AQUIFER CHARACTERIZATION TEST WORK PLAN BUILDING 8 NAS CORPUS CHRISTI TX

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ENSAFE/ALLEN & HONSHALL

AQUIFER CHARACTERIZATION TEST
WORK PLAN FOR BUILDING 8

NAS CORPUS CHRISTI, TEXAS
CONTRACT NO. N62467-89-D-0318
CTO-069

Prepared for:

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Table of Contents

List of Figures

1.0 INTRODUCTION

EnSafe/Allen & Hoshall (E/A&H) has been retained by the Department of the Navy to design and implement an aquifer characterization test at Building 8 on the Naval Air Station (NAS) Corpus Christi. During a groundwater assessment conducted by E/A&H in June 1993, groundwater contamination was detected in several onsite monitoring wells (E/A&H, 1993). The aquifer characterization test has been designed to enhance estimates of aquifer characteristics and investigate the feasibility of groundwater pumping as a remedial alternative. The test will include the: (1) installation of two wells (one pumping well and one observation well); (2) continuous monitoring of the pumping well and eight observation wells before, during, and after pumping; (3) periodic monitoring of five additional observation wells by hand; and (4) continuous monitoring of barometric pressure.

Aquifer characterization tests usually comprise several separate phases that are either monitoring periods or complete aquifer tests. This test will have four separate phases: one ambient monitoring period, two pumping periods, and one recovery period.

Aquifer Test Phases:

Phase 1 Step drawdown testing
Phase 2 Ambient condition monitoring
Phase 3 Constant rate pumping test
Phase 4 Recovery monitoring

The objectives presented below outline purposes for the aquifer characterization test.

Objectives:

- To determine the optimal pumping rate for potential extraction wells.
- To refine present estimates of the aquifer parameters.
- To determine the areal extent of influence for a pumping well on the Building 8 site.
- To determine if groundwater pumping is a feasible remedial alternative.

2.0 NEW WELLS

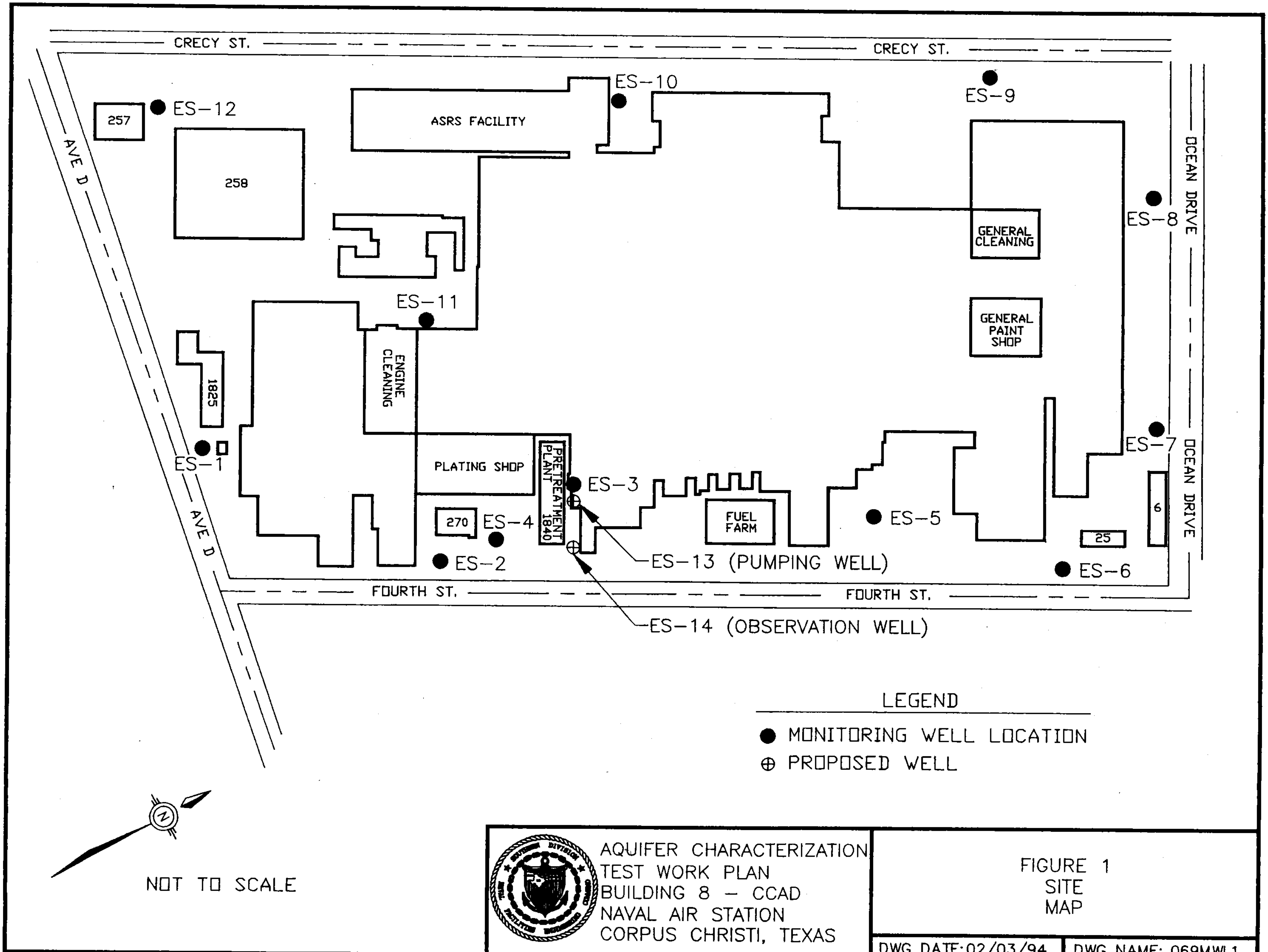
Before the aquifer characterization test begins, a pumping well and additional observation well will be installed near existing well ES-3 (Figure 1).

2.1 Rationale and Placement

The two new wells have been proposed to increase the yield and efficiency of the pumping well and improve the logistics and spacing of observation wells. Existing monitoring wells are 2 inches in diameter and have medium- to coarse-grained sand packs with a screen slot size much smaller than the sand. To improve yield and efficiency, the proposed pumping well will be 4 inches in diameter, have a more uniformly sized sand pack than existing wells, and have much larger screen slots.

If possible, the pumping well will be placed within 10 feet of well ES-3. This location was selected because ES-3 has the highest contaminant concentrations at the site. Therefore, the location will be the most likely onsite area targeted for remediation.

Additionally, the proximity of ES-3 and the pumping well is required by the low hydraulic conductivity, low yield, and unconfined nature of the aquifer. Pumping tests conducted at nearby Site 3 indicated that pumping well influence in the aquifer is limited by low discharge rates (Fugro-McClelland, 1991). An observation well 3 feet from the pumping well had less than 2 feet of drawdown after three days of pumping. Observation wells located approximately 40 feet from the pumping well had less than 0.2 feet of drawdown. Therefore, the proposed observation well will be placed within 40 feet of the proposed pumping well.



AQUIFER CHARACTERIZATION
TEST WORK PLAN
BUILDING 8 – CCAD
NAVAL AIR STATION
CORPUS CHRISTI, TEXAS

FIGURE 1
SITE
MAP

DWG DATE: 02/03/94 | DWG NAME: 069MWL1

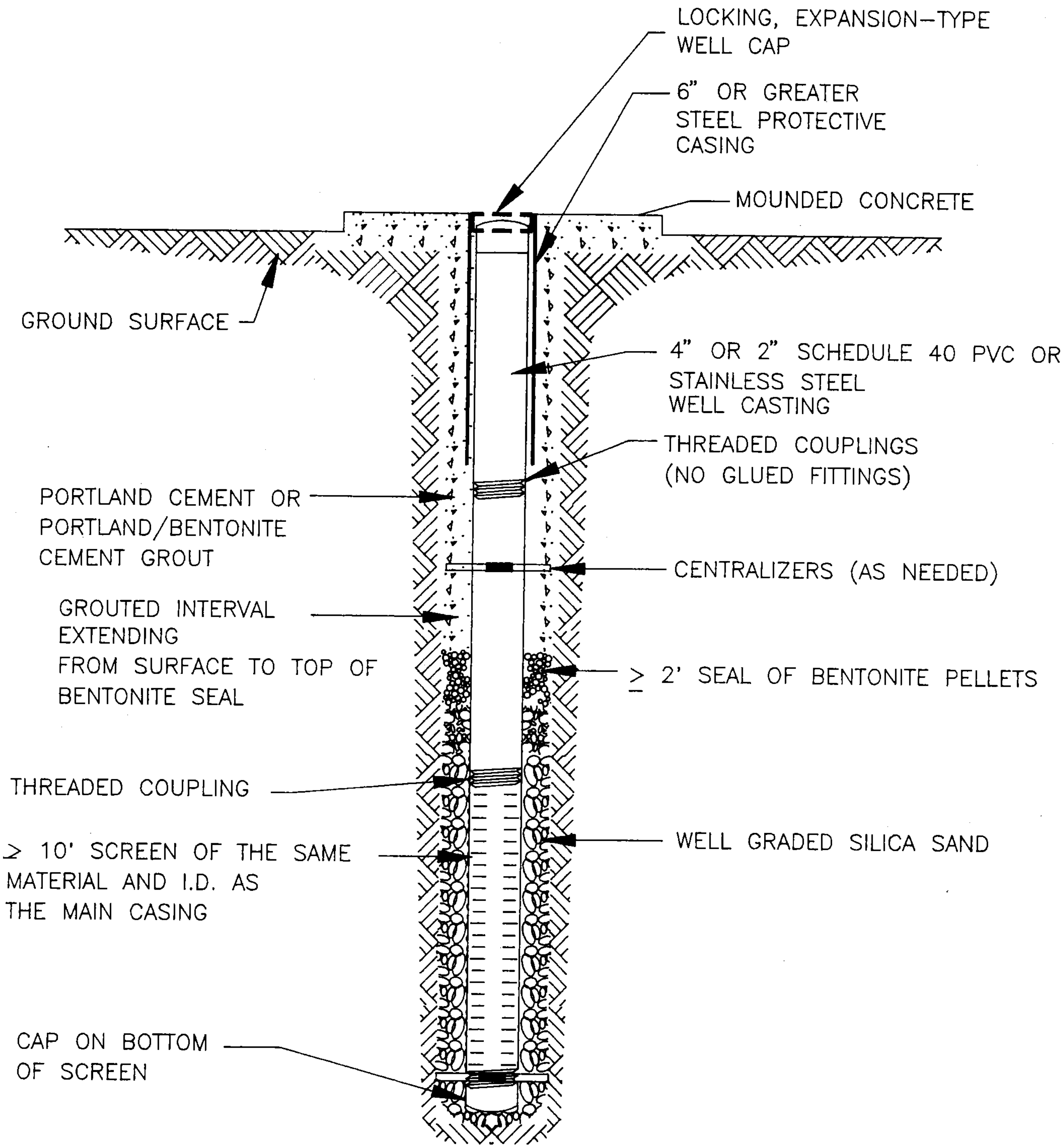
2.2 Drilling and Well Installation

Drilling activities for this pump test include the construction of a 4-inch diameter pumping well and a 2-inch diameter monitoring well. These wells will be installed using hollow-stem auger drilling techniques.

The pumping well will be constructed using 4-inch inside diameter (ID) schedule 40 poly vinyl chloride (PVC) screen and riser pipe. The well will fully penetrate the shallow aquifer to provide the most available drawdown and satisfy assumptions associated with aquifer characteristics equations. The well will have a 0.02-inch slot screen from the water table to the top of the clay at the bottom of the aquifer (estimated at 20 feet below ground surface). A 20-30 quartz sand filter pack will be installed in the annulus around the screen from the bottom of the borehole to approximately 2 feet above the screen. The sand and screen sizes were selected based on the fine-grained soil sample descriptions presented in the Groundwater Assessment Report (E/A&H, 1993). A 2-foot thick bentonite seal will be placed on top of the sand pack and allowed to hydrate at least eight hours before cement/bentonite grout is used to fill the remaining annular space.

The well will be completed with an 8-inch diameter, steel flush-mount cover cemented into the surrounding pavement. An expandable, lockable cap will be used to seal the PVC riser, and the cap will be locked for security. Figure 2 presents a schematic of the proposed monitoring well design that includes construction details.

The observation well will be constructed with the same specifications used for the pumping well except its diameter will be 2 inches instead of 4.



AQUIFER CHARACTERIZATION TEST
BUILDING 8 – CCAD
NAVAL AIR STATION
CORPUS CHRISTI, TEXAS

FIGURE 2
WELL SCHEMATIC

DWG DATE: 02/21/94 | DWG NAME: 69TIIWL1

2.3 Well Development

After installation, both wells will be developed using a hand pump, pneumatic development pump, or a submersible electric pump. The pump will be decontaminated before and after use according to the methods described in Section 2.4. Development water will be disposed of in the Corpus Christi Army Depot (CCAD) industrial wastewater treatment system.

2.4 Decontamination

Before and after each use, drilling equipment will be subjected to the decontamination steps listed below.

1. Equipment will be washed thoroughly with laboratory detergent and hot water or a pressure sprayer to remove any particulate matter or surface film.
2. Equipment will be rinsed with deionized water.

3.0 AQUIFER CHARACTERIZATION TEST

After the two proposed wells have been installed and developed, the pump, transducers, data loggers, rain gauge, and any other necessary equipment will be set up. Next, operation of the pump and data loggers will be tested, the data loggers will be programmed, and transducers and water level indicators will be calibrated.

3.1 Monitoring Equipment and Observation Wells

To improve measurement accuracy and reduce manpower requirements, water levels in the pumping well and most of the observation wells will be measured using pressure transducers and automatic data loggers. Clocks on the data loggers will be synchronized with each other before the first test begins.

During each test, water levels in the remaining observation wells will be monitored intermittently by hand. For the first eight hours of each test, water levels will be collected on one-hour intervals with a hand-held water level indicator. The interval between measurements will increase to six hours after the initial eight-hour period. Data from these intermittent measurements will be used to reveal anomalous values from transducer-derived data. As with any automatically monitored observation well, the data will also indicate whether pumping has influenced the well.

Observation wells monitored with data loggers:

ES-1 ES-2 ES-3 ES-4

ES-5 ES-10 ES-11

ES-13 (pumping well) ES-14 (new observation well)

Observation wells monitored by hand:

ES-6 ES-7 ES-8 ES-9

ES-12

The effects of barometric pressure change and tidal fluctuation on the aquifer will be investigated during each phase of the test. Barometric pressure changes will be monitored with a barometric pressure transducer connected to a data logger. Tidal influence will be investigated because Corpus Christi Bay, located approximately one-half mile northeast of the site, may affect water levels in onsite wells during the tests. Tidal affects will be monitored by measuring water levels in Corpus Christi Bay and an onsite well that is considered outside the range of influence of the pumping well, but located approximately the same distance inland as the pumping well. Water levels in the bay will be monitored with a data logger and transducer located on the beach. The transducer will be placed in piece of PVC well pipe that has been driven into the sand a few feet from the shore. Of the selected observation wells, either — ES-6, ES-7, ES-8, ES-9, ES-10, or ES-12 — will be used to monitor tidal influence. However, ES-10 is probably the best candidate because it will be monitored with a data logger. Once the amount of influence is determined, correction factors can be calculated so drawdown data can be normalized.

To measure the magnitude of precipitation events during the test phases, a rain gauge will be installed onsite.

3.2 Phase 1, Step Drawdown Testing

Step drawdown testing involves pumping a well at increasingly greater discharge rates (steps) while monitoring drawdown in the well. By comparing each discharge rate with the corresponding drawdown, the optimum pumping rate for the tested well can be estimated.

In the first phase of the aquifer characterization test, step drawdown testing will be conducted on the pumping well using an electric submersible pump, pressure transducer, and data logger. The well will be pumped at a constant rate (starting at 0.5 gallons per minute [gpm]) for one to two hours, or until pumping well drawdown stabilizes. Then the extraction rate will be increased (to 1.5 gpm) and again the drawdown will be measured after the same period of time has elapsed. This incremental process will continue until the pump's maximum discharge rate is attained, or until it is determined that the well cannot sustain a particular pumping rate. At the beginning of each step, the data logger will be programmed to record drawdown in the pumping well on logarithmic time intervals. Groundwater from the pumping well will be routed directly to the CCAD industrial wastewater treatment system.

Step drawdown data will be used to identify the pumping rate that maximizes specific capacity and minimizes turbulent head loss in the pumping well. The pumping rate will be compared to the drawdown to calculate the specific capacity of the pumping well. The maximum sustainable discharge rate estimated from these calculations will be used for the constant rate aquifer test.

3.3 Phase 2, Ambient Condition Monitoring

Static (non-pumping) aquifer conditions are investigated during the ambient condition monitoring phase of the test. Static monitoring is conducted to reveal rising or falling water level trends in the aquifer and the influence of any nearby pumping wells.

The behavior of the aquifer under ambient conditions will be monitored for 48 hours before the constant rate portion of the test begins. Because little change will be occurring in the aquifer, data loggers will be programmed to record water levels on equal time intervals. During this phase, an attempt will be made to identify any wells in use at the base. Operating wells may have a significant impact on the aquifer and may adversely influence pump test results.

3.4 Phase 3, Constant Rate Aquifer Test

As the name implies, a constant rate pumping test involves pumping a well at a constant discharge rate while simultaneously recording water levels in pumping and observation wells and the time elapsed from the start of pumping. The water level/elapsed time measurements are used to obtain estimates of aquifer characteristics (hydraulic conductivity, storativity, etc.)

An electric submersible pump will be used to pump the well at the constant rate determined from analyzing the step drawdown data. To ensure that the aquifer has been sufficiently stressed, the test will last at least 24 hours. The pump will be shut off when drawdown in observation wells stabilizes or after 48 hours of pumping, whichever comes first. The pumping well, and nearby observation well ES-3, will have data loggers set to record on a logarithmic time scale so early drawdown data can be collected. All other loggers will be set to record at equal time intervals. According to site sampling personnel, the maximum estimated discharge rate for this test will be approximately 3 gpm. At that rate, more than 8000 gallons of discharge water would be generated after 48 hours of pumping. Therefore, water from the pumping test will be discharged directly into the CCAD industrial wastewater treatment system.

3.5 Phase 4, Recovery Monitoring

Recovery tests involve monitoring the rise of water levels back to static conditions after pumping has stopped. Recovering water levels are recorded with the time elapsed after pump shut-off and the relationships between pumping rate, pumping duration, and recovery time are used to estimate aquifer characteristics. Generally, recovery data provide a means to double-check the results obtained during the constant rate test.

When 48 hours have elapsed or drawdown in observation wells has stabilized, the pump will be turned off and aquifer recovery will be monitored. The pumping well and all of the observation wells will be monitored during the recovery phase using the data logger settings outlined in Phase 3. Water level monitoring will continue for 24 hours after pump shut-down to investigate the consistency of water level trends before and after pumping.

3.6 Equipment Decontamination

To prevent cross-contamination, water level indicators, pressure transducers, and other equipment that may come in contact with contaminated groundwater will be decontaminated before and after each use.

Decontamination Steps:

1. Equipment will be rinsed with deionized water.
2. Equipment will be rinsed with isopropyl alcohol.
3. Equipment will be rinsed with deionized water.

Decontamination water will be collected and disposed of appropriately. Disposal procedures may include use of the CCAD industrial wastewater treatment system.

4.0 DATA MANAGEMENT AND MANIPULATION

Periodically during testing, drawdown data will be evaluated onsite to determine if the pressure transducers and data logging equipment are working properly. Additionally, continual data review will reveal unexpected data fluctuations or other occurrences before critical data are affected.

After testing is completed, data from the loggers will be transferred or downloaded to a portable computer for transport to the office. Then these data will be loaded into a spreadsheet program for easier manipulation and graphing. Water levels recorded by hand will be input directly into the spreadsheet files. When data have been put into a standard format, hard copies of drawdown data will be printed and kept on file. Backup data files will be kept on E/A&H system tapes in Memphis, Tennessee.

4.1 Drawdown Corrections

Drawdown data will be evaluated for correlation with barometric pressure and tidal fluctuations. If a strong barometric or tidal influence is suspected, a barometric pressure or tidal correction will be applied to drawdown data. Data also will be evaluated for delayed response, well storage effects, etc. If these data cannot be corrected and used for aquifer test analysis, their potential impact on the estimates of aquifer characteristics will be discussed.

4.2 Data Reduction and Compilation

Data from the pumping and recovery phases of the test will be compiled using the computer program Aquifer Test Solver (AQTESOLV) by the Geraghty and Miller Modeling Group (1989). AQTESOLV has several widely published and accepted analytical solutions for many different kinds of aquifer tests. Specifically, drawdown and recovery models associated with unconfined aquifers will be used to estimate aquifer characteristics. Information from AQTESOLV will be used to estimate the number of wells, radius of influence, and rate of discharge that would be needed to design an effective groundwater recovery system. These data also will be used to determine weather groundwater extraction is feasible at this site or if additional techniques could be implemented to enhance groundwater extraction rates.

5.0 REFERENCES

E/A&H, (1993). *Final Groundwater Assessment Report:* E/A&H, Memphis, Tennessee.

Fugro-McClelland, Inc. (1991). *Second Year Evaluation Report, Pilot Groundwater Remediation System Evaluation and Groundwater Quality Characterization, Site 3 NAS Corpus Christi, Texas:* Fugro-McClelland, Inc., Houston, Texas.

Geraghty and Miller Modeling Group. (1989). *AQTESOLV Aquifer Tests Solver Version 1.00 Documentation:* Geraghty & Miller, Inc., Reston, Virginia.