the former NWIRP is provided as Figure 1 of the February 2011 ARCADIS RIR (Study Area).

Former Occidental Chemical Corporation / RUCO Polymer Corporation

The former Occidental Chemical Corporation (formerly the Hooker Chemical Corporation) / RUCO Polymer Corporation (OCC / RUCO) was approximately 17 acres in area and located

on New South Road, adjacent to and west of the Grumman Property. A site plan depicting the OCC / RUCO is provided as Figure 1 of the February 2011 ARCADIS RIR (Study Area).

Surrounding Area

The surrounding area, outside the boundaries of the Park, consists of mixed land uses including residential, commercial and school properties. Located south of the Park and the Former NGC Plant 24 Access Road are Sycamore Avenue (TOB-owned roadway) and residential properties. Stewart Avenue is a Nassau County-owned roadway that adjoins the Park to the east, beyond which is a school. Located north of the Park are Cherry Avenue / Aerospace Boulevard (Grumman-owned roadway) and commercial properties. Site and Area Physical Setting

2.1.1. Topography

The Site is located in an area that is approximately 125 feet above mean sea level (msl) and is generally flat. The surrounding area land surface ranges from approximately 85 to 120 feet above msl and is generally flat.

2.1.2. Geology

The Site subsurface consists primarily of fill material underlain by native soils (fine to medium sands). The low permeability zones of unsaturated soils consist of silts, silty clay and clay with interbedded sand lenses. The subsurface from land surface downward includes the Upper Glacial Pleistocene-age outwash deposits followed by the Cretaceous-age Magothy Formation. The Upper Glacial deposits are coarser compared to the Magothy Formation deposits which become finer with depth. The Site and the general area of the Site are underlain by four major unconsolidated units, which from land surface downward include the Pleistocene Series, the Magothy Formation, the Raritan Clay Member of the Raritan Formation, and the Lloyd Sand Member of the Raritan Formation. The estimated elevation of the top of the Raritan Confining Unit is -550 feet msl. The bedrock surface in the general area of the Site is sloping in a southeasterly direction.

2.1.3. Hydrogeology

The Site is located on Long Island glacial sand deposits which have been designated as a sole source aquifer. The depth to groundwater at the Site varies seasonally from approximately 50 to 55 feet below land surface (bls). The depth to groundwater within the general area of the Site varies between 50 and 74 feet msl. Groundwater flow at the Site and in the general area of the Site is in the south-southeasterly direction.

The groundwater reservoir at the Site and in the general area of the Site is divided into three main aquifers: the Upper Glacial aquifer; the Magothy aquifer; and the Lloyd Sand aquifer. The Upper Glacial aquifer is underlain by the Magothy aquifer, which is a primary source of drinking water in Nassau County. The Raritan Clay confines the underlying Lloyd Sand aquifer. The average hydraulic conductivity of the Upper Glacial aquifer is approximately 270 feet per day and the average horizontal hydraulic conductivity of the Magothy aquifer is approximately 50 feet per day.

The Upper Glacial and Magothy aquifers were segregated into the following hydrogeologic zones during the evaluation of groundwater flow and quality presented in the Operable Unit 2 (OU2) Groundwater Remedial System Hydraulic Effectiveness Evaluation prepared by ARCADIS for the Site Area and dated May 6, 2003 (May 2003 ARCADIS OU2 GW Remedial System Evaluation):

- Shallow Zone – Extends from the water table (50 feet msl) to 40 feet msl.
- Intermediate Zone – Extends from 40 to -50 feet msl.
- Deep Zone – Extends from -50 to -365 feet msl.
- Deep2 Zone – Extends from -365 to -530 feet msl.
- D3 Zone – Extends from -530 to -550 feet msl.

Based on the Groundwater IRM Work Plan (WP) prepared by ARCADIS for OU3 and dated November 14, 2007, with a revision date of December 12, 2007 (December 2007 ARCADIS Groundwater IRM WP), the groundwater was segregated into the following two hydrogeologic zones for remediation:

- Groundwater in the upper 20 feet of the surficial aquifer (70 to 50 feet msl).
- Groundwater below the upper 20 feet of the surficial aquifer (50 feet msl and below).

There are no water supply wells located on the Site or in the Park. Public / private drinking water supply and irrigation wells located within a radial distance of 0.5 miles from the approximate center of the Site are listed below (adapted from the RIR [Site Area] prepared by ARCADIS for OU3 and dated February 1, 2008 [February 2008 ARCADIS RIR (Site Area)]):

- Approximately 975 feet to the northeast of the eastern Site boundary is irrigation well, N-4175. The irrigation well is screened from 54 to 69 feet bls.
- Approximately 1,600 feet to the northeast of the eastern Site boundary is the Bethpage Water District (BWD) Adams Avenue Wellfield (AAW). The BWD AAW consists the following:
 - Supply well N-4063 (approximately 1,600 feet northeast) is screened from 139 to 233 feet bls;
 - Supply well N-8767 / Well #7 (approximately 1,750 feet northeast) is screened from 579 to 640 feet bls;
 - Supply well N-4146 (approximately 2,000 feet northeast) is screened from 153 to 235 feet bls; and
 - Supply well N-8768 / Well #8 (approximately 2,100 feet northeast) is screened from 608 to 678 feet bls.

Local residents receive the water supply from municipal wells owned / operated by the BWD. The closest BWD supply wells south-southeast (down-gradient) of the southern Site boundary are located within the BWD Plant 4 on Sophia Street (BWD 6915 / Well #4-1 [approximately 8,400 feet] and BWD 6916 / Well #4-2 [approximately 8,600 feet]). Massapequa Lake is located approximately 7 miles southeast of the Site and the South Oyster Bay is located approximately 8 miles south of the Site.

3.0 RECORDS SEARCH

A records search was conducted for the Site, Park and general area and included a review of the Site, Park and general area environmental history, assessments, investigations, remediations, work plans, action plans, remediation measures, environmental findings, etc., as available. The records search was conducted in general accordance with Appendix 3A – Records Search Requirements and Section 3.12 – Records Search Report of NYSDEC Division of Environmental Remediation (DER)-10 / Technical Guidance for Site Investigation and Remediation.

3.1. DOCUMENT REVIEW

Available environmental documents pertaining to Site, Park and general area were obtained from TOB, the document repository at the Bethpage Park Library in Bethpage, New York (Library), the NYSDEC, the NYSDEC Online Region 1 – Environmental Remediation Project Information Database, and/or the Naval Facilities Engineering Command (NAVFAC) Online Admin Record Files Search. The environmental documents were reviewed for environmental information relative to groundwater and soil vapor and more specifically to Freon-22™ in groundwater and soil vapor at the Site, Park and general area. Additionally, as required by the NYSDEC in the April 2013 NYSDEC Comment Letter, select documents (where noted below) were reviewed for environmental information relative to Freon-12™, in groundwater and soil vapor at the Site, Park and general area and additional details regarding Freon-12™ in groundwater and soil vapor are provided in Section 3.2 of this RIWP. Historical information obtained from and findings of the records search are provided throughout this RIWP and summarized below.

Initial Assessment Study of NWIRP Bethpage, NY and NWIRP Calverton, NY prepared by RGH and dated December 1986 (December 1986 RGH IAS)

Tabulated groundwater analytical data obtained from the Bethpage and Hicksville Water Districts in 1986 did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the December 1986 RGH IAS. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TIC) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (method detection limit [MDL], contract required detection limit [CRDL], instrument detection limit [IDL], reporting limit [RL], etc.). Soil vapor was not addressed in the study.

RI / Feasibility Study (FS) WP prepared by G & M for the Grumman Property and dated March 1990 (March 1990 G & M RI / FS WP)

G & M conducted an RI / FS to identify and define “potential contamination attributable” to the Grumman Property and provide sufficient data to design a remedial action alternative (RAA). In preparing the RI / FS, G & M reviewed “all existing data” for the Grumman Property, NWIRP and OCC / RUCO, including history; waste generation, storage, disposal, and treatment processes; and water quality data. Tabulated groundwater analytical data obtained between 1982 and 1989 and utilized for mass balance reporting under the State

Pollutant Discharge Elimination System (SPDES) did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the March 1990 G & M RI / FS WP. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

RI/FS Fourth Monthly Progress Report prepared by G & M for the Grumman Property and dated May 24, 1991 (May 1991 G & M Fourth MPR)

Laboratory analytical data did not include Freon-22™. It is unknown if the groundwater samples were analyzed for VOC TICs and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.). Report references soil-gas survey methodology and survey.

RI/FS Seventh Monthly Progress Report prepared by G & M for the Grumman Property and dated September 23, 1991 (September 1991 G & M Seventh MPR)

Tabulated groundwater analytical data did not include Freon-22™. Laboratory analytical data report(s) was/were not included in the September 1991 G & M Seventh MPR. It is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

RI/FS Eleventh Monthly Progress Report prepared by G & M for the Grumman Property and dated January 15, 1992 (January 1992 G & M Eleventh MPR)

Tabulated groundwater analytical data did not include Freon-22™. Laboratory analytical data report(s) was/were not included in the January 1992 G & M Eleventh MPR. It is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

Data Report Phase I RI prepared by G & M for the Grumman Property and dated January 1992 (January 1992 G & M RI Data Report)

G & M collected groundwater samples from various monitoring wells (former Grumman Property, former OCC / RUCO and USGS monitoring wells) in October 1991 for Target Compound List (TCL) VOC analysis. Although various TICs were identified in the groundwater samples, the tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the January 1992 G & M RI Data Report. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

New York State Site Registry Delisting Petition prepared by D & B for 789 South Broadway (Grumman Property) and dated March 1992 (March 1992 D & B 789 South Broadway SRDP)

Tabulated groundwater analytical data did not include Freon-22™. Laboratory analytical data report(s) was/were not included in the March 1992 D & B 789 South Broadway SRDP. It is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

New York State Site Registry Delisting Petition prepared by D & B for the Ballfield Site (Grumman Property) and dated March 1992 (March 1992 D & B Ballfield Site SRDP)

Tabulated groundwater analytical data did not include Freon-22™. Laboratory analytical data report(s) was/were not included in the March 1992 D & B Ballfield Site SRDP. It is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

New York State Site Registry Delisting Petition prepared by D & B for the Parking Lot Adjacent to Bethpage Fire Department and dated March 1992 (March 1992 D & B BFD SRDP)

Tabulated groundwater analytical data did not include Freon-22™. Laboratory analytical data report(s) was/were not included in the March 1992 D & B BFD SRDP. It is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

Final Remedial Investigation Report (RIR) prepared by Halliburton for the NWIRP and dated May 1992 (May 1992 Halliburton RIR)

Halliburton conducted an RI that included collection of groundwater samples from various monitoring wells across the NWIRP and submittal to a laboratory for "organic analyses". Although various TICs were identified in the groundwater samples, the tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the May 1992 Halliburton RIR. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

New York State Site Registry Delisting Petition prepared by D & B for 801 and 805 South Broadway and dated March 1992 (November 1992 D & B 801 and 805 South Broadway SRDP)

Tabulated groundwater analytical data did not include Freon-22™. Laboratory analytical data report(s) was/were not included in the November 1992 D & B 801 and 805 South Broadway SRDP. It is unknown if the groundwater samples were analyzed for Freon-22™

(and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

RI/FS Nineteenth Monthly Progress Report prepared by G & M for the Grumman Property and dated November 5, 1992 (November 1992 G & M Nineteenth MPR)

Tabulated groundwater analytical data did not include Freon-22™. Laboratory analytical data report(s) was/were not included in the November 1992 G & M Nineteenth MPR. It is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.). Report references soil gas survey results for SG-13.

New York State Site Registry Delisting Petition prepared by D & B for Site 6 (Runway) and dated February 1993 (February 1993 D & B Site 6 SRDP)

Tabulated groundwater analytical data did not include Freon-22™. Laboratory analytical data report(s) was/were not included in the February 1993 D & B Site 6 SRDP. It is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

New York State Site Registry Delisting Petition prepared by D & B for Site 9 (Plant 18) and dated February 1993 (February 1993 D & B Site 9 SRDP)

Tabulated and groundwater analytical data and VOC analysis data sheets did not include Freon-22™. It is unknown if the groundwater samples were analyzed for VOC TICs and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

New York State Site Registry Delisting Petition prepared by D & B for Hangar 7 and dated April 1993 (April 1993 D & B Hangar 7 SRDP)

Tabulated and groundwater analytical data and VOC analysis data sheets did not include Freon-22™. It is unknown if the groundwater samples were analyzed for VOC TICs and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

Phase 2 RIR prepared by Halliburton for the NWIRP and dated October 1993 (October 1993 Halliburton Phase 2 RIR)

Halliburton conducted an RI at the NWIRP to further delineate the extent of VOC-impacted groundwater. The RI included collection of groundwater samples from various monitoring wells (temporary and permanent) at the NWIRP and submittal to a laboratory for "volatile organic analyses". Although various TICs were identified in the groundwater samples, the tabulated groundwater analytical data did not include Freon-22™. Based on the volatile organics analysis data sheets for TICs, it was indeterminable if Freon-22™ was identified in the groundwater samples.

FS Report prepared by Halliburton for the NWIRP and dated March 1994 (March 1994 Halliburton FS Report)

Freon-22™ was not identified as a potential groundwater contaminant of concern at the NWIRP.

New York State Site Registry Delisting Petition prepared by D & B for Central Avenue (Grumman Property) and dated June 1994 (June 1994 D & B Central Avenue SRDP)

Tabulated groundwater analytical data did not include Freon-22™. Laboratory analytical data report(s) was/were not included in the June 1994 D & B Central Avenue SRDP. It is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

RIR prepared by G & M for the Grumman Aerospace Property and dated September 1994 (September 1994 G & M RIR)

G & M conducted an RI within the Site Area (as defined by G & M) that included collection of groundwater samples from various monitoring wells and submittal to a laboratory for VOCs by United States Environmental Protection Agency (EPA) Method 8240. The tabulated groundwater analytical data and the raw analytical data report did not include Freon-22™. It should be noted that the September 1994 G & M RIR and laboratory analytical data report(s) did not include information relative to TICs. Therefore, it is unknown if Freon-22™ was detected as a TIC at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.). Report indicates VOCs detected in soil-gas survey in several locations.

New York State Site Registry Delisting Petition prepared by D & B for Building 24 and dated October 1995 (October 1995 D & B Building 24 SRDP)

Tabulated and groundwater analytical data and VOC analysis data sheets did not include Freon-22™. It is unknown if the groundwater samples were analyzed for VOC TICs and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

Quarterly Groundwater Sampling Data prepared by ARCADIS G & M for the Site Area and dated January 7, 1998 (January 1998 ARCADIS G & M QGWS Data)

Tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the January 1998 ARCADIS G & M QGWS Data. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

Annual Water Supply Statement and Supplemental Data Package for 1997 prepared by H2M for the BWD and dated March 1998 (March 1998 H2M AWS Statement)

Tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the March 1998 H2M AWS

Statement. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

First Quarter 1999 Hydraulic and Groundwater Quality Monitoring Report prepared by ARCADIS G & M for the Site Area and dated 1999 (1999 ARCADIS G & M First Quarter GWMR);

Tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the 1999 ARCADIS G & M First Quarter GWMR. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

Second Quarter 1999 Groundwater Monitoring Report prepared by ARCADIS G & M for the Site Area and dated 1999 (1999 ARCADIS G & M Second Quarter GWMR)

Although various TICs were identified in the groundwater samples, the tabulated groundwater analytical data did not include Freon-22™. Based on the data usability summary reports (DUSR), it was indeterminable if Freon-22™ was identified in the groundwater samples. It should be noted that the laboratory analytical data report(s) was/were not included in the Second Quarter GWMR. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

Third Quarter 1999 Groundwater Monitoring Report prepared by ARCADIS G & M for the Site Area and dated 1999 (1999 ARCADIS G & M Third Quarter GWMR)

Tabulated groundwater analytical data (including TICs) did not include / identify Freon-22™.

First Quarter 2000 Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2000 (2000 ARCADIS First Quarter GWMR)

Tabulated groundwater analytical data (including TICs) did not include / identify Freon-22™.

Second Quarter 2000 Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2000 (2000 ARCADIS Second Quarter GWMR)

Tabulated groundwater analytical data (including TICs) did not include / identify Freon-22™.

Groundwater FS prepared by ARCADIS for the Site Area and dated October 16, 2000 (October 2000 ARCADIS Groundwater FS)

Freon-22™ was not identified as a groundwater contaminant of concern at the Site Area (as defined by ARCADIS).

2000 Annual Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2000 (2000 ARCADIS Annual GWMR)

Tabulated groundwater analytical data (including TICs) did not include / identify Freon-22™.

2001 Annual Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2001 (2001 ARCADIS Annual GWMR)

Based on a tabulation of TICs detected in groundwater samples collected during the fourth quarter of 2001, Freon-22™ was identified in monitoring well, GM-21I at a concentration greater than the NYSDEC Division of Water Technical and Operational Guidance Series (1.1.1) Class GA drinking water ambient standards and guidance values (SGV) for Freon-22™. Monitoring well GM-21I is located in the southern portion of the Grumman Property, at a distance greater than 4,500 feet southwest of the Site (cross-gradient of the OU3 / Study Area VOC-Plume).

First Quarter 2002 Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2002 (2002 ARCADIS First Quarter GWMR)

Tabulated groundwater analytical data (including TICs) did not include / identify Freon-22™.

Third Quarter 2002 Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2002 (2002 ARCADIS Third Quarter GWMR)

Tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the 2002 ARCADIS Third Quarter GWMR. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

2002 Annual Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2002 (2002 ARCADIS Annual GWMR)

Tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the 2002 ARCADIS Annual GWMR. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

May 2003 ARCADIS OU2 GW Remedial System Evaluation

Tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the May 2003 ARCADIS OU2 GW Remedial System Evaluation. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

Investigation Sampling Program Analytical Results of Soil and Groundwater Samples prepared by D & B for the Site Area and dated August 2003 (August 2003 D & B ISP Analytical Results)

On June 19, 2003, D & B collected one groundwater sample each from three monitoring wells (BCPMW-1, BCPMW-2 and BCPMW-3) located within the southwest portion of the Park for VOC analysis. The tabulated data did not include Freon-22™. It should be noted that the

laboratory analytical data report(s) was/were not included in the August 2003 D & B ISP Analytical Results. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

Quarterly Groundwater Monitoring Report for Quarters 1 to 3 of 2003 prepared by ARCADIS for the Site Area

Tabulated groundwater analytical data (including TICs) did not include / identify Freon-22™.

2003 Annual Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2003 (2003 ARCADIS Annual GWMR)

Tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the 2003 ARCADIS Annual GWMR. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

First Quarter 2004 Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2004 (2004 ARCADIS First Quarter GWMR)

Tabulated groundwater analytical data (including TICs) did not include / identify Freon-22™.

Second Quarter 2004 Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2004 (2004 ARCADIS Second Quarter GWMR)

Tabulated groundwater analytical data (including TICs) did not include / identify Freon-22™.

Third Quarter 2004 Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2004 (2004 ARCADIS Third Quarter GWMR)

Tabulated groundwater analytical data (including TICs) did not include / identify Freon-22™.

Fourth Quarter 2004 Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated May 19, 2005 (2004 ARCADIS Fourth Quarter GWMR)

Tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the 2004 ARCADIS Fourth Quarter GWMR. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

2004 Annual Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2004 (2004 ARCADIS Annual GWMR)

Tabulated groundwater analytical data (including TICs) did not include / identify Freon-22™.

Data Report for Phase I Groundwater RI prepared by ARCADIS for the Site Area and dated December 1, 2004 (December 2004 ARCADIS Phase I Data Report)

ARCADIS drilled 12 vertical profile borings (VPB) in the Park and Park Area between July and September 2004. The final depths of the VPBs ranged between 110 and 300 feet bls. Groundwater samples were collected from the 12 VPBs (VP-1 through VP-12) at depths ranging between 65 and 301 feet bls. A total of 60 groundwater samples were submitted "to the laboratory for analysis of the full TCL VOCs using NYSDEC Analytical Services Protocol (ASP) Method 2000." The VOC analytical results were compared to "NYSDEC standards, criteria, and guidance values (SCGs)." June, September and November 2003 analytical data obtained for groundwater samples from three monitoring wells in the southwestern portion of the Park (BCPMW-1 through BCPMW-3) were also tabulated in the December 2004 ARCADIS Data Report and compared by ARCADIS to the NYSDEC SCGs.

The following is a summary of the findings, as reported by ARCADIS:

- The subsurface lithology consists of sand with discontinuous lenses of clay and silt.
- The depth to groundwater is approximately 60 feet bls.
- The direction of groundwater flow is towards the southeast.
- VOCs were detected at concentrations greater than the NYSDEC SCGs. The VOC-impacted groundwater plume extends horizontally approximately 1,000 feet in width (along the Former NGC Plant 24 Access Road) and extends to a depth greater than 200 feet bls.
- The VOC-impacted groundwater plume appears to migrate towards the east-southeast.

The tabulated data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the December 2004 ARCADIS Phase I Data Report. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

First Quarter 2005 Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2005 (2005 ARCADIS First Quarter GWMR)

Tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the 2005 ARCADIS First Quarter GWMR. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

Second Quarter 2005 Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2005 (2005 ARCADIS Second Quarter GWMR)

Tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the 2005 ARCADIS Second Quarter GWMR. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

Third Quarter 2005 Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2005 (2005 ARCADIS Third Quarter GWMR)

Tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the 2005 ARCADIS Third Quarter GWMR. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

Fourth Quarter 2005 Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated April 5, 2006 (2005 ARCADIS Fourth Quarter GWMR)

Tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the 2005 ARCADIS Fourth Quarter GWMR. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

November 2005 H2M IR and RAP

H2M conducted an IRM field investigation in May and June 2005 to characterize the nature and extent of contamination in shallow groundwater within the approximately 7-acre Construction Area to support the construction of new Park facilities, including an indoor ice skating center (replacing two former ice skating rinks) at the Site. The Site and other portions of the Construction Area were further evaluated during a supplemental investigation to the IRM (details are provided in the applicable subsection of this RIWP).

The IRM field investigation for the Construction Area included installation of four monitoring wells (CAMW-1 through CAMW-4) to depths ranging between approximately 61 and 63 feet below ground surface (bgs) and collection of one groundwater sample each from three monitoring wells for various analytical parameters, including VOCs plus TICs. The VOC analytical results were compared to the NYSDEC Class GA SGVs.



The following is a summary of the findings, as reported by H2M:

- The direction of shallow groundwater flow is towards the south-southeast.
- VOCs were detected at concentrations greater than the NYSDEC Class GA SGVs.
- Freon-22™ was detected at a concentration greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater sample collected from monitoring well CAMW-4 (south of the Site).
- Freon-12™ was not detected in any of the monitoring well locations.

The monitoring wells were abandoned subsequent to the investigation and prior to the commencement of the remedial action program. A supplemental IRM investigation was implemented to obtain additional data at and in the vicinity of the Site. The details of the supplemental IRM investigation are provided in the applicable subsection of this RIWP.

The remedial action objective for the Construction Area was to identify a remedial strategy that is protective of human health considering the intended future use and potential future use of the Construction Area (continued use as a recreational park), as well as protective of the environment. The proposed RAP, as it related to groundwater and soil vapor, was to remediate impacted soils that were affecting or having the potential to negatively affect groundwater or soil vapor quality to NYSDEC recommended soil cleanup objective concentrations for subsurface soils.

- Soil vapor samples were collected from 14 boring locations at a depth of 10 feet below grade and soil vapor samples were collected from 6 of the 14 boring locations at a depth of 52 or 58 to 60 feet bgs. An ambient sample was collected for each field day that soil vapor samples were collected. Each sample was analyzed for TCL VOCs via EPA Method TO-15. Because the State of New York has not promulgated specific standards, criteria or guidance values for concentrations of compounds in subsurface vapors, NYSDOH decision making matrices were considered when evaluating the soil vapor data collected. Soil vapor sampling results were also evaluated individually, compared with background outdoor air levels and reviewed "as a whole" to identify trends and special variations in the data. Freon-22™ was not detected in any of the soil vapor sampling locations.
- Freon-12™ was detected in the soil vapor sampling locations in the vicinity of the Site. Freon-12™ was not detected during soil sampling.

IRM Supplemental IR prepared by H2M for the Construction Area and dated December 2005 (December 2005 H2M IRM Supplemental IR)

In September 2005, H2M conducted a supplemental IRM investigation that included installation of one monitoring well (CAMW-5) north of the Site to enable an improved

evaluation of hydraulically up-gradient groundwater conditions in the Construction Area. Monitoring well CAMW-5 was completed at a depth of approximately 73 feet bgs. One groundwater sample was collected and submitted for laboratory analysis of various parameters, including VOCs plus TICs. The VOC analytical results were compared to the NYSDEC Class GA SGVs.

The following is a summary of the findings, as reported by H2M:

- The direction of shallow groundwater flow is towards the south-southeast.
- No VOCs were detected in the groundwater sample collected from CAMW-5.

The monitoring well was abandoned subsequent to the investigation and prior to the commencement of the remedial action program.

Soil vapor samples were collected from three locations and at three depths to serve as vertical profiles within the boundary of the Site. The soil vapor sampling program also included the collection and analysis of an ambient sample for each field day that soil vapor samples were collected. Each sample was analyzed for TCL VOCs via EPA Method TO-15. Because the State of New York has not promulgated specific standards, criteria or guidance values for concentrations of compounds in subsurface vapors, NYSDOH decision making matrices were considered when evaluating the soil vapor data collected. Soil vapor sampling results were also evaluated individually, compared with background outdoor air levels and reviewed "as a whole" to identify trends and special variations in the data.

- Freon-22™ was not detected in any soil vapor samples.
- Freon-12™ was detected in the soil vapor sampling locations at the Site. Freon-12™ was not detected during soil sampling.

First Quarter 2006 Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2006 (2006 ARCADIS First Quarter GWMR)

Tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the 2006 ARCADIS First Quarter GWMR. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

IRM Addendum to the RAP prepared by H2M for the Construction Area and dated March 2006 (H2M IRM RAP Addendum)

H2M summarized and evaluated three additional remedial alternatives. The remedial action proposed in the November 2005 H2M IRM IR and RAP was unchanged (with regards to groundwater and soil vapor).

Second, Third and Fourth Quarter of 2006 Groundwater Monitoring Reports prepared by ARCADIS for the Site Area and dated 2006 (2006 ARCADIS First, Second and Third Quarters GWMRs)

Tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the 2006 ARCADIS First, Second and Third Quarter GWMRs. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

2006 Annual Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated August 20, 2007 (2006 ARCADIS Annual GWMR)

ARCADIS collected groundwater samples from various monitoring wells within the Site Area (as described by ARCADIS) and submitted them for VOC analysis, including Freon-22™. Based on the tabulated analytical data tables, Freon-22™ was not identified in the groundwater samples at concentrations greater than the NYSDEC Class GA SGV for Freon-22™.

First and Second Quarters of 2007 Groundwater Monitoring Report prepared by ARCADIS for the Site Area and dated 2007 (2007 ARCADIS First and Second Quarters GWMRs)

Tabulated groundwater analytical data did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the 2007 ARCADIS First and Second Quarters GWMR. Therefore, it is unknown if the groundwater samples were analyzed for Freon-22™ (and/or VOC TICs) and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

December 2007 ARCADIS Groundwater IRM WP

Grumman implemented a groundwater treatment system IRM for the VOC-impacted plume at OU3. The groundwater IRM proposed to mitigate the off-site migration of VOCs through the implementation of a groundwater pump-and-treat system to provide a hydraulic barrier across the down-gradient OU3 Site boundary. The groundwater IRM process is described as follows: impacted groundwater is extracted from the subsurface via recovery wells that are located along the Former Plant 24 Access Road; the extracted groundwater is conveyed to the treatment area located on McKay Field; the groundwater treatment system consists of an air stripper, duct heater, and emission control system (ECS); and treated groundwater flows to the northeast NWIRP basin via gravity flow (the treated air stripper off-gas is discharged to the atmosphere).

Summary Report for an Immediate Soil Vapor Intrusion Investigation at Former Grumman Settling Ponds (1-30-003A) Bethpage, New York, prepared by EAE & ST and dated December 2007 (December 2007 EAE & ST SVI Investigation Summary Report)

The report documents a sub-slab soil vapor and indoor air quality investigation conducted at residential homes located south of the OU3 site, as well as soil vapor sampling activity

conducted on the property of BHS. Freon-12™ was detected at low concentrations (greater than the laboratory MDL; maximum concentration was 6.08 micrograms per cubic meter [$\mu\text{g}/\text{m}^3$]) in 21 of the 22 sub-slab soil vapor, indoor air, outdoor air, and duplicate samples collected. Freon-22™ was not detected at a concentration greater than the laboratory MDL in any of the 22 sub-slab soil vapor, indoor air, outdoor air, and duplicate samples collected. Freon-12 was detected in the 8 soil vapor samples collected (includes 1 duplicate sample), at concentrations ranging between approximately $3.5 \mu\text{g}/\text{m}^3$ and approximately $4,000 \mu\text{g}/\text{m}^3$. Freon-22 was detected in the 8 soil vapor samples collected (includes 1 duplicate sample), at concentrations ranging between approximately $7 \mu\text{g}/\text{m}^3$ and approximately $98,000 \mu\text{g}/\text{m}^3$.

February 2008 ARCADIS RIR (Site Area)

ARCADIS conducted an RI for OU3 to define the geology and hydrogeology; fully develop the list of the contaminants of concern; determine the nature and extent of the contaminants of concern in groundwater; identify potential source areas; determine if additional data are required; identify and characterize contaminant of concern fate and transport; and obtain data to support design and implementation of an IRM(s). ARCADIS installed a total of 49 VPBs between 2004 and 2006. The final depths of the VPBs ranged between 70 and 300 feet bls. Seven permanent monitoring wells were installed between August 2006 and March 2007 (BCPMW4-1, BCPMW4-2, BCPMW4-3, BCPMW5-1, BCPMW6-1, BCPMW6-2, AND BCPMW7-1). The final depths of the monitoring wells ranged between 70 to 148 feet bls. Groundwater samples collected from the VPBs and monitoring wells were analyzed for TCL VOCs, including Freon-22™.

The following is a summary of the findings (related to groundwater, soil vapor, Freon-12™, Freon-22™, and VOCs (including Freon-12™, Freon-22™) in the groundwater and soil vapor), as reported by ARCADIS:

- The depth to groundwater varies seasonally and is approximately 50 to 55 feet bls.
- The direction of groundwater flow is towards the south-southeast.
- The hydraulic gradient across the Site was calculated to be 0.0016 ft / ft.
- The average horizontal groundwater velocity at the water table was calculated to be 1.4 to 2.8 feet / day.
- A groundwater plume containing VOCs is present beneath the Site Area (as defined by ARCADIS) and originated from Areas "B", "C", "D", and "I" (as defined by ARCADIS).
- The VOC groundwater plume was delineated within the Site Area (as defined by ARCADIS) in the up- and cross-gradient directions (north and east-west, respectively) and vertical direction.
- Freon-12 was not detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.) in the groundwater samples.

- As reported by ARCADIS, “a sub-plume consisting of chlorodifluoromethane (Freon 22) has been identified originating from the Town former ice rink. Based on Town information, Freon 22 was used and released to the environment at the Park...”
- The Freon-22™ groundwater sub-plume was delineated within the OU3 boundary, but the down-gradient extent was not known (at the time of the RI).
- Freon-22™ was identified in the sub-plume at concentrations greater than 10 parts per billion (ppb).
- The Freon-22™ sub-plume extends over an average width of approximately 250 feet.
- The maximum concentration of Freon-22™ (290 ppb) was detected in VPB, VP-13, located approximately 250 south, southeast of the Site.
- Freon-22™ is a gas under ambient conditions and “volatilizes rapidly when released on land”.
- Based on the estimated organic carbon partitioning coefficient ($\log K_{OC}$), Freon-22™ has a high potential for leaching in soil. Biodegradation is not expected in soils.
- Freon-22™ is not expected to adsorb to suspended solids or sediments in aquatic systems. Biodegradation is not expected (under aerobic or anaerobic conditions) in aquatic systems.
- Based on the estimated octanol-water partitioning coefficient ($\log K_{OW}$), the potential for bio-concentration in aquatic organisms is considered to be low.
- Freon-22™ has a half-life of 9.4 years.
- Freon-22™ is expected to exist in a gaseous phase with degradation occurring by reaction due to direct photolysis.
- Majority of VOC mass in soil vapor is limited to the Park area.
- As reported by ARCADIS, “Freons 12 and 22 were detected in soil gas beneath the Park former ice rink.”
- Highest concentrations (defined by ARCADIS as concentrations greater than 1,000 $\mu\text{g}/\text{m}^3$) of Freon-12™ and Freon-22™ in soil vapor are located near the Town of Oyster Bay former ice rink.
- A soil gas mitigation IRM is describe along with a schedule for startup.

March 2008 H2M FER

The IRM RI included the installation of five groundwater monitoring wells at up-gradient and down-gradient locations within the Construction Area. Freon-22™ was identified as a TIC at a concentration greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater sample collected from CAMW-4, located south, southeast of the Site. No source areas for the VOC contaminants of concern were identified within the limits of the Construction Area during the soil investigation. The March 2008 H2M FER summarized the results of a

remedial action program that included the excavation and off-site disposal of contaminated soil from designated portions of the Construction Area.

NYSDEC Approval Letter for the March 2008 H2M IRM FER dated September 17, 2008

The NYSDEC concluded that the former ice rinks were the source of Freon-22™.

WP for Off-Site Monitoring Well Sampling prepared by ARCADIS for OU3 and dated June 19, 2009 (June 2009 ARCADIS Off-Site MW Sampling WP)

ARCADIS prepared an off-site monitoring well sampling work plan to determine and document the off-site groundwater flow direction and the groundwater quality at locations off-site and down-gradient of the Park. The scope included collecting two rounds of groundwater samples from a total of 26 wells and submitting the groundwater samples (along with appropriate quality assurance / quality control [QA/QC] samples) for TCL VOC, including Freon-22™, analysis via "NYSDEC ASP 2000 Method OLM 4.2".

Third Quarter Operation, Maintenance and Monitoring Report prepared by ARCADIS for OU3 and dated January 2009 [sic] (January 2010 ARCADIS Third Quarter [2009] OM&M Report)

ARCADIS conducted groundwater monitoring activities in April 2009 to serve as a "baseline" against which future groundwater quality data will be compared". Groundwater samples were collected from the influent and effluent Water Sampling Ports-5 and -7 (WSP-5 and WSP-7, respectively), 4 groundwater IRM recovery wells (RW-1 through RW-4) and 17 monitoring wells (B24MW-2, M24MW-3, B30MW-1, BCPMW-1, BCPMW-2, BCPMW-3, BCPMW-4-1, BCPMW-4-2, BCPMW-4-3, BCPMW-5-1, BCPMW-6-1, BCPMW-6-2, BCPMW-7-1, MW-200-1, MW-201-1, MW-202-1, and MW-203-1) and submitted to a laboratory for TCL VOC plus Freon-22™ analysis via NYSDEC ASP 2000 Method OLM 4.2. The April 2009 ARCADIS Baseline Analysis Report was not available for review. Select analytical data from the April 2009 sampling event were provided in subsequent ARCADIS reports, the details of which are discussed in the appropriate sub-sections of this RIWP. The following is a summary of the results of the baseline groundwater quality monitoring event, as reported by ARCADIS in the January 2010 ARCADIS Third Quarter (2009) OM&M Report:

- The groundwater containment system was determined to be "operating as expected and the associated capture zone has developed".
- The VOC analytical results (assumed to also include Freon-22™) from the Baseline Sampling Event were "consistent with previous results".

Groundwater samples were collected from the influent and effluent water sampling ports (as detailed above) in July (22nd, 24th and 29th), August (5th, 12th, 19th) and September (1st and 10th) 2009. Groundwater samples were collected from the 4 groundwater IRM recovery wells and 17 monitoring wells (as detailed above) on July 29th, August 12th and on September 10, 2009. The following is a summary of the tabulated Freon-22™ analytical data provided in the January 2010 ARCADIS Third Quarter (2009) OM&M Report:

- Freon-22™ was detected at concentrations greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater samples collected from the groundwater IRM influent Water Sampling Port-5 (WSP-5).
- The discharge limit for Freon-22™ (as per the interim SPDES equivalency program or “NYSDEC TOGS 1.1.1 Quality Standards and Guidance Values and Groundwater Effluent Limitations”) is 5 ppb.
- Freon-22™ was not detected at or above the laboratory quantification limit for Freon-22™ in the groundwater samples collected from the groundwater IRM effluent Water Sampling Port-7 (WSP-7).
- Freon-22™ was detected at a concentration greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater sample collected from recovery well RW-4 in July, August and September 2009.
- Freon-22™ was detected at a concentration greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater sample collected from recovery well RW-3 in August and September 2009.

Fourth Quarter Operation, Maintenance and Monitoring Report prepared by ARCADIS for OU3 and dated February 2010 (February 2010 ARCADIS Fourth Quarter [2009] OM&M Report)

Groundwater samples were collected from the influent and effluent water sampling ports, the 4 groundwater IRM recovery wells and 17 monitoring wells (as detailed above) in October, November and December 2009. The following is a summary of the tabulated Freon-22™ analytical data provided in the February 2010 ARCADIS Fourth Quarter (2009) OM&M Report:

- Freon-22™ was detected at concentrations greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater samples collected from the groundwater IRM influent Water Sampling Port-5 (WSP-5).
- The discharge limit for Freon-22™ (as per the interim SPDES equivalency program or “NYSDEC TOGS 1.1.1 Quality Standards and Guidance Values and Groundwater Effluent Limitations”) is 5 ppb.
- Freon-22™ was not detected at or above the laboratory quantification limit for Freon-22™ in the groundwater samples collected from the groundwater IRM effluent Water Sampling Port-7 (WSP-7).
- Freon-22™ was detected at a concentration greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater sample collected from recovery well RW-4 in November and December 2009 (analytical data, if obtained, were not provided for the October 2009 sampling event).
- Freon-22™ was detected at a concentration greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater sample collected from recovery well RW-3 in

November and December 2009 (analytical data, if obtained, were not provided for the October 2009 sampling event).

- Freon-22™ was detected at concentrations greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater samples collected from monitoring wells BCPMW-4-1, BCPMW-6-1 and MW-203-1 in December 2009 (analytical data, if obtained, were not provided for the October and November 2009 sampling events).

Freon-22™ analytical data obtained from the April 2009 sampling event (ARCADIS Baseline Analysis Report) was included in the tabulated data provided in the February 2010 ARCADIS Fourth Quarter (2009) OM&M Report and is summarized below:

- Freon-22™ was detected at concentrations greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater samples collected from monitoring wells BCPMW-4-1, BCPMW-6-1 and MW-203-1.
- Freon-22™ was not detected at concentrations greater than the NYSDEC Class GA SGV for Freon-22™ in the remaining monitoring wells sampled in April 2009.

Second Quarter 2010 Groundwater Monitoring Report prepared by ARCADIS for OU2 and dated August 13, 2010 (2010 ARCADIS Second Quarter GWMR)

Freon-22™ was not detected at concentrations greater than the NYSDEC Class GA SGV for Freon-22™.

Third Quarter 2010 Operation, Maintenance and Monitoring Report prepared by ARCADIS for OU3 and dated November 2010 (November 2010 ARCADIS Third Quarter (2010) OM&M Report)

Groundwater samples were collected from the influent and effluent water sampling ports and the 4 groundwater IRM recovery wells in July, August and September 2010. The following is a summary of the tabulated Freon-22™ analytical data provided in the November 2010 ARCADIS Third Quarter (2010) OM&M Report:

- Freon-22™ was detected at concentrations greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater samples collected from the groundwater IRM influent Water Sampling Port-5 (WSP-5).
- The discharge limit for Freon-22™ (as per the interim SPDES equivalency program or "NYSDEC TOGS 1.1.1 Quality Standards and Guidance Values and Groundwater Effluent Limitations") is 5 ppb.
- Freon-22™ was not detected at or above the laboratory quantification limit for Freon-22™ in the groundwater samples collected from the groundwater IRM effluent Water Sampling Port-7 (WSP-7).

First Quarter 2011 Groundwater Monitoring Report prepared by ARCADIS for OU2 and dated June 30, 2011 (June 2011 ARCADIS First Quarter [2011] GWMR)

Freon-22™ was not detected at concentrations greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater samples collected from OU2 monitoring wells. Tabulated groundwater analytical data for OU2 outpost wells sampled during the first quarter of 2011 did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the June 2011 ARCADIS First Quarter (2011) GWMR. Therefore, it is unknown if the OU2 outpost well groundwater samples were analyzed for Freon-22™ and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

Second Quarter 2011 Groundwater Monitoring Report prepared by ARCADIS for OU2 and dated August 12, 2011 and revision provided by ARCADIS in an electronic mail (e-mail) dated September 6, 2011 (August 2011 ARCADIS Second Quarter [2011] GWMR)

Freon-22™ was not detected at concentrations greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater samples collected from OU2 monitoring wells. Tabulated groundwater analytical data for OU2 outpost wells sampled during the second quarter of 2011 did not include Freon-22™. It should be noted that the laboratory analytical data report(s) was/were not included in the August 2011 ARCADIS Second Quarter (2011) GWMR. Therefore, it is unknown if the OU2 outpost well groundwater samples were analyzed for Freon-22™ and / or if Freon-22™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.).

Site Area Focused Feasibility Study (FFS) prepared by ARCADIS for OU3 and dated May 12, 2010

A FFS was prepared to identify and evaluate remedial technologies and remedial alternatives for soil, soil gas and groundwater at the OU3 site area. The following remedy was selected in the FFS for OU3 groundwater and soil vapor:



Alternative GW-2 (Groundwater):

- Operation, maintenance and monitoring of OU3 groundwater IRM (implemented in July 2009) to prevent migration of groundwater in the upper 20 feet of the aquifer containing total VOCs at concentrations greater than 5 ppb;
- Transition to natural attenuation with monitoring (of residual potential contaminants of concern) after groundwater IRM system shutdown criteria are achieved; and
- Implement an environmental easement to control OU3 groundwater use.

Alternative SW-2 (Soil vapor):

- Operation, maintenance and monitoring of the existing soil gas IRM to prevent the off-site migration of onsite soil gas until IRM shutdown criteria are achieved.
- Implement an environmental easement to require future onsite structures to address potential vapor intrusion.

April 2011 ARCADIS Annual Summary OM&M Report for 2010

The groundwater IRM details are included in the April 2011 ARCADIS Annual Summary OM&M Report for 2010 and summarized below:

- The groundwater is extracted via recovery wells along the Former Plant 24 Access Road;
- The groundwater is conveyed to a treatment plant at McKay Field via four underground pipelines;
- The groundwater is treated via air stripper, reducing the concentration of VOCs (including Freon-22™) in the groundwater;
- The groundwater is filtered (to remove metals);
- The treated groundwater is returned to the aquifer via a discharge pipeline to a recharge basin on the former NWIRP;
- The concentration of VOCs (not including Freon-22™) in the air stripper off-gas is reduced via a vapor phase treatment system prior to discharge to the atmosphere; and
- The groundwater IRM effectiveness is periodically monitored via the Groundwater Monitoring Network (consists of 35 monitoring locations [17 groundwater monitoring wells, 4 remedial wells and 14 piezometers]).

- Freon-22™ has been detected in the OU3 groundwater and a sub-plume of Freon-22™ was determined to be “originating from the area of the Town of Oyster Bay’s (Town’s) former ice rink”.

The following is a summary of the groundwater IRM OM&M activities between January 1 and December 31, 2010, as reported by ARCADIS:

- “Project VOCs” are defined as those VOCs that “may be related to former Grumman historical activities” and include the VOCs listed in the Interim SPEDES permit equivalency (1,1,1-trichloroethane, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, tetrachloroethene, trichloroethene, vinyl chloride, cis-1,2-dichloroethene, trans-1,2-dichloroethene, and trans-1,2-dichloroethene), toluene, benzene, and total xylenes.
- VOCs, including Freon-12™¹ and Freon-22™, that have been detected at OU3 and are “not related to former Grumman activities” are defined as “Non-Project VOCs”. It should be noted that Non-Project VOCs represents the difference between the detected total VOCs and Project VOCs. Although ARCADIS generally refers to Non-Project VOCs as Freon-12™ and Freon-22™, Non-Project VOCs may include various additional VOCs that were detected in the groundwater samples.
- Between July 2009 and December 2010, approximately 525 pounds of Non-Project VOCs were recovered. It should be noted that the mass of Non-Project VOCs recovered represents the difference between the detected masses of total VOCs (1,018 pounds) and Project VOCs (493 pounds).
- In 2010, more than 99% of Non-Project VOCs were recovered by remedial wells RW-3 and RW-4.
- The rate of Non-Project VOCs recovery was 1.3 pounds per day.
- Non-project VOCs influent concentration (between July 2009 and December 2010) ranged between 30 ppb (July and August 2009) and 650 ppb (May 2010) and averaged 337 ppb.
- Although greater than during groundwater IRM start-up, “non-project VOCs (Freon22)” concentration in groundwater is “leveling off”.

¹ Freon-12™ and Freon-22™ concentrations are frequently combined in ARCADIS reports. Based on information obtained from the records search (Section 3.0 – Records Search of this RIWP), Freon-22™ was “released to the environment at the Park”. In an NYSDEC letter dated September 17, 2008, the NYSDEC concluded that the former Town of Oyster Bay ice rinks were the source of the Freon-22™ groundwater and soil vapor impacts. Although details / information regarding a Freon-12™ release at the Site was not obtained during the records search, in the April 2013 NYSDEC Comment Letter, the NYSDEC states that “the site is a source of Freon 12”.

- During 2010, Non-Project VOCs² comprised approximately 93% of total VOCs detected in remedial well RW-3 and over 99% of total VOCs detected in remedial well RW-4.

The following is a summary of the tabulated Freon-22™ analytical data provided in the April 2011 ARCADIS Annual Summary OM&M Report for 2010:

- Non-project VOCs comprise approximately 1.7% of total VOCs detected in remedial well RW-1 and 0.2% of total VOCs in remedial well RW-2.
- Freon-22™ was detected at concentrations greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater samples collected from the groundwater IRM influent Water Sampling Port-5 (WSP-5).
- The discharge limit for Freon-22™ (as per the interim SPDES equivalency program or "NYSDEC TOGS 1.1.1 Quality Standards and Guidance Values and Groundwater Effluent Limitations") is 5 ppb.
- Freon-22™ was not detected at or above the laboratory quantification limit for Freon-22™ in the groundwater samples collected from the groundwater IRM effluent Water Sampling Port-7 (WSP-7).
- Freon-22™ was detected at concentrations greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater samples collected from remedial wells RW-3 and RW-4 in February, April, July, and October 2010.
- Freon-22™ was detected at concentrations greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater samples collected from monitoring wells BCPMW-6-1, BCPMW-7-1 and MW-203-1.
- Freon-22™ was not detected at concentrations greater than the NYSDEC Class GA SGV for Freon-22™ and/or the laboratory quantification limit for Freon-22™ in the groundwater samples collected from the remaining remedial wells and monitoring wells.

² Freon-12™ and Freon-22™ concentrations are frequently combined in ARCADIS reports. Based on information obtained from the records search (Section 3.0 – Records Search of this RIWP), Freon-22™ was "released to the environment at the Park". In an NYSDEC letter dated September 17, 2008, the NYSDEC concluded that the former Town of Oyster Bay ice rinks were the source of the Freon-22™ groundwater and soil vapor impacts. Although details / information regarding a Freon-12™ release at the Site was not obtained during the records search, in the April 2013 NYSDEC Comment Letter, the NYSDEC states that "the site is a source of Freon 12".

NYSDEC Letter to ARCADIS dated May 26, 2010 (May 2010 NYSDEC Letter)

The NYSDEC stated that a "Review of the groundwater analytical data shows that Freon 22 groundwater contamination has been identified as a sub-plume within the overall OU3 Grumman groundwater contamination plume."

February 2011 ARCADIS RIR (Study Area)

ARCADIS conducted an RI within the area hydraulically down-gradient of the Park and Sycamore Avenue (Study Area). A total of 20 VPBs were drilled within the Study Area between June 2006 and July 2009. The final depths of the VPBs ranged between 120 to 890 feet bls. A total of 15 monitoring wells were installed in the Study Area between March 2007 to May 2009 to depths ranging between 55 and 750 feet bls. Approximately 500 groundwater samples were collected from various depths within the VPBs (including QA / QC samples). Approximately 30 groundwater samples were collected at varying frequency and from various depths within the monitoring wells (including QA / QC samples). Groundwater samples obtained from the VPBs and monitoring wells were submitted for TCL VOC analysis (including Freon-12™ and Freon-22™).

The following is a summary of the findings, as reported by ARCADIS:

- Groundwater elevations within the Study Area vary between approximately 51 and 74 feet above msl.
- The direction of groundwater flow is towards the south-southeast and vertically, slightly downward.
- The horizontal hydraulic gradient in the northern portion of the Study Area is approximately 0.0017 ft / ft and the average horizontal groundwater velocity in the northern portion of the Study Area is approximately 0.85 ft / day.
- The horizontal hydraulic gradient in the southern portion of the Study Area is approximately 0.0032 ft / ft and the average horizontal groundwater velocity in the southern portion of the Study Area is approximately 2.56 ft / day.
- The maximum extent of the OU2 VOC-Plume is approximately 3.5 miles in length, 1.6 miles in width, 790 feet in depth, and 430 feet in thickness.
- The maximum extent of the Study Area VOC-Plume (south of OU3, within the eastern portion of the OU2 VOC-Plume) is approximately 8,300 feet in length and 2,100 feet in width.
- The VOC-impacted groundwater descends in the aquifer as it migrates south-southeast of OU3 (consistent with the direction of groundwater flow) and extends to a maximum depth of 670 feet bls with an approximate thickness of 430 feet.
- Based on cross-sections of the Study Area VOC-Plume, the VOC impacts are present at similar depths in the groundwater along the cross-sections. A segment of VOC-impacted groundwater was identified between VPBs VP-111 and VP-119 at depths of

100 and 330 feet bls. ARCADIS concluded this shallower segment of the VOC-impacted groundwater was "not consistent with the depth of the Study Area VOC-impacted groundwater originating" from the Park (Study Area VOC-Plume reached depths greater than 330 feet bls in the area between VPBs VP-111 and VP-119) and therefore not related to the Park.

- Soil gas impacts related to OU3 are limited to the Park Area and do not extend off-site.
- The soil gas IRM effectively prevents off-site migration of VOCs in soil gas and that additional off-site soil gas investigation is not required. Report references NYSDOH concurrence with this conclusion.

The following is a summary of the tabulated Freon-12™ and Freon-22™ analytical data provided in the February 2011 ARCADIS RIR (Study Area):

- Freon-12™ was detected at concentrations greater than the NYSDEC Class GA SGV for Freon-12™ in the groundwater samples collected from the following groundwater sampling locations (the sample depths [reported in feet bls] are provided in parenthesis): VP-108 (115 to 120); VP-108 (125 to 130); and VP-116 (194).
- Freon-22™ was detected at concentrations greater than the NYSDEC Class GA SGV for Freon-22™ in the groundwater samples collected from the following groundwater sampling locations (the sample depths [reported in feet bls] are provided in parenthesis): VP-100 (75 to 85); VP-115 (242); VP-115 (402); VP-115 (442); VP-115 (482); and VP-116 (194). It should be noted that the groundwater sample collected from 194 feet bls at VP-116 is within the portion of the impacted groundwater that ARCADIS concluded is "not consistent" with the depth of and not related to the OU3-Plume
- Freon-12™ and Freon-22™ were not detected at concentrations greater than the NYSDEC Class GA SGVs for Freon-12™ and Freon-22™ and/or the laboratory quantification limits for Freon-12™ and Freon-22™ in the groundwater samples collected from the remaining VPBs and monitoring wells.

Supplement to the RIR (Study Area Groundwater) prepared by ARCADIS for OU3 and dated March 5, 2010 (March 2010 ARCADIS SRIR [Study Area])

ARCADIS collected groundwater samples from 15 monitoring wells within the Study Area between October and November 2009. The groundwater samples were analyzed for TCL VOCs (including Freon-12™ and Freon-22™). Based on the tabulated Freon-12™ and Freon-22™ analytical data provided in the March 2010 ARCADIS SRIR (Study Area), Freon 12™ and Freon-22™ were not detected at concentrations greater than the NYSDEC Class GA SGVs for Freon-12™ and Freon-22™ and/or the laboratory quantification limits for Freon-12™ and Freon-22™ in the groundwater samples collected from the monitoring wells.

Proposed Remedial Action Plan (Northrop Grumman Bethpage Facility – Operable Unit Number: 03 – State Superfund Project – Bethpage, Nassau County- Site No. 130003A) dated May 2012 prepared by NYSDEC (May 2012 NYSDEC PRAP)

Proposed Remedial Action Plan (PRAP) includes the following conclusions by NYSDEC:

- On site soil vapor and associated potential migration of soil vapor impacts to adjacent residences has already been addressed by Grumman through implementation of the soil vapor extraction IRM.
- The continued off-site migration of impacted groundwater has largely been addressed by the on-site groundwater pump and treatment system IRM.
- PRAP recommends that the groundwater IRM in place be utilized and upgraded as necessary to “assure the capture/containment of the full depth and area of contaminated groundwater leaving the Site.”
- PRAP recommends that the existing soil vapor IRM continue operation to prevent migration of contaminated soil vapor.

NYSDEC Letter to Bethpage Union Free School District dated September 20, 2012 (September 2012 NYSDEC Letter)

The Department summarizes soil vapor and groundwater investigation findings associated with the OU3 site, as they relate to the BHS. BHS is located east of the Park property across Stewart Avenue. Reference is made to a September 18, 2008 letter (and a copy of same is attached) from NYSDOH to the School District. The NYSDOH letter summarizes indoor air sample results associated with an investigation on the BHS property. The NYSDOH indicates that Freon-12™ and -22™ were detected at low levels in crawl space and indoor air samples collected at BHS. Freon-22™ was detected in a sub-slab sample and an indoor air sample collected at the administration building. NYSDOH concludes that “these concentrations of Freon 22 are not levels that are expected to be an exposure concern.” The DEC concludes that the soil vapor IRM located south of the Park “pulls contaminated vapor away from the school and toward the Grumman Access Road.” DEC also concludes that “The remedial investigation is complete for the OU3 groundwater contamination plume in the vicinity of Bethpage High school and no additional groundwater or soil vapor monitoring points are needed at the school property for this OU.”

ROD for Northrop Grumman Bethpage Facility – Operable Unit Number: 03 – State Superfund Project – Bethpage, Nassau County- Site No. 130003A, dated March 2013 and issued by the NYSDEC (March 2013 NYSDEC OU3 ROD)

The ROD presents the NYSDEC-selected remedy to address source areas in OU3 and the capture and treatment of off-site groundwater hotspot in the OU3 plume. The ROD remedy components related to VOCs in groundwater and soil vapor are summarized below (as reported by the NYSDEC):

- “The existing groundwater extraction and treatment IRM will continue to be operated and upgraded as necessary...to assure the capture / containment of the full depth and area of contaminated groundwater”.
- The groundwater is impacted with chlorinated VOCs and total chromium.
- The impacted groundwater was identified at depths up to 150 feet bgs.
- The shallow and a majority of the deep impacted groundwater are being captured by the groundwater IRM.
- Additional groundwater extraction wells (along with the necessary treatment) may be installed. The extraction wells will be located downgradient of the “area(s) of elevated contaminant levels identified upgradient of Bethpage Water District Plant 4.” The system will be designed to capture and treat “90 percent of the mass of groundwater migrating from the elevated ‘hotspot area’.”
- Additional groundwater monitoring wells will be installed to create a three-dimensional (3-D) delineation of the leading edge of the OU3 plume and to assess the need for further evaluating the groundwater remediation.
- The Wellhead Treatment Contingency Plan outlined in the OU2 ROD will remain in effect.
- The treatment capacity of the groundwater IRM may be upgraded.
- A Site Management Plan (SMP) including, but not limited to the following:
 - Institutional controls / environmental easements will include, but not be limited to the following: Groundwater use restrictions (acceptable use as “source of potable or process water, without necessary water quality treatment...”); and evaluating potential for soil vapor intrusion).
 - Monitoring Plan including, but not limiting to the following: assessing the performance and effectiveness of the on- and off-site pump and treat systems and the Soil Vapor Extraction (SVE) system; monitoring plume migration beyond the “off-site treatment area that becomes part of the OU2 plume; monitoring the groundwater for polychlorinated biphenyls (PCB) and chromium; monitoring for vapor intrusion; and additional sampling and/or monitoring well installation “along the eastern boundary to better define the lateral extent of groundwater contamination.”
 - Operation and Maintenance Plan to ensure continued operation, maintenance, monitoring, inspecting, and reporting as applicable to, but not limited to the following: on- and off-site pump and treat systems; SVE system; and compliance monitoring of treatment systems.
- “...a source of dichlorofluoromethane (Freon-22) and dichlorodifluoromethane (Freon-12), not attributable to operations at the Northrop Grumman facility but resulting from the operation of the two former Town of Oyster Bay ice skating rinks located

Dear Undergraduate Admissions Office,
Thank you for all of your time and efforts but I will not be attending UAlbany this fall. I will be attending the College of Saint Rose for speech therapy.

Thank you,
-Julie Scharf

east of OU3, is contributing to the groundwater contamination at the site. The Freon plume emanating from the ice rinks is comingled with OU3 related VOCs.”

- The OU3 plume migrating beyond the Park boundaries becomes comingled with the OU2 plume. The OU3 plume extends to a depth of “at least 550 feet bgs” and extends approximately 5,400 feet downgradient of the Park boundary.
- “...the off-site groundwater is impacted by the Freon plume from the former Town of Oyster Bay ice skating rinks.”
- The on- and off-site groundwater will be remediated for an inorganic and various VOCs, including Freon-12™ and Freon-22™.
- The existing soil vapor extraction and treatment IRM will continue to be operated to “prevent migration of contaminated soil vapor.”
- “...no site-related soil vapor contamination of concern was identified in the off-site areas evaluated, and impacts to indoor air are not occurring. Therefore, no further action was necessary for off-site residential properties.”
- “Soil vapor contamination on the site...was addressed during the IRM”.
- The NYSDEC provided the following responses to comments from the public meeting, availability session and/or written comments:
 - The Park “groundwater containment system is intended to capture the contaminated groundwater leaving the OU3 area.”
 - The groundwater IRM is “effective in capturing the shallow groundwater plume where concentrations exceed 5 µg/L [micrograms per liter].”
 - “The Department, along with the NYSDOH, is confident that the nature and extent of contamination at OU3 has been fully characterized to allow the selection of this remedy...The Department determined that sufficient investigation had been conducted for both the on and off-site components of OU3 to enable selection of a comprehensive remedy...The nature and extent of the OU3 plume has been defined by the OU3 RI sampling program sufficient to allow this remedy selection...The off-site remedial investigation generated the information necessary to quantify the overall extent of the OU3 groundwater plume.”
 - Regarding off-site groundwater, “The full extent of this TOB off-site Freon migration has yet to be determined.”
 - “The Freon 12 and Freon 22 in the soil gas, and Freon 22 in the groundwater have been linked to the two former Ice Rinks, since demolished, which were owned by the Town of Oyster Bay...Freon 12 and Freon 22 have both been detected in soil gas, however, to date, only Freon 22 has been detected in the groundwater.”

- "The Department completed soil vapor sampling at the Bethpage High School property and in areas adjacent to Stewart Avenue in 2007 and 2008. The Department and NYSDOH have determined...the levels detected are not likely to impact indoor air quality at levels that would pose a health concern. Hence, there is no reason to regularly evaluate the Bethpage High School building for soil vapor intrusion."
- "SVI evaluations conducted near the OU3 site have shown that SVI is not occurring in buildings close to the site."
- The SVE IRM is "effectively preventing the off-site migration of all volatile vapors to adjacent residences regardless of the specific compound or its source."

It should be noted that Table 1 - On-Site Groundwater, within Exhibit A includes a reference to detections of "Chlorodifluoromethane (Freon-21)". However, dichlorofluoromethane is known to be synonymous with Freon-21™.

3.2. ENVIRONMENTAL HISTORY

3.2.1. Site and Park

The Site is owned and operated by TOB and is a part of the Park. Historically, the Park was first developed and utilized for farming activity. Grumman (predecessor to NGC) purchased the Park in 1941 and utilized the Park as sludge settling beds (settling ponds) and recharge basins for waste disposal purposes (including Grumman manufacturing processes and industrial wastes, industrial wastewater treatment sludge, spent paint booth rags, and potential used oil). The Park was also utilized for fire control training. Grumman transferred ownership of the Park to the TOB in 1962 for use as a public park. The TOB developed the Park with an ice skating rink (Site), a parking lot, basketball court, baseball field, stormwater recharge basin, paddleball, tennis and shuffleboard courts, picnic and playground areas, horseshoe pits, bicycle racks, swimming pools, and offices. The Park was partially redeveloped by the TOB in 2005. Redevelopment of the Site included demolition of the former ice skating rink and replacement with the current indoor ice skating center.

3.2.2. Operable Units 2 and 3

The NWIRP was established in 1933 and included four plants, two warehouse complexes, a salvage storage area, water recharge basins, an Industrial Wastewater Treatment Plant (ITWP), and several support buildings. Operations at the NWIRP included research prototyping, testing, design engineering, fabrication, and primary assembly of military aircraft. Freon™ was utilized at the NWIRP.

Beginning in the 1940's, operations at the Grumman Property included chemical milling, plating, and degreasing. Chromic acid wastes were disposed in open seepage basins or directly on the ground between 1940 and 1949. Chromium contamination was identified in a public water supply well south of the Grumman Property in 1949. Between 1949 and 1962

neutralized chromic acid wastes were dried in settling ponds and shipped off-site for disposal.

The approximately 17-acre OCC / RUCO site began operations in 1945 and included handling and storing natural rubber latex. Plasticizers and polyvinyl chloride were produced at the OCC / RUCO site in 1950 and between 1956 and 1976, respectively. Manufacturing processes wastes (including glycols, alcohols, tetrachloroethene [PCE], methanol, and organic acids) and non-contact cooling water were disposed of through sand sumps at the OCC / RUCO site between 1951 and 1975. The OCC / RUCO site was placed on the National Priorities List (NPL) in 1984 (CERCLIS No. NYD002920312).

In 1976, trichlorethene (TCE) was detected in a Grumman Property-owned supply well and a BWD off-line well located south of the Grumman Property. Based on the Chronological Record of the Bureau of Water Pollution Control prepared by the Nassau County Department Of Health and dated 1977 (1977 NCDOH CR), the New York State Health Department (NYSHD) set 50 ppb as "the maximum permissible level for any single contaminant" and 100 ppb as "the total for a combination of the contaminants involved." The NYSDEC did not agree with the NYSHD and required federal, state and local action "to reduce the risk factors associated with chemical contamination to an absolute minimum." The NYSHD "organic chemical limits" were not promulgated, but served as a guidance values.

In 1983, the NYSDEC added the Grumman Property to the Registry of Inactive Hazardous Waste Disposal Sites (RIHWDS) as a Class 2a site. In 1986 the BWD outlined the VOC-plume emanating from the Grumman Property (VOC-Plume) based on groundwater information from the Nassau County Department of Public Works (NCDPW) and the USGS. The Grumman Property was re-classified by the NYSDEC in 1987 as a Class 2 site.

The BWD implemented a VOC treatment system in 1987 to remediate the groundwater and bring monitoring well(s) back into service (funded by Grumman). Subsequently, the BWD implemented VOC removal systems to treat the groundwater in advance of VOC-impacted groundwater reaching two additional BWD facilities (supply wells). One remediation system was funded by Grumman and one remediation system was funded by the U.S. Navy.

Grumman entered into a consent order with the NYSDEC on October 25, 1990 to address the groundwater contamination (also Grumman Property soil). An RI conducted at the Grumman Property between 1991 and 1994 included installation and sampling of 43 monitoring wells and an RI conducted between 1991 and 1993 at the NWIRP included installation and sampling of 18 monitoring wells. Based on a remedial investigation / feasibility study (RI / FS) conducted by Grumman between 1989 and 1994, the Grumman Property and NWIRP were identified as the source of the VOC-Plume. As reported in the September 1994 G & M RIR, based on the USGS study that began in 1985, the VOC-Plume "beneath and extending southward from the Grumman, U.S. Navy, and OCC / RUCO Polymer Corporations sites" was approximately 5,700 feet wide, 12,000 feet long and greater than 500 feet thick.

The OU2 program was developed through the RI / FS to investigate and remediate the on and off-site groundwater impacts. An on-site groundwater containment and treatment (ONCT) system was installed in the southern portions of the Grumman Property and NWIRP in November 1997 and became fully operational in September 1998. Baseline groundwater quality data was obtained in May 1997. The ONCT system for VOC-impacted groundwater includes four groundwater pumping wells (three extraction wells [ONCT-4, ONCT-2 and ONCT-3] and one production well [GP-1]), two treatment facilities consisting of air stripping towers, and two sets of recharge basins. The groundwater is pumped, treated and discharged into the aquifer via recharge basins.

Based on the Proposed Remedial Action Plan (PRAP) prepared by the NYSDEC for OU2 and dated October 2000 (October 2000 NYSDEC OU2 PRAP), the groundwater plume totaled approximately 2,000 acres in area and was greater than 500 feet deep. The NYSDEC issued a Record of Decision (ROD) for OU2 in March 2001, stating that the OU2 remedy will continue operating until the NYSDEC makes a determination that remediation is no longer required. As per the ROD, the U.S. Navy installed a remediation system to address the groundwater impacts in the GM-38 area (in the vicinity of Arthur Avenue and Broadway in Bethpage, New York). The groundwater is pumped via extraction wells to a treatment system. The OU2 monitoring well network has been sampled quarterly since the system was fully operational (the record search included a review of quarterly groundwater monitoring data between 1999 and 2011 [details are provided in the Section 3.1).

Effective July 4, 2005, the NYSDEC and NGC executed an Order on Consent (CO; Index Number W1-0018-04-01) for implementation of a groundwater pump-and-treat system IRM for OU3. The groundwater IRM for OU3 consists of groundwater extraction via four remedial wells, groundwater treatment via air stripping to reduce VOCs (including Freon-22™), groundwater filtration to remove oxidized metals, and groundwater return to the aquifer via a recharge basin. A vapor phase treatment system reduces the concentrations of VOCs in the air stripper off-gas prior to discharge into the atmosphere. The OU3 groundwater IRM monitoring well network has been sampled periodically since the system was operational on July 21, 2009 (the record search included a review of quarterly groundwater monitoring data between 2009 and 2011 [details are provided in the Section 3.1).

3.2.3. Freon™ Use

Freon™ Use

Based on the December 1986 RGH IAS, halogenated solvent wastes accumulated within Plants 03 and 10 at NWIRP Bethpage. The drums stored at Plants 03 and 10 contained "freon". Filled drums were then relocated to the Main Drum Marshalling Area, which was located inside a building in the Salvage Storage Area, Site 9. Trichloroethane, methylene chloride, perchloroethylene, trichloroethylene, and "all freons" were classified as "Type 4" waste. Based on Table 6-4 of the December 1986 RGH IAS, approximately 80,000 gallons of Type 4 waste was handled by the Main Drum Marshalling Area between 1982 and 1985.

Halliburton summarized the December 1986 RGH IAS as follows:

- The former drum marshalling area at the NWIRP was identified as an area that “may pose a threat to human health or the environment”.
- From the early 1950s, drummed waste was stored on a cinder-covered surface over a cesspool field located east of Plant No. 3. In 1978, the collection and marshalling point was relocated south of the original unpaved area to a concrete pad (with no cover or berms). The drummed waste storage area was re-located to the Drum Marshalling Facility in 1982, within the Salvage Storage Area and a cover was added in 1983. The drums were taken off-site for treatment or disposal.
- No leaks or spills were reported.
- The area identified as “Site 1” is underlain by an abandoned septic drainage system.

Additionally, Registration Sheets dated 1988 and included in the New York State Site Registry Delisting Petition for the Headquarters Complex prepared by D & B and dated March 1995 (March 1995 D & B Headquarters Complex SRDP) indicated that “Plant 111 stored freon...at one indoor location...” Based on the Application for a Toxic or Hazardous Materials Storage Facility Permit dated June 1988, approximately 360 gallons of “Freon 11, 12, 22 (Gas)” were stored within storage areas at the Headquarters Complex.

Based on the April 1993 D & B Hangar 7 SRDP, an inspection of Hangar 7 on February 26, 1993 identified a 30-gallon drum refrigerant (trichloromonofluoromethane [Freon-11™]) in the Mechanical Equipment Room # 2. Based on the March 1995 D & B Headquarters Complex SRDP, the following were identified at the Headquarters Complex sometime between 1960 and 1995:

- Flammable Chemical Storage Cabinets – containing “small quantities” of “freon”;
- Thermodynamics Lab – utilizing “freon” as the working fluid for the manufacture of thermal control devices;
- Stock Room – storing dichlorodifluoromethane (Freon-12™);
- 90 Day Storage Building (with secondary containment) –storing “freon”;
- Assembly and Fabrication Shop – Receiving Area (Temporary Storage) – storing “freon” and Freon-12™;
- Shop Area – storing “freon” in flammable chemical cabinets;
- Basement (Original Section) – storing 30 gallon drums containing Freon-11™; and
- First Floor (Original Section) – storing toner (“1,1, Dichlorol-Fluoroethane” [Freon-132™]).

Based on the New York State Site Registry Delisting Petition for Plants 4 and 25 prepared by D & B and dated September 1995 (September 1995 D & B Plants 4 and 25 SRDP), the following were identified at Plants 4 and 25 sometime between 1950 and 1995:

- Boiler Room – containing 200-pound drums of Freon-11™ and an additional 30-gallon drum of Freon-11™; and
- Plant 5, Department 161 Stock Room – storing trichlorotrifluoroethane (Freon-113™).

Two former Town ice rinks are known to have utilized Freon-22™ as a coolant for the ice surface. Town personnel have indicated that coolant pipes carrying Freon-22™ occasionally leaked, requiring repair. Prior investigations associated with the Site area show high concentrations of Freon™ in the vicinity of the Site, both in groundwater and soil vapor.

Freon-22™

Based on the documents reviewed during the records search (Section 3.1), the following is a summary of available Freon-22™ analytical data obtained from groundwater samples collected within the Site, Park and surrounding area:

- In 2001 Freon-22™ was detected as a TIC, at a concentration greater than the NYSDEC Class GA SGV at monitoring well GM211, which is located immediately south of a former recharge basin in the southern portion of the Grumman property. Monitoring well GM-211 is located at a distance greater than 4,500 feet southwest of the Site (cross-gradient of the OU3 / Study Area VOC-Plume).
- In 2005 Freon-22™ was identified as a TIC, at a concentration greater than the NYSDEC Class GA SGV at monitoring well CAMW4, which located immediately south and down-gradient of the Site.
- Between 2004 and 2006 Freon-22™ was identified at a concentration greater than the NYSDEC Class GA SGV in the following groundwater sampling locations within OU3:
 - B-43E (approximately 100 feet west and cross-gradient of the Site)
 - BCPMW-6-1 (approximately 450 feet south and down-gradient of the of the Site)
 - BCPMW-7-1 (approximately 550 feet south-southeast and down-gradient of the Site)
 - CAMW4 (immediately south and down-gradient of the Site)
 - VP-6 (approximately 500 feet south-southeast and down-gradient of the Site)
 - VP-7 (approximately 550 feet south-southeast and down-gradient of the Site)
 - VP-8 (approximately 550 feet south-southeast and down-gradient of the Site)
 - VP-11 (approximately 450 feet southwest and cross-gradient of the Site)
 - VP-12 (approximately 500 feet south and down-gradient of the Site)
 - VP-13 (approximately 450 feet south-southeast and down-gradient of the Site)

- VP-14 (approximately 400 feet south and down-gradient of the Site)
 - VP-14A (approximately 400 feet south and down-gradient of the Site)
 - VP-23A (approximately 75 feet south-southwest and down- and cross-gradient of the Site)
 - VP-35 (approximately 50 feet south-southwest and down- and cross-gradient of the Site)
- Between 2006 and 2009 Freon-22™ was identified at a concentration greater than the NYSDEC Class GA SGV in the following groundwater sampling locations down-gradient of OU3 and within the OU3 / Study Area VOC-Plume (eastern portion of the OU2 VOC-Plume). The groundwater sampling depths are indicated in parenthesis and are with respect to land surface.
 - VP-100 (75-85)
 - VP-116 (194) – As detailed in Section 3.1, a segment of VOC-impacted groundwater was identified between VPBs VP-111 and VP-119 at depths of 100 and 330 feet bls. ARCADIS concluded this shallower segment of the VOC-impacted groundwater was “not consistent with the depth of the Study Area VOC-impacted groundwater originating” from the Park (OU3 / Study Area VOC-Plume reached depths greater than 330 feet bls in the area between VPBs VP-111 and VP-119) and therefore not related to the Park.
 - In June 2008, Freon-22™ was identified at a concentration greater than the NYSDEC Class GA SGV in the following groundwater sampling location within OU2:
 - VP-115 (greater than 2,000 feet southwest and cross-gradient of the Site)
 - Depth: 242 feet bls;
 - Depth: 402 feet bls;
 - Depth: 442 feet bls; and
 - Depth: 482 feet bls.
 - In 2009, Freon-22™ was identified at a concentration greater than the NYSDEC Class GA SGV in the following groundwater sampling locations within OU3:
 - WSP-5 (groundwater IRM treatment system influent Water Sampling Port-5)
 - RW-3 (groundwater IRM treatment system remedial / recovery well)
 - RW-4 (groundwater IRM treatment system remedial / recovery well)
 - B24MW-3 (approximately 900 feet southwest and cross-gradient of the Site)
 - BCPMW-4-1 (approximately 600 feet southwest and cross-gradient of the Site)



- BCPMW-6-1 (approximately 450 feet south and down-gradient of the of the Site)
- In 2009, Freon-22™ was identified at a concentration greater than the NYSDEC Class GA SGV in the following groundwater sampling location down-gradient of OU3 and within the OU3 / Study Area VOC-Plume (eastern portion of the OU2 VOC-Plume): MW-203-1.
- In 2010, Freon-22™ was identified at a concentration greater than the NYSDEC Class GA SGV in the following groundwater sampling locations within OU3:
 - WSP-5 (groundwater IRM treatment system influent Water Sampling Port-5)
 - RW-3 (groundwater IRM treatment system remedial / recovery well)
 - RW-4 (groundwater IRM treatment system remedial / recovery well)
 - BCPMW-6-1 (approximately 450 feet south and down-gradient of the of the Site)
 - BCPMW-7-1 (approximately 550 feet south-southeast and down-gradient of the Site)
- In 2010, Freon-22™ was identified at a concentration greater than the NYSDEC Class GA SGV in the following groundwater sampling location down-gradient of OU3 and within the OU3 / Study Area VOC-Plume (eastern portion of the OU2 Plume): MW-203-1.
- Freon-22™ was detected a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.) and less than the NYSDEC Class GA SGV in the following groundwater sampling locations within OU2 (general location and collection date are provided in parenthesis):
 - VP-34 (northwest [up- and cross-gradient] of the Site; 2004 through 2006)
 - VP-36 (west [cross-gradient] of the Site; 2004 through 2006)
 - VP-107 (down-gradient of OU3; 2006 through 2009)
 - VP-105 (down-gradient of OU3; 2006 through 2009)
 - VP-108 (down-gradient of OU3; 2006 through 2009)
 - MW-108-1 (down-gradient of OU3; 2006 through 2009)
 - VP-100, excluding the 75 to 85 feet bls sampling interval (down-gradient of OU3; 2006 through 2009)
 - MW-100-3 (down-gradient of OU3; 2006 through 2009)
 - MW-109-3 (down-gradient of OU3; 2006 through 2009)
 - VP-102 (down-gradient of OU3; 2006 through 2009)

- VP-109 (down-gradient of OU3; 2006 through 2009)
- VP-110 (down-gradient of OU3; 2006 through 2009)
- GM-15D2 (within OU2, in the southeastern portion of the Grumman property, southwest and cross-gradient of the Site; 2006 through 2009)
- VP-118 (down-gradient of OU3; 2006 through 2009)
- Well 1 (within OU2, in the southwestern portion of the NGC property; southwest and cross-gradient of the Site; 2006)
- Well 18 (within OU2, in the southern portion of the Grumman property, southwest and cross-gradient of the Site; 2006, 2010 and 2011)
- Well 19 (within OU2, in the southeastern portion of the Grumman property, southwest and cross-gradient of the Site; 2006 and 2010)
- GM13D (within OU2, in the east-central portion of the Grumman property, southwest and cross-gradient of the Site; 2011)
- GM15D (within OU2, in the southeast portion of the Grumman property, southwest and cross-gradient of the Site; 2011)
- GM35D2 (within OU2, south of the Grumman property, southwest and cross-gradient of the Site; 2006 and 2011)
- GM34D (within OU2, south of the Grumman property, southwest and cross-gradient of the Site; 2006 and 2010)
- GM34D2 (within OU2, south of the Grumman property, southwest and cross-gradient of the Site; 2010)
- GM73D2 (within OU2, in the southwestern portion of the Grumman property, southwest and cross-gradient of the Site; 2011)
- GM74D2 (within OU2, in the southeastern portion of the Grumman property, southwest and cross-gradient of the Site; 2011)
- RW-2 (groundwater IRM treatment system remedial / recovery well; 2009 and 2010)
- RW-3 (groundwater IRM treatment system remedial / recovery well; July 2009)
- BCPMW-4-2 (approximately 600 feet southwest and cross-gradient of the Site; 2009)
- BCPMW-7-1 (approximately 550 feet south-southeast and down-gradient of the Site; 2009)
- BCPMW-4-1 (approximately 600 feet southwest and cross-gradient of the Site; 2010)
- MW-202-1 (down-gradient of OU3; 2010)

Based on the documents reviewed during the records search (Section 3.1), the following is a summary of available Freon-22™ analytical data obtained from soil gas and outdoor air samples collected within the Site, Park and surrounding area:

- Based on the November 2005 H2M IR and RAP, Freon-22™ was not identified in the soil vapor samples collected during the investigation.
- Based on the December 2005 H2M IRM Supplemental IR, Freon-22™ was not identified in the soil vapor samples collected during the investigation.
- Based on the December 2007 EAE & ST SVI Investigation Summary Report, of the samples collected from residential homes located south of OU3 and on the property of BHS, Freon-22™ was not detected at a concentration greater than the laboratory MDL in the sub-slab soil vapor, indoor air, outdoor air, and duplicate samples collected; and Freon-22 was detected in soil vapor samples collected (includes 1 duplicate sample) at concentrations ranging between approximately 7 µg/m³ and approximately 98,000 µg/m³.
- Based on the February 2008 ARCADIS RIR (Site Area), Freon-22™ was identified at a concentration greater than 10 µg/m³ at the following locations:
 - SGP-10 (adjacent to; south-southwest of the Site; and at 7.5 - 8, 34 - 34.5 and 49 - 49.5 feet bls)
 - SGP-107 (approximately 275 feet southeast of the Site; and at 7 - 7.5 feet bls)

Freon-12™

Based on the documents reviewed during the records search (Section 3.1), the following is a summary of available Freon-12™ analytical data obtained from groundwater samples collected within the Site, Park and surrounding area:

- Freon-12™ was detected at a concentration greater than the NYSDEC SGV for dichlorodifluoromethane in groundwater samples collected from OU2 in 2003 and from OU3 in 2006 and 2008.
- Freon-12™ was detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.) and less than the NYSDEC SGV for dichlorodifluoromethane in groundwater samples collected from OU2 and/or OU3 in 1997, 1999, 2006, 2009, and 2011.
- Freon-12™ was not detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.) in groundwater samples collected from OU2 and/or OU3 in 2002 through 2006 and 2008 through 2011.

Based on the documents reviewed during the records search (Section 3.1), the following is a summary of available Freon-12™ analytical data obtained from soil gas and outdoor air samples collected within the Site, Park and surrounding area:



- Based on the November 2005 H2M IR and RAP, Freon-12™ was identified at a concentration greater than 10 µg/m³ at the following locations:
 - E-11 (Site; at 10 feet)
 - E-13 (adjacent to and east of the Site, on Stewart Avenue; and at 8 - 10 feet)
 - G-11 (adjacent to and west of the Site; and at 10 feet)
 - H-13 (adjacent to and south of the Site; and at 10 and 52 feet)

- Based on the December 2005 H2M IRM Supplemental IR, Freon-12™ was identified at a concentration greater than 10 µg/m³ at the following locations:
 - R1 (Site; and at 10 - 12, 28 - 30 and 48 - 50 feet)
 - R3 (Site; and at 8 - 10, 28 - 30 and 48 - 50 feet)
 - R6 (adjacent to and southwest of the Site; and at 8 - 10, 28 - 30 and 48 - 50 feet)

- Based on the December 2007 EAE & ST SVI Investigation Summary Report, of the samples collected from residential homes located south of OU3 and on the property of BHS, Freon-12™ was detected at low concentrations (greater than the laboratory MDL; maximum concentration was 6.08 µg/m³) in sub-slab soil vapor, indoor air, outdoor air, and duplicate samples collected; and Freon-12 was detected in the soil vapor samples collected (includes 1 duplicate sample), at concentrations ranging between approximately 3.5 µg/m³ and approximately 4,000 µg/m³.

- Based on the February 2008 ARCADIS RIR (Site Area), Freon-12™ was identified at a concentration greater than 10 µg/m³ at the following locations:
 - SGP-10 (adjacent to; south-southwest of the Site; and at 7.5 - 8, 34 - 34.5 and 49 - 49.5 feet bls)
 - SGP-115 (approximately 550 feet southeast of the Site; and at 49.5 - 50 feet bls)

3.2.4. VOC-Plumes

As of September 1994, the OU2 VOC-Plume “beneath and extending southward from the Grumman, U.S. Navy, and OCC / RUCO Polymer Corporations sites” was approximately 12,000 feet long, 5,700 feet wide and greater than 500 feet thick. Subsequently, the OU2 groundwater plume totaled approximately 2,000 acres in area and was greater than 500 feet deep (as of October 2000). As of February 2011, the maximum extent of the OU2 VOC-Plume was approximately 3.5 miles in length, 1.6 miles in width, 790 feet in depth, and 430 feet in thickness.

The OU3 VOC-Plume was identified extending across the Park (located within the northeast portion of the OU2 VOC-Plume). Also, the OU3 / Study Area VOC-Plume was identified in the eastern portion of the OU2 VOC-Plume and south and southeast of the OU3 (hydraulically down-gradient of the Park and Sycamore Avenue). As of February 2008, the OU3 VOC-Plume was approximately 1,200 feet in width and at a maximum depth of 150 feet bls. Based on groundwater investigations conducted between June 2006 and July 2009, the OU3 / Study Area VOC-Plume was approximately 8,300 feet in length, 2,100 feet in width, 670 feet bls in depth, and 430 feet in thickness (as of February 2011).

3.3. FREON-22™ SUB-PLUME

In a letter dated May 26, 2010, the NYSDEC indicated that a "review of groundwater analytical data shows that Freon-22 groundwater contamination has been identified as a sub-plume within the overall OU3 Grumman groundwater contamination plume." The Freon-22™ groundwater sub-plume was identified in the eastern portion of the Park and delineated within the OU3 boundary. Freon-22™ was identified in the sub-plume at concentrations ranging between 10 ppb and 290 ppb and as of February 2008, extended over an average width of approximately 250 feet.

Freon-22™ was detected at the highest concentrations in the groundwater samples collected from the southeast portion of OU3. Freon-22™ detections in groundwater down-gradient of OU3 and within the OU2 VOC-Plume were sporadic and irregularly distributed. The detected concentrations of Freon-22™ in groundwater down-gradient of OU3 and within the OU2 VOC-Plume are relatively insignificant compared to the total VOC concentrations in groundwater down-gradient of OU3 and within the OU2 VOC-Plume. Based on the analytical data, the Freon-22™ sub-plume appears to be limited to the OU3 boundary.

4.0 REMEDIAL INVESTIGATION WORK PLAN

To date, extensive environmental sampling of groundwater, soil and soil vapor at the Site and general area has been conducted by various entities including the U.S. Navy, USGS, NYSDEC, NYSDOH, Grumman, NGC, RGH, G & M, Halliburton, D & B, ARCADIS, EAE & ST, and H2M. Groundwater, soil and soil vapor samples were analyzed for various constituents, including, but not limited to metals, pesticides, PCBs, and semivolatile organic compounds (SVOC). Based on the findings of the environmental investigations, several remediations / IRMs were conducted / incorporated at the Site and general area including, but not limited to the following:

- Soil Excavation IRM (Construction Area): Excavation and removal of approximately 175,000 cubic yards (cu yd) of soil impacted with metals, PCBs and VOCs.
- SVE IRM (Former Grumman Plant 24 Access Road Property): An SVE system was installed to intercept / contain impacted soil vapor.
- Groundwater IRM (Former Grumman Plant 24 Access Road Property): A groundwater extraction and treatment system for impacted groundwater.

Based on the findings of the numerous environmental investigations and remediations / IRMs at the Site and general area, additional sampling for metals, pesticides, PCBs, and SVOCs is not warranted (April 2013 NYSDEC Comment Letter).

In an effort to delineate the nature and extent of the Freon-22™ groundwater sub-plume and soil vapor impact(s) and as required by the NYSDEC in the April 2013 NYSDEC Comment Letter, evaluate the conditions at the Site, Park and general area "in regard to potential impacts of Freon-12, Freon-22 and other Brownfield Site-related VOCs to soil vapor and groundwater", we propose conducting an RI. According to the February 2008 ARCADIS RIR (Site Area), the southwest portion of the Park ("Areas 'B', 'C', 'D', and 'I'", as defined by ARCADIS) "appear to be continuing sources of VOCs to groundwater." Based on the March 2013 NYSDEC OU3 ROD, the "approximately one-acre VOC rag pit area" is the source area(s) for VOCs.

Considering the above, this RIWP has been prepared to include groundwater and soil vapor sampling for VOCs, Freon-12™, Freon-22™, plus VOC TICs analysis. It is understood that the contaminant of concern associated with the subject Site is limited to Freon™, and that non-Freon™ VOC analytical data, that may be generated as part of the Remedial Investigation, will be utilized for information purposes regarding the Site setting and not for consideration as contaminants of concern associated with the Site.

This RIWP has been prepared to meet the requirements specified in Chapter 3 - Site Characterization and Remedial Investigation of the NYSDEC DER-10 and the NYSDEC Guidance for Evaluating Soil Vapor Intrusion in the State of New York dated October 2006

(SVI Guidance). The RI will be conducted with NYSDEC oversight and has the following goals:

- 1) Define the nature and extent of contamination;
- 2) Identify the source(s) of the contamination;
- 3) Assess the impact of the contamination on public health and the environment; and
- 4) Provide information to support the development of a proposed remedy to address the contamination or the determination that cleanup is not necessary.

4.1. OBJECTIVES

The specific RI objectives identified in NYSDEC DER-10, and their statuses (achieved [based on information obtained from the records search] or requires investigation), are provided below:

Objective 1

Delineate the areal and vertical extent of Freon-22™, and as required by the NYSDEC, Freon-12™ and “other Brownfield Site-related VOCs” in groundwater and soil vapor at and/or emanating from the Site. Although this RIWP has been prepared to include groundwater and soil vapor sampling for VOCs, Freon-12™, Freon-22™, plus VOC TICs analysis, it is understood that the contaminant of concern associated with the subject Site is limited to Freon™.

STATUS: Information regarding the areal and vertical extent of the Freon-12™, Freon-22™ and VOCs groundwater and soil vapor impacts were obtained from the records search and summarized in Section 3.0 – Records Search of this RIWP. A significant volume of data from many sampling and monitoring points is available showing historic impacts and ongoing monitoring results.

Based on the February 2008 ARCADIS RIR (Site Area), February 2011 ARCADIS RIR (Study Area), May 2012 NYSDEC PRAP, September 2012 NYSDEC Letter, and March 2013 NYSDEC OU3 ROD:

- The southwest portion of the Park (“Areas ‘B’, ‘C’, ‘D’, and ‘I’”, as defined by ARCADIS) “appear to be continuing sources of VOCs to groundwater.”
- The “approximately one-acre VOC rag pit area” is the source area(s) for VOCs.
- VOCs are present in the groundwater beneath the Park and the VOC-plume was delineated in the up-, cross- and down-gradient directions and in the vertical direction;

- An OU3 remedy was selected by the NYSDEC based on, but not limited to the following:
 - NYSDEC and NYSDOH confidence that the “nature and extent of contamination at OU3 has been fully characterized”;
 - NYSDEC determined that “sufficient investigation had been conducted for both the on and off-site components of OU3”;
 - “The nature and extent of the OU3 plume has been defined by the OU3 RI sampling program”; and
 - “The off-site remedial investigation generated the information necessary to quantify the overall extent of the OU3 groundwater plume.”
- The Freon-22™ groundwater sub-plume was delineated within the Park;
- Freon-12™ and Freon-22™ were detected sporadically in the groundwater down-gradient of the Park;
- The OU3 groundwater IRM was implemented in July 2009 to prevent migration of groundwater in the upper 20 feet of the aquifer containing total VOCs at concentrations greater than 5 ppb;
- The groundwater IRM effectiveness is periodically monitored via the Groundwater Monitoring Network; and
- The continued off-site migration of impacted groundwater has largely been addressed by the on-site groundwater pump and treatment system IRM.
- Soil gas impacts related to OU3 are limited to the Park Area and do not extend off-site.
- The soil vapor IRM located south of the Park “pulls contaminated vapor away from the school and toward the Grumman Access Road.”
- Soil vapor impacts to adjacent residences have been addressed by Grumman through implementation of the SVE IRM.
- The soil gas IRM effectively prevents off-site migration of VOCs in soil gas and that additional off-site soil gas investigation is not required.
- “Freon 12 and Freon 22 have both been detected in soil gas, however, to date, only Freon 22 has been detected in the groundwater.”

As required by the NYSDEC in the April 2013 NYSDEC Comment Letter, “environmental samples, analyzed for full VOC scan, must be taken in order to determine the lateral and vertical extent of contamination from the TOB former ice rink(s).” As such, this RIWP includes “monitoring well sampling...and soil gas sampling.” Although this RIWP has been prepared to include groundwater and soil vapor sampling for VOCs, Freon-12™, Freon-22™, plus VOC TICs analysis, it is understood that the contaminant of concern associated with the

Site is limited to Freon™. Existing data will be compiled as necessary to document delineation and will be reiterated within the RI Report. Additional data obtained during the RI will be presented in the RI Report.

Objective 2

Determine the surface and subsurface characteristics of the Site, including topography, geology and hydrogeology.

STATUS: Site surface and subsurface characteristic information was obtained from the records search and information is provided in Section 2.0 - Site and Area Description of this RIWP. Objective 2 has been achieved. This information will be reiterated in the RI report.

Objective 3

Identify the source(s) of contamination to the extent possible, the migration pathway(s) and actual or potential receptor(s) of Freon-22™, and as required by the NYSDEC in the April 2013 NYSDEC Comment Letter, Freon-12™ and "other Brownfield Site-related VOCs" on or through air, soil, groundwater, surface water, utilities, and structures at the contaminated site, without regard to property boundaries. Although this RIWP has been prepared to include groundwater and soil vapor sampling for VOCs, Freon-12™, Freon-22™, plus VOC TICs analysis, it is understood that the contaminant of concern associated with the Site is limited to Freon™.

STATUS: Based on information obtained from the records search (Section 3.0 - Records Search of this RIWP), the southwest portion of the Park ("Areas 'B', 'C', 'D', and 'I'", as defined by ARCADIS) "appear to be continuing sources of VOCs to groundwater"; the "approximately one-acre VOC rag pit area" is the source area(s) for VOCs; and Freon-22™ was "released to the environment at the Park". In an NYSDEC letter dated September 17, 2008, the NYSDEC concluded that the former Town of Oyster Bay ice rinks were the source of the Freon-22™ groundwater and soil vapor impacts. Although details / information regarding a Freon-12™ release at the Site was not obtained during the records search, in the April 2013 NYSDEC Comment Letter, the NYSDEC states that "the site is a source of Freon 12". A further review of available data and available periodic monitoring reports will be conducted as part of the RI to evaluate these conclusions. Additional groundwater sample and soil vapor sample data will be obtained during the RI and the findings will be presented in the RI Report.

Objective 4

If necessary, collect and evaluate data necessary for a fish and wildlife resource impact analysis (FWRIA) to determine actual and potential adverse impact(s) to fish and wildlife resources.

STATUS: Based on the available data, nature of the site and scope of the Project, an FWRIA is not necessary.

Objective 5

Collect and evaluate data necessary to evaluate the actual and potential threat(s) to public health and the environment, including an evaluation of current and future potential public health exposure pathway(s) and potential impact(s) to biota.

STATUS: Although a significant volume of data from many sampling and monitoring points is available to have achieved Objective 5, as required by the NYSDEC in the April 2013 NYSDEC Comment Letter, additional data will be obtained via groundwater and soil vapor sampling. The existing data and additional data obtained during the RI will be utilized to evaluate the actual and potential threat(s) to public health and the environment. Evaluation of the actual and potential threats to public health and the environment will be included in the RI report.

Objective 6

Collect the data necessary to evaluate any release to groundwater and soil vapor and develop remedial alternative(s) to address the release.

STATUS: Although a significant volume of data from many sampling and monitoring points is available to have achieved Objective 6, as required by the NYSDEC in the April 2013 NYSDEC Comment Letter, additional data will be obtained via groundwater and soil vapor sampling. The existing data, review of available periodic monitoring reports and additional data obtained during the RI will be utilized to evaluate any release to groundwater and soil vapor and develop remedial alternative(s) to address the release.

Objective 7

Identify removal, treatment, containment or other interim remedial measures (IRM) as necessary to remove, treat or contain any source area(s) identified and prevent, mitigate or remedy environmental damage or human exposure to contaminants during remedial alternatives analysis.

STATUS: The OU3 groundwater and soil vapor IRMs have been operational since 2009 and 2008 respectively, to mitigate the migration of contaminants from the OU3 boundary. According to NYSDEC, both systems are effectively controlling migration of VOCs, including Freon-12™ and Freon-22™, from the Park Area. Therefore, Objective 7 is not applicable and additional IRMs are not necessary.

4.2. SCOPE OF WORK

The RI Scope of Work has been developed in accordance with Chapter 2 and Chapter 3 of the NYSDEC DER-10 and the NYSDEC SVI Guidance. Fieldwork will be conducted in accordance with the Health and Safety Plan (HASP; Appendix A) and under the oversight of qualified H2M professionals. Given the availability of data and the status of various RI objectives summarized in Section 4.1 above, the RI Scope of Work will be limited to the following tasks:



- Site visit to identify any changes to the Site or vicinity;
- Further compilation of available groundwater and soil vapor data;
- Field investigation to determine the areal and vertical extent of VOC impacts;
- Comparison of data to applicable SCGs;
- Qualitative exposure assessment;
- Development of recommendations regarding additional investigation and/or remediation, if necessary; and
- Preparation of RI report.

4.2.1. Field Activities Plan

Utility Clearance and Geophysical Survey

Dig Safely New York will be contacted and a utility mark out will be requested at the Site, Park and/or general area. The subcontractor will be responsible for ensuring the utilities have been marked out and confirm that the utility mark out was performed by providing appropriate documentation (ticket numbers, certification, etc.) and visually verifying completion prior to beginning field investigative work.

Prior to the commencement of subsurface investigations, a geophysical survey will be conducted throughout the areas to be investigated using ground penetrating radar (GPR) and electromagnetic (EM) detection equipment. A geophysical survey will be conducted to minimize the potential for sampling activity to impact existing underground utilities, to clear proposed subsurface sampling locations and to accurately locate and document sample points. The survey will result in a map identifying utilities and subsurface anomalies. The survey and associated field observations will also be utilized to identify and evaluate potential subsurface anomalies and/or buried structures and debris.

Site Visit

A Site visit will be conducted to identify any changes to the Site, Park and general area. During the Site visit, monitoring wells, MW-200-1, MW-201-1, MW-202-1, and MW-203-1 will be examined to determine if the monitoring well is intact, clear, accessible, and suitable for sampling.

Groundwater

A groundwater investigation will be conducted in accordance with the NYSDEC DER-10 and will be based on available groundwater data obtained for the Site, Park and general area (as summarized in Section 3.0 of this RIWP).

Groundwater Screening

Three temporary groundwater monitoring wells will be installed as follows: RI-TMW-01 (north and up-gradient of the Site); RI-TMW-02 (southeast and down-gradient of the Site); and RI-TMW-03 (southwest and cross-gradient of the Site). The temporary monitoring well construction details and groundwater screening program are based on information obtained from the February 2008 ARCADIS RIR (Site Area) and the April 2011 ARCADIS Annual Summary OM&M Report for 2010.

The following is a summary of Freon-22™ concentrations detected (if any) in groundwater samples collected from VPBs located in the vicinity of the above-listed, proposed temporary monitoring wells (as reported in the February 2008 ARCADIS RIR [Site Area]):

- VP-34 (approximately 175 feet southwest of RI-TMW-01)
 - Freon-22™ concentration of 0.9 µg/L was detected in the groundwater sample collected from a depth of 50 to 55 feet bls.
 - Freon-22™ concentration of 0.7 µg/L was detected in the groundwater sample collected from a depth of 57 to 62 feet bls.
 - Freon-22™ was not detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.) in the groundwater sample collected from a depth of 62 to 67 feet bls.
- VP-13 (approximately 175 feet south-southwest of RI-TMW-02)
 - Based on Table 5-14, groundwater samples collected from depths of 60 to 65 feet bls, 70 to 75 feet bls, 80 to 85 feet bls, 92 to 97 feet bls, and 105 to 110 feet bls were not analyzed for Freon-22™.
 - Based on the laboratory analytical data provided in Appendix N (Laboratory Report Number 208511), Freon-22™ was not detected at a concentration greater than the laboratory detection limit (MDL, CRDL, IDL, RL, etc.) in the groundwater sample collected from 105 to 110 feet bgs.
 - Based on Figure 5-11, the maximum concentration of Freon-22™ detected at this location was 290 µg/L. According to Note # 3 on Figure 5-11, the groundwater sample with the maximum concentration of Freon-22™ was collected "at the water table". Based on the Groundwater/Perched Water Sampling Logs and Perched Water Hydrographs provided in Appendix F, the depth to groundwater at this location was approximately 55 feet bls.
- VP-14 (approximately 175 feet southeast of RI-TMW-03)
 - Based on Table 5-14, groundwater samples collected from depths of 65 to 70 feet bls, 75 to 80 feet bls, 85 to 90 feet bls, 95 to 100 feet bls, 105 to 110 feet bls, and 115 to 120 feet bls were not analyzed for Freon-22™.

- Based on Figure 5-11, the maximum concentration of Freon-22™ detected at this location was 37 µg/L (as a TIC). According to Note # 3 on Figure 5-11, the groundwater sample with the maximum concentration of Freon-22™ was collected "at the water table". Based on the Groundwater/Perched Water Sampling Logs and Perched Water Hydrographs provided in Appendix F, the depth to groundwater at this location was approximately 60 feet bls.
- VP-14A (approximately 175 feet southeast of RI-TMW-03)
 - Freon-22™ concentration of 0.9 µg/L was detected in the groundwater sample collected from a depth of 55 to 60 feet bls.
 - Freon-22™ concentration of 0.8 µg/L was detected in the groundwater sample collected from a depth of 60 to 65 feet bls.
 - Freon-22™ concentration of 32 µg/L was detected in the groundwater sample collected from a depth of 70 to 75 feet bls.

The following is a summary of Freon-22™ and OU3 Groundwater IRM information that is pertinent to the proposed temporary monitoring wells (as reported in the April 2011 ARCADIS Annual Summary OM&M Report for 2010):

- Remedial wells (RW-1 through RW-4) are located downgradient of the Site, along the southern portion of the Northrop Grumman Former Plant 24 Access Road and are utilized to extract groundwater.
- Based on the configuration of potentiometric surface and groundwater flow directions presented on Figure 4, groundwater in the location of proposed RI-TMW-03 is most likely to be captured by RW-3. The groundwater flow directions in the locations of proposed RI-TMW-01 and RI-TMW-02 are not shown on Figure 4.
- RI-TMW-01 is located approximately 825 feet north-northeast of RW-3 and approximately 875 feet northeast of RW-4.
- RI-TMW-02 is located approximately 850 feet northeast of RW-3 and approximately 300 feet northeast of RW-4.
- RI-TMW-03 is located approximately 200 feet north-northeast of RW-3 and approximately 325 feet northwest of RW-4.
- Based on Table A-1 and Figure 9, the recovery well screen is set between 84 and 104 feet bls in RW-3 and between 110 and 130 feet bls in RW-4. Although the groundwater flow presented on Figure 9 does not indicate groundwater from proposed locations for RI-TMW-01, RI-TMW-02 and RI-TMW-03 would be extracted by RW-1 or RW-2, it should be noted that the recovery well screen is set between 108 and 128 feet bls in RW-1 and 84 and 104 feet bls in RW-2. The deepest recovery well screen is set at 110 to 130 feet bls (RW-04).

- Based on the groundwater contours presented on Figure 9, the approximate maximum depth of the groundwater containing 5 µg/L of total VOCs (includes only "Project VOCs", as defined by ARCADIS) is 140 feet bls.
- Based on Figure 9, total VOC concentrations are "representative of the entire well screen interval." Accordingly, 0.4 µg/L of non-Project VOCs, as defined by ARCADIS and including Freon-22™, was detected in a groundwater sample collected from 133 to 143 feet bls in monitoring well, BCPMW-6.2.

Based on the above, a licensed New York State monitoring well driller will utilize a high-capacity direct push drilling rig (i.e., Geoprobe® 78 series, Geoprobe® 80 series, or similar machine capable of reaching the maximum desired sampling depths) to advance temporary monitoring wells, RI-TMW-01, RI-TMW-02 and RI-TMW-03 to the following proposed final depths:

- RI-TMW-01 will be completed at a final depth of 100 feet bgs (or maximum achievable final depth).
- RI-TMW-02 will be completed at a final depth of 145 feet bgs (or maximum achievable final depth).
- RI-TMW-03 will be completed at a final depth of 145 feet bgs (or maximum achievable final depth).

The direct push drilling rig will consist of a dedicated polyvinyl chloride (PVC) screen (Geoprobe® Screen Point 16 Groundwater Sampler or equivalent) that is driven within a sealed, steel sheath and then deployed at the desired sampling depths for the collection of groundwater samples. In this manner, the groundwater at each temporary monitoring well will be screened at varying depths from the groundwater table (approximately 55 feet bgs) to the proposed final depths in 10-foot intervals and sampled as follows:

- RI-TMW-01: 55, 65, 75, 85, 95, and 100 feet bgs (or maximum achievable final depth).
- RI-TMW-02: 55, 65, 75, 85, 95, 105, 115, 125, 135, and 145 feet bgs (or maximum achievable final depth).
- RI-TMW-03: 55, 65, 75, 85, 95, 105, 115, 125, 135, and 145 feet bgs (or maximum achievable final depth).

The proposed temporary monitoring well locations are provided in Figure 3. It should be noted that the final temporary monitoring well installation locations, sampling intervals within each temporary monitoring well and maximum achievable final depths may vary slightly due to field conditions.

One groundwater sample from each sampling interval within each temporary monitoring well will be collected using a dedicated bailer (or equivalent). Groundwater samples will be collected by field personnel wearing one-time use nitrile gloves and transferred into laboratory-supplied containers. Based on the above and depending on field conditions, approximately 26 groundwater samples will be submitted under chain of custody protocol to an NYSDOH Environmental Laboratory Approval Program (ELAP)-approved and ASP-certified laboratory for TCL VOCs, Freon-12™, Freon-22™, plus 20 TICs (as required by the NYSDEC in the April 2013 NYSDEC Comment Letter) via EPA Method 8260.

A trip blank sample will accompany field groundwater samples at a rate of one per shipment / sample delivery group (SDG). The trip blank will be analyzed for VOCs. Because dedicated disposable sampling equipment will be used for the groundwater screening program, equipment blank samples will not be collected. Laboratory analytical data will be provided as raw analytical data. The analytical data will be interpreted (groundwater screening results compared with the NYSDEC TOGS Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations dated June 1998 [AWQS]) and the screen depth for the permanent monitoring wells will be selected.

Non-dedicated equipment, tools, measuring / monitoring devices, etc. coming into contact with the subsurface soil and/or groundwater will be decontaminated between uses at each borehole by steam cleaning or with deionized water and non-toxic laboratory grade detergent (e.g. Alconox). Investigation derived waste (IDW) will be containerized in labeled New York State Department of Transportation (DOT)-approved 55-gallon drums and/or roll-off bins, pending characterization, as necessary. After characterization, the IDW will be removed for off-site disposal at an approved waste disposal facility (to be coordinated by the subcontractor).

Monitoring Well Installation

Three groundwater monitoring wells will be installed in the vicinity of the corresponding temporary monitoring well and as follows:

- RI-MW-01 (vicinity of RI-TMW-01, north and up-gradient of the Site);
- RI-MW-02 (vicinity of RI-TMW-02, southeast and down-gradient of the Site); and
- RI-MW-03 (vicinity of RI-TMW-03, southwest and cross-gradient of the Site).

A licensed New York State monitoring well driller will utilize a hollow stem auger (HSA) drilling rig install the 2-inch diameter, Schedule 40 PVC monitoring wells (RI-MW-01, RI-MW-02 and RI-MW-03) to two feet below where the highest Freon-22™ concentrations were detected in the groundwater screening samples collected from the corresponding temporary monitoring wells. In the absence of Freon-22 detections at a concentration greater than the NYSDEC TOGS AWQS (5 µg/L), the 10-foot screen will be set at the soil and groundwater interface (approximately 55 feet bgs [5 feet above and 5 feet below the groundwater table]). Newly installed monitoring wells RI-MW-01, RI-MW-02 and RI-MW-03 will include a 5-

foot section of 0.010 inch (#10) slot-size PVC well screen that will be set across the interval where the highest Freon-22™ concentrations were detected in the groundwater screening samples collected from the temporary monitoring well at that location. Each newly installed monitoring well will consist of a PVC flush-joint riser. The annular space in each monitoring well will be backfilled with a sand filter pack extending from six inches below the base of the borehole to two feet above the screened interval. A 3-foot thick bentonite pellet seal (continuously hydrated for 60 minutes prior to installation) will be placed above the sand filter pack. The depth to the bottom and top of each seal will be measured in the borehole to the nearest 0.1 foot using a weighted tape. The remaining annular space will be grouted with a bentonite / cement slurry using the tremie method. A cement/bentonite surface seal will be constructed by filling the annular space of the borehole and will extend from approximately three feet below-grade to grade where a flush mounted well manhole will be installed. A water tight locking cap will be attached to the top of the PVC casing. A 6-inch diameter protective steel casing in a cement collar will be installed over each well. A flush to grade steel cover assembly will be set around the well casing. This steel cover will be set into a sloped concrete pad, after the grout has been allowed to set.

During installation, the soil cuttings will be screened for total organic vapors with a hand-held photoionization detector (PID). All drilling equipment will be steam-cleaned prior to work and in between monitoring well installation locations. Decontamination water and soil cuttings will be containerized in labeled DOT-approved 55-gallon drums or roll-off bins, pending analytical characterization, as necessary. After characterization, the waste will be disposed of off-site at an approved waste disposal facility (to be coordinated by the subcontractor).

Groundwater Sampling

Monitoring wells will be sampled as follows:

- One sample from each of the following newly installed monitoring wells:
 - RI-MW-01;
 - RI-MW-02;
 - RI-MW-03.

- One sample from each of the following existing monitoring wells (the monitoring well screen depth interval is shown in parenthesis):
 - MW-200-1 (85 to 95 feet bls);
 - MW-201-1 (70 to 80 feet bls);
 - MW-202-1 (125 to 135 feet bls); and
 - MW-203-1 (103 to 113 feet bls).

Assuming the monitoring wells are suitable for sampling, a total of 7 groundwater samples will be analyzed to evaluate the groundwater quality at the Site. It is assumed that permission will be granted for access to the off-site wells. The proposed sampling locations are provided in Figure 3. It should be noted that the final monitoring well installation locations may vary slightly due to field conditions.

Each monitoring well that is to be sampled will be developed by the subcontractor to remove fine-grained sediment from the filter pack and surrounding formation to increase the overall hydraulic efficiency. Purge water generated during monitoring well development will be containerized in labeled DOT-approved 55-gallon drums for off-site disposal (to be coordinated by the subcontractor). After monitoring well development, the elevation of the top of casing (TOC) and top of manhole cover (ground surface) of each monitoring well will be surveyed to the nearest reference datum to allow for the preparation of an accurate potentiometric surface map of the upper glacial aquifer.

Prior to sample collection, a minimum of three well screen volumes will be purged from the monitoring well with a Grundfos Pump (or equivalent) and dedicated tubing and transferred into labeled DOT-approved 55-gallon drums for off-site disposal (to be coordinated by the subcontractor). Chemical and physical groundwater parameters such as total organic vapors, temperature, pH, electroconductivity, turbidity, oxidation-reduction potential, and dissolved oxygen concentration will be recorded during purging of the monitoring wells. Groundwater samples will be collected after a minimum of three well screen volumes have been purged and the chemical and physical parameters have stabilized (at the discretion of the field sampler). One groundwater sample from each monitoring well and QA/QC samples (blind duplicate [BD], matrix spike and matrix spike duplicate [MS/MSD] samples; each collected at a frequency of 1 sample per 20 samples, but not less than 1 per day) will be collected using a dedicated bailer (or equivalent). Synoptic depth to groundwater measurements will be obtained prior to and after well development and prior to and after groundwater sample collection. The monitoring well construction, development, purging, and sampling details will be documented.

Groundwater samples will be collected by field personnel wearing one-time use nitrile gloves and transferred into laboratory-supplied containers. The groundwater samples and QA/QC samples will be submitted under chain of custody protocol to an NYSDOH ELAP-approved and ASP-certified laboratory for TCL VOCs, Freon-12™, Freon-22™, plus 20 TICs (as required by the NYSDEC in the April 2013 NYSDEC Comment Letter) via EPA Method 8260. Although this RIWP has been prepared to include groundwater sampling for VOCs, Freon-12™, Freon-22™, plus VOC TICs analysis, it is understood that the contaminant of concern associated with the Site is limited to Freon™.

A trip blank sample will accompany field groundwater samples at a rate of one per shipment / SDG. The trip blank will be analyzed for VOCs. Because dedicated disposable sampling equipment will be used for the sampling program, equipment blank samples will not be collected. Laboratory analytical data will be provided as NYSDEC ASP Category B data

packages. Upon completing the data evaluation, a DUSR will be prepared by an independent data validator.

Non-dedicated equipment, tools, measuring / monitoring devices, etc. coming into contact with the subsurface soil and/or groundwater will be decontaminated between uses at each borehole by steam cleaning or with deionized water and non-toxic laboratory grade detergent (e.g. Alconox). IDW will be containerized in labeled DOT-approved 55-gallon drums and/or roll-off bins, pending characterization, as necessary. After characterization, the IDW will be removed for off-site disposal at an approved waste disposal facility (to be coordinated by the subcontractor).

Soil Vapor

A soil vapor investigation will be conducted in accordance with the NYSDOH SVI Guidance and will be based on available soil vapor data obtained for the Site, Park and general area (as summarized in Section 3.0 of this RIWP). The soil vapor investigation will consist of collecting soil vapor samples from 30 locations (set on a grid of approximately 200-feet on center) that will contain two nested temporary soil vapor sampling points. The proposed sampling locations are provided in Figure 4. It should be noted that the final soil vapor sampling locations may vary slightly due to field conditions.

Each nest of soil vapor sampling points will consist of two temporary soil vapor probes, one facilitating the collection of a soil vapor sample from approximately 10 feet bgs and one facilitating the collection of a soil vapor sample from a minimum of 2 feet above the expected depth to groundwater, at approximately 53 feet bgs. The temporary soil vapor probe implants will be installed by boring through the surface cover (asphalt or concrete) with a direct-push drill rig (e.g., Geoprobe®) to a depth of 10 feet bgs for collection of the soil gas samples and with a direct-push drill rig (e.g., Geoprobe®) or hollow stem auger drill rig to a depth of 53 feet bgs for collection of the deep soil gas samples. A soil vapor probe attached to inert tubing (e.g., polyethylene) will be inserted at each soil vapor sample location and the annulus around the probe and tubing will be filled to two feet above the sampling point with inert backfill material (e.g., glass beads, washed #1 crushed stone). The soil vapor probe will be sealed above the sampling zone with a 3-foot thick (minimum thickness) bentonite slurry. The remainder of the borehole will be backfilled with non-impacted backfill material (e.g., sand, soil cuttings).

After installation of the probe and prior to sample collection, up to three volumes (volume of the sample probe and tube) will be purged. A helium tracer gas will be utilized as a QA/QC measure to verify the integrity of the surface seal and to ensure that the soil vapor sampling point is properly sealed and ambient air does not infiltrate the sample. Prior to sample collection, the soil vapor will be screened for total organic vapors with a hand-held PID.

The soil vapor samples will be collected into laboratory-supplied, certified-clean Summa® canisters that are calibrated for a sampling rate of one hour per sample and with a flow rate not to exceed 0.2 liters per minute. For each day that soil vapor sampling is conducted, one outdoor air sample will be collected into laboratory-supplied, certified-clean Summa®

canisters that are calibrated for a sampling rate of one hour per sample and with a flow rate not to exceed 0.2 liters per minute. The soil vapor and outdoor air samples will be submitted under chain of custody protocol to an NYSDOH ELAP-approved and ASP-certified laboratory. Each sample will be analyzed for TCL VOCs, Freon-12™, Freon-22™, plus 20 TICs (as required by the NYSDEC in the April 2013 NYSDEC Comment Letter) via EPA Method TO-15. Although this RIWP has been prepared to include soil vapor sampling for VOCs, Freon-12™, Freon-22™, plus VOC TICs analysis, it is understood that the contaminant of concern associated with the Site is limited to Freon™. Laboratory analytical data will be provided as NYSDEC ASP Category B data packages.

Following sample collection, the in-hole sampling materials will be removed, the borehole will be backfilled with non-impacted backfill material (e.g., sand, soil cuttings) and the surface will be restored to grade with material matching the existing surface (asphalt or concrete). Excess soil cuttings will be containerized in labeled, DOT-approved 55-gallon drums or roll-off bins, pending analytical characterization, as necessary. After characterization, the waste will be disposed of off-site at an approved waste disposal facility (to be coordinated by the subcontractor).

4.2.2. IDW Disposal

IDW generated during the investigation will include, but not be limited to the following: decontamination rinsate; soil cuttings; monitoring well purge water; and monitoring well development water. IDW will be containerized in labeled DOT-approved 55-gallon drums and/or roll-off bins, pending characterization, as necessary. The 55-gallon drums will be staged on pallets at an appropriate location at the Site until final characterization and disposal. Initial labels will be green, non-hazardous and will state the date of drum closure / storage and name of the generator. Pending characterization analysis, the drums will be re-labeled accordingly. The IDW will be removed for off-site disposal at an approved waste disposal facility (to be coordinated by the subcontractor). Solid waste generated during the investigations will include, but not be limited to disposable personal protective equipment (e.g., nitrile gloves) and disposable rags. All solid waste will be disposed of in a waste receptacle.

4.2.3. QAPP

The Quality Assurance Project Plan (QAPP) has been prepared in accordance with the NYSDEC DER-10 (Section 2.4) and is included herein as Appendix B. The following is a summary of the sampling procedures, data quality / usability and decontamination procedures:

- Non-dedicated drill rig tools, sampling equipment, measuring / monitoring devices, etc. coming into contact with the subsurface soil and/or groundwater will be decontaminated between uses at each borehole with deionized water and non-toxic laboratory grade detergent (e.g. Alconox).

- HSAs will be steam cleaned in a decontamination pad (to be constructed by the subcontractor) and the rinsate will be containerized in DOT-approved 55-gallon drums for off-site disposal (to be coordinated by the subcontractor).
- Samples will be handled by field personnel wearing clean nitrile gloves to eliminate the potential for cross-contamination between samples.
- QA/QC samples will include, but not be limited to BD samples, MS/MSD samples, and TB samples. The BD and MS/MSD samples will be collected at a frequency of 1 sample per 20 samples, but not less than 1 per day. A TB sample will accompany field groundwater samples at a rate of one per SDG.
- Analytical results, including QA/QC sample results, will be subjected to independent data validation. Laboratory data packages will be reviewed for quality control parameters including, but not limited to, custody documentation, holding times, surrogate and matrix spike recoveries, duplicate correlation, calibration standard and blank performance, instrument performance, blank contamination, matrix interferences and method compliance.
- Upon completing the data evaluation, a DUSR will be prepared. Data validation services will be subcontracted to an independent data validator.

4.2.4. HASP

A HASP is included herein as Appendix A. Fieldwork will be conducted in accordance with the HASP and under the oversight of qualified H2M professionals.

4.2.5. CAMP

A copy of the NYSDEC Community Air Monitoring Plan (CAMP) is included herein as Appendix C. The CAMP will be implemented during any drilling, well construction and/or soil vapor probe installation.

4.2.6. RI Report

Following completion of the RI outlined above, an RI report will be prepared consistent with NYSDEC DER-10 requirements. The RI Report will include information collected by the investigation(s) completed as per the NYSDEC-approved RIWP(s), addenda or supplements; data collected during the RI; and the conclusions drawn from that data. The RIR will include, but not be limited to the following:

- Description of the field investigation activities (i.e., sample logs);
- Field observations (including, but not limited to weather during field activities, odors [if any], PID readings) and findings;
- Photograph log;
- Chain(s) of custody;

- Laboratory NYSDOH ELAP certification;
- Raw analytical data report(s);
- NYSDEC ASP Category B analytical data package(s);
- Analytical results presented in summary tables;
- Analytical data interpretation (sampling results compared with the relevant standards and guidelines):
 - Groundwater sample analytical results compared to the NYSDEC TOGS AWQS; and
 - Soil vapor sample analytical results compared to the NYSDOH Air Guideline Values (AGV) established for methylene chloride, PCE and TCE and evaluated utilizing the applicable Matrices 1 or 2 provided in the NYSDOH SVI Guidance.
 - Soil vapor sample analytical results compared to background outdoor air levels.
- Field investigation drawings (e.g., survey map, geophysical survey map, updated base map, sample locations, north orientation, and summary of findings); and
- Recommendations for further action, as appropriate, based on the investigation results.

5.0 RI SCHEDULE AND PROJECT PERSONNEL

5.1. RI SCHEDULE

The proposed RI schedule is provided below.

Task	Schedule
Submit revised Draft RIWP and revised Draft RIWP Fact Sheet to NYSDEC	0 days
Receipt of Final Fact Sheet from NYSDEC	30 days
Provide Final Fact Sheet to Site Contact List and Place Final Fact Sheet and Draft RIWP in Document Repository	10 days
Public Comment Period	30 days
Submit Certificate of Mailing to NYSDEC	10 days
NYSDEC and NYSDOH Review of Draft RIWP	30 days
NYSDEC and NYSDOH Approval of RIWP	0 days
Place NYSDEC-Approved RIWP in Document Repository	1 day
Conduct RI Field Work (to commence after the end of the Park swimming pool season ⁽¹⁾)	9 - 12 months
Compile Data and Prepare RIR	3 months
RIR Review by Town Personnel and Attorneys	30 days
Submit RIR and Draft Fact Sheet to NYSDEC	1 day
Receipt of Final Fact Sheet from NYSDEC	30 days
Provide Final Fact Sheet to Site Contact List and Place Final Fact Sheet and RIWP in Document Repository	10 days
Public Comment Period	30 days
Submit Certificate of Mailing to NYSDEC	10 days
NYSDEC and NYSDOH Review of RI	60 days
NYSDEC and NYSDOH Approval of RI	0 days

30 days

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Notes:

1. To cause minimal disturbance to and ensure the safety of the community and Park patrons, the RI field work will commence after the end of the Park swimming pool season.

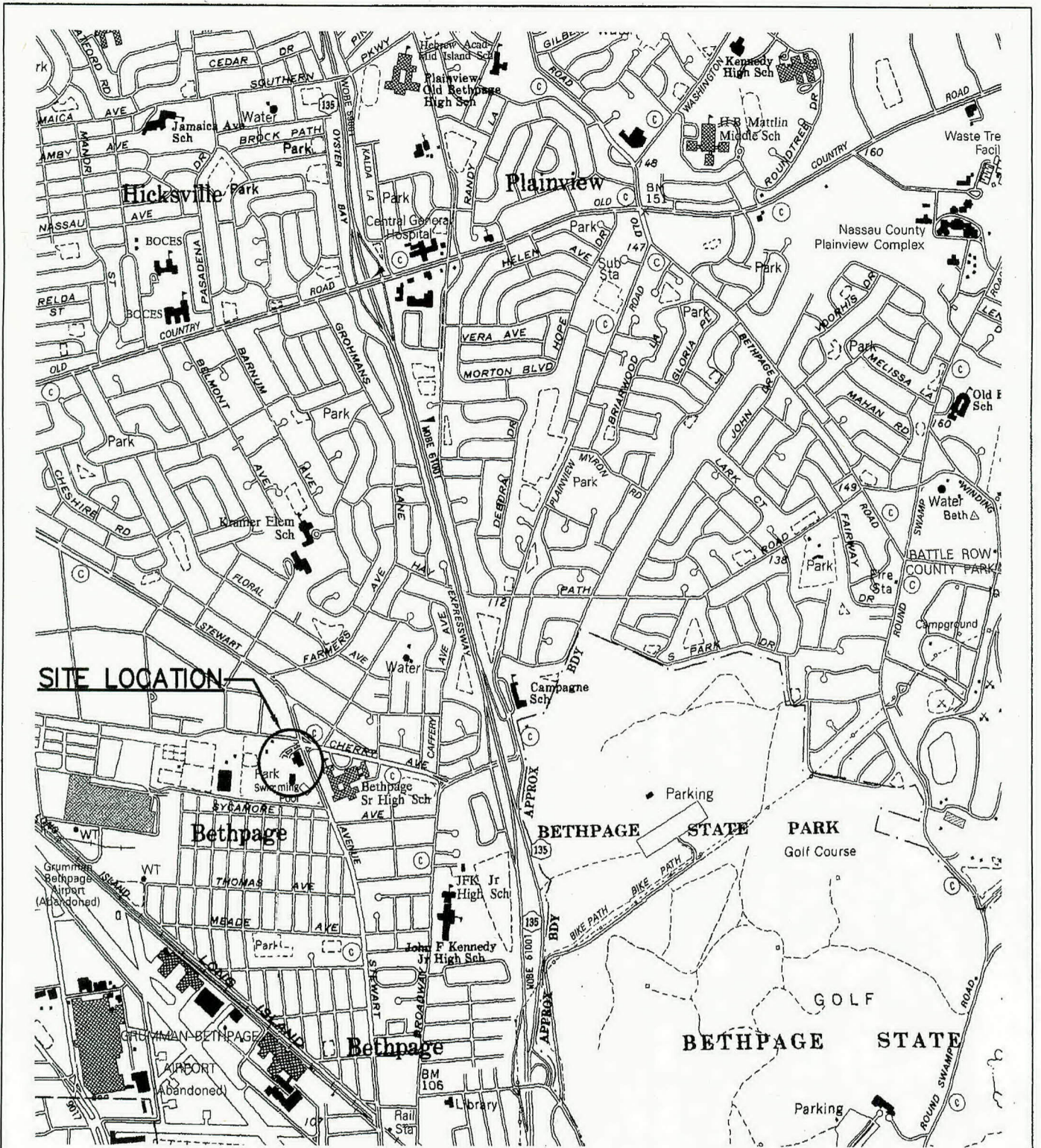
The NYSDEC will be notified a minimum of 10 days prior to commencing field activities.

5.2. PROJECT PERSONNEL

A list of the names, contact information and roles of the principal personnel who will participate in the investigation are provided in the HASP included as Appendix A.

6.0 CITIZEN PARTICIPATION ACTIVITIES

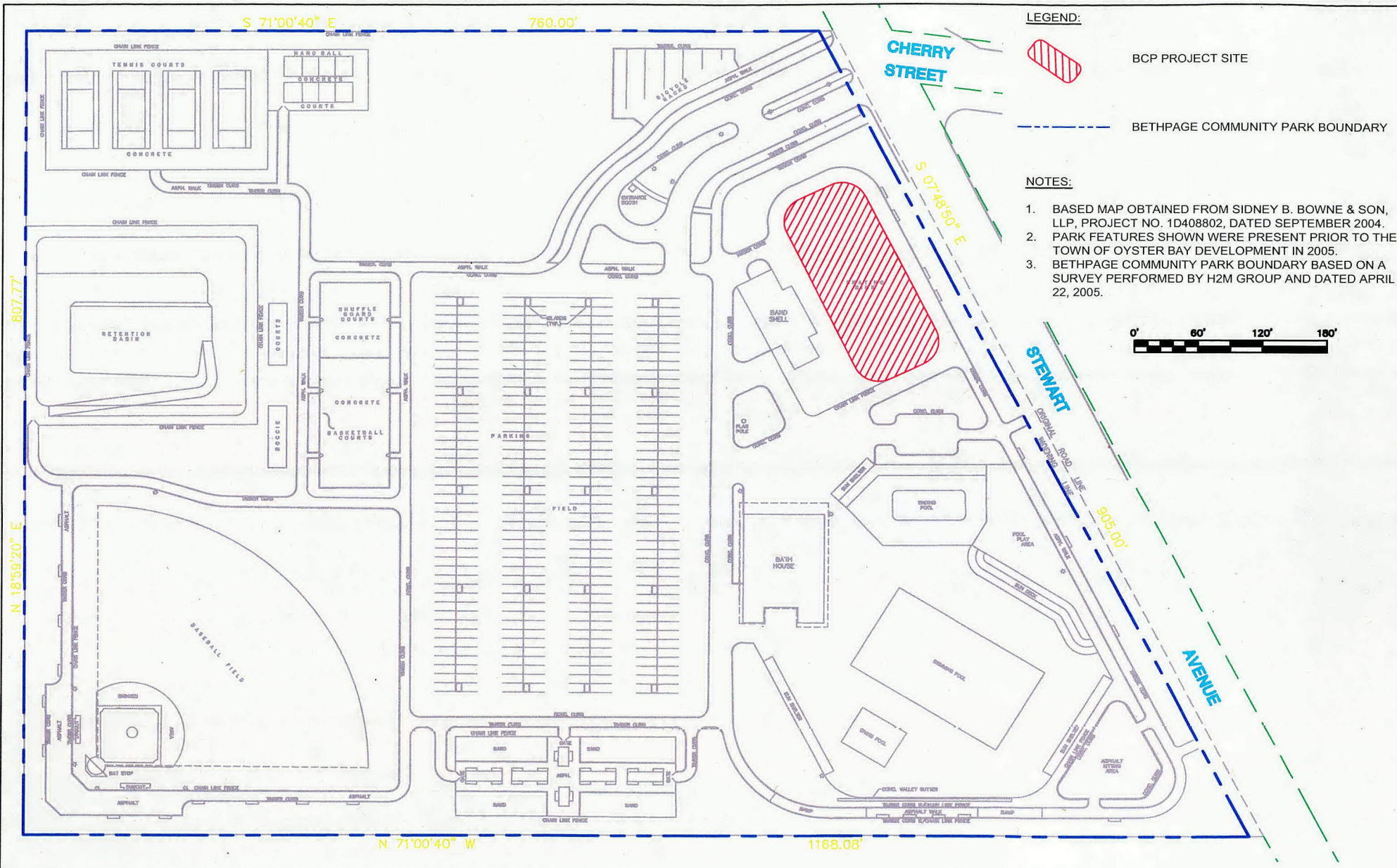
A Citizen Participation Plan (CPP) has been prepared for the project and submitted to NYSDEC for approval. A copy of the CPP is included herein as Appendix D



SCALE: 1" = 2,000'

<p>PROJECT: BROWNFIELD CLEANUP PROGRAM BETHPAGE COMMUNITY PARK ICE RINK AREA REMEDIAL INVESTIGATION WORK PLAN TOWN OF OYSTER BAY BETHPAGE, NEW YORK NYSDEC SITE NO.: C130212</p>	<p>DRAWING: FIGURE 1: SITE LOCATION MAP</p>	<p>H2M PROJECT NO.: TOBY 1203</p>	<p>H 2 architects + engineers M Melville, NY Albany, NY New City, NY Parsippany, NJ</p>
<p>SCALE: AS SHOWN</p>	<p>DATE: OCTOBER 2012</p>		


FIGURES



PROJECT:
BROWNFIELD CLEANUP PROGRAM
BETHPAGE COMMUNITY PARK ICE RINK AREA
REMEDIAL INVESTIGATION WORK PLAN
 TOWN OF OYSTER BAY
 BETHPAGE, NEW YORK
 NYSDEC SITE NO.: C130212

DRAWING:
 FIGURE 2: PARK AND SITE VICINITY

SCALE:
 AS SHOWN



H2M PROJECT NO.:
 TOBY1203

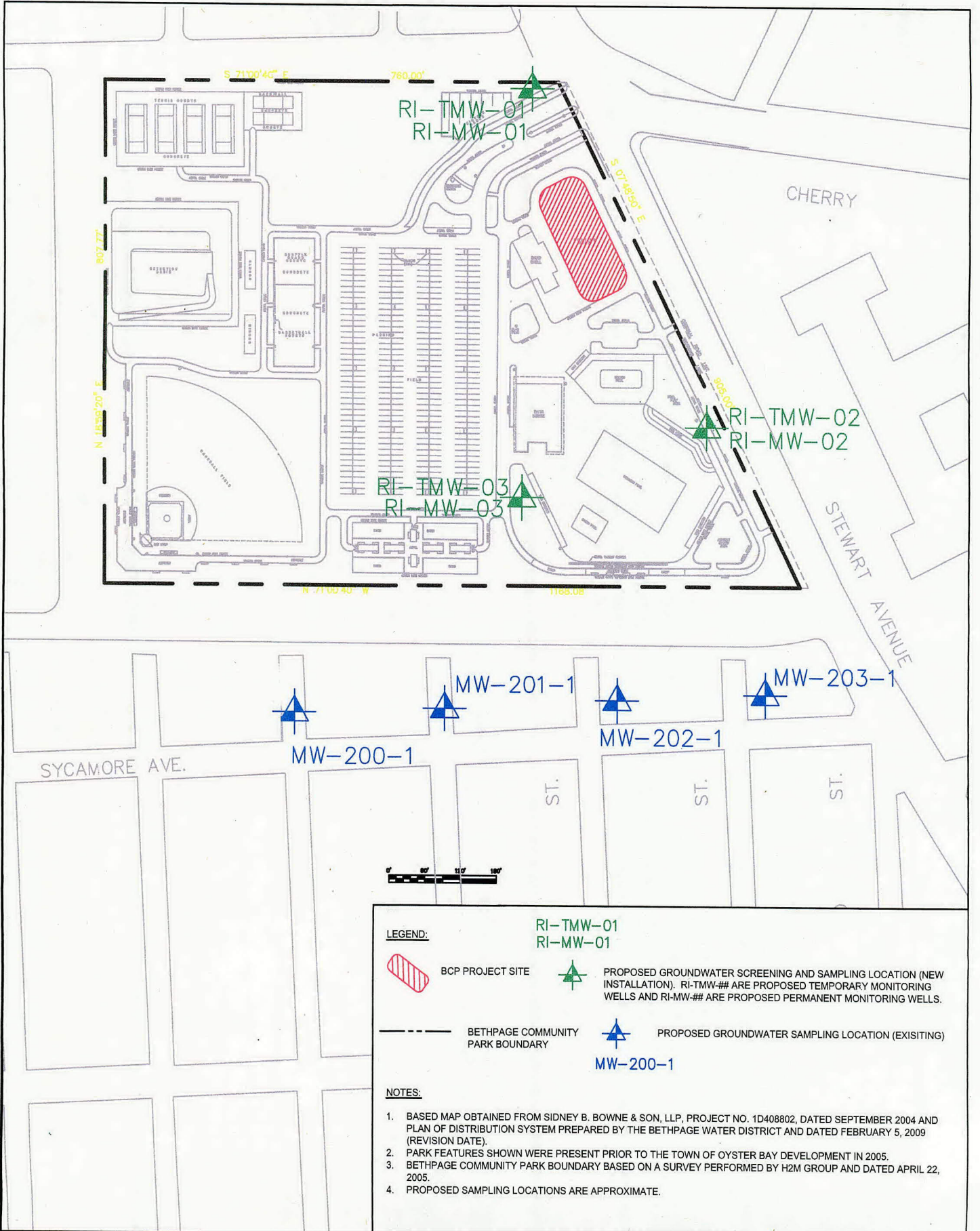
DATE:
 JUNE 2013







architects + engineers

Melville, NY Albany, NY
 New City, NY Parsippany, NJ

M:\cadd\TOBY1203 (Bethpage Pk Env Consulting)\2013-10-18 RIWP Revision\Figure 3 - Proposed GW Sampling Locations.dwg Last Modified: Oct 18, 2013 - 2:51pm By scay



LEGEND:

-  BCP PROJECT SITE
-  PROPOSED GROUNDWATER SCREENING AND SAMPLING LOCATION (NEW INSTALLATION). RI-TMW-## ARE PROPOSED TEMPORARY MONITORING WELLS AND RI-MW-## ARE PROPOSED PERMANENT MONITORING WELLS.
-  BETHPAGE COMMUNITY PARK BOUNDARY
-  PROPOSED GROUNDWATER SAMPLING LOCATION (EXISTING)
MW-200-1

NOTES:

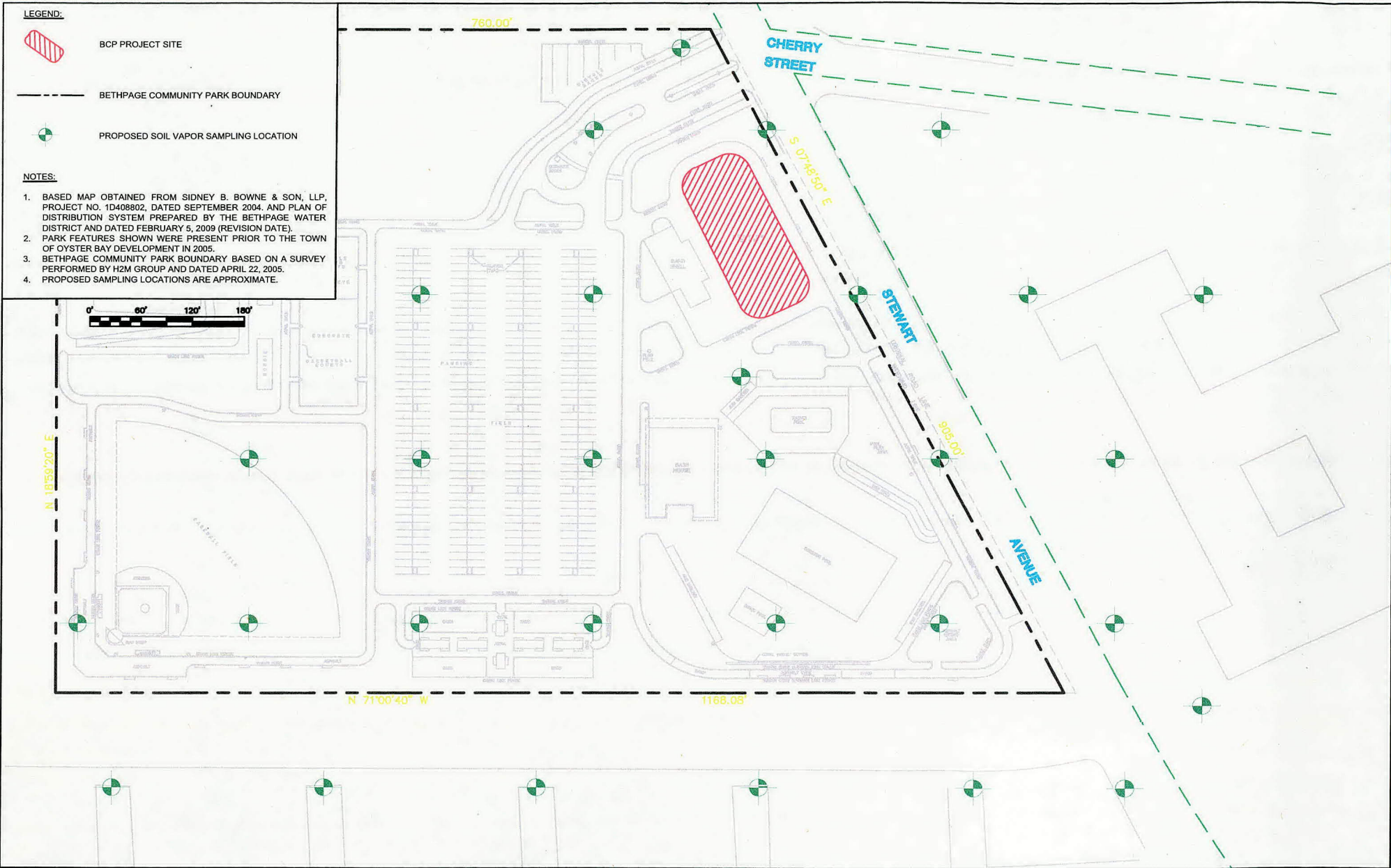
1. BASED MAP OBTAINED FROM SIDNEY B. BOWNE & SON, LLP, PROJECT NO. 1D408802, DATED SEPTEMBER 2004 AND PLAN OF DISTRIBUTION SYSTEM PREPARED BY THE BETHPAGE WATER DISTRICT AND DATED FEBRUARY 5, 2009 (REVISION DATE).
2. PARK FEATURES SHOWN WERE PRESENT PRIOR TO THE TOWN OF OYSTER BAY DEVELOPMENT IN 2005.
3. BETHPAGE COMMUNITY PARK BOUNDARY BASED ON A SURVEY PERFORMED BY H2M GROUP AND DATED APRIL 22, 2005.
4. PROPOSED SAMPLING LOCATIONS ARE APPROXIMATE.

PROJECT:
BROWNFIELD CLEANUP PROGRAM
BETHPAGE COMMUNITY PARK ICE RINK AREA
REMEDIAL INVESTIGATION WORK PLAN
 TOWN OF OYSTER BAY
 BETHPAGE, NEW YORK
 NYSDEC SITE NO.: C130212

DRAWING:
FIGURE 3: PROPOSED GROUNDWATER
SCREENING AND SAMPLING LOCATIONS
SCALE:
 AS SHOWN

H2M PROJECT NO.:
 TOBY1203
 DATE:
 OCTOBER 2013


H 2 M architects + engineers
 Melville, NY Albany, NY
 New City, NY Parsippany, NJ



PROJECT:
BROWNFIELD CLEANUP PROGRAM
BETHPAGE COMMUNITY PARK ICE RINK AREA
REMEDIAL INVESTIGATION WORK PLAN
 TOWN OF OYSTER BAY
 BETHPAGE, NEW YORK
 NYSDEC SITE NO.: C130212

DRAWING:
FIGURE 4: PROPOSED SOIL VAPOR SAMPLING LOCATIONS

SCALE:
 AS SHOWN



H2M PROJECT NO.:
 TOBY1203

DATE:
 JUNE 2013

H 2 M	architects + engineers	
	Melville, NY New City, NY	Albany, NY Parsippany, NJ