2016 OU2 GROUNDWATER INVESTIGATION RE106D1, RE106D2, RE106D3 (VPB140) INSTALLATION REPORT

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT (NWIRP)
SITE 1 OU2
BETHPAGE, NY

Prepared for:

Department of the Navy
Naval Facilities Engineering Command, Atlantic
9324 Virginia Avenue
Building Z-144
Norfolk, Virginia 23511

August 2017

RE106D1, RE106D2, RE106D3 (VPB140)
INSTALLATION REPORT

NWIRP BETHPAGE
SITE 1 OU2
BETHPAGE, NY

Prepared for:

Department of the Navy
Naval Facilities Engineering Command, Atlantic
9324 Virginia Avenue
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Norfolk, Virginia 23511

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Contract Number: N62470-11-D-8013
CTO WE15

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List of Acronyms and Abbreviations

AOC	Area of Concern
bgs	below ground surface
CSM	Conceptual Site Model
COR	Continuously Operating Reference
EPA	Environmental Protection Agency, United States
ESS	Environmental Sequence Stratigraphy
ft	feet
GOCO	Government-Owned Contractor-Operated
GPS	Global Positioning System
IDW	Investigation Derived Waste
IR	Installation Restoration
Katahdin	Katahdin Analytical Services
NAD	North American Datum
NAVD	North American Vertical Datum
NAVFAC	Naval Facilities Engineering Command
NG	Northrop Grumman
NTU	nephelometric turbidity units
NWIRP	Naval Weapons Industrial Reserve Plant
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
ONCT	On-site Containment Treatment System
OU	Operable Unit
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethene
POTW	Publicly Owned Treatment Works
PPE	Personal Protective Equipment
PVC	Polyvinylchloride
SAP	Sampling and Analysis Plan
SVOC	Semivolatile Organic Compounds
TCE	Trichloroethene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
UFP	United Federal Programs
US	United States
VOC	Volatile Organic Compounds
VPB	Vertical Profile Boring

1.0 PROJECT BACKGROUND

Resolution Consultants has prepared this Data Summary Report for the Naval Facilities Engineering Command (NAVFAC), Mid-Atlantic under contract task order WE15 Contract N62470-11-D-8013. This report describes the installation of three monitoring wells and one initial groundwater monitoring event in 2017 for the Naval Weapons Industrial Reserve Plant (NWIRP) Bethpage Operable Unit (OU) 2 Site 1 offsite plume. NWIRP Bethpage is located in east-central Nassau County, Long Island, New York, approximately 30 miles east of New York City (Figure 1).

1.1 Scope and Objectives

This report provides information on the installation of RE106D1, RE106D2 and RE106D3 monitoring wells associated with Vertical Profile Boring (VPB) 140. The purpose of this investigation was to ascertain contaminant levels and depths south of the On-site Containment Treatment system (ONCT), west of Wantagh Avenue and northwest of the RE108 Hot Spot, to provide information on the effectiveness of the ONCT, and to evaluate the possibility of contaminant influx to the RE108 hotspot from the northwest. The locations of RE106D1, RE106D2 and RE106D3, as well as other VPBs and monitoring well locations, are shown in Figure 2.

The field investigation included completing three monitoring wells, well development, soil/groundwater analysis, groundwater samples, and surveying. Field tasks were conducted in 2016 in accordance with the *United Federal Programs Sampling and Analysis Plan (UFP SAP)*, Bethpage, New York (Resolution, 2013a). In addition, the work adhered to the following UFP SAP Addendums: *Groundwater Sampling Using Low Stress (Low Flow) Purging and Sampling Protocol* (Resolution Consultants, 2013b) and *Installation of Vertical Profile Borings and Monitoring Wells* (Resolution Consultants, 2013c).

Documentation of these activities is included in Appendix A of this report.

1.2 Site History

NWIRP Bethpage is in the Hamlet of Bethpage, Town of Oyster Bay, New York. Since its inception in 1941, the plant's primary mission was the research, prototyping, testing, design, engineering, fabrication, and primary assembly of military aircraft. The facilities at NWIRP included four plants used for assembly and prototype testing, a group of quality control laboratories, two warehouse complexes (north and south), a salvage storage area, water recharge basins, the Industrial Wastewater Treatment Plant, and several smaller support buildings.

The Navy's property originally totaled 109.5 acres and was formerly a Government-Owned Contractor-Operated (GOCO) facility that was operated by Northrop Grumman (NG) until September 1998. Prior to 2002, the NWIRP property was bordered on the north, west, and south by current or former NG facilities, and on the east by a residential neighborhood. By March 2008, approximately 100 acres of NWIRP property were transferred to Nassau County in three separate actions. The remaining 9 acres and access easements were retained by the Navy to continue remedial efforts at Installation Restoration (IR) Site 1 – Former Drum Marshalling Area and Site 4 – Former Underground Storage Tanks (Area of Concern [AOC] 22). A parcel of land connecting the two sites was also retained. Currently, the 9-acre parcel of NWIRP is bordered on the east by the residential neighborhood and on the north, south, and west by Steel Equities; however, a small portion is still owned by Nassau County. Access to the NWIRP is from South Oyster Bay Road.

1.3 Geology and Hydrogeology

Overburden at the site consists of well over 1,000 feet (ft) of unconsolidated deposits overlying crystalline bedrock of the Hartland Formation. Overburden is divided into four geologic units: the upper Pleistocene deposits, the Magothy Formation, the clay member of the Raritan Formation ("Raritan Clay") and the Lloyd Sand member of the Raritan Formation ("Lloyd Sand") (Geraghty and Miller, 1994).

The upper Pleistocene ranges in thickness from approximately 50 to 100 ft and consists of till and outwash deposits of medium to coarse sand and gravel with lenses of fine sand, silt and clay (Smolensky and Feldman, 1988); these deposits form the Upper Glacial Aquifer. Directly underlying this unit is the Magothy Formation with a thickness of 650 to 900 ft and lower extent of 700 to 1,000 ft below ground surface (bgs), as observed at the former NWIRP and extending southeast to areas south of Southern State Parkway. Locally at VPB140, the bottom of the Magothy (top of the Raritan Clay) is encountered at approximately 861 feet bgs. The Magothy is characterized by fine to medium sands and silts interbedded with zones of clays, silty sands and sandy clays. Sand and gravel lenses are found in some areas between depths of 600 and 880 ft bgs; these deposits form the main producing zones of the Magothy Aquifer.

Investigations performed by the Navy since 2012 indicate that the bottom of the Magothy (top of the Raritan Clay) can extend to depths of 700 to greater than 1,000 ft bgs. The top of the Raritan Clay deepens to the south-southeast, as evidenced by clay depths of 1,000 ft bgs (or more) in borings installed offsite. The Raritan Clay Unit is of continental origin and consists of clay, silty clay, clayey silt, and fine silty sand. This member acts as a confining layer over the Lloyd Sand Unit. The Lloyd Sand Unit is also of continental origin, having been deposited in a large fresh water lacustrine

environment. The material consists of fine to coarse-grained sands, gravel, inter-bedded clay, and silty sand. These deposits form the Lloyd Aquifer.

The Upper Glacial Aquifer and the Magothy Aquifer comprise the aquifers of interest at the NWIRP. Regionally, these formations are generally considered to form a common, interconnected aquifer as the coarse nature of each unit near their contact and the lack of any regionally confining clay unit allows for the unrestricted flow of groundwater between the formations.

The Magothy Aquifer is the major source of public water in Nassau County. The most productive water bearing zones are the discontinuous lenses of sand and gravel that occur within the siltier matrix. The major water-bearing zones are coarse sand and gravel lenses located in the lower portion of the Magothy. The Magothy Aquifer is commonly regarded to function overall as an unconfined aquifer at shallow depths and a confined aquifer at deeper depths. The drilling program at the NWIRP has revealed that clay zones beneath the facility are common but laterally discontinuous. No confining clay units of facility-wide extent have been encountered. This is also the case for borings installed offsite.

Groundwater is encountered at a depth of approximately 50 ft bgs at the facility. Historically, because of pumping and recharge at the facility, groundwater depths have been measured to range from 40 to 60 ft bgs. The groundwater flow in the area is to the south-southeast.

Resolution Consultants reviewed the geologic data and regional literature and developed four representative base-wide cross sections to support development of a Conceptual Site Model (CSM). A description of the application of Environmental Sequence Stratigraphy (ESS) and the results are provided in Appendix B.

2.0 FIELD PROGRAM

Three monitoring wells were installed in the vicinity of VPB140 between September 2016 and November 2016. Field investigation activities consisted of drilling, well installation, well development, sampling, soil/groundwater analysis, and surveying. Drilling during this investigation was performed by Delta Well and Pump Company of Ronkonkoma, New York. A description of these tasks is provided below.

2.1 Drilling and Well Construction

Monitoring wells RE106D1, RE106D2 and RE106D3 were installed using mud rotary drilling techniques (Figure 2). Depths of monitoring wells RE106D1, RE106D2 and RE106D3 were 462 ft, 492 ft and 535 ft respectively. Well construction details are summarized in Table 1. Boring logs with lithologic descriptions of the well screen interval are included in Appendix A. *2014 OU2 Groundwater Investigation VPB140* (Resolution Consultants, 2014) documents the installation of this VPB including detailed lithologic descriptions, continuous gamma plot and multiple Volatile Organic Compounds (VOC) sample results over the entire boring length. The gamma and trichloroethene (TCE) tetrachloroethene (PCE) plot for VPB140 along with the well screen intervals at RE106D1, RE106D2 and RE106D3 are included in Appendix A.

Prior to installing each monitoring well, screen intervals were determined based on intervals with the highest VOC concentrations as measured in the VPB140 hydropunch samples and coincident intervals with the highest apparent permeability based on the VPB140 gamma logs and geologist logs. During the monitoring well installation, split spoon samples were collected every 5 ft in the screen interval. One soil sample per monitoring well was analyzed for Total Organic Carbon (TOC) via United States (US) Environmental Protection Agency (EPA) series SW-846 method 9060A by Katahdin Analytical Services (Katahdin). Data validation of TOC data was performed by Resolution Consultants. Data validation packages and analytical data tables are included in Appendix A.

Wells were constructed of 4-inch diameter, Schedule 80, National Sanitation Foundation-approved polyvinylchloride (PVC) riser pipe and 0.010-slot well screen. Wells were completed at the surface with a 12-inch diameter steel curb box. Well risers were set below grade and fit with lockable J plugs. Detailed monitoring well construction diagrams are included in Appendix A.

2.2 Well Development

Following installation, all monitoring wells were developed to evacuate silts and other fine-grained materials and to establish the filter pack to promote a hydraulic connection between the well and

the surrounding aquifer. Well development was not initiated until at least 24 hours after well installation.

Monitoring well screens were developed using a combination of air lifting, manual surging, and pumping with a submersible pump. Turbidity was monitored during development to determine stabilization. In compliance with New York State Department of Environmental Conservation (NYSDEC) policy, wells were developed until turbidity was less than 50 nephelometric turbidity units (NTUs) if possible. Table 2 summarizes total pumped volume from air and pump development and final turbidity. Well development logs are included in Appendix A.

2.3 Sampling

Following development, wells were allowed to stabilize for at least 2 weeks prior to groundwater sampling in accordance with low flow sampling procedures. Wells were purged using a bladder pump with a drop tube intake placed at the approximate midpoint of the screened interval. The following water quality parameters were continuously measured: water temperature, pH, conductivity, oxidation-reduction potential, dissolved oxygen and turbidity. Groundwater analytical samples were collected when water quality parameters stabilized. Samples were analyzed for VOCs via method 8260C and 1,4-dioxane via Method 8270D SIM by Katahdin. The flow rate for sample collection was 200 mL/minute. All development and purge water was managed as investigation derived waste (IDW). Groundwater sample logs and data validation packages are included in Appendix A.

Monitoring wells RE106D1, RE106D2 and RE106D3 were sampled by Resolution Consultants on March 8, 2017. Analytical results and stabilized field parameters for these monitoring wells are summarized in Table 3 and 4, respectively. Data validation is documented in Appendix A. These monitoring wells will be included in quarterly sampling as part of the Navy's ongoing Environmental Restoration Program.

2.4 Decontamination and Investigation Derived Waste

Resolution Consultants utilized dedicated and disposable sampling equipment when possible to avoid the potential for cross-contamination of samples. The sampling equipment included dedicated plastic scoops, disposable polyethylene tubing, disposable gloves, and laboratory supplied sample bottles. Hand held equipment and split spoons were decontaminated using Luminox and water wash, a potable water rinse, followed by a distilled water rinse. Water was collected in 5-gallon pails or 55-gallon drums. Non dedicated sampling equipment was decontaminated as outlined in

the UFP SAP Addendum - *Groundwater Sampling Using Low Stress (Low Flow) Purging and Sampling Protocol* (Resolution Consultants, 2013b).

As part of the IDW management practices and in accordance with the SAP, the investigation waste (consisting of soil cuttings, drilling muds, IDW fluids, and personal protective equipment [PPE]) generated during the groundwater monitoring well installation and sampling was containerized and staged at NWIRP Bethpage.

IDW solids were containerized in roll offs. Representative samples from each roll off were submitted to Katahdin for analysis of:

- Target Compound List (TCL) VOCs
- TCL Semi-volatile Organic Compounds (SVOCs)
- Toxicity Characteristic Leaching Procedure (TCLP) Metals
- Polychlorinated Biphenyls (PCBs)
- Total petroleum hydrocarbons
- Corrosivity
- Ignitability
- Reactive Cyanide
- Reactive Sulfide
- Paint Filter

IDW fluid generated during well development and purging was containerized in frac tanks and stored at NWIRP Bethpage for characterization and ultimate disposal to the Publicly Owned Treatment Works (POTW), in accordance with the facilities existing discharge permit. A representative water sample was collected from each frac tank and submitted to Katahdin for analysis of VOCs via Method SW 624, pH via Method SW 9040B, PCBs via Method 8082 and Total Metals via Method SW 846. All analytical criteria were met for disposal of water.

2.5 Surveying

A survey of the monitoring well locations was conducted at the end of fieldwork by C. T. Male, Inc., of Latham, NY, under the direct supervision of Resolution Consultants. The locations were tied into the existing base map developed for this investigation. The survey elevation is referenced to the North American Vertical Datum (NAVD) 1988 and has a vertical accuracy of 0.01 foot. Vertical

control is based on observations of the Continuously Operating Reference (COR) Stations Queens and Central Islip. The horizontal location is referenced to the North American Datum (NAD) 1983 (2011) NY. Long Island Zone 3104 and has an accuracy of 0.1 foot. Local horizontal and vertical control is based on Global Positioning System (GPS) observations using the NYSNet Real Time Network.

A table of survey data (latitude/longitude, northing/easting, elevations of ground, rim and PVC) and a survey map is included in Appendix A.

3.0 REFERENCES

Geraghty and Miller, Inc., 1994. *Remedial Investigation Report, Grumman Aerospace Corporation, Bethpage, New York*. Revised September 1994.

Resolution Consultants, 2013a. *United Federal Programs Sampling and Analysis Plan*, *Site OU-2 Offsite Trichloroethene (TCE) Groundwater Plume Investigation, Bethpage, New York*. April 2013.

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Resolution Consultants, 2014. *2014 OU2 Groundwater Investigation VPB140, Bethpage, NY.* November 2014.

Smolensky, D., and Feldman, S., 1988. *Geohydrology of the Bethpage-Hicksville-Levittown Area, Long Island, New York, U.S*. Geological Survey Water-Resourced Investigations Report 88-4135, 25 pp.

Tables

TABLE 1
MONITORING WELL CONSTRUCTION SUMMARY
2016 OU2 GROUNDWATER INVESTIGATION
NWIRP BETHPAGE, NY

MONITORING WELL	WELL COMPLETION DATE	GROUND ELEVATION (MSL)	PVC ELEVATION (INNER CASING) (MSL)	WELL DEPTH (ft bgs)	SURFACE CASING DEPTH (ft bgs)	SCREEN INTERVAL (ft bgs)	SUMP DEPTH INTERVAL (ft bgs)	BORING DEPTH (ft bgs)
RE106D1	10/27/2016	101.66	101.19	462	53.5	440 - 460	460 - 462	466
RE106D2	11/17/2016	101.76	101.37	492	53.6	480 - 490	490 - 492	496
RE106D3	10/12/2016	101.71	101.34	535	52.7	510 - 530	530 - 535	547

MSL - mean sea level
ft bgs - feet below ground surface

TABLE 2
MONITORING WELL DEVELOPMENT SUMMARY
2016 OU2 GROUNDWATER INVESTIGATION
NWIRP BETHPAGE, NY

MONITORING WELL	AIR DEVELOPMENT		PUMP DEVELOPMENT			APPROX. TOTAL DEVELOPMENT VOLUME (GAL)	FINAL TURBIDITY (NTUs)
	DATE	APPROX. VOLUME (GAL)	DATE	FINAL PUMP DEPTH (FT BGS)	APPROX. VOLUME (GAL)		
RE106D1	12/5/2016	5,800	12/08/2016, 12/09/2016	440-460	3000, 2500	11,300	13.15
RE106D2	12/6/2016	1,000	12/09/2016,12 /12/2016	480-490	1000, 2500	4,500	8.29
RE106D3	11/28/2016	2,000	12/7/2016	510-530	4,600	6,600	16.33

GAL - gallon
FT BGS - feet below ground surface
NTUs - Nephelometric Turbidity Units

TABLE 3
ANALYTICAL DATA SUMMARY
2016 OU2 GROUNDWATER INVESTIGATION
NWIRP BETHPAGE, NY

Location	NYSDEC Groundwater Guidance or Standard Value (Note 1)	RE106D1	RE106D2	RE106D3
Sample Date		3/8/2017	3/8/2017	3/8/2017
Sample ID		RE106D1-GW-030817	RE106D2-GW-030817	RE106D3-GW-030817
Sample type code		N	N	N
VOC 8260C (ug/L)				
1,1,1-TRICHLOROETHANE	5	<0.50 U	<0.50 U	<0.50 U
1,1,2,2-TETRACHLOROETHANE	5	<0.50 U	<0.50 U	<0.50 U
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	5	**1.3**	**12**	**71**
1,1,2-TRICHLOROETHANE	1	<0.50 U	<0.50 U	<0.50 U
1,1-DICHLOROETHANE	5	<0.50 U	<0.50 U	<0.50 U
1,1-DICHLOROETHENE	5	<0.50 U	<0.50 U	**0.71 J**
1,2,4-TRICHLOROBENZENE	5	<0.50 U	<0.50 U	<0.50 U
1,2-DIBROMO-3-CHLOROPROPANE	0.04	***<0.75 U***	***<0.75 U***	***<0.75 U***
1,2-DIBROMOETHANE	NL	<0.50 U	<0.50 U	<0.50 U
1,2-DICHLOROBENZENE	3	<0.50 U	<0.50 U	<0.50 U
1,2-DICHLOROETHANE	5	<0.50 U	<0.50 U	<0.50 U
1,2-DICHLOROETHENE, TOTAL	5	<1.0 U	**0.97 J**	**2**
1,2-DICHLOROPROPANE	1	<0.50 U	<0.50 U	<0.50 U
1,3-DICHLOROBENZENE	3	<0.50 U	<0.50 U	<0.50 U
1,4-DICHLOROBENZENE	3	<0.50 U	<0.50 U	<0.50 U
1,4-DIOXANE (Method 8270D_SIM)	NL	**11 J**	**14 J**	**14 J**
2-BUTANONE	50	<2.5 U	<2.5 U	<2.5 U
2-HEXANONE	50	<2.5 U	<2.5 U	<2.5 U
4-METHYL-2-PENTANONE	NL	<2.5 U	<2.5 U	<2.5 U
ACETONE	50	<2.5 UJ	<2.5 UJ	<2.5 U
BENZENE	1	<0.50 U	<0.50 U	<0.50 U
BROMODICHLOROMETHANE	50	<0.50 U	<0.50 U	<0.50 U
BROMOFORM	50	<0.50 U	<0.50 U	<0.50 U
BROMOMETHANE	5	<1.0 U	<1.0 U	<1.0 U
CARBON DISULFIDE	60	<0.50 U	<0.50 U	<0.50 U
CARBON TETRACHLORIDE	5	<0.50 U	<0.50 U	<0.50 U
CHLOROBENZENE	5	<0.50 U	<0.50 U	<0.50 U
CHLOROETHANE	5	<1.0 U	<1.0 U	<1.0 U
CHLOROFORM	7	<0.50 U	<0.50 U	<0.50 U
CHLOROMETHANE	5	<1.0 U	<1.0 U	<1.0 U
CIS-1,2-DICHLOROETHENE	5	<0.50 U	**0.97 J**	**2**
CIS-1,3-DICHLOROPROPENE	0.4	***<0.50 U***	***<0.50 U***	***<0.50 U***
CYCLOHEXANE	NL	<0.50 U	<0.50 U	<0.50 U
DIBROMOCHLOROMETHANE	5	<0.50 U	<0.50 U	<0.50 U
DICHLORODIFLUOROMETHANE	5	<1.0 UJ	<1.0 UJ	<1.0 UJ
ETHYLBENZENE	5	<0.50 U	<0.50 U	<0.50 U
ISOPROPYLBENZENE	5	<0.50 U	<0.50 U	<0.50 U
M- AND P-XYLENE	NL	<1.0 U	<1.0 U	<1.0 U
METHYL ACETATE	NL	<0.75 U	<0.75 U	<0.75 U
METHYL CYCLOHEXANE	NL	<0.50 U	<0.50 U	<0.50 U
METHYL TERT-BUTYL ETHER	10	<0.50 U	<0.50 U	<0.50 U
METHYLENE CHLORIDE	5	<2.5 U	<2.5 U	<2.5 U
O-XYLENE	NL	<0.50 U	<0.50 U	<0.50 U
STYRENE	5	<0.50 U	<0.50 U	<0.50 U
TETRACHLOROETHENE	5	**0.68 J**	**8.1**	**35**
TOLUENE	5	<0.50 U	<0.50 U	<0.50 U
TRANS-1,2-DICHLOROETHENE	5	<0.50 U	<0.50 U	<0.50 U
TRANS-1,3-DICHLOROPROPENE	0.4	***<0.50 U***	***<0.50 U***	***<0.50 U***
TRICHLOROETHENE	5	**7.4**	**46**	**84**
TRICHLOROFLUOROMETHANE	5	<1.0 U	<1.0 U	<1.0 U
VINYL CHLORIDE	2	<1.0 U	<1.0 U	<1.0 U
XYLENES, TOTAL	5	<1.5 U	<1.5 U	<1.5 U

TABLE 3
ANALYTICAL DATA SUMMARY
2016 OU2 GROUNDWATER INVESTIGATION
NWIRP BETHPAGE, NY

Notes:

1 New York State Department of Environmental Conservation Division of Water Technical and Operation Guidance series (6 NYCRR 700-706, Part 703.5 summarized in TOGS 1.1.1)
Ambient water quality standards and groundwater effluent limitations, class GA; NL = Not Listed

Bold = Detected; ***Bold and Italics*** =Not detected exceeds NYS Groundwater Standards or guidance value
Yellow highlighted values exceed Groundwater Standards or guidance value

Sample type codes: N - normal environmental sample, FD - field duplicate

U = Nondetected result. The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte.
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
M = the matrix spike or matrix spike duplicate did not meet recovery or precision requirements.

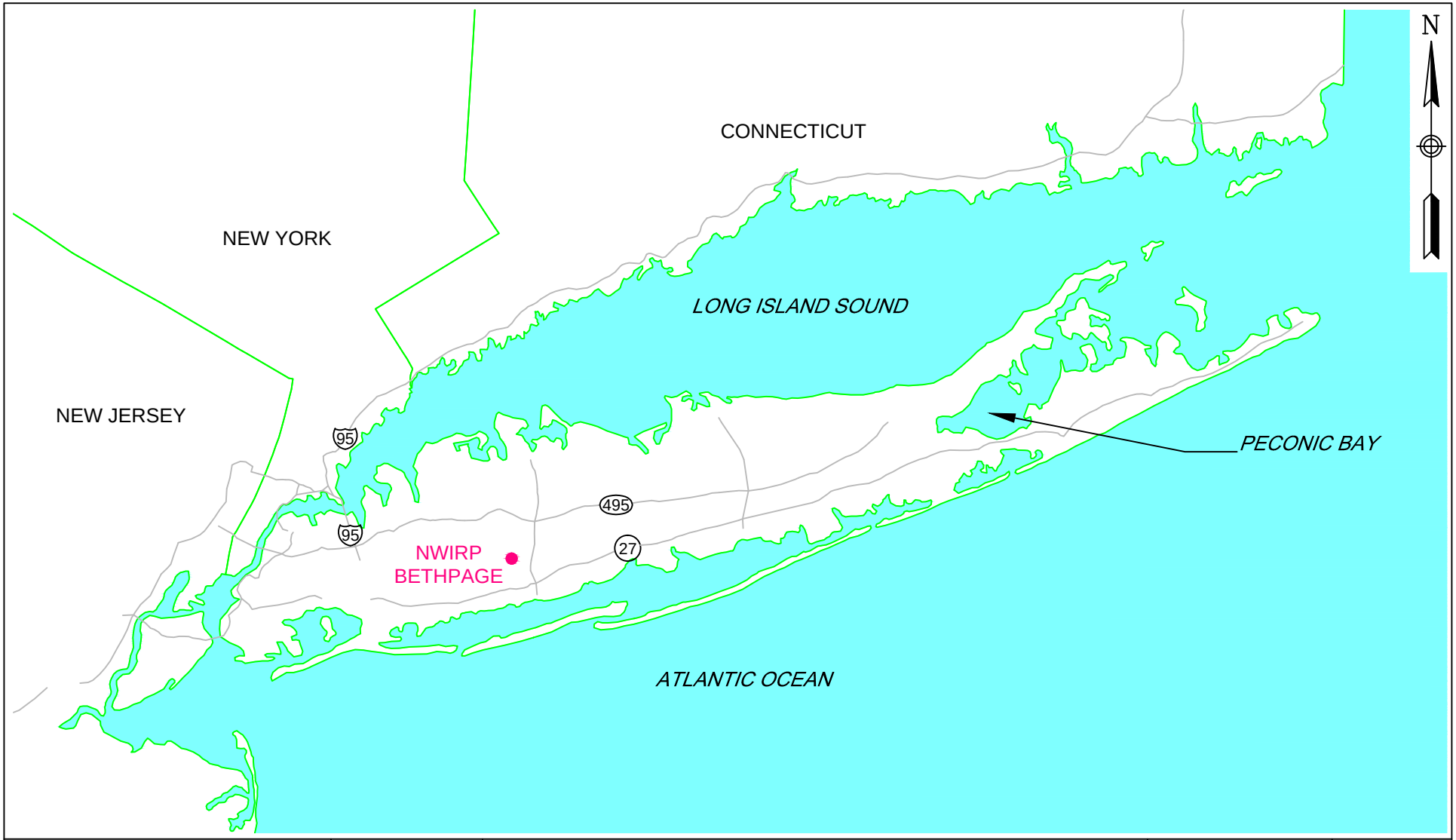
TABLE 4
STABILIZED FIELD PARAMETERS
2017 OU2 GROUNDWATER INVESTIGATION
NWIRP BETHPAGE, NY

Well	Date	Temperature (°C)	pH	Specific Conductance (µS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Depth to water (ft bgs)	Purge Flow rate (ml/min)
RE106D1	3/8/2017	15.77	6.46	0.12	5.09	152	6.5	44.95	600
RE106D2	3/8/2017	15.10	6.39	0.135	4.52	107.1	113	45.82	600
RE106D3	3/8/2017	14.45	5.94	0.279	4.07	-46.3	88.1	45.69	500

°C - degrees Celsius
µS/cm - Microsiemens per Centimeter
mg/L - milligrams per liter
mV - Millivolts
NTU - Nephelometric Turbidity Unit
ft bgs - feet below ground surface
ml/min - mililiters per minute
NM - not measured

Figures

112G00622\0510\112G00622CM01.DWG 08/02/10 MKB



0 15 30

SCALE IN MILES

NAVFAC

GENERAL LOCATION MAP
NWIRP BETHPAGE
BETHPAGE, NEW YORK

CONTRACT NUMBER	CTO NUMBER
N62470-11-D-8013	WE15
APPROVED BY --	DATE --
APPROVED BY --	DATE --
FIGURE NO. 1	REV 0

F:\Projects\Navy\Bethpage WXE0817.0 Deliverables\7.2 CADD\GIS_files\Bethpage\MAP DOCS\MXD\MISC\Location Maps\F2 RE106 2017 06 14 R1.mxd

Former Naval Weapons Industrial Reserve Plant

Former Northrop Grumman Site

RE106D1
RE106D2
RE106D3

Old Bethpage

Bethpage

Plainedge

South Farmingdale

Levittown

North Wantagh

State Hwy 135

Cherry Ave

Stewart Ave

Powell Ave

Plainview Rd

Central Ave

Access Rd

Hempstead Tpke

Merritts Rd

N Wantagh Ave

Seamans Neck Rd

S Oyster Bay Rd

S Broadway

Hicksville Rd

Wantagh Ave

Inset: RE106D1, RE106D2 and RE106D3 Location

0 750 1,500 3,000 Feet

0 375 750 Feet

Legend

- Monitoring Well
- Vertical Profile Boring
- Vertical Profile Boring - Proposed
- Water Supply Well
- Extraction Well

NAVFAC

RE106D1, RE106D2 AND RE106D3 LOCATION MAP
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BETHPAGE, NEW YORK

CONTRACT NUMBER	CTO NUMBER
N62470-11-D8013	WE15
APPROVED BY: PS	DATE: 6/14/2017
APPROVED BY: —	DATE: —
FIGURE NO.: 2	REV: 0

Appendices

Appendix A

RE106D1, RE106D2, RE106D3

Section 1

Boring Logs

Resolution Consultants

Boring Log

BORING #: **RE106D1**
Sheet 1 of 2

Client: Department of the Navy, Naval Facilities Engineering Command, Mid-Atlantic		**Logged By:** V. Thayer
Location: Arrandale Rd and Martha Blvd, Bethpage, NY		**Drilling Company:** Delta Well & Pump
Project #: 60266526	**Ground Elevation (msl):** 101.66	**Well Screen Interval (ft):** 440-460
Start Date: 10/19/2016	**Drilling Method:** Auger (0-50' bgs) Mud Rotary (>50' bgs)	**Water Level (ft):**
Finish Date: 10/27/2016	**Northing:** 209374.84 **Easting:** 1122873.48	**Total Depth (ft):** 466.0

DEPTH (ft)	PID (ppm)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	Well Completion	Well Construction
0					0-443 ft bgs: See VPB140 for Descriptions		10" Diameter Steel Casing
50							
100							
150							Bentonite Grout
200							
250							
300							
350							4" Diameter Schedule 80 PVC Riser
400							

Resolution Consultants

Boring Log

BORING #: **RE106D1**
Sheet 2 of 2

Client: Department of the Navy, Naval Facilities Engineering Command, Mid-Atlantic		**Logged By:** V. Thayer
Location: Arrandale Rd and Martha Blvd, Bethpage, NY		**Drilling Company:** Delta Well & Pump
Project #: 60266526	**Ground Elevation (msl):** 101.66	**Well Screen Interval (ft):** 440-460
Start Date: 10/19/2016	**Drilling Method:** Auger (0-50' bgs) Mud Rotary (>50' bgs)	**Water Level (ft):**
Finish Date: 10/27/2016	**Northing:** 209374.84 **Easting:** 1122873.48	**Total Depth (ft):** 466.0

DEPTH (ft)	PID (ppm)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	Well Completion	Well Construction
410					0-443 ft bgs: See VPB140 for Descriptions *(continued)*		4" Diameter Schedule 80 PVC Riser *(continued)*
412							
414							
416							
418							
420							
422							#00 Filter Sand
424							
426							
428							
430							
432							
434							#1 Filter Sand
436							
438							
440							
442							
444	0		SP		Light gray (10YR 7/2) poorly graded SAND, subangular medium Sand		
446							
448					No Recovery		
450							4" Diameter Schedule 80 PVC, 10 Slot Well Screen (440-460 ft bgs)
452							
454	0		SP SP-SM SP		Reddish yellow (7.5 YR 6/6) poorly graded SAND, subangular medium Sand, 2 iron nodules Very pale brown (10YR 7/3) poorly graded SAND with Silt, subangular medium Sand, 10% silt		
456					Light gray (10YR 7/2) poorly graded SAND, subangular medium Sand		
458	0		SP		Light gray (10YR 7/2) Poorly graded SAND, subangular medium Sand		
460							Sump
462							
464							#1 Sand to Bottom
466					End of boring at 466.0 ft. bgs.		

Resolution Consultants

Boring Log

BORING #: **RE106D2**
Sheet 1 of 2

Client: Department of the Navy, Naval Facilities Engineering Command, Mid-Atlantic		**Logged By:** V. Thayer
Location: Arrandale Rd and Martha Blvd, Bethpage, NY		**Drilling Company:** Delta Well & Pump
Project #: 60266526	**Ground Elevation (msl):** 101.76	**Well Screen Interval (ft):** 480-490
Start Date: 11/7/2016	**Drilling Method:** Auger (0-50' bgs) Mud Rotary (>50' bgs)	**Water Level (ft):**
Finish Date: 11/17/2016	**Northing:** 209390.49 **Easting:** 1122872.97	**Total Depth (ft):** 496.0

DEPTH (ft)	PID (ppm)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	Well Completion	Well Construction
0					0-478 ft bgs: See VPB140 for Descriptions		10" Diameter Steel Casing
50							
100							
150							Bentonite Grout
200							
250							
300							
350							
400							4" Diameter Schedule 80 PVC Riser

Resolution Consultants

Boring Log

BORING #: **RE106D2**
Sheet 2 of 2

Client: Department of the Navy, Naval Facilities Engineering Command, Mid-Atlantic		**Logged By:** V. Thayer
Location: Arrandale Rd and Martha Blvd, Bethpage, NY		**Drilling Company:** Delta Well & Pump
Project #: 60266526	**Ground Elevation (msl):** 101.76	**Well Screen Interval (ft):** 480-490
Start Date: 11/7/2016	**Drilling Method:** Auger (0-50' bgs) Mud Rotary (>50' bgs)	**Water Level (ft):**
Finish Date: 11/17/2016	**Northing:** 209390.49 **Easting:** 1122872.97	**Total Depth (ft):** 496.0

DEPTH (ft)	PID (ppm)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	Well Completion	Well Construction
420					0-478 ft bgs: See VPB140 for Descriptions *(continued)*		4" Diameter Schedule 80 PVC Riser *(continued)*
422							
424							
426							
428							
430							
432							
434							
436							
438							
440							
442							
444							
446							
448							
450							
452							
454							
456							
458							
460							
462							
464							
466							
468							
470							
472							
474							#00 Filter Sand
476							
478	0				No Recovery		#1 Filter Sand
480							
482							
484	0		SM		Light yellowish brown (10YR 6/4) Silty SAND, fine to medium Sand, trace coarse sand, 15-20% Silt		4" Diameter Schedule 80 PVC, 10 Slot Well Screen (480-490 ft bgs)
486							
488	0		SP-SM		Light yellowish brown (10YR 6/4) poorly graded SAND with Silt, fine to medium sand, 10% silt		Sump
490							
492							
494							#1 Sand to Bottom
496					End of boring at 496.0 ft. bgs.		

Resolution Consultants

Boring Log

BORING #: **RE106D3**
Sheet 1 of 2

Client: Department of the Navy, Naval Facilities Engineering Command, Mid-Atlantic		**Logged By:** V. Thayer
Location: Arrandale Rd and Martha Blvd, Bethpage, NY		**Drilling Company:** Delta Well & Pump
Project #: 60266526	**Ground Elevation (msl):** 101.71	**Well Screen Interval (ft):** 510-530
Start Date: 9/30/2016	**Drilling Method:** Auger (0-50' bgs) Mud Rotary (>50' bgs)	**Water Level (ft):**
Finish Date: 10/12/2016	**Northing:** 209340.07 **Easting:** 1122872.12	**Total Depth (ft):** 547.0

DEPTH (ft)	PID (ppm)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	Well Completion	Well Construction
0					0-510 ft bgs: See VPB140 for Descriptions		10" Diameter Steel Casing
50							
100							
150							Bentonite Grout
200							
250							
300							
350							
400							4" Diameter Schedule 80 PVC Riser
450							

Resolution Consultants

Boring Log

BORING #: **RE106D3**
Sheet 2 of 2

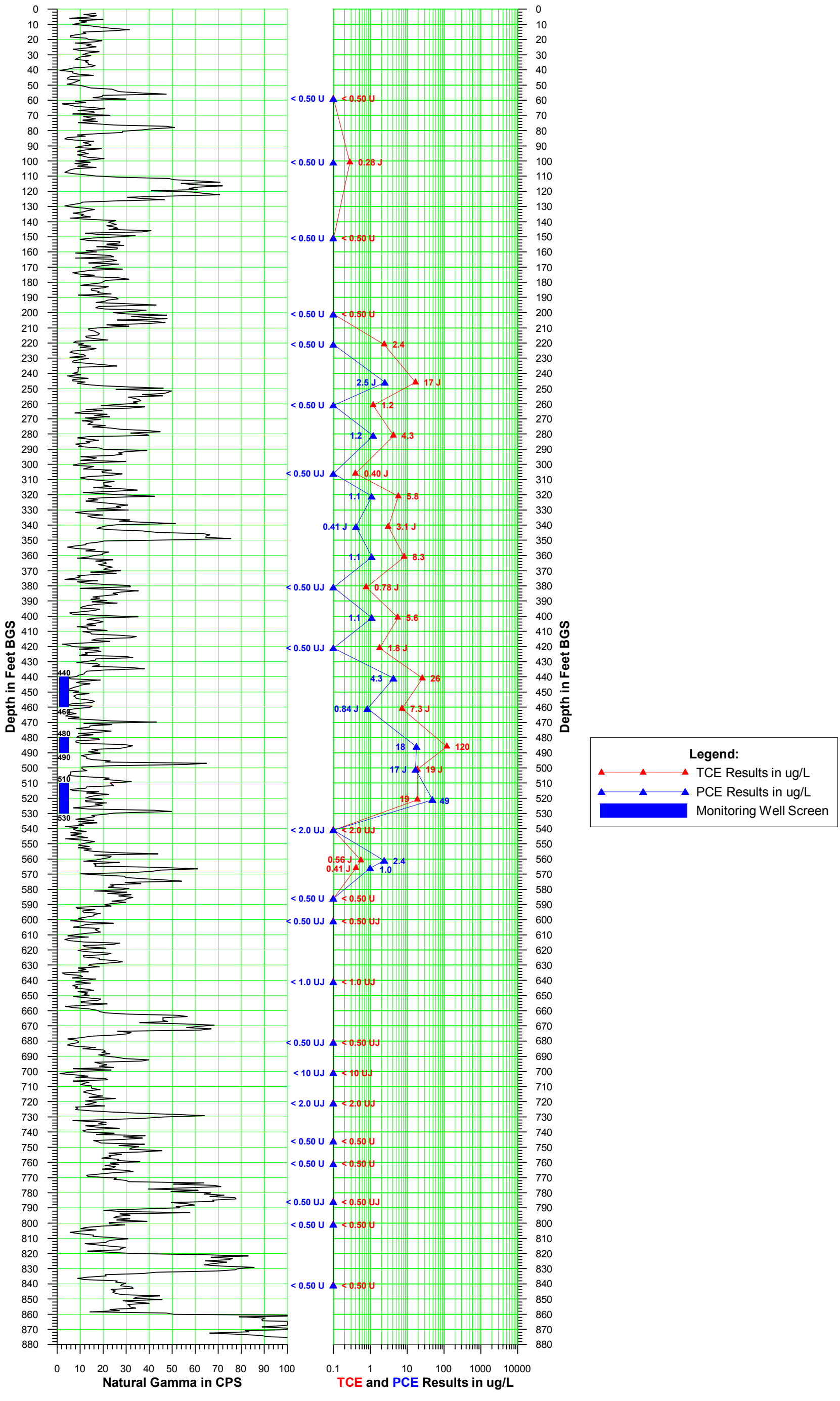
Client: Department of the Navy, Naval Facilities Engineering Command, Mid-Atlantic		**Logged By:** V. Thayer
Location: Arrandale Rd and Martha Blvd, Bethpage, NY		**Drilling Company:** Delta Well & Pump
Project #: 60266526	**Ground Elevation (msl):** 101.71	**Well Screen Interval (ft):** 510-530
Start Date: 9/30/2016	**Drilling Method:** Auger (0-50' bgs) Mud Rotary (>50' bgs)	**Water Level (ft):**
Finish Date: 10/12/2016	**Northing:** 209340.07 **Easting:** 1122872.12	**Total Depth (ft):** 547.0

DEPTH (ft)	PID (ppm)	Formation	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	Well Completion	Well Construction
470					0-510 ft bgs: See VPB140 for Descriptions *(continued)*		4" Diameter Schedule 80 PVC Riser *(continued)*
472							
474							
476							
478							
480							
482							
484							
486							#00 Filter Sand
488							
490							
492							
494							
496							
498							
500							
502							
504							#1 Filter Sand
506							
508							
510	0		ML		Light gray (7.5YR 7/1) Clayey SILT, laminated		
512			SP-ML		Very pale brown (10YR 8/3) poorly graded SAND, subangular medium sand interbedded with clayey silt seams, several reddish yellow sand seams		
514			SP				
516	0		SP		Very pale yellow (10YR 8/3) and bands of yellow (10YR 8/6) poorly graded SAND, subangular medium Sand, trace fine sand, 1 micro lamination of lignite and silty sand		
518							
520	0		SP		Very pale brown (10YR 7/2) and reddish yellow (10YR 7/8) poorly graded SAND, subangular medium Sand, one 3.5" band of reddish yellow sand in middle of sample		4" Diameter Schedule 80 PVC, 10 Slot Well Screen (510-530 ft bgs)
522			SP				
524					Very pale brown (10YR 7/4) poorly graded SAND, subangular medium Sand		
526	0		SC		Very pale brown (10YR 7/4) with 1 inch band of reddish yellow and band of yellowish brown (10YR 5/6) poorly graded SAND, angular medium Sand		
528			SP				
530			SM		Multicolored Clayey SAND micro laminated with seams of lignite, sandy reddish yellow (10YR 6/8) clay and yellow medium sand		
532			SP				Sump
534					Very pale brown (10YR 7/4) poorly graded SAND		
536					Pinkish brown (7.5yr 6/2) Silty SAND, medium Sand		
538					Very pale brown (10YR 7/4) with reddish yellow banding poorly graded SAND, medium sand		
540							
542							#1 Sand to Bottom
544							
546							
					End of boring at 547.0 ft. bgs.		

Section 2

VPB140 Gamma and TCE/PCE Plot

Vertical Profile Boring VPB-140
Downward Run - May 8, 2014
Validated Analytical Data



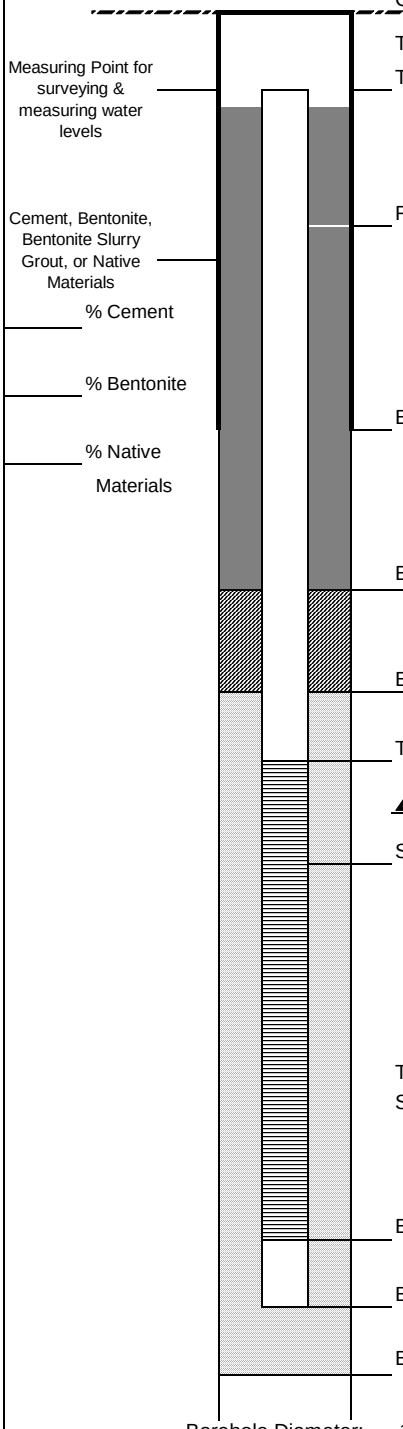
Section 3

Monitoring Well Construction Logs

RESOLUTION CONSULTANTS	Client: NAVFAC	Project Number: 60266526	***WELL ID: RE106D1***
	Site Location: NWIRP BETHPAGE, NY		
	Well Location: Arrandale Rd & Martha Blvd, Bethpage, NY		Date Installed: 10/19-10/27/2016
	Method: MUD ROTARY		Inspector: V. Thayer
	Coords: Northing: 209374.84	Easting: 1122873.48	Contractor: DELTA WELL & PUMP

MONITORING WELL CONSTRUCTION DETAIL

* Casing installed with Auger rig 9/20/16 - 9/21/16.



		Depth from G.S. (feet)	Elevation(feet) Datum
Ground Surface (G.S.)		0.00	101.66
Top of 12 inch diameter Steel Curb Box			
Top of Riser Pipe fit with locking j-plug		0.47	101.19
Riser Pipe:			
Length	440		
Inside Diameter (ID)	4 inch		
Type of Material	PVC		
Bottom of 10 inch diameter Steel Surface Casing		53.5	48.16
Bottom of Bentonite Grout		418.0	-316.34
Bottom of #00 Filter Sand/Top of #1 Filter Sand		428	-326.34
Top of Screen		440	-338.34
▲ Stabilized Water Level			
Screen:			
Length	20		
Inside Diameter (ID)	4 inch		
Slot Size	10		
Type of Material	PVC		
Type/Size of Sand	#1		
Sand Pack Thickness	38		
Bottom of Screen		460	-358.34
Bottom of Sump:		462	-360.34
Bottom of Borehole		466	-364.34

Borehole Diameter: 10 inch

Approved:

Describe Measuring Point:

Ground Surface

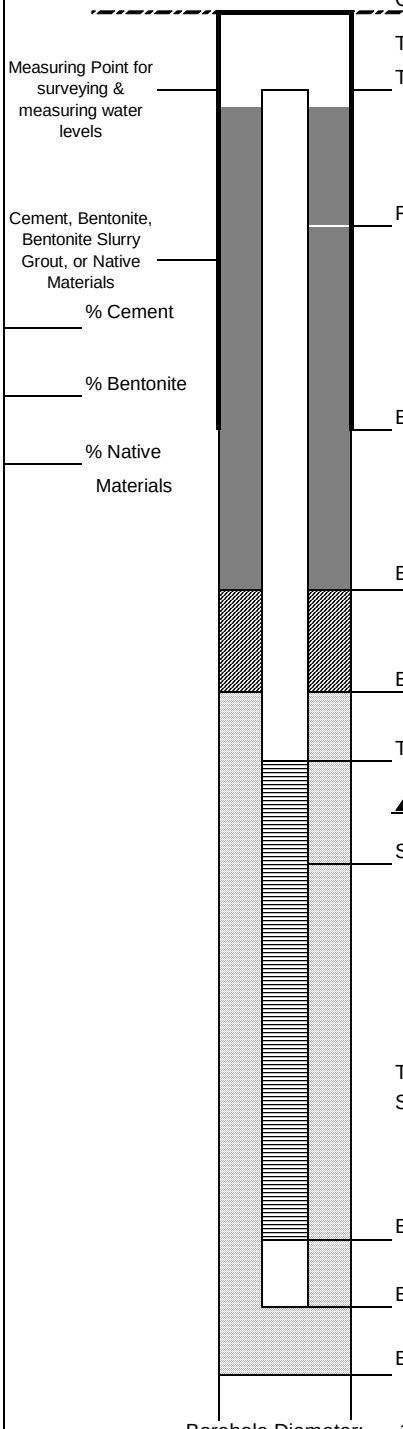
Valerie Thayer
Signature

10/31/2016
Date

RESOLUTION CONSULTANTS	Client: NAVFAC	Project Number: 60266526	***WELL ID: RE106D2***
	Site Location: NWIRP BETHPAGE, NY		
	Well Location: Arrandale Rd & Martha Blvd, Bethpage, NY		Date Installed: 11/7-11/17/2016
	Method: MUD ROTARY		Inspector: V. Thayer
	Coords: Northing: 209390.49	Easting: 1122872.97	Contractor: DELTA WELL & PUMP

MONITORING WELL CONSTRUCTION DETAIL

* Casing installed with Auger rig 9/22/16 - 9/23/16.



		Depth from G.S. (feet)	Elevation(feet) Datum
Ground Surface (G.S.)		0.00	101.76
Top of 12 inch diameter Steel Curb Box			
Top of Riser Pipe fit with locking j-plug		0.39	101.37
Riser Pipe:			
Length	480		
Inside Diameter (ID)	4 inch		
Type of Material	PVC		
Bottom of 10 inch diameter Steel Surface Casing		53.6	48.16
Bottom of Bentonite Grout		469.0	-367.24
Bottom of #00 Filter Sand/Top of #1 Filter Sand		479	-377.24
Top of Screen		480	-378.24
▲ Stabilized Water Level			
Screen:			
Length	10		
Inside Diameter (ID)	4 inch		
Slot Size	10		
Type of Material	PVC		
Type/Size of Sand	#1		
Sand Pack Thickness	17		
Bottom of Screen		490	-388.24
Bottom of Sump:		492	-390.24
Bottom of Borehole		496	-394.24

Borehole Diameter: 10 inch

Approved:

Describe Measuring Point:

Ground Surface

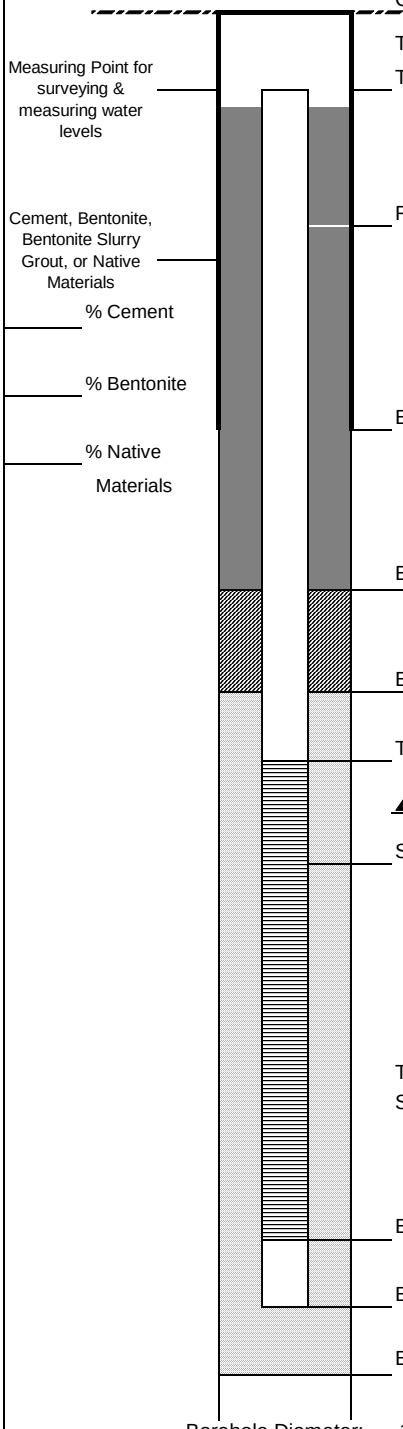
Valerie Thayer
Signature

11/17/2016
Date

RESOLUTION CONSULTANTS	Client: NAVFAC	Project Number: 60266526	***WELL ID: RE106D3***
	Site Location: NWIRP BETHPAGE, NY		
	Well Location: Arrandale Rd & Martha Blvd, Bethpage, NY		Date Installed: 9/30-10/12/16
	Method: MUD ROTARY		Inspector: V. Thayer
	Coords: Northing: 209340.07	Easting: 1122872.12	Contractor: DELTA WELL & PUMP

MONITORING WELL CONSTRUCTION DETAIL

* Casing installed with Auger rig 9/16/16 - 9/19/16.



	Depth from G.S. (feet)	Elevation(feet) Datum
Ground Surface (G.S.)	0.00	101.71
Top of 12 inch diameter Steel Curb Box		
Top of Riser Pipe fit with locking j-plug	0.37	101.34
Riser Pipe:		
Length: 510		
Inside Diameter (ID): 4 inch		
Type of Material: PVC		
Bottom of 10 inch diameter Steel Surface Casing	52.7	49.01
Bottom of Bentonite Grout	475.0	-373.29
Bottom of #00 Filter Sand/Top of #1 Filter Sand	499	-397.29
Top of Screen	510	-408.29
▲ Stabilized Water Level		
Screen:		
Length: 20		
Inside Diameter (ID): 4 inch		
Slot Size: 10		
Type of Material: PVC		
Type/Size of Sand: #1		
Sand Pack Thickness: 48		
Bottom of Screen	530	-428.29
Bottom of Sump:	535	-433.29
Bottom of Borehole	547	-445.29

Borehole Diameter: 10 inch

Approved:

Describe Measuring Point:

Ground Surface

Valerie Thayer
Signature

10/13/2016
Date

Section 4

Groundwater Sample Log Sheets

Well ID: RE10601

RESOLUTION CONSULTANTS

Low Flow Ground Water Sample Collection Record

Client: Navy NWIRP Bethpage Date: 3/08/17 Time: Start 1220 am/pm
Project No: 60266526 Finish _____ am/pm
Site Location: _____
Weather Conds: _____ Collector(s): _____

1. WATER LEVEL DATA: (measured from Top of Casing)

a. Total Well Length 465 ft c. Length of Water Column _____ ft (a-b) Casing Diameter/Material 4-inch PVC

b. Water Table Depth 44.86 ft d. Calculated System Volume (see back) 13.1 gal. 20 screen length (ft)

2. WELL PURGE DATA

a. Purge Method: Geotech bladder pump with drop tube assembly

b. Acceptance Criteria defined (see workplan)

- Temperature ± 3%
- pH ± 0.1 unit
- Conductivity ± 3%
- Turbidity ± 10%
- ORP ± 10mV
- Drawdown < 0.3'
- D.O. ± 10% (values >0.5 mg/L)

Remove a minimum 1 screen volume

c. Field Testing Equipment used:

	Make	Model	Serial Number
	YSI	556	53258
	LaMotte	2020	65722

Time (24hr)	Volume Removed (gallons)	Temp. (°C)	Conduct. (mS/cm)	DO (mg/L)	pH	ORP (mV)	Turbidity (NTU)	Flow Rate (mL/min)	Depth to water (ft)	Color/Odor
1220										Start pump
1225		15.61	0.108	9.30	5.93	195.5	7.27	450	44.95	
1230		15.60	0.109	7.48	5.91	189.8		600		
1235		15.68	0.120	5.70	6.44	171.4	5.28	600	44.95	
1240		15.67	0.121	5.56	6.44	170.2				
1245	5G	15.73	0.121	5.33	6.43	165.7	4.78	600	44.95	

(continued on back)

d. Acceptance criteria pass/fail

	Yes	No	N/A
Has required volume been removed	☑	☐	☐
Has required turbidity been reached	☑	☐	☐
Have parameters stabilized	☑	☐	☐

If no or N/A - Explain below.

_____

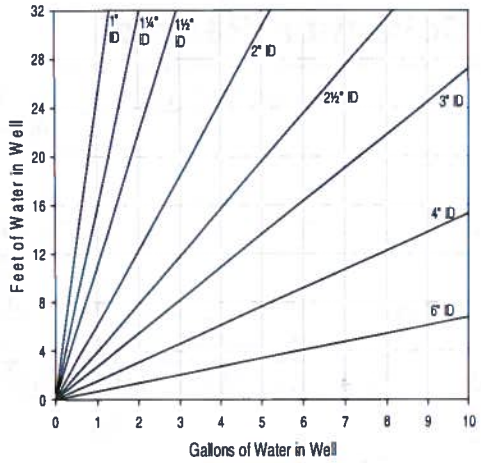
3. SAMPLE COLLECTION: Method: Geotech bladder pump with drop tube assembly

Sample ID	Container Type	No. of Containers	Preservation	Analysis Req.	Time
RE10601-GW-030817	40-mL vials	3	HCl	VOCs	1330
RE10601-GW-030817	1-L amber	2	none	1,4-Dioxane	1330

Comments _____

Signature Gaby Motte Date 03/08/17

Purge Volume Calculation



Volume / Linear Ft. of Pipe		
ID (in)	Gallon	Liter
0.25	0.0025	0.0097
0.375	0.0057	0.0217
0.5	0.0102	0.0386
0.75	0.0229	0.0869
1	0.0408	0.1544
1.25	0.0637	0.2413
1.5	0.0918	0.3475
2	0.1632	0.6178
2.5	0.2550	0.9653
3	0.3672	1.3900
4	0.6528	2.4711
6	1.4688	5.5600

One screen volume (4-inch well)

15 ft = 37.1 L / 9.8 G
20 ft = 49.4 L / 13.1 G
25 ft = 61.8 L / 16.3 G
30 ft = 74.3 L / 19.6 G
40 ft = 99.2 L / 26.1 G
50 ft = 123.6 L / 32.6 G

Well ID:

(continued from front)

Time (24 hr)	Volume Removed (gallons)	Temp (°C)	Conduct. (mS/cm)	DO (mg/L)	pH	ORP (mV)	Turbidity (NTU)	Flow Rate (mL/min)	Depth to water (ft)	Color/Odor
1250		15.70	0.12	5.13	6.45	158.1	3.2	600	44.95	clear, no odor
1300		15.75	0.12	5.03	6.48	155				
1305		15.79	0.12	5.09	6.45	154				
1310	10G	15.78	0.12	5.11	6.46	153	7.8	600	44.95	
1315		15.77	0.12	5.07	6.47	152				
1320		15.79	0.12	5.07	6.45	153	6.5	600	44.95	
1325		15.77	0.12	5.09	6.46	152				
Sample time 1330								200		

RESOLUTION CONSULTANTS

Well ID: RE10602

Low Flow Ground Water Sample Collection Record

Client: Navy NWIRP Bethpage Date: 3 / 8 / 17 Time: Start 1200 am/pm
Project No: 60266526 Finish _____ am/pm
Site Location: _____
Weather Conds: Sunny 60° Collector(s): _____

1. WATER LEVEL DATA: (measured from Top of Casing)

a. Total Well Length 492 ft c. Length of Water Column _____ ft (a-b) Casing Diameter/Material 4-inch PVC

b. Water Table Depth 45.36 ft d. Calculated System Volume (see back) 6.5 gal. 10 screen length (ft)

2. WELL PURGE DATA

a. Purge Method: Geotech bladder pump with drop tube assembly

b. Acceptance Criteria defined (see workplan)

- Temperature ± 3%
- pH ± 0.1 unit
- Conductivity ± 3%
- Turbidity ± 10%
- ORP ± 10mV
- Drawdown < 0.3'
- D.O. ± 10% (values >0.5 mg/L)

Remove a minimum 1 screen volume

c. Field Testing Equipment used:

	Make	Model	Serial Number
	YSI	556	83946
	Hanna	2020	65722

Time (24hr)	Volume Removed (gallons)	Temp. (°C)	Conduct. (mS/cm)	DO (mg/L)	pH	ORP (mV)	Turbidity (NTU)	Flow Rate (mL/min)	Depth to water (ft)	Color/Odor
1213										ON
										pump problems restart
1406										
1405		15.11	0.110	8.82	5.69	143.8		600	45.83	
1410		15.11	0.108	8.02	5.67	142.3	29.1			
1415	3gal	15.15	0.123	7.56	6.13	131.1	136		45.80	

d. Acceptance criteria pass/fail

	Yes	No	N/A
Has required volume been removed	☑	☐	☐
Has required turbidity been reached	☐	☐	☐
Have parameters stabilized	☑	☐	☐

If no or N/A - Explain below.

(continued on back)

3. SAMPLE COLLECTION:

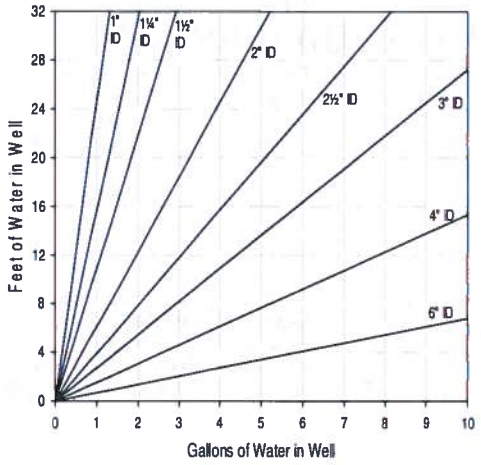
Method: Geotech bladder pump with drop tube assembly

Sample ID	Container Type	No. of Containers	Preservation	Analysis Req.	Time
RE10602-GW-030817	40-mL vials	3	HCl	VOCs	1510
	1-L amber	2	none	1,4-Dioxane	

Comments problems with the pump pulled the entire pump found 30ft of silt in the tubing, drop screen was silt loaded cleaned everything and reinstalled 5ft short purge at 480

Signature Paul Kruth Date 3/8/17

Purge Volume Calculation



Volume / Linear Ft. of Pipe		
ID (in)	Gallon	Liter
0.25	0.0025	0.0097
0.375	0.0057	0.0217
0.5	0.0102	0.0386
0.75	0.0229	0.0869
1	0.0408	0.1544
1.25	0.0637	0.2413
1.5	0.0918	0.3475
2	0.1632	0.6178
2.5	0.2550	0.9653
3	0.3672	1.3900
4	0.6528	2.4711
6	1.4688	5.5600

One screen volume (4-inch well)

15 ft = 37.1 L / 9.8 G
20 ft = 49.4 L / 13.1 G
25 ft = 61.8 L / 16.3 G
30 ft = 74.3 L / 19.6 G
40 ft = 99.2 L / 26.1 G
50 ft = 123.6 L / 32.6 G

Well ID: RE 106 D2 @ 1400

(continued from front)

Time (24 hr)	Volume Removed (gallons)	Temp (°C)	Conduct. (mS/cm)	DO (mg/L)	pH	ORP (mV)	Turbidity (NTU)	Flow Rate (mL/min)	Depth to water (ft)	Color/Odor
1420		15.05	0.142	6.81	6.37	125.8	162			
1425		15.09	0.140	6.33	6.37	124.1	~~172~~ 170		45.84	
1430	5 gal	15.08	0.139	5.84	6.37	120.5	163			
1435		15.09	0.137	5.52	6.37	116.9	150	600		
1440	6.5 gal	15.05	0.136	5.30	6.37	114.2	127		45.83	
1445		15.09	0.136	5.08	6.39	113.4	129			
1450		15.09	0.136	4.94	6.39	111.6	~~129~~ 109			
1455	10 gal	14.92	0.136	4.81	6.39	109.2	103	600	45.82	
1500		15.09	0.136	4.60	6.38	109.4	111			
1505	11.5	15.10	0.135	4.52	6.39	107.1	113			
1510								150		Sample
		Stopped	last low 6 ft out of	with hole	after	sampling				

RESOLUTION CONSULTANTS

Well ID: RE106D3

Low Flow Ground Water Sample Collection Record

Client: Navy NWIRP Bethpage Date: 3/8/17 Time: Start 1200 am/pm
Project No: 60266526 Finish 1455 am/pm
Site Location:
Weather Conds: Collector(s): JC

1. WATER LEVEL DATA: (measured from Top of Casing)

a. Total Well Length 535 ft c. Length of Water Column _____ ft (a-b) Casing Diameter/Material 4-inch PVC

b. Water Table Depth 45.60 ft d. Calculated System Volume (see back) 13.1 gal. 20 screen length (ft)

2. WELL PURGE DATA

a. Purge Method: Geotech bladder pump with drop tube assembly

b. Acceptance Criteria defined (see workplan)

- Temperature ± 3%
- pH ± 0.1 unit
- Conductivity ± 3%
- Turbidity ± 10%
- ORP ± 10mV
- Drawdown < 0.3'
- D.O. ± 10% (values >0.5 mg/L)

Remove a minimum 1 screen volume

c. Field Testing Equipment used:

	Make	Model	Serial Number
	YSI	556	49024
	LaMotte	2020	6J722

Time (24hr)	Volume Removed (gallons)	Temp. (°C)	Conduct. (mS/cm)	DO (mg/L)	pH	ORP (mV)	Turbidity (NTU)	Flow Rate (mL/min)	Depth to water (ft)	Color/Odor
1215		14.92	0.333	11.21	5.60	6.3	—	500	45.61	slight fog / none
1220		14.26	0.294	7.78	5.00	6.2	—	500	—	"
1225		14.27	0.286	7.59	5.25	6.0	5.95	—	45.65	"
1230		14.28	0.279	7.22	5.30	-18.9	—	500	—	"
1235		14.28	0.270	6.78	5.58	-22.3	—	—	45.69	"
1240		14.30	0.270	6.45	5.74	-28.5	65.0	500	45.69	"

d. Acceptance criteria pass/fail

	Yes	No	N/A
Has required volume been removed	☒	☐	☐
Has required turbidity been reached	☐	☒	☐
Have parameters stabilized	☒	☐	☐

(continued on back)

If no or N/A - Explain below.

Turb >50 NTU, stable @ 80+ NTU

3. SAMPLE COLLECTION:

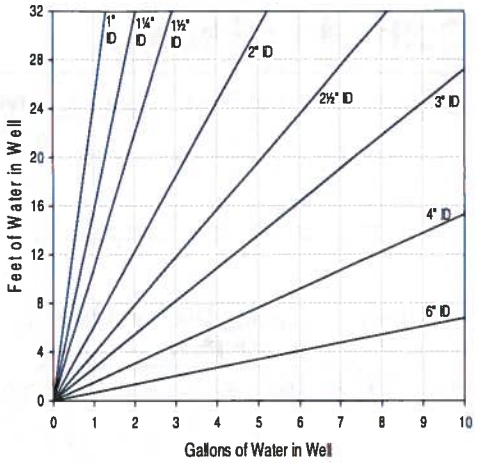
Method: Geotech bladder pump with drop tube assembly

Sample ID	Container Type	No. of Containers	Preservation	Analysis Req.	Time
RE106D3-GW-030817	40-mL vials	3	HCl	VOCs	1340
RE106D3-GW-030817	1-L amber	2	none	1,4-Dioxane	

Comments Water @ 1210
1300 - 1310 trouble shooting RE106D2

Signature _____ Date 3/8/17

Purge Volume Calculation



Volume / Linear Ft. of Pipe		
ID (in)	Gallon	Liter
0.25	0.0025	0.0097
0.375	0.0057	0.0217
0.5	0.0102	0.0386
0.75	0.0229	0.0869
1	0.0408	0.1544
1.25	0.0637	0.2413
1.5	0.0918	0.3475
2	0.1632	0.6178
2.5	0.2550	0.9653
3	0.3672	1.3900
4	0.6528	2.4711
6	1.4688	5.5600

One screen volume (4-inch well)

15 ft = 37.1 L / 9.8 G
20 ft = 49.4 L / 13.1 G
25 ft = 61.8 L / 16.3 G
30 ft = 74.3 L / 19.6 G
40 ft = 99.2 L / 26.1 G
50 ft = 123.6 L / 32.6 G

Well ID: RE106 D3

(continued from front)

Time (24 hr)	Volume Removed (gallons)	Temp (°C)	Conduct. (mS/cm)	DO (mg/L)	pH	ORP (mV)	Turbidity (NTU)	Flow Rate (mL/min)	Depth to water (ft)	Color/Odor
1245	5 gal	14.32	0.273	5.55	6.02	-38.2	85.5	500	45.69	foggy / none
1250		14.33	0.274	4.98	6.03	-39.9	—	500	45.69	"
1255		14.32	0.275	4.85	6.04	-42.1	—	500	—	"
1300		14.32	0.275	4.86	6.04	-42.3	—	—	—	—
1305		—	—	—	—	—	—	—	—	—
1310		—	—	—	—	—	—	—	—	—
1315		—	—	—	—	—	—	—	—	—
1320		14.44	0.279	4.13	6.02	-44.1	—	—	—	—
1325		14.44	0.279	4.12	5.98	-46.4	81.3	500	45.69	foggy / none
1330		14.46	0.279	4.10	5.97	-46.3	86.2	500	45.69	"
1335	14 gal	14.45	0.279	4.07	5.94	-46.3	88.1	500	45.69	"
	Sample time			1340				zero		

Section 5

Analytical Data Validation

[The Data Validation report included here contains only result tables for RE106D1, RE106D2 and RE106D3; for the complete March 2017 Quarterly Sampling Data Validation, see *March 2017 Groundwater Sampling Data Summary Report, Bethpage, NY*, Resolution Consultants, 2017.]

March 2017
Final Results after Data Review
NWIRP Bethpage OU 2 Regional Groundwater Investigation

		Sample Delivery Group	SK1820		
		Lab ID	SK1820-13		
		Sample ID	RE106D1-GW-030817		
		Sample Date	3/8/2017		
		Sample Type	Groundwater		
Method	**Analyte**	**CAS No**	**Units**	Result	Qual	RC
8260C	1,1,1-TRICHLOROETHANE	71-55-6	UG_L	0.5	U	
8260C	1,1,2,2-TETRACHLOROETHANE	79-34-5	UG_L	0.5	U	
8260C	1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	UG_L	1.3		
8260C	1,1,2-TRICHLOROETHANE	79-00-5	UG_L	0.5	U	
8260C	1,1-DICHLOROETHANE	75-34-3	UG_L	0.5	U	
8260C	1,1-DICHLOROETHENE	75-35-4	UG_L	0.5	U	
8260C	1,2,4-TRICHLOROBENZENE	120-82-1	UG_L	0.5	U	
8260C	1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	UG_L	0.75	U	
8260C	1,2-DIBROMOETHANE	106-93-4	UG_L	0.5	U	
8260C	1,2-DICHLOROBENZENE	95-50-1	UG_L	0.5	U	
8260C	1,2-DICHLOROETHANE	107-06-2	UG_L	0.5	U	
8260C	1,2-DICHLOROETHENE, TOTAL	540-59-0	UG_L	1	U	
8260C	1,2-DICHLOROPROPANE	78-87-5	UG_L	0.5	U	
8260C	1,3-DICHLOROBENZENE	541-73-1	UG_L	0.5	U	
8260C	1,4-DICHLOROBENZENE	106-46-7	UG_L	0.5	U	
8260C	2-BUTANONE	78-93-3	UG_L	2.5	U	
8260C	2-HEXANONE	591-78-6	UG_L	2.5	U	
8260C	4-METHYL-2-PENTANONE	108-10-1	UG_L	2.5	U	
8260C	ACETONE	67-64-1	UG_L	2.5	UJ	bf,c
8260C	BENZENE	71-43-2	UG_L	0.5	U	
8260C	BROMODICHLOROMETHANE	75-27-4	UG_L	0.5	U	
8260C	BROMOFORM	75-25-2	UG_L	0.5	U	
8260C	BROMOMETHANE	74-83-9	UG_L	1	U	
8260C	CARBON DISULFIDE	75-15-0	UG_L	0.5	U	
8260C	CARBON TETRACHLORIDE	56-23-5	UG_L	0.5	U	
8260C	CHLOROBENZENE	108-90-7	UG_L	0.5	U	
8260C	CHLOROETHANE	75-00-3	UG_L	1	U	
8260C	CHLOROFORM	67-66-3	UG_L	0.5	U	
8260C	CHLOROMETHANE	74-87-3	UG_L	1	U	
8260C	CIS-1,2-DICHLOROETHENE	156-59-2	UG_L	0.5	U	
8260C	CIS-1,3-DICHLOROPROPENE	10061-01-5	UG_L	0.5	U	
8260C	CYCLOHEXANE	110-82-7	UG_L	0.5	U	
8260C	DIBROMOCHLOROMETHANE	124-48-1	UG_L	0.5	U	
8260C	DICHLORODIFLUOROMETHANE	75-71-8	UG_L	1	UJ	c
8260C	ETHYLBENZENE	100-41-4	UG_L	0.5	U	
8260C	ISOPROPYLBENZENE	98-82-8	UG_L	0.5	U	
8260C	M- AND P-XYLENE	108-38-3/106-42	UG_L	1	U	
8260C	METHYL ACETATE	79-20-9	UG_L	0.75	U	
8260C	METHYL CYCLOHEXANE	108-87-2	UG_L	0.5	U	
8260C	METHYL TERT-BUTYL ETHER	1634-04-4	UG_L	0.5	U	
8260C	METHYLENE CHLORIDE	75-09-2	UG_L	2.5	U	
8260C	O-XYLENE	95-47-6	UG_L	0.5	U	
8260C	STYRENE	100-42-5	UG_L	0.5	U	
8260C	TETRACHLOROETHENE	127-18-4	UG_L	0.68	J	
8260C	TOLUENE	108-88-3	UG_L	0.5	U	
8260C	TRANS-1,2-DICHLOROETHENE	156-60-5	UG_L	0.5	U	
8260C	TRANS-1,3-DICHLOROPROPENE	10061-02-6	UG_L	0.5	U	
8260C	TRICHLOROETHENE	79-01-6	UG_L	7.4		
8260C	TRICHLOROFLUOROMETHANE	75-69-4	UG_L	1	U	
8260C	VINYL CHLORIDE	75-01-4	UG_L	1	U	
8260C	XYLENES, TOTAL	1330-20-7	UG_L	1.5	U	
8270D_SIM	1,4-DIOXANE	123-91-1	UG_L	11	J	l

Notes:

UG_L = Micrograms per liter
NA = Not applicable
Qual = Final qualifiers (See Attachment A)
RC = Reason codes (See Attachment B)

March 2017
Final Results after Data Review
NWIRP Bethpage OU 2 Regional Groundwater Investigation

		Sample Delivery Group		SK1820		
		Lab ID		SK1820-14		
		Sample ID		RE106D2-GW-030817		
		Sample Date		3/8/2017		
		Sample Type		Groundwater		
Method	**Analyte**	**CAS No**	**Units**	Result	Qual	RC
8260C	1,1,1-TRICHLOROETHANE	71-55-6	UG_L	0.5	U	
8260C	1,1,2,2-TETRACHLOROETHANE	79-34-5	UG_L	0.5	U	
8260C	1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	UG_L	12		
8260C	1,1,2-TRICHLOROETHANE	79-00-5	UG_L	0.5	U	
8260C	1,1-DICHLOROETHANE	75-34-3	UG_L	0.5	U	
8260C	1,1-DICHLOROETHENE	75-35-4	UG_L	0.5	U	
8260C	1,2,4-TRICHLOROBENZENE	120-82-1	UG_L	0.5	U	
8260C	1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	UG_L	0.75	U	
8260C	1,2-DIBROMOETHANE	106-93-4	UG_L	0.5	U	
8260C	1,2-DICHLOROBENZENE	95-50-1	UG_L	0.5	U	
8260C	1,2-DICHLOROETHANE	107-06-2	UG_L	0.5	U	
8260C	1,2-DICHLOROETHENE, TOTAL	540-59-0	UG_L	0.97	J	
8260C	1,2-DICHLOROPROPANE	78-87-5	UG_L	0.5	U	
8260C	1,3-DICHLOROBENZENE	541-73-1	UG_L	0.5	U	
8260C	1,4-DICHLOROBENZENE	106-46-7	UG_L	0.5	U	
8260C	2-BUTANONE	78-93-3	UG_L	2.5	U	
8260C	2-HEXANONE	591-78-6	UG_L	2.5	U	
8260C	4-METHYL-2-PENTANONE	108-10-1	UG_L	2.5	U	
8260C	ACETONE	67-64-1	UG_L	2.5	UJ	bf,c
8260C	BENZENE	71-43-2	UG_L	0.5	U	
8260C	BROMODICHLOROMETHANE	75-27-4	UG_L	0.5	U	
8260C	BROMOFORM	75-25-2	UG_L	0.5	U	
8260C	BROMOMETHANE	74-83-9	UG_L	1	U	
8260C	CARBON DISULFIDE	75-15-0	UG_L	0.5	U	
8260C	CARBON TETRACHLORIDE	56-23-5	UG_L	0.5	U	
8260C	CHLOROBENZENE	108-90-7	UG_L	0.5	U	
8260C	CHLOROETHANE	75-00-3	UG_L	1	U	
8260C	CHLOROFORM	67-66-3	UG_L	0.5	U	
8260C	CHLOROMETHANE	74-87-3	UG_L	1	U	
8260C	CIS-1,2-DICHLOROETHENE	156-59-2	UG_L	0.97	J	
8260C	CIS-1,3-DICHLOROPROPENE	10061-01-5	UG_L	0.5	U	
8260C	CYCLOHEXANE	110-82-7	UG_L	0.5	U	
8260C	DIBROMOCHLOROMETHANE	124-48-1	UG_L	0.5	U	
8260C	DICHLORODIFLUOROMETHANE	75-71-8	UG_L	1	UJ	c
8260C	ETHYLBENZENE	100-41-4	UG_L	0.5	U	
8260C	ISOPROPYLBENZENE	98-82-8	UG_L	0.5	U	
8260C	M- AND P-XYLENE	108-38-3/106-42	UG_L	1	U	
8260C	METHYL ACETATE	79-20-9	UG_L	0.75	U	
8260C	METHYL CYCLOHEXANE	108-87-2	UG_L	0.5	U	
8260C	METHYL TERT-BUTYL ETHER	1634-04-4	UG_L	0.5	U	
8260C	METHYLENE CHLORIDE	75-09-2	UG_L	2.5	U	
8260C	O-XYLENE	95-47-6	UG_L	0.5	U	
8260C	STYRENE	100-42-5	UG_L	0.5	U	
8260C	TETRACHLOROETHENE	127-18-4	UG_L	8.1		
8260C	TOLUENE	108-88-3	UG_L	0.5	U	
8260C	TRANS-1,2-DICHLOROETHENE	156-60-5	UG_L	0.5	U	
8260C	TRANS-1,3-DICHLOROPROPENE	10061-02-6	UG_L	0.5	U	
8260C	TRICHLOROETHENE	79-01-6	UG_L	46		
8260C	TRICHLOROFLUOROMETHANE	75-69-4	UG_L	1	U	
8260C	VINYL CHLORIDE	75-01-4	UG_L	1	U	
8260C	XYLENES, TOTAL	1330-20-7	UG_L	1.5	U	
8270D_SIM	1,4-DIOXANE	123-91-1	UG_L	14	J	l

Notes:

UG_L = Micrograms per liter
NA = Not applicable
Qual = Final qualifiers (See Attachment A)
RC = Reason codes (See Attachment B)

March 2017
Final Results after Data Review
NWIRP Bethpage OU 2 Regional Groundwater Investigation

		Sample Delivery Group	SK1820		
		Lab ID	SK1820-15		
		Sample ID	RE106D3-GW-030817		
		Sample Date	3/8/2017		
		Sample Type	Groundwater		
Method	**Analyte**	**CAS No**	**Units**	Result	Qual	RC
8260C	1,1,1-TRICHLOROETHANE	71-55-6	UG_L	0.5	U	
8260C	1,1,2,2-TETRACHLOROETHANE	79-34-5	UG_L	0.5	U	
8260C	1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	UG_L	71		
8260C	1,1,2-TRICHLOROETHANE	79-00-5	UG_L	0.5	U	
8260C	1,1-DICHLOROETHANE	75-34-3	UG_L	0.5	U	
8260C	1,1-DICHLOROETHENE	75-35-4	UG_L	0.71	J	
8260C	1,2,4-TRICHLOROBENZENE	120-82-1	UG_L	0.5	U	
8260C	1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	UG_L	0.75	U	
8260C	1,2-DIBROMOETHANE	106-93-4	UG_L	0.5	U	
8260C	1,2-DICHLOROBENZENE	95-50-1	UG_L	0.5	U	
8260C	1,2-DICHLOROETHANE	107-06-2	UG_L	0.5	U	
8260C	1,2-DICHLOROETHENE, TOTAL	540-59-0	UG_L	2		
8260C	1,2-DICHLOROPROPANE	78-87-5	UG_L	0.5	U	
8260C	1,3-DICHLOROBENZENE	541-73-1	UG_L	0.5	U	
8260C	1,4-DICHLOROBENZENE	106-46-7	UG_L	0.5	U	
8260C	2-BUTANONE	78-93-3	UG_L	2.5	U	
8260C	2-HEXANONE	591-78-6	UG_L	2.5	U	
8260C	4-METHYL-2-PENTANONE	108-10-1	UG_L	2.5	U	
8260C	ACETONE	67-64-1	UG_L	2.5	U	bf
8260C	BENZENE	71-43-2	UG_L	0.5	U	
8260C	BROMODICHLOROMETHANE	75-27-4	UG_L	0.5	U	
8260C	BROMOFORM	75-25-2	UG_L	0.5	U	
8260C	BROMOMETHANE	74-83-9	UG_L	1	U	
8260C	CARBON DISULFIDE	75-15-0	UG_L	0.5	U	
8260C	CARBON TETRACHLORIDE	56-23-5	UG_L	0.5	U	
8260C	CHLOROBENZENE	108-90-7	UG_L	0.5	U	
8260C	CHLOROETHANE	75-00-3	UG_L	1	U	
8260C	CHLOROFORM	67-66-3	UG_L	0.5	U	
8260C	CHLOROMETHANE	74-87-3	UG_L	1	U	
8260C	CIS-1,2-DICHLOROETHENE	156-59-2	UG_L	2		
8260C	CIS-1,3-DICHLOROPROPENE	10061-01-5	UG_L	0.5	U	
8260C	CYCLOHEXANE	110-82-7	UG_L	0.5	U	
8260C	DIBROMOCHLOROMETHANE	124-48-1	UG_L	0.5	U	
8260C	DICHLORODIFLUOROMETHANE	75-71-8	UG_L	1	UJ	c
8260C	ETHYLBENZENE	100-41-4	UG_L	0.5	U	
8260C	ISOPROPYLBENZENE	98-82-8	UG_L	0.5	U	
8260C	M- AND P-XYLENE	108-38-3/106-42	UG_L	1	U	
8260C	METHYL ACETATE	79-20-9	UG_L	0.75	U	
8260C	METHYL CYCLOHEXANE	108-87-2	UG_L	0.5	U	
8260C	METHYL TERT-BUTYL ETHER	1634-04-4	UG_L	0.5	U	
8260C	METHYLENE CHLORIDE	75-09-2	UG_L	2.5	U	
8260C	O-XYLENE	95-47-6	UG_L	0.5	U	
8260C	STYRENE	100-42-5	UG_L	0.5	U	
8260C	TETRACHLOROETHENE	127-18-4	UG_L	35		
8260C	TOLUENE	108-88-3	UG_L	0.5	U	
8260C	TRANS-1,2-DICHLOROETHENE	156-60-5	UG_L	0.5	U	
8260C	TRANS-1,3-DICHLOROPROPENE	10061-02-6	UG_L	0.5	U	
8260C	TRICHLOROETHENE	79-01-6	UG_L	84		
8260C	TRICHLOROFLUOROMETHANE	75-69-4	UG_L	1	U	
8260C	VINYL CHLORIDE	75-01-4	UG_L	1	U	
8260C	XYLENES, TOTAL	1330-20-7	UG_L	1.5	U	
8270D_SIM	1,4-DIOXANE	123-91-1	UG_L	14	J	l

Notes:

UG_L = Micrograms per liter
NA = Not applicable
Qual = Final qualifiers (See Attachment A)
RC = Reason codes (See Attachment B)

Attachment A
Final Qualifier Codes and Explanations

Qualifier	Explanation
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual quantitation limit necessary to accurately and precisely measure the analyte in the sample.
U	The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Attachment B
Reason Codes and Explanations

Reason Code	Explanation
be	Equipment blank contamination
bf	Field blank contamination
bl	Laboratory blank contamination
bm	Missing Blank Information
bt	Trip blank contamination
c	Calibration issue
cr	Chromatographic resolution
d	Reporting limit raised due to chromatographic interference
dt	Dissolved result > total over limit
e	Ether interference
ej	Above calibration range; result estimated.
f	Presumed contamination from FB or ER.
fd	Field duplicate RPDs
h	Holding times
hs	Headspace greater than 6mm in all sample vials
i	Internal standard areas
ii	Injection internal standard area or retention time exceedance
it	Instrument Tune
k	Estimated Maximum Possible Concentrations (EMPC)
l	LCS recoveries
lc	Labeled compound recovery
ld	Laboratory duplicate RPDs (matrix duplicate, MSD, LCSD)
lp	Laboratory control sample/laboratory control sample duplicate RPDs
m	Matrix spike recovery
mc	Deviation from the method
md	MS/MSD precision
nb	Negative laboratory blank contamination
p	Chemical preservation issue
p-h	Uncertainty near detection limit (< Reporting Limit), historical reason code applied.
pe	Post Extraction Spike
q	Quantitation issue
r	Dual column RPD
rt	SIM ions not within + 2 seconds
s	Surrogate recovery
sp	Sample preparation issue
su	Evidence of ion suppression
t	Temperature Preservation Issue
x	Low % solids
y	Serial dilution results
z	ICS results

DATA VALIDATION REPORT

Project:	Regional Groundwater Investigation — NWIRP Bethpage	
Laboratory:	Katahdin Analytical	
Sample Delivery Groups:	SJ8312	
Analyses/Method:	Total Organic Carbon (TOC) by U.S. EPA SW-846 Method 9060A	
Validation Level:	2	
Project Number:	0888812477.SA.DV	
Prepared by:	Dana Miller/Resolution Consultants	Completed on: 11/30/2016
Reviewed by:	Tina Clemmey/Resolution Consultants	File Name: SJ8312_9060A

SUMMARY

This report summarizes data review findings for samples listed below, collected by Resolution Consultants from the Regional Groundwater Investigation — NWIRP Bethpage site on 6 October 2016 in accordance with the following Sampling and Analysis Plans:

- *Sampling and Analysis Plan, Bethpage, New York.* (Resolution Consultants April 2013).
- *UFP SAP Addendum, Installation of Vertical Profile Borings and Monitoring Wells, Operable Unit 2, NWIRP Bethpage, New York.* (Resolution Consultants November 2013).
- *UFP SAP Addendum, Inclusion of Additional Target Analytes for Volatile Organics Analyses, NWIRP Bethpage OU2, Bethpage, New York*. (Resolution Consultants August 2014).

Sample ID	Lab ID	Matrix/Sample Type	Analysis
RE106D3-EB-100616	SJ8312-1	Equipment Blank	9060A
RE106D3-SOIL-101616-510-512	SJ8312-2	Soil	9060A, 2540G

Data validation activities were conducted using the following guidance documents: *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846, specifically Method 9060A, Total Organic Carbon* (U.S. EPA, 1996), *U.S. Environmental Protection Agency (U.S. EPA) Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review* (NFG, January 2010, and Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 4.2 (October 2010). In the absence of method-specific information, laboratory quality control (QC) limits, project-specific requirements and/or professional judgment were used as appropriate.

REVIEW ELEMENTS

The data were evaluated based on the following parameters (where applicable to the method):

✓	Data completeness (chain-of-custody)/sample integrity
✓	Holding times and sample preservation
NA	Gas chromatography/Mass spectrometer performance checks
NA	Initial calibration/continuing calibration verification
✗	Laboratory blanks/equipment blanks
NA	Surrogate spike recoveries
NA	Matrix spike and/or matrix spike duplicate results
✓	Laboratory control sample / laboratory control sample duplicate results
NA	Field duplicates
NA	Internal standards
✓	Sample results/reporting issues

The symbol (✓) indicates that no validation qualifiers were applied based on this parameter. NA indicates that the parameter was not included as part of this data set or was not applicable to this validation and therefore not reviewed. The symbol (X) indicates that a QC non-conformance resulted in the qualification of data. Acceptable data parameters for which all criteria were met and no qualification was performed, and non-conformance or other issues that were noted during validation, but did not result in qualification of data are not discussed further.

RESULTS

Laboratory Blanks/ Equipment Blanks

Field blanks help determine how much, if any, contamination was introduced in the field. Laboratory blanks were analyzed with samples to assess contamination imparted by sample preparation and/or analysis. All results associated with a particular blank were evaluated to determine whether there was an inherent variability in the data, or if a problem was an isolated occurrence that did not affect the data. Because blank samples may not be prepared using the same sample weight, volume, or dilution, those variables were considered when using the blank criteria. All field and laboratory blanks were flagged in accordance with *Functional Guidelines* (shown below) where detections were not believed to be site-related.

Blank Non-conformance Charts:

Blank type	Blank result	Sample result	Action for samples
Method, Storage, Trip, Field, or Equipment	Detects	Not detected	No qualification
	< 2x LOQ	< 2x LOQ	Report sample LOQ value with a U
		≥ 2x LOQ	Use professional judgment
	> 2x LOQ	< 2x LOQ	Report sample LOQ value with a U
		≥ 2x LOQ and < blank contamination	Report the blank result with a U or reject the sample result as unusable R
		≥ 2x LOQ and ≥ blank contamination	If the result is ≤2x blank result, report the sample result U. If the result is > 2x blank result, no qualification is required.
	= 2x LOQ	< 2x LOQ	Report sample LOQ value with a U
		≥ 2x LOQ	Use professional judgment
	Gross contamination	Detects	Qualify results as unusable R

Notes:

LOQ	=	Limit of quantitation	LOD	=	Limit of detection
U	=	Undetected	R	=	Rejected

The laboratory blank non-conformance is summarized in Attachment A in Table A-1.

Qualifications Actions

The data was reviewed independently from the laboratory to assess data quality. TOC was detected in the equipment blank but professional judgement was used not to qualify the associated sample as undetected. All analytes detected at concentrations less than the limit of quantitation but greater than the method detection limit were qualified by the laboratory as estimated (J). This "J" qualifier was retained during data validation.

No results were rejected; therefore, analytical completeness was calculated to be 100 percent. Data not qualified during data review are considered usable by the project. The remaining results qualified as estimated may be high or low, but the data are usable for their intended purpose, according to U.S. EPA and Department of Defense guidelines. Final data review qualifiers used to describe results and how they should be interpreted by the end data user are provided in Attachment B, Table B-1.

ATTACHMENTS

Attachment A: Table A-1, Non-Conformance Summary Tables

Attachment B: Table B-1, Final Results after Data Review

Attachment A
Non-Conformance Summary Table

Table A-1
Laboratory Blank Non-Conformance
Regional Groundwater Investigation NWIRP Bethpage

Blank ID	Batches	Method	Analyte	Blank Result (MG_L)	LOQ	Detected Associated Samples	Qualifier
WG193179-1	WG193179	9060A	Total Organic Carbon	0.21	1	RE106D3-EB-100616	U

Notes:
ID = Identification
MG_L = Milligrams per liter
LOQ = Limit of quantitation
U = Undetected value

Attachment B
Final Results after Data Review

Table B-1
Final Results after Data Review
Regional Groundwater Investigation NWIRP Bethpage

		Sample Delivery Group		SJ8312			SJ8312		
		Lab ID		SJ8312-1			SJ8312-2		
		Sample ID		RE106D3-EB-1000616			RE106D3-SOIL-1001616-510-512		
		Sample Date		10/6/2016			10/6/2016		
		Sample Type		Equipment Blank			Soil		
Method	**Analyte**	**CAS No**	**Units**	Result	Qual	RC	Result	Qual	RC
2540G	TOTAL SOLIDS	-29	PCT	NA			83		
9060A	TOTAL ORGANIC CARBON	-28	MG_L	0.5	U	bl	NA		
9060A	TOTAL ORGANIC CARBON	-28	UG_G	NA			130	J	

Notes:
ID = Identification
Qual = Final qualifier
RC = Reason code
PCT = Percent
MG_L = Milligrams per liter
UG_G = Micrograms per gram
NA = Not analyzed

Final Qualifier:
U = **Undetected** – The analyte was qualified as undetected during data review due to blank artifacts.
J = **Estimated Value** –The analyte concentration was less than the limit of quantitation.

Reason Code:
bl = Qualified undetected and estimated due to lab blank contamination.

DATA VALIDATION REPORT

Project:	Regional Groundwater Investigation — NWIRP Bethpage	
Laboratory:	Katahdin Analytical	
Sample Delivery Groups:	SJ8892	
Analyses/Method:	Total Organic Carbon (TOC) by U.S. EPA SW-846 Method 9060A	
Validation Level:	2	
Project Number:	0888812477.SA.DV	
Prepared by:	Dana Miller/Resolution Consultants	Completed on: 11/30/2016
Reviewed by:	Tina Clemmey/Resolution Consultants	File Name: SJ8892_9060A

SUMMARY

This report summarizes data review findings for samples listed below, collected by Resolution Consultants from the Regional Groundwater Investigation — NWIRP Bethpage site on 24 October 2016 in accordance with the following Sampling and Analysis Plans:

- *Sampling and Analysis Plan, Bethpage, New York.* (Resolution Consultants April 2013).
- *UFP SAP Addendum, Installation of Vertical Profile Borings and Monitoring Wells, Operable Unit 2, NWIRP Bethpage, New York.* (Resolution Consultants November 2013).
- *UFP SAP Addendum, Inclusion of Additional Target Analytes for Volatile Organics Analyses, NWIRP Bethpage OU2, Bethpage, New York*. (Resolution Consultants August 2014).

Sample ID	Lab ID	Matrix/Sample Type	Analysis
RE106D1-EB-102416	SJ8892-1	Equipment Blank	9060A
RE106D1-SOIL-102416-443-445	SJ8892-2	Soil	9060A, 2540G
RE106D1-FD-SOIL-102416	SJ8892-3	Soil	9060A, 2540G

Data validation activities were conducted using the following guidance documents: *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846, specifically Method 9060A, Total Organic Carbon* (U.S. EPA, 1996), *U.S. Environmental Protection Agency (U.S. EPA) Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review* (NFG, January 2010, and Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 4.2 (October 2010). In the absence of method-specific information, laboratory quality control (QC) limits, project-specific requirements and/or professional judgment were used as appropriate.

REVIEW ELEMENTS

The data were evaluated based on the following parameters (where applicable to the method):

✓	Data completeness (chain-of-custody)/sample integrity
✓	Holding times and sample preservation
NA	Gas chromatography/Mass spectrometer performance checks
NA	Initial calibration/continuing calibration verification
✗	Laboratory blanks/equipment blanks
NA	Surrogate spike recoveries
NA	Matrix spike and/or matrix spike duplicate results
✓	Laboratory control sample / laboratory control sample duplicate results
NA	Field duplicates
NA	Internal standards
✓	Sample results/reporting issues

The symbol (✓) indicates that no validation qualifiers were applied based on this parameter. NA indicates that the parameter was not included as part of this data set or was not applicable to this validation and therefore not reviewed. The symbol (X) indicates that a QC non-conformance resulted in the qualification of data. Acceptable data parameters for which all criteria were met and no qualification was performed, and non-conformance or other issues that were noted during validation, but did not result in qualification of data are not discussed further.

RESULTS

Laboratory Blanks/ Equipment Blanks

Field blanks help determine how much, if any, contamination was introduced in the field. Laboratory blanks were analyzed with samples to assess contamination imparted by sample preparation and/or analysis. All results associated with a particular blank were evaluated to determine whether there was an inherent variability in the data, or if a problem was an isolated occurrence that did not affect the data. Because blank samples may not be prepared using the same sample weight, volume, or dilution, those variables were considered when using the blank criteria. All field and laboratory blanks were flagged in accordance with *Functional Guidelines* (shown below) where detections were not believed to be site-related.

Blank Non-conformance Charts:

Blank type	Blank result	Sample result	Action for samples
Method, Storage, Trip, Field, or Equipment	Detects	Not detected	No qualification
	< 2x LOQ	< 2x LOQ	Report sample LOQ value with a U
		≥ 2x LOQ	Use professional judgment
	> 2x LOQ	< 2x LOQ	Report sample LOQ value with a U
		≥ 2x LOQ and < blank contamination	Report the blank result with a U or reject the sample result as unusable R
		≥ 2x LOQ and ≥ blank contamination	If the result is ≤2x blank result, report the sample result U. If the result is > 2x blank result, no qualification is required.
	= 2x LOQ	< 2x LOQ	Report sample LOQ value with a U
		≥ 2x LOQ	Use professional judgment
	Gross contamination	Detects	Qualify results as unusable R

Notes:

LOQ = Limit of quantitation
LOD = Limit of detection
U = Undetected
R = Rejected

The laboratory blank non-conformance is summarized in Attachment A in Table A-1.

Qualifications Actions

The data was reviewed independently from the laboratory to assess data quality. TOC was detected in the equipment blank but professional judgement was used not to qualify the associated sample as undetected. All analytes detected at concentrations less than the limit of quantitation but greater than the method detection limit were qualified by the laboratory as estimated (J). This "J" qualifier was retained during data validation.

No results were rejected; therefore, analytical completeness was calculated to be 100 percent. Data not qualified during data review are considered usable by the project. The remaining results qualified as estimated may be high or low, but the data are usable for their intended purpose, according to U.S. EPA and Department of Defense guidelines. Final data review qualifiers used to describe results and how they should be interpreted by the end data user are provided in Attachment B, Table B-1.

ATTACHMENTS

Attachment A: Table A-1, Non-Conformance Summary Tables

Attachment B: Table B-1, Final Results after Data Review

Attachment A
Non-Conformance Summary Table

Table A-1
Laboratory Blank Non-Conformance
Regional Groundwater Investigation NWIRP Bethpage

Blank ID	Batches	Method	Analyte	Blank Result (MG_L)	LOQ	Detected Associated Samples	Qualifier
WG194632-1	WG194632	9060A	Total Organic Carbon	0.2	1	RE106D1-EB-102416	U

Notes:

ID = Identification
MG_L = Milligrams per liter
LOQ = Limit of quantitation
U = Undetected value

Attachment B
Final Results after Data Review

Table B-1
Final Results after Data Review
Regional Groundwater Investigation NWIRP Bethpage

				Sample Delivery Group	SJ8892		SJ8892		
				Lab ID	SJ8892-1		SJ8892-2		
				Sample ID	RE106D1-EB-102416		RE106D1-SOIL-102416-443-445		
				Sample Date	10/24/2016		10/24/2016		
				Sample Type	Equipment Blank		Soil		
Method	**Analyte**	**CAS No**	**Units**	Result	Qual	RC	Result	Qual	RC
2540G	TOTAL SOLIDS	-29	PCT	NA			84		
9060A	TOTAL ORGANIC CARBON	-28	MG_L	0.5	U	bl	NA		
9060A	TOTAL ORGANIC CARBON	-28	UG_G	NA			180	J	

				Sample Delivery Group	SJ8892		
				Lab ID	SJ8892-3		
				Sample ID	RE106D1-FD-SOIL-102416		
				Sample Date	10/24/2016		
				Sample Type	Field Duplicate		
Method	**Analyte**	**CAS No**	**Units**	Result	Qual	RC	
2540G	TOTAL SOLIDS	-29	PCT	82			
9060A	TOTAL ORGANIC CARBON	-28	MG_L	NA			
9060A	TOTAL ORGANIC CARBON	-28	UG_G	160	J		

Notes:
ID = Identification
Qual = Final qualifier
RC = Reason code
PCT = Percent
MG_L = Milligrams per liter
UG_G = Micrograms per gram
NA = Not analyzed

Final Qualifier:
U = **Undetected** – The analyte was qualified as undetected during data review due to blank artifacts.
J = **Estimated Value** –The analyte concentration was less than the limit of quantitation.

Reason Code:
bl = Qualified undetected and estimated due to lab blank contamination.

DATA VALIDATION REPORT

Project:	Regional Groundwater Investigation — NWIRP Bethpage	
Laboratory:	Katahdin Analytical	
Sample Delivery Groups:	SJ9762	
Analyses/Method:	Total Organic Carbon (TOC) by U.S. EPA SW-846 Method 9060A	
Validation Level:	2	
Project Number:	0888812477.SA.DV	
Prepared by:	Dana Miller/Resolution Consultants	Completed on: 11/30/2016
Reviewed by:	Tina Clemmey/Resolution Consultants	File Name: SJ9762_9060A

SUMMARY

This report summarizes data review findings for samples listed below, collected by Resolution Consultants from the Regional Groundwater Investigation — NWIRP Bethpage site on 14 November 2016 in accordance with the following Sampling and Analysis Plans:

- *Sampling and Analysis Plan, Bethpage, New York.* (Resolution Consultants April 2013).
- *UFP SAP Addendum, Installation of Vertical Profile Borings and Monitoring Wells, Operable Unit 2, NWIRP Bethpage, New York.* (Resolution Consultants November 2013).
- *UFP SAP Addendum, Inclusion of Additional Target Analytes for Volatile Organics Analyses, NWIRP Bethpage OU2, Bethpage, New York*. (Resolution Consultants August 2014).

Sample ID	Lab ID	Matrix/Sample Type	Analysis
RE106D2-EB-111416	SJ9762-1	Equipment Blank	9060A
RE106D2-SOIL-111416-483-485	SJ9762-2	Soil	9060A, 2540G

Data validation activities were conducted using the following guidance documents: *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846, specifically Method 9060A, Total Organic Carbon* (U.S. EPA, 1996), *U.S. Environmental Protection Agency (U.S. EPA) Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review* (NFG, January 2010, and Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 4.2 (October 2010). In the absence of method-specific information, laboratory quality control (QC) limits, project-specific requirements and/or professional judgment were used as appropriate.

REVIEW ELEMENTS

The data were evaluated based on the following parameters (where applicable to the method):

✓	Data completeness (chain-of-custody)/sample integrity
✓	Holding times and sample preservation
NA	Gas chromatography/Mass spectrometer performance checks
NA	Initial calibration/continuing calibration verification
✗	Laboratory blanks/equipment blanks
NA	Surrogate spike recoveries
NA	Matrix spike and/or matrix spike duplicate results
✓	Laboratory control sample / laboratory control sample duplicate results
NA	Field duplicates
NA	Internal standards
✓	Sample results/reporting issues

The symbol (✓) indicates that no validation qualifiers were applied based on this parameter. NA indicates that the parameter was not included as part of this data set or was not applicable to this validation and therefore not reviewed. The symbol (X) indicates that a QC non-conformance resulted in the qualification of data. Acceptable data parameters for which all criteria were met and no qualification was performed, and non-conformance or other issues that were noted during validation, but did not result in qualification of data are not discussed further.

RESULTS

Laboratory Blanks/ Equipment Blanks

Field blanks help determine how much, if any, contamination was introduced in the field. Laboratory blanks were analyzed with samples to assess contamination imparted by sample preparation and/or analysis. All results associated with a particular blank were evaluated to determine whether there was an inherent variability in the data, or if a problem was an isolated occurrence that did not affect the data. Because blank samples may not be prepared using the same sample weight, volume, or dilution, those variables were considered when using the blank criteria. All field and laboratory blanks were flagged in accordance with *Functional Guidelines* (shown below) where detections were not believed to be site-related.

Blank Non-conformance Charts:

Blank type	Blank result	Sample result	Action for samples
Method, Storage, Trip, Field, or Equipment	Detects	Not detected	No qualification
	< 2x LOQ	< 2x LOQ	Report sample LOQ value with a U
		≥ 2x LOQ	Use professional judgment
	> 2x LOQ	< 2x LOQ	Report sample LOQ value with a U
		≥ 2x LOQ and < blank contamination	Report the blank result with a U or reject the sample result as unusable R
		≥ 2x LOQ and ≥ blank contamination	If the result is ≤2x blank result, report the sample result U. If the result is > 2x blank result, no qualification is required.
	= 2x LOQ	< 2x LOQ	Report sample LOQ value with a U
		≥ 2x LOQ	Use professional judgment
	Gross contamination	Detects	Qualify results as unusable R

Notes:

LOQ = Limit of quantitation
LOD = Limit of detection
U = Undetected
R = Rejected

The laboratory blank non-conformance is summarized in Attachment A in Table A-1.

Qualifications Actions

The data was reviewed independently from the laboratory to assess data quality. TOC was detected in the equipment blank but professional judgement was used not to qualify the associated sample as undetected. All analytes detected at concentrations less than the limit of quantitation but greater than the method detection limit were qualified by the laboratory as estimated (J). This "J" qualifier was retained during data validation.

No results were rejected; therefore, analytical completeness was calculated to be 100 percent. Data not qualified during data review are considered usable by the project. The remaining results qualified as estimated may be high or low, but the data are usable for their intended purpose, according to U.S. EPA and Department of Defense guidelines. Final data review qualifiers used to describe results and how they should be interpreted by the end data user are provided in Attachment B, Table B-1.

ATTACHMENTS

Attachment A: Table A-1, Non-Conformance Summary Tables

Attachment B: Table B-1, Final Results after Data Review

Attachment A
Non-Conformance Summary Table

Table A-1
Laboratory Blank Non-Conformance
Regional Groundwater Investigation NWIRP Bethpage

Blank ID	Batches	Method	Analyte	Blank Result (MG_L)	LOQ	Detected Associated Samples	Qualifier
WG195806-1	WG195806	9060A	Total Organic Carbon	0.41	1	RE106D2-EB-111416	U

Notes:

ID = Identification
MG_L = Milligrams per liter
LOQ = Limit of quantitation
U = Undetected value

Attachment B
Final Results after Data Review

Table B-1
Final Results after Data Review
Regional Groundwater Investigation NWIRP Bethpage

		Sample Delivery Group		SJ9762			SJ9762		
		Lab ID		SJ9762-1			SJ9762-2		
		Sample ID		RE106D2-EB-111416			RE106D2-SOIL-111416-483-485		
		Sample Date		11/14/2016			11/14/2016		
		Sample Type		Equipment Blank			Soil		
Method	**Analyte**	**CAS No**	**Units**	Result	Qual	RC	Result	Qual	RC
2540G	TOTAL SOLIDS	-29	PCT	NA			83		
9060A	TOTAL ORGANIC CARBON	-28	MG_L	0.5	U	bl	NA		
9060A	TOTAL ORGANIC CARBON	-28	UG_G	NA			260	J	

Notes:
ID = Identification
Qual = Final qualifier
RC = Reason code
PCT = Percent
MG_L = Milligrams per liter
UG_G = Micrograms per gram
NA = Not analyzed

Final Qualifier:
U = **Undetected** – The analyte was qualified as undetected during data review due to blank artifacts.
J = **Estimated Value** –The analyte concentration was less than the limit of quantitation.

Reason Code:
bl = Qualified undetected and estimated due to lab blank contamination.

Section 6

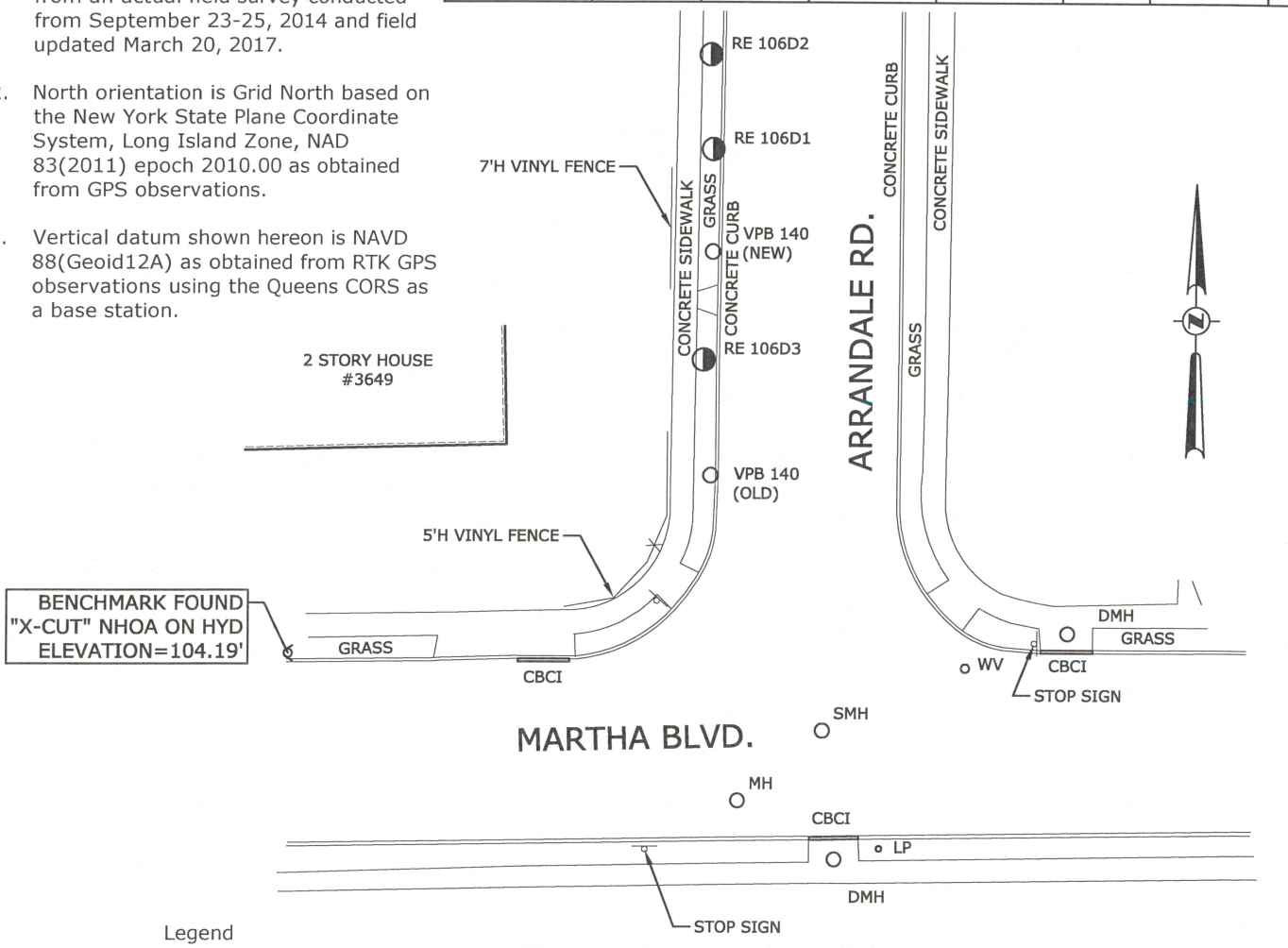
Survey

NONE :XREFS

Description	Northing	Easting	Latitude	Longitude	Ground	Top of Casing	PVC
VPB 140 (OLD)	209320.99	1122873.41	N40-44-24.46	W73-29-59.13	101.58	NA	NA
VPB 140 (NEW)	209357.89	1122873.52	N40-44-24.83	W73-29-59.12	101.77	100.55	NA
RE 106D1	209374.84	1122873.48	N40-44-24.99	W73-29-59.12	101.66	101.74	101.19
RE 106D2	209390.49	1122872.97	N40-44-25.15	W73-29-59.13	101.76	101.82	101.37
RE 106D3	209340.07	1122872.12	N40-44-24.65	W73-29-59.14	101.71	101.74	101.34

Map Notes

1. Information shown hereon was compiled from an actual field survey conducted from September 23-25, 2014 and field updated March 20, 2017.
2. North orientation is Grid North based on the New York State Plane Coordinate System, Long Island Zone, NAD 83(2011) epoch 2010.00 as obtained from GPS observations.
3. Vertical datum shown hereon is NAVD 88(Geoid12A) as obtained from RTK GPS observations using the Queens CORS as a base station.



Legend

═══	CBCI	Catch Basin Curb Inlet
○	DMH	Drainage Manhole
∘	LP	Light Pole
○	MH	Manhole
◑	RE 106D1	Monitor Well
○	SMH	Sanitary Manhole
○	VPB 140	Vertical Profile Boring
∘	WV	Water Valve

BAR SCALE

30 0 15 30 60

1 inch = 30 ft.

DWG NO. 14-496

Date	RECORD OF WORK	Appr.
3/20/17	SURVEY UPDATE/NEW VERT. BORING & MONITOR WELLS	wjn

STATE OF NEW YORK JOHN J. NEVINS 049513 LICENSED LAND SURVEYOR

Drafter: LMK Checker: JFC

Appr. by: JFC Proj. No. 14.4121

VERTICAL PROFILE BORING 140 SURVEY LOCATION
3649 MARTHA BOULEVARD

TOWN OF BETHPAGE | NASSAU COUNTY, NEW YORK

C.T. MALE ASSOCIATES
Engineering, Surveying, Architecture & Landscape Architecture, D.P.C.
50 CENTURY HILL DRIVE, LATHAM, NY 12110
518.786.7400 * FAX 518.786.7299

SCALE: 1"=30' DATE: SEPT. 24, 2014

CAD DWG. FILE NAME: K:\Projects\144121\Survey\Drawings and Maps\2017 DRAWINGS\2017 VPB 140.dwg

Appendix B

Geologic Cross Sections derived from

Environmental Sequence Stratigraphy (ESS)

Appendix B. Geologic Cross Sections derived from Environmental Sequence Stratigraphy

Resolution Consultants reviewed the geologic data and regional literature at the Naval Weapons Industrial Reserve Plant at Bethpage, New York and developed four representative base-wide cross sections to support development of a CSM. The cross sections are presented in Figure 1 - Figure 4. The cross sections provide geologic context for groundwater and analytical data and can be used as the framework upon which new and existing datasets (groundwater, analytical chemistry, geophysical data, etc.) can be analyzed to better understand groundwater flow-paths and contaminant transport and storage zones. As such, these sections are an integral component of an effective CSM.

The cross sections were developed using ESS. The ESS approach examines subsurface data in the context of the depositional environments and petroleum industry best practices of sequence stratigraphy and facies models. Shown for each boring included in the stratigraphic analysis are a vertical series of colored blocks which correspond to boring log lithology and a continuous data curve (in red or as a scan of a paper document, which corresponds to the gamma log). These colored blocks represent vertical grain size distribution and are the basis for the correlations between the data points.

The color coded blocks correspond to the graphic grainsize scale as shown in the cross-sections' keys. The width of the block increases with relative grainsize. Block color indicates the textural classification of the sediment (e.g., yellow for sand, green for silt, blue for clay) as written in the field notes of the core logging geologist (see the cross section keys for further definition).

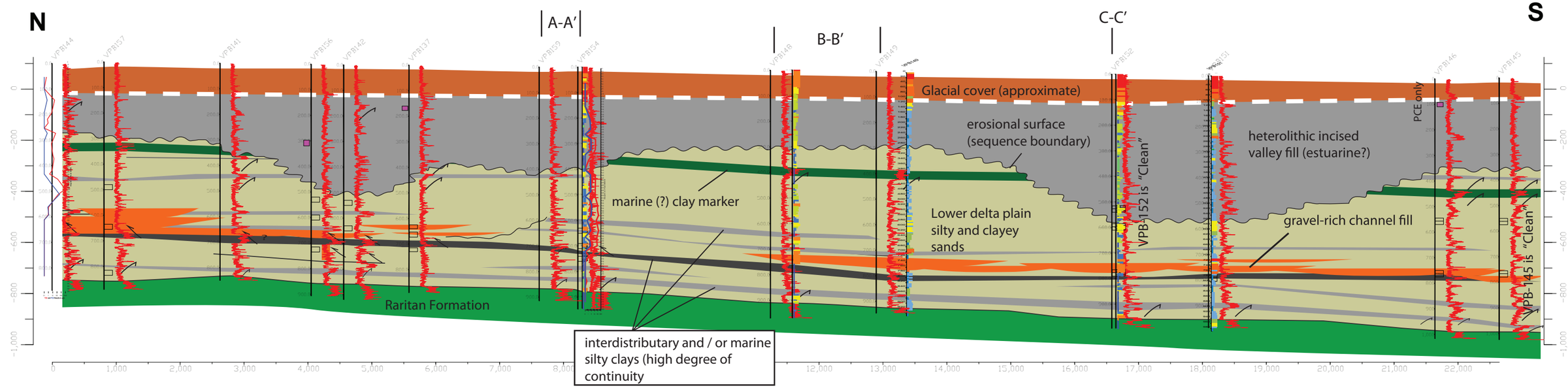
Logs of natural gamma emissions are a common proxy for grainsize. They typically are used as a correlation aide because repetitive spatially extensive trends in grainsize are easily identified visually when curves are examined along a given section. In non-granitic aquifer material, the chemistry of minerals found in clays result in higher concentrations of gamma emitting anions as opposed to the quartz, heavy minerals, and lithic fragments that generally predominate the coarser size fractions. Thus, peaks in the gamma logs can be indicative of clay layers and in general as gamma count per second increases, the grainsize decreases. Gamma logs should always be "calibrated" by comparing side by side with a lithologic log at representative locations. Good agreement between gamma logs and lithology logs were noted in the data points used for the ESS sections at Bethpage.

The previously established general hydrostratigraphy at Bethpage consists of the basal Raritan confining unit, the Magothy aquifer, and the shallow glacial aquifer. The stratigraphy shown in the sections presented in this technical memo is consistent with this general model but additionally shows the Magothy to consist of basal zone gravel-rich channel fills (orange in sections); extensive, planar marine clays (thin units shown in grey and dark green); and silty sands of inter-distributary and delta front origins (shown in tan). Additionally, an erosional incision into the lower delta plain sediments is observed throughout the site (portrayed in sections as a wavy solid black line). Above this, the Magothy sediments are more likely estuarine "incised valley fill" as indicated by the more heterogeneous gamma ray character. In some locations, such as VPB139 on section A-A', there appears to be clear lithologic control on contaminant distribution within the estuarine facies where the higher TCE and PCE concentrations occur in the coarser lithologic zones.

The depositional axis of the incised valley fill likely trends north-south/southeast. The incision is clearly indicated on all sections via the correlation of a prominent clay layer shown in sections in dark green. Where this clay is missing in the gamma logs, it is likely that it was eroded during a lowstand of sea level. Additionally, while relatively planar in their geometry, the major units dip gently south-south east. This is an important geologic characteristic to consider when comparing analytical results because hydrologic zones separated by thin confining layers within the Magothy may be accessed by screens of similar depth.

One of the most important benefits of the ESS approach is to develop and refine the CSM. ESS facilitates an understanding of the geology governing groundwater occurrence and movement, and provides an element for refining the approaches for assessment and remediation. The ESS results from this effort suggest that a modern analog (a modern geological setting that allows an understanding of the ancient environment) for the Magothy depositional environments is the Mackenzie River Delta, shown in Figure 5. Basal gravel zones are represented by the braided river deposits of the Toklat River, Alaska, in Figure 6.

Environmental Sequence Stratigraphy Cross Section



GRAIN SIZE LOG INDEX*

* not all grainsize categories shown in the comprehensive key are present at the site.
Site sediments are predominatly fine (clays, sandy clays, silts,and fine to medium sand)

- Clay
- Clay with 10% Sand
- Clay with 20% Sand
- Clay with 30% Sand
- Clay with 40% Sand
- Clay with Fine Gravel
- Clay with Medium Gravel
- Clay with Coarse Gravel
- Silt
- Silt with 10% Sand
- Silt with 20% Sand
- Sandy Silt
- Silty Sand
- Clayey Sand
- Silty Sand (Fine Sand with 40% Fines)
- Clayey Sand (Fine Sand with 40% Fines)
- Silty Sand (Fine Sand with 30% Fines)
- Clayey Sand (Fine Sand with 30% Fines)
- Silty Sand (Fine Sand with 10-20% Fines)
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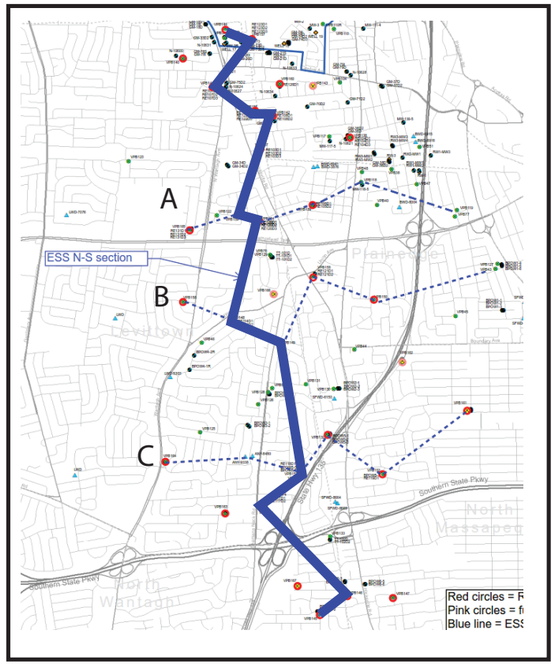


Figure 1. Cross Section N-S

A – A′

West

A

intersection with N-S

VPB-165 VPB-159 VPB-154 VPB-139 BWD 6-1 BWD 6-2 VPB-118 VPB-46 VPB-40 VPB-77 VPB-119

A′

East

Elevation (Ft.)

100 0 -100 -200 -300 -400 -500 -600 -700 -800

Apparent lithologic control on TCE and PCE concentrations

Potentially leaky zone in basal clay here

Raritan Formation

0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000 9,000 10,000 11,000 12,000 13,000 14,000 15,000

Distance

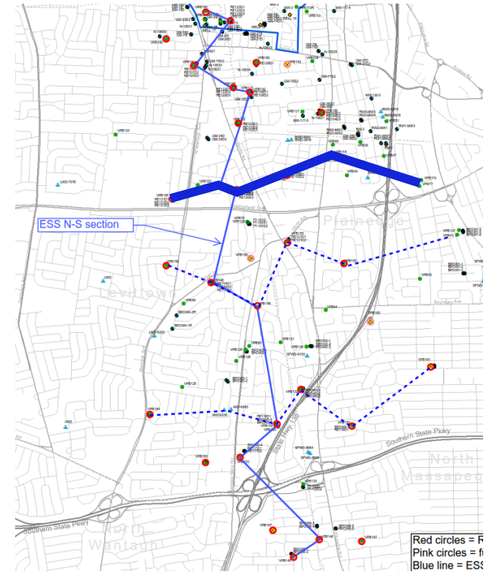
Glacial cover (approximate)

heterolithic incised valley fill (estuarine?)

marine (?) clay marker

interdistributary and / or marine silty clays (high degree of continuity (darkest grey clay may serve as base to contaminant)

gravel-rich channel fill



GRAIN SIZE LOG INDEX*

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- Clay
- Clay with 10% Sand
- Clay with 20% Sand
- Clay with 30% Sand
- Clay with 40% Sand
- Clay with Fine Gravel
- Clay with Medium Gravel
- Clay with Coarse Gravel
- Silt
- Silt with 10% Sand
- Silt with 20% Sand
- Sandy Silt
- Silty Sand
- Clayey Sand
- Silty Sand (Fine Sand with 40% Fines)
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- Coarse Gravel

Figure 2. Cross Section A-A’

B

B–B′

B′

West

East

VPB-156

VPB-148

VPB-149

VPB-155

VPB-150

VPB-45

VPB-43

VPB-127

intersection with N-S

Glacial cover (approximate)

heterolithic incised valley fill (estuarine?)

marine (?) clay marker

Lower delta plain silty and clayey sands

gravel-rich channel fill

interdistributary and / or marine silty clays (high degree of continuity (darkest grey clay may serve as base to contaminant)

?

Raritan Formation

100

0

-100

-200

-300

-400

-500

-600

-700

-800

0

1,000

2,000

3,000

4,000

5,000

6,000

7,000

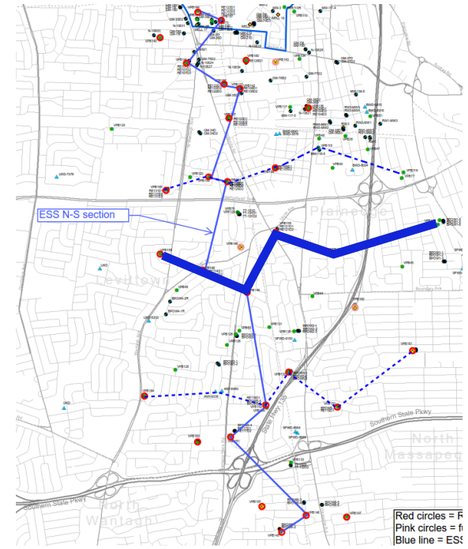
8,000

9,000

10,000

11,000

12,000



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- Clay with Coarse Gravel
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- Silt with 10% Sand
- Silt with 20% Sand
- Sandy Silt
- Silty Sand
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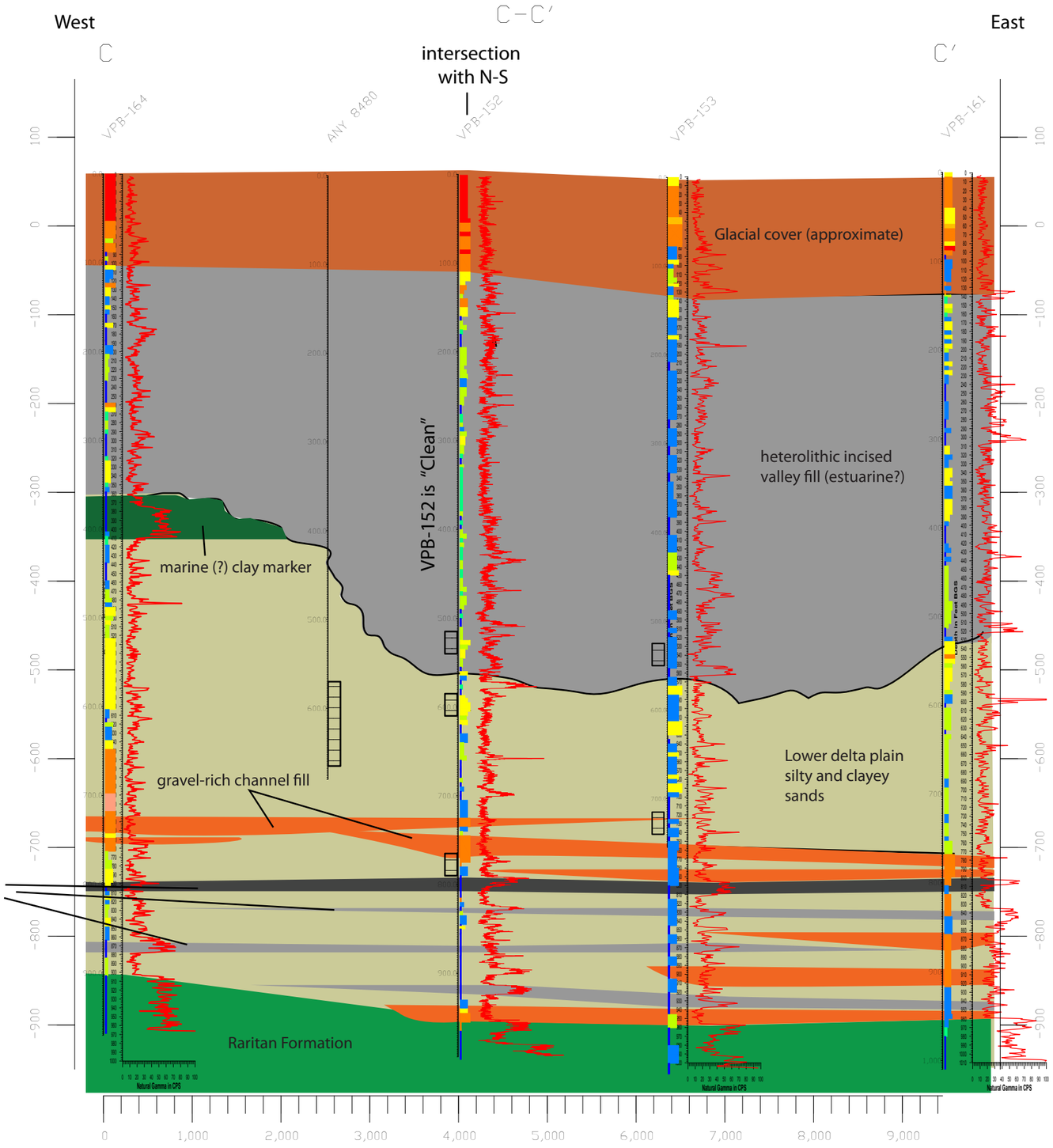
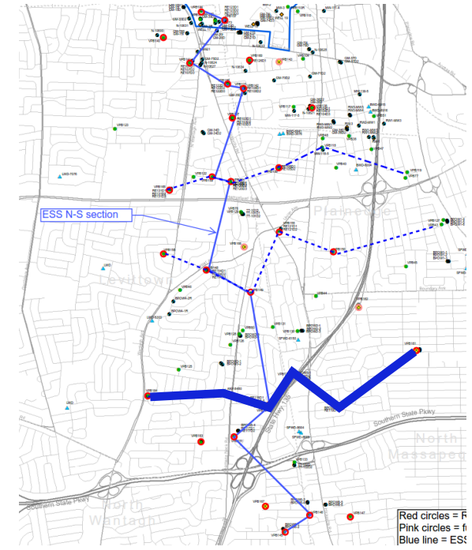
Figure 3. Cross Section B-B’



interdistributary and / or marine silty clays (high degree of continuity (darkest grey clay may serve as base to contaminant)



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- Coarse Gravel

Figure 4. Cross Section C-C’

Figure 5. Mackenzie River Delta Depositional Environment

Source: Thermal Emission and Reflection Radiometer image from NASA's TERRA satellite, August 4, 2005, Mackenzie River, Canada. Image from GSFC/METI/ERSDAC/JAROS and the US/Japan ASTER Science Team. http://earthobservatory.nasa.gov/IOTD/view.php?id=8320

Figure 6. Braided River Depositional Environment

Source: East Fork Toklat River, Alaska Range, Denali National Park https://pubs.usgs.gov/of/2004/1216/b/b.html