TETRA TECH

October 2, 2017

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Reference: CLEAN Contract No. N62470-16-D-9008
Contract Task Order WE24

Subject: 30 Percent Basis of Design Report
Phase I RE-108 Groundwater Hotspot Treatment System
Naval Weapons Industrial Reserve Plant (NWIRP) Bethpage, New York

Dear Mr. Pelton:

On behalf of the Department of the Navy, Tetra Tech is submitting the subject document to the New York State Department of Environmental Conservation (NYSDEC) for information. This report was prepared to support the ongoing design for the Phase I RE-108 Groundwater Hotspot Treatment System, also referred to as the Interim Conveyance System. If you have any questions please contact Ms. Lora Fly, NAVFAC Mid-LANT, at lora.fly@navy.mil or (757) 341-2012.

Sincerely

David D. Brayack, P.E.
Project Manager

Enclosure: 30 Percent Basis of Design Report
Phase I RE-108 Groundwater Hotspot Treatment System
Naval Weapons Industrial Reserve Plant (NWIRP) Bethpage, New York

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Naval Facilities Engineering Command Mid-Atlantic
Norfolk, Virginia

30 Percent Basis of Design Report
Phase I RE108 Area Hotspot Treatment System

Site 00001 – Former Drum Marshalling Area, OU 2 Groundwater

Naval Weapons Industrial Reserve Plant Bethpage, Bethpage, New York

October 2017

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30 PERCENT BASIS OF DESIGN REPORT
PHASE I RE-108 AREA HOTSPOT TREATMENT SYSTEM

SITE 00001 – FORMER DRUM MARSHALLING AREA, OU 2 GROUNDWATER

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BETHPAGE, NEW YORK

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
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Naval Facilities Engineering Command Mid-Atlantic
9742 Maryland Avenue
Norfolk, Virginia 23511

Submitted by:
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Contract Number N62472-16-D-9008
Contract Task Order WE24

OCTOBER 2017

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Acronyms and Abbreviations

bgs	below ground surface
CFM	cubic feet per minute
GAC	granular activated carbon
GM38 GWTS	GM38 Area Hotspot Groundwater Treatment System
gpm	gallons per minute
Hp	horsepower
HD	heavy duty
HDPE	high density polyethylene
HMI	human machine interface
ID	internal diameter
K	hydraulic conductivity
LIRR	Long Island Railroad
µg/L	microgram(s) per liter
MCL	Maximum Contaminant Level
mg/L	milligram(s) per liter
msl	mean sea level
mV	millivolt(s)
MV	motorized valve
MW	monitoring well
NAVFAC	Naval Facilities Engineering Command
NWIRP	Naval Weapons Industrial Reserve Plant
OU	Operable Unit
PCE	tetrachloroethane
P&ID	piping and instrumentation diagram
PLC	programmable-logic controller
PSEG	Public Service Electric Group
ROD	Record of Decision
psig	pound(s)-force per square inch gauge
PT	pressure transmitter

PVC	polyvinyl chloride
rpm	revolution(s) per minute
RW	Recovery well
TCE	Trichloroethene
TOB	Town of Oyster Bay
USACE	United States Army Corps of Engineers
USDOT	United States Department of Transportation
VAC	volt(s) alternating current
VFD	variable frequency drive
VGAC	Vapor-phase granular activated carbon
VOC	volatile organic compound

1.0 Introduction

This 30 Percent Basis of Design Report and associated drawings were prepared to identify the preliminary requirements to construct the Phase I RE108 Area Hotspot Treatment System for the Naval Weapons Industrial Reserve Plant (NWIRP) in Bethpage, New York (Figure 1-1). This Report was prepared by Tetra Tech for the United States Department of the Navy (Navy), Naval Facilities Engineering Command (NAVFAC), Mid-Atlantic, under Contract Number N62470-16-D-9008, Contract Task Order WE24.

1.1 Background

The Navy is conducting groundwater investigations and remediation in accordance with the Operable Unit (OU) 2 Record of Decision (ROD) for NWIRP Bethpage (NAVFAC, 2003). One of the components of the OU2 ROD is extraction, treatment, and discharge of groundwater with sustained concentrations of volatile organic compounds (VOCs) at more than 1,000 micrograms per liter (µg/L) that originated, at least in part, from the former NWIRP Bethpage facility. The RE108 Area Hotspot meets this definition. It is estimated to extend from near the Northrop Grumman OU2 Onsite Containment System (ONCT) south to approximately Hempstead Turnpike (Figures 1-2 and 1-3) and is present at a depth of approximately 500 to 750 feet below ground surface (bgs) (Figures 1-4). In the planned area of the Phase I System (south of RE-103 well cluster), the plume is present at a depth of approximately 550 to 650 feet bgs.

The primary VOC is trichloroethene (TCE) and represents approximately 98 percent of the total VOCs in the RE108 Hotspot Area. Several other VOCs are present in portions of this groundwater at concentrations greater than New York State Maximum Contaminant Levels (MCLs), including 1,1,2-trichloro- 1,2,2-trifluoroethane, 1,1-dichloroethene, cis-1,2 dichloroethene, tetrachloroethene (PCE), and 1,1-dichloroethane. Even though 1,4-dioxane was not identified in the OU2 ROD, it is a potential chemical of concern because it has been detected at concentrations that may require treatment. There is no specific MCL for 1,4-dioxane at this time, but in New York, it is currently regulated at 50 µg/L. Other VOCs are also present in groundwater, but are either detected infrequently, or at concentrations less than the MCLs.

Data used in this report is based on the results from RE108 Area groundwater sampling events conducted from 2014 to 2016. Representative metal, nitrogen, biochemical oxygen demand, and other water quality data were collected in 2016 from select area monitoring wells. Additional detail on the chemicals and other water quality data detected in the RE108 Hotspot Area is provided in Appendix A.

Two groundwater extraction and treatment systems and three public water supply systems are in operation in close proximity to the RE108 Area Hotspot. Northrop

Grumman operates the OU2 Onsite Containment System that captures and remediates VOC-contaminated groundwater from the former NWIRP and Northrop Grumman properties. The Navy operates the GM38 Area Hotspot Groundwater Extraction and Treatment System (GM38 GWTS) to address a hotspot east of the RE108 Area Hotspot. Bethpage Water District (BWD) operates three public water supply well fields in the area.

1.2 Objectives and Rationale

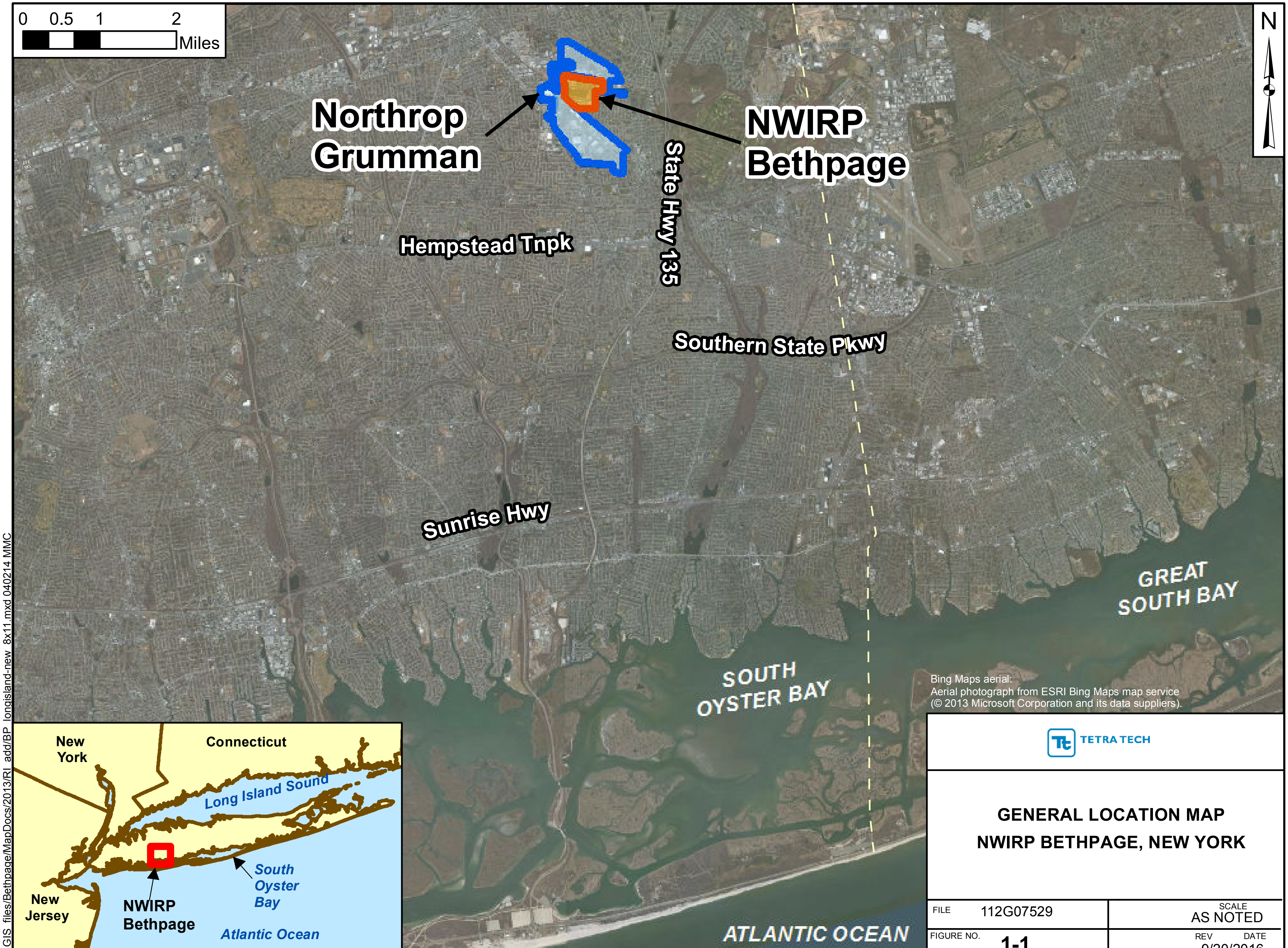
The Phase I RE108 Area Hot Treatment System (Phase I System) is being installed to intercept and treatment the northern half of RE108 Area Hotspot. The Phase I System will consist of one recovery well (RW4) that will be located in the center of the RE108 Area Hotspot and underground piping from RW4 to the existing GM38 GWTS using a utility corridor (Figure 1-2). Pending access agreements, the Phase I System could be operational by the end of 2018. It is anticipated that this system will operate for up to 50 years. During this time, it will remove significant volatile organic compound (VOC) mass from the aquifer, reduce aquifer overall cleanup times, and reduce the plume migration to the south and southeast.

The Phase II RE108 Area Hotspot Treatment System is in the planning phase and will be located approximately one mile to the south of the Phase I recovery well to address the remainder of the RE108 Area Hotspot. Groundwater flow is to the south. The Phase II system is anticipated to be larger than the Phase I system and require additional extraction wells and a new treatment and discharge system. Because of the plume location, the Phase II system will be located in an area of dense residential and commercial development, which makes planning, access, design, and construction more difficult. Startup of the Phase II is anticipated to occur in 2022.

1.3 Organization

This 30 Percent Basis of Design Report is organized as follows:

- Section 1.0 - Introduction*:* Presents the background, purpose, scope, and organization of the design basis report.
- Section 2 - Design Criteria*:* Presents project background information and summarizes the technical parameters upon which the remedial design is based.
- Section 3 - Basis of Design: Presents the analyses that were conducted to select and guide the remedial design approach.
- Section 4 - References: Presents references for the information used in the report.



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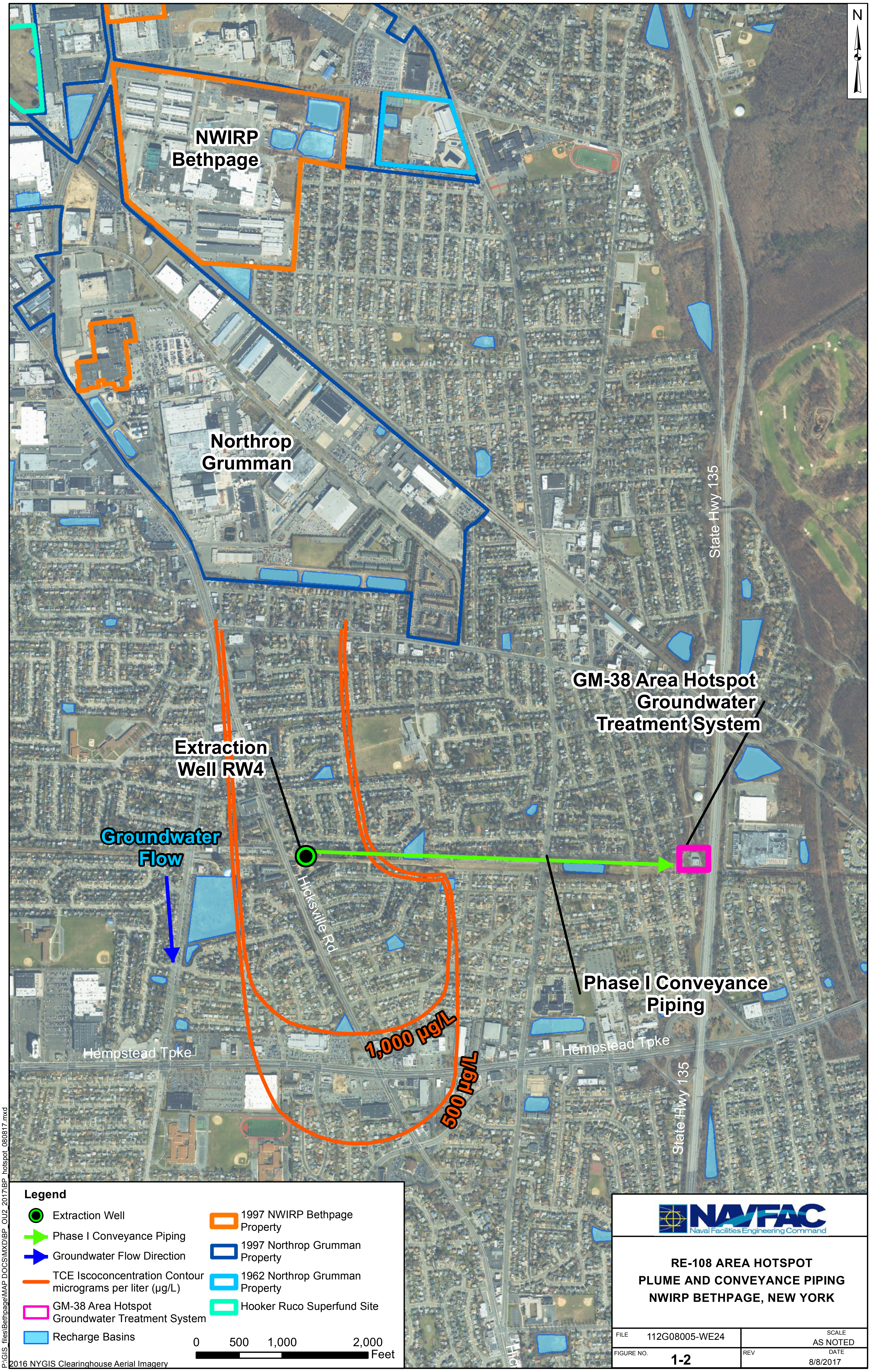
GENERAL LOCATION MAP
NWIRP BETHPAGE, NEW YORK

FILE	112G07529	SCALE	AS NOTED
FIGURE NO.	1-1	REV	DATE 9/20/2016

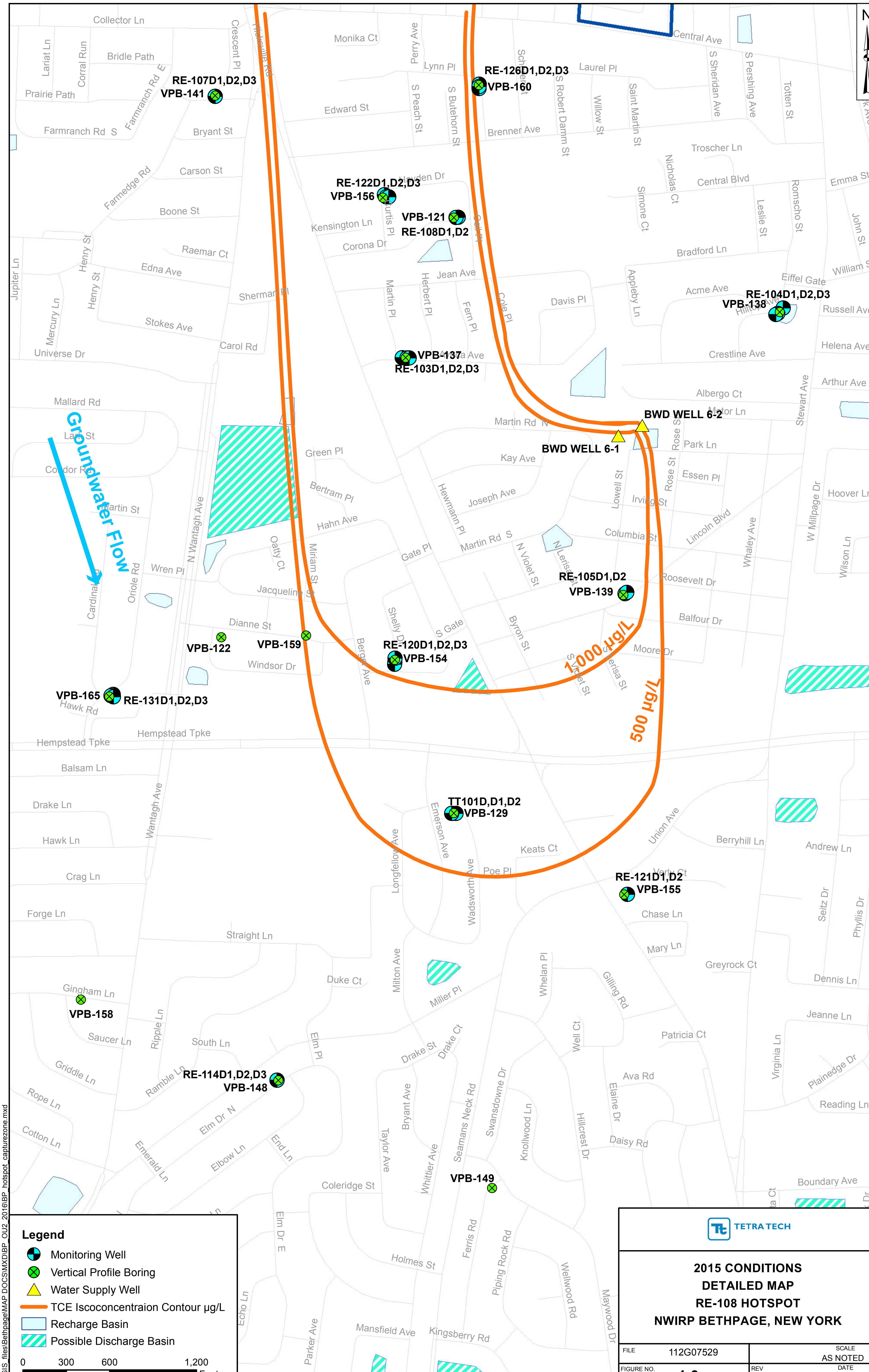
P:GIS files/Bethpage/MapDocs/2013/RI add/BP longisland-new 8x11.mxd 040214 MMC



NAVFAC Naval Facilities Engineering Command

RE-108 AREA HOTSPOT
PLUME AND CONVEYANCE PIPING
NWIRP BETHPAGE, NEW YORK

FILE 112G08005-WE24	SCALE AS NOTED
FIGURE NO. 1-2	REV	DATE 8/8/2017



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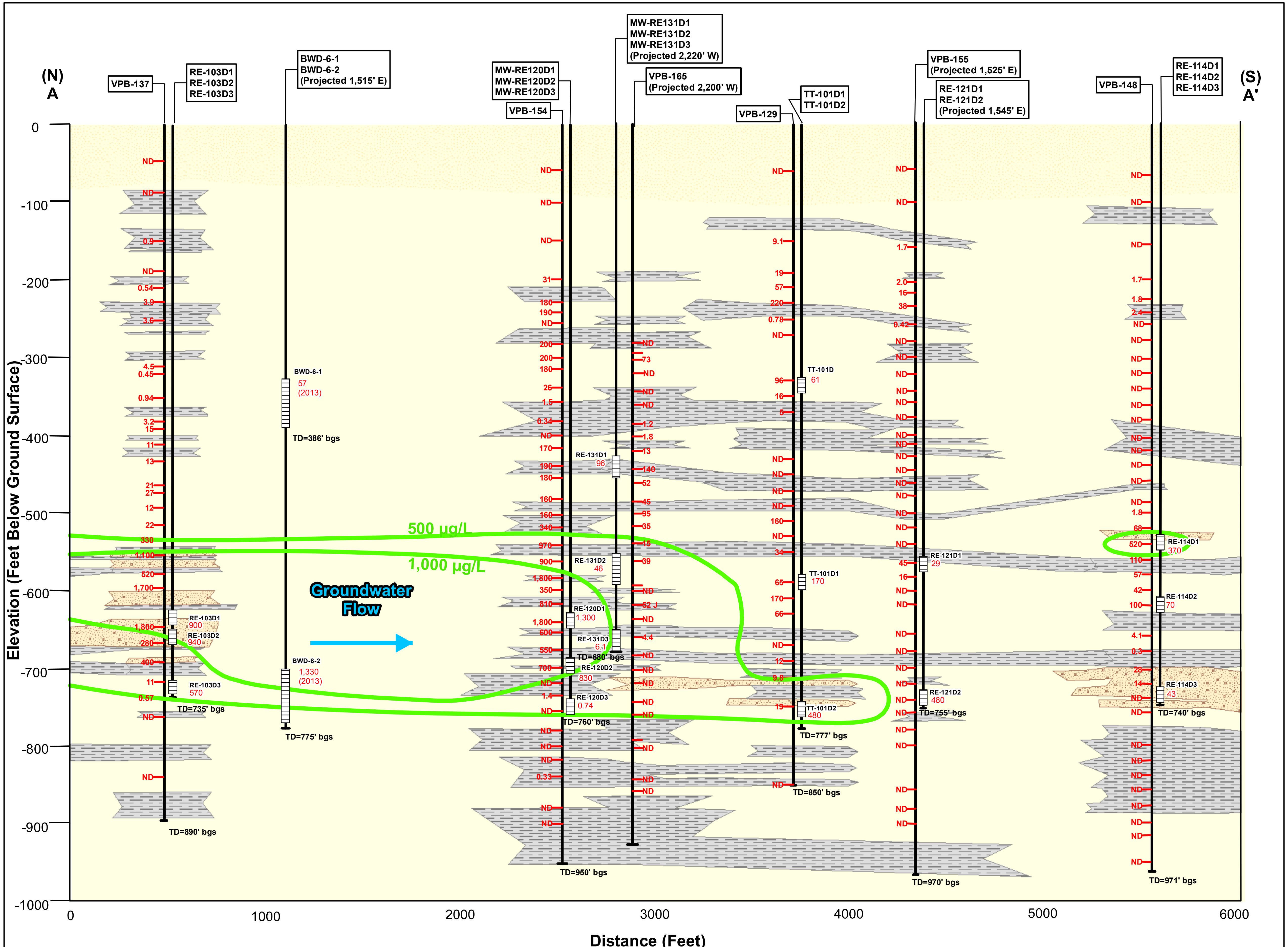
2015 CONDITIONS
DETAILED MAP
RE-108 HOTSPOT
NWIRP BETHPAGE, NEW YORK

FILE	112G07529	SCALE	AS NOTED
FIGURE NO.	1-3	REV	DATE 9/22/2016



Note: Monitoring well data March and December 2015 and June 2016 Sampling Event

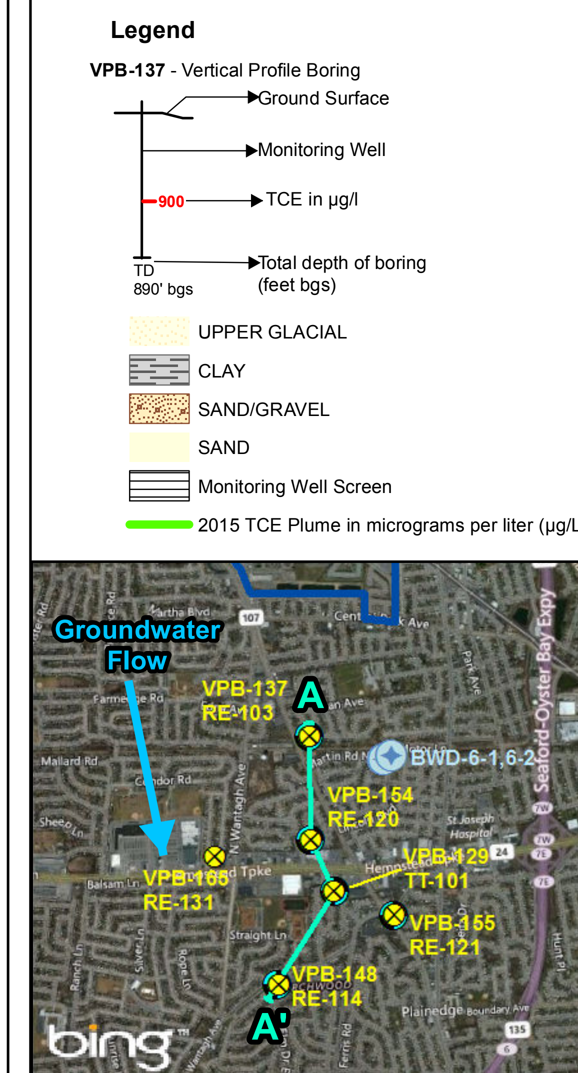


FIGURE 1-4
CROSS SECTION A-A'
2015 CONDITIONS
RE-108 HOTSPOT
NWIRP BETHPAGE, NEW YORK

TETRA TECH | 9/22/2016

Bing Maps aerial:
Aerial photograph from ESRI Bing Maps map service
(© 2010 Microsoft Corporation and its data suppliers).

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2.0 Design Criteria

This section presents background information for the project and summarizes the technical parameters upon which the remedial design is based.

2.1 Project Description

This project will consist of extracting VOC-impacted groundwater from the RE108 Area Hotspot, transferring it to the GM38 GWTS for treatment, followed by discharge in the area of the GM38 Area Hotspot Treatment System. Based on this report, the Navy will initiate property access agreements with the property owners of the well and the utility corridor. The property owners are believed to consist of Long Island Railroad (LIRR) and Town of Oyster Bay (TOB), and potentially one private residence.

Recovery well RW4 will be approximately 650 feet deep and 12 inches diameter. An underground pipeline will be constructed to connect RW4 to and the GM38 GWTS. The new pipeline (8-inch HDPE within 12-inch secondary containment pipe) will be routed through LIRR property, under Stewart Avenue (TOB), and around a recharge basin (TOB). The new pipeline will be connected to the GM38 GWTS via existing unused 6-inch underground piping with secondary containment from recovery well RW3.

Due to a long distance (approximately 1 mile) from RW4 to the GM38 GWTS, RW4 will be connected to a power source via a local power drop and controlled from the GM38 GWTS via a remote communication link.

The influent from the new recovery well RW4 will have higher concentrations of VOCs compared to the current influent conditions at the GM38 GWTS, and as a result, the VOCs loading to the GM38 GWTS will increase. The treatment components at the GM38 GWTS was evaluated and it was determined that the additional VOC loading from RW4 can be effectively treated. The primary change will be more frequent replacement of the liquid- and vapor-phase granular activated carbon.

2.2 Site Characteristics

Except for the LIRR and TOB utility corridor, the area between the new recovery well RW4 and the existing GM38 GWTS is a densely-built residential area. This congestion effectively limits routing of the new pipeline (approximately 3,800 feet distance) to an area through the LIRR and TOB utility corridor. The corridor is generally flat and the surface consists primarily of lightly vegetated soil, a gravel road, and wood lands. The conveyance piping will also need to cross Stewart Avenue.

Utilities that have been identified along this route consist of:

- High voltage overhead (two) and underground (one or two) electrical lines (138 and 69 kilovolts) running the entire length of the utility corridor. Underground structures associated with power transmission infrastructure also exist within the utility corridor. The new pipeline routing will need to consider this infrastructure. Public Services Electric Group (PSEG) review for the use of the utility corridor will be needed.
- A natural gas line appears to run along the northern edge of the corridor along the entire length. Except along Stewart Avenue, other underground utilities including natural gas, water, and storm and sanitary sewer lines were not identified in preliminary site surveys.
- The pipeline will have to cross Stewart Avenue, which likely has underground utilities (gas, electrical, potable water, and sewer). Crossing of Stewart Avenue should be via horizontal drilling or other approaches that minimize interference to the flow of traffic on this road.
- TOB recharge basin #495 is installed within the LIRR and TOB corridor. The pipeline should pass along the top edge of the basin. Removal of trees should be minimized.

3.0 Basis of Design

This section presents an analysis of the components of the Phase I RE108 Area Hotspot System. Specific design elements addressed in this section consist of:

- Recovery Well RW4
- RW4 Pump and Conveyance Piping
- GM38 GWTS Evaluation
- Power and Controls

3.1 Recovery Well RW4

Recovery Well RW4 will be located in the approximate center of the RE108 Area Hotspot. The RE108 Area Hotspot originates south of the Northrop Grumman ONCT system and flows to the south southeast (approximately 177 degrees from north). The RE108 Area Hot Spot is approximately 1,600 feet wide near and north of the LIRR and TOB utility corridor and widens to approximately 2,700 south of this corridor. The shape of the southern portion of the plume is believed to have resulted from the seasonal operation of a high volume and deep public water supply operating between Hicksville Road and Stewart Avenue. The seasonal operation of the deep public water supply is also suspected to have caused the plume thicken and move deeper.

The location of RW4 near the utility corridor, approximately 200 feet east of Hicksville Road provides an optimum location, as follow:

- Horizontally, the plume width is relatively thin compared to areas further south.
- Vertically, the plume is thinner and shallower at this location.
- The higher concentrations of VOCs are near or north (upgradient) of this location.
- The utility corridor represents a pathway to convey extracted water from RW4 to the GM38 GWTS.
- Well construction within the utility corridor is restricted due to the drill rig mast height (approximately 48 feet) and the proximity of the existing overhead high tension power lines.

<u>Design Assumptions</u>

The following assumptions (based on previous investigations and available geologic/ hydrogeologic reports) are used in development of the groundwater extraction system design of RW4:

- The width of the greater than approximately 1,000 ug/l VOC plume is projected to be approximately 1,600 feet at and upgradient of RE-103D1 and -103D2, and -103D3 (RE-103 wells).
- The greater than 1,000 ug/l VOC plume thickness is typically approximately 100 feet and occurs across the 550 to 650 feet depth range at the RE-103 wells.
- The transmissivity of the Magothy aquifer in the 500- to 800-foot depth range is approximately 28,500 feet^2/day, (or a K value of 95 feet/day) (Resolution, 2016). This rate is the highest transmissivity value from several Navy aquifer tests performed in the area, thus it provides a conservative value for design purposes. During startup and operation, the pumping rate at RW4 may need to be reduced to avoid over pumping minimally impacted groundwater.
- The average groundwater flow system thickness in the area is approximately 900 feet, including a 50-foot thickness for the upper glacial aquifer and 850-foot thickness for the Magothy aquifer.
- Confining units serve to limit the vertical movement of groundwater as evidenced by discrete zones of high contaminant distributions and pumping test results; i.e., the drawdown/capture effects of pumping from discrete depths within the Magothy aquifer will be focused primarily within the depth interval of the pumped well.
- The average groundwater flow gradient across the area is 0.0016, with a flow direction to the south southeast (Resolution, 2016).
- The goal of the groundwater extraction system design is to minimize further downgradient migration of the greater than 1,000 ug/l portion of the RE108 Area Hotspot. As practical, the system will also target the 500 ug/l portion of the RE108 Area Hotspot.
- The extraction system is expected to decrease the flow of VOCs to BWD Plant 6 and further south.
- The portion of the RE108 Area Hotspot plume further downgradient from the RW4 well will be addressed separately as part of a future Phase II extraction system design.

Design Approach

The following outlines the general approach that will be taken in designing the groundwater extraction system:

- The extraction well will be located near Avoca Avenue to provide capture of the high concentration VOC plume
- During operation and based on capture zone analysis, the extraction rate may be modified to provide a maximum capture zone width of 1,600 feet.

- Plume containment calculations, extraction well capture zone calculations, extraction well pumping capacity calculations, and screen entrance velocity calculations are performed as part of this design.
- The 500- to 700-foot depth range will be targeted for capture for the new extraction well(s), to contain/capture the greater than 1,000 ug/l VOC plume near Avoca Avenue.
- The final screened interval(s) of the extraction well will be within the 550- to 650-foot depth range and may be modified based on pending pilot boring data (lithology and sampling results).
- The extraction well pumping rate will be capped at no more than ½ the estimated long-term sustainable pumping rates (assuming steady-state drawdown conditions are reached within 30 days), to ensure that the well has adequate flexibility for pumping rate adjustment based on observed operating conditions.
- The well will consist of a stainless screen with a carbon steel riser. Appendix B provides the well diagram for GM38 RW3, which will serve as a basis for the constructing RW4. The screen length and depth, and gravel pack details will be finalized based on the results of a pilot boring to be installed at the location.

3.2 Pump and Conveyance Piping

A pump and conveyance piping will be used to extract and transport groundwater from RW4 to the GM38 GWTS. For long-term corrosion control, the piping will be high density polyethylene (HDPE) rated for maximum system pressure, including surges. Because of the relatively high concentration of VOCs in the extracted groundwater and the routing through publically accessible areas, secondary containment piping will also be used.

Sizing

The submersible well pump is based on the RW4 design flow (400 gpm) and the discharge pressure. The pump's discharge pressure considers the elevation difference between the water level in the RW4 under pumping conditions and the height of the equalization tank discharge piping plus the friction losses in the entire pipeline system between the well pump discharge and the GM38 GWTS equalization tank discharge piping. The pump capacity shall also allow for a certain additional flow and pressure capacity as a safety factor.

The diameter of the new pipeline between RW4 and the GM38 GWTS was selected to keep friction losses to a reasonably low levels to minimize a power consumption. At the same time the new pipeline diameter will be as small as possible to minimize the amount of materials and therefore the cost of the new pipeline. Based on these considerations, the pipeline from RW4 will be 8 inches and connect to the existing 6-

inch piping between recovery well RW3 and the GM38 GWTS. Recovery well RW3 is not being operated at this time. Connections between the new and old piping will be made adjacent to the RW3 vault. The existing well, pump, and piping to the point of the new connection will remain in place, but will be blanked off.

Hydraulic calculations are presented in Appendix C. A variable frequency drive will be used for the RW4 well pump and thus the spreadsheet also includes calculations that factor the speed of the RW4 well pump at the design flowrate.

The static depth to groundwater in the area of RW4 is approximately 50 feet below the grade surface (bgs). The estimated drawdown in the well is approximately 11 feet. To address potential long-term degradation of the well capacity, the design drawdown is assumed to be 50 feet. The height of equalization tank in the GM38 GWTS is 15 feet above grade level. Therefore, the elevation difference between the water level in the RW4 under pumping conditions and the height of the equalization tank discharge piping will be 115 feet.

The pipeline system will consist of several sections with different lengths and diameters as shown in Table 3-1. Hazen-Williams equation was used to calculate friction losses. Table 3-1 summarizes the calculations. Table 3-1 also includes the values of coefficient C used in calculations for different piping materials. The calculation results for the selected pipeline system indicate that at the design flow of 400 gpm the entire pipeline system friction losses will be 29 feet and thus a total pump discharge pressure will be approximately 144 feet.

A typical pump curve for a 25 horsepower submersible pump is provided in Appendix C. The maximum flowrate for this pump would be approximately 500 gpm. The anticipated final flowrate for this pump will be approximately 250 to 500 gpm. Due to uncertainty with the exact flowrate needed to effectively capture the northern portion of the RE108 Area Hotspot plume, a variable frequency drive pump will be used.

3.3 GM38 GWTS Evaluation

Projected Groundwater Quality

Recovery well RW4 will be located to optimize VOC removal in the RE108 Area Hotspot as shown on Figures 3-1 and 3-2. The expected screen interval for the new recovery well RW4 is from 550 to 650 feet below grade surface. To estimate the initial quality of groundwater entering the GM38 GWTS from RW4, recent data from three monitoring wells located up-gradient of RW4 and screened in approximately the same depth interval will be used (RE-103D1, RE-108D2, and RE-122D2) (Figures 3-1 and 3-2). The analytical data for these monitoring wells and the projected influent conditions for RW4 are presented in Table 3-2. Based on this calculation, the total expected VOCs in the

RW4 influent will be 3,119 ug/L. The majority of the total VOCs (3,067 ug/L or over 98 percent) is represented by TCE.

The current GM38 GWTS flow rate is approximately 1,000 gpm and comes from recovery well RW1. Historically, RW1 operated at a rate of 700 to 800 gpm. When RW4 is connected to the GM38 GWTS (at 400 gpm), the flow from RW1 will be reduced to approximately 600 gpm so that the overall GM38 GWTS flow rate would remain the same. The associated calculations with this mixture are reflected in Table 3-3. The projected total VOCs concentration at the GM38 GWTS influent is 1,337 ug/L. The majority of VOCs is represented by TCE (1,293 ug/L). This expected VOCs load is approximately 1.7 times higher than higher GWTS influent quality near startup (March 2010).

Treatment Train Evaluation

The treatment system at GM38 GWTS consists of air stripping, bag filtration, and liquid-phase granular activated carbon polishing (GAC). The VOCs are transferred from liquid phase to vapor phase in the air stripping process. The air stripper off gas is treated using vapor-phase carbon and permanganate-based resin. The Process Flow Diagram is presented on Drawing P-1. Potential effects of the operation of RW4 on the GWTS are evaluated in this section.

For this evaluation, data from operation of the GM38 GWTS in 2011 are also considered. In 2011, the GM38 Area Hotspot groundwater contained significantly higher concentrations of VOCs than under current (2017) conditions.

RW1 Capture Zone Consideration

Currently RW1 is operating at 1,000 gpm. Historically, RW1 was operated at 700 to 800 GPM. Operation of RW4 at 400 gpm (200 to 500 gpm) would result in the flow rate of RW1 being reduced to approximately 600 gpm (500 to 800 gpm), which would reduce its capture zone. This decreased flow rate is not anticipated to significantly effect the RW1 capture zone, but may extend the time required for RW1 to operate.

Air Stripping Process

Because the groundwater flow rate to the air stripper is not expected to change, the air stripper removal efficiency will also remain the same. Therefore, the expected air stripper VOCs effluent can be readily determined by using the projected GM38 GTWS influent conditions and using measured GM38 GWTS air stripper removal efficiency. If needed, the air stripper efficiency could be improved by using excess capacity on with the existing air stripper blowers (i.e., increasing the air-to-water ratio).

TCE under current conditions and with projected loading from RW4 will continue to drive treatment requirements for water and air discharges. The air stripper typical removal efficiency for TCE (based on historical operational data) is 98.8 percent (see Table 3-4). The projected GM38 GWTS air stripper influent water TCE concentration is 1,293 ug/L. Based on 98.8 percent removal efficiency, the projected GM38 GWTS air stripper effluent water TCE concentration is 15.6 ug/L. The concentration of the remaining VOCs in the air stripper effluent is expected to be below the discharge limit of 2 or 5 µg/L.

To control emissions from the equalization tank, a vent line is connected to the suction side of the air stripping blower. To improve performance of the air stripping tower, a 1,000-pound vapor-phase GAC unit was installed in 2011. This unit allowed the effluent water from air stripping tower to decrease from approximately 6 to 8 µg/L to 3 to 4 µg/L. This unit has been in operation for 6 years and is to be replaced as part of this project.

Bag Filtration Process

Bag filters are used to protect the liquid-phase GAC from excessive backwashing. The operation of RW4 is not expected to effect this operation. The concentration of metals in the RE108 Area Hotspot groundwater, such as iron, is similar to those in the GM38 Area Hotspot groundwater.

Liquid-Phase GAC Process

Currently the aqueous effluent of the air stripper is directed to three liquid-phase GAC vessels (8,000 pounds of GAC each) operating in parallel for final polishing before the discharge. The additional well RW4 will increase the VOCs load (primarily as TCE) at the liquid-phase GAC treatment system influent.

Under current conditions, the air stripping process achieves the discharge goals for all of the VOCs and the liquid-phase GAC units are used for polishing and to protect against upsets in the air stripping system. The GAC is changed out every 15 to 19 months based on TCE break through.

The projected GM38 GWTS air stripper effluent water TCE concentration will be 15.6 ug/L, which means that more frequent monitoring and GAC change outs will be required. The GAC adsorption capacity for organic compounds increases with an increase in a contaminant concentration. Therefore, the future liquid-phase GAC consumption will increase but not as much as the influent TCE concentration.

To perform liquid-phase GAC consumption calculations, a mathematical relationship that was developed to describe the equilibrium distribution of a solute between the dissolved (liquid) and adsorbed (solid) phases is used (Adsorption Design Guide, United States Army Corps of Engineers [USACE], 2001). These relationships help interpret the adsorption data obtained during constant temperature tests, referred to as adsorption isotherms. The Fruendlich Isotherm Equation is the most widely used in the industry and is used here to evaluate the projected liquid-phase GAC consumption:

$$\frac{x}{m} = K \times C^{\frac{1}{n}} \qquad \text{Equation 3-1}$$

x	=	amount of solute adsorbed (milligram)
m	=	mass of adsorbent (gram)
C	=	concentration of solute remaining in solution at equilibrium (milligram per liter)
K, n	=	empirical constants specific for each solute, carbon type, and temperature. For TCE and FILTRASORB 300 at room temperature: $K = 28 \; and \; \frac{1}{n} = 0.62$ (Adsorption Design Guide, USACE, 2001)

Using Equation 3-1 with *K* and *n* values as specified above and the projected liquid-phase GAC influent TCE concentration, the projected liquid-phase GAC consumption is calculated and compared with the GAC consumption with GM38 GWTS data from December 2011. These calculations are presented in Table 3-4.

The results of this calculation suggest that the projected liquid-phase GAC consumption will increase to approximately 1.6 times that in December 2011, while the projected TCE load will increase to approximately 3.4 times that in December 2011. The estimated time for TCE to breakthrough will decrease from approximately 15 months to 9 months.

Vapor-Phase GAC Process

Currently the vapor-phase effluent of the air stripper is directed to two vapor-phase GAC vessels (20,000 pounds of GAC each) operating in series for removal of VOCs (TCE only) from the air stream before the discharge to the atmosphere. The additional well RW4 will increase the VOC load (primarily as TCE) to the vapor-phase GAC treatment system influent.

Vapor-phase GAC treatment is required to achieve the discharge goals for TCE in the off gas. The GAC units are currently changed out every 21 to 23 months, when substantial breakout of TCE occurs in the first vapor unit, (i.e., the second vapor-phase GAC unit is not saturated).

With RW4 in operation, the projected GM38 GWTS air stripper off gas concentration will be approximately 23,000 micrograms per cubic meter or 0.65 pound per hour of TCE (see Table 3-5). For comparison, the vapor-phase GAC TCE loading in December 2011 was 0.18 pound per hour.

Similar to the liquid-phase GAC, the vapor-phase GAC adsorption capacity for organic compounds increases with an increase in a contaminant concentration. Vapor-phase GAC consumption calculations are similar to liquid-phase GAC described above, using Equation 3-1 of the Adsorption Design Guide (USACE, 2001). The input data for this calculation at a temperature of 140 Fahrenheit (F) were taken from Figure III provided in Activated Carbon Adsorption for Treatment of VOC Emissions (Shepherd, 2001). The results of this calculation are presented in Table 3-5.

Using Equation 3-1 with *K* and *n* values as presented in Table 3-5, the projected vapor-phase TCE influent concentration, air flow, temperature, pressure, and the vapor-phase GAC mass in the system, the projected vapor-phase GAC consumption is calculated and compared with the vapor-phase GAC consumption in December 2011. These calculations are presented on Table 3-5.

The results of these calculations indicate that the projected vapor-phase GAC consumption will increase to approximately 2.4 times to that of December 2011, while the projected TCE load will increase to approximately 3.4 times to that of December 2011. The calculated time for TCE to breakthrough will decrease from approximately 38 months to 14 months.

3.4 Power and Controls

This section summarizes the power and controls for this project (See Appendix D for literature).

Power

RW4 will be located approximately 1 mile from the GM38 GWTS, therefore direct power and control of RW4 from the GM38 facility is not feasible. As a result, the power for the RW4 well pump (25 HP, 3-phase, and 460 volts) will be by a local power drop from one of the power lines located along Hicksville Road (Route 107). The local utility company (PSEG) will need to install a meter and local service for RW4. The variable frequency drive and electrical and control components for the RW4 will be located in an small above-ground enclosure located approximately 10 to 20 feet from RW4.

Controls

Control features associated with RW4 are anticipated to be nearly identical to RW1 and RW3. Programmable logic controls (PLCs) will be located at RW4 and GM38 GWTS and linked via radio transmission. The PLC at GM38 GWTS will output signals to mimic the current information from RW3. The existing GM38 GWTS control system will be reprogrammed to reflect the operation of RW4, instead of RW3. The existing operation and maintenance contractor will work with the construction constructor to coordinate this communication.

RW4 will also have a high level alarm in the RW4 vault. This alarm will shut down the RW4 pump and signal a local alarm within the RW4 electrical panel. The existing controls at GM38 GWTS will be modified. In well controls will consist of a level probe (in a piezometer within the boring) to ensure the water level in the well does not drop below the pump.

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TABLE 3-1
PIPE LINE PRESSURE DROP CALCULATIONS
PHASE I - RE108 AREA HOTSPOT SYSTEM BASIS OF DESIGN REPORT

Pipeline section	Pipe internal diameter (inches)	Pipe nominal size (inches)	Pipe material and schedule	Hazen-Williams equation coefficient (C)	Pipe length (feet)	Fluid velocity at design flow (feet per second)	Pressure Drop (feet)
RW4 pump discharge to pump vault	6.07	6	New pipe, stainless steel, SCH 40 (530 psig pressure rating)	120	150	4.4	2.2
RW4 vault to existing RW-3 vault	7.63	8	New pipeline, HDPE, SDR 13.5 (160 pound pressure rating)	140	3800	2.8	14.3
Existing RW3 vault to GWTS entrance	6.07	6	Existing pipeline, HDPE, SDR 13.5 (160 pound pressure rating)	140	800	4.4	11.1
GWTS internal piping	7.63	8	Existing piping, HDPE, SDR 13.5 (160 pound pressure rating)	140	75	2.8	0.3
Fittings	6.07	6	Friction losses assumed (conservatuvely) as equivalent to 100 feet of 6-inch steel piping	120	100	4.4	1.1
						SUM (feet - water column)	29

DP/foot = 4.52 x Q^1.852 /(C^1.852 x D^4.8704)

HDPE - High Density Polythylene

DP in pounds per square foot.

Q in gallons per minute.

D in inches.

psig - pounds per square inch.

GWTS - Groundwater Treatment System

TABLE 3-2
RW4 WATER QUALITY FOR VOCS
PHASE I - RE108 AREA HOTSPOT SYSTEM BASIS OF DESIGN REPORT

Well Number	RE-103D1				RE-108D2				RE-122D2			RW4 Projected
Well Screen Interval (feet below ground surface)	625 to 640				630 to 650				590 to 610			550 to 650
Date	Mar-15	Jun-15	Dec-16	Average	Mar-15	Jun-15	Dec-16	Average	Mar-15	Dec-16	Average	Future
Tetrachloroethene	4.6	4	4.1	4.2	2.2	2.2	2.5	2.3	2.7	3.4	3.1	3.2
Trichloroethene	900	810	940	883	3,300	3,900	2,900	3,367	4,600	5,300	4,950	3,067
cis-1,2-Dichloroethene	3.9	3	3.4	3.4	8.4	8.1	7.3	7.9	6	6.6	6.3	5.9
trans-1,2-Dichloroethene	0.5	0.5	0.5	0.5	0.5	0.5	2.5	1.2	0.5	2	1.3	1.0
1,1-Dichloroethene	6.8	4.2	6.6	5.9	5.3	6.6	5.4	5.8	8.7	7.4	8.1	6.6
Vinyl Chloride	0.5	0.5	1	0.7	0.5	0.5	5	2.0	0.5	4	2.3	1.6
1,1,1-Trichloroethane	0.53	0.38	0.42	0.4	1	0.98	2.5	1.5	0.71	2	1.4	1.1
Freon 113	16	11	13	13.3	3.1	6.8	4.9	4.9	31	15	31.0	16.4
1,4-Dioxane	19	16	17	17.3	9.2	6.1	5.3	6.9	14	12	13.0	12.4
1,1-Dichloroethane	1.1	0.64	ND	0.9	4.4	4.6	4.3	4.4	1.7	2	1.9	2.4
1,1,2-Trichloroethane	0.77	0.51	ND	0.6	1.1	1.8	2.5	1.8	2.8	2.5	2.7	1.7
Total VOCs	954	851	986	931	3,336	3,938	2,942	3,405	4,669	5,357	5,021	3,119

Units are micrograms per liter.
ND - Not detected.
VOC - Volatile organic compound.

TABLE 3-3
PROJECTED GM38 GWTS INFLUENT
PHASE I - RE108 AREA HOTSPOT SYSTEM BASIS OF DESIGN REPORT

Parameter	RW1 (March 2017)	RW4	GWTS Projected Influent	GWTS (March 2010)
Flow (gallons per minute)	600	400	1,000	1,000
Volatile Organic Compound (micrograms per liter)				
Tetrachloroethene	24	3.2	15.7	109
Trichloroethene	110	3,067	1,293	584
cis-1,2-Dichloroethene	8	5.9	7.2	95
trans-1,2-Dichloroethene	ND	1.0	1.0	NA
1,1-Dichloroethene	1.4	6.6	3.5	NA
Vinyl Chloride	0.41	1.6	0.9	18
1,1,1-Trichloroethane	0.97	1.1	1.1	NA
Freon 113	ND	16.4	6.6	NA
1,4-Dioxane	2.5	12.4	5.0	NA
1,1-Dichloroethane	2	2.4	2.2	NA
1,1,2-Trichloroethane	ND	1.7	1.7	NA
Total VOCs	149	3,119	1,337	806

ND - Not detected.
NA - Not available.
VOC - Volatile organic compound.
GWTS - Groundwater Treatment System.

TABLE 3-4
LIQUID PHASE GRANULAR ACTIVATED CARBON EVALUATION
PHASE I - RE108 AREA HOTSPOT SYSTEM BASIS OF DESIGN REPORT

Parameter	Projected Conditons with RW4	GM38 GWTS (Dec 2011)
Flow rate (gallons per minute)	1,000	1,000
Air Stripper TCE Influent (microgram per liter)	1,293	377
Air Stripper TCE Effluent (microgram per liter)	15.4	4.5
TCE Removal Efficiency (percent)	98.8%	98.8%
LGAC TCE Influent (microgram per liter)	15.5	4.5
LGAC TCE loading (pound per week)	1.3	0.4
K (TCE Fruendlich isotherm)	28.0	28.0
1/N (TCE Fruendlich isotherm)	0.62	0.62
LGAC adsorption (pound per 1,000 pound)	2.1	1.0
LGAC consumption (pound per week)	616	386
LGAC media at GM38 GWTS (pound)	24,000	24,000
LGAC time to breakthrough (month)	9	14

TCE - Trichloroethene.
LGAC - Liquid phase granular activated carbon
Isotherms are based on Filtrasorb 300.
GWTS - Groundwater Treatment System.

TABLE 3-5
VAPOR PHASE GRANULAR ACTIVATED CARBON EVALUATION
PHASE I - RE108 AREA HOTSPOT SYSTEM BASIS OF DESIGN REPORT

Parameter	Projected Conditons with RW4	GM38 GWTS (Dec 2011)
Groundwater flow rate (gallons per minute)	1,000	1,000
Air flow rate (cubic feet per minute)	7,400	7,400
Air temperature (effluent stack, F)	120	120
TCE molar volume at stack conditions	26.43	26.43
Air stripper aqueous TCE Influent	1,293	377
Air Stripper TCE removal efficiency	98.8%	98.8%
VGAC Inlet TCE Concentration (part per million)	133	38.7
VGAC Inlet TCE Concentration (microgram/meter^3)	23105	6739
VGAC TCE loading (pound per hour)	0.647	0.189
K (TCE Freundlich isotherm coefficient)	7.0	7.0
1/N (TCE Freundlich isotherm coefficient)	0.17	0.2
VGAC adsorption (pound per 1,000 pound)	15.8	12.9
VGAC consumption (pound per week)	687	246
VGAC media at GM38 GWTS (pound)	40,000	40,000
VGAC time to breakthrough (months)	14	38

TCE - Trichloroethene.
VGAC - Vapor phase granular activated carbon
Isotherms are based on Carbotrol at 140 F.
GWTS - Groundwater Treatment System.

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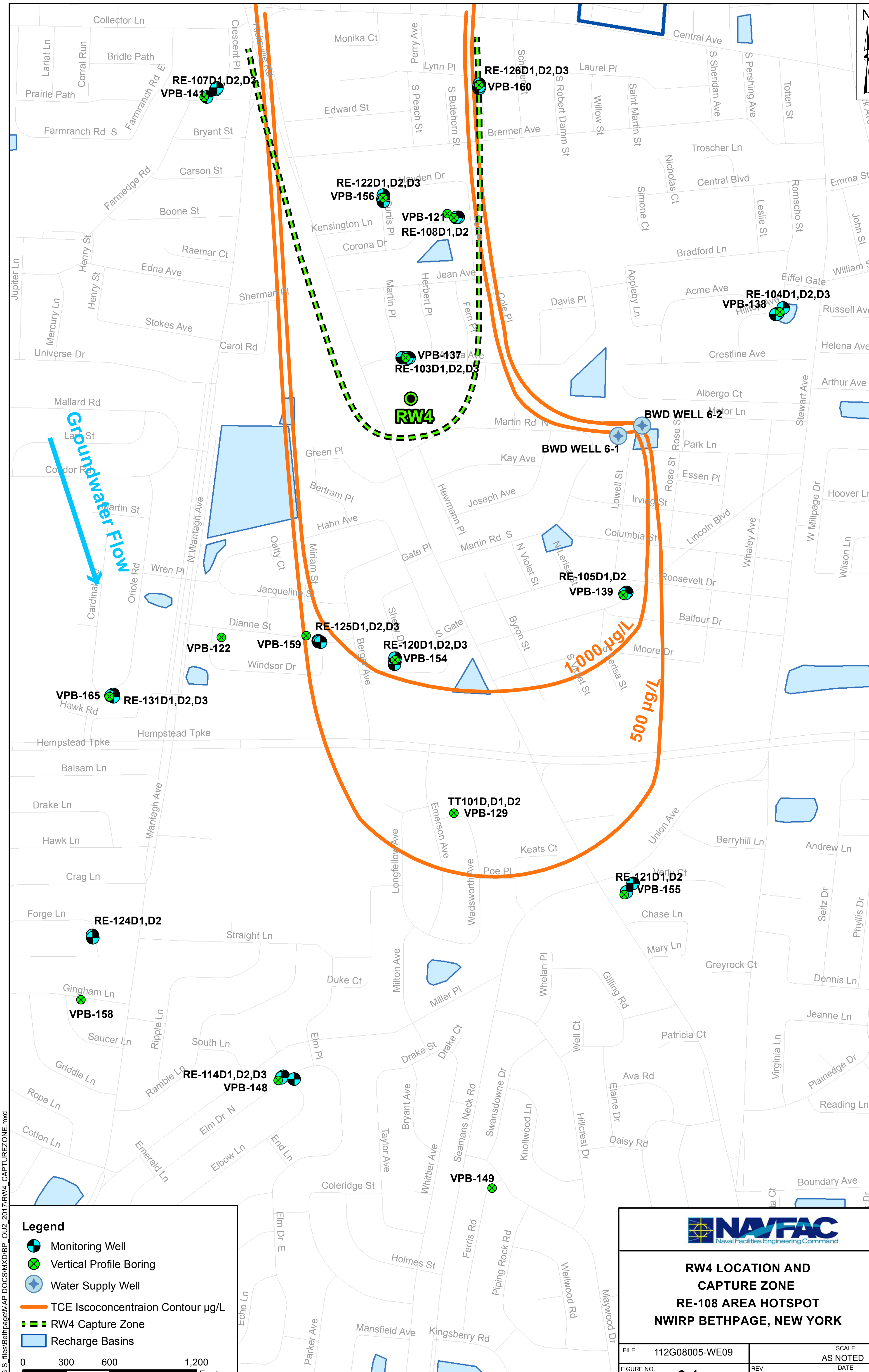
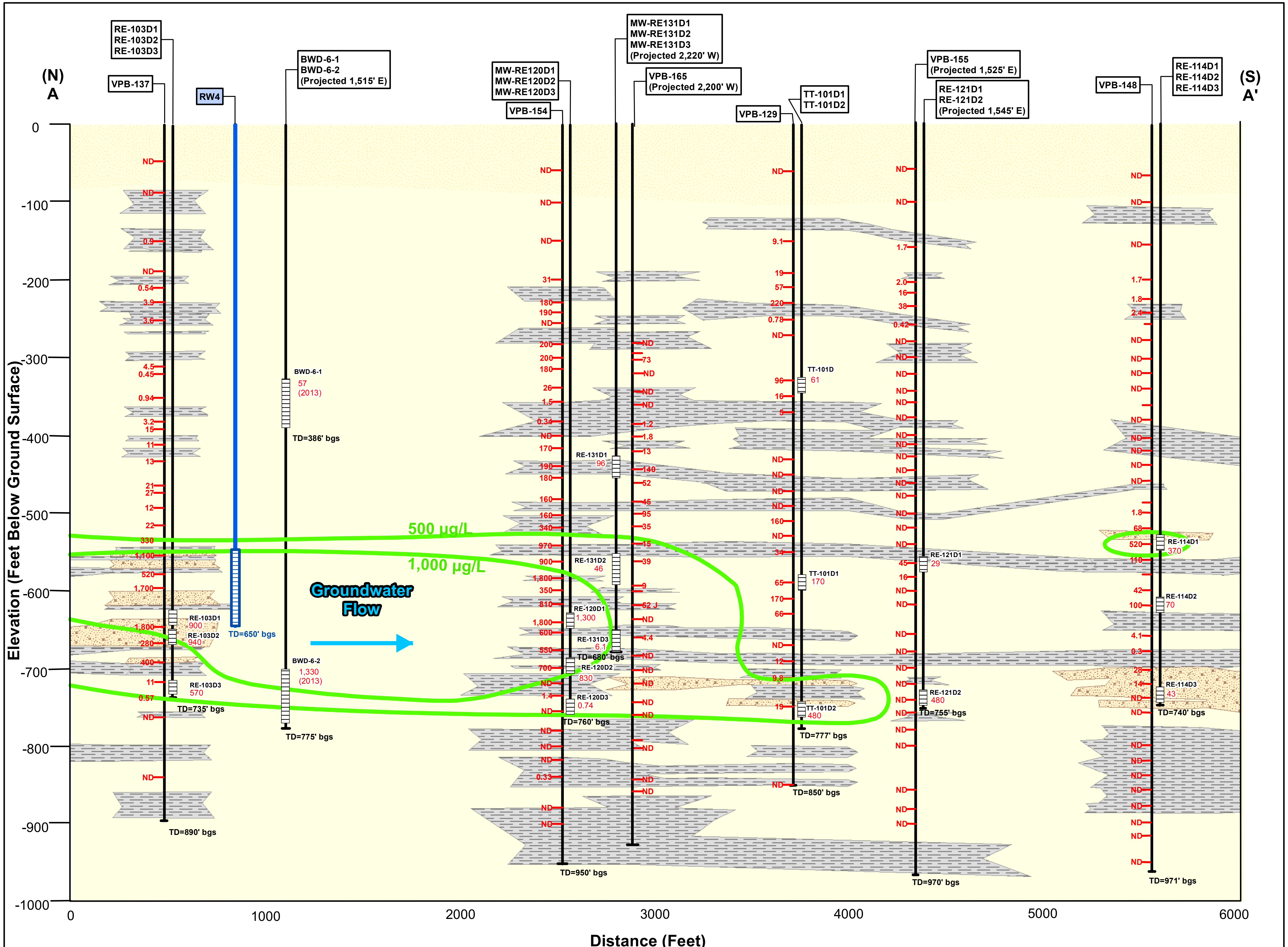


NAVFAC Naval Facilities Engineering Command

RW4 LOCATION AND CAPTURE ZONE RE-108 AREA HOTSPOT NWIRP BETHPAGE, NEW YORK

FILE 112G08005-WE09	SCALE AS NOTED
FIGURE NO. 3-1	REV	DATE 8/14/2017



Note: Monitoring well data March and December 2015 and June 2016 Sampling Event

Legend

VPB-137 - Vertical Profile Boring

- Ground Surface
- Monitoring Well
- 900 — TCE in µg/l
- TD 890' bgs — Total depth of boring (feet bgs)
- UPPER GLACIAL
- CLAY
- SAND/GRAVEL
- SAND
- Monitoring Well Screen
- 2015 TCE Plume in micrograms per liter (µg/L)

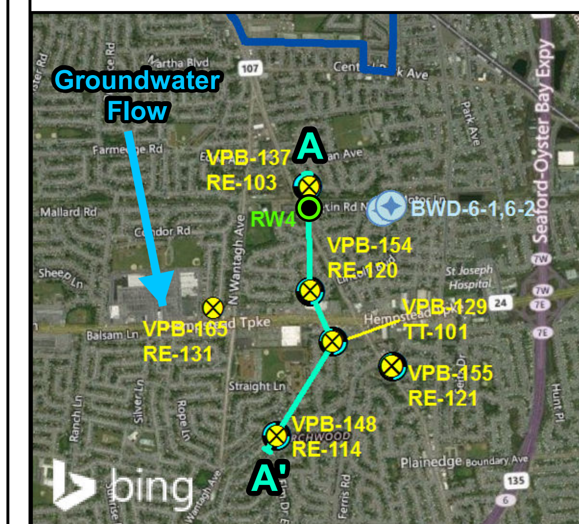


FIGURE 3-2
CROSS SECTION A-A'
RW4 CROSS SECTION
RE-108 HOTSPOT
NWIRP BETHPAGE, NEW YORK

NAVFAC Naval Facilities Engineering Command

8/14/2017

Bing Maps aerial:
Aerial photograph from ESRI Bing Maps map service
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APPENDIX A

ANALYTICAL BACKUP

Table A-1
RE-108 Hotspot Groundwater Data
2014 and 2015 (microgram per liter)
Page 1 of 5

Well ID	TT-101D1								TT-101D2							
Well Screen Interval (feet below ground surface)	570 - 590								740 - 760							
Date	Mar-14	Jun-14	Sep-14	Dec-14	Mar-15	Jun-15	Sep-15	Dec-15	Mar-14	Jun-14	Sep-14	Dec-14	Mar-15	Jun-15	Sep-15	Dec-15
Tetrachloroethene	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.53	0.47	0.82	0.84	0.5
Trichloroethene	170	165	160	160	170	180	170	200	250	405	560	520	480	620	640	510
cis-1,2-Dichloroethene	2		2	1.8	1.8	1.8	0.92	1.9	1.6		2.2	1.9	2	2	1	1.7
trans-1,2-Dichloroethene	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5
1,2-Dichloroethene	2		2	1.8	1.8	1.8	0.5	0.5	1.6		2.2	1.9	2	2	0.5	0.5
1,1-Dichloroethene	4.3		4.7	5	4.9	4.8	4	4.6	2.1		5.7	4.6	4	4.8	4.7	3.6
Vinyl Chloride	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5
1,1,1-Trichloroethane	0.68		0.62	0.5	0.68	0.5	0.5	0.5	0.5		0.49	0.42	0.44	0.5	0.5	0.5
1,1-Dichloroethane	0.63		0.74	0.78	0.71	0.86	0.5	0.5	0.5		0.92	0.76	0.75	0.79	0.5	0.5
1,1,2-Trichloroethane	0.49		0.4	0.45	0.49	0.54	0.49	0.5	0.5		0.63	0.6	0.62	0.57	0.6	0.5
Total CVOCs	181.6		171.96	171.83	181.88	191.8	178.41	210	258.3		573.64	531.71	491.28	632.48	649.64	518.8
Freon 113	18		16		21	16	13	16	14		22		25	24	19	19
1,4-Dioxane			9.6	12	8.7	8.7	11	11			2.9	2.9	2.4	2.3	3.8	1.7

Blank indicates no data.
0.5 indicates not detected at 0.5 microgram per liter.

Table A-1
RE-108 Hotspot Groundwater Data
2014 and 2015 (microgram per liter)

Well ID	RE103D1								RE103D2							
Well Screen Interval (feet below ground surface)	625 - 640								653 - 673							
Date	Mar-14	Jun-14	Sep-14	Dec-14	Mar-15	Jun-15	Sep-15	Dec-15	Mar-14	Jun-14	Sep-14	Dec-14	Mar-15	Jun-15	Sep-15	Dec-15
Tetrachloroethene	8.1	4.9	4.7	5.4	4.6	4	6.7	3	0.93	0.77	1.1	0.76	1.1	0.88	4	0.5
Trichloroethene	1000	1200	850	1300	900	810	860	930	750	670	1300	930	940	770	830	620
cis-1,2-Dichloroethene	4.4	4.2	4.5	4.3	3.9	3	3.6	3.2	1.8	1.1	1.8	1.8	1.9	1.4	1.5	1.1
trans-1,2-Dichloroethene	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
1,2-Dichloroethene	4.4	4.2	4.5	4.3	3.9	3	0.5	0.5	1.8	1.1	1.8	1.8	1.9	1.4	0.5	0.5
1,1-Dichloroethene	9.8	9.4	5.9	9.4	6.8	4.2	8.4	0.5	1	0.61	1.1	1.5	1.6	0.81	1.3	0.77
Vinyl Chloride	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
1,1,1-Trichloroethane	0.75	0.5	0.55	0.61	0.53	0.38	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
1,1-Dichloroethane	1.3	1.3	1.3	1.4	1.1	0.64	1	1.1	0.81	0.67	0.73	0.87	0.92	0.5	0.72	0.5
1,1,2-Trichloroethane	0.79	0.68	0.82	0.76	0.77	0.51	0.52	0.62	0.6	0.37	0.47	0.55	0.54	0.57	0.54	0.5
Total CVOCs	1,031	1,226	873	1,327	923	827	882	940	758	676	1,309	939	949	777	840	625
Freon 113	16	18	16		16	11	12	12	4.2	3.8	5.3		8.1	4.3	4.9	3.2
1,4-Dioxane		20	21	20	19	16	24	12		1	2.2	3	3	1.9	2.1	1.2

Blank indicates no data.
0.5 indicates not detected at 0

Table A-1
RE-108 Hotspot Groundwater Data
2014 and 2015 (microgram per liter)

Well ID	**RE103D3**								**RE105D2**							
Well Screen Interval (feet below ground surface)	**715 - 730**								**730 - 750**							
Date	**Mar-14**	**Jun-14**	**Sep-14**	**Dec-14**	**Mar-15**	**Jun-15**	**Sep-15**	**Dec-15**	**Mar-14**	**Jun-14**	**Sep-14**	**Dec-14**	**Mar-15**	**Jun-15**	**Sep-15**	**Dec-15**
Tetrachloroethene	0.45	0.5	0.5	0.5	0.47	0.5	3.6	0.5	0.5	0.77	0.79	0.92	1.1	1.6	1.4	1.9
Trichloroethene	430	510	460	600	570	420	470	510	620	1500	1500	1700	1600	1400	1900	1800
cis-1,2-Dichloroethene	1	0.87	1	1	1.2	0.89	0.96	1	2.6	3.1	3.5	3.8	3.7	3.4	3.6	4
trans-1,2-Dichloroethene	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
1,2-Dichloroethene	1	0.87	1	1	1.2	0.89	0.5	0.5	2.6	3.1	3.5	3.8	3.7	3.4	0.5	0.5
1,1-Dichloroethene	0.61	0.71	0.39	0.83	0.69	0.47	0.64	0.62	3.1	6.2	5.5	7.1	5.6	6	6.8	7
Vinyl Chloride	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
1,1,1-Trichloroethane	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.38	0.71	0.5	0.84	0.63	0.53	0.5	0.5
1,1-Dichloroethane	0.48	0.64	0.55	0.67	0.5	0.5	0.5	0.5	1.1	1.5	1.5	1.7	1.5	1.3	1.7	1.9
1,1,2-Trichloroethane	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.97	1.2	1.2	1	1.2	1.1	1.1	1.3
Total CVOCs	436	516	465	606	576	425	478	515	632	1,518	1,517	1,720	1,618	1,418	1,917	1,818
Freon 113	2.2	2.9	2.6		3.5	2	2.3	2.5	14	32	28	32	34	25	30	26
1,4-Dioxane	0.5	0.92	1	1	1.3	0.86	1	0.81		6.2	5.8	8.7	2.7	6.1	8,7	5.8

Blank indicates no data.
0.5 indicates not detected at 0

Table A-1
RE-108 Hotspot Groundwater Data
2014 and 2015 (microgram per liter)

Well ID	RE108D2								RE114D1		RE121D2		RE120D1			
Well Screen Interval (feet below ground surface)	630 - 650								610 - 630		755		630 - 650			
Date	Mar-14	Jun-14	Sep-14	Dec-14	Mar-15	Jun-15	Sep-15	Dec-15	Sep-15	Dec-15	Sep-15	Dec-15	Dec-14	Mar-15	Sep-15	Dec-15
Tetrachloroethene	2.9	1.6	1.7	1.6	2.2	2.2	2.5	0.5		0.5		0.5	1.8	1.8	1.9	2.1
Trichloroethene	4600	3400	3700	3100	3300	3900	3400	2900		370		480	1300	1300	1300	1300
cis-1,2-Dichloroethene	10	9.9	9.9	9	8.4	8.1	8.6	9		5.1		2.1	4.1	4.4	2.7	4
trans-1,2-Dichloroethene	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5		0.5	0.5	0.5	0.5	0.5
1,2-Dichloroethene	10	9.9	9.9	9	8.4	8.1	0.5	0.5		0.5		0.5	4.1	4.4	0.5	0.5
1,1-Dichloroethene	12	8.2	7.6	7.4	5.3	6.6	7.6	9		4		3.1	21	23	20	23
Vinyl Chloride	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5		0.5		0.5	0.5	0.5	0.5	0.5
1,1,1-Trichloroethane	1.7	1.3	1.2	1.3	1	0.98	0.5	1.4		0.64		0.48	1.9	2	1.4	0.5
1,1-Dichloroethane	6	5.8	4.8	5.2	4.4	4.6	5.3	5.1		1.5		0.51	3.4	3.5	2.9	3.2
1,1,2-Trichloroethane	2.4	1.8	1.8	1.5	1.1	1.8	1.5	0.5		1.6		0.64	1.2	1.8	1.6	1.4
Total CVOCs	4,646	3,440	3,738	3,136	3,332	3,933	3,428	2,927		385		489	1,339	1,342	1,332	1,336
Freon 113	10	8.7	7.4	6.4	3.1	6.8	8.3	6.2		20		17	40	60	36	42
1,4-Dioxane		6.9	5.8	12	9.2	6.1	7.5	8.8		5.5		4.9	30	19	25	12

Blank indicates no data.
0.5 indicates not detected at 0

Table A-1
RE-108 Hotspot Groundwater Data
2014 and 2015 (microgram per liter)

Well ID	RE120D2				RE122D1			RE122D2		
Well Screen Interval (feet below ground surface)	690 - 710							590 - 610		
Date	Dec-14	Mar-15	Sep-15	Dec-15	Mar-15	Sep-15	Dec-15	Mar-15	Sep-15	Dec-15
Tetrachloroethene	3.6	1.6	3.1	3.7	1.3	1	1.5	2.7	2.6	2.3
Trichloroethene	900	830	760	680	570	600	600	4600	5200	4700
cis-1,2-Dichloroethene	3.4	3.7	2.7	3.4	2	1	1.9	6	4.9	5.7
trans-1,2-Dichloroethene	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
1,2-Dichloroethene	3.4	3.7	0.5	3.4	2	0.5	0.5	6	0.5	0.5
1,1-Dichloroethene	5.6	4.9	4.9	5.7	0.5	0.45	0.63	8.7	8.9	8.9
Vinyl Chloride	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
1,1,1-Trichloroethane	0.5	0.41	0.5	0.5	0.5	0.5	0.5	0.71	0.5	0.5
1,1-Dichloroethane	1.2	1.1	0.5	1.1	0.5	0.5	0.5	1.7	0.5	1.5
1,1,2-Trichloroethane	0.69	0.56	0.45	0.64	0.4	0.5	0.5	2.8	2.4	3.1
Total CVOCs	919	847	774	699	578	605	607	4,630	5,221	4,724
Freon 113	24	33	21	25	7.2	4.4	4.7	31	20	21
1,4-Dioxane	16	5.8	16	8.8	8.1	13	8.7	14	17	11

Blank indicates no data.
0.5 indicates not detected at 0

Report of Analytical Results

Client: Dana Miller
EnSafe
5724 Summer Trees Drive
Memphis,TN 38134

Lab Sample ID: SJ1829-8
Report Date: 05-APR-16
Client PO: 20128
Project: Navy Clean WE15-03-0
SDG: BETHPAGE-5

Sample Description	Matrix	Date Sampled	Date Received
TT101D2-GW-031616	AQ	16-MAR-16 14:50:00	17-MAR-16

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Alkalinity	J1.9 mg/L	5.0	0.23	4	STDM 2320B	WG180618	21-MAR-16 15:58:26	N/A	N/A	
Chemical Oxygen Demand	U15. mg/L	15.	3.8	10	EPA 410.4	WG180760	24-MAR-16 15:04:00	N/A	N/A	
Chloride	8.2 mg/L	2.0	0.42	1.0	SM 4500 Cl E	WG180597	21-MAR-16 14:38:24	N/A	N/A	
Nitrate As N	2.1 mg/L	0.20	0.061	0.10	EPA 353.2	WG180581	18-MAR-16 11:20:27	N/A	N/A	
Nitrite As N	U0.050 mg/L	0.050	.00321	0.025	EPA 353.2	WG180581	18-MAR-16 10:53:14	N/A	N/A	
Nitrogen-Ammonia As N	U0.10 mg/L	0.10	.0321	.05	EPA 350.1	WG180603	21-MAR-16 16:04:48	EPA 350.2	21-MAR-16	
Phosphorus, Total As P	U0.10 mg/L	0.10	.0461	0.080	EPA 365.4	WG180580	21-MAR-16 10:42:03	EPA 365.4	18-MAR-16	
Solids-Filterable Residue	37. mg/L	10.	5.0	8	STDM 2540C	WG180682	24-MAR-16 11:49:00	SM 2540C	22-MAR-16	
Solids-Nonfilterable Residue	U4.0 mg/L	4.0	1.2	3	SM 2540D	WG180684	23-MAR-16 15:27:00	SM 2540D	22-MAR-16	
Sulfate-Turbidimetric	J0.45 mg/L	1.0	0.29	0.50	ASTM 516-90	WG180593	21-MAR-16 11:16:48	N/A	N/A	
Sulfide-Iodometric	J0.75 mg/L	1.0	0.69	0.75	SM4500S E	WG180461	17-MAR-16 13:27:00	N/A	N/A	
Total Biochemical Oxygen Demand	J0.27 mg/L	2.0	0.23	1	SM 5210B	WG180567	22-MAR-16 12:27:00	SM 5210B	17-MAR-16 1128	
Total Cyanide	U10. ug/L	10.	4.0	8	SW846 M9012B	WG180499	18-MAR-16 14:24:00	SW846 M9012	18-MAR-16	
Total Organic Carbon	J0.16 mg/L	1.0	0.10	0.50	SM5310B	WG180754	23-MAR-16 13:27:44	N/A	N/A	

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P.O. Box 540, Scarborough, ME 04070

http://www.katahdinlab.com

Katahdin
ANALYTICAL SERVICES

Cert No E87604

Report of Analytical Results

Client: Dana Miller
EnSafe
5724 Summer Trees Drive
Memphis,TN 38134

Lab Sample ID: SJ1829-2
Report Date: 05-APR-16
Client PO: 20128
Project: Navy Clean WE15-03-0
SDG: BETHPAGE-5

Sample Description	Matrix	Date Sampled	Date Received
RE120D1-GW-031616	AQ	16-MAR-16 11:45:00	17-MAR-16

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Alkalinity	J0.73 mg/L	5.0	0.23	4	STDM 2320B	WG180618	21-MAR-16 15:56:37	N/A	N/A	
Chemical Oxygen Demand	U15. mg/L	15.	3.8	10	EPA 410.4	WG180760	24-MAR-16 15:04:00	N/A	N/A	
Chloride	14. mg/L	2.0	0.42	1.0	SM 4500 Cl E	WG180597	21-MAR-16 14:38:24	N/A	N/A	
Nitrate As N	4.8 mg/L	0.20	0.061	0.10	EPA 353.2	WG180581	18-MAR-16 11:16:54	N/A	N/A	M2
Nitrite As N	U0.050 mg/L	0.050	.00321	0.025	EPA 353.2	WG180581	18-MAR-16 10:49:37	N/A	N/A	M2
Nitrogen-Ammonia As N	U0.10 mg/L	0.10	.0321	.05	EPA 350.1	WG180603	21-MAR-16 16:04:48	EPA 350.2	21-MAR-16	
Phosphorus, Total As P	U0.10 mg/L	0.10	.0461	0.080	EPA 365.4	WG180580	21-MAR-16 10:52:06	EPA 365.4	18-MAR-16	
Solids-Filterable Residue	80. mg/L	10.	5.0	8	STDM 2540C	WG180622	23-MAR-16 09:49:00	SM 2540C	21-MAR-16	
Solids-Nonfilterable Residue	J1.2 mg/L	4.0	1.2	3	SM 2540D	WG180584	21-MAR-16 18:09:00	SM 2540D	18-MAR-16	
Sulfate-Turbidimetric	11. mg/L	1.0	0.29	0.50	ASTM 516-90	WG180593	21-MAR-16 11:16:48	N/A	N/A	
Sulfide-Iodometric	U0.75 mg/L	1.0	0.69	0.75	SM4500S E	WG180461	17-MAR-16 13:27:00	N/A	N/A	
Total Biochemical Oxygen Demand	U2.0 mg/L	2.0	0.23	1	SM 5210B	WG180567	22-MAR-16 12:23:00	SM 5210B	17-MAR-16 1118	
Total Cyanide	U10. ug/L	10.	4.0	8	SW846 M9012B	WG180499	18-MAR-16 14:38:24	SW846 M9012	18-MAR-16	
Total Organic Carbon	J0.29 mg/L	1.0	0.10	0.50	SM5310B	WG180754	23-MAR-16 13:16:11	N/A	N/A	

000121

Katahdin
ANALYTICAL SERVICES

Cert No E87604

Report of Analytical Results

Client: Dana Miller
EnSafe
5724 Summer Trees Drive
Memphis,TN 38134

Lab Sample ID: SJ1863-6
Report Date: 05-APR-16
Client PO: 20128
Project: Navy Clean WE15-03-0
SDG: BETHPAGE-5

Sample Description	Matrix	Date Sampled	Date Received
RE105D2-GW-031716	AQ	17-MAR-16 14:10:00	18-MAR-16

Parameter	Result	Adj LOQ	Adj MDL	Adj LOD	Anal. Method	QC.Batch	Anal. Date	Prep. Method	Prep. Date	Footnotes
Alkalinity	J1.6 mg/L	5.0	0.23	4	STDM 2320B	WG180618	21-MAR-16 16:00:28	N/A	N/A	
Chemical Oxygen Demand	U15. mg/L	15.	3.8	10	EPA 410.4	WG180760	24-MAR-16 15:04:00	N/A	N/A	
Chloride	11. mg/L	2.0	0.42	1.0	SM 4500 Cl E	WG180597	21-MAR-16 14:38:24	N/A	N/A	
Nitrate As N	3.2 mg/L	0.10	0.030	0.050	EPA 353.2	WG180581	18-MAR-16 11:12:10	N/A	N/A	
Nitrite As N	U0.050 mg/L	0.050	.00321	0.025	EPA 353.2	WG180581	18-MAR-16 11:03:52	N/A	N/A	
Nitrogen-Ammonia As N	U0.10 mg/L	0.10	.0321	.05	EPA 350.1	WG180603	21-MAR-16 13:26:24	EPA 350.2	21-MAR-16	
Phosphorus, Total As P	U0.10 mg/L	0.10	.0461	0.080	EPA 365.4	WG180580	21-MAR-16 10:43:07	EPA 365.4	18-MAR-16	
Solids-Filterable Residue	40. mg/L	10.	5.0	8	STDM 2540C	WG180622	23-MAR-16 09:49:00	SM 2540C	21-MAR-16	
Solids-Nonfilterable Residue	U4.0 mg/L	4.0	1.2	3	SM 2540D	WG180684	23-MAR-16 15:27:00	SM 2540D	22-MAR-16	
Sulfate-Turbidimetric	J0.39 mg/L	1.0	0.29	0.50	ASTM 516-90	WG180593	21-MAR-16 11:16:48	N/A	N/A	
Sulfide-Iodometric	U1.0 mg/L	1.0	0.69	.8	SM4500S E	WG180757	24-MAR-16 15:15:00	N/A	N/A	
Total Biochemical Oxygen Demand	U2.0 mg/L	2.0	0.23	1	SM 5210B	WG180568	23-MAR-16 16:14:00	SM 5210B	18-MAR-16 1147	
Total Cyanide	U10. ug/L	10.	4.0	8	SW846 M9012B	WG180499	18-MAR-16 14:38:24	SW846 M9012	18-MAR-16	
Total Organic Carbon	J0.15 mg/L	1.0	0.10	0.50	SM5310B	WG180754	23-MAR-16 13:39:01	N/A	N/A	

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TABLE 2-2
VOC AND METALS GROUNDWATER RESULTS - MARCH 2016
MONITORING WELLS RE120D1, TT102D2, AND RE105D2
RE-108 HOT SPOT, NWIRP BETHPAGE, NEW YORK

Sample ID / Sample Date / Sample Type		NYSDOH MCL [1]	NYSDEC Class GA GW H(WS) [2]	NYSDEC Class A FW (WS) [2]	NYSDEC Class A/C FW H(FC) [2]	NYSDEC Class A/C FW A(C) [2]	NYSDEC Class A/C FW A(A) [2]	NYSDEC Class SA Saline SW H(FC) [2]	NYSDEC Class SA Saline SW A(C) [2]	NYSDEC Class SA Saline SW A(A) [2]	NYSDEC Class SA Saline SW W [2]	RE120D1-GW-031616 3/16/2016 Groundwater		TT101D2-GW-031616 3/16/2016 Groundwater		TT101D2-GW-031616 (Dup) 3/16/2016 Groundwater		RE105D2-GW-031716 3/16/2016 Groundwater	
	Units											Result	Qual	Result	Qual	Result	Qual	Result	Qual
VOCS																			
1,1,1-TRICHLOROETHANE	µg/L	5	5	5	--	--	--	--	--	--	--	1.0	U	0.5	U	0.5	U	0.5	U
1,1,2-TRICHLORO-1,2,2-	µg/L	**5**	**5**	**5**	--	--	--	--	--	--	--	**29**	J	**16**	J	**16**	J	**18**	J
1,1,2-TRICHLOROETHANE	µg/L	5	1	1	--	--	--	--	--	--	--	1.3	J	0.5	J	0.5	U	1.2	
1,1-DICHLOROETHANE	µg/L	5	5	5	--	--	--	--	--	--	--	2.4		0.5	U	0.7	J	1.4	
1,1-DICHLOROETHENE	µg/L	**5**	**5**	--	--	--	--	--	--	--	--	**17**		3.8		3.6		**6.4**	
1,2-DICHLOROETHENE, TOTAL	µg/L	5	5	5	--	--	--	--	--	--	--	3.6	J	1.9	J	2.0		3.7	
CARBON TETRACHLORIDE	µg/L	5	5	--	--	--	--	--	--	--	--	1.0	U	1.1		1.1		3.0	
CIS-1,2-DICHLOROETHENE	µg/L	5	5	5	--	--	--	--	--	--	--	3.6		1.9		2.0		3.7	
TETRACHLOROETHENE	µg/L	5	5	--	--	--	--	--	--	--	--	2.3		0.8	J	0.5	U	2.0	
TRANS-1,2-DICHLOROETHENE	µg/L	5	5	5	--	--	--	--	--	--	--	1.0	U	0.5	U	0.5	U	0.5	U
TRICHLOROETHENE	µg/L	**5**	**5**	**5**	**40**	--	--	**40**	--	--	--	**1,200**		**590**		**590**		**1,800**	
TRICHLOROFLUOROMETHANE	µg/L	5	5	5	--	--	--	--	--	--	--	2.0	U	1.0	U	1.0	U	1.0	U
VINYL CHLORIDE	µg/L	2	2	--	--	--	--	--	--	--	--	2.0	U	1.0	U	1.0	U	1.0	U
1,4-DIOXANE	µg/L	50	50	--	--	--	--	--	--	--	--	19.0		2.3	J	2.4		7.5	
METALS																			
ALUMINUM	µg/L	--	--	--	--	100	--	--	--	--	--	40	UJ	40	UJ	40	UJ	40	UJ
ANTIMONY	µg/L	6	3	3	--	--	--	--	--	--	--	0.5	UJ	0.5	UJ	0.5	UJ	0.5	UJ
ARSENIC	µg/L	10	25	50	--	150 (3)	340 (3)	--	63 (3)	--	--	4	U	4	U	4	U	4	U
BARIUM	µg/L	2,000	1,000	1,000	--	--	--	--	--	--	--	6.6		1.1	J	1.2	J	3.96	
BERYLLIUM	µg/L	4	--	--	--	11 (4)	--	--	--	--	--	0.051	J	0.2	U	0.2	U	0.049	J
CADMIUM (5)	µg/L	5	5	5	--	0.38	0.33	--	7.7	--	--	0.1	J	0.2	U	0.036	J	0.1	J
CALCIUM	µg/L	--	--	--	--	--	--	--	--	--	--	3,840		1,440		1,500		2,520	
CHROMIUM, TOTAL (5)	µg/L	--	50	50	--	6.8	97	--	--	--	--	4	UJ	4	UJ	4	UJ	4	UJ
COBALT	µg/L	--	--	5	--	--	--	--	--	--	--	2.72		2.37		2.44		4.9	
COPPER (5)	µg/L	--	200	200	--	**1.4**	**1.8**	--	**3.4**	**4.8**	--	**6.5**		**4.6**	J	2	UJ	**5.77**	
IRON, Total	µg/L	300	300	--	--	--	--	--	--	--	--	17	J	60	U	60	U	15	J
IRON, Dissolved	µg/L	--	--	--	--	--	--	--	--	--	--	60	U	60	U	60	U	60	U
LEAD (5)	µg/L	--	25	50	--	**0.34**	8.7	--	8	204	--	0.27	J	0.13	J	0.11	J	**0.43**	J
MAGNESIUM	µg/L	--	--	35,000	--	--	--	--	--	--	--	1,670		822		798		1,260	
MANGANESE, Total	µg/L	300	--	--	--	--	--	--	--	--	--	11.9		1	UJ	1	UJ	5.93	
MANGANESE, Dissolved	µg/L	--	--	--	--	--	--	--	--	--	--	12.2		1.3		1.1		4.69	
NICKEL (5)	µg/L	--	100	100	--	8.3	75	--	8.2	74	--	4.38		3.26		3.37		7.17	
POTASSIUM	µg/L	--	--	--	--	--	--	--	--	--	--	400	UJ	400	UJ	400	UJ	508	J
SELENIUM	µg/L	--	10	10	--	4.6	--	--	--	--	--	3	UJ	3	U	3	UJ	3	U
SILVER	µg/L	--	50	50	--	0.1	--	--	--	--	--	0.4	U	0.4	U	0.4	U	0.4	U
SODIUM	µg/L	--	20,000	--	--	--	--	--	--	--	--	13,900		4,780		4,950		7,510	
THALLIUM	µg/L	2	--	--	--	8	--	--	--	--	--	0.16	J	0.11	J	0.09	J	0.16	J
VANADIUM	µg/L	--	--	--	--	14	190	--	--	--	--	4	U	4	U	4	U	4	U
ZINC (5)	µg/L	5,000	--	--	--	**13**	**19**	--	66	--	--	**22**		5	J	5	J	**32**	
MERCURY	µg/L	2	0.7	0.7	0.0007	0.77	1.4	0.0007	--	--	0.0026 (4)	0.1	U	0.1	U	0.1	U	0.1	U

TABLE 2-2
VOC AND METALS GROUNDWATER RESULTS - MARCH 2016
MONITORING WELLS RE120D1, TT102D2, AND RE105D2
RE-108 HOT SPOT, NWIRP BETHPAGE, NEW YORK

VOCs - volatile organic compounds.
µg/L - Micrograms per liter.
Qual - Qualifier.
NYSDEC - New York State Department of Environmental Conservation.
NYSDOH - New York State Department of Health.
"--" indicates no value.

GW - groundwater.
FW - freshwater.
SW - surface water.
H(WS) - Health Water Source.
H(FC) - Health (Fish Consumption).
bold /shaded - indicates exceed a screening criteria.

A(C) - Aquatic (Chronic).
A(A) - Aquatic (Acute).
W - Wildlife.
MCL - Maximum Contaminant Level.
Dup - duplicate.

(1) Part 5, Subpart 5-1 Public Water Systems.
(2) 6 CRR-NY 703.5.
(3) dissolved form.
(4) when hardness is ≤ 75 ppm.
(5) see Appendix A for NYSDEC criteria backup calculations.

Qualifier:

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.

APPENDIX B

CAPTURE ZONE AND PUMPING RATE CALCULATIONS

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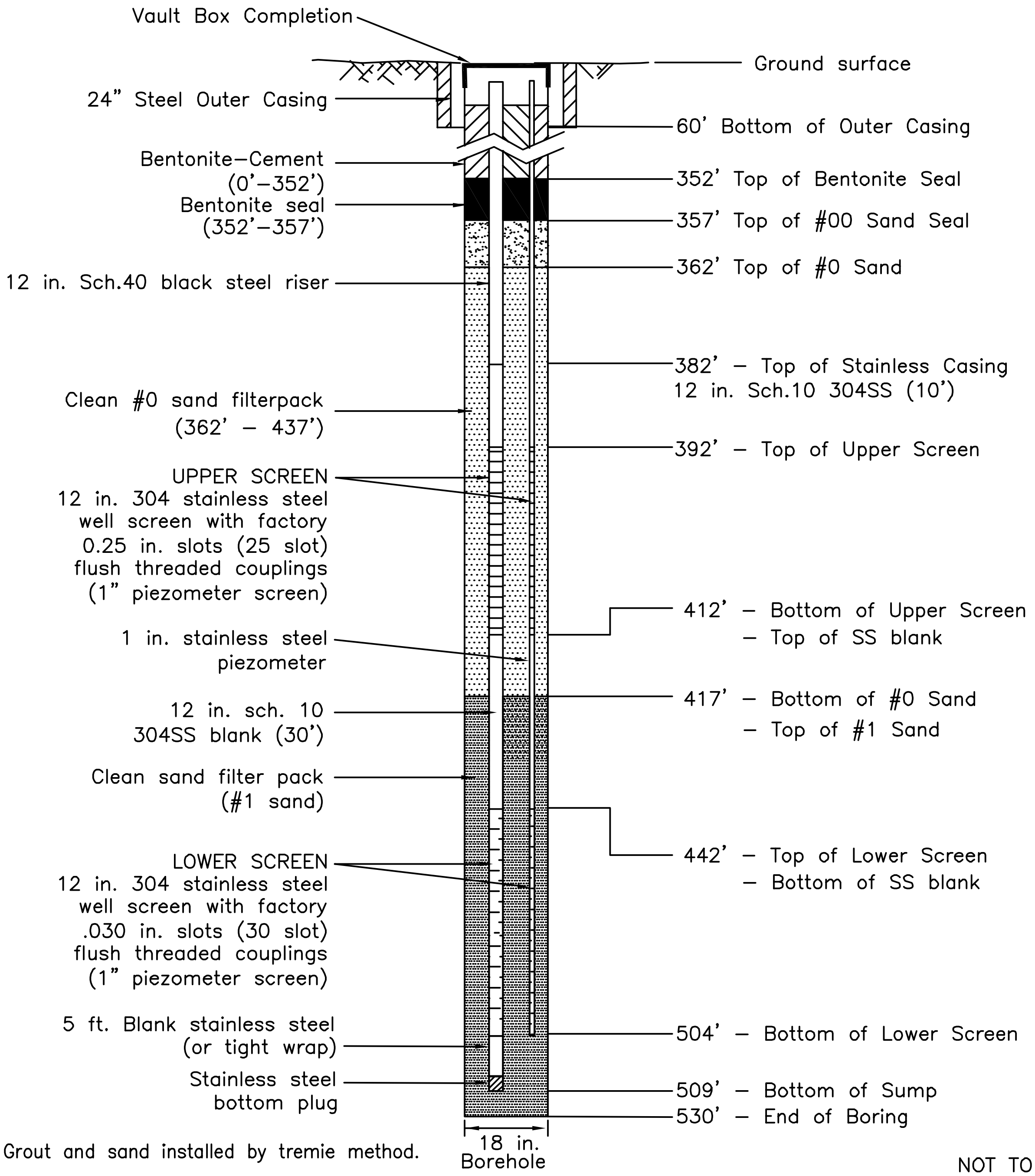
UNCONSOLIDATED
RECOVERY WELL
CONSTRUCTION DIAGRAM

WELL NO. RW–3

PROJECT: NWIRP–Bethpage, NY GM–38 Remediation
PROJECT NO.: 106–2282.096
DATE: 11–19/11–26–2009 BORING NO.: RW–3
ELEVATION: 90.01 MSL
FIELD GEOLOGIST: A. BARROQUIERO/N. DEDIC

DRILLER: W. PRATT/R. DEVINE/DELTA
DRILLING METHOD: REVERSE ROTARY
DEVELOPMENT METHOD: AIR LIFT/SURGE & PUMP



Note: Grout and sand installed by tremie method.

NOT TO SCALE

WELL ID	(A) SCREEN INTERVAL (FT. BGS)	(B) SCREEN MATERIAL	(C) CASING MATERIAL
RW–3 UPPER	392–412	SS FT–WIRE WRAPPED	WELDED CS/SS
RW–3 LOWER	442–504	SS FT–WIRE WRAPPED	WELDED CS/SS

SS = STAINLESS STEEL CS = CARBON STEEL (SCH 40) FT = FLUSH THREADED

U.S. Navy RAC
NAVFAC, MID-ATLANTIC

NWIRP, Bethpage, NY
GM-38 Area
Groundwater Remediation Project

Recovery Well No. 3
Proposed Construction Diagram

TETRA TECH EC, INC.

Project:	NWIRP Bethpage	Project No.:	112G08005-WE24
Site:	RE-108 Hot Spot Plume		
Subject:	Extraction Well 4 Design - Avoca Avenue area		
By:	J. Orient	Date:	8/8/2017
Checked:		Date:	

Project/Design Objective:

Design a groundwater extraction system for containment of a portion of the deep downgradient RE-108 hot spot VOC plume migrating south from the NWIRP. The extraction well is to be installed in the Avoca Avenue area for capture of the >500 ug/l plume in that area. The VOC plume averages approximately 200 ft thick within the deep (550 - 750 ft) portion of the unconsolidated groundwater flow system within the Magothy aquifer in this area. The final design should be capable of minimizing plume migration to nearby water supply well BWD 6-2. Other (further upgradient and/or downgradient) portions of the plume will be addressed separately.

Basis of Design Data: (Input cells yellow, blue automatically calculated)

Groundwater Plume Information

Plume Width (W):	1600	ft.
Plume Thickness:	200	ft.
Plume Area:	5,760,000	ft^2
Volume of Groundwater in Plume:	288000000	ft^3
Avg Hydraulic Conductivity, Plume Area:	95	ft/day

Aquifer Characteristics

Thickness (B):	300	ft.
Avg. Hydraulic Conductivity (K):	95	ft/day
Transmissivity (T):	28500	ft^2/day
Porosity (n):	0.25	
Storativity (S):	0.0001	
Fractional Organic Carbon Content (foc):	0.002	
Flow Gradient (i):	0.0016	

Contaminant Characteristics

Contaminant A Representative gw conc.:	TCE		ug/L
Contaminant B Representative gw conc.:			
Koc, Contaminant A:		61	l/kg
Koc, Contaminant B:			l/kg
Kd, Contaminant A:		0.122	l/kg
Kd, Contaminant B:		0	l/kg
Half-life, Contaminant A:		5	years
Half-life, Contaminant B:			years
Target Cleanup Level, Contaminant A:		5	ug/L
Target Cleanup Level, Contaminant B:			ug/L

Remedial System Information

Extraction Well Radius, (r) :	0.5	ft.
Time to Reach Steady-State Drawdown (t):	30	days
Allowable Drawdown, Single Well, (s):	50	ft.
Assumed well efficiency, WE	50	%

Technical Approach:

Use aquifer characteristics, plume area/volume, representative groundwater concentration data, and standard equations to calculate the minimum required pumping rate for plume containment, per-well achievable pumping rates, number of extraction well needed, and well spacings. Develop an extraction system design based on the calculations, adjusting/optimizing the design as appropriate based on observed well performance and best scientific judgement. Assume T from 2016 BWD 6-2 pumping test (Resolution, 2016) is representative of T at the extraction well location for plume capture purposes (factors in stratification/preferential flow).

Required Pumping Rate (Qt) for Total Plume Capture

Qt_1 = TiW (if max plume width is far upgradient of extraction point)

Qt_1 = 72960.00 ft^3/day, or 378.99 gpm

Qt_2 = TiW x 2 [if max plume width occurs at or near extraction well location(s)]

Qt_2 = 72960.00 ft^3/day x 2, or 378.99 gpm x 2

Qt_2= 145920.00 ft^3/day, or 757.99 gpm

Maximum Achievable Pumping Rate in a Single Well (Qa)

Qa = $[[4\pi Ts/2.3] / \log [2.25Tt/r^2S]] \times WE\%$

Qa = 357594.85 ft^3/day, or 1857.54 gpm

Estimated Drawdown (s) at Q of 400 gpm = 10.77 ft

Minimum Number of Extraction Wells Required

= Qt/Qa

= 0.2 wells, for Qt_1 pumping rate

= 0.4 wells, for Qt_2 pumping rate

Plume Cleanup Rate Projections (From Spreadsheet Program or Other Source)

At		gpm,		years
At		gpm,		years
At		gpm,		years
At natural GW flow rate: (plume area only)	252.66	gpm,		years

Contaminant that cleanup rate is based on: TCE

Based on the limiting conditions calculated above, projections regarding cleanup times at various pumping rates (see accompanying spreadsheets), a suitable safety factor based on the degree of confidence in the design data, and best scientific judgement, the following are the number of extraction wells and pumping rates selected for the design:

Number of Wells:	1		
Per-well Pumping Rate (Qw):	400	gpm, or	77004.00 ft^3/day
Total System Pumping Rate (Qes):	400	gpm, or	77004.00 ft^3/day

Extraction Well Spacings, (WSp), ft Perpendicular to Groundwater Flow Direction

WSp = $Qw/\pi Ti$, for a 2-well extraction system

WSp = 537.52 ft

or

WSp = $1.26(Qw)/\pi Ti$, for a 3-well extraction system

WSp = 677.28 ft

or

WSp = $1.2(Qw)/\pi Ti$, for an extraction system with 4+ wells

WSp = 645.03 ft

Downgradient Stagnation Point (SPd) Approximation

SPd = $Qes/2\pi Ti$, Qes = total extraction system pumping rate, ft^3/day

SPd = 268.76 ft

Alternate Layout of Extraction Well System (I.e., parallel to GW flow direction):

N/A

Final Configuration, Groundwater Extraction System:

One 12-inch diameter extraction well (well diameter based on expected 8-inch diameter submersible pump), located near Avoca Avenue along the plume centerline, with the screen centered across the most contaminated portion of the deep aquifer (~550-650 ft bgs) above the screened interval of BWD 6-2 (700-770 ft) to minimize interference. Actual screened interval(s) to be based on the results of a pilot boring to be drilled at the location. Screen slot size(s) to be determined based on grain size analysis from screen interval soil samples collected from the pilot test boring. The well will be designed to pump at an approximate rate of 400 gpm, with an estimated 11 ft of drawdown, which provides an upgradient capture zone width of approximately 1600 feet (800 ft capture width at the extraction well location).

CAPTURE ZONE CONFIGURATION - PUMPING OR INJECTION WELL SYSTEM

Project:	**NWIRP Bethpage**	**Project No.:**	**112G08005-WE24**
Site:	**RE-108 Hot Spot Plume**		
Subject:	**Extraction Well 4 Design - Avoca Avenue area**		
By:	J. Orient	**Date:**	8/8/2017

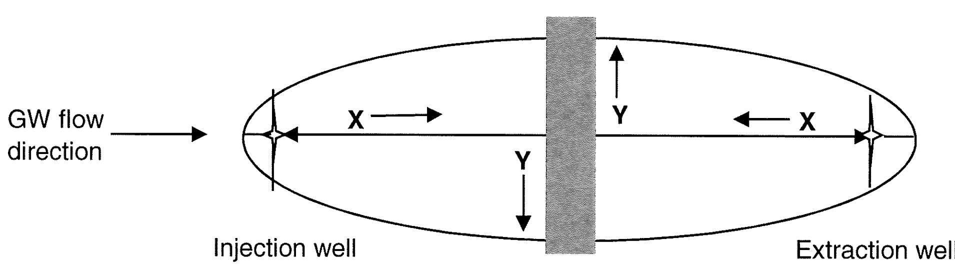
Q (gpm)	**Q (ft3/day)**	**Aquifer K (ft/day)**	**Background gradient i**	**Aquifer thickness b (ft)**	**1/2 of max CZ width Y_{max} (ft)**	**Y/X ratio**	**1/2 CZ width @ X, Y_X (ft)**	**Distance from well X (ft)**
400	77004	95	0.0016	300	844	1000	422	1
400	77004	95	0.0016	300	844	100	425	8
400	77004	95	0.0016	300	844	60	427	14
400	77004	95	0.0016	300	844	30	431	28
400	77004	95	0.0016	300	844	15	440	56
400	77004	95	0.0016	300	844	8	456	106
400	77004	95	0.0016	300	844	4	488	211
400	77004	95	0.0016	300	844	3	509	281
400	77004	95	0.0016	300	844	2	547	422
400	77004	95	0.0016	300	844	1.4	589	603
400	77004	95	0.0016	300	844	1	633	844
400	77004	95	0.0016	300	844	0.8	663	1055
400	77004	95	0.0016	300	844	0.6	699	1407
400	77004	95	0.0016	300	844	0.4	742	2111
400	77004	95	0.0016	300	844	0.3	766	2814
400	77004	95	0.0016	300	844	0.25	779	3377
400	77004	95	0.0016	300	844	0.2	791	4222
400	77004	95	0.0016	300	844	0.15	804	5629

Downgradient capture zone limit, ft (Q/2πTi):	269

Y_{max} = 1/2 the maximum capture zone width, = Q/2Ti, = Q/2Kbi

X = Distance from the pumping/recharge well along the axis parallel to the gw flow direction

$Y_X = Y_{max} - (Q/2\pi Ti)(\tan^{-1} Y/X)$



Assumptions:

Does not factor in outside pumping influences

System capture zone can be adequately approximated as one well pumping at the aggregate extraction system rate

SCREEN ENTRANCE VELOCITY

(edit inputs shown in blue only)

Step 1 **Surface Area for each 1-foot length of screen**

Pi	Diameter (in)	1 foot length (in)			
3.14159	12	12	=	452.39	in^2/foot of screen

Step 2 **Calculate total area for selected screen length**

Screen length (ft)	Surface Area			
100	452.38896	=	45238.90	in^2

Step 3 **Calculate percentage of open area in screen**

Slot Size (in)	Wire width (in)			
0.03	0.156	=	16.13	%

Step 4 **Calculate amount of open area in screen**

Surface Area	% Open Area	Conversion (in^2/ft)			
45238.896	16.13	144	=	50.67	ft^2

Step 5 **Calculate amount of open area per foot of screen**

Open Area in Screen	Screen Length (ft)			
50.67	100	=	0.51	ft^2

Step 6 **Calculate average entrance velocity of water moving through slots**

Yield (gpm)	Yield (ft^3/sec)	Screen Open Area (ft^2)			
400	0.89	50.67	=	**0.018**	**ft/sec**

Target entrance velocity should not exceed 0.15 ft/sec.

Discharge pipe velocity calcs (desired flow rate 3-10 ft/sec).

Pipe diameter In.	Pipe radius ft	Pipe X-Sect area, ft^2	Anticipated flow rate, gpm	Anticipated flow rate, ft^3/sec	Flow velocity ft^3/sec
1	0.04	0.01	400	0.89	163.41
2	0.08	0.02	400	0.89	40.85
3	0.13	0.05	400	0.89	18.16
4	0.17	0.09	400	0.89	10.21
5	0.21	0.14	400	0.89	6.54
6	0.25	0.20	400	0.89	4.54
8	0.33	0.35	400	0.89	2.55

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APPENDIX C

PUMP AND PIPING SIZE CALCULATIONS

Project:	NWIRP Bethpage Groundwater Treatment Plant				
Client:	US NAVY			**Page:**	**of**
Subject:	Pump Sizing	**Prpd by:**		**Date:**	
Calc. No.:	Pump P-4	**Chkd by:**		**Date:**	

Pump: P-6
Name: Recovery Well RW-4 Pump
From: Recovery Well RW-4
To: Equalization Tank

Design Flow Rate	400	gpm	
Minimum Flow Rate	300	gpm	(Minimum is 25% less than design)
Maximum Flow Rate	500	gpm	(Maximum is 25% greater than design)

Description:
Water flows at design rate to equalization tank

Elevation (Grade level is 0 elevation):

Static Depth to Water	-50	ft
Depth to Water under pumping	-100	ft
Height of Eq Tank	15	ft
Total Elevation Change	115	ft

Piping Friction Loss Calculation

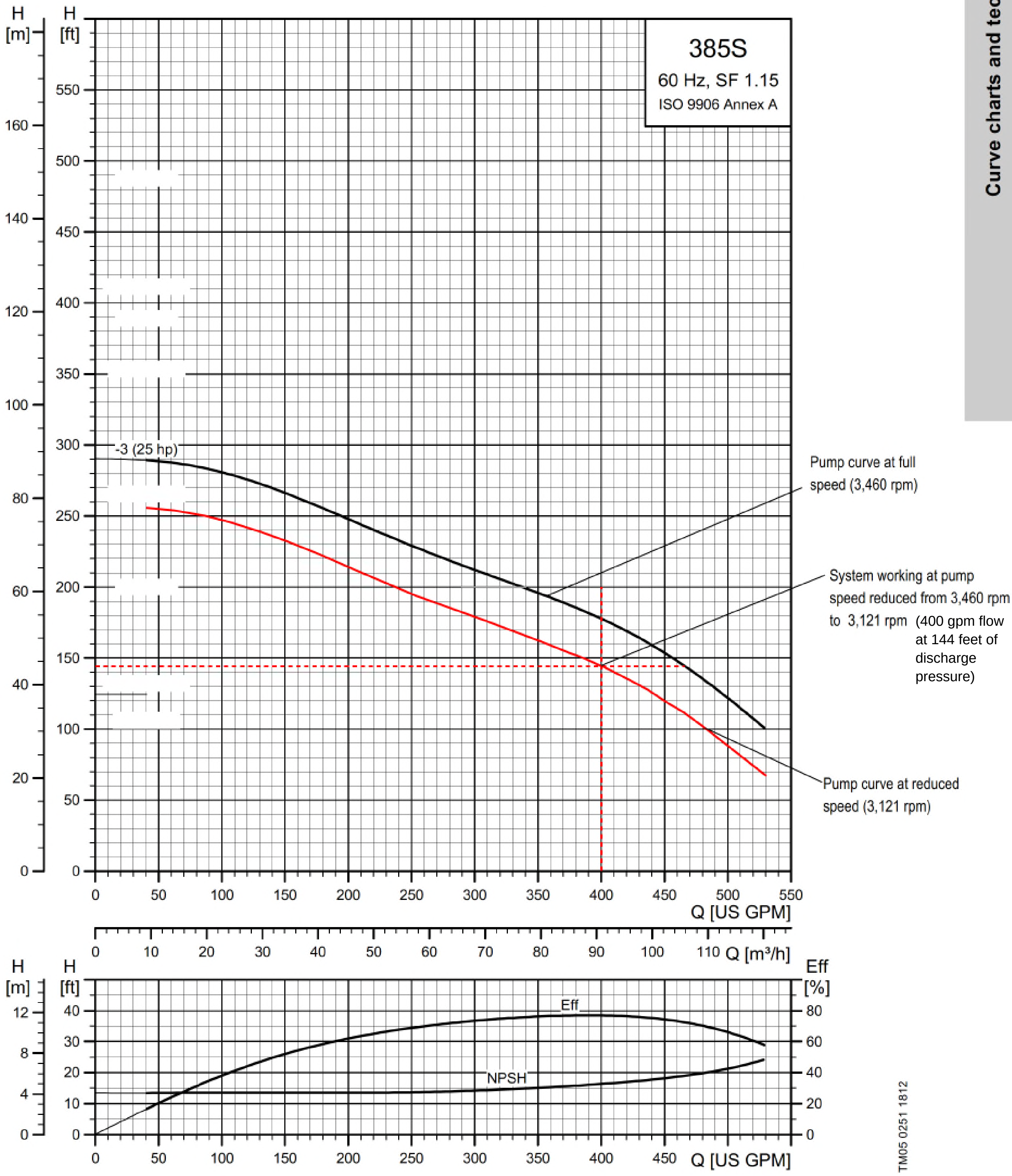
Section	Length (ft)	Nominal size	Pipe type	pipe ID	SDR	Pressure Rating (psig)	Friction loss at design flow (ft)	notes
Pump to vault	150	6"	Sch 40 steel	6.07	24	530	2.2	future, c=120 for steel pipe
Vault to RW-3	3850	8"	HDPE SDR 11	7.629	13.5	160	14.3	future, c=140 for plastic pipe
RW-3 to Building	800	6"	HDPE SDR ?	5.816	13.5	160	11.1	existing, c=140 for plastic pipe, SDR 13.5 assumed
8" in Building	75	8"	HDPE SDR ?	7.625	13.5	160	0.3	existing, c=140 for plastic pipe, SDR 13.5 assumed
Fittings	100			6.07			1.1	assumed as 100' of 6" steel pipe
Total friction losses							29.0	feet

Total required pump discharge pressure 144.0 feet

SYSTEM WORKING POINT CALCULATION FOR
GRUNDFOS 385S-250-3 PUMP AND 8-INCH HDPE
PIPELINE SYSTEM FROM RW4 TO GWTS

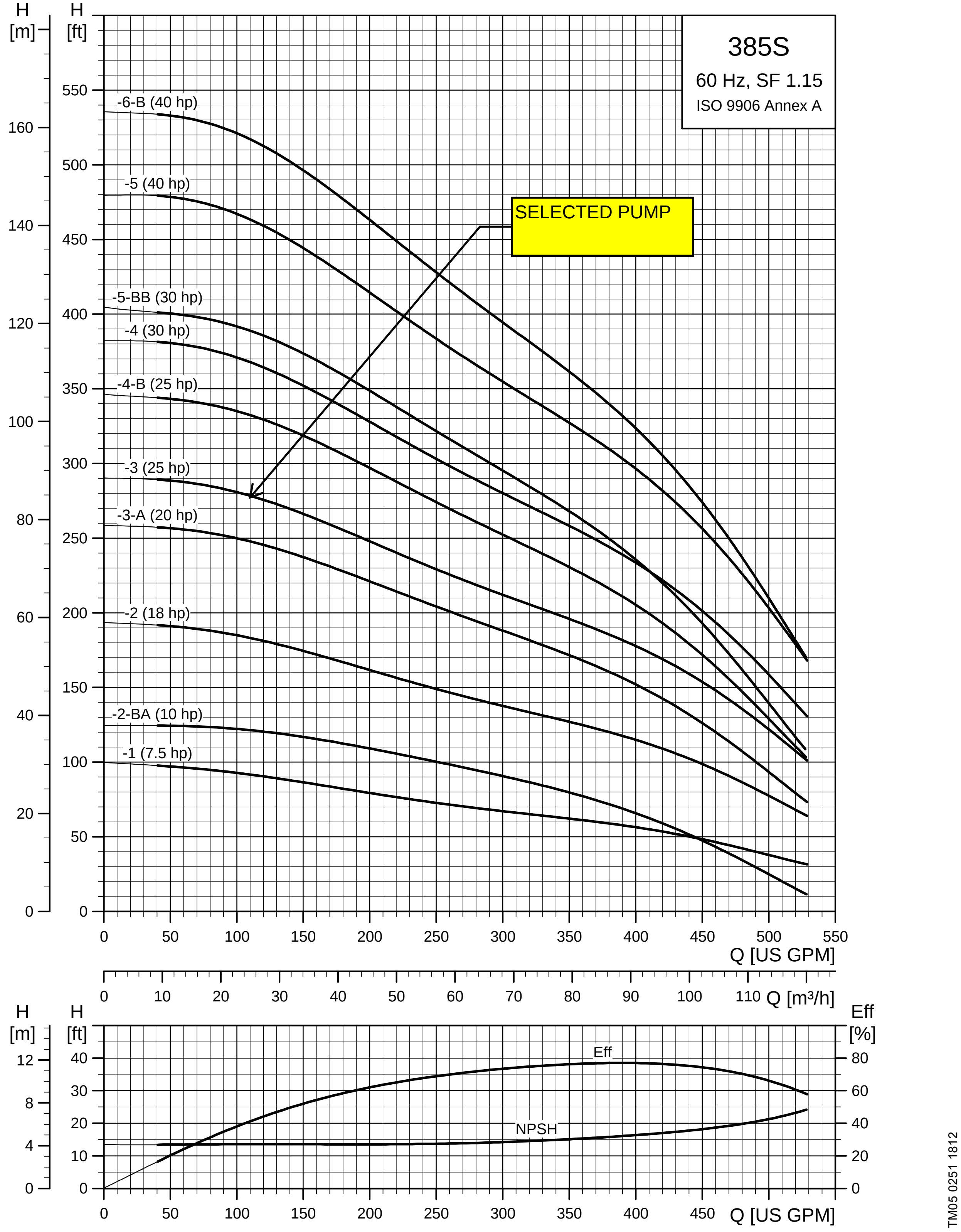
8" and larger wells

SP 385S (385 gpm)



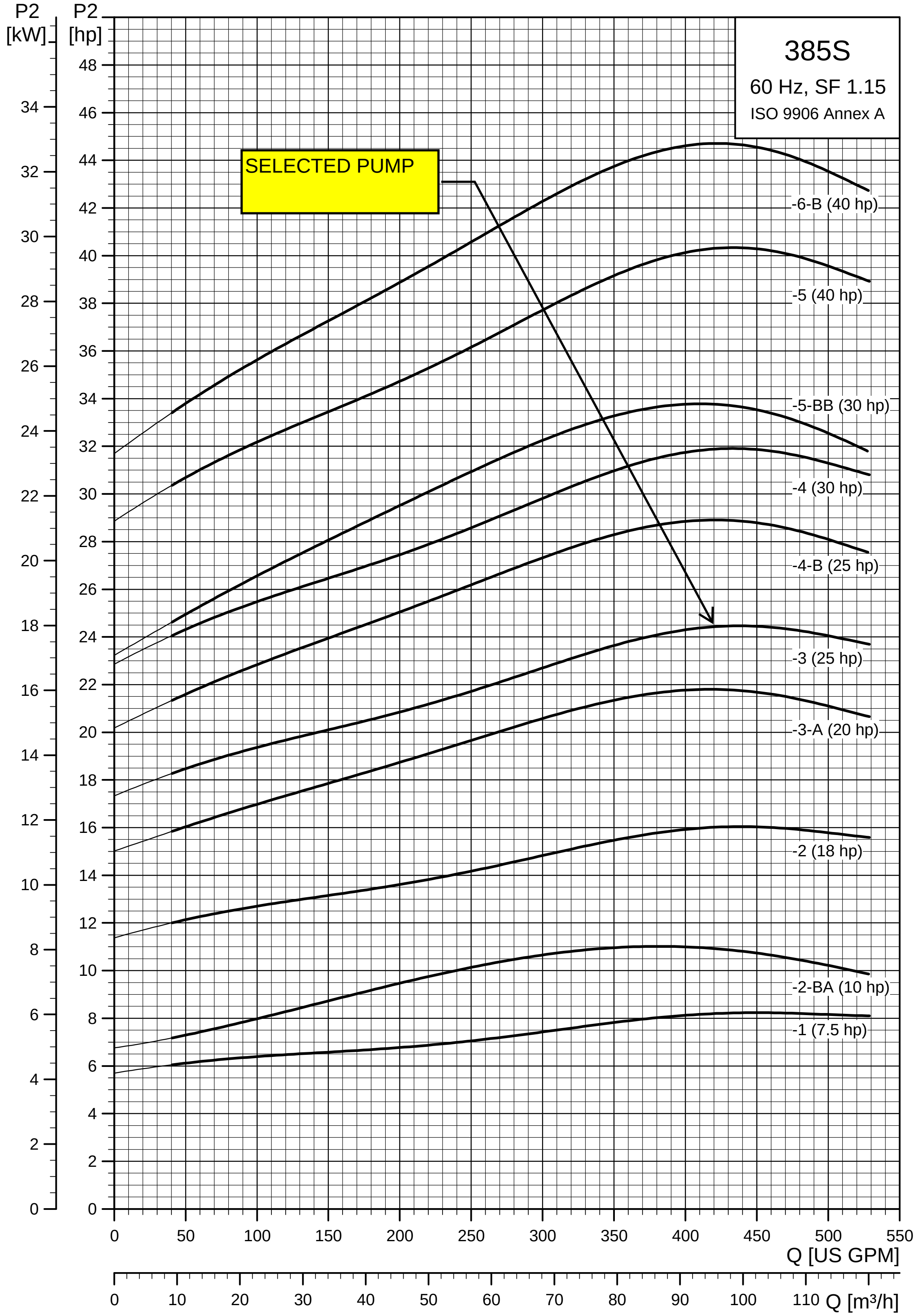
8" and larger wells

SP 385S (385 gpm)



8" and larger wells - continued

SP 385S (385 gpm) pump power requirement (P2)

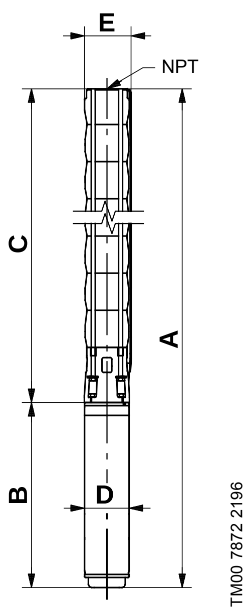


8" and larger wells - continued

SP 385S (385 gpm) / 6, 8, 10 inch motor

Pump model	Nom. head [ft]	Ph	Volts [V]	Motor [Hp]		Dimensions A [in. (mm)]	B [in. (mm)]	C [in. (mm)]	D [in. (mm)]	E [in. (mm)]	Net weight (complete) [lb]
385S - Motor dia. 6 inch, 60 Hz, rated flow 385 gpm (4" NPT)											
385S75-1	57	3	230	7.5	▲	46.58 (1183)	22.25 (565)	24.34 (618)	5.63 (143)	7.01 (178)	135.9
		3	460	7.5	▲	46.58 (1183)	22.25 (565)	24.34 (618)	5.63 (143)	7.01 (178)	135.9
385S100-2BA	69	3	230	10	▲	52.6 (1336)	23.23 (590)	29.38 (746)	5.63 (143)	7.01 (178)	169.2
		3	460	10	▲	52.6 (1336)	23.23 (590)	29.38 (746)	5.63 (143)	7.01 (178)	169.2
385S150-2	117	3	230	15	▲	57.25 (1454)	27.88 (708)	29.38 (746)	5.63 (143)	7.01 (178)	169.2
		3	460	15	▲	57.25 (1454)	27.88 (708)	29.38 (746)	5.63 (143)	7.01 (178)	169.2
385S200-3A	155	3	230	20	▲	65.24 (1657)	30.83 (783)	34.41 (874)	5.63 (143)	7.01 (178)	188.1
		3	460	20	▲	65.24 (1657)	30.83 (783)	34.41 (874)	5.63 (143)	7.01 (178)	188.1
385S250-3	177	3	230	25	▲	67.41 (1712)	33.00 (838)	34.41 (874)	5.63 (143)	7.01 (178)	188.1
		3	460	25	▲	67.41 (1712)	33.00 (838)	34.41 (874)	5.63 (143)	7.01 (178)	188.1
385S250-4B	210	3	230	25	▲	72.45 (1840)	33.00 (838)	39.45 (1002)	5.63 (143)	7.01 (178)	239.4
		3	460	25	▲	72.45 (1840)	33.00 (838)	39.45 (1002)	5.63 (143)	7.01 (178)	239.4
385S300-4	237	3	230	30	▲	75.00 (1905)	35.56 (903)	39.45 (1002)	5.63 (143)	7.01 (178)	239.4
		3	460	30	▲	75.00 (1905)	35.56 (903)	39.45 (1002)	5.63 (143)	7.01 (178)	239.4
385S300-5BB	343	3	230	30	▲	80.04 (2033)	35.56 (903)	44.49 (1130)	5.63 (143)	7.01 (178)	247.5
		3	460	30	▲	80.04 (2033)	35.56 (903)	44.49 (1130)	5.63 (143)	7.01 (178)	247.5
385S400-5	297	3	460	40	▲	84.77 (2153)	40.28 (1023)	44.49 (1130)	5.63 (143)	7.01 (178)	247.5
385S400-6B	330	3	460	40	▲	89.81 (2281)	40.28 (1023)	49.53 (1258)	5.63 (143)	7.01 (178)	252.0
385S500-6	357	3	460	50	☼	110.99 (2825)	56.11 (1425)	54.88 (1394)	5.67 (144)	7.88 (200)	-
385S500-7A	400	3	460	50	☼	110.99 (2825)	56.11 (1425)	54.88 (1394)	5.67 (144)	7.88 (200)	-
385S600-7	416	3	460	60	†	-	-	55.12 (1400)	-	7.88 (200)	-
385S600-8	476	3	460	60	†	-	-	55.12 (1400)	-	7.88 (200)	-
385S - Motor dia. 8 inch, 60 Hz, rated flow 385 gpm (4" NPT)											
385S400-6B	330	3	460	40	*	93.78 (2382)	43.71 (1110)	50.08 (1272)	7.56 (192)	7.88 (200)	428.3
385S500-6	357	3	460	50	*	95.75 (2432)	45.67 (1160)	50.08 (1272)	7.56 (192)	7.88 (200)	451.2
385S500-7A	400	3	460	50	*	100.79 (2560)	45.67 (1160)	55.12 (1400)	7.56 (192)	7.88 (200)	461.1
385S600-7	416	3	460	60	*	105.12 (2670)	50.00 (1270)	55.12 (1400)	7.56 (192)	7.88 (200)	507.3
385S600-8	476	3	460	60	*	110.16 (2798)	50.00 (1270)	60.16 (1528)	7.56 (192)	7.88 (200)	517.2
385S750-9	536	3	460	75	*	118.35 (3006)	53.15 (1350)	65.2 (1656)	7.56 (192)	7.88 (200)	558.7
385S750-10	596	3	460	75	*	123.39 (3134)	53.15 (1350)	70.24 (1784)	7.56 (192)	7.88 (200)	568.6
385S1000-11	656	3	460	100	*	137.88 (3502)	62.60 (1590)	75.28 (1912)	7.56 (192)	7.88 (200)	677.5
385S1000-12	716	3	460	100	*	142.92 (3630)	62.60 (1590)	80.32 (2040)	7.56 (192)	7.88 (200)	687.4
385S1000-13	776	3	460	100	*	147.96 (3758)	62.60 (1590)	85.36 (2168)	7.56 (192)	7.88 (200)	697.3

385S



E = Maximum diameter of pump including cable guard and motor.

Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
Performance conforms to ISO 9906 Annex A @ 8 ft. minimum submergence.

- ▲ MS 6000C motor.
- ☼ Takes MMS 6 motor; not available as complete.
- * Takes MMS 8000 motor; not available as complete.
- † Takes MMS 10000 motor; not available as complete.

7. Electrical data

Grundfos submersible pump motors - 60 Hz											
Hp	Ph	Volt [V]	S.F.	Circuit breaker or fuses		Amperage		Full load		Max. thrust [lb]	Product number
				Std.	Delay	Start [A]	Max. [A]	Eff. [%]	PF [%]		
4-inch, single-phase, 2-wire motors (control box not required)											
.5	1	115	1.60	35	15	55.0	12.0	62	76	900	96465574
.5	1	230	1.60	15	7	34.5	6.0	62	76	900	96465616
.75	1	230	1.50	20	9	40.5	8.4	62	75	900	96465618
1	1	230	1.40	25	12	48.4	9.8	63	82	900	96465620
1.5	1	230	1.30	35	15	62.0	13.1	64	85	900	96465622
4-inch, single-phase, 3-wire motors											
.5	1	115	1.60	35	15	42.5	12.0	61	76	900	96023039
.5	1	230	1.60	15	7	21.5	6.0	62	76	900	96465606
.75	1	230	1.50	20	9	31.4	8.4	62	75	900	96465608
1	1	230	1.40	25	12	37.0	9.8	63	82	900	96465610
1.5	1	230	1.30	35	15	45.9	11.6	69	89	900	96465612
2	1	230	1.25	35	20	57.0	13.2	72	86	1500	96449947
3	1	230	1.15	45	30	77.0	17.0	74	93	1500	96449948
5	1	230	1.15	70	45	110.0	27.5	77	92	1500	96449949
4-inch, three-phase motors											
1.5	3	230	1.30	15	8	40.3	7.3	75	72	900	96465629
1.5	3	460	1.30	10	4	20.1	3.7	75	72	900	96465651
1.5	3	575	1.30	10	4	16.1	2.9	75	72	900	96785912
2	3	230	1.25	20	10	48	8.7	76	75	900	96465630
2	3	460	1.25	10	5	24	4.4	76	75	900	96465652
2	3	575	1.25	10	4	19.2	3.5	76	75	900	96785917
3	3	230	1.15	30	15	56	12.2	77	75	1500	96405801
3	3	460	1.15	15	7	28	6.1	77	75	1500	96405810
3	3	575	1.15	15	6	22	4.8	77	75	1500	96405815
5	3	230	1.15	40	25	108	19.8	80	82	1500	96405802
5	3	460	1.15	20	12	54	9.9	80	82	1500	96405811
5	3	575	1.15	15	9	54	7.9	80	82	1500	96405816
7.5	3	230	1.15	60	30	130	25.0	81	82	1500	96405805
7.5	3	460	1.15	35	15	67	13.2	81	82	1500	96405814
7.5	3	575	1.15	30	15	67	10.6	81	82	1500	96405819
10	3	460	1.15	50	30	90	18	81	80	1500	96440318
6-inch, three-phase motors											
7.5	3	208-230	1.15	65	40	114 - 130	23.4 - 27.5	81	85 - 84	6070	96166181
7.5	3	460	1.15	30	17	68	13.2	81	85	6070	96166161
7.5	3	575	1.15	30	17	51	10.2	81	85	6070	96166141
10	3	208-230	1.15	90	50	126 - 142	30.0 - 37.5	82	86 - 84	6070	96166182
10	3	460	1.15	40	25	75	17.4	82	85	6070	96166162
10	3	575	1.15	40	25	56.5	13.4	82	85	6070	96166142
15	3	208-230	1.15	130	75	198 - 224	44.5 - 53.5	83	86 - 84	6070	96166184
15	3	460	1.15	60	35	112	25	83	84	6070	96166164
15	3	575	1.15	60	35	84	19.4	83	84	6070	96166144
20	3	208-230	1.15	175	100	310 - 350	57.5 - 71.5	84	86 - 84	6070	96166186
20	3	460	1.15	80	45	186	33.5	84	84	6070	96166166
20	3	575	1.15	80	45	144	26	84	84	6070	96166146
25	3	208-230	1.15	200	125	395 - 445	71 - 87	84	87 - 84	6070	96166187
25	3	460	1.15	100	60	236	41	84	84	6070	96166167
25	3	575	1.15	100	60	180	32	84	84	6070	96166147
30	3	208-230	1.15	250	150	445 - 500	81 - 104	84	87 - 84	6070	96166188
30	3	460	1.15	125	70	265	48	85	85	6070	96166168
30	3	575	1.15	125	70	194	37	85	85	6070	96166148
40	3	460	1.15	170	90	330	65	85	84	6070	96166170
40	3	575	1.15	170	90	250	49.5	85	84	6070	96166150
50	3	460	1.15	225	125	405	73.0	83	83	6182	96879560
8-inch, three-phase motors											
40	3	460	1.15	175	100	380	55.7	83	85	13000	96023204
50	3	460	1.15	225	125	550	67.8	84	85	13000	96023205
60	3	460	1.15	250	150	640	80.4	86	85	13000	96023206
75	3	460	1.15	300	175	580	97.4	86	86	13000	96023207
100	3	460	1.15	400	225	570	130.4	87	86	13000	96023208
125	3	460	1.15	500	300	600	160.0	87	87	13000	96023209
150	3	460	1.15	600	350	580	191.3	86	87	13000	96023210
10-inch, three-phase motors											
175	3	460	1.15	700	400	570	230.4	88	85	13000	96937300
200	3	460	1.15	800	500	620	265.2	87	82	13000	96937302
250	3	460	1.15	1100	600	610	352.2	87	79	13000	96937316

Other motor manufacturers: For Hitachi motors refer to the Hitachi submersible motors application maintenance manual; for Franklin motors refer to the Franklin submersible motors application maintenance manual.

APPENDIX D

CONTROL AND ELECTRICAL BACKUP

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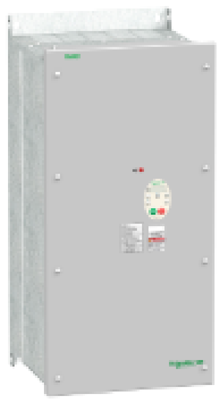
Product data sheet
Characteristics

ATV212WD18N4
variable speed drive ATV212 - 18.5kW - 25hp - 480V - 3ph - EMC class C2 - IP55

Product availability : Stock - Normally stocked in distribution facility

Price* : 2219.00 USD



Main

Range of product	Altivar 212
Product or component type	Variable speed drive
Device short name	ATV212
Product destination	Asynchronous motors
Product specific application	Pumps and fans in HVAC
Assembly style	With heat sink
Phase	3 phases
Motor power kW	18.5 kW
Motor power hp	25 hp
[Us] rated supply voltage	380...480 V - 15...10 %
Supply voltage limits	323...528 V
Supply frequency	50...60 Hz - 5...5 %
Network frequency	47.5...63 Hz
EMC filter	Class C2 EMC filter integrated
Line current	27.8 A 480 V 34.9 A 380 V

Complementary

Apparent power	28.2 kVA 380 V
Prospective line Isc	22 kA
Continuous output current	37 A 380 V 37 A 460 V
Maximum transient current	40.7 A 60 s
Speed drive output frequency	0.5...200 Hz
Nominal switching frequency	8 kHz
Switching frequency	6...16 kHz adjustable 8...16 kHz with derating factor

Speed range	1...10
Speed accuracy	+/- 10 % of nominal slip 0.2 Tn to Tn
Torque accuracy	+/- 15 %
Transient overtorque	120 % of nominal motor torque +/- 10 % 60 s
Asynchronous motor control profile	Flux vector control without sensor, standard Voltage/Frequency ratio, automatic IR compensation (U/f + automatic Uo) Voltage/Frequency ratio - Energy Saving, quadratic U/f Voltage/Frequency ratio, 2 points Voltage/Frequency ratio, 5 points
Regulation loop	Adjustable PI regulator
Motor slip compensation	Adjustable Automatic whatever the load Not available in voltage/frequency ratio motor control
Local signalling	1 LED red DC bus energized
Output voltage	<= power supply voltage
Isolation	Electrical between power and control
Type of cable	IEC cable without mounting kit 1 113 °F (45 °C) copper 90 °C XLPE/EPR IEC cable without mounting kit 1 45 °C copper 70 °C PVC UL 508 cable with UL Type 1 kit 3 40 °C copper 75 °C PVC
Electrical connection	Terminal 0 in² (2.5 mm²) AWG 14 VIA, VIB, FM, FLA, FLB, FLC, RY, RC, F, R, RES Terminal 25 mm² AWG 3 L1/R, L2/S, L3/T
Tightening torque	47.79 lbf.in (5.4 N.m) 48 lb.in L1/R, L2/S, L3/T 0.6 N.m VIA, VIB, FM, FLA, FLB, FLC, RY, RC, F, R, RES
Supply	Internal supply for reference potentiometer (1 to 10 kOhm) 10.5 V DC +/- 5 % <= 10 A overload and short-circuit protection Internal supply 24 V DC 21...27 V <= 200 A overload and short-circuit protection
Analogue input number	2
Analogue input type	Switch-configurable voltage VIA 0...10 V DC 24 V max 30000 Ohm 10 bits Configurable voltage VIB 0...10 V DC 24 V max 30000 Ohm 10 bits Configurable PTC probe VIB 0...6 probes 1500 Ohm Switch-configurable current VIA 0...20 mA 250 Ohm 10 bits
Sampling duration	2 ms +/- 0.5 ms F discrete 2 ms +/- 0.5 ms R discrete 2 ms +/- 0.5 ms RES discrete 3.5 ms +/- 0.5 ms VIA analog 22 ms +/- 0.5 ms VIB analog
Response time	2 ms +/- 0.5 ms FM analog 7 ms +/- 0.5 ms FLA, FLC discrete 7 ms +/- 0.5 ms FLB, FLC discrete 7 ms +/- 0.5 ms RY, RC discrete
Accuracy	+/- 0.6 % VIA for a temperature variation 60 °C +/- 0.6 % VIB for a temperature variation 60 °C +/- 1 % FM for a temperature variation 60 °C
Linearity error	+/- 0.15 % of maximum value input VIA +/- 0.15 % of maximum value input VIB +/- 0.2 % output FM
Analogue output number	1
Analogue output type	Switch-configurable voltage FM 0...10 V DC 7620 Ohm 10 bits Switch-configurable current FM 0...20 mA 970 Ohm 10 bits
Discrete output number	2
Discrete output type	Configurable relay logic FLA, FLC NO 100000 cycles Configurable relay logic FLB, FLC NC 100000 cycles Configurable relay logic RY, RC NO 100000 cycles
Minimum switching current	3 mA 24 V DC configurable relay logic
Maximum switching current	5 A 250 V AC resistive cos phi = 1 L/R = 0 ms FL, R 5 A 30 V DC resistive cos phi = 1 L/R = 0 ms FL, R 2 A 250 V AC inductive cos phi = 0.4 L/R = 7 ms FL, R 2 A 30 V DC inductive cos phi = 0.4 L/R = 7 ms FL, R
Discrete input type	Programmable F 24 V DC level 1 PLC 4700 Ohm Programmable R 24 V DC level 1 PLC 4700 Ohm Programmable RES 24 V DC level 1 PLC 4700 Ohm
Discrete input logic	Positive logic (source) F, R, RES <= 5 V >= 11 V Negative logic (sink) F, R, RES >= 16 V <= 10 V

Acceleration and deceleration ramps	Automatic based on the load Linear adjustable separately from 0.01 to 3200 s
Braking to standstill	By DC injection
Protection type	Motor phase break motor Break on the control circuit drive Thermal power stage drive Overvoltages on the DC bus drive Against exceeding limit speed drive Against input phase loss drive With PTC probes motor Input phase breaks drive Line supply overvoltage and undervoltage drive Line supply undervoltage drive Overcurrent between output phases and earth drive Overheating protection drive Short-circuit between motor phases drive Thermal protection motor
Dielectric strength	3535 V DC between earth and power terminals 5092 V DC between control and power terminals
Insulation resistance	>= 1 MOhm 500 V DC for 1 minute
Frequency resolution	0.024/50 Hz analog input 0.1 Hz display unit
Communication port protocol	Modbus BACnet APOGEE FLN LonWorks METASYS N2
Connector type	1 open style 1 RJ45
Physical interface	2-wire RS 485
Transmission frame	RTU
Transmission rate	9600 bps or 19200 bps
Data format	8 bits, 1 stop, odd even or no configurable parity
Type of polarization	No impedance
Number of addresses	1...247
Communication service	Time out setting from 0.1 to 100 s Write multiple registers (16) 2 words maximum Write single register (06) Read holding registers (03) 2 words maximum Read device identification (43) Monitoring inhibitable
Option card	Communication card LonWorks
Operating position	Vertical +/- 10 degree
Width	12.2 in (310 mm)
Height	26.18 in (665 mm)
Depth	12.4 in (315 mm)
Product weight	82.45 lb(US) (37.4 kg)
Functionality	Mid
Specific application	HVAC
IP degree of protection	IP55

Environment

Electromagnetic compatibility	Conducted radio-frequency immunity test level 3 IEC 61000-4-6 Voltage dips and interruptions immunity test IEC 61000-4-11 1.2/50 µs - 8/20 µs surge immunity test level 3 IEC 61000-4-5 Electrical fast transient/burst immunity test level 4 IEC 61000-4-4 Electrostatic discharge immunity test level 3 IEC 61000-4-2 Radiated radio-frequency electromagnetic field immunity test level 3 IEC 61000-4-3
Pollution degree	2 IEC 61800-5-1
IP degree of protection	IP55 EN/IEC 61800-5-1 IP55 EN/IEC 60529
Vibration resistance	1 gn 13...200 Hz EN/IEC 60068-2-8

	1.5 mm 3...13 Hz EN/IEC 60068-2-6
Shock resistance	15 gn 11 ms IEC 60068-2-27
Environmental characteristic	Classes 3C1 IEC 60721-3-3 Classes 3S2 IEC 60721-3-3
Noise level	60.2 dB 86/188/EEC
Operating altitude	3280.84...9842.52 ft (1000...3000 m) limited to 2000 m for the Corner Grounded distribution network with current derating 1 % per 100 m <= 3280.84 ft (1000 m) without derating
Relative humidity	5...95 % without condensation IEC 60068-2-3 5...95 % without dripping water IEC 60068-2-3
Ambient air temperature for operation	14...104 °F (-10...40 °C) without derating > 104...122 °F (> 40...50 °C) with derating factor
Ambient air temperature for storage	-13...158 °F (-25...70 °C)
Standards	EN 61800-3 environments 1 category C2 IEC 61800-3 environments 1 category C2 IEC 61800-3 environments 2 category C3 EN 61800-3 environments 2 category C1 EN 61800-3 environments 1 category C1 IEC 61800-3 category C2 IEC 61800-3 environments 2 category C1 IEC 61800-3 environments 1 category C3 EN 55011 class A group 1 EN 61800-3 environments 2 category C3 IEC 61800-3 IEC 61800-3 environments 2 category C2 EN 61800-3 category C3 IEC 61800-5-1 EN 61800-5-1 EN 61800-3 IEC 61800-3 environments 1 category C1 EN 61800-3 environments 1 category C3 IEC 61800-3 category C3 EN 61800-3 environments 2 category C2 EN 61800-3 category C2
Product certifications	CSA C-Tick UL NOM 117
Marking	CE

Ordering and shipping details

Category	22157 - ATV212 1 - 25 HP 460 VOLT
Discount Schedule	CP4D
GTIN	00785901957294
Nbr. of units in pkg.	1
Package weight(Lbs)	77
Returnability	N
Country of origin	FR

Offer Sustainability

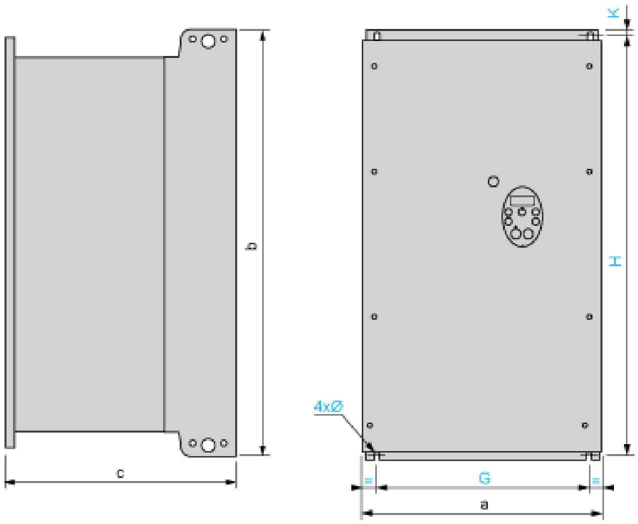
Sustainable offer status	Green Premium product
RoHS (date code: YYWW)	Compliant - since 1112 - Schneider Electric declaration of conformity Schneider Electric declaration of conformity
REACh	Reference not containing SVHC above the threshold Reference not containing SVHC above the threshold
Product environmental profile	Available Product Environmental Profile
Product end of life instructions	Available End of life manual

Contractual warranty

Warranty period	18 months

ATV212WD18N4

Dimensions



Dimensions in mm

ATV212W	a	b	c	G	H	K	ø
D11N4, D15N4 D11N4C, D15N4C	290	560	315	250	544	8	6
D18N4 D18N4C	310	665	315	270	650	10	6
D22N4, D30N4 D22N4C, D30N4C	284	720	315	245	700	10	7
D37N4, D45N4 D37N4C, D45N4C	284	880	343	245	860	10	7
D55N4, D75N4 D55N4C, D75N4C	362	1000	364	300	975	10	9

Dimensions in in.

ATV212W	a	b	c	G	H	K	ø
D11N4, D15N4 D11N4C, D15N4C	11.42	22.05	12.40	9.84	21.42	0.31	0.24
D18N4 D18N4C	12.20	26.18	12.40	10.63	25.59	0.39	0.24
D22N4, D30N4 D22N4C, D30N4C	11.18	28.35	12.40	9.65	27.56	0.39	0.27
D37N4, D45N4 D37N4C, D45N4C	11.18	34.65	13.50	9.65	33.86	0.39	0.27
D55N4, D75N4 D55N4C, D75N4C	14.25	39.37	14.33	11.81	38.39	0.39	0.35

Product Data Sheet

New!

Reliable SCADA Communications in Difficult Terrain

Raveon VHF / UHF / MURS Data Radios

Very High performance Long-Range 5 Watt radios with Remote Management

- Reliable long-distance wireless communications for industrial SCADA systems – up to 60 miles
- Point-to-Multipoint, Peer-to-Peer operation
- High penetration 150MHz (VHF) and 450MHz (UHF) operation
- Industry Leading Sensitivity and overall Receiver Performance
- Ultra-fast Transmit/Receive Switching Times for fast system throughput
- Store & Forward Repeater operation to extend radio range
- RS-232, RS-485 and USB Communications Interfaces
- Allen-Bradley (DF1), Modicon (Modbus) and Harris (DNP3) protocol support
- Low-power and smart power management for solar/battery backed applications
- Compact DIN Rail Mounting Available
- Wide operating Temperature Range: -30°C to +60°C
- 3-year factory warranty on parts and labor

Raveon 5 Watt Data Radio

Wideband Coverage – Raveon Radios are available to cover the entire VHF and UHF Bands in the US and around the world; 136MHz to 174MHz (VHF) and 403 MHz to 512MHz (UHF) (includes non-domestic frequencies).

Extremely Fast - Raveon Radios support over-the-air data rates of up to 19,200 baud and transmit/receive switching times down to 3mS. Message throughput rates of 50 messages per second are possible depending on configuration settings and message sizes.

Superior Receiver Performance – Not all 5 watt radios are the same. Raveon radios have extreme sensitivity and front-end performance to dig out even the weakest signals, even up to 60 miles away!.

Simple Universal Interface - Raveon radios can be used with nearly any industrial control device with a standard serial or USB port. No modem control signals are used and messages are transferred in error-checked packets, compatible with standard protocols including Modbus, DF1 and DNP3.

Point-to-Multipoint and Peer-to-peer Topologies - In addition to conventional point-to-multipoint configurations, Raveon radios support peer-to-peer communications for newer high-performance, high-reliability system configurations that don't depend on a "Master" radio, eliminating a potential single-point of failure.

Integral Repeater Functionality – Raveon radios have built-in Store-and-Forward capability so any radio can also act as a repeater to effectively extend the reach of a radio system.

License-Free Operation Available – Raveon radios are available in MURS configuration without requiring an FCC License. Output power is limited to 2 watts, there are four available non-exclusive VHF frequencies and repeaters are not allowed.

RS-232, RS-485 and USB Interfaces– Raveon radios are available with four industry standard communications interfaces to simplify connection into nearly any system; RS-232, RS-422 and RS-485 for use in legacy point-to-point and multi-drop configurations, and USB for more modern systems and PC computers.

Remote Diagnostics and Management – Channel performance, RSSI, RF power, packet counters, and radio configuration are easily accessed locally via the serial port or remotely over-the-air, simplifying the installation and management of larger installations over wide areas. "Radio Manager" software makes configuration and system troubleshooting even easier.

Very Low Power Consumption– Raveon radios can be powered down to very low power consumption levels (sleep mode), ideal for solar powered and battery backed systems.

Rugged Reliability – Raveon radios are 100% tested over an extended temperature range of -30C to 60C, and backed by an industry leading 3-year factory parts and labor warranty.

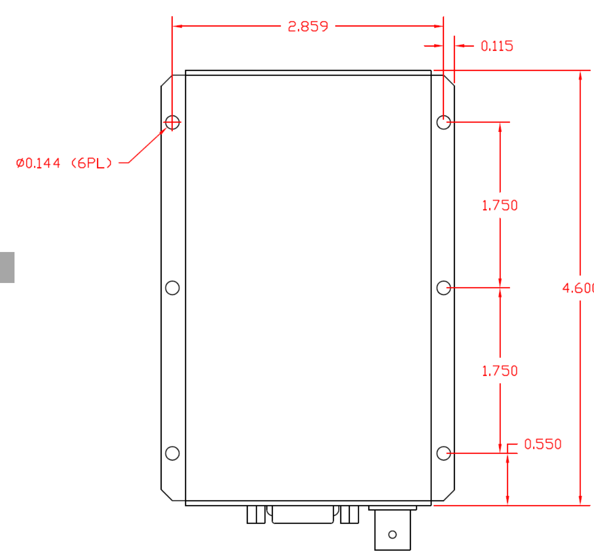
Specifications	VHF / MURS	UHF
RF Performance		
Transmit Power	0.5Watt to 5 Watt - user configurable (up to 2 watts - MURS)	
Maximum Duty Cycle	100% @ 2W to 40C, 25% @5W (100% w/ optional heat-sink)	
Operating Frequency	A 136-155MHz (for export) B 150-174MHz (domestic & export)	A 403-434MHz (for export) B 419-440MHz (for export) C 450-480MHz domestic & export) D 470-512MHz (for export)
Frequency Stability	Better than +/- 2.5ppm	Better than +/- 1.5ppm
Tx/Rx Turnaround Time	<5mS	<3mS
Receiver Sensitivity (0.1% BER)	< -118 dBm @ 1200bps < -114 dBm @ 4800bps < -108 dBm @ 9600bps	< -116 dBm @ 4800bps < -108 dBm @ 9600bps
Adjacent Channel Selectivity	-70dB (1200bps Wide) -65dB (1200bps Narrow) -60dB (4800bps Narrow)	-50 dB
Alternate Channel Selectivity	-70dB (1200bps Wide)	-65 dB
Blocking and Spurious Rejection	-80dB	-75dB
Rx Intermodulationm Rejection	75dB (4800bps Narrow) 80dB (1200bps Narrow)	75dB (4800bps Narrow) 80dB (1200bps Narrow)

Data Communications Port

Interface	RS-232, RS-485 RS-422 (user selectable) or USB (option)
Serial Data Rate	1200 baud to 115200bps (user configurable)

Power	10 to 16Vdc.	
Sleep	: <25mA	: <25mA
Receive/Idle	: <65mA (55mA typ),	: <90mA (85mA typ),
Transmitting	1.8A @ 5W, 1.1A @ 2W typical	2.7A @ 5W, 1.2A @ 2W typical

Antenna Connector	BNC (female)
Mounting	Panel mount (35mm. DIN rail optional)
Dimensions	4.60" X 2.60" X .956 (11.7cm X 6.6cm X 2.43cm)
Environment	- 22°F(- 30°C) to 140°F (60°C), 5%RH to 95% RH, non-condensing
Warranty	3 years, factory parts and labor



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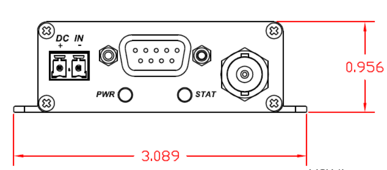


Industrial Control Links, Inc.
www.iclinks.com
Tel: 530-888-1800

Scadaflex II

INTEGRATED SCADA SYSTEM

- Pre-packaged solution minimizes installation labor, time and cost
- Graphical HMI, historical trending, alarming, & control
- Remote I/O runs years on just a "D" cell.
- Reliable wireless wide-area license free meshing radios!
- Complete with antennas, batteries & NEMA 4X enclosures
- Optional local Wi-Fi "hotspot" at Controller
- Optional built-in cell modems, radios and LCD HMI display

Remote I/O

Controller w/LCD HMI, radio & cellular options

With the Scadaflex II System . . .

- ✓ Easily monitor and record levels, flows, pressures, temperatures, soil moisture; nearly any measurement. Operate pumps, motors, valves and gates remotely.
- ✓ See what's going on in your system on any web-enabled device: PCs, tablets and smart phones. There's no "apps" needed.
- ✓ Interact with the system by text message or e-mail! A basic cell phone is all you need.
- ✓ Replace your old unreliable mechanical recorders with the built-in electronic strip charting. Display trending history and pull up reports going back years. There's no extra software or supplies to buy. Regulatory compliance at a fraction of the cost!
- ✓ Eliminate buying a separate PLC. Scadaflex II has built-in programmable control with pre-engineered duplex pump control.
- ✓ Battery powered Remote I/O eliminates the cost and maintenance of power wiring and solar panels at remote sites.
- ✓ Installs in hours, not days!

Scadaflex II – Controllers and Remote I/O

A Scadaflex II system consists of one or more "Controllers" and up to 64 "Remote I/O" units. Controllers have built-in LCD, Graphical Web, e-mail and text message HMIs (Human Machine Interfaces), as well as data recording (years of capacity), alarming, programmable control, and communications capabilities over radio, cellular and Ethernet/Internet. Controllers communicate with Remote I/O using high-reliability wireless meshing technology that ensures successful communications via multiple "self-healing" paths for optimum reliability.

Remote I/O modules are extremely low-power intelligent devices that that can operate for years powered by single "D" cell lithium batteries. This eliminates the cost of installation and maintenance of power wiring, solar panels, chargers and bulky batteries. Remote I/O units spend much of their time "sleeping", consuming very little power until there is an input change, or periodically for "check-in". When they wake up, they send their current I/O information to a Scadaflex II Controller.

A Scadaflex II Controller can serve as a central hub (the "Host") of a SCADA system, or as a collection point feeding information back to a higher-level Host. The Controller not only collects and records information from sensors; it has the tools to display the current system status with a full graphical "web" HMI, send text message and/or e-mail alarms, chart current and historical measurements, and generate reports of what happened going back years. There are no license fees or user limits, so multiple users can access the information simultaneously at very low cost using any standard web browser, like the ones that come with every PC, laptop, tablet or smart phone.

Scadaflex II components come complete and ready to operate in sealed (NEMA 4X) enclosures, with all radio antennas and batteries. All that's required for most systems are the sensors themselves and some configuration using simple "fill-in-the-form" web pages. No particular computer skills beyond web browsing are required.

Scadaflex II

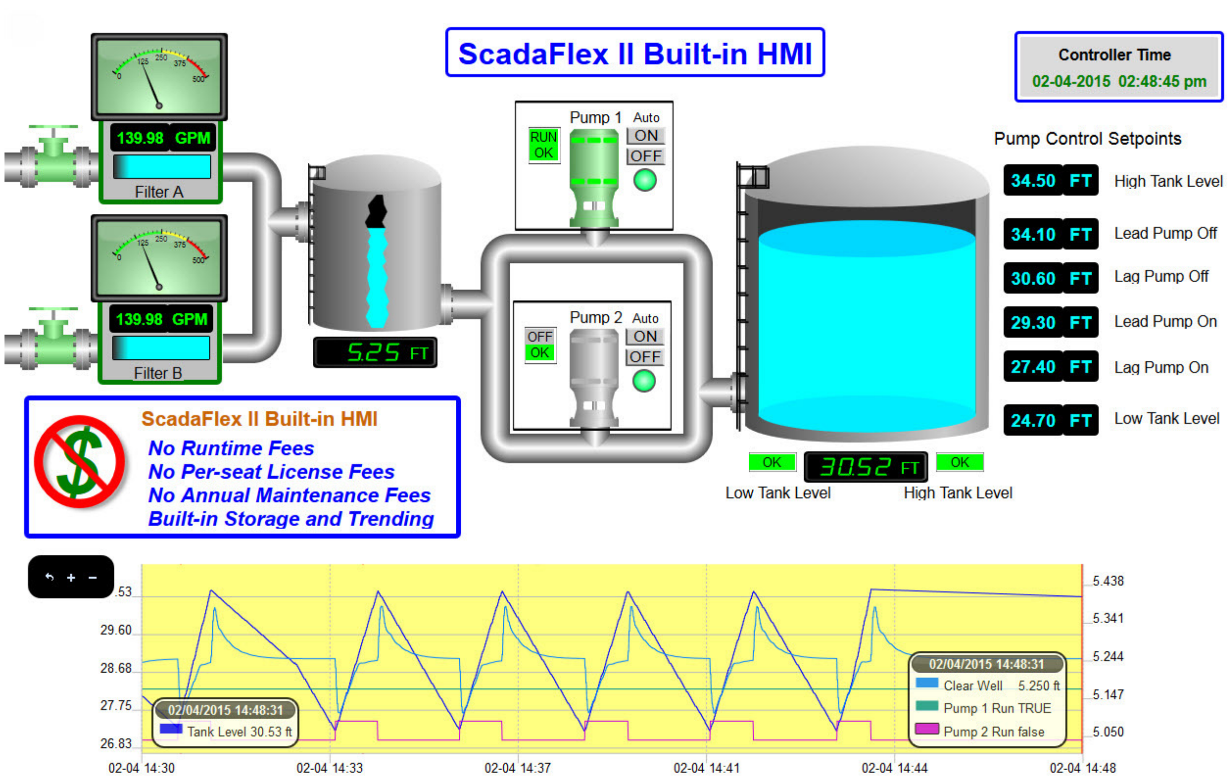
VISUALIZE

with the free built-in Graphical HMI

- ✓ **See what's going on in your system** on any web-enabled device: PCs, tablets and smart phones. No "apps" needed.
- ✓ **Multiple simultaneous user access** on a local network or the Internet at no extra charge
- ✓ **Interact with the system in real time;** change setpoints, turn devices on and off, view historical data and extract reports
- ✓ **Security:** restricted operator access and permissions by a system of usernames and passwords
- ✓ **Absolutely no additional fees or software to purchase**

A Scadaflex II Controller includes a full graphical HMI (Human Machine Interface) that can provide a brilliant high-resolution display of your system and its processes; on PCs and laptops, tablets, smart phones, or anything else that runs a browser. Operators instantly see what's going on with full animation and security controlled access. The HMI is user configurable with the built-in designer tools and a library of graphical elements, so there is no programming or web design skills required; just drag, drop and configure (tag names, colors, etc.). Even the web page designer consists of web pages built into the Scadaflex II Controller, so there is no software to buy or install, no license or maintenance fees to pay, and hours of time saved.

A special simplified reduced-size HMI is included for small screen devices such as cell phones.



The built-in graphical library includes buttons, switches, lights, LED displays and panel meters, analog meters, bar graphs, chasers, pipes, pumps and fans, slider controls and indicators, tanks, valves, text and numerical displays, page links, video display window (from an IP address or camera), and much more. Everything is there that you need to show what's going on in your system, without needing any web programming or artistic skills.

Scadaflex II

Specifications

Controller Modules:		
Analog Inputs:	**4**	16-bit, 20 mA (standard) [5Vdc or 10Vdc optional]
Analog Outputs:	**2**	12-bit, 20 mA, Scadaflex II sources loop power to device from +V input
Digital Inputs:	**12**	Optically Isolated - 10 to 30Vdc.
Pulse Inputs:	**2**	Contact closure or 0 to 30Vdc. Each measures rate and totalizes in addition to acting as a Digital Input
Digital Outputs:	**4**	Solid-state FET transistor, 0 to 30Vdc, 0.5A each, electronically overload and transient protected
Remote I/O:	**64**	Remote I/O modules per Controller (maximum). See Remote I/O counts below.
Data Trending Storage:	**63**	channels on customer supplied micro SD card, 0.5GB or 4GB per year (8 or 1 second resolution). For example,16GB for 32 years of storage at 8s resolution, 63 channels. Report format is CSV file (spreadsheet compatible)
Event Logging Storage:	**2**	MB , internal flash disk, report format is standard CSV file (spreadsheet compatible)
Alarming:	**500**	Alarms by text message and/or e-mail via Ethernet or optional cell modem, 32 alarm contacts (destinations)
Communications:	**1** **1** **1** **1**	10/100 mbps Ethernet port with POE (Power-Over-Ethernet) support RS-232/RS-485 serial port (4-wire RS-422 optional) Optional internal 900Mhz radio (see below) Optional internal cellular modem(see below)
Connectivity:		Most standard PLCs and devices via Modbus (RTU and TCP/IP), DF1, Ethernet IP, SNP, SDX (AES-128 encryption)
Programmable Logic:		Industrial BASIC with SCADA/control enhancements, 4KB, program entry via web page editor/debugger/monitor
Special Functions:		Duplex Pump Control, PID control, Sensorless flow calculation
Configuration:		Built-in web pages accessed via Ethernet Port and/or Cellular Modem
Internal LCD HMI Option:		Wide temperature LCD w/LED backlight, 4 lines x 20 char, 4 navigation/adjustment keys plus Enter and Escape keys
Radio Option (remote I/O):		License-free 900MHz, up to +24dBm (1/4 W) TX power. Up to -110 dBm sensitivity. This option is required for Remote I/O). 3dB whip antenna included – RP-SMA connector for external antennas
Cellular Options:		3G (EV-DO for Verizon, or HSPA+ for most others such as AT&T, Telus, etc.), with 3dB whip antenna (included) SMA connector for external antennas
Wi-Fi Option:		802-11e compatible; recommended for local (no cellular) tablet and smartphone access
Input Power:		10Vdc to 30Vdc, 0.5 watts (typical), 2 watts (maximum), 110/220 Vac optional

Remote I/O Modules:		
Analog Inputs:	**8**	16-bit: 4 x 5Vdc (standard) [10Vdc or 20mA optional], 4 x 25,000 ohms (i.e. position, temperature and soil moisture)
Digital Inputs:	**4**	Contact closure or 0 to 30Vdc. One input includes 16-bit rate and 32-bit totalizer
Digital Outputs:	**2**	Latching relay contacts, 1A, 220Vdc or 250Vac maximum (60W, 125VA maximum switching power)
Serial Ports:	**1**	TTL serial for planned future Serial sensor support
Internal Radio:	**1**	License-free 900MHz, up to +24dBm (1/4 W) maximum TX power, up to -110 dBm sensitivity, with 3dB whip antenna, RP SMA connector for external antennas
Configuration:		By web pages built into Controller, automated updated on power-up or when “CFG” button in Remote is pressed
Analog Loop Power:		15Vdc 50mA maximum, switched for power management
Input Power:		3.6V 19AH Lithium “D” cell (included) or 10Vdc to 30Vdc, field selectable 110/220 Vac optional

Specifications common to all modules:		
Wiring Termination:	**2**	16 position pluggable terminal blocks, 3.5mm, 2 x 14GA wires per terminal maximum, for power and field wiring
Field Wiring Entry:	**1**	Pre-drilled for ¾” conduit (2nd ¾” conduit hole optional)
Temperature:		-40°C to 70°C (operating), -40°C to 85°C (storage)
Humidity:		<95% RH (non-condensing)
Enclosure:		8” (H) x 4”(W) x 3”(D), NEMA 4X, Polycarbonate, wall-mount hardware provided (pipe mount optional)

Scadaflex II

Industrial Control Links, Inc .

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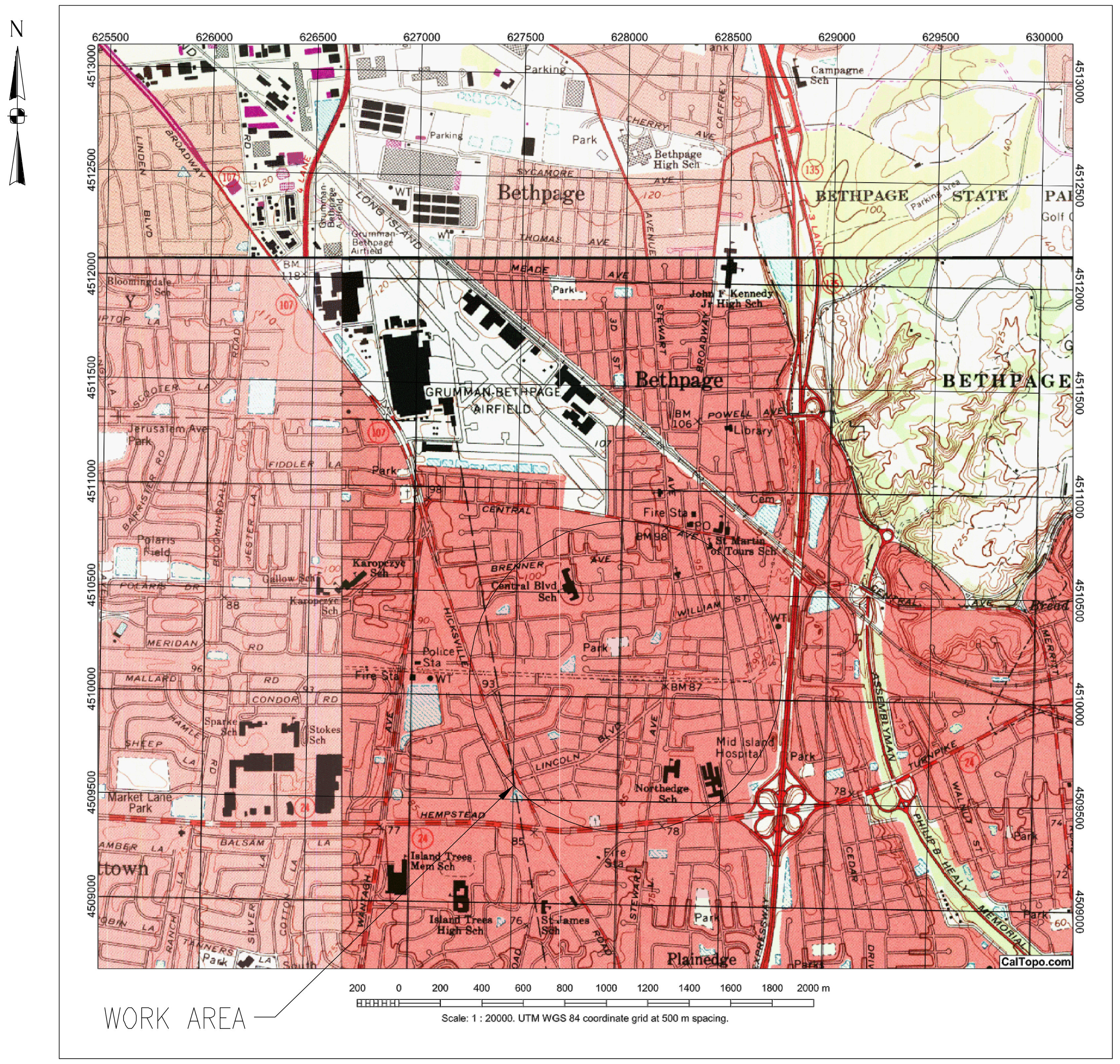

NWIRP BETHPAGE VICINITY MAP

0 1,600 3,200
SCALE IN FEET

30% DESIGN DRAWINGS – REVISION 1

PHASE 1 – RE108 AREA HOTSPOT TREATMENT SYSTEM INTERIM CONVEYANCE SYSTEM

BETHPAGE, NEW YORK

CONTRACT N62472-16-D-9008
CONTRACT TASK ORDER WE24

DRAWING INDEX

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SAT TO | DATE
CODE I.D. NO. 80091
SCALE : AS SHOWN
SPEC. NO.
CONSTRN. CONTR. NO. N62472-99-D-0032
NAVFAC DRAWING NO.
SHEET OF
SIZE: D
DIS. SH. NO. T-1

SEAL AREA

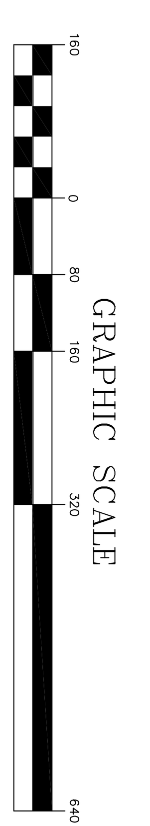
DEPARTMENT OF THE NAVY | NAVAL FACILITIES ENGINEERING COMMAND
NAVAL FACILITIES ENGINEERING COMMAND, MID-ATLANTIC
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT | BETHPAGE, NEW YORK
PHASE 1 – RE108 AREA HOTSPOT TREATMENT SYSTEM
INTERIM CONVEYANCE SYSTEM
TITLE SHEET
APPROVED | DATE | FOR COMMANDER, NAVFAC MID-ATLANTIC

REV	DESCRIPTION	PREP BY	DATE	APPRVD
0	30% DESIGN 1ST DRAFT	BD	08/14/17	DB
1	MINOR TEXT EDITS	BD	09/28/17	DB

DR: CHK:
SUPV: CH ENG:
SUBMITTED BY: (FIRM MEMBER) (TITLE) (DATE)
NORTHDIV DM: HD:
HD:
FPE: DIR:
OFFICER IN CHARGE
APPROVED DATE

LEGEND:

- = TAX LOT LINE
- = GW38 AREA GWTS CHAIN-LINK FENCE
- = EXISTING 6-INCH HDPE PIPE
- = NEW 8-INCH HDPE PIPE
- RW4 = RECOVERY WELL
- = MONITORING WELL



THIS DRAWING PRODUCED ON AUTOCAD
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CODE I.D. NO. 80091
SCALE: AS SHOWN
SPEC. NO.
CONSTR. CONTR. NO. N62472-99-D-0032
NAVFAC DRAWING NO.
SIZE D
SHEET OF
DWG. SH. NO. C-1

SAT TO
DATE

SEAL AREA

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

NAVAL FACILITIES ENGINEERING COMMAND, MID-ATLANTIC

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT — BETHPAGE, NEW YORK

PHASE 1 – RE108 AREA HOTSPOT TREATMENT SYSTEM
INTERIM CONVEYANCE SYSTEM

RW4 PIPING LAYOUT

APPROVED — DATE — FOR COMMANDER, NAVFAC MID-ATLANTIC

REV	DESCRIPTION	PREP BY	DATE	APPRVD
0	30% DESIGN 1ST DRAFT	BD	08/14/17	DB
1	LINES WEIGHTS MODIFIED	BD	09/28/17	DB

DSGN: DR: CHK:
SUPV: CH ENG:
SUBMITTED BY: (FIRM MEMBER) (TITLE) (DATE)
NORTHDIV DM: HD:
HD:
FPE: DIR:
OFFICER IN CHARGE
APPROVED DATE

LEGEND:

- = ROADS
- = POTENTIAL LIMIT OF PIPING ROUTING
- = TOWN LINE
- = TAX LOT LINE
- = EXISTING 6-INCH HDPE PIPE
- = 8-INCH HDPE PIPE WITHIN 12-INCH HDPE SECONDARY CONTAINMENT
- = EXTENT OF TRENCH
- = UNDERGROUND ELECTRICAL CONDUIT
- = EXISTING ELECTRICAL OVERHEAD (APPROXIMATE LOCATION)
- = EXISTING HIGH VOLTAGE ELECTRICAL UNDERGROUND (SUSPECTED LOCATION)
- = EXISTING GAS UNDERGROUND (APPROXIMATE LOCATION)
- = EXISTING SANITARY SEWER (APPROXIMATE LOCATION)
- = EXISTING FENCE/CHAIN-LINK FENCE (APPROXIMATE LOCATION)
- = EXISTING ELECTRICAL MANHOLE (APPROXIMATE LOCATION)
- = EXISTING SANITARY SEWER MANHOLE (APPROXIMATE LOCATION)
- RW-4 = RECOVERY WELL

NOTE

ROADS, TOWN LINES, UTILITY CORRIDORS, RIGHT OF WAYS, TAX LOT LINES, AND VARIOUS UTILITIES SHOWN ON THIS DRAWING ARE APPROXIMATE AND BASED ON AVAILABLE AERIAL IMAGING SUCH AS GOOGLE EARTH AND GOOGLE MAPS. FINAL CONSTRUCTION DRAWINGS WILL BE BASED ON SURVEY INFORMATION AND RECORD DEEDS.

GRAPHIC SCALE

30 0 15 30 60 120

REV	DESCRIPTION	PREP BY	DATE	APPRVD
0	30% DESIGN 1ST DRAFT	BD	08/14/17	DB
1	RW4 MOVED TO ROW, LEGEND MODIFIED	BD	09/28/17	DB
	FINAL RECORD DRAWING			

DSGN: DR: CHK:
SUPV: CH ENG:
SUBMITTED BY: (FIRM MEMBER) (TITLE) (DATE)
NORTHDIV DM: HD: HD: FPE: DIR:
OFFICER IN CHARGE
APPROVED DATE

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

NAVAL FACILITIES ENGINEERING COMMAND, MID-ATLANTIC

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT — BETHPAGE, NEW YORK

PHASE 1 - RE108 AREA HOTSPOT TREATMENT SYSTEM
INTERIM CONVEYANCE SYSTEM

RW4 AREA LAYOUT

APPROVED DATE FOR COMMANDER, NAVFAC MID-ATLANTIC

SEAL AREA

SAT TO DATE
CODE I.D. NO. 80091
SCALE : AS SHOWN
SPEC. NO.
CONSTRN. CONTR. NO. N62472-99-D-0032
NAVFAC DRAWING NO.
SHEET OF
SIZE: D DWG. SH. NO. C-2

LEGEND

- = ROADS
- = POTENTIAL LIMIT OF PIPING ROUTING
- = TOWN LINE
- = TAX LOT LINE
- = EXISTING 8-INCH HDPE PIPE
- = 8-INCH HDPE PIPE WITHIN 12-INCH HDPE SECONDARY CONTAINMENT
- = EXTENT OF TRENCH
- = UNDERGROUND ELECTRICAL CONDUIT
- = EXISTING ELECTRICAL OVERHEAD (APPROXIMATE LOCATION)
- = EXISTING HIGH VOLTAGE ELECTRICAL UNDERGROUND (SUSPECTED LOCATION)
- = EXISTING GAS UNDERGROUND (APPROXIMATE LOCATION)
- = EXISTING SANITARY SEWER (APPROXIMATE LOCATION)
- = EXISTING FENCE/CHAIN-LINK FENCE (APPROXIMATE LOCATION)
- = EXISTING ELECTRICAL MANHOLE (APPROXIMATE LOCATION)
- = EXISTING SANITARY SEWER MANHOLE (APPROXIMATE LOCATION)
- RW-4 = RECOVERY WELL

NOTE

ROADS, TOWN LINES, UTILITY CORRIDORS, RIGHT OF WAYS, TAX LOT LINES, AND VARIOUS UTILITIES SHOWN ON THIS DRAWING ARE APPROXIMATE AND BASED ON AVAILABLE AERIAL IMAGING SUCH AS GOOGLE EARTH AND GOOGLE MAPS. FINAL CONSTRUCTION DRAWINGS WILL BE BASED ON SURVEY INFORMATION AND RECORD DEEDS.

SIZE	SHEET OF	DIS. SH. NO.
D		C-3

CONSTR. CONTR. NO. N62472-99-D-0032
NAVFAC DRAWING NO.
SPEC. NO.
SCALE : AS SHOWN
CODE I.D. NO. 80091
SAT TO DATE
SEAL AREA

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

NAVAL FACILITIES ENGINEERING COMMAND, MID-ATLANTIC

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT — BETHPAGE, NEW YORK

PHASE 1 - RE108 AREA HOTSPOT TREATMENT SYSTEM
INTERIM CONVEYANCE SYSTEM

MARTIN ROAD AREA LAYOUT

APPROVED — DATE — FOR COMMANDER, NAVFAC MID-ATLANTIC

REV	DESCRIPTION	PREP BY	DATE	APPRVD
0	30% DESIGN 1ST DRAFT	BD	08/14/17	DB
1	LEGEND MODIFIED	BD	09/28/17	DB

DSGN: DR: CHK:
SUPV: CH ENG:
SUBMITTED BY: (FIRM MEMBER) (TITLE) (DATE)
NORTHDIV DM: HD: HD: DIR:
FPE:
OFFICER IN CHARGE
APPROVED DATE

LEGEND:

- = ROADS
- = POTENTIAL LIMIT OF PIPING ROUTING
- = TOWN LINE
- = TAX LOT LINE
- = EXISTING 8-INCH HDPE PIPE
- = 8-INCH HDPE PIPE WITHIN 12-INCH HDPE SECONDARY CONTAINMENT
- = EXTENT OF TRENCH
- = UNDERGROUND ELECTRICAL CONDUIT
- OH OH = EXISTING ELECTRICAL OVERHEAD (APPROXIMATE LOCATION)
- E E = EXISTING HIGH VOLTAGE ELECTRICAL UNDERGROUND (SUSPECTED LOCATION)
- G G = EXISTING GAS UNDERGROUND (APPROXIMATE LOCATION)
- S S = EXISTING SANITARY SEWER (APPROXIMATE LOCATION)
- x x x = EXISTING FENCE/CHAIN-LINK FENCE (APPROXIMATE LOCATION)
- = EXISTING ELECTRICAL MANHOLE (APPROXIMATE LOCATION)
- = EXISTING SANITARY SEWER MANHOLE (APPROXIMATE LOCATION)
- RW-4 = RECOVERY WELL

NOTE

ROADS, TOWN LINES, UTILITY CORRIDORS, RIGHT OF WAYS, TAX LOT LINES, AND VARIOUS UTILITIES SHOWN ON THIS DRAWING ARE APPROXIMATE AND BASED ON AVAILABLE AERIAL IMAGING SUCH AS GOOGLE EARTH AND GOOGLE MAPS. FINAL CONSTRUCTION DRAWINGS WILL BE BASED ON SURVEY INFORMATION AND RECORD DEEDS.

GRAPHIC SCALE

30 0 15 30 60 120

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

NAVAL FACILITIES ENGINEERING COMMAND, MID-ATLANTIC

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT — BETHPAGE, NEW YORK

PHASE 1 – RE108 AREA HOTSPOT TREATMENT SYSTEM
INTERIM CONVEYANCE SYSTEM

ALBERGO COURT AREA LAYOUT

APPROVED DATE FOR COMMANDER, NAVFAC MID-ATLANTIC

SEAL AREA

SAT TO DATE

CODE I.D. NO. 80091

SCALE : AS SHOWN

SPEC. NO.

CONSTRN. CONTR. NO. N62472-99-D-0032

NAVFAC DRAWING NO.

SHEET OF

SIZE: D

DIS. SH. NO. C-4

REV	DESCRIPTION	PREP BY	DATE	APPRVD
0	30% DESIGN 1ST DRAFT	BD	08/14/17	DB
1	LEGEND MODIFIED	BD	09/28/17	DB

DSGN: DR: CHK:
SUPV: CH ENG:
SUBMITTED BY: (FIRM MEMBER) (TITLE) (DATE)
NORTHDIV DM: HD: HD: FPE: DIR:
OFFICER IN CHARGE
APPROVED DATE

LEGEND

- = ROADS
- = POTENTIAL LIMIT OF PIPING ROUTING
- = TOWN LINE
- = TAX LOT LINE
- = EXISTING 8-INCH HDPE PIPE
- = 8-INCH HDPE PIPE WITHIN 12-INCH HDPE SECONDARY CONTAINMENT
- = EXTENT OF TRENCH
- = UNDERGROUND ELECTRICAL CONDUIT
- = EXISTING ELECTRICAL OVERHEAD (APPROXIMATE LOCATION)
- = EXISTING HIGH VOLTAGE ELECTRICAL UNDERGROUND (SUSPECTED LOCATION)
- = EXISTING GAS UNDERGROUND (APPROXIMATE LOCATION)
- = EXISTING SANITARY SEWER (APPROXIMATE LOCATION)
- = EXISTING FENCE/CHAIN-LINK FENCE (APPROXIMATE LOCATION)
- = EXISTING ELECTRICAL MANHOLE (APPROXIMATE LOCATION)
- = EXISTING SANITARY SEWER MANHOLE (APPROXIMATE LOCATION)
- RW-4 = RECOVERY WELL

NOTE

ROADS, TOWN LINES, UTILITY CORRIDORS, RIGHT OF WAYS, TAX LOT LINES, AND VARIOUS UTILITIES SHOWN ON THIS DRAWING ARE APPROXIMATE AND BASED ON AVAILABLE AERIAL IMAGING SUCH AS GOOGLE EARTH AND GOOGLE MAPS. FINAL CONSTRUCTION DRAWINGS WILL BE BASED ON SURVEY INFORMATION AND RECORD DEEDS.

GRAPHIC SCALE

30 0 15 30 60 120

SIZE	SHEET OF	NAVFAC DRAWING NO.	CONSTR. CONTR. NO.	SPEC. NO.	SCALE:	CODE I.D. NO.	SAT TO	DATE
D	DES. SH. NO. C-5		N62472-99-D-0032		AS SHOWN	80091		

SEAL AREA

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

NAVAL FACILITIES ENGINEERING COMMAND, MID–ATLANTIC

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT — BETHPAGE, NEW YORK

PHASE 1 – RE108 AREA HOTSPOT TREATMENT SYSTEM
INTERIM CONVEYANCE SYSTEM

MOTOR LANE AREA LAYOUT

APPROVED — DATE — FOR COMMANDER, NAVFAC MID–ATLANTIC

REV	DESCRIPTION	PREP BY	DATE	APPRVD
0	30% DESIGN 1ST DRAFT	BD	08/14/17	DB
1	LEGEND MODIFIED	BD	09/28/17	DB

DSGN: DR: CHK:
SUPV: CH ENG:
SUBMITTED BY: (FIRM MEMBER) (TITLE) (DATE)
NORTHDIV DM: HD:
HD:
FPE: DIR:
OFFICER IN CHARGE
APPROVED DATE

LEGEND

= ROADS
= POTENTIAL LIMIT OF PIPING ROUTING
= TOWN LINE
= TAX LOT LINE
= EXISTING 8-INCH HDPE PIPE
= 8-INCH HDPE PIPE WITHIN 12-INCH HDPE SECONDARY CONTAINMENT
= EXTENT OF TRENCH
= UNDERGROUND ELECTRICAL CONDUIT
= EXISTING ELECTRICAL OVERHEAD (APPROXIMATE LOCATION)
= EXISTING HIGH VOLTAGE ELECTRICAL UNDERGROUND (SUSPECTED LOCATION)
= EXISTING GAS UNDERGROUND (APPROXIMATE LOCATION)
= EXISTING SANITARY SEWER (APPROXIMATE LOCATION)
= EXISTING FENCE/CHAIN-LINK FENCE (APPROXIMATE LOCATION)
= EXISTING ELECTRICAL MANHOLE (APPROXIMATE LOCATION)
= EXISTING SANITARY SEWER MANHOLE (APPROXIMATE LOCATION)
RW-4 = RECOVERY WELL

NOTE
ROADS, TOWN LINES, UTILITY CORRIDORS, RIGHT OF WAYS, TAX LOT LINES, AND VARIOUS UTILITIES SHOWN ON THIS DRAWING ARE APPROXIMATE AND BASED ON AVAILABLE AERIAL IMAGING SUCH AS GOOGLE EARTH AND GOOGLE MAPS. FINAL CONSTRUCTION DRAWINGS WILL BE BASED ON SURVEY INFORMATION AND RECORD DEEDS.

GRAPHIC SCALE
30 0 15 30 60 120

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
NAVAL FACILITIES ENGINEERING COMMAND, MID-ATLANTIC
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT — BETHPAGE, NEW YORK
PHASE 1 – RE108 AREA HOTSPOT TREATMENT SYSTEM
INTERIM CONVEYANCE SYSTEM
RECHARGE BASIN #495 AREA LAYOUT

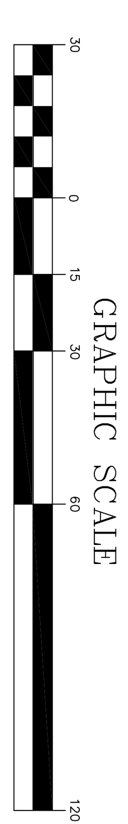
REV	DESCRIPTION	PREP BY	DATE	APPRVD
0	30% DESIGN 1ST DRAFT	BD	08/14/17	DB
1	RW3 CONNECTION MODIFIED, LEGEND MODIFIED	BD	09/28/17	DB

SIZE: D
SHEET OF
CONSTR. CONTR. NO. N62472-99-D-0032
NAVFAC DRAWING NO.
DES. SH. NO. C-6
SPEC. NO.
SCALE: AS SHOWN
CODE I.D. NO. 80091
SAT TO / DATE
SEAL AREA
APPROVED / DATE / FOR COMMANDER, NAVFAC MID-ATLANTIC
DSGN: DR: CHK:
SUPV: CH ENG:
SUBMITTED BY: (FIRM MEMBER) (TITLE) (DATE)
NORTHDIV DM: HD: HD: FPE: DIR:
OFFICER IN CHARGE
APPROVED DATE

LEGEND

- ROADS
- POTENTIAL LIMIT OF PIPING ROUTING
- TOWN LINE
- TAX LOT LINE
- EXISTING 8-INCH HDPE PIPE
- 8-INCH HDPE PIPE WITHIN 12-INCH HDPE SECONDARY CONTAINMENT
- EXTENT OF TRENCH
- UNDERGROUND ELECTRICAL CONDUIT
- EXISTING ELECTRICAL OVERHEAD (APPROXIMATE LOCATION)
- EXISTING HIGH VOLTAGE ELECTRICAL UNDERGROUND (SUSPECTED LOCATION)
- EXISTING GAS UNDERGROUND (APPROXIMATE LOCATION)
- EXISTING SANITARY SEWER (APPROXIMATE LOCATION)
- EXISTING FENCE/CHAIN-LINK FENCE (APPROXIMATE LOCATION)
- EXISTING ELECTRICAL MANHOLE (APPROXIMATE LOCATION)
- EXISTING SANITARY SEWER MANHOLE (APPROXIMATE LOCATION)
- RW-4 = RECOVERY WELL

NOTE
ROADS, TOWN LINES, UTILITY CORRIDORS, RIGHT OF WAYS, TAX LOT LINES, AND VARIOUS UTILITIES SHOWN ON THIS DRAWING ARE APPROXIMATE AND BASED ON AVAILABLE AERIAL IMAGING SUCH AS GOOGLE EARTH AND GOOGLE MAPS. FINAL CONSTRUCTION DRAWINGS WILL BE BASED ON SURVEY INFORMATION AND RECORD DEEDS.



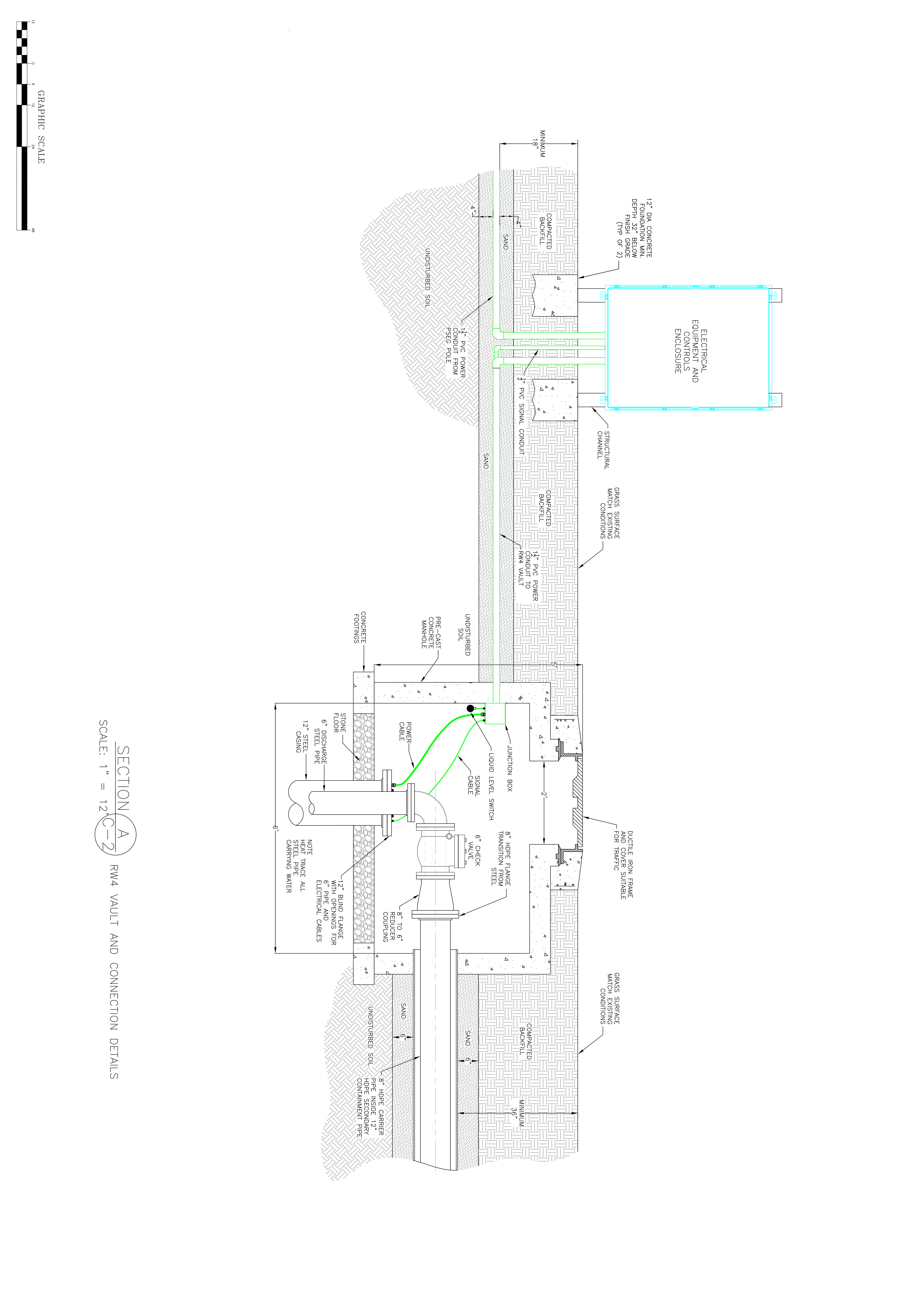
DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND	REV	DESCRIPTION	PREP BY	DATE	APPRVD
NAVAL FACILITIES ENGINEERING COMMAND, MID-ATLANTIC	0	30% DESIGN 1ST DRAFT	BD	08/14/17	DB
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT, BETHPAGE, NEW YORK PHASE 1 – RE108 AREA HOTSPOT TREATMENT SYSTEM INTERIM CONVEYANCE SYSTEM GWTS AREA LAYOUT	1	LEGEND MODIFIED	BD	09/28/17	DB

APPROVED ___ DATE ___ FOR COMMANDER, NAVFAC MID-ATLANTIC

DR: ___ CHK: ___
SUPV: ___ CH ENG: ___
SUBMITTED BY: (FIRM MEMBER) (TITLE) (DATE)
NORTHDIV DM: ___ HD: ___
FPE: ___ HD: ___ DIR: ___
OFFICER IN CHARGE
APPROVED ___ DATE ___

SEAL AREA

SAT TO ___ DATE ___
CODE I.D. NO. 80091
SCALE: AS SHOWN
SPEC. NO.
CONSTR. CONTR. NO. N62472-99-D-0032
NAVFAC DRAWING NO.
SIZE: D
SHEET ___ OF ___
DWG. SH. NO. C-7



REV	DESCRIPTION	PREP BY	DATE	APPRVD
0	30% DESIGN 1ST DRAFT	BD	08/14/17	DB
1	RW4 VAULT LOCATION CHANGED	BD	09/28/17	

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

NAVAL FACILITIES ENGINEERING COMMAND, MID-ATLANTIC

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT — BETHPAGE, NEW YORK

PHASE 1 – RE108 AREA HOTSPOT TREATMENT SYSTEM
INTERIM CONVEYANCE SYSTEM

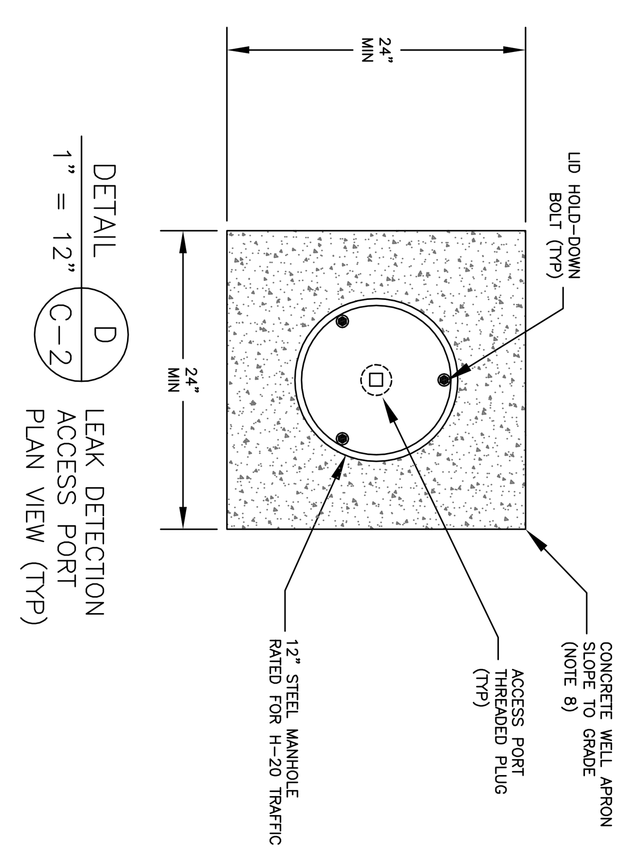
RW4 VAULT AND CONNECTION DETAILS

APPROVED — DATE — FOR COMMANDER, NAVFAC MID-ATLANTIC

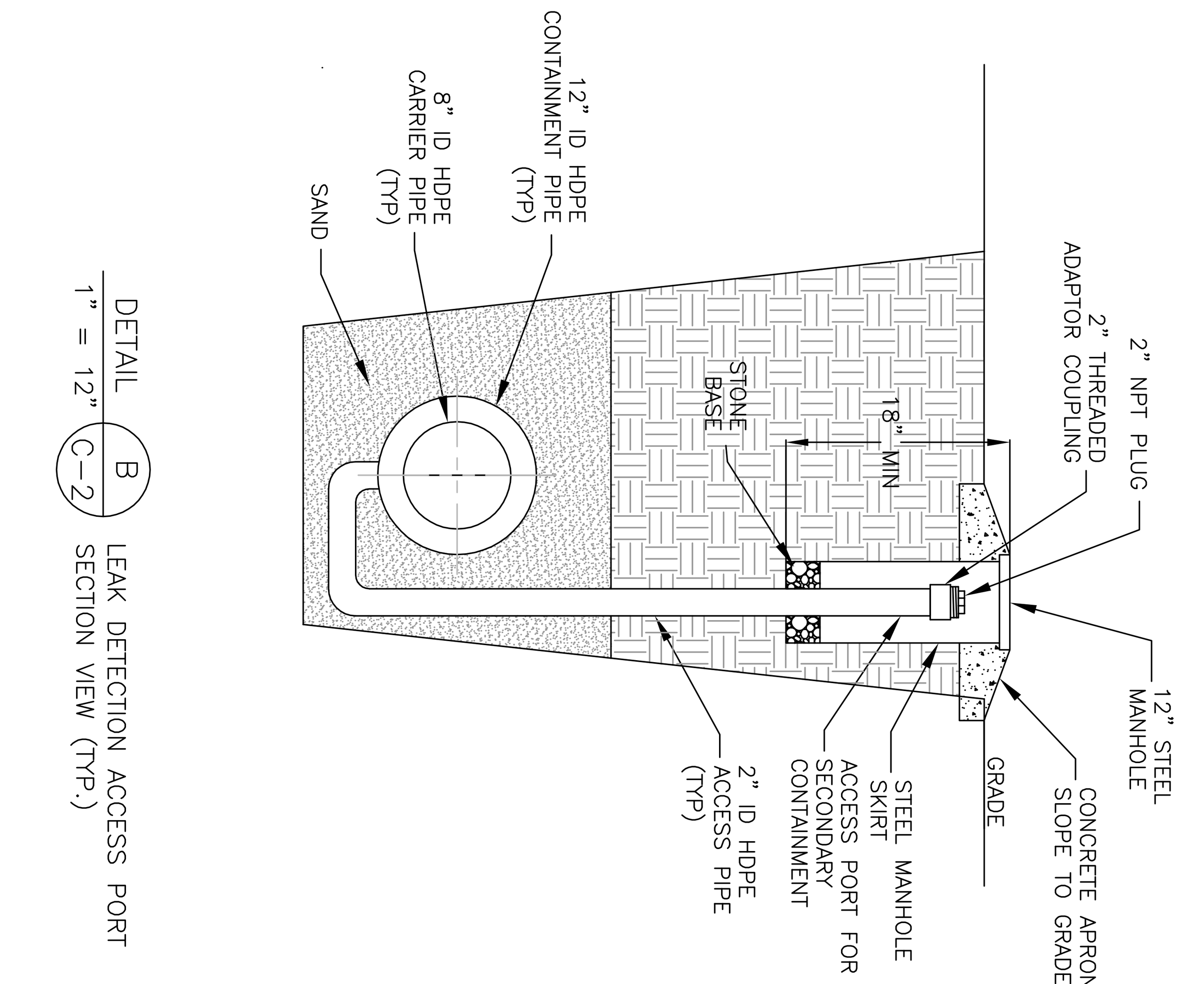
SEAL AREA

DSGN: DR: CHK:
SUPV: CH ENG:
SUBMITTED BY: (FIRM MEMBER) (TITLE) (DATE)
NORTHDIV DM: HD: HD: FPE: DIR:
OFFICER IN CHARGE
APPROVED DATE

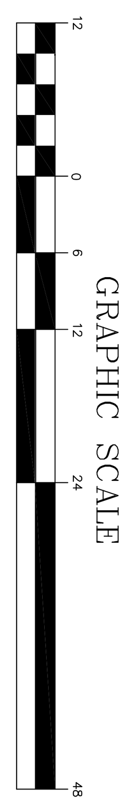
SAT TO: DATE
CODE I.D. NO. 80091
SCALE: AS SHOWN
SPEC. NO.
CONSTR. CONTR. NO. N62472-99-D-0032
NAVFAC DRAWING NO.
SIZE D
SHEET OF
DIS. SH. NO. C-8

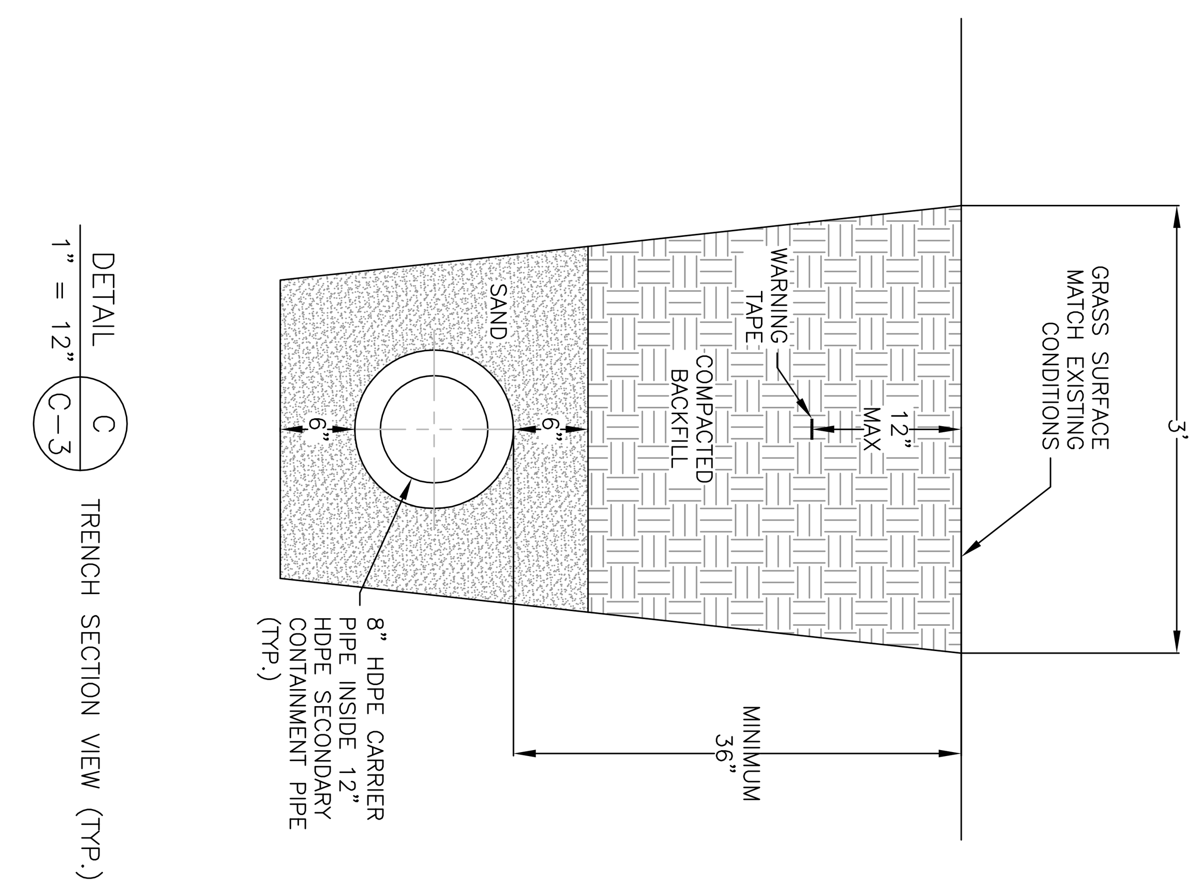


DETAIL D C-2 LEAK DETECTION ACCESS PORT PLAN VIEW (TYP)
1" = 12"

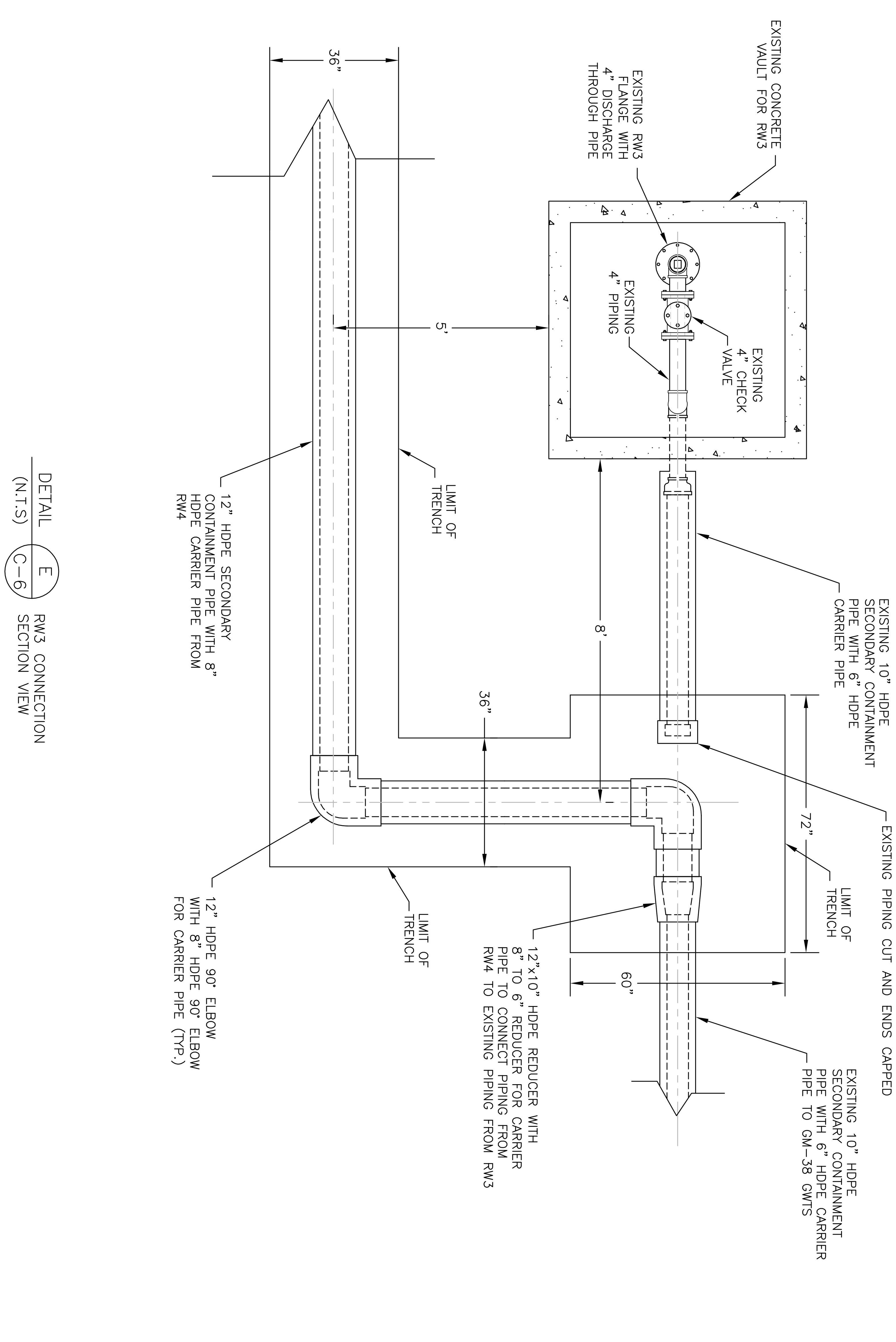


DETAIL B C-2 LEAK DETECTION ACCESS PORT SECTION VIEW (TYP.)
1" = 12"





DETAIL C C-3 TRENCH SECTION VIEW (TYP.)
1" = 12"

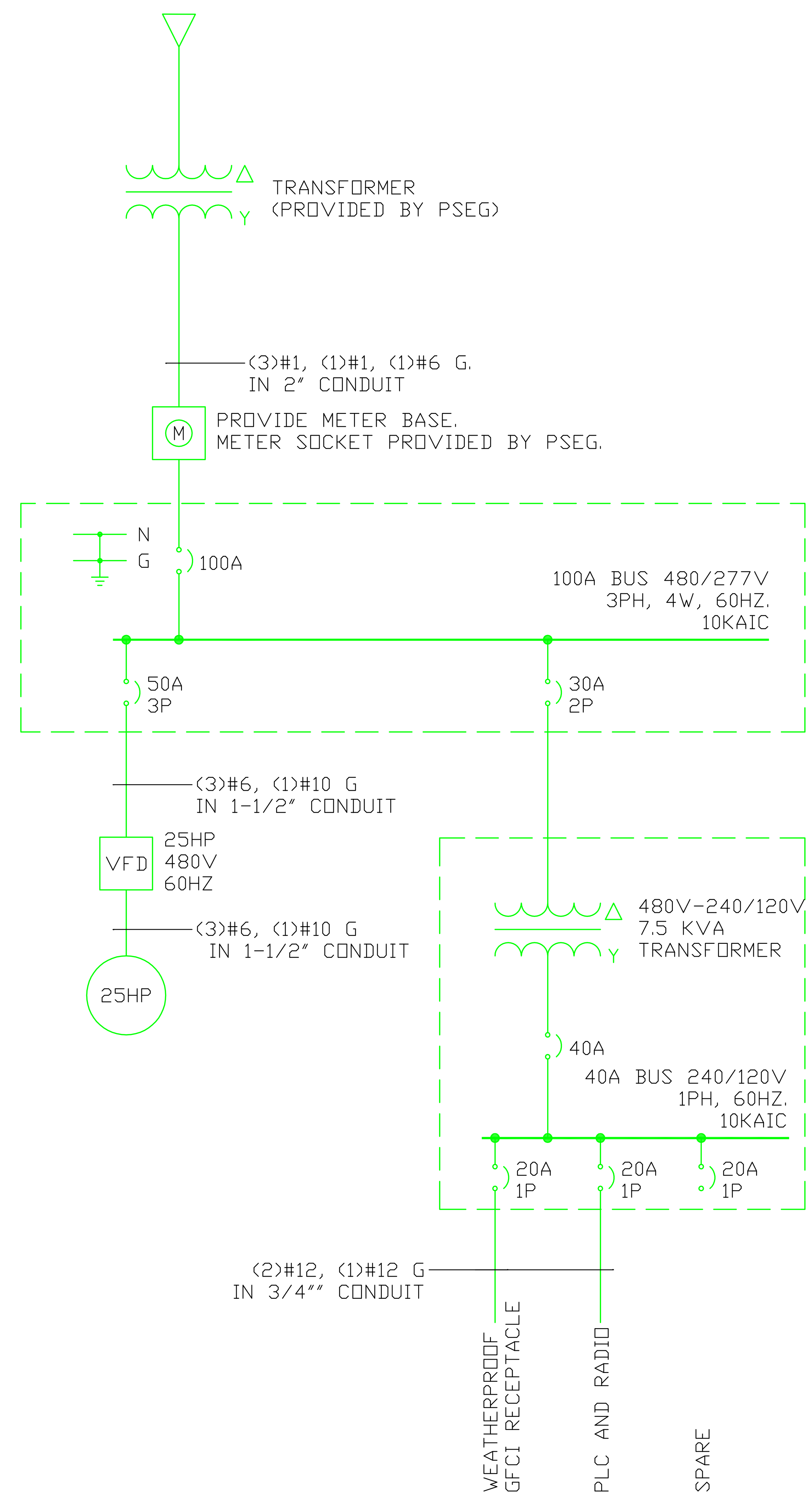


DETAIL E C-6 RW3 CONNECTION SECTION VIEW
(N.T.S)

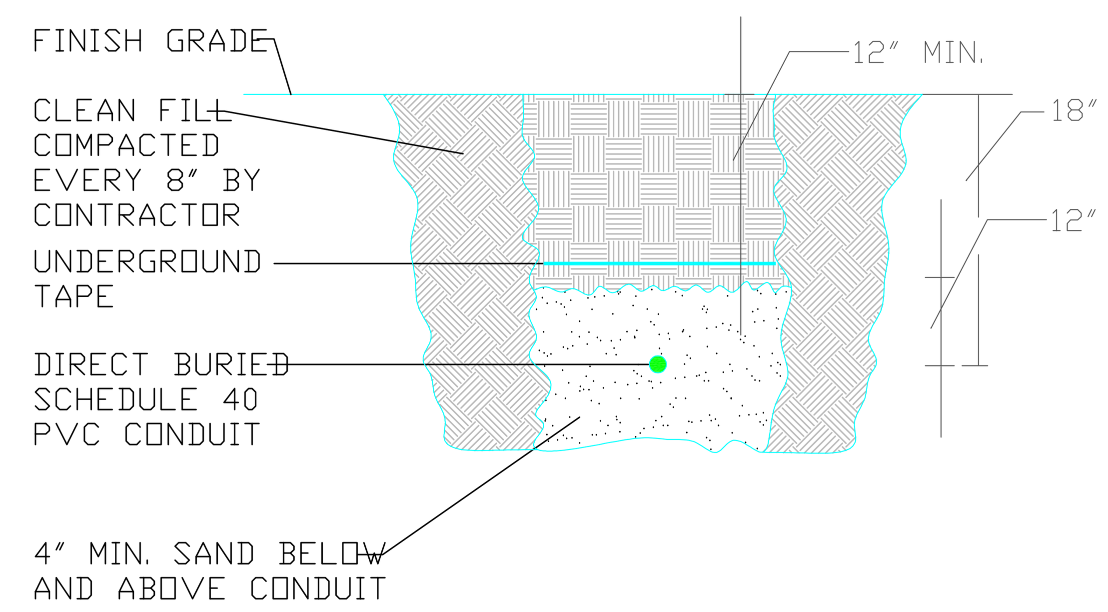
SEAL AREA	DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND	REV	DESCRIPTION	PREP BY	DATE	APPRVD
	NAVAL FACILITIES ENGINEERING COMMAND, MID-ATLANTIC	0	30% DESIGN 1ST DRAFT	BD	08/14/17	DB
	NAVAL WEAPONS INDUSTRIAL RESERVE PLANT — BETHPAGE, NEW YORK; PHASE 1 – RE108 AREA HOTSPOT TREATMENT SYSTEM INTERIM CONVEYANCE SYSTEM	1	NEW PIPING BYPASS RW3	BD	09/28/17	DB
	TRENCHING DESIGN DETAILS					
	APPROVED — DATE — FOR COMMANDER, NAVFAC MID-ATLANTIC					

DSGN: DR: CHK:
SUPV: CH ENG:
SUBMITTED BY: (FIRM MEMBER) (TITLE) (DATE)
NORTHDIV DM: HD:
HD:
FPE: DIR:
OFFICER IN CHARGE
APPROVED DATE

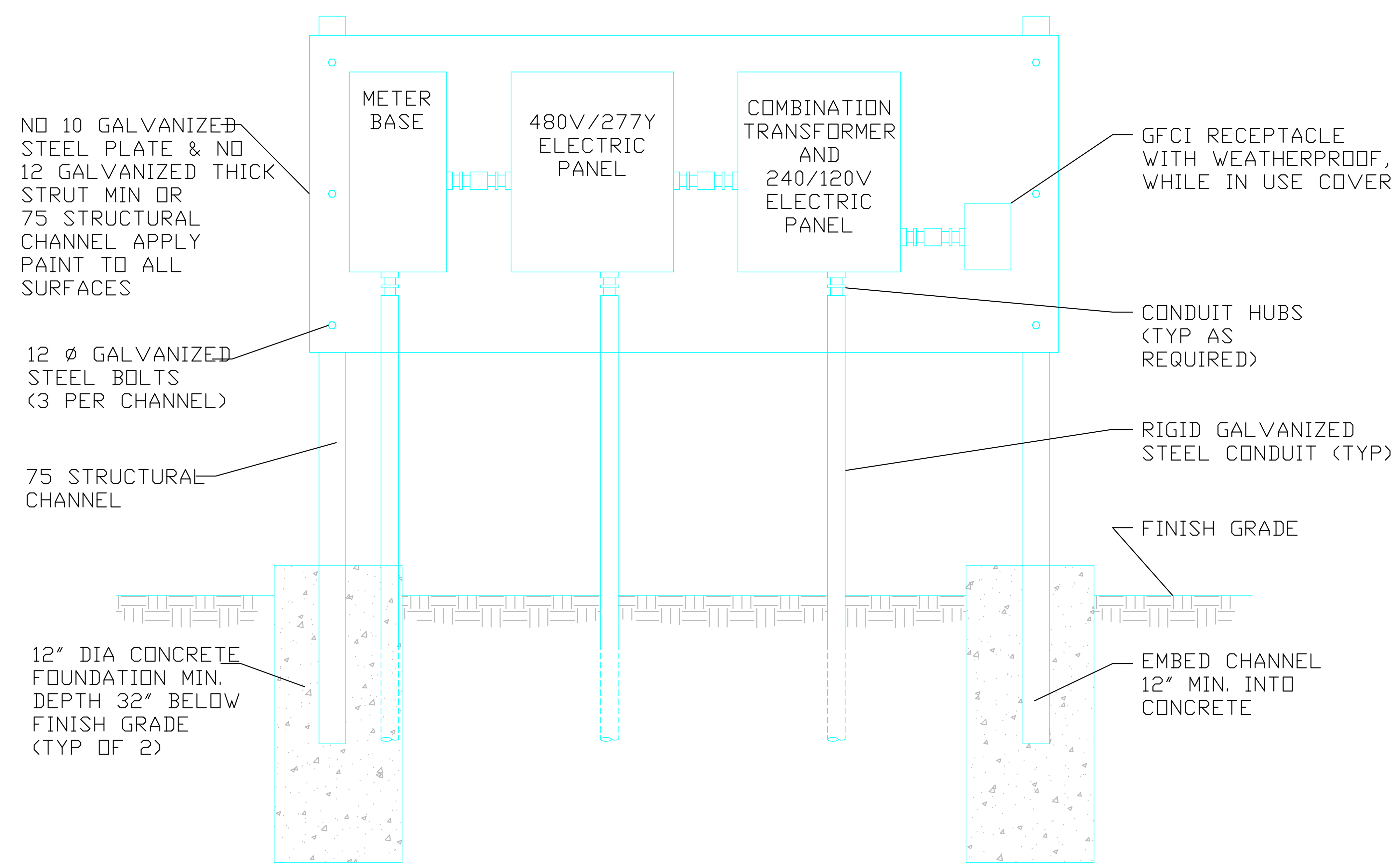
SAT TO: DATE
CODE I.D. NO. 80091
SCALE: AS SHOWN
SPEC. NO.
CONSTR. CONTR. NO. N62472-99-D-0032
NAVFAC DRAWING NO.
SIZE D
SHEET OF
DIS SH. NO. C-9



1 One-Line Diagram
N.T.S.



2 Low-Voltage Direct Bury Conduit
N.T.S.



3 Electrical Equipment Exterior Mounting
N.T.S.

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
NAVAL FACILITIES ENGINEERING COMMAND, MID-ATLANTIC
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT — BETHPAGE, NEW YORK
PHASE 1 - RE108 AREA HOTSPOT TREATMENT SYSTEM
INTERIM CONVEYANCE SYSTEM
ELECTRICAL DESIGN DETAILS
APPROVED — DATE — FOR COMMANDER, NAVFAC MID-ATLANTIC

SEAL AREA

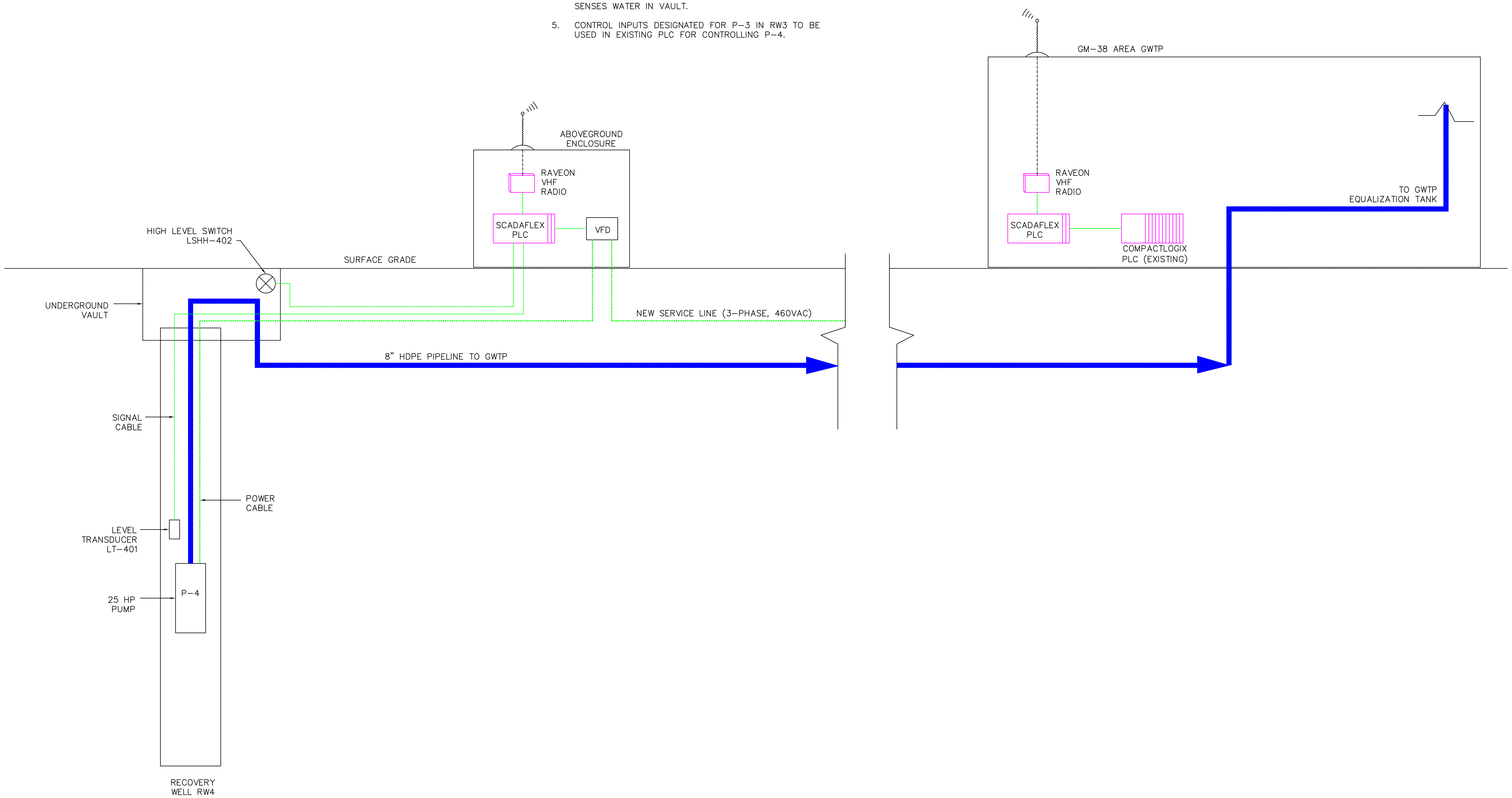
REV	DESCRIPTION	PREP BY	DATE	APPRVD
0	30% DESIGN 1ST DRAFT	DS	08/14/17	GK
1	NO CHANGES	DS	09/28/17	GK

DSGN: DR: CHK:
SUPV: CH ENG:
SUBMITTED BY: (FIRM MEMBER) (TITLE) (DATE)
NORTHDIV DM: HD: HD:
FPE: DIR:
OFFICER IN CHARGE
APPROVED DATE

SAT TO — DATE
CODE I.D. NO. 80091
SCALE : AS SHOWN
SPEC. NO.
CONSTRN. CONTR. NO. N62472-99-D-0032
NAVFAC DRAWING NO.
SHEET OF
SIZE: D — DIS. SH. NO. E-1

RW4 CONTROL SYSTEM FUNCTIONALITY

1. RW4 CONTROL LOGIC IS BASED ON EXISTING GWTS PLC INPUTS SIMILAR TO RECOVERY WELL RW1. THESE INCLUDE ALL SAFETY INTERLOCKS AND P-4 MOTOR SPEED ADJUSTMENT.
2. DISPLAY RW4 LIQUID LEVEL AND PUMP P-4 STATUS INFORMATION ON EXISTING GWTS PLC SIMILAR TO EXISTING PUMP RW1.
3. RW4 WILL BE SHUT DOWN IF COMMUNICATION IS LOST FOR MORE THAN CERTAIN PRE-SET TIME INTERVAL (FOR EXAMPLE 5 MINUTES).
4. RW4 WILL BE SHUT DOWN IF LEVEL SWITCH LSHH-401 SENSES WATER IN VAULT.
5. CONTROL INPUTS DESIGNATED FOR P-3 IN RW3 TO BE USED IN EXISTING PLC FOR CONTROLLING P-4.



LEGEND:

- POWER
- SIGNAL
- DATA
- GROUNDWATER

REV	DESCRIPTION	PREP BY	DATE	APPRVD
0	30% DESIGN 1ST DRAFT	BD	08/14/17	DB
1	FLOW DIRECTION ADDED	BD	09/28/17	DB

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

NAVAL FACILITIES ENGINEERING COMMAND, MID-ATLANTIC

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT — BETHPAGE, NEW YORK

PHASE 1 – RE108 AREA HOTSPOT TREATMENT SYSTEM
INTERIM CONVEYANCE SYSTEM

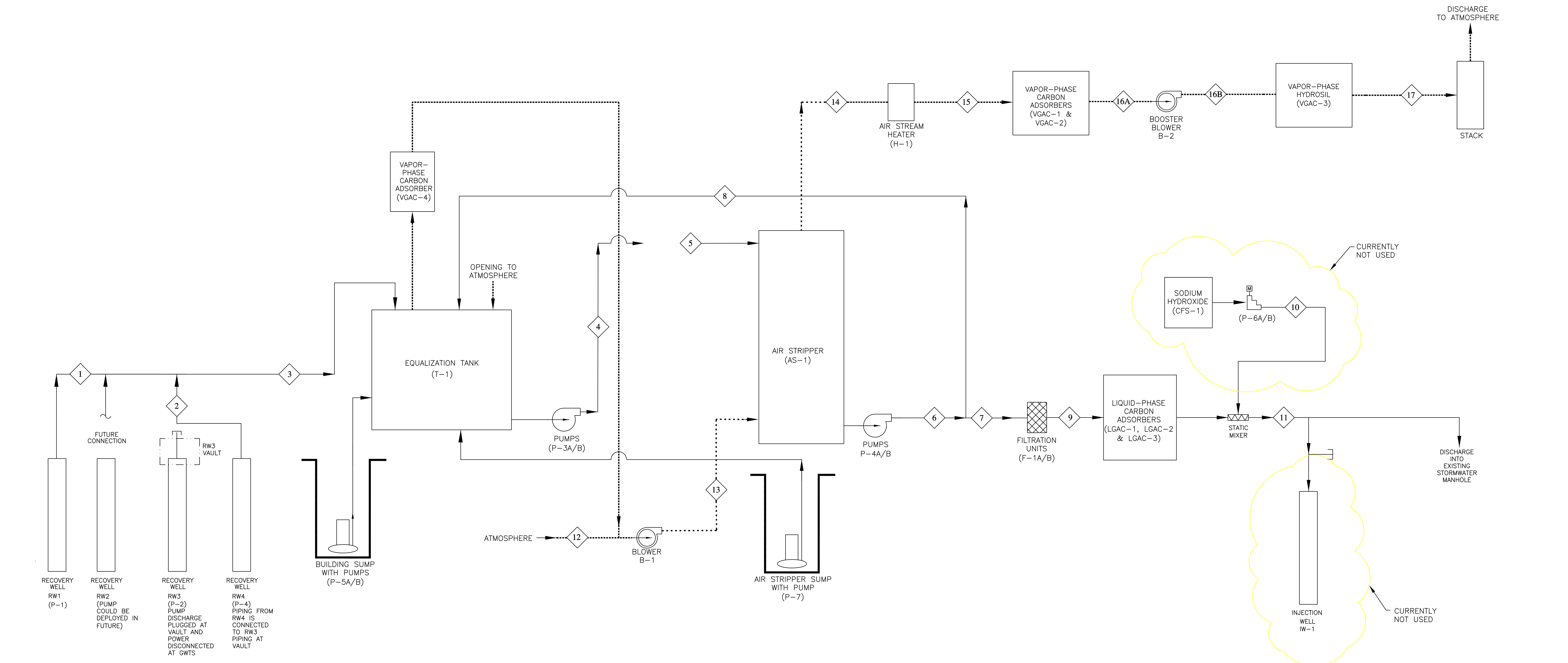
RW4 CONTROL ARCHITECTURE

APPROVED DATE FOR COMMANDER, NAVFAC MID-ATLANTIC

DR: CHK:
SUPV: CH ENG:
SUBMITTED BY: (FIRM MEMBER) (TITLE) (DATE)
NORTHDIV DM: HD: FPE: RD: DIR:
OFFICER IN CHARGE
APPROVED DATE

SEAL AREA

SAT TO DATE
CODE I.D. NO. 80091
SCALE : AS SHOWN
SPEC. NO.
CONSTRN. CONTR. NO. N62472-99-D-0032
NAVFAC DRAWING NO.
SHEET OF
SIZE: D
DIS. SH. NO. E-2



DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

NAVAL FACILITIES ENGINEERING COMMAND, MID-ATLANTIC

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT — BETHPAGE, NEW YORK

PHASE 1 – RE108 AREA HOTSPOT TREATMENT SYSTEM
INTERIM CONVEYANCE SYSTEM

GWTS PROCESS FLOW DIAGRAM

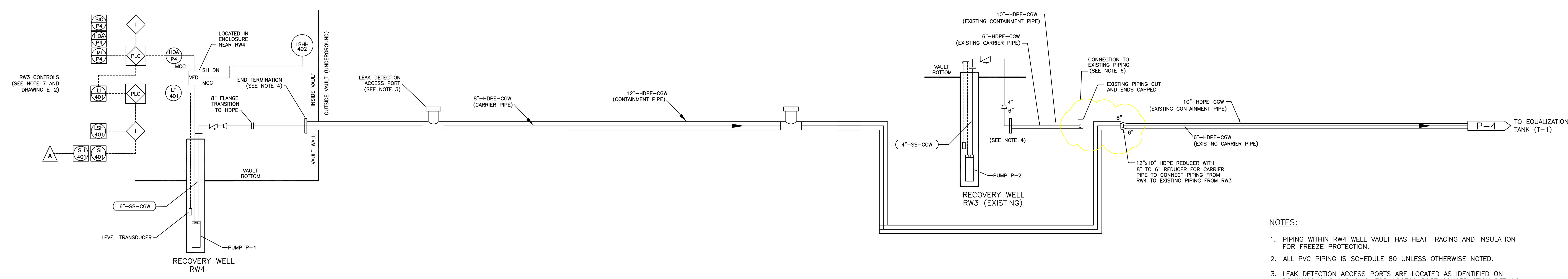
APPROVED — DATE — FOR COMMANDER, NAVFAC MID-ATLANTIC

SEAL AREA

REV	DESCRIPTION	PREP BY	DATE	APPRVD
0	30% DESIGN 1ST DRAFT	BD	08/04/17	DB
1	NEW PIPING BYPASS RW3 VAULT	BD	09/28/17	DB

DSGN: DR: CHK:
SUPV: CH ENG:
SUBMITTED BY: (FIRM MEMBER) (TITLE) (DATE)
NORTHDIV DM: HD: HD:
FPE: DIR:
OFFICER IN CHARGE
APPROVED DATE

SAT TO DATE
CODE I.D. NO. 80091
SCALE : AS SHOWN
SPEC. NO.
CONSTRN. CONTR. NO. N62472-99-D-0032
NAVFAC DRAWING NO.
SHEET OF
SIZE: D
DIS. SH. NO. P-1



NOTES:

1. PIPING WITHIN RW4 WELL VAULT HAS HEAT TRACING AND INSULATION FOR FREEZE PROTECTION.
2. ALL PVC PIPING IS SCHEDULE 80 UNLESS OTHERWISE NOTED.
3. LEAK DETECTION ACCESS PORTS ARE LOCATED AS IDENTIFIED ON DRAWINGS C-2 AND C-6. FOR ACCESS PORT CONSTRUCTION DETAILS SEE DRAWING C-9 (DETAILS B AND D).
4. END TERMINATIONS ARE USED TO SEAL SECONDARY CONTAINMENT PIPING AT THE ENDS OF THE PIPING RUNS.
5. ALL STAINLESS STEEL PIPING IS SCHEDULE 40, 304L.
6. EXISTING DISCHARGE PIPE FROM RW3 VAULT IS ACCESSED OUTSIDE OF RW3 VAULT. NEW PIPING FROM RW4 IS CONNECTED TO EXISTING PIPING FOR RW3 TO GM-38 GWTS.
7. CONTROL INPUTS DESIGNATED FOR P-3 IN RW3 TO BE USED IN PLC FOR CONTROLLING P-4 IN RW4. COMMUNICATION BETWEEN P-4 AND PLC IS VIA RADIO LINK AS SHOWN ON DRAWING E-2.

GENERAL INSTRUMENT SYMBOLS

ONE VARIABLE — TWO VARIABLES

- LOCALLY MOUNTED
- PANEL MOUNTED
- REAR-OF-PANEL MOUNTED
- INTERLOCK (FOR LOGIC DESCRIPTION SEE SPEC. 13600)
- PURGE
- PROGRAMMABLE LOGIC CONTROLLER
- PERSONAL COMPUTER SOFT SWITCH
- PERSONAL COMPUTER HUMAN MACHINE INTERFACE
- PERSONAL COMPUTER
- ALARM

LINE SYMBOLS

- PROCESS PIPES OR CHANNELS
- HEAT TRACE
- CONNECTION TO PROCESS, MECHANICAL LINK OR INSTRUMENT SUPPLY
- PNEUMATIC SIGNAL
- ELECTRIC SIGNAL
- CAPILLARY TUBING (FILLED SYSTEM)
- HYDRAULIC SIGNAL
- ELECTROMAGNETIC OR SONIC SIGNAL NO WIRING OR TUBING
- DATA HIGHWAY SIGNAL

PROCESS LINE ABBREVIATIONS

AIR	AIR, ATMOSPERIC PRESSURE
BW	BACKWASH
CA	COMPRESSED AIR
CF	CHEMICAL FEED
CGW	CONTAMINATED GROUNDWATER
D	DRAIN
EFF	EFFLUENT
EXH	EXHAUST
GW	GROUNDWATER
PW	POTABLE WATER
S	SANITARY
SP	SAMPLE PORT
SS	STORM SEWER
TF	TOTAL FLUIDS
V	VENT
VAP	VAPOR

INSTRUMENT IDENTIFICATION

INSTR LOOP — FIT-100A

- SUFFIX (NOT NORMALLY USED)
- TAG NUMBER
- SUCCEEDING LETTERS
- FIRST LETTER

FUNCTION ABBREVIATIONS

DO	DISSOLVED OXYGEN	OC	OPEN-CLOSE
FC	FAIL CLOSED	OO	ON-OFF (MAINTAINED)
FL	FAIL LOCKED	ORP	OXIDATION REDUCTION POTENTIAL
FO	FAIL OPEN	OSC	OPEN-STOP-CLOSE (MOMENTARY)
HOA	HAND-OFF-AUTOMATIC	SI	MOTOR SPEED INDICATION
I/I	CURRENT-TO-CURRENT	SS	START-STOP (MOMENTARY)
I/P	CURRENT-TO-PNEUMATIC	↑	HIGH SELECT
LCP	LOCAL CONTROL PANEL	↓	LOW SELECT
LEL	LOWER EXPLOSIVE LIMIT	√	SQUARE ROOT
LR	LOCAL-REMOTE	Σ	ADD OR TOTALIZE
MI	MOTOR RUN INDICATION		

PIPING MATERIAL ABBREVIATIONS

AL	ALUMINUM
CPVC	CHLORINATED POLYVINYL CHLORIDE
CS	CARBON STEEL
COP	COPPER
CMP	CORRUGATED METAL PIPE
CIP	CAST IRON PIPE
DIP	DUCTILE IRON PIPE
FLEX	FLEXIBLE PIPE/DUCT/TUBING
GALV	GALVANIZED STEEL
HDPE	HIGH DENSITY POLYETHYLENE
NEO	NEOPRENE HOSE
PE	POLYETHYLENE
PP	POLYPROPYLENE
PVC	POLYVINYL CHLORIDE
RCP	REINFORCED CONCRETE PIPE
RUB	RUBBER HOSE
SS	STAINLESS STEEL PIPE/TUBING
TEF	TEFLON TUBING
VCP	VITRIFIED CLAY PIPE

VALVE AND PIPING SYMBOLS

- REMOVABLE CAP
- GATE VALVE
- CHECK VALVE
- NO — NORMALLY OPEN
- NC — NORMALLY CLOSED
- MOTOR, ELECTRIC
- BF — BLIND FLANGE
- EXHAUST TO ATMOSPERE (INSIDE)
- EXHAUST TO ATMOSPERE (OUTSIDE)
- REDUCER
- FLANGE

EQUIPMENT SYMBOLS

- SUBMERSIBLE WELL PUMP
- PUMP
- BLOWER
- METERING PUMP
- VFD — VARIABLE FREQUENCY DRIVE
- STATIC MIXER

PROCESS PIPING IDENTIFICATION

PROCESS PIPE — XXX-YY-Z

- PIPE CONTENTS
- PIPING MATERIAL
- PIPE DIAMETER (INCHES)

REV	DESCRIPTION	PREP BY	DATE	APPRVD
0	30% DESIGN 1ST DRAFT	BD	08/14/17	DB
1	RW3 PIPING BYPASS RW3 VAULT	BD	09/28/17	DB

DSGN: DR: CHK:
SUPV: CH ENG:
SUBMITTED BY: (FIRM MEMBER) (TITLE) (DATE)
NORTHDIV DM: HD: FPE: HD: DIR:
OFFICER IN CHARGE
APPROVED DATE

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

NAVAL FACILITIES ENGINEERING COMMAND, MID-ATLANTIC

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT — BETHPAGE, NEW YORK

PHASE 1 – RE108 AREA HOTSPOT TREATMENT SYSTEM
INTERIM CONVEYANCE SYSTEM

RW4 PROCESS AND INSTRUMENTATION DIAGRAM

APPROVED — DATE — FOR COMMANDER, NAVFAC MID-ATLANTIC

SEAL AREA

SAT TO — DATE
CODE I.D. NO. 80091
SCALE : AS SHOWN
SPEC. NO.
CONSTRN. CONTR. NO. N62472-99-D-0032
NAVFAC DRAWING NO.
SHEET OF
SIZE: D — DIS. SH. NO. P-2