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C-49-06-4-267

Halliburton NUS Project Number 1412

Jun 20, 1994

Mr. Lonnie Monaco
Northern Division , Code 0223
Naval Facilities Engineering Command
10 Industrial Highway, Mail Stop #82
Lester, Pennsylvania 19113

**Reference:** **Contract No. N624472-90-D-1298 (CLEAN)**
**Contract Task Order (CTO) 0159**

**Subject:** **Final Technical Memorandum - Area B Pumping Test Plan**

Dear Mr. Monaco:

Attached is the subject document for the focused RI at NAWC Warminster. Copies of this memorandum are being sent to individuals identified on the distribution list. Comments received from Technical Subgroup members have been incorporated into the document.

Please contact me at (412) 921-8778, if you have any questions or comments.

Sincerely,

Jeffrey P. Orient
Project Manager

JPO/sic

Attachment

cc: Ray Manella (Navy, NORTHDIV)
Tom Ames (NAWC, Warminster)
Dave Kennedy (PADER)
Darius Ostrauskas (EPA, Region III)
Kathy Davies (EPA, Region III)
Ron Sloto (U.S.G.S.)
Kevin Kilmartin (Halliburton NUS, Wayne)
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Michael Turco (Halliburton NUS, Wayne)
Dave Fennimore (Earth Data)
Tony Bartolomeo

**TECHNICAL MEMORANDUM**
**AREA B PUMPING TEST PLAN**

## 1.0 OBJECTIVE

The objective of the Area B pumping test is to quantify the hydraulic characteristics of the shallow portion of the Stockton Formation in Area B. The pumping test is intended to provide information regarding the following:

- Transmissivity and storativity of the shallow portion of the Stockton Formation.

- Cross-formational (vertical) and intraformational (i.e., strike-parallel versus dip-parallel) anisotropy.

The test results will be used to define the local hydraulic conditions and to evaluate groundwater and contaminant migration rates within and from Area B. The results will also be compared against the assumptions used in the Area B interim groundwater extraction system design, to provide a preliminary indication regarding any design modifications that may be required for the extraction system to attain plume capture as intended.

## 2.0 PUMPING/OBSERVATION WELL NETWORK

The well to be pumped for the long term pumping test will be either HN-02I (preferred) or HN-02D (alternate). These wells are both located near the center of the Area B TCE plume, and a number of monitoring wells are located nearby to be used as observation wells. The monitoring zone for well HN-02I is from 85 to 104 feet in depth, which is similar to the planned depth of the Area B extraction wells (100 ft.). The estimated yield of this well, based on development data, is 8 gpm. The monitoring zone for well HN-02D is from 116 to 133 feet in depth. This well yields an estimated 20 gpm. The determination of which well will be used as the long term test well will be made after completion of the step-drawdown testing, based on the ability of the wells to yield sufficient water to adequately stress the aquifer.

A number of nearby observation wells will be monitored during the pumping test. The following are the primary sets of monitoring wells that will be monitored.

Well cluster 2 contains an overburden well (DG-27) and a shallow bedrock well (DG-21), in addition to the two wells considered for pumping. All 4 wells in this cluster will be monitored for drawdown during the pumping test. Well cluster 3, located approximately 250 feet updip of Cluster 2, also contains an overburden well (DG-08) and shallow, intermediate, and deep bedrock monitoring wells (DG-20, HN-03I, and HN-03D) that will be monitored. Approximately 160 feet downdip the pumping well cluster, shallow bedrock well DG-18 and new intermediate and deep bedrock wells will be monitored for drawdown.

A new shallow/intermediate/deep bedrock well cluster will be monitored across the road along bedrock strike (approximately 50 feet east-northeast) from the pumping well cluster. Along strike to the west-southwest, shallow bedrock well DG-25 and a new intermediate/deep well cluster, located approximately 275 feet from the pumping well cluster, will be monitored.

In addition to the primary network of observation wells, a number of wells located further away from the test site will be monitored periodically for drawdowns. These wells include shallow/intermediate/deep well clusters HN-05S/I/D and HN-10S/I/D, shallow bedrock well MW05 and a new deeper bedrock monitoring well, shallow bedrock well MW06 and a new deeper bedrock monitoring well, and shallow bedrock wells DG-17 and DG-19.

The pumping test well layout is shown on Figure 1.

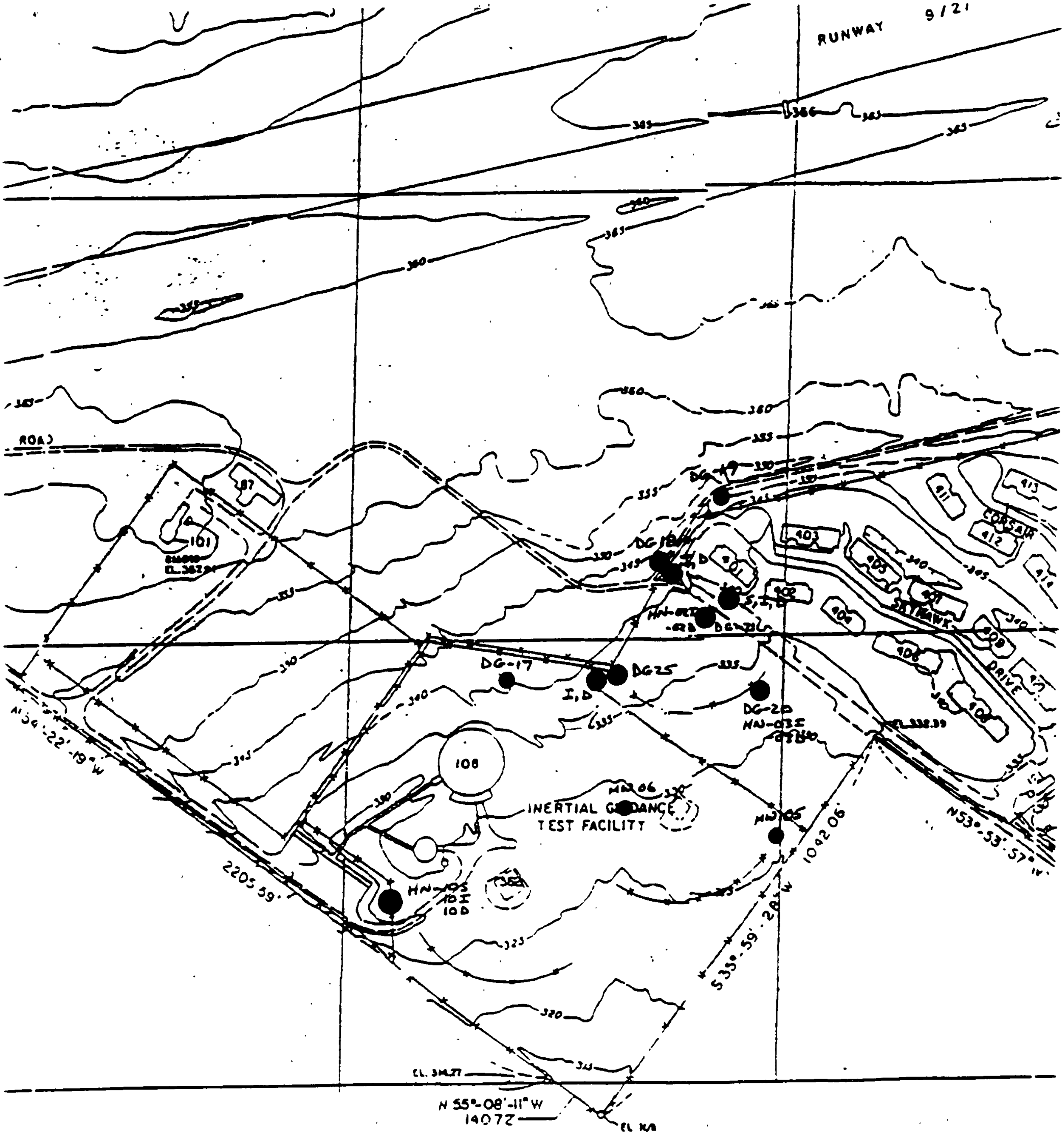


**FIGURE 1**
**AREA B PUMPING TEST**
**WELL LAYOUT**

## 3.0 STEP-DRAWDOWN TESTING

Prior to performing the long term pumping test, a step-drawdown test will be performed to select the pumping well and set the pumping rate for the long term test. Prior to beginning the test, water levels will be measured in the pumping well cluster and in the surrounding primary observation well clusters, to provide comparison points for subsequent readings. Initially, well HN-02I will be tested. The well will be pumped, using a submersible pump, for short (100 minute) time periods at successively higher rates until the drawdown rate exceeds the well's yield capacity. Between each step, the water level in the pumped well will be allowed to recover to the static level.

The initial pumping rate will be 6 gpm. The pumping rate will be increased in approximately 3 gpm intervals until the rate exceeds the projected long term yield capability of the well. A totalizing flow meter will be used to measure flow rates, with a calibrated bucket and stopwatch used also used to check the flow meter readings.

During each step of the test, water levels will be monitored in the three bedrock wells in cluster 2, along with the wells in the other primary monitoring locations. A data logger and transducer set to the log cycle reading frequency will be used to monitor the drawdown in the pumping well, with periodic hand measurements also obtained to provide a check of the transducer data. The surrounding observation wells will be checked every 20 minutes for drawdown.

The time-drawdown data for the pumping well will be recorded on pumping test data sheets and graphed on semilog paper as the test progresses, to determine the drawdown rates and project long term drawdowns at the various pumping rates. Observation well data will be evaluated to determine whether any drawdowns occur in response to the pumping. If a drawdown response is seen in the nearby observation wells (outside of the pumping well cluster) during the step-drawdown testing of well HN-02I, the long term test will be performed using this well as the pumping well. If no responses are noted, well HN-02D will be step-tested using the same methodologies as outlined above, to evaluate whether the anticipated higher pumping rate will result in observed drawdowns in the nearby wells.

Water pumped during the step-drawdown and long term pumping tests will be routed through an activated carbon filter, then discharged to a nearby stormwater sewer.

## 4.0 LONG TERM PUMPING TEST

The long term pumping test is designed to be run for a maximum of 72 hours. The test may be terminated prior to the full 72 hour duration if steady-state drawdown conditions are reached in the pumping and observation wells or if changing field conditions make the data obtained from further testing of highly questionable usefulness (i.e., a sustained rainfall event occurs that causes significant water level changes in the wells). The Halliburton NUS project manager will contact the Navy RPM for approval prior to shutting down the test ahead of the full 72 hour duration. Every effort will be made to schedule the test during a time period when no significant precipitation is anticipated, to avoid precipitation-related complications.

At the conclusion of the active pumping phase of the test, recovery measurements will be taken in all observation wells in which significant drawdowns were observed, for a period of 12 hours.

The long term pumping test will be run as a constant rate test, using the pumping rate selected based on the step-drawdown test.

Trend Measurements

Based on the long term water level study performed as part of the Area B hydrogeologic investigation, the magnitude of background water level changes over time in response to background influences varies significantly at different locations within Area B. For example, the maximum change in water level over a four week time period at cluster HN-07S/I/D averaged about 4 feet in the three wells, while the maximum change in cluster HN-05S/I/D averaged about 1.6 feet and in cluster HN-02S/I/D about 1.9 feet. In addition, the magnitude of changes varied within each cluster, i.e., the shallow bedrock well in cluster HN-05 had a maximum change of 0.95 feet while the water level in the deep well changed by 2.4 feet, and in cluster HN-02 the water level in the shallow well had a change of 2.4 feet while the water level in the intermediate well changed by 1.4 feet (in all cases, the net change was a drop in water level).

Based on this information, it appears that trend is both location-specific and depth-specific in Area B, thus it does not appear that trend data from a well or wells located outside of the area of the pumping test could be applied to making trend corrections to wells within the area of the pumping test. As a result, trend data will be extrapolated directly from the wells monitored during the test. Prepumping static water levels in the wells will be compared against post-pumping static water levels, and a straight line trend projection made based on the water levels before and after the test. This extrapolated trend data will be applied to the drawdown data as necessary. The application of this trend correction technique requires that no significant precipitation events occur between the pre- and post- pumping test static water level measurements.

In addition, trend data will be collected from the pumping well and the primary observation wells, for a period of 48 hours prior to beginning the test. This trend data may provide backup trend projection capabilities in the event that a precipitation event occurs during or immediately following the pumping test that would render the static water level based projections invalid. At a minimum, the trend measurements will be obtained at 4 hour intervals (for wells screened within the stratigraphic interval to be pumped), or at 8 hour intervals (for wells screened in strata above or below the pumped formation). Barometric pressure readings will be recorded during the same 48 hour period over which trend measurements are taken.

Pumping Test Setup

Immediately prior to beginning the pumping test, a round of water levels will be obtained from the pumping well and all observation wells. For those wells that are to be monitored with pressure transducers, the transducers will be set in the well at a depth below the maximum anticipated drawdown level due to pumping. The submersible pump will be installed in the selected pumping well, and set near the bottom of the well, below the anticipated maximum drawdown level due to pumping. The discharge line from the pump will be connected to a ball valve (for controlling the discharge rate) and the flow meter, then the line will be run from the flow meter into the activated carbon canister. A sampling port will be installed in the discharge line at a point between the flow meter and the activated carbon canister. Water discharge lines will be extended out from the canister to the south, away from the test area. A schematic of the water discharge line layout is presented in Figure 2. Electrical power will be obtained from a nearby permanent power source, if available, or a portable generator if no power source is available nearby.

Distances from the pumping well to each of the observation wells, and the orientation (i.e., compass direction) of each observation well relative to the pumping well will be field measured and recorded on pumping test data sheets.

Pumping Test Performance

Immediately upon starting the pump for the long term pumping test, water level readings will begin to be obtained from the pumping and observation wells. For the primary observation wells, at least 10 water level readings will be obtained per log cycle of time, i.e., 10 readings during the first 10 minutes of the test, 10 readings during the time period from 10 to 100 minutes, etc.. For the primary observation wells monitored using pressure transducers and data loggers, the log cycle data recording option will be utilized.

Water level readings will be obtained from the secondary observation wells at reduced frequencies. It is anticipated that water levels will initially be obtained at 20 minute time intervals from these wells for the first two hours, with the frequency of readings decreasing to hourly for the next four hours, then every 4 hours for the remainder of the test. Wells that show responses to pumping may be monitored more frequently than described above, at the discretion of the field hydrogeologist.

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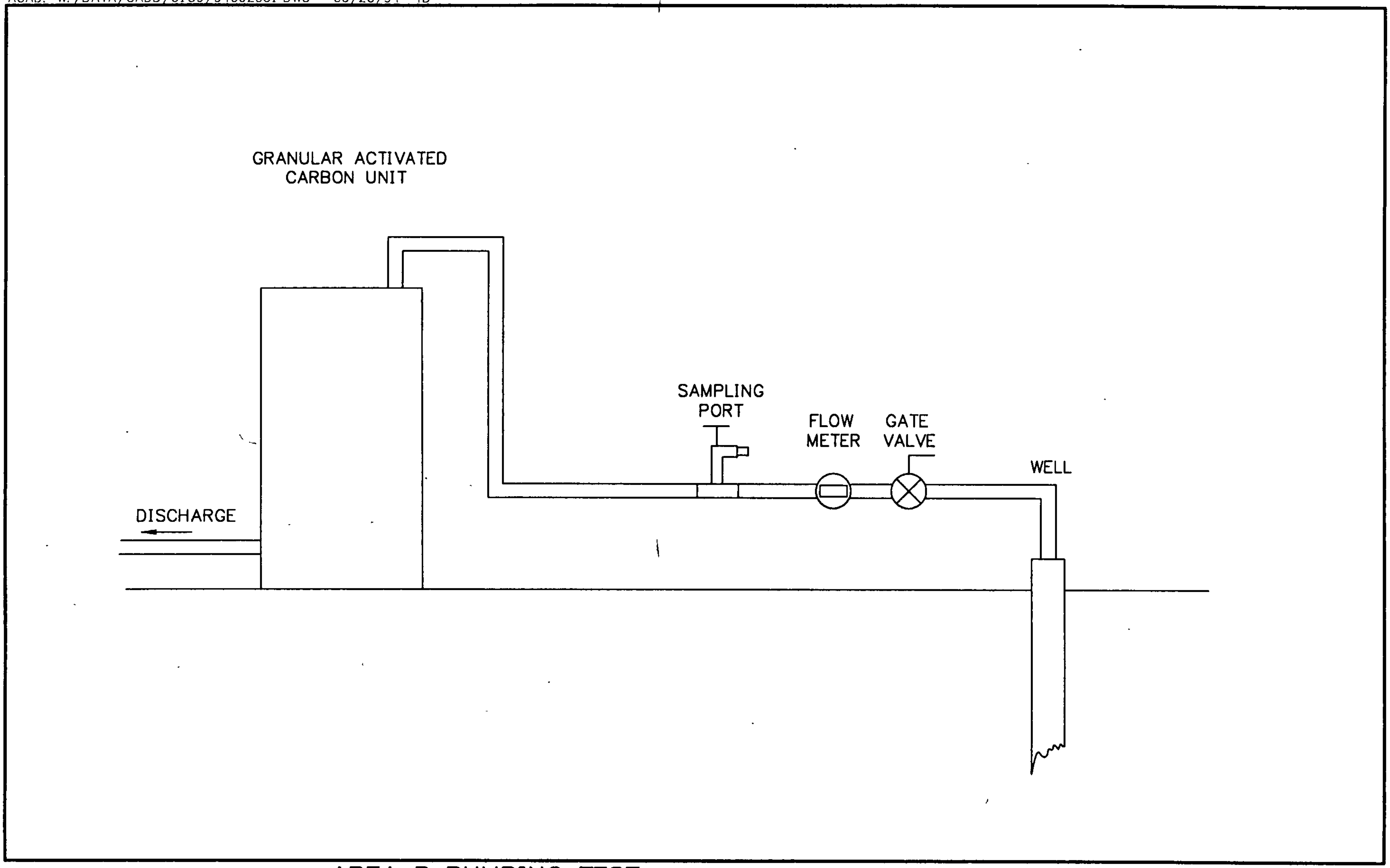


AREA B PUMPING TEST
DISCARGE LINE LAYOUT
NAWC WARMINSTER, PA

FIGURE 2

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Drawdown data from the pumping and observation wells will be field plotted on semilog graph paper as the test progresses. The field data plots will be used to evaluate drawdown trends, look for boundary conditions, project drawdowns for the latter stages of the test, and to determine whether steady-state drawdown conditions have been reached. Field personnel will be in frequent communication with senior technical personnel to provide updates of the test progress.

Barometric pressure will be recorded at 2-hour intervals throughout the test, or more frequently if a weather front approaches during the test period.

Flow rate measurements will be obtained throughout the pumping test. During the startup phase, pumping rates will be constantly monitored until the flow is stabilized at the desired rate. Following flow rate stabilization, flow measurements will be recorded at least every 10 minutes for the first 100 minutes of the test, at least every 20 minutes for the next 100 minutes, and at least hourly for the remaining duration of the test. Both the flow rate at the time of measurement and the total number of gallons pumped from the start of the test to the time of measurement will be recorded. A variance in flow rate of no more than 5% will be considered acceptable for the test.

The flow rate measurements will be obtained from a totalizing flow meter. As a check of the flow meter, a calibrated bucket and stopwatch will be used to check the flow rate periodically.

Water quality samples will be obtained from the pumping well discharge at three time periods during the test. The first sample will be obtained within 10 minutes of test startup, the second approximately 100 minutes into the test, the third approximately 1,000 minutes into the test, and the last sample obtained immediately prior to pump shutoff. The samples obtained will be submitted for TCL volatiles analysis, to evaluate changes in contaminant levels due to pumping.

<u>Recovery Measurements</u>

At the conclusion of the active pumping portion of the test, the pump will be shut off and recovery measurements will be obtained from the pumping well and the observation wells where significant drawdowns were observed, for a period of up to 12 hours. The frequency of readings will be the same as for the start of the pumping test, i.e., water levels will be taken at log cycle frequencies. In addition, rounds of water levels will be obtained from the pumping and observation wells approximately 24 and 48 hours after the conclusion of the pumping test.

## 5.0 DATA EVALUATION

The drawdown data obtained from the wells monitored during the test will be evaluated to determine aquifer characteristics. Prior to analysis, the data will be corrected for trend. It is not anticipated that dewatering, barometric pressure, or partial penetration corrections will be required, however they will be applied if necessary. The corrected data will be plotted on both semilog and log-log graph paper and analyzed using appropriate data analysis methods. Both time-drawdown and distance-drawdown methods will be considered for use, with final selection of the analysis methods made based a review of the data plots and hydrogeologic conditions.