Hydraulic Effectiveness Evaluation Work Plan for the Operable Unit 2 On-Site Containment System

Northrop Grumman and NWIRP Sites, Bethpage, New York
NYSDEC Sites 1-30-003A & B

PREPARED FOR

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Bethpage, New York

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1. Introduction

This work plan was prepared by ARCADIS on behalf of the Northrop Grumman Corporation to comply with the requirements of the March 2001 Record of Decision (ROD) for Operable Unit 2 (OU2) (NYSDEC 2001) and the anticipated requirements, under Exhibit K, of the OU2 Remedial Design/Remedial Action (RD/RA) Consent Order, which is currently being prepared by the New York State Department of Environmental Conservation (NYSDEC) in cooperation with the NYS Department of Health (NYSDOH), for the Northrop Grumman Corporation (NGC) and Naval Weapons Industrial Reserve Plant (NWIRP) Bethpage, New York sites. This work plan describes the proposed scope of work and methodologies to be used to conduct a hydraulic effectiveness evaluation of the OU2 on-site containment system currently in operation at the NGC site.

The key objectives of the OU2 on-site containment system hydraulic effectiveness evaluation are as follows:

- Evaluate whether the goals described in the OU2 ROD for the on-site containment system are being achieved by implementing a phased investigation/evaluation to determine whether the on-site containment system creates and maintains an effective hydraulic barrier that prevents the off-site migration of groundwater impacted by volatile organic compounds (VOCs).
- Re-evaluate the delineation of the on-site VOC plume, and supplement the data currently available to determine the horizontal and vertical extent of VOCs relative to the screen zones of the OU2 remedial wells, particularly Remedial Well ONCT-1, which exhibits the highest VOC concentrations of the OU2 remedial wells.

The Navy work plan addendum (Appendix A) provides additional details of the work elements associated with the field program. Changes to this work plan will be reflected accordingly in the Navy work plan addendum. The field investigation and subsequent data evaluation and reporting described in this work plan will be conducted separately from the ongoing OU2 quarterly groundwater monitoring, which includes the collection of hydraulic and groundwater quality data from monitoring wells and the OU2 on-site containment system. A description of the proposed scope of work and the associated rationale is provided below.

2. Scope of Work

The site plan is shown on Figure 1. The OU2 on-site containment system described in the ROD consists of the following:

- Remedial Well GP-1 and the associated groundwater treatment system (i.e., the GP-1 system).

- Remedial Wells ONCT-1, ONCT-2, and ONCT-3 and the associated groundwater treatment system (i.e., the ONCT system).
- The Plant 5 Recharge Basins and the South Recharge Basins.

In general, the proposed scope of the field investigation consists of drilling vertical profile borings (VPBs); drilling, installing, and developing permanent monitoring wells; collecting depth-to-groundwater (hydraulic) measurements; and collecting groundwater samples from the new and select existing wells in the vicinity of the southern boundary of the NGC site. A detailed rationale for the scope of work described below is provided in Section 3 (Rationale) of this work plan.

Drilling services for the proposed field investigation will be performed by a NYS-licensed well driller. Field oversight during drilling operations will be provided by a qualified geologist.

Drilling, well installation, equipment decontamination, investigation-derived waste (IDW) management, IDW disposal, and site restoration activities will be performed in accordance with methods provided in the NYSDEC-approved work plans that were prepared by the U.S. Navy (U.S. Navy 2000).

2.1 Vertical Profile Borings

The locations of the proposed VPBs are shown on Figure 1. Two VPBs will be drilled and sampled, as follows: VPB-39 will be drilled and sampled immediately north of Well ONCT-1 and VPB-73 will be drilled and sampled along the north side of the South Recharge Basins adjacent to existing Monitoring Well GM-73D2. VPB drilling and sampling methodologies will be consistent with those described in the NYSDEC-approved work plans that were prepared by the U.S. Navy (U.S. Navy 2000). Mud rotary (MR) drilling/split spoon sampling and Hydropunch sampling will be used to collect lithologic and groundwater samples, respectively. Split spoon (lithologic) samples will be collected at 20 ft intervals from land surface to total depth, and Hydropunch groundwater samples will also be collected at the same frequency, but starting at the water table, which is approximately 50 ft bls. The maximum drilling depth of the VPBs will be to the top of the Raritan Formation, approximately 800 feet below land surface (ft bls). Once the total depth of the VPB has been attained, the borehole will be geophysically logged using the natural gamma method. The VPB borehole will then be abandoned in accordance with NYSDEDC-approved methods (U.S. Navy 2000).

Groundwater samples will be submitted for laboratory analysis of the Target Compound List (TCL) VOCs using United States Environmental Protection Agency (USEPA) Method 8260 or NYSDEC Analytical Services Protocol (ASP) Method 95-1.

2.2 Monitoring Well Installation

After completion of VPB-39, a permanent two-well cluster designated as GM-39D and GM-39D2 will be installed. The total depths and screened zones for the wells comprising this cluster will be determined based on the VPB-39 results. After completion of VPB-73, a permanent monitoring well designated as Well GM-73D will be installed such that it is clustered with existing Monitoring Well GM-73D2. The need for additional monitoring wells will be evaluated based on the results of the VPBs. If necessary, additional monitoring wells (i.e., Wells GM-39D3 and GM-73D3) may be installed at the respective locations (see Section 3.1 of this work plan).

Each monitoring well borehole will be of 8-inch nominal diameter and will be drilled using the MR method, in accordance with NYSDEC approved procedures. Permanent monitoring wells will be installed to total depths that will be based on VPB data (i.e., lithologic, groundwater quality, and geophysical). Monitoring well construction material will consist of the following: nominal 4-inch inner diameter, National Sanitary Foundation (NSF)-grade, Schedule 80 polyvinyl chloride (PVC) with no more than 20 feet of 0.010-inch slot screen. Wells will be completed with a flush-mounted wellhead protective assembly. Monitoring wells will be developed no sooner than 24 hours after installation using a combination of air lift/over-pumping and surging methodologies, consistent with NYSDEC approved procedures.

A NYS-licensed surveyor will survey the locations of the permanent wells to the NYS Plane Coordinate System and land surface and inner casing elevations to the National Geodetic Vertical Datum (NGVD).

2.3 Water-Level Measurements

Two rounds of groundwater-level (hydraulic) measurements will be carried out: the first round will be a minimum of two weeks after development of all proposed monitoring wells has been completed, followed by a second round a minimum of one month later. Sixteen or eighteen wells will be measured as part of these rounds, as follows:

- On-site Monitoring Wells GM-33D2; GM-73D2; GM-74I; GM-74D; and GM-74D2.
- Off-site Monitoring Wells GM-75D2; N-10627; GM-20I; and GM-20D.
- Proposed Monitoring Wells (i.e., GM-39D, GM-39D2, GM-73D, along with any additional new wells [i.e., GM-39D3 and GM-73D3]).
- OU2 Remedial Wells ONCT-1; ONCT-2; ONCT-3; and GP-1.

Collection of depth-to-groundwater measurements and calculation of water-level elevations will be performed consistent with the methods described in the OU2 quarterly groundwater monitoring reports (ARCADIS Geraghty & Miller, Inc., 2001).

2.4 Groundwater Sampling

As part of this investigation, two rounds of groundwater samples will be collected beginning a minimum of two weeks after development of the new wells has been completed, with the second round performed one month after the groundwater quality data from the first round has been received. Four or six wells will be sampled as part of these rounds, as follows:

- If additional monitoring wells (i.e., Wells GM-39D3 and GM-73D3) are not installed, then Wells GM-39D and GM-39D2, GM-73D, and GM-73D2 will be sampled.
- If additional monitoring wells (i.e., Wells GM-39D3 and GM-73D3) are installed, then Wells GM-39D, GM-39D2, GM-39D3, GM-73D, GM-73D2, and GM-73D3 will be sampled.

The monitoring wells will be purged and sampled using methods described in the 2000 annual groundwater monitoring report (ARCADIS Geraghty & Miller, Inc. 2001) and analyzed by a NYS-certified laboratory for the TCL VOCs using NYSDEC ASP Method 95-1. Purge water from monitoring wells will be discharged to the Nassau County Publicly-Owned Treatment Works (POTW), consistent with the ongoing OU2 quarterly groundwater monitoring program.

2.5 Data Evaluation and Reporting

In addition to documentation of the field effort (provided as a summary report to be prepared by Navy – see Appendix A), after receipt of the field investigation results (i.e., VPB lithologic, geophysical, and groundwater quality data, along with permanent monitoring well groundwater elevation data and groundwater quality results), a hydraulic effectiveness report will be prepared that will include the following:

- VPB-39 and VPB-73 groundwater quality data will be provided in a summary table, along with copies of the sample/core logs, geophysical logs, and water sampling logs.
- Water-level elevation data from the permanent wells will be plotted on a plan view base map and will be contoured (or triangulated, depending on the number of data points available) to determine groundwater flow directions in the various aquifer horizons (i.e., deep and deep2 zones). Water-level data may also be evaluated versus model-predicted head values and vertical gradients.

- Groundwater sampling data from the proposed monitoring wells will be validated using methods described in the 2000 annual groundwater monitoring report, tabulated, and compared to NYS Standards, Criteria, and Guidance values (SCGs).

The updated OU2 contaminant-transport model may also be used to evaluate the hydraulic data, based on vertical VOC distribution in the subject area (see discussion below).

3. Rationale

Based on our current knowledge of groundwater quality conditions at the site, OU2 Remedial Well ONCT-1 and the area along the western boundary of the NGC site have exhibited the highest VOC concentrations in groundwater predominantly in the horizons slightly above and within the screen zone of Well ONCT-1, as nearby shallow and intermediate wells have exhibited few or no VOC detections with no exceedences of NYSDEC SCGs. In addition, Well GM-73D2 has exhibited VOC impacts above SCGs and is located nearly equidistant from Remedial Wells ONCT-1 and ONCT-2. The area between Wells ONCT-1 and ONCT-2 has exhibited groundwater VOC concentrations that are close to one part per million in the D2 zone. If VOCs are detected below the screened interval of Remedial Well ONCT-1, then the next logical location to investigate would be at the location of Monitoring Well GM-73D2 to determine whether VOCs are present at depths greater than the ONCT well screens.

The field investigation will be conducted after confirmation that the OU2 containment system wells have operated at greater than 90 percent up-time and at or close to the design pumping rates of 1,075 gallons per minute (GPM) (GP-1); 1,000 GPM (ONCT-1); 600 GPM (ONCT-2); and 700 GPM (ONCT-3) for a minimum of one month, and that the associated treated water discharge is being routed to the South Recharge Basins/Plant 5 Recharge Basins consistent with the rates predicted by the model to prevent the off-site migration of VOCs. The pumping rates above are based on hydraulic evaluation using the groundwater flow model and, based on model predictions, will prevent the off-site migration of VOCs. Operation of the remedial wells at these rates before and during the field investigation will, therefore, produce conditions that are representative of the planned long-term operation of the system and serve as the most appropriate basis for evaluation of the hydraulic effectiveness of the system.

3.1 Vertical Profile Borings and Permanent Wells

The locations of proposed VPBs and wells are shown on Figure 1. VPB-39 will be drilled and sampled near the NGC site southern boundary, north of Remedial Well ONCT-1 and VPB-73 will be drilled and sampled near Well GM-73D2. Both VPBs will serve to characterize and vertically delineate VOC impacts in these areas. After

completion of the VPBs, permanent wells will be installed at the VPB-39 and VPB-73 locations. In general, the proposed permanent wells will be installed to better characterize VOC plume concentrations and monitor water levels at depth.

Permanent monitoring wells will be installed as follows:

- Based on the groundwater sampling conducted at VPB-39, if VOCs are detected above and within the screen zone of Well ONCT-1, then one D/D2 monitoring well cluster will be installed (i.e., Monitoring Wells GM-39D/GM-39D2). Data collected from these wells will be used to determine and monitor vertical hydraulic gradients and groundwater flow directions from these zones to determine whether VOCs will be captured and contained by the on-site containment system.
- Based on the groundwater sampling conducted at VPB-73, if VOCs are detected above and within the screen zone of Well ONCT-1, then one deep monitoring well will be installed (i.e., Monitoring Well GM-73D). Data collected from Proposed Well GM-73D and Existing Well GM-73D2 will be used to determine and monitor vertical hydraulic gradients and groundwater flow directions from these zones to determine whether VOCs will be captured and contained by the on-site containment system.
- Based on the groundwater sampling conducted at VPB-39 and VPB-73, if VOCs are detected at depths significantly below the screen zone of Well ONCT-1, then the need for additional monitoring wells will be evaluated to potentially include two deep3 monitoring wells installed at the VPB-39 and VPB-73 locations (i.e., Wells GM-39D3 and GM-73D3). Data collected from these wells will be used collectively with the other newly installed monitoring wells at these locations to determine and monitor vertical hydraulic gradients and groundwater flow directions from these zones to determine whether VOCs will be captured and contained by Remedial Wells ONCT-1 and ONCT-2.

3.2 Hydraulic Measurements and Groundwater Sampling

A minimum of two weeks after the new, permanent monitoring wells have been drilled, installed and developed, a round of hydraulic measurements (depth to groundwater) will be collected from the new, permanent monitoring wells and selected nearby existing monitoring wells to evaluate and monitor groundwater flow (both horizontally and vertically) in these areas. To confirm results of the first round, a second round will be conducted after evaluation of the first round of data is performed (using the model, if needed).

Following completion of the first hydraulic measurement round, the new, permanent monitoring wells will be sampled and analyzed for VOCs to confirm impacts identified in these zones during sampling of the VPBs.

3.3 Model Transport Simulations

The updated contaminant transport model may also be used as part of the data evaluation, as follows:

- If VOCs are detected at substantial concentrations over a substantial thickness of aquifer, and these concentrations are present at depths significantly below the total depth of OU2 Remedial Well ONCT-1, additional VOC transport simulations using the updated model may be performed to determine whether the on-site containment system would capture and contain this VOC mass.
- If VOCs are not detected at depths significantly below the total depth of Well ONCT-1 or are not detected entirely at these depths, then additional VOC transport simulations would not be performed.

4. References

ARCADIS Geraghty & Miller, Inc., 2001. 2000 Annual Groundwater Monitoring Report, Northrop Grumman Corporation, Bethpage, New York.

U.S. Navy. 2000. Work Plan for the Installation of Additional Vertical Profile Borings, Naval Weapons Industrial Reserve Site, Bethpage, New York.

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Table 1. Proposed Construction Specifications for Vertical Profile Borings and Monitoring Wells, Northrop Grumman Corporation, Bethpage, New York.

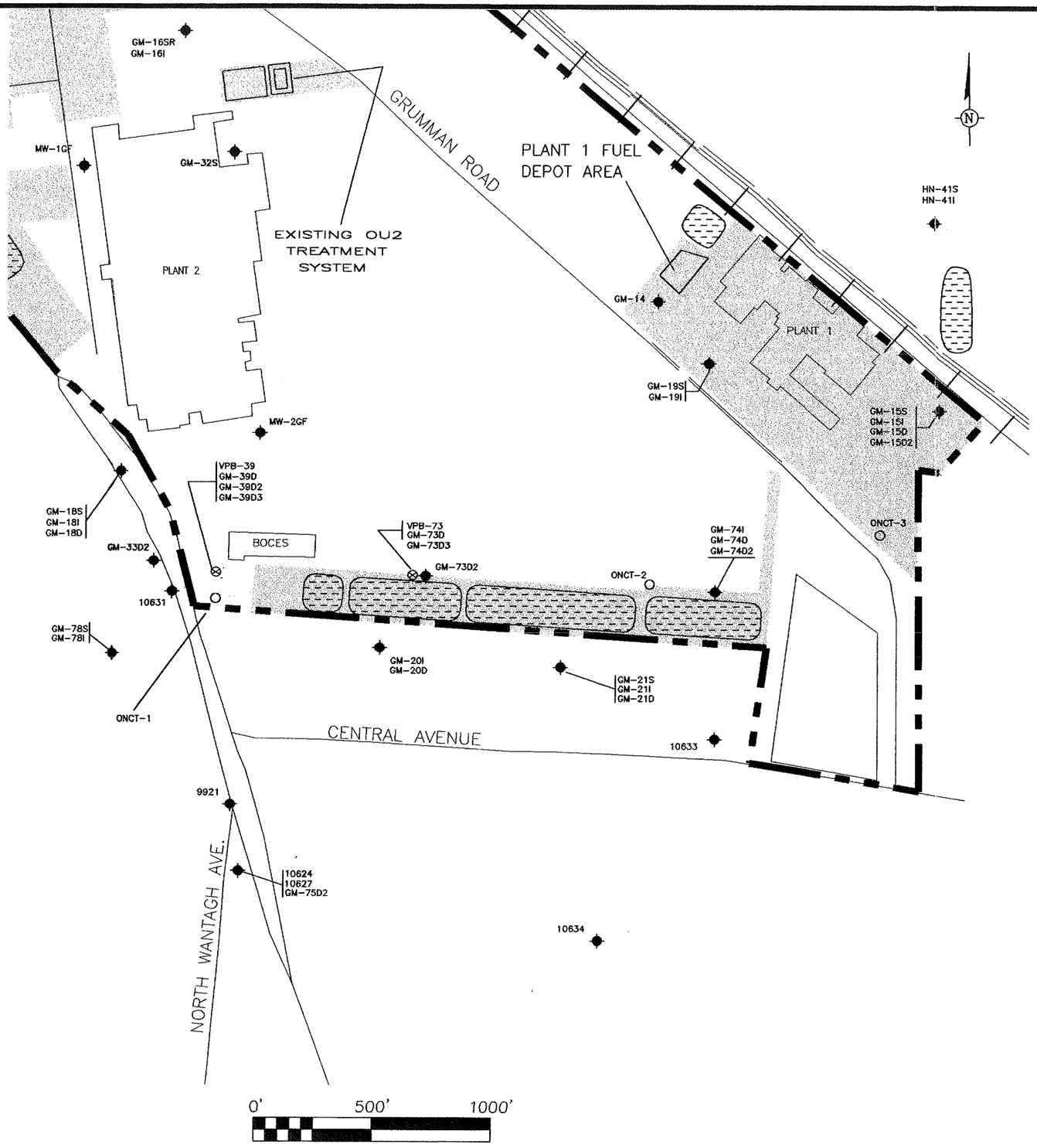
VPB/ Well ID	Nominal Diameter of VPB/Well	Estimated Total Depth [a] (ft bls)	Well Screen/ VPB Sampling Intervals	Water Level Collected	Sample(s) Collected for TCL VOCs	Site Gamma Logged
Vertical Profile Borings						
VPB-39	8	800	Every 20 ft from LS to TD [b]	--	X	X
VPB-73	8	800	Every 20 ft from LS to TD [b]	--	X	X
Permanent Monitoring Wells						
GM-39D	4	TBD	20 ft long	X	X	--
GM-39D2	4	TBD	20 ft long	X	X	--
GM-39D3	***4***	***TBD***	***20 ft long***	***X***	***X***	--
GM-73D	4	TBD	20 ft long	X	X	--
GM-73D3	***4***	***TBD***	***20 ft long***	***X***	***X***	--

Bold/Italics Denotes contingency wells that may/may not be installed based on the results of VPB-39 and VPB-73.

[a] Total depths of VPBs will be to the top of the Raritan Formation.
Total depths of wells will be based on the vertical distribution of VOCs in VPB-39 and VPB-73.

[b] Split spoon samples and groundwater hydropunch samples will be collected at 20-foot intervals from the water table (approximately 50 ft bls) to depth.

VPB	Vertical Profile Boring
ft bls	feet below land surface
TCL VOCs	Target Compound List of Volatile Organic Compounds analyzed by NYSDEC ASP Method 95-1
TD	Total Depth
X	Activity Performed
--	Activity Not Performed
NYSDEC	New York State Department of Environmental Conservation
ASP	Analytical Services Protocol
TBD	To Be Determined
LS	Land Surface



EXPLANATION

- PROPERTY BOUNDARY OF THE FORMER GRUMMAN AEROSPACE SITE
- DENOTES NORTHROP GRUMMAN OWNED PROPERTY
- BASINS
- 9921 EXISTING OBSERVATION, MONITORING WELL
- ONCT 1 OU2 REMEDIAL WELL
- VP-39 PROPOSED VPB OR MONITORING WELL
- VPB VERTICAL PROFILE BORING
- OU2 OPERABLE UNIT 2

NOTES:

1. THIS FIGURE DOES NOT INCLUDE ALL ACTIVE MONITORING AND OBSERVATION WELLS INSTALLED SINCE 1992.
2. BASIN LOCATIONS OBTAINED FROM USGS TOPOGRAPHIC MAPS (HICKSVILLE, AMITYVILLE, HUNTINGTON, AND FREEPORT QUADRANGLES), AND INFORMATION PROVIDED BY NORTHROP GRUMMAN.
3. NORTHROP GRUMMAN PROPERTY HOLDINGS BASED ON DATA PROVIDED IN SEPTEMBER 2000.
4. LOCATIONS OF PROPOSED VPBs AND MONITORING WELLS AS SHOWN ARE APPROXIMATE AND WILL BE BASED ON SITE ACCESS AND UTILITY CLEARANCE.
5. INSTALLATION OF WELLS GM-39D3 AND GM-73D3 WILL BE CONTINGENT ON RESULTS OF VPB-39 AND VPB-73.

NO.	DATE	REVISION DESCRIPTION	BY CKD

NORTHROP GRUMMAN CORPORATION

BETHPAGE, NEW YORK

LOCATIONS OF PROPOSED VPBs AND PROPOSED AND EXISTING WELLS

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NY001348	1

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Appendix A

Work Plan Addendum for Installation of Supplemental Monitoring Wells, On-Site Containment System Hydraulic Effectiveness Evaluation, Naval Weapons Industrial Reserve Site, Bethpage, New York.

Draft Work Plan Addendum
for
Installation of Supplemental Monitoring Wells On-Site Containment System Hydraulic Effectiveness Evaluation

Naval Weapons Industrial Reserve Plant Bethpage, New York

Engineering Field Activity Northeast
Naval Facilities Engineering Command

Contract No. N62467-94-D-0888
Contract Task Order 0812

June 2002

DRAFT WORK PLAN ADDENDUM
FOR
INSTALLATION OF SUPPLEMENTAL MONITORING WELLS
ON-SITE CONTAINMENT SYSTEM HYDRAULIC
EFFECTIVENESS EVALUATION

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BETHPAGE, NEW YORK

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Engineering Field Activity Northeast
Environmental Branch Code EV2
Naval Facilities Engineering Command
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Contract No. N62467-94-D-0888
Contract Task Order 0812

JUNE 2002

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1.0 INTRODUCTION AND OVERVIEW

Tetra Tech NUS, Inc. (TtNUS) has been contracted to perform a subsurface investigation for the Department of Navy, Engineering Field Activity Northeast (EFANE) at and near the Naval Weapons Industrial Reserve Plant (NWIRP) in Bethpage New York (hereinafter referred to as the site). Since 1994, Northrop Grumman, the U.S. Navy, and the New York State Department of Environmental Conservation (NYSDEC) have been working together to address the regional groundwater contamination issues associated with historic NWIRP Bethpage and Northrop Grumman Corporation operations. This current program is being conducted on a voluntary basis in support of a planned Operable Unit No. 2 groundwater record of decision (ROD) for the NWIRP Bethpage (Navy) and Northrop Grumman Corporation (NGC) sites. Historic activities conducted in conjunction with this project include the following.

- The installation of onsite and offsite groundwater monitoring wells by Northrop Grumman and the Navy.

- The installation of well head treatment units on Bethpage Water District Wells by Northrop Grumman and the Navy as Interim Remedial Measures.

- Installation of an onsite groundwater containment and treatment system by Northrop Grumman.

Another component of the NYSDEC's OU2 ROD for groundwater is the development of an On-Site Containment System (ONCT) Hydraulic Effectiveness Report. As part of the ONCT Effectiveness Report, approximately three new groundwater monitoring wells and two vertical profile borings (VPBs) are to be installed on former/current NGC property. The results of this field effort will be provided in a Summary Report.

This document is the work plan for the subsurface investigation, which will include the drilling and installation of approximately three monitoring wells and two vertical profile borings (VPBs). The drilling locations are shown on Figure 1. A summary of the drilling program is included in Table 1. Figures and tables are provided at the end of the document.

This section provides an introduction and overview of the program. Section 2 describes the necessary tasks to complete the fieldwork activities.

The VPBs will be drilled to depths of approximately 800 feet beneath ground surface (bgs), depending on location. The VPBs will be drilled at the proposed well locations to determine contaminant distribution,

lithology, and the screen intervals for the monitoring wells. In all cases, the VPBs will be the first boring drilled at each cluster location, followed by the deepest to the shallowest monitoring well boring(s).

The monitoring wells will be installed to different depths, which are classified as deep and D2, as defined below.

- deep (D) zone 170 ft to 485 ft bgs (-50 to -365 ft msl)
- deep 2 (D2) zone 485 ft to 650 ft bgs (-365 to -530 ft msl)
- deep 3 (D3) zone 650 ft to 800 ft bgs (-530 to –680 ft msl)

Monitoring well clusters will be drilled, installed, and developed in the following general order, however, site-specific conditions may cause the sequence to be modified:

1. Drilling the deepest boring (VPB) and collecting both soil and groundwater samples.
2. Conducting geophysical logging (by TtNUS) of the deepest boring (VPB).
3. Constructing the deepest monitoring well (includes setting the screen and installing the backfill materials, seals, and locking protective casing).
4. Drilling and installing the remaining shallow wells in the cluster.
5. Well development.

2.0 FIELD INVESTIGATION TASKS

The tasks that are necessary to complete the field activities are described in this section.

2.1 MOBILIZATION/DEMOBILIZATION

The subsurface investigation will be performed by TtNUS, with support from subcontractors for drilling, investigation derived waste (IDW) disposal, and surveying activities. The supervisor of the team will be a TtNUS representative, who will be identified as the Field Operations Leader (FOL). Additional TtNUS staff will be on-site as needed, and the subcontractor staff will vary from one individual for IDW activities upwards to several people for drilling activities.

It should be noted that portions of the site are high security areas. All onsite personnel must be United States citizens, and proof of citizenship will be required prior to site entry. All personnel will be required to get access to the site through TtNUS. Access will include a check in and out each day with site security, and all personnel will be required to wear a badge at all times while on site. Access to NGC property will be coordinated through the Navy.

The TtNUS FOL will obtain the necessary equipment for completion of the fieldwork, including setting up the command post. Health and Safety training will be conducted for all site personnel, including maintaining all necessary documentation and ensuring compliance in accordance with the Health and Safety Plan and the subcontract documents. Locations will be cleared of utilities prior to drilling.

2.2 DRILLING ACTIVITIES

Drilling activities will be performed by using mud rotary drilling techniques. A boring log will be maintained for each boring drilled.

2.2.1 Mud Rotary Drilling

The well boring diameters will be at least 8 inches to provide sufficient annular space for the installation of 4 inch-diameter wells. A smaller diameter pilot hole can be drilled during soil sampling, however, the boring must be reamed with a larger drill bit prior to well installation. The drill bit and drill rods shall be the type to accommodate split spoon sampling through the drill string. The VPB diameters will be at least 4 inches to accommodate direct push and split-spoon samples. Each VPB will be installed with a temporary casing from the surface to approximately 150 feet bgs to minimize the potential for boring collapse. A multi-baffle chamber, high capacity mud pan or dug mud pit will be used to hold drilling mud during the drilling activity. The injection of water and polymer-free bentonite drilling mud is allowed. All

lubricants that will potentially come in contact with the drilling mud will be of food grade quality. The use of any other types of additives is prohibited without prior approval of the TtNUS Project Manager.

2.3 SOIL SAMPLING

Soil samples will be collected for lithologic descriptive purposes. The soil samples will be collected using split spoon samplers according to American Society for Testing and Materials (ASTM) D-1586 methods, at the depths specified in Table 1, or as directed by the field geologist.

The split spoon samples in the monitoring well borings will be collected at 5-foot intervals starting at approximately 20 feet above the proposed screen interval and continuing to the total depth of the well.

Split spoon samples (and groundwater sample) in the VPBs will be collected on 20 foot intervals starting at the water table (50 feet bgs) to the Raritan clay layer (800 feet bgs) (as described in Section 2.4).

2.4 GROUNDWATER SAMPLING USING DIRECT PUSH TECHNOLOGY (DPT)

Groundwater samples will be collected from the VPBs using DPT. Once the desired sample depth is reached by mud rotary drilling, a DPT sampling point that is capable of water sample collection will be advanced a distance of 5 feet below the boring bottom, or as directed by the field geologist to ensure representative groundwater samples. Samples will be collected at intervals as defined in Table 1, starting once the water table is reached, and will continue to the total depth of the boring.

Once the DPT sampler is advanced to the desired sample depth, the retractable tip will be opened, thus allowing water to fill the sampler. The filled sampler will be raised to the ground surface and the sample will be directly transferred to the sample containers for laboratory analyses. Measurements of pH, specific conductivity, and temperature will be taken from the remaining sample volume using a water quality meter. Drilling and sampling will continue to the next depth interval until the total depth of the boring is reached. All groundwater samples will be submitted to a local laboratory for analyses of volatile organic compounds for the analytes listed in, and in accordance with, gas chromatography (GC) method SW846 8260B or equivalent New York State method. The results for the groundwater samples shall be reported within approximately 48 hours.

2.5 NATURAL GAMMA LOGGING

Downhole natural gamma logging will be performed by the drilling subcontractor in the VPBs as shown on Table 1. Upon reaching the final depth of each boring, the downhole drilling equipment will be removed, and gamma logging will be performed from the land surface to the total depth of the boring. The results

of the logging will be evaluated by TtNUS and Arcadis Geraghty and Miller (Northrop Grumman) and will be used in combination with split spoon sample observations to determine exact well screen placements.

2.6 MONITORING WELL INSTALLATION

Monitoring wells will be installed in the mud rotary borings at the approximate depths shown on Table 1. A typical well construction detail is provided in Figure 2. The well screen and riser pipe will be lowered into the open hole after the drilling mud is thinned to the fullest extent possible without resulting in excessive caving. The mud rotary borings will also be reamed along the screened interval, prior to well installation, to remove as much drilling mud as possible.

The depths of all backfilled materials will be constantly monitored during the well installation process by means of a wire-line measuring device. Those monitoring wells that are deeper than 200 feet below ground surface will be fitted with centralizers at a frequency of one per 40 linear feet.

The monitoring wells will be constructed of 4-inch inside diameter, schedule 80, National Sanitation Foundation (NSF)-grade Polyvinyl Chloride (PVC) well casing and screen. Only materials meeting American Petroleum Institute (API) and ASTM water well standards will be used. All well screens (slotted construction) will be 10 slot (0.010 inches). A vented PVC well cap and threaded PVC bottom cap will be installed on each well.

All riser and screen sections will be flush-joint, internally-threaded. Joints will be made up so that when tight, all threads are buried within the riser walls. No couplings, solvents, glues, or chemical cleaners will be used in well construction.

After setting the well screen and casing, the gravel pack will be placed within the boring annulus, to a depth as identified in Table 1. In general, well gravel will be placed as follows:

- Deep (D) Wells: to a minimum of 10 feet above the top of the screen.
- Deep 2 (D2) Wells: to a minimum of 20 feet above the top of the screen.
- Deep 3 (D3) Wells: to a minimum of 25 feet above the top of the screen.

The gravel pack will be carefully placed into the annulus through a tremie pipe and its depth will be carefully checked during placement to be sure that it has not bridged. The gravel pack shall consist of Nos. 20/40 U.S. standard sieve size silica sand. A fine sand layer (finer than gravel pack) will be placed in the annulus on top of the gravel pack in the same manner as the gravel pack, as follows:

- Deep (D) Wells: 5 feet thick above the top of the gravel pack.

- Deep 2 (D2) Wells: 10 feet thick above the top of the gravel pack.
- Deep 3 (D3) Wells: 15 feet thick above the top of the gravel pack.

A 4- to 8-foot thick bentonite seal will be installed above the fine sand layer using a tremie pipe. The seal will consist of approximately 1.25 pounds of pure bentonite per gallon of water. A Volclay® high solids bentonite slurry will be installed within the annular space above the bentonite seal using a tremie pipe. In all wells, the slurry will be installed to approximately 3 feet below land surface in one continuous operation. The tremie pipe will be gradually removed from the annular space as the slurry is added from the bottom up. Manufacturer's specifications for all bentonite products must be submitted and approved by TtNUS prior to use.

Wells will be completed at grade by cementing a 6-inch diameter, locking curb box in place over the wells. A fine sand will be installed above the top of the bentonite slurry and inside the curb box to permit any water which may accumulate inside the curb box to drain. A 0.5 foot thick concrete apron measuring 2 feet by 2 feet square will be placed around each well. Keyed alike well locks will be used to secure the wells. A typical well detail is provided on Figure 2.

2.7 MONITORING WELL DEVELOPMENT

The monitoring wells will be developed no sooner than 24 hours after installation to remove fine materials and sediments from the area around the well screens, and to remove drill cuttings and residual fluids from the area around the monitored interval of the boring.

Monitoring wells will be developed using a combination of air lift (using an oil free compressor) and mechanical surging. A threaded, 2-inch diameter steel eductor pipe with a dual surge block assembly (i.e., two rubber swabs set three feet apart along a length of perforated steel pipe) will be installed in the well with the surge block set at the base of the well screen. A 3/4-inch diameter polyethylene airline will then be inserted in the eductor pipe to a depth above the top of the well screen. The well will be developed using the combination of air lift pumping and surging (vertical movement of the surge block in the screen zone) at 2-foot discrete intervals upwards along the entire length of the well screen. Field parameters, including pH (standard units), specific conductance [millisiemen per centimeter (mS/cm)], temperature (degrees in centigrade), and turbidity [nephelometric turbidity units (NTU)] will be monitored and recorded periodically throughout well development.

Well development will also include purging stagnant water from the well above the screen interval and rinsing the interior well casing above the water table by using only water from that well. The well will be covered with a clean well cap, which will be rinsed with distilled water prior to installation. The result of this operation will be a well casing free of extraneous materials (grout, bentonite, sand, etc.).

Development will continue until all traces of the drilling mud are removed and the well produces clear, sediment-free water, to the extent practical. In compliance with NYSDEC policy, every effort will be made to develop wells until turbidity (as measured in the field) is less than 50 NTUs. However, in some instances, the 50 NTU standard may not be attainable, if the observed turbidity is the result of the formation screened and not related to well design, installation, or development. Therefore, if after a "best well development effort," the 50 NTU standard cannot be attained and turbidity stabilizes (above the 50 NTU standard), the well will be considered acceptable, provided the integrity of the well is satisfactorily proven.

The development fluid will be containerized and transported to the decontamination area where it will be stored in a tank, tested, and ultimately discharged.

2.8 INVESTIGATIVE DERIVED WASTE HANDLING

All Investigative Derived Waste (IDW) accumulated during drilling activities will be collected, accumulated at the NWIRP Bethpage, and eventually disposed off site. These materials include soil cuttings, drilling mud, development water, and decontamination water. The soil cuttings and drilling mud will be collected in 55 gallon drums by the drilling subcontractor and will be transferred to a rolloff container that is capable of separating liquids from solid materials. The separated liquids will be pumped from the rolloff container to a holding tank. The discharge waters and decontamination waters will be collected by the drilling contractor and will be transferred to the holding tank. All wastes will be staged for future characterization and disposal.

2.9 DECONTAMINATION

A centrally located decontamination pad will be constructed on the NWIRP Bethpage to allow for the collection of all decontamination-generated fluids. The decontamination pad will consist of a plastic liner that drains to a sump with a pump, and a plywood protective cover. All decontamination fluids will be collected and staged for characterization and subsequent disposal.

The decontamination operations will consist of washing drilling equipment using a high-pressure potable steam wash. The spilt spoons and the downhole groundwater sampling equipment will be decontaminated with a detergent wash, a potable water rinse, and a deionized water rinse.

2.10 SURVEYING

All newly installed monitoring wells and the VPBs will be surveyed for both horizontal and vertical control. A total of three monitoring well reference points will be surveyed for vertical control, including the top of the protective casing, the top of the riser pipe, and the ground surface. The center of the well cap will be surveyed for horizontal control. The VPBs will be surveyed for vertical control at the ground surface adjacent to the boring location, and for horizontal control in the center of the boring.

2.11 DOCUMENTAITON

Documentation required to support this project will consist of the following items:

- Field Notebook
- Boring log for each boring
- Well completion form for each well
- Well development record for each well
- Sample logsheet for each sample collected for laboratory analyses
- Chain of custody form for each laboratory shipment
- Gamma Log

2.12 SPILL CONTROL MEASURES

Spills will be controlled using the measures that are defined in the Heath and Safety Plan. The general process will include immediate response to contain the spill and subsequent cleanup measures to prevent any further impact to the environment.

TABLE 1

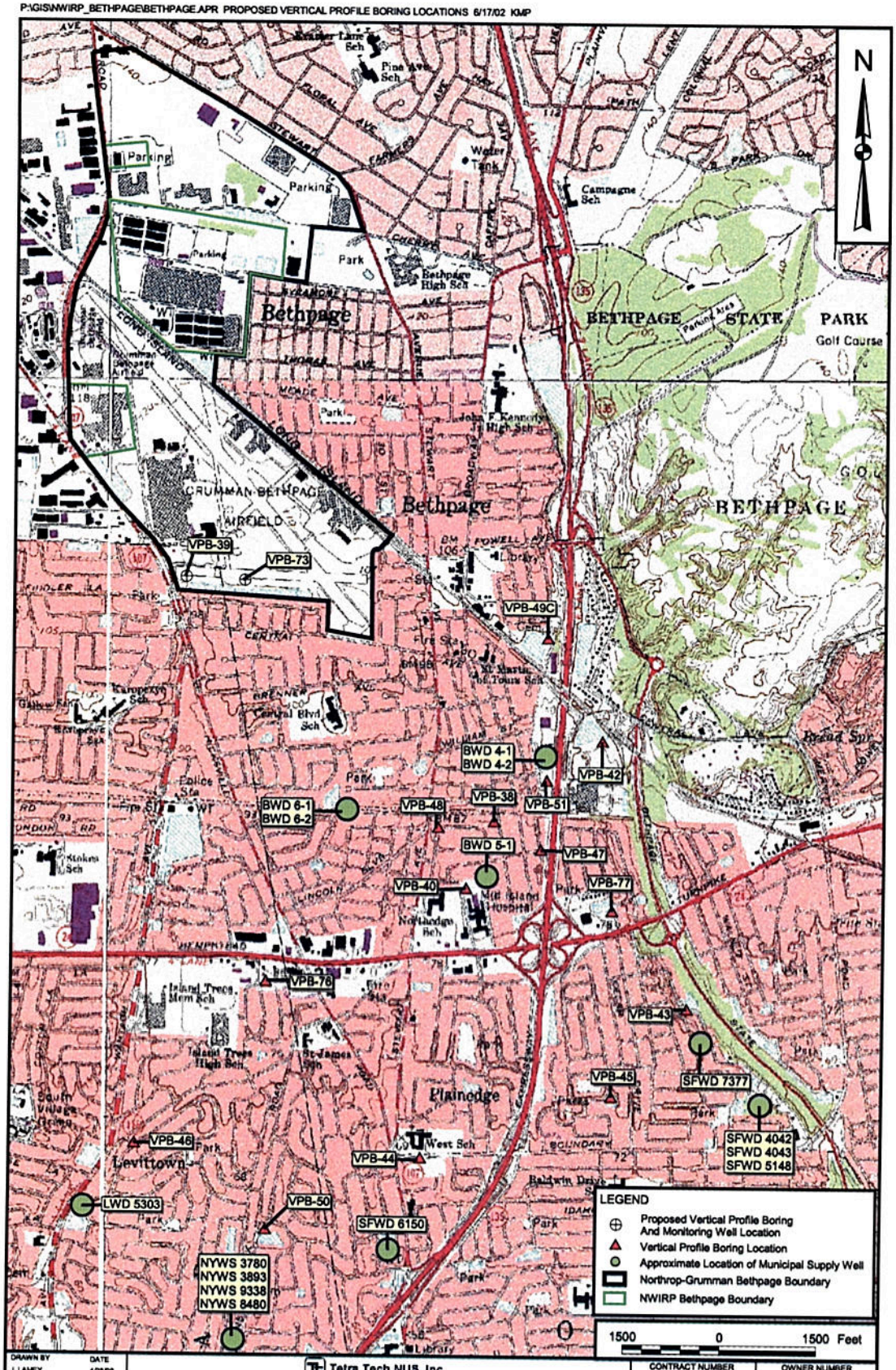
ONCT SYSTEM HYDRAULIC EFFECTIVENESS WELL DRILLING AND VERTICAL PROFILE BORING SPECIFICATONS
NWIRP BETHPAGE, NEW YORK

Well or VPB Designation	Screened Interval (ft bgs)	Total Well or VPB Depth (ft bgs)(2)	Nominal Borehole/Well Diameter and Casing Specifications (inches)	Height Gravel Pack (ft bgs)	Height Fine Sand (ft bgs)	Number of Split Spoons	Split Spoon or Groundwater Sample Interval @ Frequency (ft)(1)	Gamma Log
VPB-39	--	800	8	--	--	38	WT-800 @ 20	Y
GM-39D	300-320	320	8/4 Sch 80 PVC	290	285	8	280-320 @ 5	N
GM-39D2	540-560	560	8/4 Sch 80 PVC	520	510	8	520-560 @ 5	N
VPB-73	--	800	8	--	--	38	WT-800 @ 20	Y
GM-73D	300-320	320	8/4 Sch 80 PVC	290	285	8	280-320 @ 5	N

1 Groundwater samples from VPBs are collected at the same intervals and frequency as the split spoons.
2 Total depth of VPBs will be to the top of the Raritan Formation: total depths of the wells will be based on the vertical distribution of VOCs in VPB-39 and VPB-73.
3 Well screen intervals are preliminary. Final screen intervals will be determined based on the results of the VPB groundwater samples and lithology testing.

WT - Water table
bgs - Below ground surface
VPB - Vertical profile boring
ft - feet

P:\GIS\NWIRP_BETHPAGE\BETHPAGE.APR PROPOSED VERTICAL PROFILE BORING LOCATIONS 6/17/02 KMP



DRAWN BY J. LAMEY	DATE 4/28/00	Tetra Tech NUS, Inc.	CONTRACT NUMBER N4037 / OWNER NUMBER
CHECKED BY	DATE	LOCATION OF PROPOSED VERTICAL PROFILE BORINGS AND MONITORING WELLS FOR ONCT EFFECTIVENESS EVALUATION NAVAL WEAPONS INDUSTRIAL RESERVE PLANT BETHPAGE, NEW YORK	APPROVED BY / DATE
COST/SCHEDULE-AREA			APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1 / REV 0

FIGURE 2

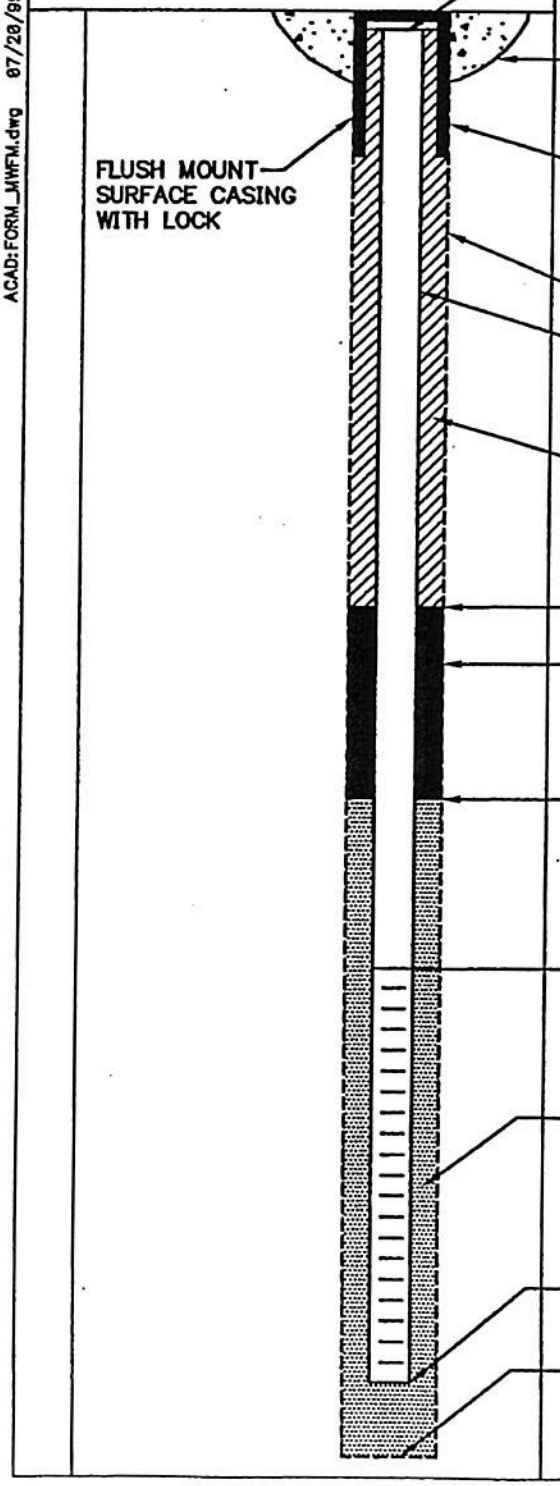
WELL NO.: GM-43D

Tetra Tech NUS, Inc.

OVERBURDEN
MONITORING WELL SHEET
FLUSH - MOUNT

PROPOSED GM-43D

PROJECT NWIRP	LOCATION BETHPAGE	DRILLER TBD
PROJECT NO.	BORING GM-43D	DRILLING METHOD MUD ROTARY
DATE BEGUN TBD	DATE COMPLETED TBD	
FIELD GEOLOGIST TBD		DEVELOPMENT METHOD TBD
GROUND ELEVATION ~95 MSL	DATUM NAVD 88	



ELEVATION TOP OF RISER: ~95' MSL

TYPE OF SURFACE SEAL: CONCRETE

TYPE OF PROTECTIVE CASING: FLUSH MOUNT COVER

I.D. OF PROTECTIVE CASING: 8"

DIAMETER OF HOLE: 8"

TYPE OF RISER PIPE: PVC SCH. 80 4-INCH DIA.

RISER PIPE I.D.: 3"/8

TYPE OF BACKFILL/SEAL: VOLCLAY BENTONITE SLURRY

ELEVATION/DEPTH TOP OF SEAL: -245/340'

TYPE OF SEAL: POLYMER FREE BENTONITE

ELEVATION/DEPTH TOP OF SAND (FINE) -250/345'

DEPTH TO SAND PACK -255/350'

ELEVATION/DEPTH TOP OF SCREEN: -265/360'

TYPE OF SCREEN: PVC SCH. 80, 4"-DIA.

SLOT SIZE x LENGTH: .010" x 40'

TYPE OF SAND PACK: SILICA SAND 20/30 US SIEVE SIZE

DIAMETER OF HOLE IN BEDROCK: NA

ELEVATION / DEPTH BOTTOM OF SCREEN: -305/400

ELEVATION / DEPTH BOTTOM OF SAND: -305/400

ELEVATION/DEPTH BOTTOM OF HOLE: -305/400

BACKFILL MATERIAL BELOW SAND: NONE

ACAD:FORM_MWFM.dwg 07/20/99 INL