Contract Report 613

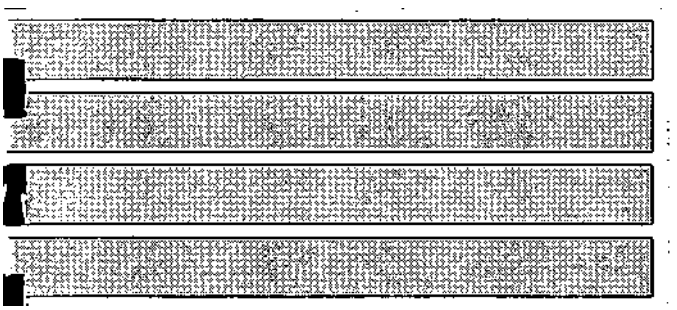
Dewatering Well Assessment for the Highway Drainage System at Four Sites in the East St. Louis Area, Illinois (FY92 - Phase 9)

by

Robert D. Olson and Ellis W. Sanderson
Office of Ground-Water Resources Evaluation & Management

Prepared for the
Illinois Department of Transporation

April 1997



Illinois State Water Survey
Hydrology Division
Champaign, Illinois

A Division of the Illinois Department of Natural Resources

DEWATERING WELL ASSESSMENT

FOR THE HIGHWAY DRAINAGE SYSTEM

AT FOUR SITES IN THE EAST ST. LOUIS AREA, ILLINOIS

(FY 92 - Phase 9)

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ABSTRACT

In the East St. Louis vicinity, the Illinois Department of Transportation (IDOT) owns 52 wells that are used to maintain the elevation of the ground-water table below the highway surface in areas where the highway is depressed below the original land surface. The dewatering systems are located at four sites in the alluvial valley of the Mississippi River in an area known as the American Bottoms. At the dewatering sites, the alluvial deposits are about 90 to 115 feet thick and consist of fine sand, silt, and clay in the upper 10 to 30 feet, underlain by medium to coarse sand about 70 to 100 feet thick.

The condition and efficiency of a number of the dewatering wells became suspect in 1982 on the basis of data collected and reviewed by IDOT staff. Since 1983, a cooperative investigation has been conducted by IDOT and the Illinois State Water Survey to more adequately assess the operation and condition of the wells, to attempt to understand the probable causes of well deterioration, and to evaluate rehabilitation procedures used on the wells. Nine phases of the investigation have now been completed.

During FY 92 (Phase 9), five wells were constructed at the I-70 dewatering site. Four of these wells (I-70 Wells 1A, 2A, 3A, and 11A) were replacement wells, and the other well (I-70 Well 15) was new. The boreholes for the wells were drilled using the reverse rotary method. The wells were finished with 16-inch-diameter stainless steel casing and continuous-slot stainless-steel well screen. Gravel-pack material was selected and installed based on the best aquifer material grain size information that was available for each well site. The well screens installed to retain the gravel pack are 50 feet in length and have slot openings from 0.020- to 0.055-inches tailored to the grain-size of the gravel pack used.

During FY 92, 16 step tests with water quality analyses were performed on 16 wells, the rehabilitation of three wells was reviewed, 14 dewatering wells were investigated for sand pumpage, and two wells were video inspected. Eight of the step tests were conducted to assess the present condition of wells to either determine their need for chemical treatment in the future or to monitor the results of previous chemical treatments. Four of the wells were in good condition with an average specific capacity of about 115 gallons per minute per foot (gpm/ft). Four wells were in poor to fair condition with an average specific capacity of about 52 gpm/ft, and treatment was recommended. The five new wells also were step-tested and found to be in poor condition with an average specific capacity of about 38 gpm/ft.

Pre- and post-treatment step tests were used to help document the rehabilitation of three dewatering wells (I-70 Well 6, 25th Street Well 4, and Venice Well 3) during FY 92. Chemical treatments used to restore the capacity of these three wells were moderately successful. The improvement in specific capacity ranged from about 55 to 656 percent based on data from the pre- and post-treatment step tests. The specific capacities of I-70 Well 6, 25th Street Well 4, and Venice Well 3 were restored to about 124, 98, and 96 percent, respectively, of the average specific capacity of wells in good condition at these sites.

The sand pumpage investigation conducted during 14 step tests revealed that I-70 Well 6 is pumping sand and gravel-pack material, and I-70 Well 8A, I-64 Well 1, 25th Street Well 4, and Venice Well 2 are pumping fine sand. These conditions may pose a threat to the long-term operation of these wells and should be monitored. Little or insignificant amounts of sand were found following step tests on newly constructed I-70 Wells 2A, 3A, and 15 that may be a temporary condition related to well development.

The video inspection of I-70 Well 3 and 25th Street Well 6 revealed little new information as to the cause of sand pumpage from these wells.

INTRODUCTION

Background

The Illinois Department of Transportation (IDOT) operates 52 high-capacity water wells at four sites in the East St. Louis area. The wells are used to control and maintain ground-water levels at acceptable elevations to prevent depressed sections of interstate and state highways from becoming inundated by ground water. When the interchange of Interstate (I) 55/70 and I-64 was originally designed, ground-water levels were at lower elevations because of large withdrawals by the area's industries. Because of a combination of water conservation, production cutbacks, and conversion from ground water to river water as a source, ground-water withdrawals by industry have decreased at least 50 percent since 1970. As a result, ground-water levels in many areas have recovered to early development levels, which exacerbates IDOT's need to dewater the areas of depressed highways.

Scope of Study

The Illinois Department of Transportation first installed 12 dewatering wells in 1973, followed by an additional 30 wells in 1975. By 1977, the initial 12 wells were showing signs of loss of capacity. As a result, all 42 wells in use then were chemically treated to restore capacity. Although good results were obtained on most of the wells, routine monitoring by IDOT showed that deterioration problems were continuing to develop. Chemical treatment of isolated wells was made by IDOT personnel as required.

In 1982, six more wells were installed. In October 1982, IDOT asked the Illinois State Water Survey to begin an investigative study to learn more about the condition of the dewatering wells, to determine efficient monitoring and operating procedures, and to determine suitable methods of rehabilitation.

The first phase of the work, begun in March 1983, included an assessment of the condition of 14 selected wells, a review of IDOT's monitoring program, a model study to outline efficient operating schemes, recommendations on wells to be treated, and recommendations for chemical treatment procedures.

Phase 2, begun in March 1984, included an assessment of the condition of 12 selected wells; testing of a noninvasive, portable flow meter; and an initial study of the chemistry of the ground water as it moved toward an operating well.

Project work begun in July 1985 (FY 86-Phase 3) included an assessment of the condition of six wells; demonstration of a noninvasive, portable flow meter; a continued study of ground-water chemistry; and documentation of the rehabilitation of seven dewatering wells, along with follow-up step tests.

Project work begun in July 1986 (FY 87-Phase 4) included ten step tests; documentation of the treatment of five wells; documentation of the construction of I-70 Well 14 (7A); investigation of I-70 Well 9 to determine the probable cause of gravel-pack settlement; specific-capacity testing using the noninvasive, portable flow meter; and installation of piezometers at two underpass sites in East St. Louis.

Project work begun in July 1987 (FY 88-Phase 5) included nine step tests, documentation of the treatment of four wells, investigation of possible sand pumpage at three wells, and initial investigation of the condition of relief wells at two detention ponds near the intersection of I-255 and I-70/I-55.

Project work begun in July 1988 (FY 89-Phase 6) included 12 step tests, review of the chemical treatment of four wells, investigation of possible sand pumpage at nine wells, continued investigation of the relief wells at the two detention ponds along I-255, and documentation of the installation of two replacement wells (I-70 Wells 8A and 9 A).

Project work begun in July 1989 (FY 90-Phase 7) included 12 step tests, review of the chemical treatment of five wells, investigation of possible sand pumpage at ten wells, and the conclusion of the investigation of the condition of relief wells at the two detention ponds near the intersection of I-255 and I-55/I-70.

Project work begun in July 1990 (FY 91-Phase 8) included 20 step tests, review of the chemical treatment of four wells, documentation of the construction of four new wells (I-70 Wells 13 and 14, and Venice Wells 6A and 7), investigation of possible sand pumpage at 17 wells, and implementation of a ground-water-level measurement program.

Project work begun in July 1991 (FY 92-Phase 9) included 16 step tests, review of the chemical treatment of three wells, documentation of the construction of five new or replacement wells (I-70 Wells 1A, 2A, 3A, 11A, and 15), downhole video inspection of I-70 Well 3 and 25th Street Well 6 to determine the probable cause of sand pumpage and settlement, and continuation of the ground-water-level measurement program implemented in FY 90. Field and analytical data collected during the course of this project are included in appendices A-I.

Physical Setting of Study Area

The study area is located in the alluvial valley of the Mississippi River in East St. Louis, IL, in an area known as the American Bottoms (see figure 1). The geology of the area consists of alluvial deposits overlying limestone and dolomite of the Mississippian and Pennsylvanian Ages. The alluvium varies in thickness from zero to more than 170 feet, averaging about 120 feet. The region is bounded on the west by the Mississippi River and on the east by upland bluffs. The regional ground-water hydrology of the area is well documented (Bergstrom and Walker, 1956; Schicht, 1965; Collins and Richards, 1986; Ritchey et al., 1984; Kohlhase, 1987; Schicht and Buck, 1995). Except where it is diverted by pumpage or drainage systems, ground water generally flows from the bluffs toward the river.

Detailed location maps of the four dewatering sites operated by IDOT are shown in figures 2 and 3. The geology at these sites is consistent with regionally mapped conditions. The land surface lies at about 410 to 415 feet above mean sea level (ft msl). The alluvial deposits are about 90 to 115 feet thick, meaning the bedrock surface lies at approximately 300 to 320 ft msl. The alluvium becomes progressively coarser with depth. The uppermost 10 to 30 feet consists of extremely fine sand, silt, and clay, underlain by the aquifer, which is about 70 to 100 feet thick. The elevation of the top of the aquifer is about 390 to 395 ft msl.

Acknowledgments

This phase of the assessment of the condition of the highway dewatering well systems in the American Bottoms was funded by the Illinois Department of Transportation, Kirk Brown, Secretary. Thanks are due Stan Gregowicz, Bridge Inspector; Frank Opfer, Hydraulic Engineer; and Vic Modeer, Geotechnical Engineer, District 8, who reviewed and coordinated the investigation. The District 8 Bureau of Maintenance crew, under the supervision of Carl Pinkston, provided field support during step-drawdown tests on the selected wells. Water Survey staff Andy Buck, Dean Jurss, Steve Wilson, and Thad Wilson ably assisted the authors with field data and water sample collection.

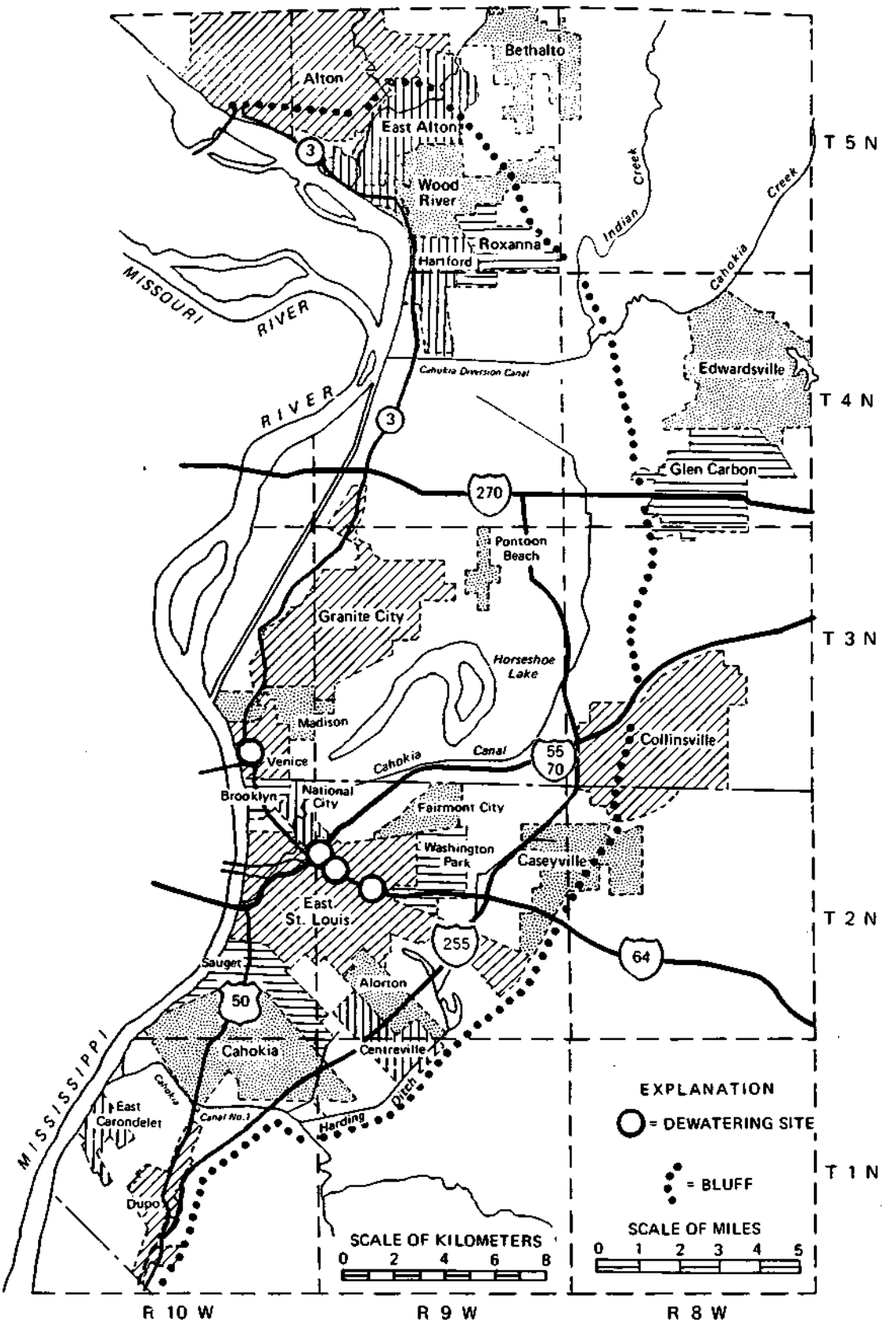

Figure 1. Location of the East St. Louis area

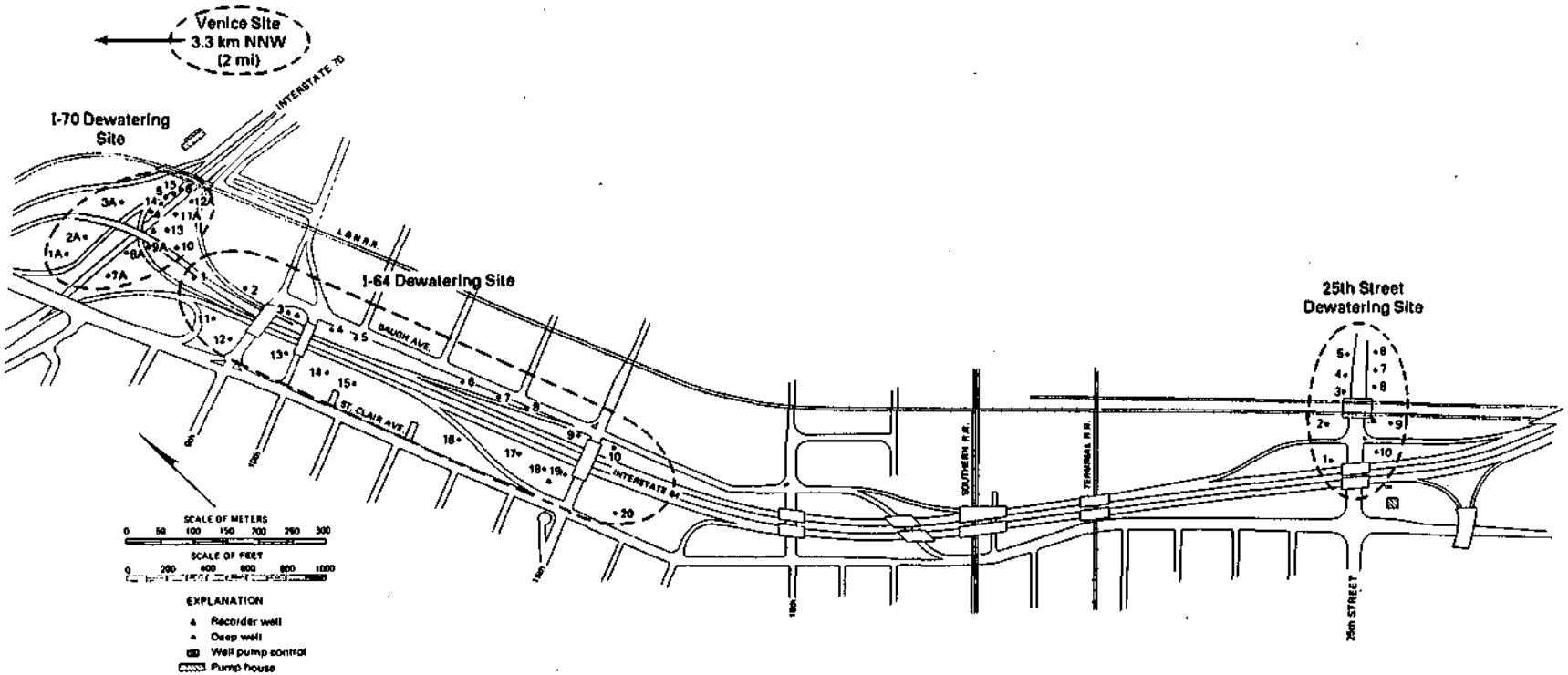

Figure 2. Locations of dewatering wells at the I-70 Tri-level Bridge, I-64, and 25th Street

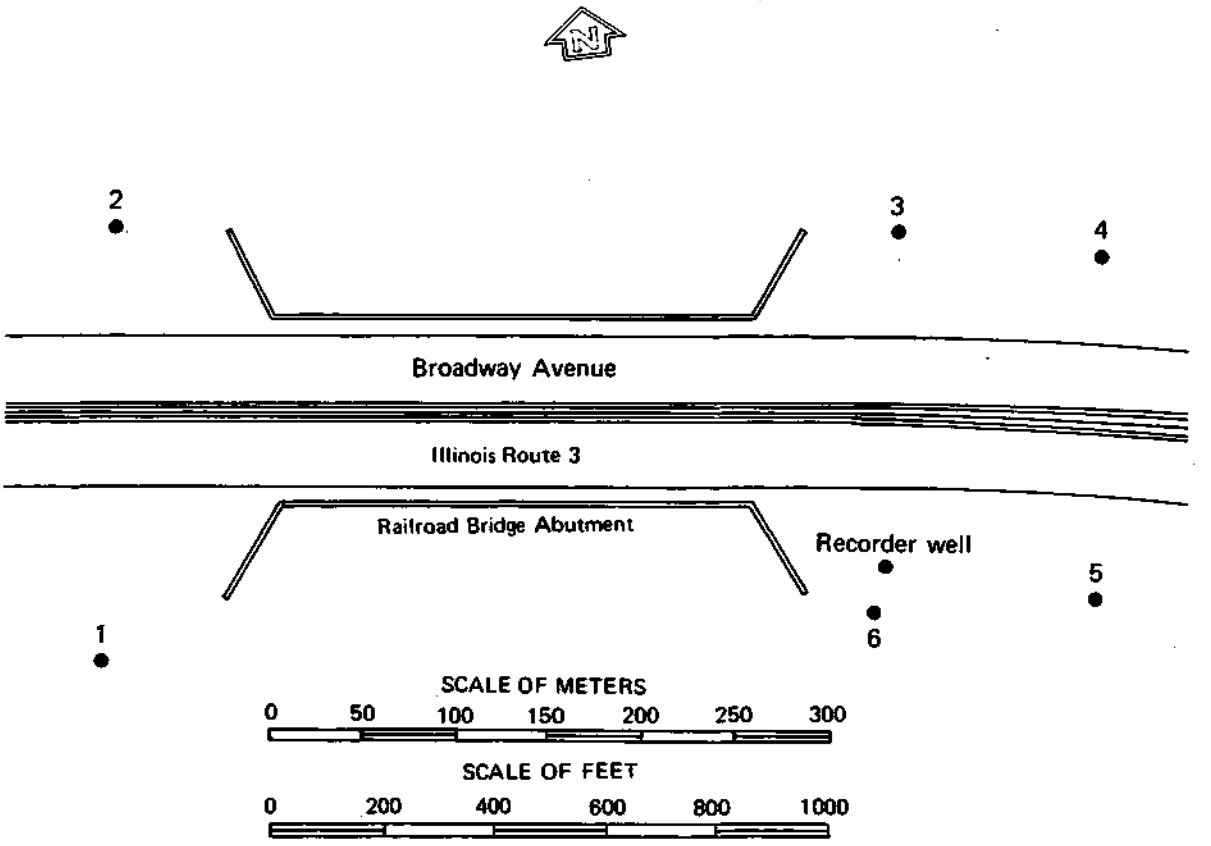

Figure 3. Locations of dewatering wells at the Venice Subway (Illinois Route 3)

Analytical work was done by the Water Survey's Chemistry Division, Office of Analytical and Water Treatment Services, under the direction of Chester H. Neff (now retired), with Brian Kaiser, Loretta Skowron, Lauren Sievers, and Daniel Webb performing the lab analyses. Manuscript editing was done by Eva Kingston, and the illustrations were prepared by John Brother, Jr. (now retired), David Cox, and Linda Hascall. Word processing was done by Pamela Lovett.

HISTORICAL SUMMARY OF DEWATERING DEVELOPMENT

The eastbound lanes of I-70 below the Tri-Level Bridge between St. Clair and Bowman Avenues in East St. Louis dip to an elevation of 383.5 feet above mean sea level (ft msl), or approximately 32 feet below natural ground surface. When the highway was designed in 1958, the ground-water levels were near an elevation of 390 ft msl, or about 6.5 feet above the planned highway (McClelland Engineers, Inc., 1971). Highway construction was carried out in 1961-1962.

Horizontal Drain System

A horizontal French drain system was designed to control the ground-water levels along an 800-foot reach of depressed highway. For highway construction, the excavation area was dewatered by pumping from seven wells 100 feet deep and 16 inches in diameter. The wells were equipped with 1,800-gallon-per-minute (gpm) turbine pumps. The construction dewatering system was designed to maintain the ground-water level at the site near an elevation of 370 ft msl.

The French drain system failed shortly after the construction dewatering system was turned off in the fall of 1962. This failure was attributed to the fact that the filter sand around the perforated diagonal drains and collector pipes was too fine for the ¼-inch holes in the drain pipes. A sieve analysis of the filter sand showed that 98.5 percent of the filter sand was finer than the ¼-inch perforations in the drain pipes. As a result, when the construction dewatering system was turned off and ground-water levels rose above the drains, filter sand migrated through the holes into the drain pipes. After the filter sand migrated into the drain, the very fine "sugar" sand used as the pavement foundation was free to move downward to the drains, resulting in development of potholes above the drains. Further migration of sand into the French drainage system was halted by operating the construction dewatering system to lower the ground-water table. Since it was very likely that the foundation sands had been piped from beneath the pavement, the diagonal drains beneath the pavement were cement-grouted to prevent any further loss of support beneath the pavement (McClelland Engineers, Inc., 1971).

Horizontal and Vertical Well Drainage System

A new drainage system was designed and installed in early 1963. It consisted of 20 vertical wells and 10-inch- to 12-inch-diameter horizontal drain pipes. The 20 wells (10 wells on each side of the highway) were spaced about 75 feet apart. They were 6 inches in diameter, about 50 feet deep, and equipped with 32 feet of stainless steel well screen (Doerr) with 0.010-inch slots. The horizontal drains were sized for a flow of about 1 gpm/ft of drain, perforated with ⅜-inch-diameter holes on 3-inch centers, and surrounded with 6 inches of gravel-and-sand filter. A total of six 2-inch-diameter piezometers were installed for ground-water-level measurements.

Tests immediately after the installation indicated that the new system was performing satisfactorily, with a discharge of about 1,200 to 2,000 gpm, compared to a computed design flow of 4,500 gpm. Ground-water levels were lowered to an elevation of 375.5± ft msl, about 2 feet below the design ground-water elevation of 377.5 ft msl, or about 8 feet below the top of the concrete pavement.

The system performed efficiently until March 1965, when a gradual rise in ground-water levels was detected. By July 1967, a 1-foot rise had occurred, and from July 1967 to April 1969, an additional 4-foot rise was observed. No additional rise was observed between August 1969 and August 1970.

Visual inspection during the late 1960s revealed some sinking of the asphalt shoulders and areas around the storm drainage inlets. Several breaks and/or blockages of the horizontal transit drain pipes were noted on both sides of the pavement, and a break in the steel tee in Well 17 was also observed. Depressions in the earth slopes immediately adjacent to the curb and gutter sections were noticed. Loss of foundation sands through the transit pipe breaks appeared to be the cause of these depressions. One manhole had settled a total of 15 inches. The attempt to correct this condition was suspended with the detection of a shift in the bottom of this manhole.

A thorough field investigation was begun to correct the damages to the underground system or to replace it if necessary. During the cleaning process of the collector pipes (using a hydrojet at the rate of 100 gpm under pressure of about 800 pounds per square inch or psi), a significant amount of scale was removed from inside the mild steel pipes, indicating serious corrosion. Nearly all the transit drain pipes also showed signs of stress. Some drains were broken and filled with sand. Attempts to clean or restore the drain pipes were abandoned in favor of a complete replacement of the system.

The field investigation also showed that the tees in the manholes, the collector pipes, and the aluminum rods on the check valves were badly corroded. Sinks, potholes, and general settlement of the shoulders indicated a distressed condition requiring immediate attention. Television inspection of the vertical wells showed no damage to the stainless steel well screens.

Excessive corrosion of the mild steel tees, well risers, and collector pipes was one of the major causes or contributors to the overall failure of the drainage system. The investigations concluded that the corrosion was caused primarily by galvanic action between the stainless steel (cathode) and mild steel (anode) components of the drainage system, with anaerobic bacteria and carbonic acid attack from the carbon dioxide (CO_2) dissolved in the well water. Galvanic action was magnified by the lack of oxygen and the high chloride content of the water. A chemical analysis showed the extremely corrosive quality of the ground water as evidenced by:

- Extremely high concentrations of dissolved carbon dioxide: 160 to 240 parts per million (ppm)
- Complete lack of oxygen: 0 ppm
- High chloride: 54 to 128 ppm; sulfates: 294 to 515 ppm; and iron concentrations: 12 ppm
- Biological activity

To withstand the possibility of severe corrosion caused by the chemical contents of ground water and to prevent galvanic action between different metals, the field investigators recommended the use of Type-304 stainless steel pipes throughout any replacement system (McClelland Engineers, Inc., 1971).

Individual Deep Well Systems

Experience during highway construction in 1961-1962 and during the 1963 drainage system replacement showed that individual deep wells were effective in temporarily maintaining ground-water levels at desired elevations. This alternative was, therefore, given further study as a permanent system. A 1972 consultant's report (Layne-Western Company, Inc., 1972) showed that water levels at the I-70 Tri-Level Bridge site could be maintained at desired elevations with ten deep wells equipped with 600 gpm pumps. Two additional wells were included to permit well rotation and maintenance. These 12 wells were constructed in 1973, and the new system was placed in service in April 1974 (I-70 site). The 16-inch gravel-packed (42-inch borehole) wells had an average depth of 96 feet, and they were equipped with 60 feet of Layne stainless steel well screen. Pumps with 600-gpm capacity and 6-inch-diameter stainless steel (flanged coupling) column pipe were set in the wells.

A recorder well was included in the well dewatering system to monitor ground-water levels near the critical elevation of the highway. The well is 8 inches in diameter and is constructed of stainless steel casing and screen. A Leupold-Stevens Type F recorder is in use. Additionally, 2-inch-diameter piezometers with 3-foot-long screens were placed about 5 feet from each dewatering well to depths corresponding to the upper third point of each dewatering well screen. These piezometers provide information on

ground-water levels and monitor the performance of individual wells by measuring water-level differences between the wells and the piezometers.

In the late 1970s, the exit ramp from the I-64 westbound lanes onto the I-55/70 northbound lanes was relocated, necessitating the abandonment of I-70 Well 12. Replacement Well 12A was then constructed at a nearby location using components similar to those in the original wells. Also in the 1970s, the well screen in I-70 Well 7 reportedly failed, and an attempt was made to rehabilitate the well by inserting a new screen inside the old screen. The well's pumping capacity remained unsatisfactory following this modification, so the well was used only on an emergency basis until it was replaced in 1986. The replacement well (7A) was constructed using components similar to those used in the original wells, with the exception of a continuous slot well screen designed on the basis of the sieve data from the nearest original test boring (Wilson et al., 1990).

In late 1986, loss of gravel pack was discovered at I-70 Well 9, and subsequent investigation revealed pumpage of fine sand, apparently from the upper 5 to 10 feet of well screen. In 1987, sand pumpage was also discovered at I-70 Wells 2 and 8, and at Venice Well 6. Replacement wells were constructed in the spring of 1989 for I-70 Well 8 (now Well 8A) and I-70 Well 9 (now Well 9A). Continuous-slot well screens were also designed and used in these wells as in I-70 Well 7A (Olson et al., 1992).

In 1990 (FY 91), two new wells were added at the I-70 site to provide greater flexibility in operation, maintenance, treatment, and repair of the other wells at the site. These wells (I-70 Wells 13 and 14) were located on either side of the eastbound lanes of I-55/70 near the lowest point of the highway. The wells were similar in construction to the replacement wells (7A, 8A, and 9A) that were drilled in 1987 and 1989.

In 1991 (FY 92), four replacement wells and one new well were added at the I-70 site. Because of various sand pumpage, settlement, and potential operational problems, replacement wells were constructed for Wells 1, 2, 3, and 11 (now Wells 1 A, 2A, 3A, and 11A). The new well (Well 15) was placed between Wells 5 and 6. The wells were similar in construction to the wells drilled in 1987, 1989, and 1990.

The western terminal of I-64 joins I-70 at the Tri-Level Bridge site. A 2,200-foot stretch of this highway also is depressed below the original land surface as it approaches the Tri-Level Bridge site. To maintain ground-water levels along I-64, a series of 20 wells was added to the dewatering system (I-64 site). The wells were built in 1975 and are essentially identical to the original wells constructed for the Tri-Level Bridge site.

About 6,200 feet southeast of the Tri-Level Bridge, at the East St. Louis 25th Street interchange with I-64, the street was designed to pass below the highway and adjacent railroad tracks. As a result, the 25th Street pavement is about 3.5 feet below ground-water levels. Ten wells were installed at this site in 1975 to control ground-water levels (25th Street site). These wells are identical in design to the original I-70 wells.

The pumps installed in the wells along I-64 and at 25th Street have nominal pumping capacities of 600 gpm. Two 8-inch observation wells, located near each end of the I-64 depressed section, are used to monitor ground-water levels. An 8-inch observation well also is installed near the critical location at the 25th Street underpass. As at the I-70 wells, each dewatering well for I-64 and 25th Street has a piezometer located approximately 5 feet away to monitor performance at the installation.

Approximately 2¼ miles north of the I-70 Tri-Level Bridge, Illinois Highway 3 passes beneath the N&W, ICG, and Conrail railroad tracks. When the highway was constructed, ground-water levels were controlled with a horizontal drain system placed 3 feet below the pavement. Problems with the pavement and drainage system were noted in May 1979 and were attributed to the above-normal ground-water levels resulting from three to four months of continuous flood stage in the Mississippi River (about 2,000 feet west). Subsequent investigation showed deterioration of the drainage system, and the consultants recommended installation of six wells to control ground-water levels at the site (Johnson, Depp, and Quisenberry, 1980). The wells were installed in 1982 and are 16 inches in diameter with 50 feet of well screen (Venice site). They range in depth from 78 to 89 feet below grade and are equipped with submersible turbine pumps with nominal capacities of 600 gpm. One recorder well for the site and piezometers at each dewatering well were constructed to monitor system performance.

Problems with Venice Well 6 were encountered after chemical treatment in FY 88 (Phase 5). The well pumped sand-formation and gravel-pack particles, indicating a possible split or weld failure of the well screen or well casing. In 1990 (FY 91) replacement Well 6A was drilled and a new Well 7 was added at the Venice site. The additional well was considered desirable by the District Highway staff because of operational problems maintaining appropriate ground-water levels in 1984 when the Mississippi River was at high stages for several months.

Thus, the highway dewatering operation in the American Bottoms presently consists of 52 individual dewatering wells fully penetrating the water-bearing sand-and-gravel aquifer. The wells are distributed at four sites as follows:

I-70 (Tri-Level Bridge)	-	15 wells
I-64	-	20 wells
25th Street	-	10 wells
Venice (Route 3)	-	7 wells

The wells are of similar construction, with 16-inch-diameter stainless steel casing and screen, and 6-inch-diameter stainless steel column pipe (figure 4). Each well is equipped with a 600-gpm submersible pump with bronze impellers, bowls, and jacket motors. The early experience with severe corrosion problems showed that corrosion-resistant materials are required to maximize service life. Five 8-inch recorder wells are available to monitor ground-water elevations near critical locations at the four sites. Each of the 52 wells has a 2-inch-diameter piezometer to monitor individual well performance.

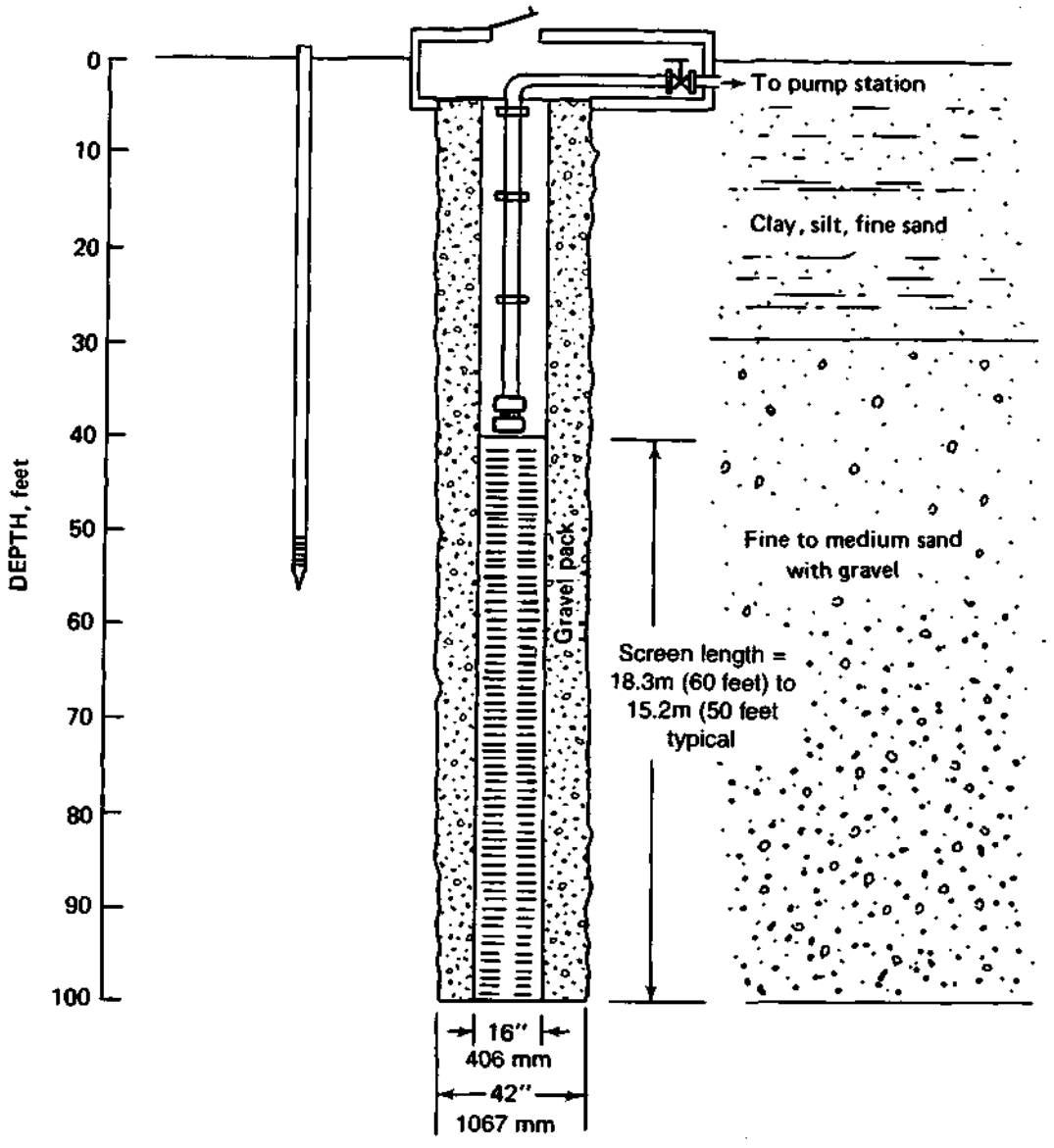

Figure 4. Typical features of a dewatering well

Usually, about one-third of the wells operate simultaneously. Total pumpage was estimated to be about 11.2 million gallons per day (mgd) in 1991.

DEWATERING SYSTEM MONITORING

When originally constructed, the well installations at I-70,I-64, and 25th Street included pitot-tube flow-rate meters. Reportedly, a combination of corrosion and chemical deposition caused premature failure of these devices. Flow rates were occasionally checked with a pitot-tube meter temporarily inserted, but erratic results were reported by the field crew. The six installations at Venice included a bronze-lined venturi tube coupled to a bellows-type differential pressure indicator to measure the flow rate. However, the water quality and environment in the well pits also adversely impacted the operation of these instruments. Accurate flow measurements became impossible and at least one direct failure of the venturi tube was reported. These meters have now been disconnected.

As part of the scope of work in FY 85-FY 87 (Phases 2-4), a noninvasive, portable ultrasonic flow meter was tested, calibrated, and used to check the specific capacity of 21 dewatering wells. Although the application of this meter was found to be limited in some cases, it was turned over to IDOT for use in their routine monitoring program.

Operational records have shown that wells are pumped for periods of about two to nine months and then left off for longer periods while another set of wells is operated. No standard sequence of pumping rotation is followed because of maintenance and rehabilitation requirements. Annual withdrawals currently are calculated on the basis of pumping time and estimated or measured pumping rates.

Until November 1989, water levels at each dewatering well were measured periodically, to monitor the overall performance of the dewatering system by the IDOT highway maintenance personnel. Due to internal reorganization of the highway maintenance staff in District 8, the Water Survey staff began monitoring the ground-water levels at the dewatering sites at the end of February 1990. Water levels are measured every two months in each dewatering well and in the adjacent piezometer of each pumping well. The data collected during FY 92 (Phase 9) have been tabulated in appendix I.

Each dewatering well site also includes at least one observation well (two at the I-64 site) equipped with a Leupold-Stevens Type F water-level recorder. The recorder charts, which are changed monthly, provide a continuous record of water levels near the critical location at each dewatering site. Because of the District 8 reorganization activities mentioned above, the Water Survey also assumed the monthly servicing of the recorders beginning at the end of November 1989.

The Water Survey forwards a report of the ground-water-level data, including any recommendations, to IDOT each time measurements are collected. This information is used to monitor ground-water levels in relation to the pavement elevation for determining whether any adjustments in pumpage are necessary. The data are also useful for assessing the condition of individual dewatering wells. Water-level differences of 3 to 5 feet between the pumping wells and the adjacent piezometers have been considered normal by IDOT. Greater differences are interpreted to indicate that well deterioration is occurring.

INVESTIGATIVE METHODS AND PROCEDURES

Well Loss

When a well is pumped, water is removed from storage within the aquifer, causing water levels to decline over time in the vicinity of the well. This effect, referred to as drawdown, is most pronounced at the pumped well and gradually diminishes at increasing distances away from the well. Drawdown is the distance that the water level declines from its nonpumping stage and, under ideal conditions, is a function of pumping rate, time, and the aquifer's hydraulic properties. Aquifer boundaries, spatial variation in aquifer thickness or hydraulic properties, interference from nearby wells, and partial-penetration conditions all can affect observed drawdowns at both pumping and observation wells. On the other hand, well loss or the additional drawdown inside the pumped well due to turbulent flow of water into and inside the well is a measure of the hydraulic efficiency of the pumping well only, reflecting the unique flow geometry of the borehole, well screen, and pump placement.

Because of well loss, the observed drawdown in a pumped well is usually greater than that in the aquifer formation outside the borehole. In addition to considerations of flow geometry, as noted above, the amount of well loss can also depend on the materials used (screen openings, gravel-pack size distribution, drilling fluids, etc.) and the care taken in constructing and developing the well using mechanical and hydraulic means to remove drilling fluids from the borehole. Some well loss is natural because of the physical blocking of the aquifer interstices caused by the well screen and the disturbance of aquifer material around the borehole during construction. However, an improperly designed well and/or ineffective well construction and development techniques can result in unacceptable well losses. In addition, well losses often reflect a deterioration in the condition of an existing well, especially if they are observed to increase over time.

Specific capacity, the quotient of pumping rate divided by the drawdown observed after a given time period, is often used in the field as an indicator of well performance. However, specific capacity combined with an analysis of well loss provides a more complete picture of the condition of the well that allows for normalization and comparison at various pumping rates.

Well loss is a function of pumping rate but ideally not of time. It is associated with changes in flow velocity in the immediate vicinity of the well, resistance to flow through the well screen, and changes in flow path and velocity inside the well, all of which cause the flow to change from laminar to turbulent in form. Head losses under turbulent conditions are nonlinear; that is, drawdowns increase more rapidly with increases in pumping rate than under laminar conditions, as discussed below.

While it is possible to have turbulent flow within the aquifer and laminar flow within a pumping well, under near-ideal conditions the observed drawdown (s_o) in a pumping well is made up of two components: the formation loss (s_a), resulting from laminar flow head loss within the aquifer; and well loss (s_w), resulting from the turbulent flow of water into and inside the well, as shown in equation 1.

$$s_o = s_a + s_w \tag{1}$$

Jacob (1947) devised a technique for separating the well losses from the formation losses, assuming that all formation losses are laminar and all well losses are turbulent. These components of theoretical drawdown, s, in the pumped well are expressed as being proportional to pumping rate, Q, in the following manner:

$$s = BQ + CQ^2 \tag{2}$$

where B is the formation-loss coefficient at the well-aquifer interface per unit discharge, and C is the well-loss coefficient. For convenience, s is expressed in feet and Q in cubic feet per second (ftVsec). Thus, the well-loss coefficient C has the units sec^2/ft^5.

Rorabaugh (1953) suggested that the well-loss component be expressed as CQ^n, where n is a constant greater than 1. He thus expressed the drawdown as:

$$s = BQ + CQ^n \tag{3}$$

To evaluate the well-loss component of the total drawdown, one must know the well-loss coefficient (if using equation 2) or both the coefficient and the exponent (if using equation 3). This analysis requires a controlled pumping test, called a step-drawdown test (described below), in which total drawdown is systematically measured while pumping rates are varied in a stepwise manner.

Methodology for Determining Well Loss

If Jacob's equation is used to express drawdown, then the coefficients B and C must be determined. A graphical procedure can be employed after first modifying equation 2 as:

$$s/Q = B + CQ \tag{4}$$

After this modification, a plot of s_o/Q versus Q can be prepared on arithmetic graph paper from data collected during a step drawdown test, with the observed drawdown, s_o, substituted for s. The slope of a line fitted to these data is equal to C, while the y-intercept is equal to B, as shown in figure 5. If the data do not fall within a straight line, but instead curve concavely upward, the curvature of the plotted data indicates that the second-order relationship between Q and s_o is not valid, and the Rorabaugh method of analysis usually is appropriate.

Occasionally the data plot of s_o/Q versus Q may yield a straight-line fit with essentially zero slope or with a negative slope, or the data may be too scattered to allow a reasonable fit to be made at all. In these instances, the well-loss parameters are immeasurable. Possible explanations for this are: 1) turbulent well loss was negligible for the range of pumping rates utilized during the test; 2) inadequate data collection or test methods were employed during the test; 3) the hydraulic condition of the well was unstable, as is the case during well development; or 4) the contribution of water from the aquifer was not uniform along the entire length of the well screen over the range of pumping rates, as might occur due to the pump setting in relationship to the screen or to vertical heterogeneity of the aquifer materials.

If Rorabaugh's equation is used, then the coefficients B and C as well as the exponent n must be determined. To facilitate a graphical procedure, equation 3 is rearranged as:

$$(s/Q) - B = CQ^{n-1} \qquad (5)$$

Taking logs of both sides of the equation leads to:

$$\log [(s/Q) - B] = \log C + (n - 1) \log Q \qquad (6)$$

A plot of $(s_o/Q) - B$ versus Q can be made on logarithmic graph paper from step-test data by replacing s with s_o. Values of B are tested until the data fall on a straight line (figure 6). The slope of the line equals n - 1, from which n can be found. The value of C is determined from the y-intercept at Q = 1. In the example shown, the graphical procedure is facilitated if Q is plotted as cubic feet per second, and $(s_o/Q) - B$ is plotted as seconds per foot squared. It is also convenient (although not mandatory) to use these same units in the Jacob method.

Step-Test Procedure

The primary objective of a step drawdown test (or step test) is the determination of the well-loss coefficient (and exponent, if Rorabaugh's method is used). With this information, the turbulent well-loss portion of drawdown for any pumping rate of interest can be estimated. During the test, the well is pumped successively at a number of selected pumping rates. Equally spaced pumping rates are selected to facilitate the data

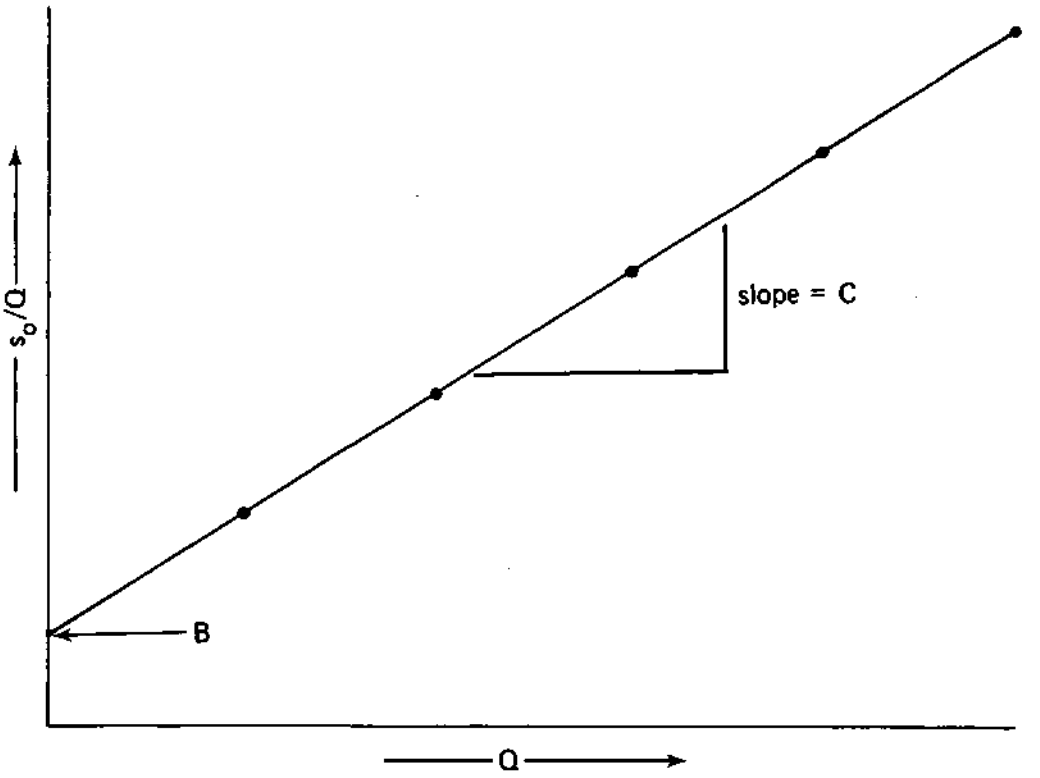

Figure 5. Graphical solution of Jacob's equation for well loss coefficient, C

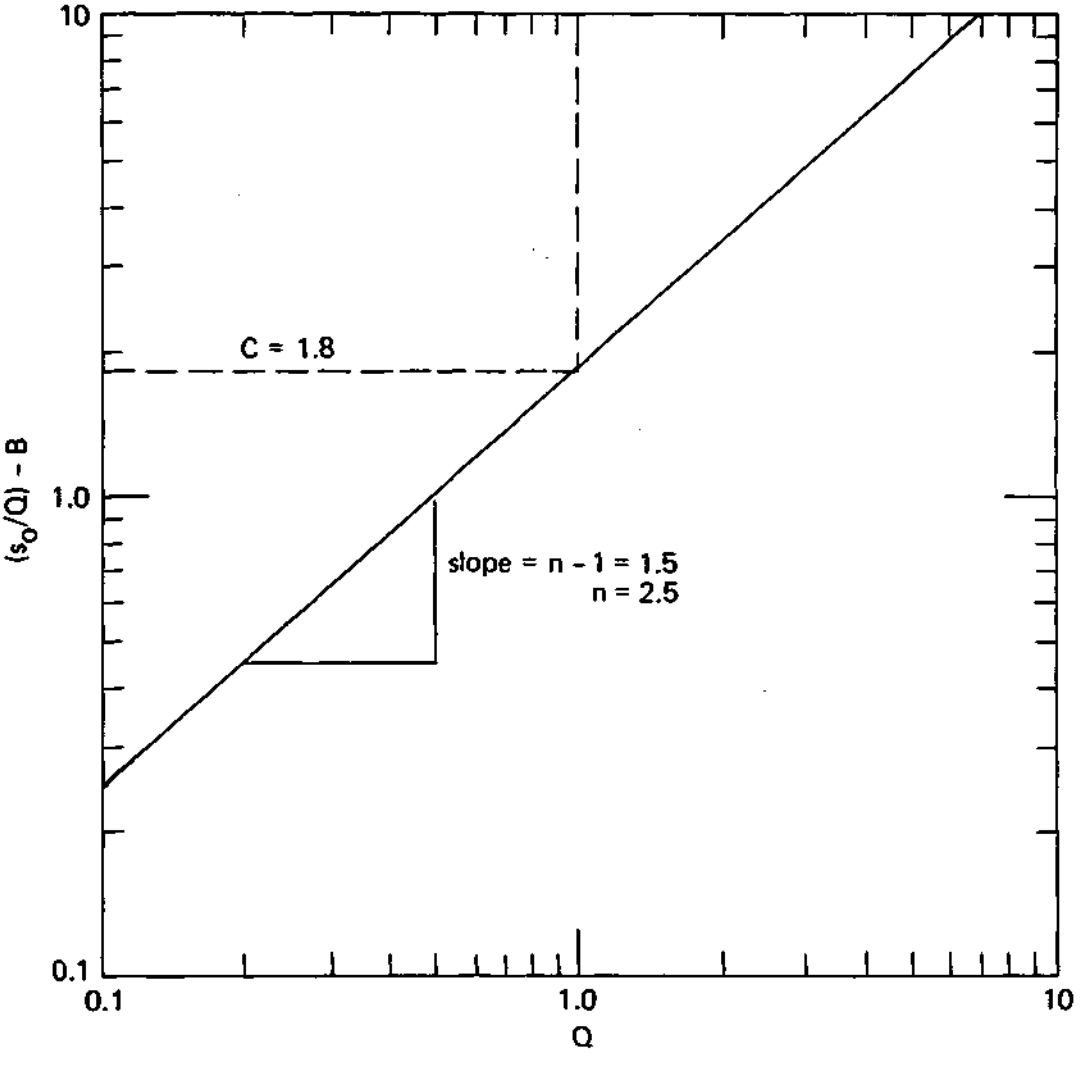

Figure 6. Graphical solution of Rorabaugh's equation for well loss coefficient (C) and exponent (n)

analysis. Each pumping period at a given rate is called a step, and all steps are of equal time duration. Generally, the pumping rates increase from step to step, but the test also can be conducted by decreasing pumping rates. Conducting the steps at decreasing rates has been found to be the most efficient procedure at the dewatering well sites.

During each step, pumpage is held constant. If data are collected manually, water-level measurements are made every minute for the first six minutes, every two minutes for the next ten minutes, and then every four to five minutes thereafter until the end of the step. For most of the step tests in this study, the Water Survey's Micro-computer Data Acquisition System (McDAS) was used to collect the data. It can be set to read the data either at a selected frequency or logarithmically as conditions dictate. If the logarithmic frequency is selected, the readings progress from several readings a second at the start of the step to readings every two to three minutes at the end of each step. In this investigation, water levels were measured for 30 minutes per step. At the end of each 30-minute interval, the pumping rate was immediately changed, the water-level measurements again reverted to the initial frequency, and so on, until a wide range of pumping rates within the capacity of the pump was tested.

Schematically, the relationship between time and water levels resembles that shown for a five-step test in figure 7. Drawdowns for each step (shown as ΔS_i) are measured as the distance between the extrapolated water levels from the previous step and the final water level of the current step. For step 1, the nonpumping water-level trend prior to the start of the test is extrapolated, and As, is measured from this datum. All data extrapolations should be performed on semilog graph paper for the most accurate results. For the purpose of plotting s_o/Q versus Q or (s_o/Q) - B versus Q, values of observed drawdown s_o are equal to the sum of ΔS_i for the step of interest. Thus, for step 3, $s_o = \Delta s$, $+ \Delta s_2 + \Delta s_3$.

Piezometers

Piezometers —small-diameter wells with a short length of screen —are used to measure water levels (head) at a point in space within an aquifer and are often used in clustered sets to measure variations in water levels with depth. In the case of well-loss studies, piezometers can be employed to measure head losses across a well screen, gravel pack, or well bore. As previously described, all 52 of the IDOT dewatering wells have piezometers drilled approximately 5 feet from the center line of each well and finished at a depth corresponding to approximately the upper third point of the screen in the pumping well. Historical monitoring of the difference in head (Δh) between water levels in the well and those in the adjacent piezometer has been used to help detect and track well deterioration problems.

Measuring piezometer water levels continuously during each step test also allows an indication of turbulent well losses in the pumped well to be found by plotting the Δh data over a large range of pumping rates. If turbulent losses exist within that range, the

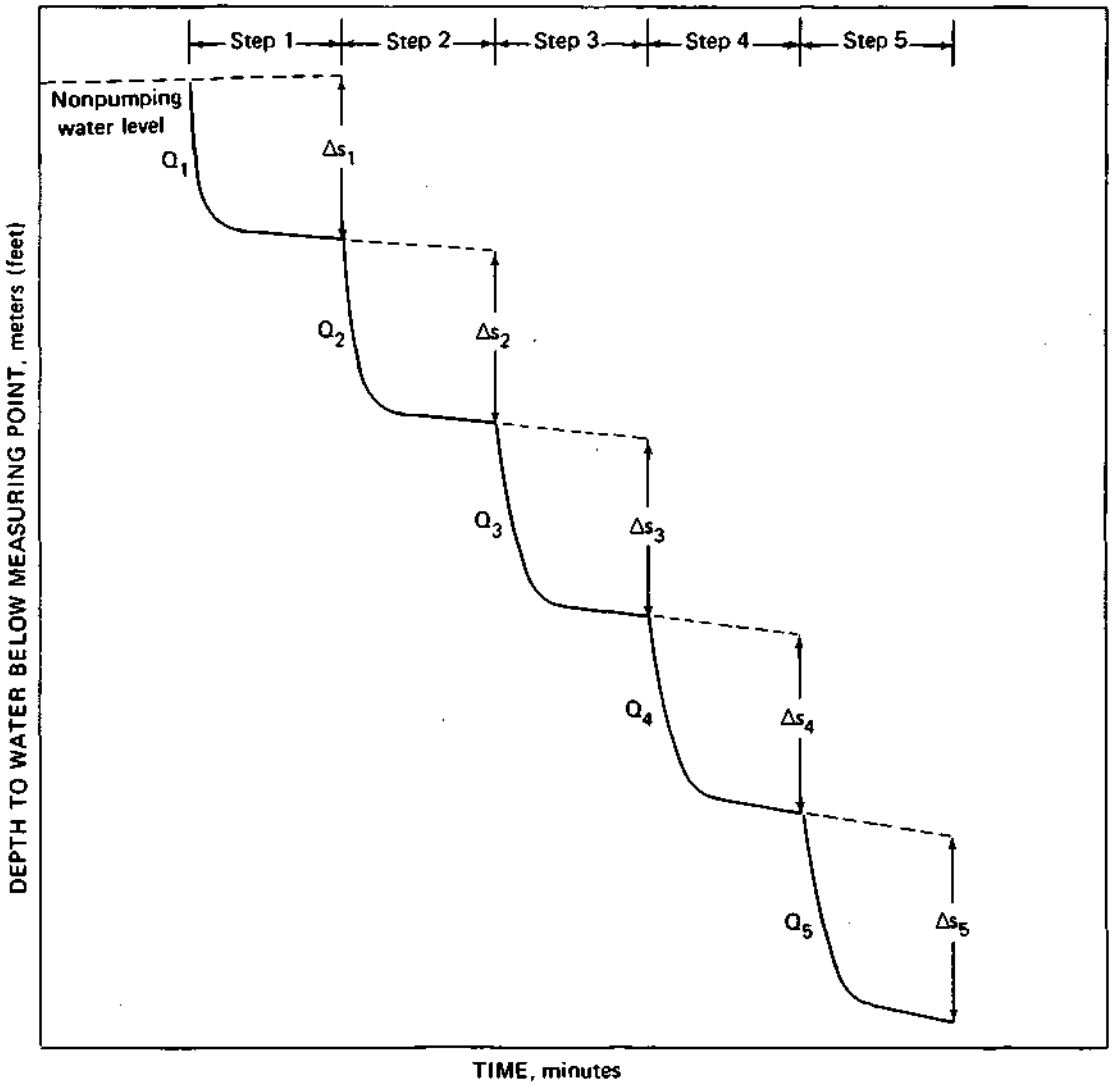

Figure 7. Relationship between time and water level during a five-step drawdown test

head differences should be nonlinear with increasing pumping rate. In addition, it can sometimes be useful to simply plot depth to water (or drawdown) in the piezometer versus pumping rate. If turbulence extends outward from the well to the piezometer, then this relationship will be nonlinear.

FIELD RESULTS

Construction of New Wells

During FY 92 (Phase 9), IDOT contracted for the construction of five wells at the I-70 site. Four of these, I-70 Wells 1A, 2A, 3A, and 11A, replaced Wells 1,2, 3, and 11, and the other well, I-70 Well 15, was an additional well. The general contractor for the work was Davinroy Mechanical Contractors, but the actual drilling work was sublet to Sisk Well Drilling, Buckner, MO.

The Water Survey made well screen and gravel-pack design recommendations for the wells based on data from the original site borings and several borings completed more recently by the IDOT drill crew. In addition, Water Survey staff were present during most construction activities for observation purposes and for consultation with the IDOT field engineer as necessary.

The wells were drilled from October 24, 1991 to February 6, 1992, although some of the other work details concerning the project (well pit boxes, pumps, piezometers, and so forth) were completed much later. Water Survey staff were not present during these activities. The wells were brought on line in late summer 1992, but a series of well operation problems caused considerable delay before the wells were finally inspected and accepted by IDOT. Appendix E contains the Dlinois Department of Public Health's Well Construction Reports and Water Well Sealing Forms (for abandoned I-70 Wells 1, 2, 3, and 11) that were filed by the drilling contractor. The sieve-analysis results from the washed samples collected by the driller and the gravel-pack materials used in the well construction appear in appendix F.

The well boreholes were drilled using the reverse rotary method. The established procedure was to first auger a hole down to the upper saturated materials and install a temporary, 42-inch-diameter steel surface casing. An auger bucket rig, converted to reverse-circulation rotary, was used to continue advancement of the borehole utilizing a drag bit. In most cases, however, the drag bit could not remove the cobbles and boulders that were encountered near the bottom of the borehole, necessitating the use of the auger bucket to complete the holes to the target elevations. Galactasol (similar to Revert®) was added to the drilling fluid to enhance the drilling operation and help control water loss from the borehole into the sand-and-gravel formations.

A total of 50 feet of 16-inch diameter, Cook continuous-slot, stainless steel well screen was used in each well. Material from the Northern Gravel Company, Muscatine, IA, was used to gravel pack the annulus between the borehole and the well screen.

For Wells 1A and 2A, the lower 30 feet of screen has 55-slot (0.055-inch) openings, and the upper 20 feet of screen has 20-slot (0.020-inch) openings. Northern pack material No. 1 (Type A in the IDOT specifications) was placed from the borehole bottom to about 3 feet above the top of the lower (55-slot) screen section with pack material No. 00 (Type C in the IDOT specifications) placed on top of the No. 1 pack to about 5 feet above the top of the upper (20-slot) screen. Figures 8 and 9 depict the final construction features of each well.

For Well 3A, the lower 30 feet of screen has 55-slot openings and the upper 20 feet of screen has 30-slot (0.030-inch) openings. Northern pack material No. 1 (Type A) was placed from the borehole bottom to about 3 feet above the top of the lower (55-slot) screen section with pack material No. 0 (Type B) placed on top of the No. 1 pack to about 5 feet above the top of the upper (30-slot) screen. Figure 10 depicts the final construction features of this well.

For Wells 11A and 15, the lower 40 feet of screen has 55-slot openings and the upper 10 feet of screen has 20-slot openings. Northern pack material No. 1 (Type A) was placed from the borehole bottom to about 3 feet above the top of the lower (55-slot) screen section with pack material No. 00 (Type C) placed on top of the No. 1 pack to about 5 feet above the top of the upper (30-slot) screen. Figures 11 and 12 depict the final construction features of these wells.

After each well was drilled, but prior to placement of the cement grout on top of the gravel pack, it was surge-pumped to remove debris left from drilling and fine formation sand in order to improve the hydraulic efficiency. Surge pumping was to continue until the well was capable of producing clear, sand-free water for one hour at about 1,000 gpm. Detailed pumping and drawdown data were not available to determine the specific capacities for these wells at this time.

The post-construction step tests were conducted on the five new wells once the contract was finalized in mid-1993. The following sections describe the results of the step tests.

Well Selection for Step Tests

Sixteen wells were step-tested for FY 92 (Phase 9). Eight wells were selected for step tests to assess their condition, five new wells were step-tested to establish initial conditions, and three post-treatment step tests were conducted on the three wells chemically treated to restore production capacity (a total of 16 step tests).

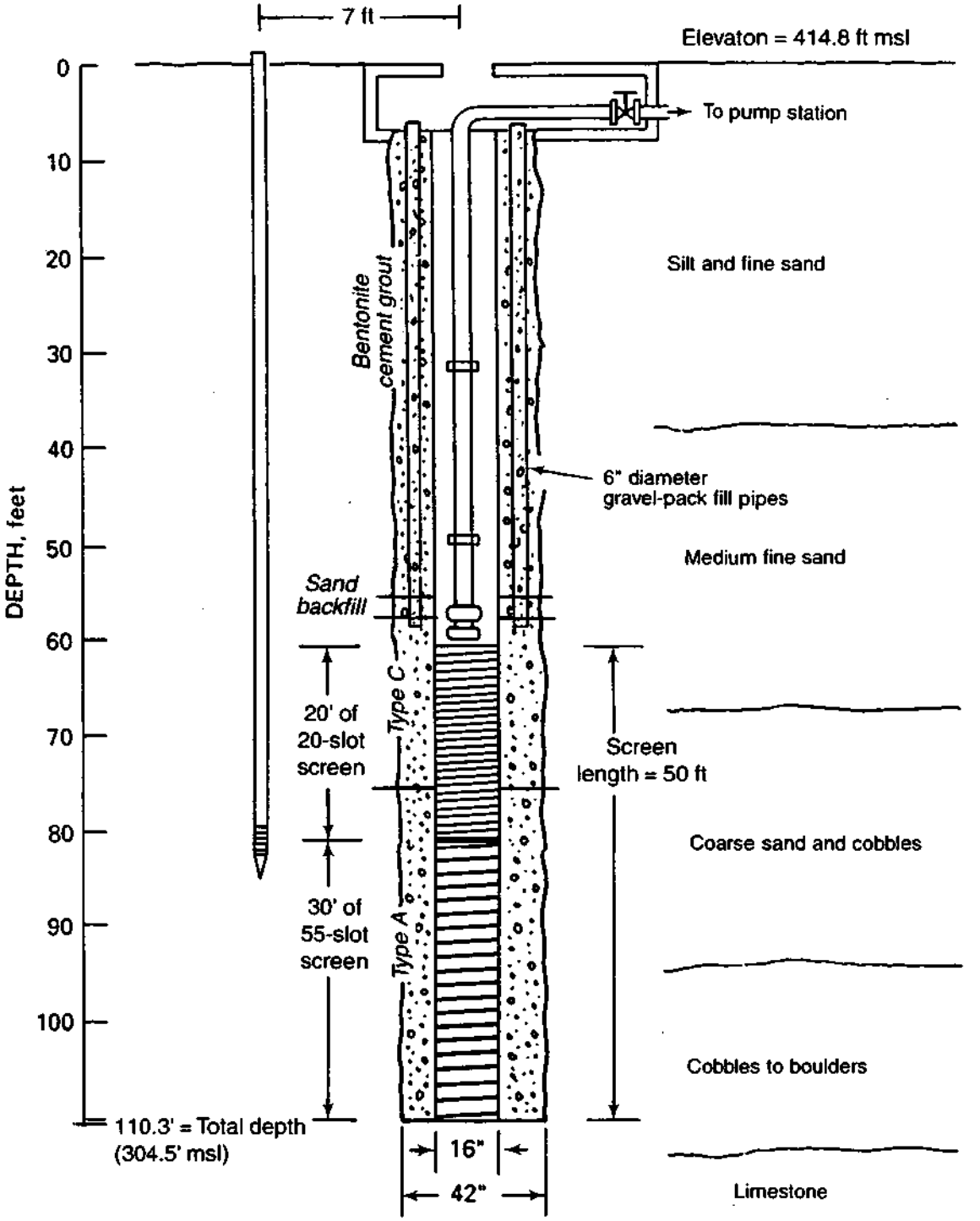

Figure 8. Construction features of I-70 Well 1A

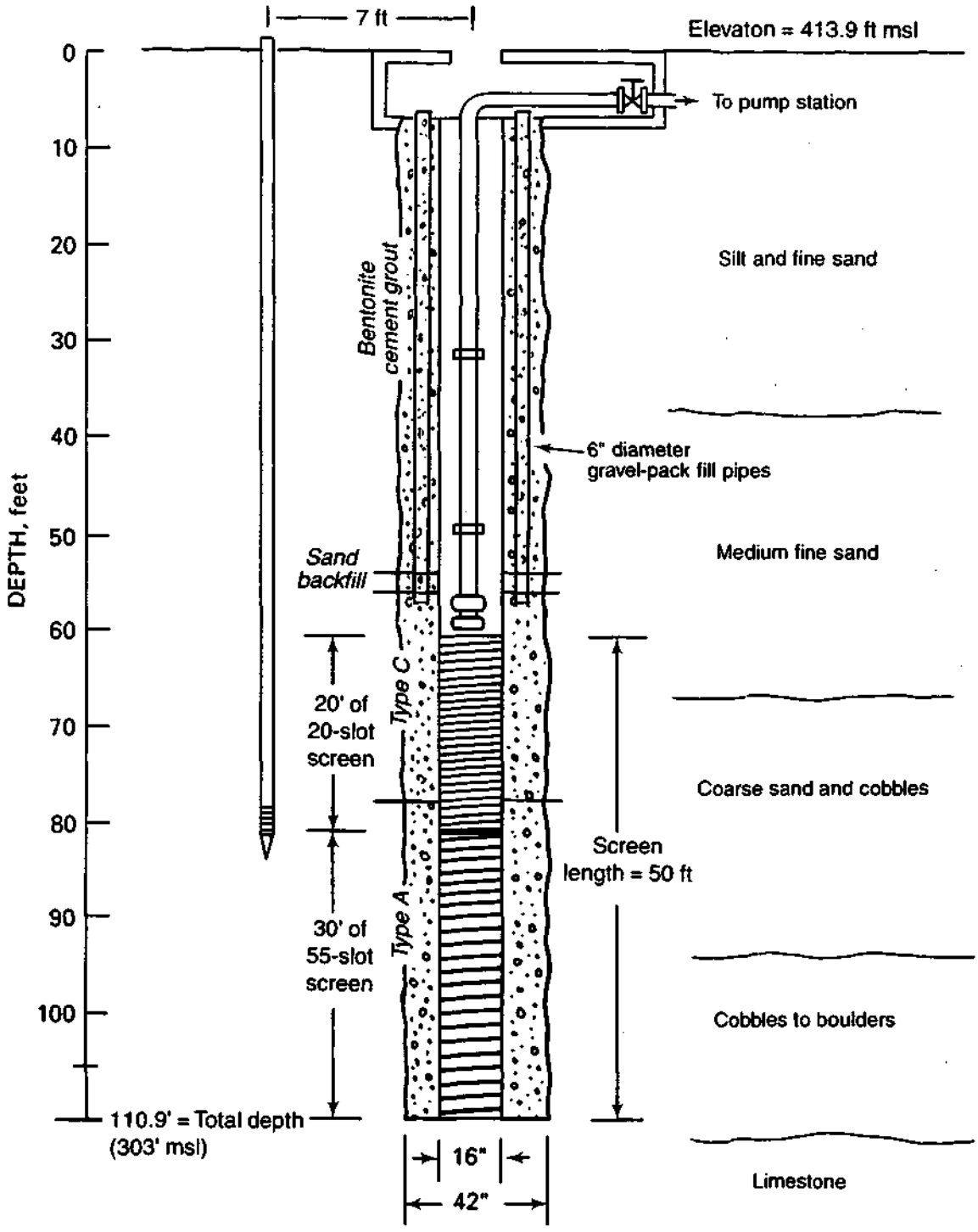

Figure 9. Construction features of I-70 Well 2A

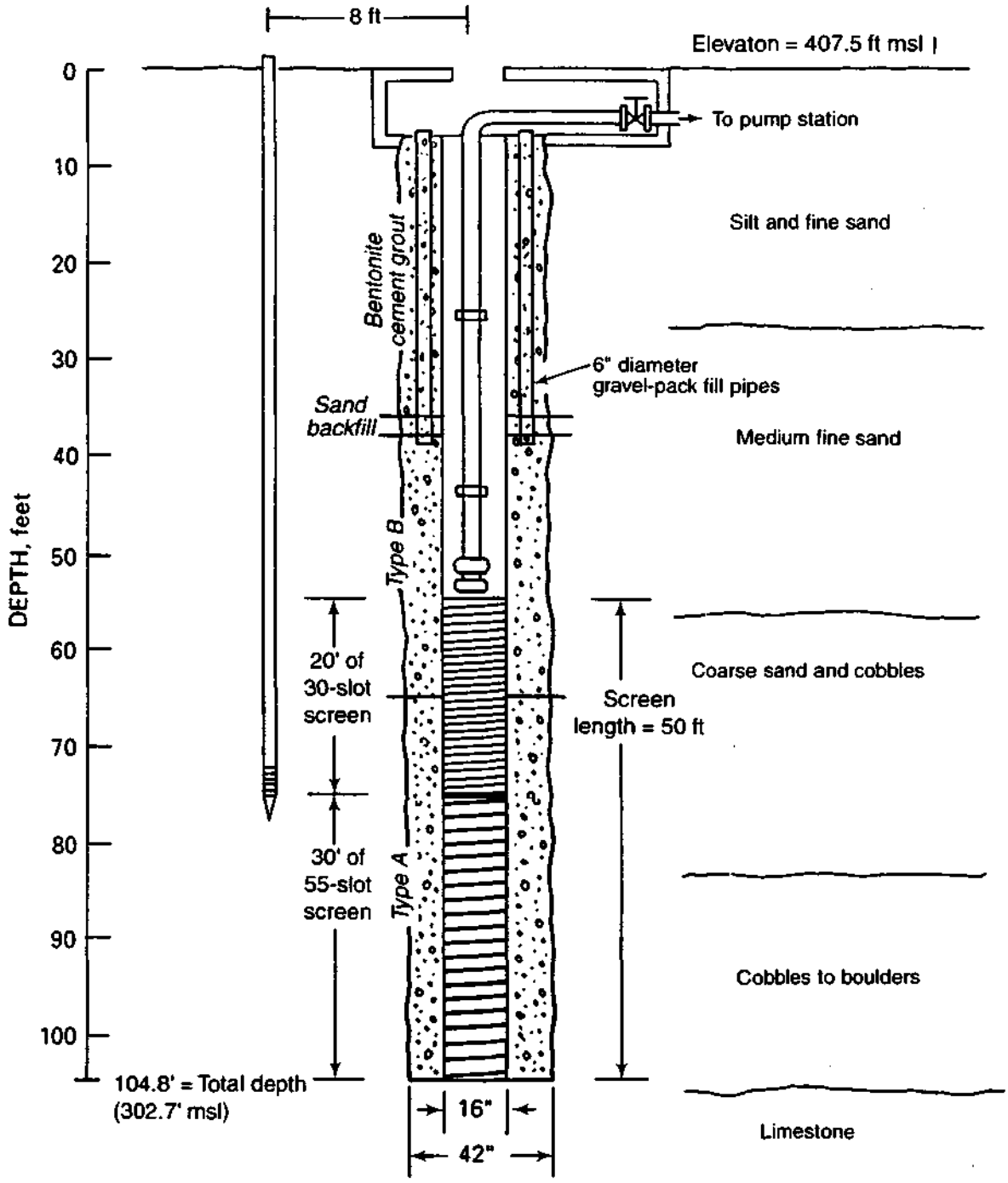

Figure 10. Construction features of I-70 Well 3A

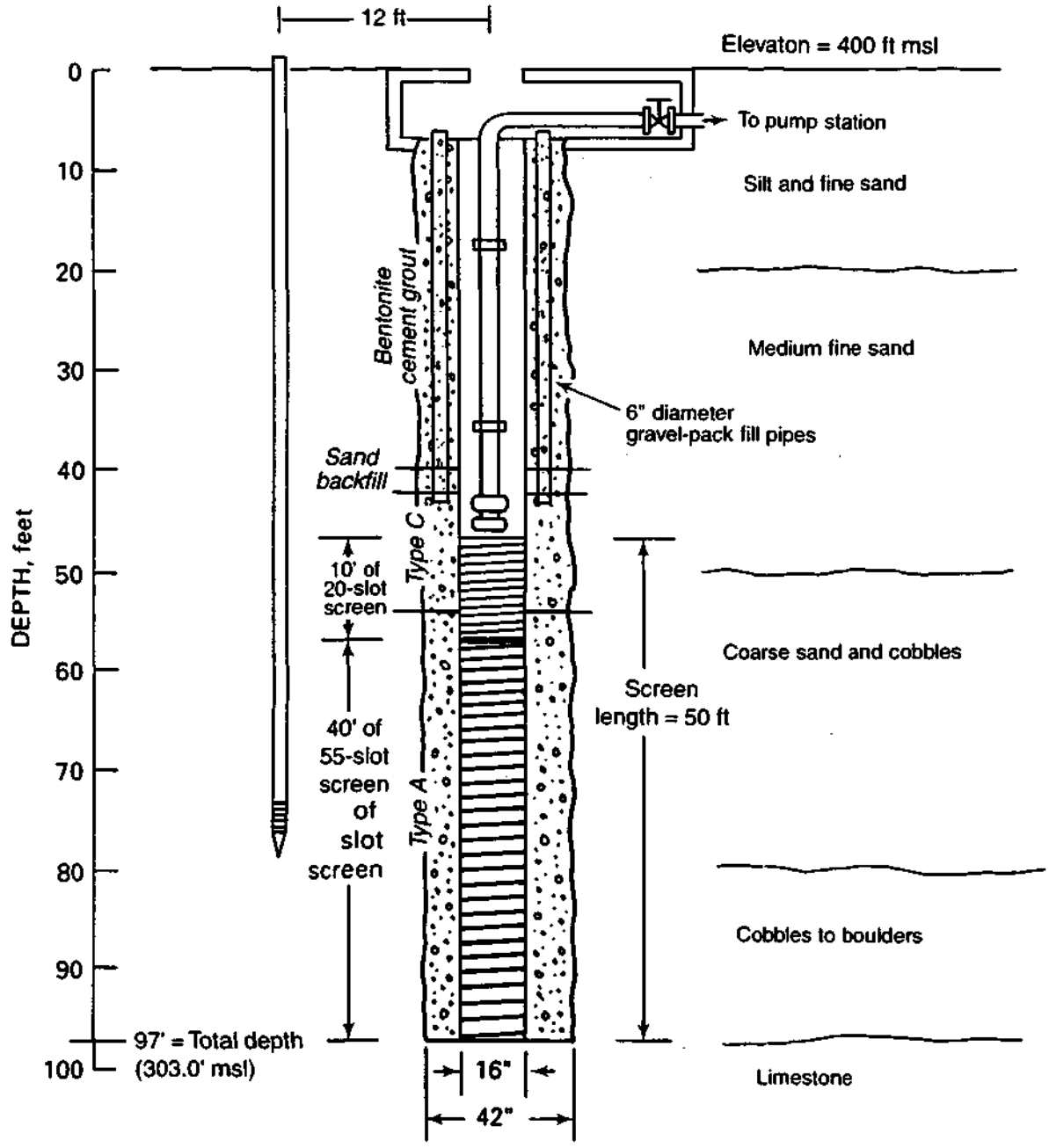

Figure 11. Construction features of I-70 Well 11A

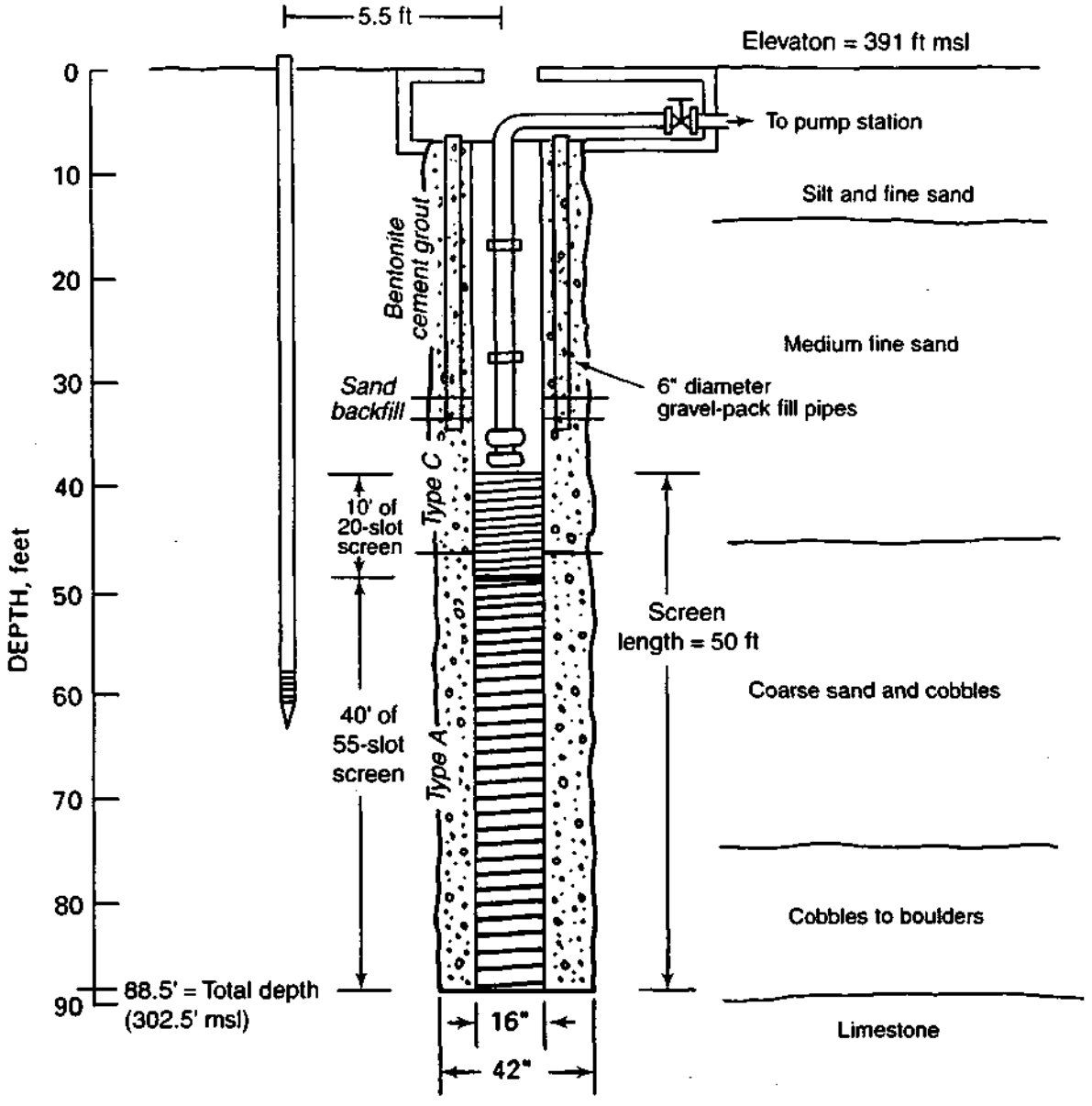

Figure 12. Construction features of I-70 Well 15

The eight wells selected for condition-assessment step tests were:

I-70	Wells 5, 8A, and 9A
I-64	Well 1
25th St.	Wells 1 and 9
Venice	Wells 2 and 5

An additional well, 25th Street Well 10, was to have been step-tested in FY 92 for condition assessment but would not operate because of a pump malfunction. Because of several factors, including plans to eventually remove the rail bridge and 25th Street underpass, IDOT decided not to repair this well.

The new wells tested to establish their new condition were:

I-70	Wells 1 A, 2A, 3A, 11 A, and 15

The three wells treated and then tested in post-treatment step tests were:

I-70	Well 6
25th St.	Well 4
Venice	Well 3

FY 92 also included pretreatment step tests on these wells, but they were dropped because of scheduling problems and the treatment contractor's early removal of all three well pumps at the same time.

Step Tests

Field Testing Procedure

Field work was conducted by Water Survey staff with the assistance of the IDOT Bureau of Maintenance crew under the supervision of Carl Pinkston. The IDOT crew made all necessary well head pipe modifications and provided special piping adapters that allowed connection of the Water Survey's flexible hose and orifice tube to measure the flow rate. Discharge from the orifice tube was directed to nearby stormwater drains.

Orifice tubes are standard equipment for accurately measuring flow rates. The orifice tube and orifice plate used to measure the range of flow rates was previously calibrated at the University of Illinois Hydraulics Lab under discharge conditions similar to those expected in the field.

The objective of each step test on the selected wells was to control the flow rate at increments of 50 gpm and to include as many 30-minute steps as possible at 300 gpm or greater for each well. Early experience with the step tests showed that at rates of less than

about 300 gpm, well-loss coefficients rarely could be determined from the collected data. Also such a low pumping rate often results from a very low specific capacity, indicating a well in poor condition. When a step test on a dewatering well encounters a pumping rate less than about 300 gpm, the drawdown in water levels is observed for a period of 30 to 60 minutes to obtain an approximate specific capacity for later comparison and this is then called a drawdown test instead of a step test.

Prior to the start of each test, the nonpumping water levels in the well and piezometer were measured with a steel tape or electric dropline. Usually, pressure transmitters, coupled to the previously described field computer system for analog to digital conversion and data storage, were placed in the pumped well and piezometer to measure water levels during the step tests.

During the step tests, the discharge from each well was also checked for the presence of sand (unless the site accessibility or condition does not allow set-up of the testing equipment) by directing the open flow from the orifice tube into a 1,000-gallon portable tank. The tank acts as a sedimentation basin, allowing sand grains to be caught, collected at the end of the step test as the tank is drained, and delivered to the geotechnical laboratory for analysis.

Three wells (I-64 Well 1 and 25th Street Wells 1 and 9) were tested in September 1991, two wells in October 1991 (I-70 Well 8A and Venice Well 2), one well each in March 1992 (Venice Well 5), July 1992 (I-70 Well 9A), and October 1993 (I-70 Well 5, delayed by construction work). Step tests on the newly constructed wells were delayed by IDOT's late final inspection and acceptance, and a pump electrical problem (I-70 Well 1A). Three of these wells were tested in October 1993 (I-70 Wells 3A, 11A, and 15), and one well each in November 1993 (I-70 Well 2A) and April 1995 (I-70 Well 1 A). Three wells were rehabilitated during the period September 16-October 15, 1991, with post-treatment step tests in October, November, and December 1991: I-70 Well 6, 25th Street Well 4, and Venice Well 3.

The data for the 16 step tests are included in appendix A. Water samples were collected at the time of each test and analyzed for chemical/mineral content and nuisance bacteria. The results from the water sample analyses are described in the following sections and presented in appendix B.

Results of Step Tests

The step-test data were analyzed by using the Jacob method, as described earlier in this report. The results of the analyses performed on the data from the 16 step tests conducted for the FY 92 investigation are summarized in table 1. As the amount of drawdown due to well loss is proportional to the pumping rate squared, the well loss reported in table 1 has been calculated for a base rate of 600 gpm utilizing the well-loss coefficient determined from the analysis of the step-test data. This enables comparison

Table 1. Results of SWS step tests on IDOT wells, FY 92 (Phase 9)

Well	*Date of test*	*Well loss @ 600 gpm (ft)*	*Drawdown @ 600 gpm (ft)*	*Well loss portion (%)*	*Observed specific capacity (gpm/ft)*	*Δh* @ 600 gpm (ft)*	*Observed Q_{max}, gpm*	*Remarks*
I-70								
No. 1A	4/26/95	0.92	14.98 e	6.1	40.8	8.7 e	445	Initial test-New well
No. 2A	11/16/93	1.78 e	20.82 e	8.5	29.7	14.0 e	438	Initial test-New well
No. 3A	10/29/93	1.34 e	15.25 e	8.8	40.0	7.7 e	540	Initial test-New well
No. 5	10/14/93	1.19 e	13.67 e	8.7	44.8	P	500	
No. 6(T)	10/29/91	0.19	4.93	3.8	121.7	--	750	Piez. buried
No. 8A	10/1/91	0.29	11.61	2.5	51.7	6.4	620	
No. 9A	7/23/92	0.24e	7.8 e	3.1	78.7	2.9 e	525	
No. 11A	10/28/93	0.40 e	16.09 e	2.5	37.6	12.5 e	474	Initial test-New well
No. 15	10/15/93	2.95 e	14.88 e	19.8	41.5	9.1 e	545	Initial test-New well
I-64								
No. 1	9/24/91	0.12	4.33	2.8	138.6	P	630	
25th St.								
No. 1	9/4/91				31.6	P	235	Drawdown test only
No. 4(T)	11/19/91	0.62	4.75	13.1	119.9	P	840	

Table 1. Concluded

Well	*Date of test*	*Well loss @ 600 gpm (ft)*	*Drawdown @ 600 gpm (ft)*	*Well loss portion (%)*	*Observed specific capacity (gpm/ft)*	*Δh* @ 600 gpm (ft)*	*Observed Q_{mix}, gpm*	*Remarks*
25th St.(Cont'd)								
No. 9	9/18/91	0.66 e	5.10 e	12.9	117.6	1.8 e	580	
Venice								
No. 2	10/2/91	1.30	6.14	21.1	92.8	2.3	780	
No. 3(T)	12/16/91	**	6.26 e	**	97.2	2.3	840	
No. 5	3/24/92	0.73	5.28	13.8	110.5	P	760	

Notes:

* Head difference between pumped well and adjacent piezometer

** Coefficient immeasurable. Turbulent well loss negligible over the pumping rates tested.

e = Estimate based on interpolated values adjusted to 600 gpm

T = Post-treatment step test

P = piezometer plugged or partially plugged

among dewatering wells that operate at different rates. The well loss also is reported in table 1 as a percentage of total drawdown calculated using equation 2 ($s = BQ + CQ^2$) at the base rate of 600 gpm. All step tests conducted in FY 92 were run with steps at decreasing rates so the observed specific capacity included in table 1 is calculated based on the total observed drawdown at the end of the first step when the highest pumping rate is used.

Step tests were conducted to assess the condition of eight existing wells and five new wells. (Results for the three post-treatment step tests are addressed in the Well Rehabilitation section.) Wells 5, 8A, and 9A were checked at the I-70 site. Initial step tests were also conducted on new I-70 Wells 1 A, 2A, 3A, 11 A, and 15.

When tested on October 14, 1993, the specific capacity of I-70 Well 5 was 44.8 gpm/ft, with well loss accounting for about 8.7 percent of the total drawdown. The maximum pumping rate was about 500 gpm. The Δh could not be determined as the piezometer was plugged. Several previous step tests have been conducted on Well 5. For comparative purposes, the most recent step test, conducted on February 2, 1989, following treatment, showed a specific capacity of about 96 gpm/ft and an estimated well loss of 11.4 percent. The specific capacity had declined over 50 percent during this time even though well loss has remained about the same.

A step test on I-70 Well 8A on October 1, 1991, showed a specific capacity of about 51.7 gpm/ft, a well loss estimate of about 2.5 percent, and a Δh of about 6.4 feet. The only previous step test on this well was conducted on October 4, 1989, following construction. At that time the specific capacity was about 98 gpm/ft and the Δh about 1.4 feet (well loss could not be estimated), meaning the well's condition had declined significantly in just two years.

I-70 Well 9A was step-tested on July 23, 1992, and showed a specific capacity of about 78.7 gpm/ft, a well loss estimate of 3.1 percent, and an estimated Δh value of 2.9 feet at 600 gpm. The specific capacity compares to about 101 gpm/ft in April 1991, when the Δh was about 2.7 feet. Well 9A has been step-tested annually since construction in 1989. Until this year's step test, the specific capacity had remained at about 100 gpm/ft, although there has been a slow but steady increase in the Δh from the original 1.7 feet.

The initial step tests on new I-70 Wells 1 A, 2A, 3A, 11 A, and 15 were conducted on April 26, 1995; November 16, 1993; October 29, 1993; October 28, 1993; and October 15, 1993, respectively. (All of the wells were pumped for an extended period of months before the step tests could be conducted, the step test on Well 1A being delayed even further until its nonoperational pump was repaired.) For all of these wells, the specific capacities were very low, ranging from about 29.7 to 41.5 gpm/ft, and Δh was high, ranging from about 7.7 to 14 feet. The well loss estimates were within an acceptable range of 2.5 to 8.8 percent, except for I-70 Well 15 (well loss approximately 20 percent). Because of the delay in conducting the step tests following construction, it is not known whether these new wells were initially in poor condition or whether they

deteriorated between the time of construction (October 1991-February 1992) and the step tests.

Well 1 at the I-64 site was step-tested on September 24, 1991. The results showed a specific capacity of about 137 gpm/ft and a well loss of about 2.8 percent. The Δh could not be determined because of a plugged piezometer. The only previous step test, conducted on this well in 1987, showed a specific capacity of about 145 gpm/ft (well loss could not be determined). This well remains in good to excellent condition.

At the 25th Street Site, Wells 1,9, and 10 were slated for condition-assessment step-tests during FY 92. However, the pump in Well 10 was discovered in an inoperable condition just prior to the set-up for the step test. IDOT decided not to repair the pump because of their intent to remove the 25th Street underpass and the relatively distant location of Well 10 from the underpass low point.

A step test was attempted on 25th Street Well 1 on September 4, 1991, but its low pumping capacity allowed only a partial drawdown test. The results showed an observed specific capacity of about 31.6 gpm/ft as compared to a specific capacity of 185 gpm/ft in 1989, the only other test on this well. A partially plugged piezometer precluded Δh measurements.

Well 9 at 25th Street was step-tested on September 18, 1991. The results showed a specific capacity of about 118 gpm/ft, an estimated well loss of 13 percent, and a Δh value of about 1.8 feet at 600 gpm. This compared favorably with a specific capacity of about 110 gpm/ft and Δh of about 2.0 feet on June 25, 1986, the only other step test on this well (well loss could not be estimated). This well remains in good to excellent condition.

Two wells at the Venice site were scheduled for condition-assessment step tests in FY 92. An October 2, 1991, step test on Well 2 showed a specific capacity of about 93 gpm/ft, an estimated well loss of 21 percent, and a Δh of about 2.3 feet. Several step tests have been conducted on this well, and it has been treated previously to restore capacity. This compares to the most recent test conducted on May 8, 1990, which followed the chemical treatment, when the specific capacity was about 95 gpm/ft and the Δh was about 2.4 feet (well loss could not be estimated). This well remains in good condition.

A March 24, 1992, step test on Venice Well 5 showed a specific capacity of about 111 gpm/ft, an estimated well loss of 14 percent, but no Δh data because the piezometer was plugged. Several step tests also have been conducted on this well, and it had been treated previously to restore capacity. By comparison, in the most recent test, conducted on May 2, 1990, following chemical treatment, the specific capacity was about 110 gpm/ft (well loss could not be estimated). This well remains in good to excellent condition.

Chemical treatment is recommended for the five new wells (I-70 Wells 1 A, 2A, 3A, 11 A, and 15) as well as I-70 Wells 5 and 9A and 25th Street Well 1, which are all in poor condition. Although the condition of I-70 Well 9A is not as bad as those noted above, its specific capacity has declined over 20 percent in a 15-month period and probably would benefit from treatment. A video inspection of these wells for excessive buildup of incrusting minerals also should be considered.

Step-Test Data Summary

Since FY 84 (Phases 1-9), 118 step tests have been completed at all sites. The results are included in appendix C, and the specific capacity data are summarized in table 2. The average specific capacity for all 118 step tests is about 82 gpm/ft. By excluding the results from 46 pretreatment step tests and other step tests that show wells in poor condition, the average specific capacity of 72 step tests is about 105 gpm/ft. The highest specific capacities are generally found at the 25th Street site where 23 step tests have been completed. Specific capacities for all step tests at the 25th Street site averaged about 93 gpm/ft, but the average jumps to about 122 gpm/ft when nine step tests on wells in poor condition are excluded. At the I-70, I-64, and Venice sites, respectively, 57, 16, and 22 step tests have been completed with average specific capacities of about 71, 99, and 83 gpm/ft. Without the step tests on wells in poor condition at these sites, the specific capacities are about 98, 105, and 101 gpm/ft, respectively.

Table 2. Average specific capacity of dewatering wells based on FY 84 - FY 92 (phases 1-9)

	I-70	*I-64*	*25th St.*	*Venice*	*All Sites*
All wells:					
Number of step tests	57	16	23	22	118
Average specific capacity, gpm/ft	71	99	93	83	82
Wells in good condition or post-treatment:					
Number of step tests	29	14	14	15	72
Average specific capacity, gpm/ft	98	105	122	101	105
Wells in poor condition or pretreatment:					
Number of step tests	28	2	9	7	46
Average specific capacity, gpm/ft	43	58	49	45	45

Well Rehabilitation

Chemical Treatment Procedure

The specifications for the well rehabilitation work initially were developed in FY 86 by IDOT and the Water Survey based on chemical treatment practices in common use. Revisions to the specifications have been made periodically based on results and experience. Similar treatment procedures were used for all of the wells treated in FY 92, although adjustments occurred as specific conditions were encountered from day to day and from well to well. Table 3 summarizes the treatment procedure as required by IDOT specifications. The actual procedure used by the contractor, Layne-Western Company, Inc., varied in some instances, and the significant changes are noted in the table.

Figure 13 schematically shows the typical injection assembly/discharge apparatus used by the contractor for injecting solutions and acid into the wells, pumping spent solutions to waste, and conducting drawdown pumping tests during the treatment work.

The well rehabilitation work was periodically observed by Water Survey staff. The documentation that was developed by the resident engineer and the contractor as the treatment work progressed was reviewed by Water Survey staff. The field notes for each well treated in FY 92 are included in appendix D.

Chemical Treatment Results

The wells to be chemically treated were selected on the basis of data from the most recent Water Survey step tests and available water-level difference (Δh) information. Step tests completed in FY 91 indicated that I-70 Well 6, 25th Street Well 4, and Venice Well 3 were in poor condition and should be chemically treated.

I-70 Well 6 had been tested on August 1, 1990, when the specific capacity was only about 16.1 gpm/ft. Well loss could not be determined, due to the low pumping rate, and Δh data were not available, because the piezometer was buried by construction activity. At the 25th Street site, Well 4 had been tested for the first time on August 2, 1990. The specific capacity was about 55 gpm/ft, and well loss was about 17 percent. A plugged piezometer precluded Δh measurements. Venice Well 3 had been tested on December 5, 1990, showing a specific capacity of about 63 gpm/ft, and the Δh was estimated to be about 6.1 feet. Well loss could not be determined. This well originally had been scheduled for chemical treatment during FY 91, but the treatment was postponed until FY 92, when Venice Well 4 was found to be in much poorer condition.

During FY 92 (Phase 9) the Layne-Western Company, Inc. chemically treated the three dewatering wells (I-70 Well 6, 25th Street Well 4, and Venice Well 3). The work was performed from September 16, 1991, to October 15, 1991.

Table 3. Outline of typical well rehabilitation

Day 1

1. Pretreatment specific capacity test (contractor orifice tube, open to free discharge, used for flow measurements).
   a. Measurement of SWL (static water level) following 30 or more minutes of well inactivity.
   b. Measurement of PWL (pumping water level) and orifice piezometer tube following 60 or more minutes of pumping.

2. Polyphosphate application, 400 pounds, and displacement with 16,000 gallons water containing at least 500 ppm (mg/L) chlorine.
   a. Initial chlorination of well with 2,500 gallons water containing 500 ppm or more chlorine injected at a minimum rate of 750 gpm.
   b. Injection of polyphosphate solution at a minimum rate of 2,000 gpm (actual rates, when reported: 423 to 642 gpm) in two 1,800-gallon batches, each batch containing 200 pounds polyphosphate, at least 500 ppm chlorine.
   c. Injection of 16,000 gallons water chlorinated to at least 500 mg/1 in 2,000-gallon batches at a minimum rate of 1,500 gpm.
   d. Time allowance for chemicals to react, 1 to 2 hours (actual time, when reported: 60-70 minutes).

3. Pump to waste and check specific capacity.
   a. Pump continuously 6 or more hours to clear well of chemicals (actual time: 5 hours).
   b. Same procedure for specific capacity check as step 1 above.

Day 2

1. Acidization with 1,000 gallons 20° Baume-inhibited muriatic (hydrochloric) acid and displacement with 4,000 to 5,000 gallons water (not chlorinated).
   a. Pump 1,000 gallons of bulk-inhibited acid into well within 1 hour, 17 gpm minimum.
   b. Allowance time for acid to react, 1 hour.
   c. Injection of 4,000 to 5,000 gallons water at 1,000 to 2,000 gpm.
   d. Allowance for reaction, 2 to 3 hours.

2. Pump to waste and check specific capacity.
   a. Pump continuously 3 hours or more (actual time: 2 to 3 hours) to clear well of acid.
   b. Same procedure for specific capacity check as Day 1, step 1 above.

Table 3. Concluded

Day 3

1. Polyphosphate application, 600 pounds, and displacement with 30,000 gallons water containing at least 500 ppm chlorine.

   Same procedure as Day 1, step 2 above, except three batch injections (actual rates, when reported: 1,007 to 1,770 gpm) of 1,800 gallons (5,400 gallons total) with 200 pounds phosphate each in part b, and injection of 30,000 gallons in part c.

2. Pump to waste and check specific capacity.

   a. Pump continuously 6 or more hours to clear well of chemicals (actual time, when reported: 5 to 6 hours).
   b. Same procedure for specific capacity check as Day 1, step 1 above.

Day 4 (Optional)

1. Polyphosphate application, 600 pounds, and displacement with 54,000 gallons water containing at least 500 ppm chlorine.

   Same procedure as Day 1, step 2 above, except three batch injections of 1,800 gallons (5,400 gallons total) with 200 pounds phosphate each in part b, and injection of 54,000 gallons in part c.

2. Pump to waste and check specific capacity.

   a. Pump continuously 6 or more hours to clear well of chemicals (actual time, when reported: 6 hours).
   b. Same procedure for specific capacity check as Day 1, step 1 above.

Day 5 (Optional)

1. Polyphosphate application, 400 pounds, and displacement with 16,000 gallons water containing at least 500 ppm chlorine.

   Same procedure as Day 1, step 2 above.

2. Pump to waste and final specific capacity test.

   a. Pump continuously 6 or more hours to clear well of chemicals (actual time, when reported: 6 hours).
   b. Same procedure for specific capacity check as Day 1, step 1 above.

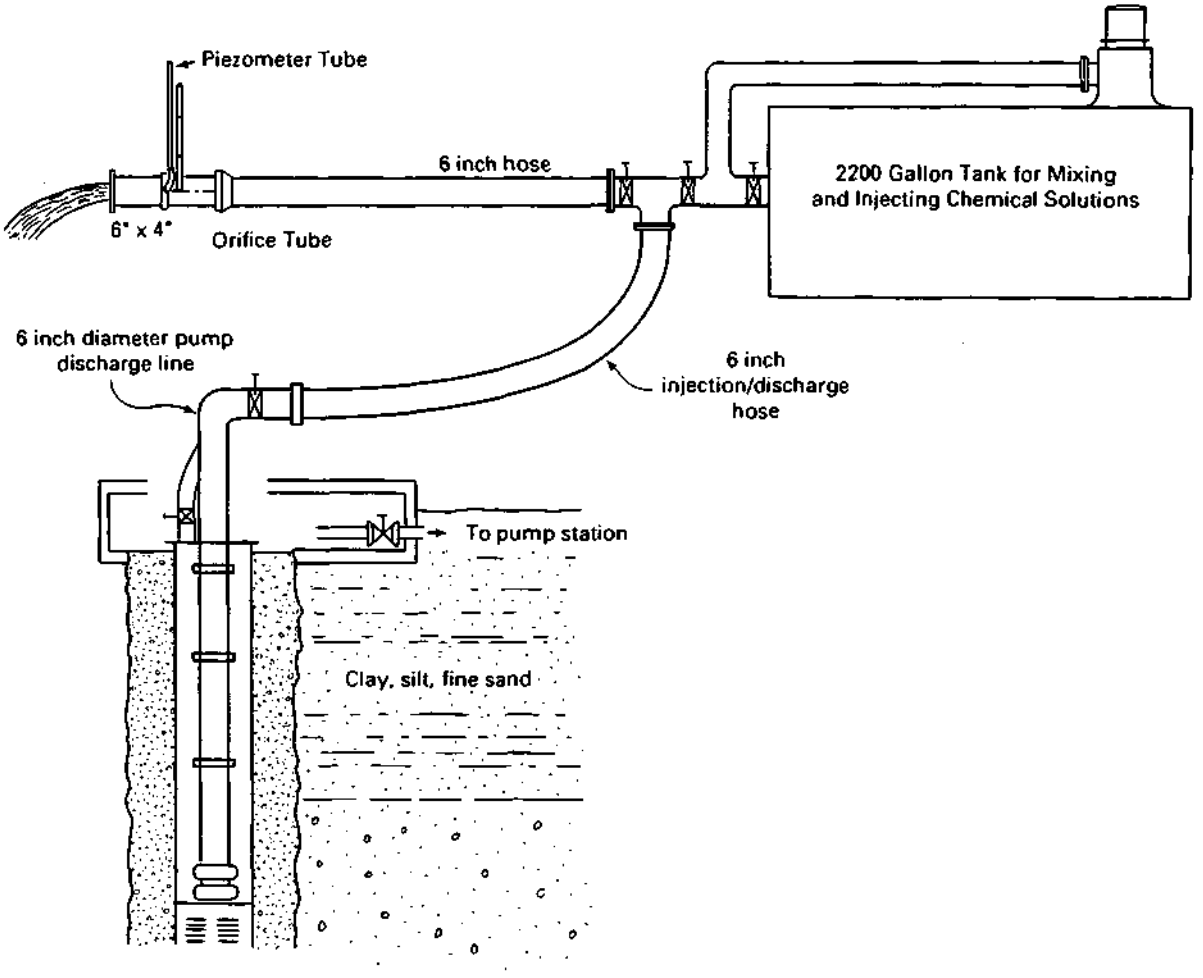

Figure 13. Schematic diagram of equipment used in well treatment

As indicated in table 3, the chemical treatment procedure required the treatment contractor to conduct 60-minute drawdown tests to approximate the specific capacity after each successive treatment step. Table 4 summarizes these drawdown pumping test data collected as part of the field documentation during the chemical treatment of each dewatering well. The table shows the approximate specific capacity prior to treatment and following each step in the treatment process (polyphosphate or acid injection episode). In a departure from the project specifications, Layne-Western was granted permission to substitute their Sonar Jet rehabilitation process for one of the polyphosphate treatments. The Sonar Jet treatment consists of setting off a series of small explosives inside the well screen to send a series of shock waves through the water. The shock waves dislodge incrusted material from the well screen for later removal by pumping. The Sonar Jet treatment was inserted as an initial treatment step on I-70 Well 6 followed by the usual first treatment step with polyphosphates.

In general, the percent improvement in specific capacity diminishes with each successive step of the treatment. This trend also has been noted in the results of the chemical treatment in some prior years. In FY 92 about 45 percent of the total improvement occurred with the first polyphosphate treatment (including the improvement from the Sonar Jet treatment on I-70 Well 6) and about 14 percent during the second polyphosphate treatment (following acidization).

The trend of reduced improvement for successive treatment steps has been shown by the results of the treatment for each of the seven years that this general well treatment procedure has been followed. For the previous six years, from about 76 to 96 percent of the total improvement had occurred after the second polyphosphate treatment step. Depending on the specific response of each well, it is possible to eliminate treatment steps if expectations for specific capacity have been achieved. An overall reduction in the treatment cost may thus be realized by eliminating any unnecessary treatment steps. To do this, progress and results from each step in the rehabilitation work must be closely monitored in the field.

During FY 92, the third and fourth polyphosphate treatment of I-70 Well 6 was eliminated (although the Sonar Jet treatment was added), and the fourth polyphosphate treatment of 25th Street Well 4 was eliminated, as expected specific capacity levels had been achieved (see table 4). This reduced the cost of treating these two wells.

Following the chemical treatments in FY 92, the Water Survey conducted step tests on each treated well to evaluate its condition and response to treatment, as well as to provide results for comparison with the contractor's drawdown tests conducted during the well treatment. The results of these tests are summarized in table 5. The improvement in I-70 Well 6 was the most dramatic of the three wells treated, with the specific capacity increasing about 350 percent. The specific capacities of 25th Street Well 4 and Venice Well 3 increased about 117 and 55 percent, respectively.

Table 4. Drawdown test data collected by contractor during well rehabilitation

	Pretreatment	*Sonar Jet treatment*	*1st PPP treatment*	*Acid treatment*	*2nd PPP treatment*	*3rd PPP treatment*
I-70 No. 6						
Date ('91)	9/16 PM	9/18 AM	9/19 AM	9/20 AM	9/23 AM	
SWL	13.5	13.6	13.7	13.7	13.6	
PWL	34.7	30.0	19.2	18.6	18.3	
s	21.2	16.4	5.5	5.0	4.7	
Q	603	940	603	603	603	
Q/s	28.4	57.2	109.6	121.3	128.3	

	Pretreatment	*1st PPP treatment*	*Acid treatment*	*2nd PPP treatment*	*3rd PPP treatment*	*4th PPP treatment*
25th St. No. 4						
Date ('91)	10/8 PM	10/9PM	10/10 PM	10/11 PM	10/15 PM	
SWL	11.0	11.6	11.9	12.0	12.4	
PWL	24.7	19.6	19.1	18.0	17.7	
s	13.7	8.0	7.2	6.0	5.3	
Q	603	603	603	603	603	
Q/s						

Venice No. 3						
Date ('91)	9/24 AM	9/26 AM	9/26 AM	9/27 PM	9/30 PM	10/1 PM
SWL	16.3	17.2	17.6	17.9	16.8	17.3
PWL	28.5	25.4	25.2	24.1	22.3	22.1
s	12.2	8.3	7.6	6.2	5.5	5.4
Q	603	603	603	603	603	603
Q/s	49.5	72.8	79.3	97.9	109.6	111.7

Note: Numbers in table were rounded off.

Legend

SWL - Static (nonpumping) water level, feet
PWL - Pumping water level, feet
s - Drawdown (PWL-SWL), feet
Q - Pumping rate, gpm
Q/s - Specific capacity, gpm/ft
PPP - Polyphosphate

Table 5. Results of chemical treatment, FY 92 (Phase 9)

			Pretreatment		*Post-treatment*		
Site	*Well*		*Date*	*Q/s (gpm/ft)*	*Date*	*Q/s (gpm/ft)*	*% Change*
I-70	Well 6	ISWS	8/1/90	16.1	10/29/91	121.7	+656
		LWC	9/16/91	28.4	9/23/91	128.3	+352
25th St.	Well 4	ISWS	8/2/90	55.2	11/19/91	119.9	+117
		LWC	10/8/91	44.1	10/15/91	112.9	+156
Venice	Well 3	ISWS	12/5/90	62.9	12/16/91	97.2	+55
		LWC	9/24/91	49.5	10/1/91	111.7	+126
Average		ISWS		44.7		112.9	+153
		LWC		40.7		117.6	+189

Notes:
Q/s = Specific capacity, gpm/ft
ISWS = Illinois State Water Survey
LWC = Layne Western Company

The specific capacity of I-70 Well 6 is above the average specific capacity of wells in good condition (98 gpm/ft) at the I-70 site (see table 2). The specific capacity of I-70 Well 6 increased from about 16 to 122 gpm/ft, and the post-treatment step test showed the well loss was about 3.8 percent (see table 1 and appendix C). The Δh values were not available for comparison because the piezometer was buried.

The specific capacity of 25th Street Well 4 increased from about 55 to 120 gpm/ft, while well loss was reduced from about 17 to 13 percent. The Δh value could not be determined because of a plugged piezometer. The specific capacity of this well is about 98 percent of the average specific capacity of wells in good condition at the 25th Street site (see table 2). Sand pumpage was discovered in the discharge from this well during the post-treatment step test, and this is discussed in greater detail in the next section.

For Venice Well 3, the specific capacity was increased from about 63 gpm/ft to about 97 gpm/ft, an improvement of about 55 percent, based on the Water Survey step-test data. Well loss before and after the chemical treatment could not be determined; however, the Δh value was reduced from about 6.1 feet to about 2.3 feet. The specific capacity of this well is about 96 percent of the average specific capacity of wells in good condition at the Venice site (see table 2).

During several of the previous years the results of the post-treatment step tests conducted by the Water Survey have generally shown a significantly better specific capacity than that calculated from the treatment contractor's final drawdown test, implying that many wells continued to improve following treatment. However, this year this is the case in only one of the three wells treated in FY 92 (see table 5).

A group of wells has now been rehabilitated in each of seven years for a total of 32 treatments (7 in FY 86, 5 in FY 87, 4 in FY 88,4 in FY 89, 5 in FY 90,4 in FY 91, and 3 in FY 92). Three contractors performed the treatments: one during the first two years (FY 86 and 87) and the fourth year (FY 89), a second during the third, fifth, and sixth years (FY 88, FY 90, and FY 91), and a third during FY 92.

Sand Pumpage Investigation

Field Procedure

Prior occurrences of sand pumpage from the dewatering wells have resulted in the standard practice of checking for the presence of sand in the discharge during each step test unless precluded by site conditions and available equipment. To continue to address these concerns, the possibility of sand pumpage was investigated during 14 of the 16 step tests conducted in FY 92 (Phase 9). [Site conditions and available equipment precluded checking for sand during the step tests on I-70 Well 5 and 25th Street Well 1.] During each step test, water is discharged from the orifice tube into a portable 1,000-gallon tank (see figure 14). Siphon tubes are used as necessary to help control the discharge from the

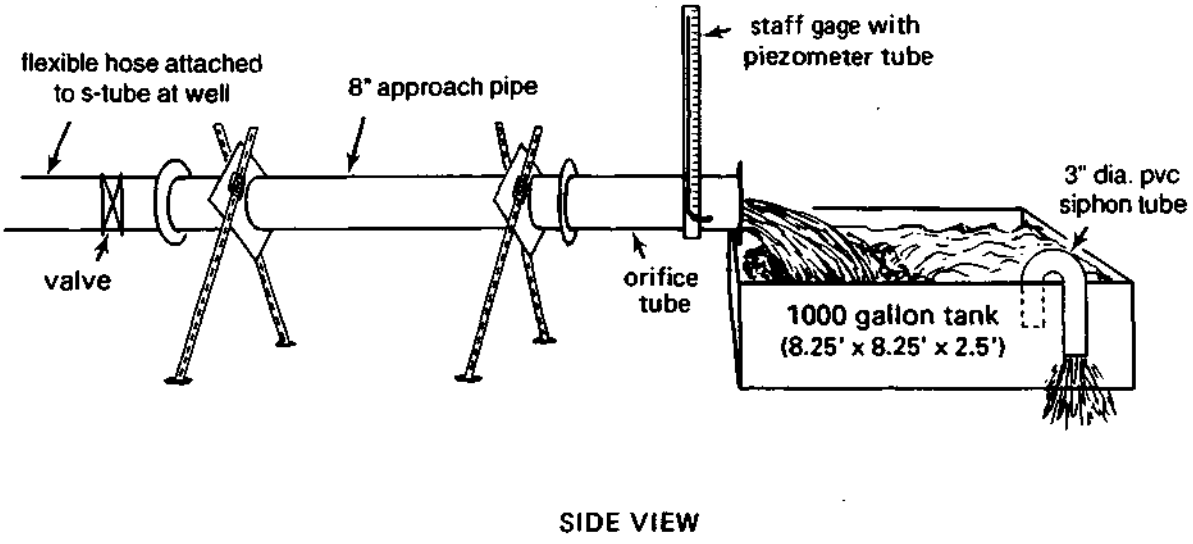

Figure 14. Sand pumpage test setup

tank. The tank itself acts as a sedimentation basin that, under ideal conditions, should allow sand with minimum grain diameters of no more than 0.1 millimeter (mm) to settle out at the design pumping rates of the wells (600 to 800 gpm). Usually 80 to 90 percent or more of the aquifer material in the screened interval of the wells exceeds the 0.1 mm grain size.

Sand Pumpage Results

Samples were collected following the step tests, whenever a sufficient amount of sediment remained in the tank to allow analysis of the grain size distribution. The samples were prepared and sieved at the Quaternary Materials Laboratory of the Illinois State Geological Survey. In all, 5 of the 16 step tests generated a sample large enough for collection. Appendix G contains the resulting data for these samples. A discussion of the results for each well follows.

I-70 Site

Well 1 A: Some particles of incrustation, but no sand, were detected in the settling tank after the initial step test on April 26, 1995.

Well 2A: A few grains of sand and a small amount of soft incrustation were noted in the settling tank following the initial step test on November 16, 1993. No sample was collected.

Well 3A: A very small amount of sand was detected in the settling tank following the initial step test on October 29, 1993. The amount was insufficient for collection of a sample.

Well 5: The site conditions and available equipment did not enable the settling tank to be used during the condition-assessment step test on October 14, 1993; no observations were possible.

Well 6: A sample of sand material, including a few large chunks of metal or incrustation, was collected following the post-treatment step test conducted on October 29, 1991. The results of the sieving of the sample are shown in figure 15. As much as 70 percent of the sample consists of medium to coarse sand. Whether material of this grain size could migrate through the gravel pack is unknown, because the grain size distribution of the gravel pack is not known. It also is possible that the chemical treatment of the well disturbed the gravel pack and native aquifer material enough to allow the sand to be pumped. During the previous step test in FY 91, monitoring did not show sand. This condition might be only temporary and should be monitored.

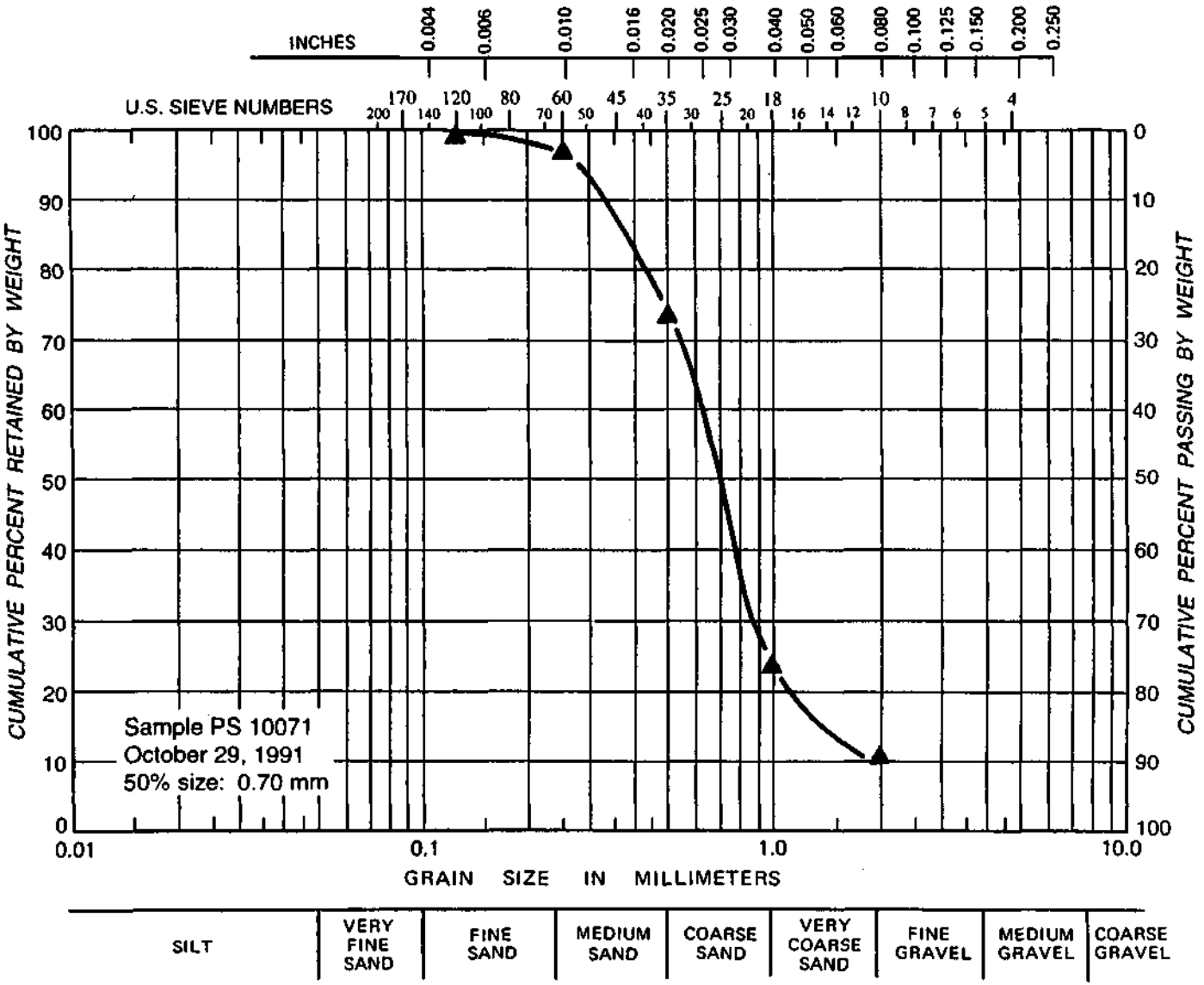

Figure 15. Sieve analysis of material pumped from I-70 Well 6

Well 8A: A sample of sand was collected following the condition-assessment step test conducted on October 1, 1991. The sieve data for the sample are presented in figure 16. As much as 60 percent of the sample is medium to coarse sand. The sand being pumped might be the result of problems encountered during construction of the well in 1989. As described by Olson et al. (1992), the drilling was stopped short of the target depth due to large cobbles, and the borehole collapsed during placement of the gravel pack. These problems likely resulted in aquifer material lodging against the upper part of the installed well screen (0.020-inch slot openings). About 65 percent of the collected sample could pass through the well screen. The amount of sand following the previous step test in FY 89 was insignificant.

Well 9A: No sand was detected in the portable settling tank after the condition-assessment step test conducted on July 23, 1992. A small amount of very coarse material was produced during the most recent (FY 91) of three previously monitored step tests.

Well 11 A: No sand was detected in the settling tank after the initial step test conducted on October 28, 1993.

Well 15: A few grains of sand were detected in the settling tank following the initial step test on October 15, 1993. The amount of sand was insufficient for the collection of a sample.

I-64 Site

Well 1: A small sample of sand was collected from the settling tank after the condition-assessment step test on September 24, 1991. The sieve data for the sample are presented in figure 17. About 70 percent of the sample consists of fine to very fine sand. The coarser fraction of the sample appears to be rust or iron particles that could not be removed prior to sieving. Although the grain-size distribution of the gravel pack is unknown, it is possible that this sand could migrate through the gravel pack into the well.

25th Street Site

Well 1: The settling tank was not used during the short drawdown test conducted on September 4, 1991.

Well 4: A large sample of sand (approximately 1 cup) was collected following the post-treatment step test conducted on November 19, 1991. The sieve data for the sample are shown in figure 18. About one-half of the sample is fine to very fine sand. The relatively large volume of sand (as compared to

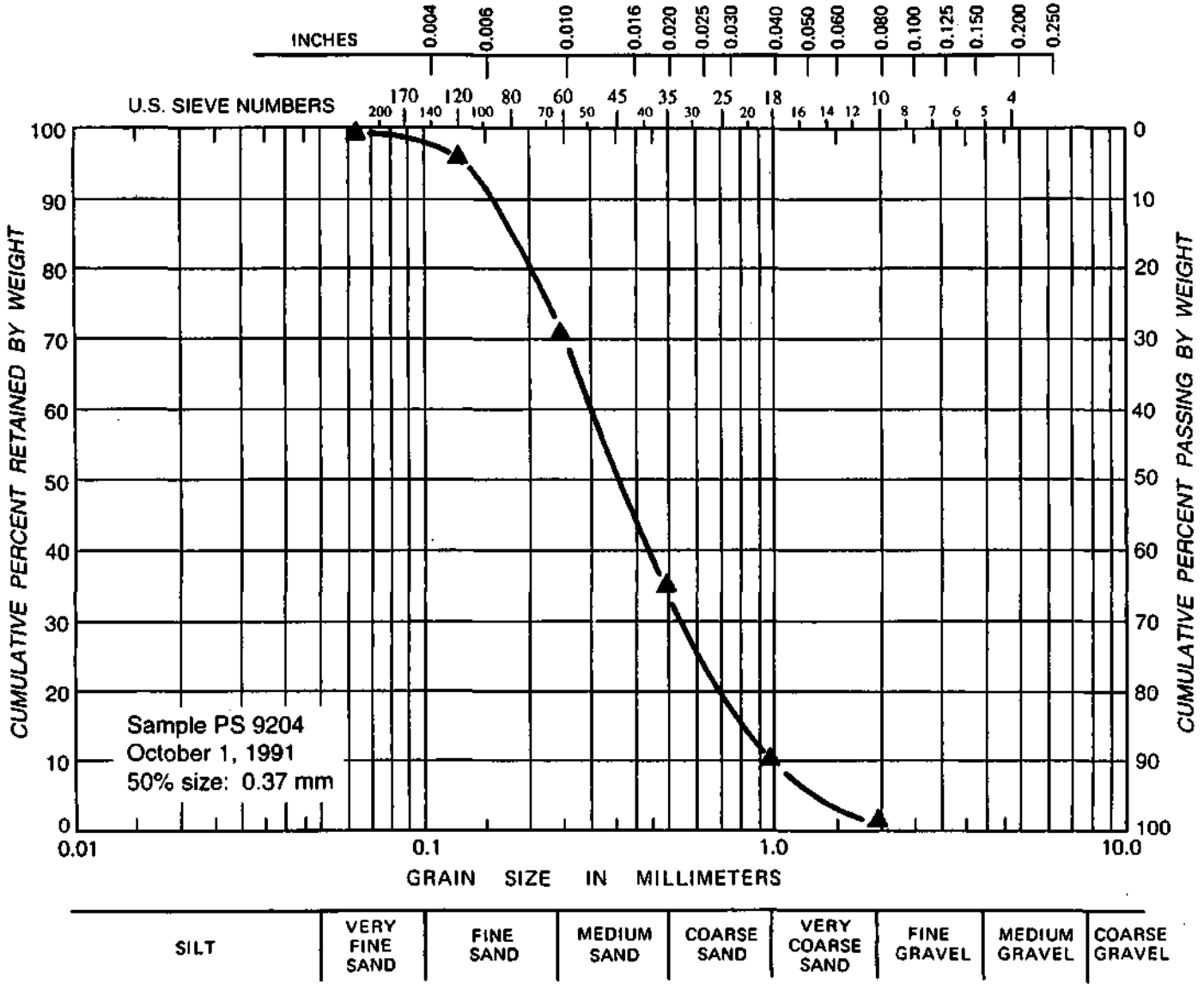

Figure 16. Sieve analysis of material pumped from I-70 Well 8A

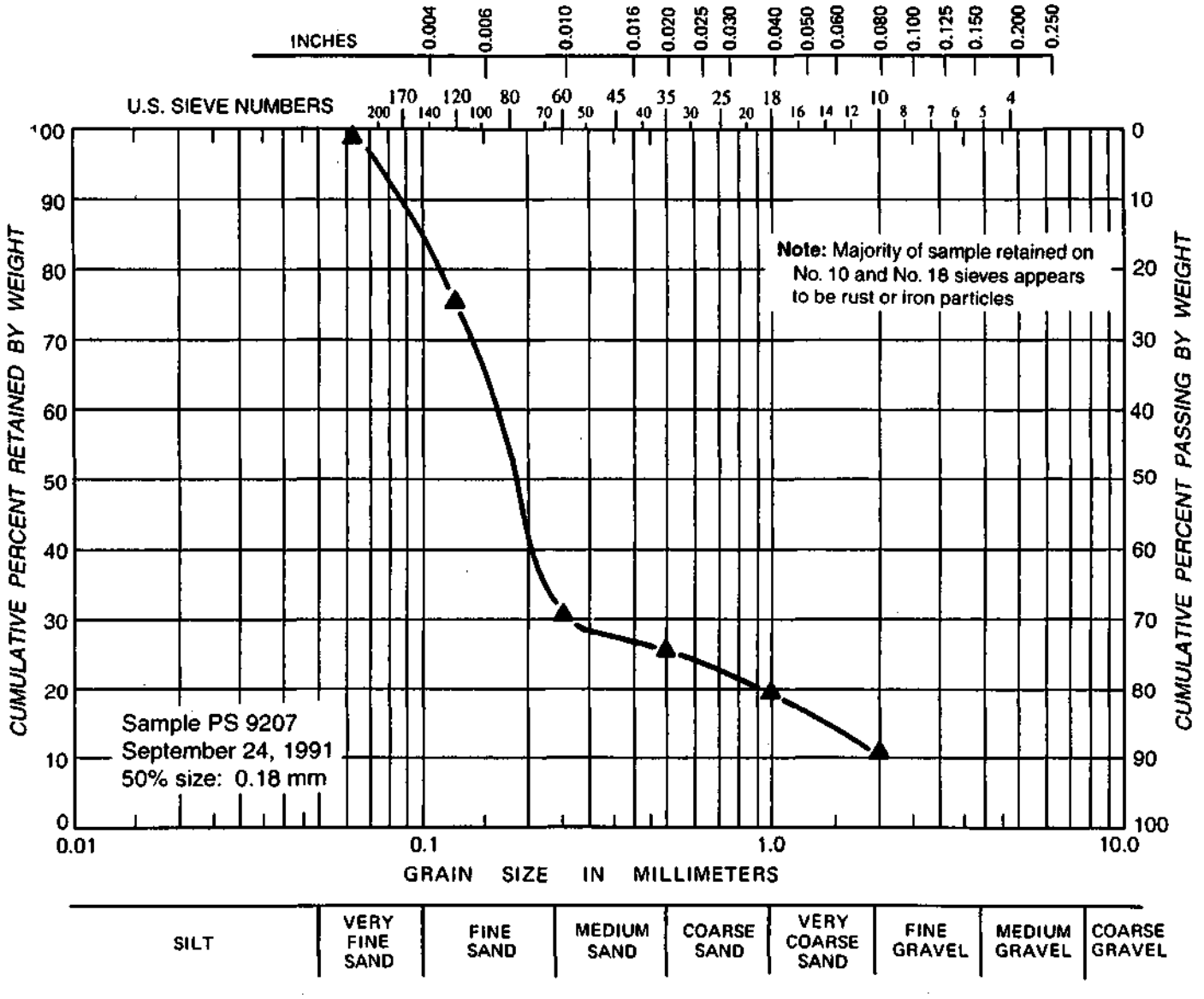

Figure 17. Sieve analysis of material pumped from I-64 Well 1

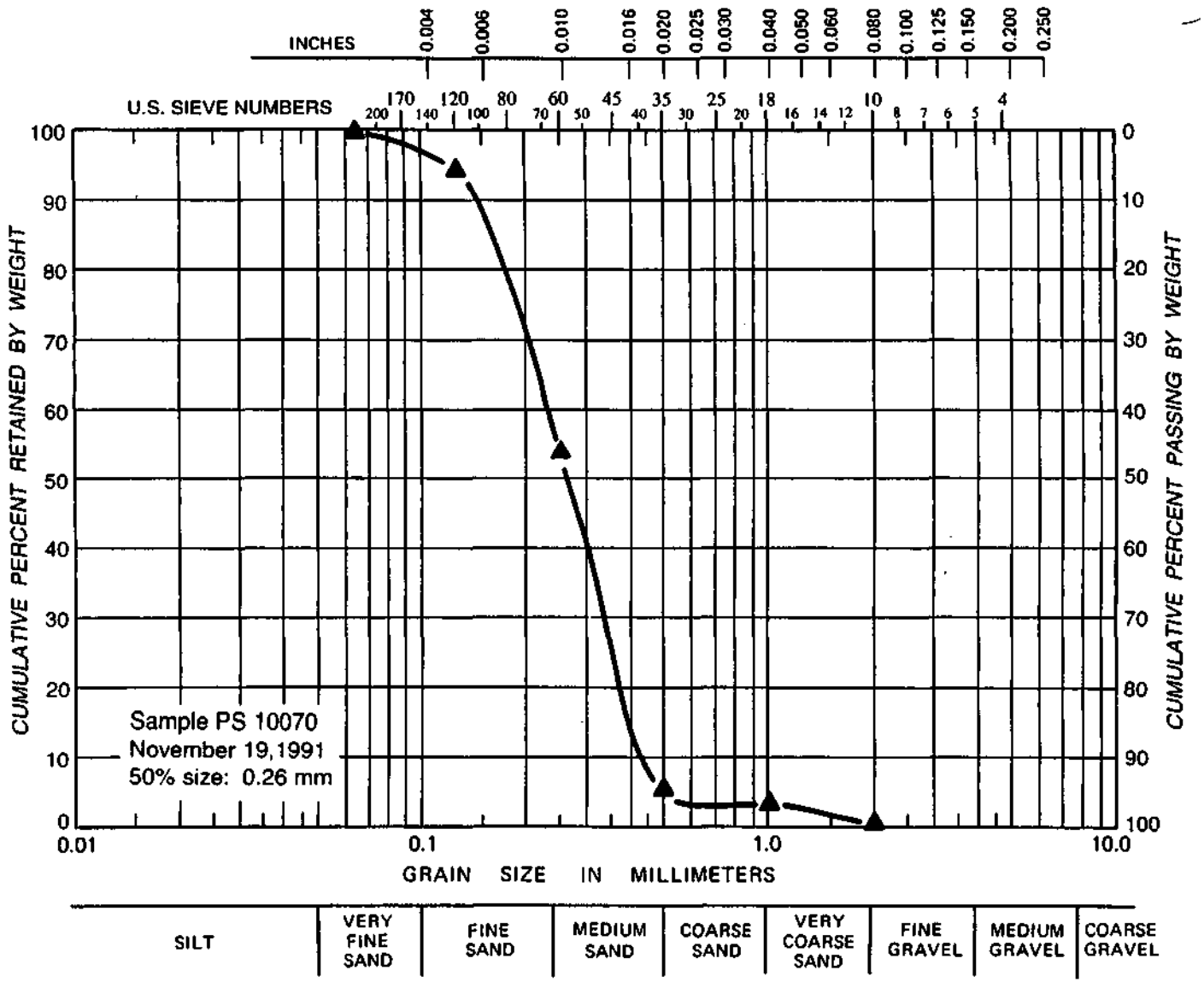

Figure 18. Sieve analysis of material pumped from 25th Street Well 4

other samples) collected in this sample suggests a situation that merits very close observation. It is possible that disturbance to the gravel pack and native formation during the chemical treatment of the well has only temporarily caused the well to pump sand, since during the previous step test, in FY 91, monitoring did not show sand.

Well 9: A significant sample of incrustation was observed in the settling tank following the condition-assessment step test on September 18, 1991. However, no sand was present and no sample was collected.

Venice Site

Well 2: A sample of sand and possible incrustation was collected from the settling tank after the condition-assessment step test on October 2, 1991. The sieve data for the sample are shown in figure 19. More than 90 percent of the sample consists of fine to very fine sand. It is possible that the sample could have migrated through the pack material into the well. This cannot be concluded, because the grain size distribution of the gravel pack installed in this well is unknown. Although the volume of the sample is small, the situation should be monitored closely in the future. The previous step test, following treatment in FY 90, was monitored but did not show sand.

Well 3: No sand attributable to the post-treatment step test on December 16, 1991, was detected in the settling tank. This well pumped fine to medium sand during the previous step test in FY 91.

Well 5: No sand was detected in the settling tank after the condition-assessment step test on March 24, 1992.

Seven of the above wells had been checked for sand pumpage during step tests in previous phases of work. Four wells pumping sand during the step tests conducted for this phase, I-70 Wells 6 and 8A, 25th Street Well 4, and Venice Well 2, had not done so in previous tests. I-70 Well 9A and Venice Well 3 produced some sand previously but not during the FY 92 step tests (I-70 Well 9A produced sand after one of three previously monitored step tests). Only Venice Well 5 was consistently sand-free in FY 92 and previously checked step tests. It is possible that some of the wells produce sand occasionally because of redevelopment, as might occur immediately after an idle well is restarted. This can be verified as more wells are repeatedly tested.

Interestingly, two of the three chemically treated wells, I-70 Well 6 and 25th Street Well 4, pumped sand during the post-treatment step test but had not done so during their pretreatment step tests conducted in FY 91 (Phase 8). By contrast, the third chemically treated well, Venice Well 3, did not pump sand during the post-treatment step test, even though it had done so in the pretreatment step test in FY 91 (Phase 8). Prior to

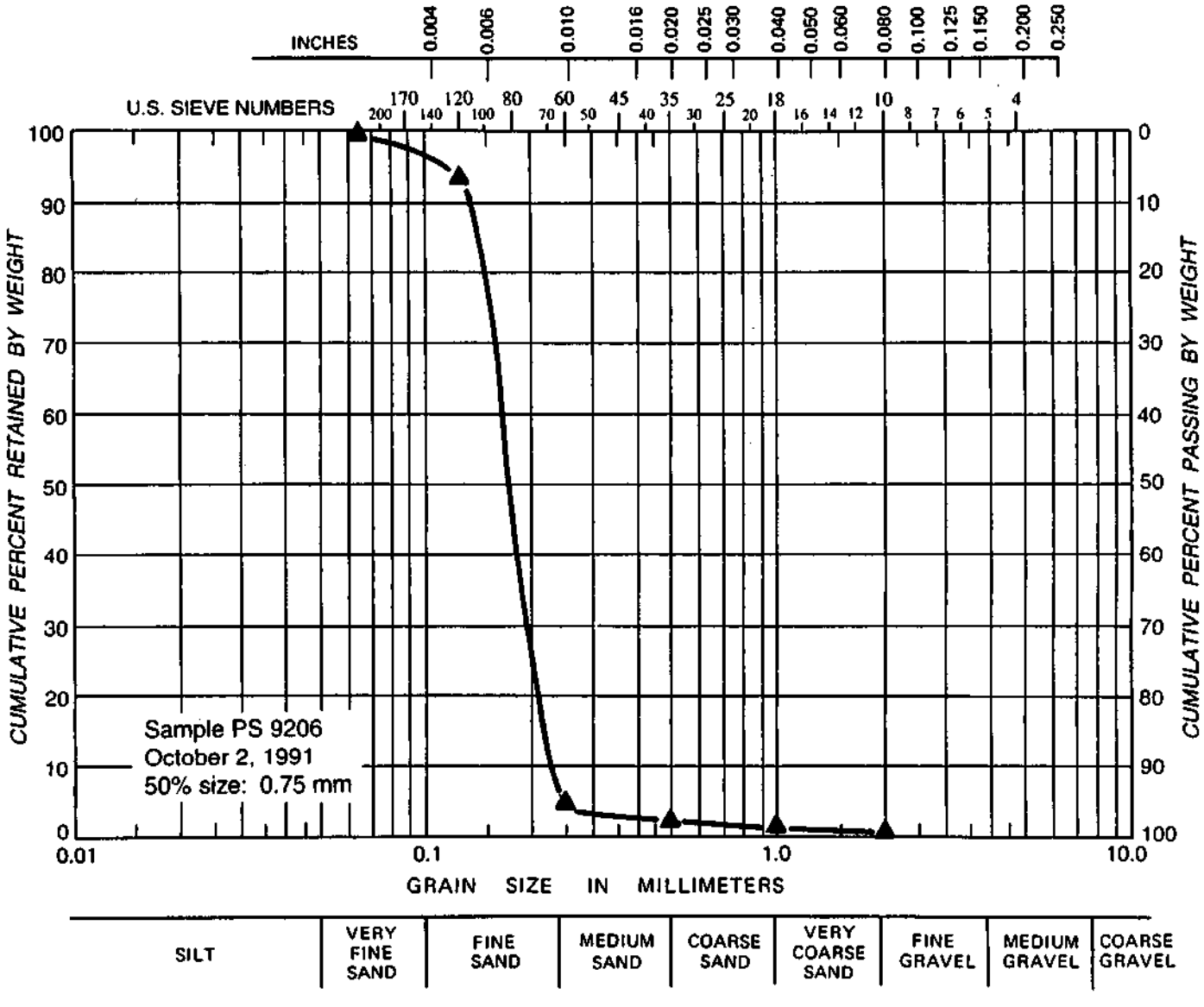

Figure 19. Sieve analysis of material pumped from Venice Well 2

FY 92, 12 chemically treated wells had been checked for sand pumpage during post-treatment step tests, with four producing sand. Two of these four sand-producing wells had been checked during pretreatment step tests, and these also indicated the presence of sand in the discharge.

Since sand pumpage tests began in FY 87 (Phase 4), a total of 38 wells have been checked for sand pumpage. Nineteen of these wells pumped sand on at least one occasion, of which five have been abandoned and replaced with new wells. Nine of 20 different wells that have been tested at I-70 (a total of 23 wells have existed), three of eight different wells that have been tested at 25th Street, and six of the eight wells that have existed at Venice have pumped sand on at least one occasion. Only two wells have been tested at I-64, with one well pumping sand.

Evaluation of Ground-Water Quality

A water sample was collected for analysis by the Water Survey's Office of Analytical Services during all 16 of the step tests. The results are reported in appendix B. Analytical methods conform to the latest procedures certified by the U.S. Environmental Protection Agency. Samples were preserved with acid for determining iron, calcium, and magnesium concentrations. The sample temperature was determined at each well site, and pH was determined in the laboratory immediately after transit of the samples. The range of concentrations and potential influence of the major water quality parameters analyzed for are presented in table 6.

Although the ground-water samples vary in water chemistry, generally the ground water can be described as highly mineralized, very hard, and alkaline, with unusually high concentrations of soluble iron. The water quality is consistent with that of previously analyzed samples from the dewatering wells.

A total of 115 water samples have been analyzed since our studies began in FY 84 (Phase 1). Almost one-half (55) are from the I-70 site. Appendix H contains results from all of the analyses, grouped according to site. Results for the major parameters are summarized in table 7. There appear to be few important differences between the sites in terms of these water-quality parameters. Iron concentration is indicated to be higher in the water from the I-64 and Venice sites, and the water from I-64 and 25th Street contains more dissolved minerals, but these trends probably do not matter much from a practical standpoint, since the concentrations are already very high at all of the locations.

Nuisance Bacteria Sampling

Nuisance bacteria (e.g., iron bacteria, sulfate-reducing bacteria, etc.) that inhabit wells, gravel packs, and the aquifer matrix often produce well-plugging biofilms, as well as an environment favorable for chemical deposition and corrosion processes. To explore

Table 6. Range of Concentrations and Potential Influence of Common Dissolved Constituents (FY 92)

Parameter	*Concentration. ms/L* Min.	Max.	*Potential influence*
Iron (Fe)	8.28	18.84	Major - incrustative
Manganese (Mn)	0.39	1.49	Major - incrustative
Calcium (Ca)	156.	235.	Major - incrustative
Magnesium (Mg)	40.7	63.8	Minor - incrustative
Sodium (Na)	34.0	262.	Neutral
Silica (SiO_2)	27.0	39.6	Minor - incrustative
Nitrate (NO_3)	<0.02	0.3	Neutral
Chloride (Cl)	28.9	200.	Moderate - corrosive
Sulfate (SO_4)	151.	850.	Major - corrosive
Alkalinity (as $CaCO_3$)	363.	593.	Major - incrustative
Hardness (as $CaCO_3$)	562.	834.	Major - incrustative
Total dissolved solids	833.	1777.	Major - corrosive
pH	7.3	8.0	Major - incrustative

in as many of the dewatering wells as possible the chance that such bacteria might be present, water samples were collected from the well discharge at the time of the step tests and checked for the presence of nuisance bacteria with the Biological Activity Reaction Test (BART) systems developed by Droycon Bioconcepts, Inc., Regina, Saskatchewan. The BART tests have been customized to detect three general classes of nuisance bacteria commonly associated with problems in wells: iron-related bacteria (IRB), slime-forming bacteria (SLYM), and sulfate-reducing bacteria (SRB). The BART system was previously used during FY 90 to identify the presence of nuisance bacteria in the I-255 Detention Pond relief wells and during FY 91 on 14 of the step-tested dewatering wells (Sanderson et al., 1993).

The testing protocol requires that a sample of water be placed in a test vial and examined over a period of days and that any reactions that may occur be documented. The bacterial population and/or activity in the water is inversely related to the length of time before reactions occur. The reaction patterns and types depend on the dominant bacterial groups present (Cullimore, 1990). Multiple sets of samples collected at time intervals of pumping are recommended for detailed analysis of the bacterial activity (Mansuy et al., 1990).

BART samples were collected from all 16 of the dewatering wells step-tested for FY 92, all using the same procedure. Since the purpose was to simply determine whether nuisance bacteria are present in the wells, only one sample set, consisting of three samples (IRB, SLYM, and SRB), was collected for each step-tested well. The samples

Table 7. Ground-water chemical quality summary, FY 84 - FY 92 (Phases 1-9)

Site		*Iron (mg/l)*	*Manganese (mg/l)*	*Calcium (mg/l)*	*Magnesium (mg/l)*	*Sodium (mg/l)*	*Silica (mg/l)*	*Nitrate (mg/l)*	*Chloride (mg/l)*	*Sulfate (mg/l)*	*Alkalinity (mg/l)*	*Hardness (mg/l)*	*TDS (mg/l)*
I-70	Average	11.68	0.76	190	45.1	*16.1*	31.8	0.6	101	302	416	658	1048
	Minimum	5.55	0.44	131	35.2	29.3	20.0	<0.02	39	151	316	507	736
	Maximum	18.84	1.49	234	63.8	230.0	37.2	3.7	230	694	593	834	1642
	No. of samples	55	39	55	55	55	48	24	55	55	55	55	55
I-64	Average	16.23	0.55	232	58.0	102.7	33.7	0.6	79	540	447	821	1403
	Minimum	12.30	0.47	202	44.3	29.8	30.5	<0.1	41	350	412	725	974
	Maximum	20.00	0.60	277	74.1	269.0	35.6	2.3	390	787	512	998	1997
	No. of samples	15	6	15	15	15	14	6	15	15	15	15	15
25th St.	Average	11.92	0.57	176	50.8	121.9	33.8	0.1	33	519	395	647	1231
	Minumum	4.50	0.36	123	35.4	14.2	31.2	<0.1	21	122	331	467	612
	Maximum	22.90	0.82	250	73.1	314.0	38.1	0.2	49	1171	477	898	2335
	No. of samples	22	18	22	22	22	15	8	22	22	22	22	22
Venice	Average	17.08	0.55	209	51.2	41.7	32.1	0.3	63	346	435	732	1044
	Minimum	8.28	0.39	180	42.2	30.1	24.4	<0.1	25	218	387	635	890
	Maximum	25.70	0.72	261	61.2	65.1	39.6	0.8	124	490	476	890	1241
	No. of samples	22	15	22	22	22	20	6	22	22	22	22	22

were collected from the orifice tube discharge, usually in sequence with the other water samples being collected for analysis of the dissolved constituents, near the end of the test.

The results for most of the BART samples indicated high to moderate amounts of nuisance bacteria activity in the discharge water from the wells. In general, the SLYM tests appeared to show positive reactions somewhat sooner than the IRB and SRB tests. In all but one well, the SLYM tests show high to moderate bacterial activity; whereas the IRB and SRB tests indicated at least a moderate level of bacterial activity in about half of the wells. The results are similar to those reported in FY 91 (Phase 8), the first time these tests were conducted on the dewatering wells.

There continues to be little correlation between the indication of well conditions from the step tests and reaction response times from the BART samples. BART samples collected from the wells in the poorest hydraulic condition showed similar patterns of response to those collected from the wells in very good condition.

BART samples were collected during all three of the post-treatment step tests. For comparison, BART sample results were available from only two of the pretreatment step tests on these wells, which were conducted in FY 91. Although some differences in the reactions occurred before and after treatment, it is unclear whether any meaningful conclusions can be drawn at this time from such a small data set. When compared to the BART results from all of the nontreated wells, results for the seven treated wells in FY 91 and FY 92 fall comfortably within the same range; nuisance bacteria activity is rated high to moderate.

Since the samples have been collected near the end of the step tests after many well volumes of water have been pumped from the wells, it is safe to assume that the water sampled is being derived totally from the aquifer. Therefore, the rapid bacterial activity usually observed means that either there is substantial biomass development within the well casing and screen that is slowly sloughing off during the step test pumping, or a significant population of the bacteria are present in the aquifer (or both).

When taking into consideration that all of the dewatering well-heads are located in pits that can be readily subjected to contamination from pit seepage or spill water, the high degree of nuisance bacteria activity is not that surprising. Although nuisance bacteria can be present in ground water, most of these types of bacteria are relatively common on the land surface.

Video Inspection of I-70 Well 3 and 25th Street Well 6

The post-treatment step test conducted on April 17, 1990, on I-70 Well 3 showed a very high well loss and only a very small amount of sand in the settlement tank following the step test. However, later in the year severe settlement occurred in the vicinity of the well vault, leading to the tentative conclusion that some severe failure in

the well had occurred. The condition-assessment step test conducted on February 8, 1991, on 25th Street Well 6 provided a sample identified as sand and gravel pack. The size of the material suggested that the gravel pack material might be entering via a breech in the well casing or screen.

A video inspection was made in an effort to further pursue the actual condition of these two wells. The inspection was conducted by the Layne-Western Company on September 25, 1991. The submersible well pumps were removed from the dewatering wells prior to the inspection.

At 25th Street Well 6, Layne-Western provided and installed a smaller pump to attempt to pull the sand and/or gravel pack into the well bore during the inspection, thus pinpointing the problem spot. This effort failed as the water in the well bore was cloudy and murky, greatly limiting the visual capacity. Even though the temporary well pump was operated for several hours, the water failed to clear sufficiently to permit a meaningful inspection. The only meaningful result of the inspection came when the temporary pump was removed. Several grains of gravel pack material were found on the edge of the column pipe coupling, suggesting that gravel pack particles can enter the well, probably above a depth of about 30 feet below the top of the casing. The precise location could not be determined. Operation of the well pump for several days prior to the inspection likely would have cleared the water.

A plan to pump while conducting the video inspection also had been planned at I-70 Well 3, but when the murky water was found at 25th St Well 6 the video equipment was moved to I-70 Well 3 to proceed with that inspection under nonpumping conditions. The video inspection of I-70 Well 3 failed to show any detectable problems in the structural integrity of the casing/well screen assembly that would explain the settlement in the vicinity of the well.

CONCLUSIONS AND RECOMMENDATIONS

Construction of New Wells

Water Survey step tests verified that I-70 Wells 1A, 2A, 3A, 11A, and 15 were in poor hydraulic condition compared to other wells at this site. However, the considerable delay in the finalization of the construction project allowed extensive use of the wells (necessitated by excessive rainfall) for over a year before they could be step-tested. The step test on Well 1A was delayed even longer by a broken pump. Thus, the initial conditions for the wells are unknown. Rehabilitative treatment is recommended for each well in an attempt to attain hydraulic conditions comparable to nearby wells that are in good condition.

The well pits that were used to house the well heads will continue to be a problem, both from a sanitary standpoint, and for personnel who must enter the pits to

conduct maintenance and collect measurements. Discontinuing the use of well pits or substantially modifying the design to minimize these problems should be given high priority. The protectors used on the piezometers have been damaged by roadside maintenance activities (mowers, etc.) exposing the tops to weather and debris. Another type of protector (similar to those at Wells 7A, 8A, and 9A) that affords better protection is recommended for use in the future.

Condition of Wells

The results of the step tests conducted to assess the condition of eight existing wells and five new wells show that I-64 Well 1, 25th Street Well 9, and Venice Wells 2 and 5 are in good to excellent condition. Although the well loss at Venice Well 2 is somewhat high, its specific capacity and low Δh value compare favorably with those from a previous step test in 1990. I-70 Well 9A is in fair condition, but its specific capacity has declined well below the site average since last year's step test, warranting consideration for treatment.

Eight wells are in poor condition. I-70 Well 5 shows a low specific capacity, I-70 Well 8A shows a low specific capacity and high Δh, and 25th Street Well 1 has a very low specific capacity and pumping rate. As discussed above, all of the newly constructed wells (I-70 Wells 1 A, 2A, 3A, 11 A, and 15) are in poor condition, showing specific capacities much below the site average and high Δh values. Chemical treatment is recommended to improve the condition of these eight wells. A video inspection of these wells for excessive buildup of incrusting minerals is also recommended.

The three wells step-tested after chemical treatment, I-70 Well 6, 25th Street Well 4, and Venice Well 3, appear to be in good condition on the basis of the specific capacity, well loss, and Δh data.

Well Rehabilitation

The chemical treatments used to restore well capacity in FY 92 (Phase 9) were moderately successful. The drawdown data collected during the treatment by the contractor indicate that the average increase in specific capacity of the three wells ranged from about 126 to 352 percent, while the Water Survey step-test data show the improvement to range from about 55 to 656 percent. The post-treatment specific capacity of I-70 Well 6 is about 124 percent of the average specific capacity of wells in good condition at the I-70 site, and the well loss is within an acceptable range. The post-treatment specific capacities of 25th Street Well 4 and Venice Well 3 are about 98 percent and 96 percent of the average specific capacity of wells in good condition at those sites. The well loss of 13.1 percent for 25th Steet Well 4 is somewhat greater than desired (the Δh value was not available because of a plugged piezometer) and the Δh

value for Venice Well 3 is low (the well loss could not be determined). Overall, the present condition of these wells is acceptable.

The change in chemical treatment specifications made in FY 90 to provide for optional polyphosphate treatment steps after the second application did reduce the total number of polyphosphate treatments applied to these three wells. Two polyphosphate steps were dropped at I-70 Well 6 (although a Sonar Jet treatment was added) and one polyphosphate step at 25th Street Well 4.

Sand Pumpage Investigation

The discharge from 14 dewatering wells was tested for sand pumpage during 16 step tests. Two wells, I-70 Well 5 and 25th Street Well 1, were not checked due to site conditions at the time of the step tests. Sediment collected after 5 of the step tests on 14 wells was visually inspected for the presence of sand and gravel pack, and sieved for the grain size distribution.

Sediment that accumulated during step tests on I-70 Wells 2A, 3A, and 15 was judged to contain an insignificant amount of sand, and no samples were collected. No detectable sediment/sand was present following step tests on six of the wells. None of the newly constructed wells produced enough sand for collection during the step tests.

The size of the pumped sand and gravel pack from I-70 Well 6 suggests that the gravel pack and native aquifer material may have been disturbed during chemical treatment. This condition should be closely monitored. The sand pumpage from I-70 Well 8A may be the result of problems encountered during the construction of the well in 1989. No detectable sand was present after previous step tests on either of these wells.

Most of a small sample of pumped sand from I-64 Well 1 was fine to very fine sand that apparently was able to migrate through the gravel pack. This condition is not regarded as serious at this time but should be monitored.

A large sample of sand was found in the settling tank following the post-treatment step test on 25th Street Well 4. As with I-70 Well 6, it is possible that the gravel pack and native formation were disturbed during the chemical treatment. The condition may be only temporary but should be monitored. Sand was not identified after a previous step test on this well.

Most of a small sample of pumped sand from Venice Well 2 was fine to very fine sand that might have been able to migrate through the gravel pack. This condition is not regarded as serious at this time but should be monitored. If the amount of pumped sand remains small, the well could remain operable for a long time. Sand was not found after a previous step test on this well.

It is recommended that I-70 Wells 6 and 8A, I-64 Well 1, 25th Street Well 4, and Venice Well 2 be checked for the status of sand pumpage during future step tests. Information from a new step test and sand pumpage check can be compared to results collected for FY 92 to begin to assess whether the sand pumpage problem has increased or has diminished. It is possible that some of the wells produce sand occasionally because of redevelopment, as might occur immediately after an idle well is restarted. This can be verified as more wells are repeatedly checked during the step tests.

Nuisance Bacteria Sampling

The results from this limited sampling can only be considered preliminary. Even though the relatively high level of nuisance bacteria identified in the dewatering wells present a significant potential for plugging processes, the data clearly show that even wells in good condition contain the bacteria. It also appears that the chemical treatments do not eliminate the nuisance bacteria from the wells. The widespread bacteria in the wells sampled might mean that they are indigenous to the ground water, or that they are being regularly introduced into the wells from some other source. In either case, the problems associated with their presence will need to be managed on a continual basis. It is recommended that more background data be collected using the BART sets, as additional dewatering wells are step-tested. Although the use of the BART for more detailed analysis of some of the wells probably is not warranted now, it may be considered in the future.

Videotape Inspection

A video inspection was undertaken in an effort to pursue the actual condition of two wells, I-70 Well 3 and 25th Street Well 6. Although no unusual conditions were found during a post-treatment step test on I-70 Well 3 on April 17, 1990, severe settlement took place later in the year in the vicinity of the well vault, leading to the tentative conclusion that some severe failure in the well had occurred. At 25th Street Well 6 the condition-assessment step test conducted on February 8, 1991, provided a sample identified as sand and gravel pack. Layne-Western Company, Inc., conducted the video inspections on September 25, 1991.

The video inspection of I-70 Well 3 failed to detect any problems in the structual integrity of the casing/well screen assembly that would explain the settlement in the vicinity of the well. At 25th Street Well 6, even though a temporary well pump was operated for several hours, the water failed to clear sufficiently to permit a meaningful inspection.

Future Investigations

A program of continued investigation of the condition of the dewatering wells is recommended. Measuring the difference between water levels in the piezometers and their adjacent wells will continue to be important as a first step in determining whether wells are candidates for future step tests or treatment. In addition, if a well is pumping sand, it points to a potentially major problem with the well. A sand pumpage investigation is recommended as a standard part of each step test.

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Appendix A.

Step Test Data
FY 92 (Phase 9)

Appendix A.

Step Test Data
FY 92 (Phase 9)

I-70	Well 1A	4/26/95
	Well 2A	11/16/93
	Well 3A	10/29/93
	Well 5	10/14/93
	Well 6	10/29/91
	Well 8A	10/1/91
	Well 9A	7/23/92
	Well11A	10/28/93
	Well 15	10/15/93
I-64	Well 1	9/24/91
25th St.	Well 1	9/4/91
	Well 4	11/19/91
	Well 9	9/18/91
Venice	Well 2	10/2/91
	Well 3	12/16/91
	Well 5	3/24/92

DEWATERING WELL DATA

	Well No.		Piezometer No.	
	I70	W1A	I70	P1A
Date Drilled:	10/24/91		1992	
Casing				
Top elevation:	408.7		na	
Diameter:	16-in. SS		2-in. PVC	
Length (ft):	54.3		na	
Screen				
Bottom elevation:	304.5		na	
Diameter:	16-in. SS		2-in. PVC	
Length, lower (ft):	30		3	
Slot size, lower:	0.055-in.		na	
Length, upper (ft):	20		-	
Slot size, upper:	0.020-in.		-	
Measuring Point Elevation:	na		na	
Nonpumping Water Level				
Depth below temp. MP (ft):	35.58		-	
Height of temp. MP (ft):	5.85		-	
Depth below perm. MP (ft):	29.63		36.10	
Elevation:	-		-	
Date of Step Test:	4/26/95		-	
Water Sample				
Time:	11:04 am		-	
Temperature:	59.4° F		-	
Laboratory No.:	228642		-	
Distance and Direction to Piez. from PW:			7.0 ft East	
Time PW Off Before Step Test:			Not recorded	

Notes: SWS 8-in. dia. orifice tube w/plate No. 4, sand tank, Omnidata

SWS Crew: E. Sanderson, R. Olson

WATER-LEVEL MEASUREMENTS
I-70 Well No. 1A
Condition-Assessment Step Test

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
04/26/95						
08:38 am	0	35.58				Solinst dropline
08:42 am	0		36.10			Solinst dropline
08:58 am	0	35.58	36.10			Water level trend
09:00 am	0	35.58	36.11			
09:02 am	0	35.58	36.12			
09:04 am	0	35.58	36.15			
09:06 am	0	35.57	36.14			
09:08 am	0	35.57	36.13			
09:10 am	0	35.57	36.14			
09:12 am	0	35.57	36.15			
09:14 am	0	35.57	36.16			
09:16 am	0	35.57	36.16			
09:18 am	0	35.57	36.14			
09:20 am	0	35.57	36.13			
09:22 am	0	35.57	36.14			
09:24 am	0	35.57	36.13			
09:26 am	0	35.57	36.12			
09:28 am	0	35.57	36.11			
09:30 am	0	35.57	36.10			
09:32 am	0	35.57	36.11			
09:34 am	0	35.57	36.09			
09:36 am	0	35.57	36.10			
09:38 am	0	35.57	36.10			
09:40 am	0	35.58	36.11			
09:42 am	0	35.57	36.12			
09:44 am	0	35.58	36.12			
09:46 am	0	35.57	36.12			
09:48 am	0	35.57	36.12			
09:50 am	0	35.57	36.12			
09:52 am	0	35.57	36.12			
09:54 am	0	35.56	36.11			
09:56 am	0	35.57	36.12			
09:58 am	0	35.57	36.11			
09:59 am	0	35.57	36.11			
10:00 am	0	35.57	36.10			Pump On
10:01 am	1	45.37	39.66			
10:02 am	2	45.66	39.90			

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 1A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
10:03 am	3	45.19	39.95	1.75	445	Max Q
10:04 am	4	44.89	39.78	1.43	401	
10:05 am	5	44.96	39.84			
10:06 am	6	45.02	39.89			
10:07 am	7	45.06	39.93	1.42	400	
10:08 am	8	45.09	39.96			
10:09 am	9	45.13	40.00			
10:10 am	10	45.15	40.03	1.42	400	
10:11 am	11	45.17	40.04			
10:12 am	12	45.19	40.06			
10:13 am	13	45.21	40.08			
10:14 am	14	45.24	40.10			
10:15 am	15	45.25	40.11			
10:16 am	16	45.25	40.12	1.41	399	
10:17 am	17	45.26	40.14			
10:18 am	18	45.28	40.15			
10:19 am	19	45.29	40.15			
10:20 am	20	45.29	40.16			
10:21 am	21	45.29	40.17			
10:22 am	22	45.30	40.18	1.41	399	
10:23 am	23	45.30	40.18			
10:24 am	24	45.31	40.19			
10:25 am	25	45.32	40.19			
10:26 am	26	45.33	40.20			
10:27 am	27	45.34	40.21			
10:28 am	28	45.33	40.22			
10:29 am	29	45.34	40.22			
10:30 am	30	45.34	40.22	1.41	399	Reduce rate
10:31 am	1	44.05	39.79			Step 2
10:32 am	2	44.16	39.79	1.08	350	
10:33 am	3	44.14	39.78			
10:34 am	4	44.15	39.78			
10:35 am	5	44.15	39.78			
10:36 am	6	44.14	39.77			
10:37 am	7	44.14	39.77	1.08	350	
10:38 am	8	44.14	39.76			
10:39 am	9	44.14	39.75			
10:40 am	10	44.13	39.76			
10:41 am	11	44.14	39.76			

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 1A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
10:42 am	12	44.14	39.77			
10:43 am	13	44.14	39.77			
10:44 am	14	44.14	39.77	1.08	350	
10:45 am	15	44.15	39.76			
10:46 am	16	44.14	39.75			
10:47 am	17	44.15	39.75			
10:48 am	18	44.15	39.75			
10:49 am	19	44.16	39.75			
10:50 am	20	44.15	39.74			
10:51 am	21	44.15	39.74	1.08	350	
10:52 am	22	44.16	39.74			
10:53 am	23	44.16	39.75			
10:54 am	24	44.16	39.75			
10:55 am	25	44.16	39.76			
10:56 am	26	44.16	39.76	1.08	350	
10:57 am	27	44.16	39.76			
10:58 am	28	44.16	39.76			
10:59 am	29	44.16	39.77			
11:00 am	30	44.16	39.77	1.08	350	Reduce rate
11:01 am	1	42.94	39.32	0.79	300	Step 3
11:02 am	2	43.00	39.34			
11:03 am	3	43.00	39.34			
11:04 am	4	42.97	39.33			Water sample collected,
11:05 am	5	42.97	39.32			T = 59.4°F
11:06 am	6	42.97	39.32			
11:07 am	7	42.96	39.32			
11:08 am	8	42.96	39.32			
11:09 am	9	42.96	39.31			
11:10 am	10	42.96	39.32			
11:11 am	11	42.96	39.32			
11:12 am	12	42.96	39.32	0.80	300	BART samples collected
11:13 am	13	42.95	39.31			
11:14 am	14	42.96	39.32			
11:15 am	15	42.95	39.32			
11:16 am	16	42.96	39.32			
11:17 am	17	42.97	39.33			
11:18 am	18	42.95	39.32			
11:19 am	19	42.95	39.32			
11:20 am	20	42.96	39.32	0.80	300	

WATER-LEVEL MEASUREMENTS (Concluded)
I-70 Well No. 1A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
11:21 am	21	42.96	39.32			
11:22 am	22	42.96	39.32			
11:23 am	23	42.96	39.33			
11:24 am	24	42.96	39.32			
11:25 am	25	42.96	39.33			
11:26 am	26	42.95	39.33			
11:27 am	27	42.96	39.33			
11:28 am	28	42.96	39.33	0.80	300	
11:29 am	29	42.96	39.33			
11:30 am	30	42.96	39.32			End of Test No sand in tank after test

DEWATERING WELL DATA

	Well No. I70 W2A		Piezometer No. I70 P2A
Date Drilled:	2/6/92		1992
Casing			
Top elevation:	408		na
Diameter:	16-in. SS		2-in. PVC
Length (ft):	55		na
Screen			
Bottom elevation:	303		na
Diameter:	16-in. SS		2-in. PVC
Length, lower (ft):	30		3
Slot size, lower:	0.055-in.		na
Length, upper (ft):	20		-
Slot size, upper:	0.020-in.		-
Measuring Point Elevation:	na		na
Nonpumping Water Level			
Depth below temp. MP (ft):	35.31		-
Height of temp. MP (ft):	4.37		-
Depth below perm. MP (ft):	30.94		35.50
Elevation:	-		-
Date of Step Test:	11/16/93		-
Water Sample			
Time:	11:10 am		-
Temperature:	60.0° F		-
Laboratory No.:	227238		-
Distance and Direction to Piez. from PW:			7.0 ft North
Time PW Off Before Step Test:			Not recorded

Notes: SWS 8-in. dia. orifice tube w/plate No. 4, Omnidata datalogger, sand tank
Only a few grains of sand and a small of amount of soft Fe deposits in the tank following the step test.

SWS Crew: E. Sanderson, R. Olson

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 2A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
10:28 am	14	48.62	39.77			
10:30 am	16	48.64	39.79	1.39	396	Increase rate
10:31 am	17	48.63	39.80	1.42	400	
10:32 am	18	48.70	39.82			
10:34 am	20	48.72	39.83			
10:36 am	22	48.74	39.85			
10:38 am	24	48.75	39.86			
10:39 am	25	48.74	39.86			
10:40 am	26	48.76	39.87			
10:41 am	27	48.75	39.87			
10:42 am	28	48.76	39.88	1.41	399	
10:43 am	29	48.75	39.88			
10:44 am	30	48.76	39.87			Decrease rate
10:45 am	1	47.07	39.42	1.08	350	Step 2
10:46 am	2	47.08	39.41			
10:47 am	3	47.07	39.40			
10:48 am	4	47.07	39.40			
10:49 am	5	47.08	39.41	1.06	347	Increase rate
10:50 am	6	47.09	39.41	1.08	350	
10:52 am	8	47.08	39.40			
10:54 am	10	47.08	39.41			
10:56 am	12	47.09	39.41	1.08	350	
10:58 am	14	47.09	39.40			
11:00 am	16	47.09	39.40			
11:02 am	18	47.09	39.40			
11:03 am	19	47.09	39.41	1.08	350	
11:04 am	20	47.09	39.41			
11:06 am	22	47.09	39.41			
11:08 am	24	47.10	39.42			
11:09 am	25	47.10	39.42	1.08	350	Water sample collected,
11:10 am	26	47.10	39.42			T=60°F
11:11 am	27	47.12	39.42			
11:12 am	28	47.11	39.42			
11:13 am	29	47.11	39.42			
11:14 am	30	47.12	39.43	1.08	350	Decrease rate
11:15 am	1	45.58	39.00	0.79	300	Step 3
11:16 am	2	45.45	38.95			
11:17 am	3	45.44	38.94			
11:18 am	4	45.43	38.94			
11:19 am	5	45.43	38.94			

WATER-LEVEL MEASUREMENTS
I-70 Well No. 2A
Condition-Assessment Step Test

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
11/16/93						
08:30 am		35.31				Electric dropline
08:40 am			35.50			Electric dropline
09:01 am		35.31	35.50			Begin logging
09:02 am		35.31	35.50			Water level trend
09:03 am		35.31	35.49			
09:04 am		35.31	35.50			
09:05 am		35.31	35.50			
09:10 am		35.31	35.51			
09:20 am		35.31	35.51			
09:30 am		35.31	35.51			
09:40 am		35.30	35.50			
09:50 am		35.30	35.50			
09:55 am		35.31	35.50			
10:00 am		35.31	35.50			
10:01 am		35.31	35.50			
10:02 am		35.31	35.51			
10:03 am		35.31	35.50			
10:04 am		35.31	35.50			
10:05 am		35.31	35.50			
10:06 am		35.31	35.50			
10:07 am		35.31	35.50			
10:08 am		35.30	35.50			
10:09 am		35.31	35.50			
10:10 am		35.31	35.50			
10:11 am		35.31	35.50			
10:12 am		35.31	35.50			
10:13 am		35.31	35.50			
10:14 am	0	35.25	35.47			Pump On
10:15 am	1	49.25	39.56	1.70	438	Step 1; Max Q
10:16am	2	48.58	39.55	1.41	399	
10:17 am	3	48.35	39.49			
10:18 am	4	48.38	39.53			
10:19 am	5	48.45	39.58			
10:20 am	6	48.50	39.62			
10:21 am	7	48.52	39.64	1.41	399	
10:22 am	8	48.53	39.67			
10:24 am	10	48.56	39.71			
10:26 am	12	48.60	39.74	1.41	399	

WATER-LEVEL MEASUREMENTS (Concluded)
I-70 Well No. 2A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
11:20 am	6	45.43	38.93			
11:22 am	8	45.43	38.93			
11:23 am	9	45.42	38.92	0.79	300	BART samples collected
11:24 am	10	45.41	38.92			
11:26 am	12	45.41	38.92			
11:28 am	14	45.42	38.92			
11:29 am	15	45.41	38.91	0.79	300	
11:30 am	16	45.42	38.92			
11:32 am	18	45.43	38.92			
11:34 am	20	45.42	38.92			
11:36 am	22	45.43	38.92			
11:38 am	24	45.43	38.92			
11:39 am	25	45.43	38.92			
11:40 am	26	45.43	38.92			
11:41 am	27	45.43	38.93			
11:42 am	28	45.43	38.93			
11:43 am	29	45.44	38.93	0.79	300	
11:44 am	30	45.43	38.93			End of Test

DEWATERING WELL DATA

	Well No. I70 W3A	Piezometer No. I70 P3A
Date Drilled:	1/21/92	1992
Casing		
Top elevation:	402.4	na
Diameter:	16-in. SS	2-in. PVC
Length (ft):	49.7	na
Screen		
Bottom elevation:	302.7	na
Diameter:	16-in. SS	2-in. PVC
Length, lower (ft):	30	3
Slot size, lower:	0.055-in.	na
Length, upper (ft):	20	-
Slot size, upper:	0.020-in.	-
Measuring Point Elevation:	na	na
Nonpumping Water Level		
Depth below temp. MP (ft):	29.55	-
Height of temp. MP (ft):	3.60	-
Depth below perm. MP (ft):	25.95	29.42
Elevation:	-	-
Date of Step Test:	10/29/93	-
Water Sample		
Time:	11:47 am	-
Temperature:	57.9° F	-
Laboratory No.:	227203	-
Distance and Direction to Piez. from PW:		7.9 ft East
Time PW Off Before Step Test:		Not recorded

Notes: SWS 8-in. dia. orifice tube w/plate No. 4, using Omnidata, sand tank

SWS Crew: R. Olson, E. Sanderson

WATER-LEVEL MEASUREMENTS
I-70 Well No. 3A
Condition-Assessment Step Test

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
10/29/93						
09:10 am	0		29.42			Measured depth to water
09:15 am	0	29.55				Measured depth to water
09:20 am	0					Logging started
09:21 am	0					Water level trend
09:22 am	0					Transmitter 16 (15 psi)
09:23 am	0					in PW
09:24 am	0					Transmitter 4 (6 psi)
09:25 am	0					in Piez
09:26 am	0					
09:27 am	0	29.56	29.43			
09:28 am	0	28.55	29.42			
09:29 am	0	28.55	29.41			
09:30 am	0	28.55	29.41			
09:31 am	0	28.55	29.40			
09:32 am	0	28.55	29.40			
09:33 am	0	28.55	29.40			
09:34 am	0	28.54	29.39			
09:35 am	0	28.55	29.39			
09:36 am	0	28.54	29.39			
09:37 am	0	28.54	29.39			
09:38 am	0	28.54	29.38			
09:39 am	0	28.54	29.38			
09:40 am	0	28.54	29.38			Pump On
09:41 am	1	40.65	34.82	2.60	540	Step 1; Max Q
09:42 am	2	41.16	35.21	2.23	500	
09:43 am	3	40.23	34.87			
09:44 am	4	40.25	34.90			
09:45 am	5	40.33	34.95	2.23	500	Adjust rate up slightly
09:46 am	6	40.37	34.99			
09:47 am	7	40.40	35.02			
09:48 am	8	40.44	35.05			
09:49 am	9	40.49	35.07			
09:50 am	10	40.51	35.09			
09:51 am	11	40.54	35.11			
09:52 am	12	40.55	35.13			
09:53 am	13	40.60	35.16	2.19	496	Increase rate
09:54 am	14	40.59	35.17			
09:55 am	15	40.62	35.19			

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 3A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
09:56 am	16	40.72	35.24	2.23	500	
09:57 am	17	40.78	35.28			
09:58 am	18	40.82	35.30			
09:59 am	19	40.83	35.31			
10:00 am	20	40.83	35.32			
10:01 am	21	40.86	35.34	2.22	499	Increase rate
10:02 am	22	40.88	35.35	2.22	499	
10:03 am	23	40.91	35.37			
10:04 am	24	40.94	35.39			
10:05 am	25	40.96	35.40			
10:06 am	26	40.97	35.41			
10:07 am	27	40.97	35.42			
10:08 am	28	40.98	35.42			
10:09 am	29	41.01	35.42			
10:10 am	30	40.99	35.42	2.21	498	Decrease rate
10:11 am	1	39.96	34.98	1.80	450	Step 2
10:12 am	2	39.94	34.96	1.82	453	
10:13 am	3	39.93	34.97			
10:14 am	4	39.95	34.97			
10:15 am	5	39.93	34.98			
10:16 am	6	39.93	34.98			
10:17 am	7	39.95	34.99			
10:18 am	8	39.95	34.99	1.82	453	
10:19 am	9	39.96	34.99			
10:20 am	10	39.96	35.00			
10:21 am	11	39.96	35.00			
10:22 am	12	39.98	35.01			
10:23 am	13	39.99	35.02			
10:24 am	14	39.98	35.03	1.82	453	
10:25 am	15	40.00	35.03			
10:26 am	16	40.00	35.03			
10:27 am	17	40.00	35.04			
10:28 am	18	40.01	35.04			
10:29 am	19	40.01	35.04	1.82	453	
10:30 am	20	40.00	35.04			
10:31 am	21	40.00	35.04			
10:32 am	22	40.02	35.05			
10:33 am	23	40.01	35.05			
10:34 am	24	40.02	35.06			
10:35 am	25	40.03	35.06			

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 3A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
10:36 am	26	40.03	35.07			
10:37 am	27	40.03	35.06			
10:38 am	28	40.04	35.06			
10:39 am	29	40.05	35.06			
10:40 am	30	40.03	35.07	1.82	453	Decrease rate
10:41 am	1	38.88	34.57	1.42	400	Step 3
10:42 am	2	38.85	34.54			
10:43 am	3	38.86	34.54			
10:44 am	4	38.84	34.54			
10:45 am	5	38.84	34.54	1.42	400	
10:46 am	6	38.84	34.54			
10:47 am	7	38.82	34.53			
10:48 am	8	38.84	34.53			
10:49 am	9	38.83	34.53			
10:50 am	10	38.82	34.53			
10:51 am	11	38.82	34.52			
10:52 am	12	38.82	34.53			
10:53 am	13	38.83	34.53			
10:54 am	14	38.82	34.52			
10:55 am	15	38.83	34.52	1.42	400	
10:56 am	16	38.83	34.52			
10:57 am	17	38.83	34.52			
10:58 am	18	38.82	34.51			
10:59 am	19	38.82	34.51			
11:00 am	20	38.83	34.51			
11:01 am	21	38.84	34.52	1.42	400	
11:02 am	22	38.82	34.52			
11:03 am	23	38.83	34.52			
11:04 am	24	38.83	34.52			
11:05 am	25	38.83	34.53			
11:06 am	26	38.84	34.53			
11:07 am	27	38.84	34.52			
11:08 am	28	38.84	34.53			
11:09 am	29	38.84	34.53			
11:10 am	30	38.85	34.53	1.42	400	Decrease rate
11:11 am	1	37.72	34.04	1.08	350	Step 4
11:12 am	2	37.68	34.01			
11:13 am	3	37.67	34.00	1.08	350	
11:14 am	4	37.66	33.99			
11:15 am	5	37.65	33.99			

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 3A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
11:16 am	6	37.64	33.99			
11:17 am	7	37.64	33.99			
11:18 am	8	37.65	33.99			
11:19 am	9	37.63	33.98			
11:20 am	10	37.64	33.99	1.09	352	
11:21 am	11	37.63	33.99			
11:22 am	12	37.62	33.98			
11:23 am	13	37.62	33.98	1.08	350	
11:24 am	14	37.61	33.98			
11:25 am	15	37.62	33.98			
11:26 am	16	37.62	33.98			
11:27 am	17	37.62	33.98			
11:28 am	18	37.62	33.98			
11:29 am	19	37.62	33.98			
11:30 am	20	37.62	33.98			
11:31 am	21	37.61	33.97			
11:32 am	22	37.61	33.98			
11:33 am	23	37.61	33.97			
11:34 am	24	37.61	33.97	1.08	350	
11:35 am	25	37.61	33.97			
11:36 am	26	37.60	33.97			
11:37 am	27	37.61	33.97			
11:38 am	28	37.61	33.97			
11:39 am	29	37.61	33.97			
11:40 am	30	37.61	33.97	1.08	350	Decrease rate
11:41 am	1	36.39	33.43	0.79	300	Step 5
11:42 am	2	36.36	33.40			
11:43 am	3	36.34	33.39	0.78	298	
11:44 am	4	36.33	33.38			
11:45 am	5	36.33	33.37			
11:46 am	6	36.32	33.37			
11:47 am	7	36.32	33.37	0.78	298	Water sample collected;
11:48 am	8	36.32	33.37			T=57.9°F
11:49 am	9	36.31	33.36			BART samples collected
11:50 am	10	36.32	33.36			
11:51 am	11	36.31	33.36			
11:52 am	12	36.31	33.35			
11:53 am	13	36.30	33.35			
11:54 am	14	36.31	33.36			
11:55 am	15	36.31	33.36			

WATER-LEVEL MEASUREMENTS (Concluded)
I-70 Well No. 3A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
11:56 am	16	36.29	33.35			
11:57 am	17	36.29	33.34			
11:58 am	18	36.29	33.35	0.78	298	
11:59 am	19	36.29	33.35			
12:00 pm	20	36.29	33.34			
12:01 pm	21	36.28	33.34			
12:02 pm	22	36.28	33.34			
12:03 pm	23	36.28	33.34			
12:04 pm	24	36.29	33.33			
12:05 pm	25	36.28	33.33			
12:06 pm	26	36.27	33.33	0.78	298	
12:07 pm	27	36.27	33.32			
12:08 pm	28	36.28	33.32			
12:09 pm	29	36.27	33.32			
12:10pm	30	36.27	33.33			End of Test

DEWATERING WELL DATA

	Well No. I70 W5		Piezometer No. I70 P5
Date Drilled:	1973		1973
Casing			
Top elevation:	385.3		391.1
Diameter:	16-in. SS		2-in. PVC
Length (ft):	21.4		na
Screen			
Bottom elevation:	303.91		na
Diameter:	16-in. SS		2-in. PVC
Length (ft):	60		3
Slot size:	0.080-in.		na
Measuring Point Elevation:	385.9		391.1
Nonpumping Water Level			
Depth below temp. MP (ft):	14.37		-
Height of temp. MP (ft):	5.3		-
Depth below perm. MP (ft):	9.07		Plugged
Elevation:	376.83		-
Date of Step Test:	10/14/93		-
Water Sample			
Time:	2:50 pm		-
Temperature:	58.5° F		-
Laboratory No.:	227164		-
Distance and Direction to Piez. from PW:			6.5 ft East
Time PW Off Before Step Test:			>1 year

Notes: SWS 8-in. dia. orifice tube w/plate No. 4, manual data collection, sand tank not used

SWS Crew: R. Olson, E. Sanderson

WATER-LEVEL MEASUREMENTS
I-70 Well No. 5
Condition-Assessment Step Test

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
10/14/93						
11:25 am	0	14.39				Solinst Dropline
12:32 pm	0	14.38				Piezometer plugged
12:34 pm	0	14.37				Water level trend
12:40 pm	0	14.37				Pump On
12:41 pm	1	25.25				Step 1
	1.5			2.23	500	
	2	25.35				
	3	25.39		2.23	500	
	4	25.40				
	5	25.40				
	6	25.41				
	8	25.42		2.23	500	
	10	25.45				
	12	25.47				
	14	25.48		2.23	500	
	16	25.49				
	18	25.49		2.23	500	
	20	25.50				
	22	25.50		2.23	500	
	24	25.52				
	25	25.52				
	26	25.52				
	27	25.52		2.23	500	
	28	25.54				
	29	25.53		2.23	500	
01:10 pm	30	25.50				Reduce rate
01:11 pm	1	24.42				Step 2
	2	24.40		1.80	450	
	3	24.39				
	4	24.39				
	5	24.39		1.80	450	
	6	24.40				
	8	24.41				
01:20 pm	10	24.42				
	12	24.42		1.80	450	
	14	24.43				
	16	24.44				
	18	24.44				

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 5

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
01:30 pm	20	24.44				
	22	24.45		1.80	450	
	24	24.46				
	25	24.46				
	26	24.46				
	27	24.46				
	28	24.46				
	29	24.47				
01:40 pm	30	24.48				Reduce rate
01:41 pm	1					Step 3
	2	23.31		1.42	400	
	3	23.33				
	4	23.33				
	5	23.33		1.43	401	
	6	23.33				
	8	23.34				
01:50 pm	10	23.34		1.43	401	
	12	23.34				
	14	23.34				
	16	23.34				
	18	23.34		1.43	401	
02:00 pm	20	23.34				
	22	23.34				
	24	23.34				
	26	23.35		1.43	401	
	27	23.36				
	28	23.35				
	29	23.36		1.43	401	
02:10 pm	30	23.36				Reduce rate
02:11 pm	1	22.15		1.09	352	Step 4
	2	22.14				
	3	22.13		1.08	350	
	4	22.13				
	5	22.14				
	6	22.14				
	8	22.16		1.08	350	
02:20 pm	10	22.16				
	12	22.17		1.08	350	
	14	22.16				
	16	22.17		1.09	352	

WATER-LEVEL MEASUREMENTS (Concluded)
I-70 Well No. 5

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	18	22.17				
02:30 pm	20	22.17				
	22	22.18		1.08	350	
	24	22.19				
	26	22.17				
	27	22.17		1.08	350	
	28	22.17				
	29	22.17				
02:40 pm	30	22.17				Reduce rate
02:41 pm	1	21.00		0.79	300	Step 5
	2	20.98				
	3	20.98				
	4	20.97		0.79	300	
	5	20.97				
	6	20.97				
	8	20.97				
02:50 pm	10	20.96		0.79	300	Water sample collected;
	12	20.97				T=58.5°F
	14	20.97				BART samples collected
	16	20.97				
	18	20.97				
03:00 pm	20	20.97		0.79	300	
	22	20.97				
	24	20.97		0.79	300	
	25	20.97				
	26	20.97				
	27	20.97				
	28	20.97				
	29	20.97				
03:10 pm	30	20.97				End of Test

DEWATERING WELL DATA

	Well No.		Piezometer No.	
	I70	W6	I70	P6
Date Drilled:	1973		1973	
Casing				
Top elevation:	385.9		392.14	
Diameter:	16-in. SS		2-in. PVC	
Length (ft):	22.4		na	
Screen				
Bottom elevation:	303.45		na	
Diameter:	16-in. SS		2-in. PVC	
Length (ft):	60		3	
Slot size:	0.080-in.		na	
Measuring Point Elevation:	386.6		392.14	
Nonpumping Water Level				
Depth below temp. MP (ft):	8.25		-	
Height of temp. MP (ft):	5.08		-	
Depth below perm. MP (ft):	3.17		Buried	
Elevation:	383.43		-	
Date of Step Test:	10/29/91		-	
Water Sample				
Time:	-2:00 pm		-	
Temperature:	59° F		-	
Laboratory No.:	225019		-	
Distance and Direction to Piez. from PW:			5.5 ft North	
Time PW Off Before Step Test:			Not recorded	

Notes: Piezometer covered w/dirt due to construction of traffic barrier wall.
SWS 8-in. dia. orifice tube w/plate No. 4; 1000-gal settling tank; 50-ft 6-in.-diameter flexible hose; McDAS w/15 psi transducer #5

SWS Crew: E. Sanderson, A. Buck, D. Jurss, T. Wilson

WATER-LEVEL MEASUREMENTS
I-70 Well No. 6
Condition-Assessment Step Test

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
10/29/91						
09:45 am	0.0	8.25				Solinst DL Buried
11:47 am	0.0					Pump On
11:48 am	1.0					Step 1
	8.0			5.08	750	
	18.0			5.03	750	
	19.0			5.08	750	
	26.0			5.08	750	
12:17 pm	30.0					Decrease rate
12:18 pm	1.0			4.41	700	Step 2
	7.0			4.50	700	Adjust rate
	8.0			4.41	700	
	12.0			4.41	700	
	16.0			4.41	700	
	25.0			4.41	700	
	29.0			4.41	700	
12:47 pm	30.0			4.41	700	Decrease rate
12:48 pm	1.0					Step 3
	2.0			3.80	650	
	4.0			3.80	650	
	16.0			3.80	650	
	20.0			3.80	650	
	24.0			3.80	650	
	28.0			3.80	650	
01:17 pm	30.0					Decrease rate
01:18 pm	1.0	McDAS operation foul-up;		3.23	600	Step 4
	2.0	reboot w/new floppy;		3.20	600	Adjust rate
	4.0	system now ok		3.22	600	
	8.0			3.21	600	
01:35 pm	18.0	13.18				Rate steady to
01:36 pm	19.0	13.17				end of step 4
01:37 pm	20.1	13.18				
	21.1	13.19				
	22.0	13.19				
01:39 pm	22.0	13.16				
01:41 pm	24.0	13.18				
		13.18				
01:43 pm	26.0	13.17				

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 6

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
01:44 pm	27.0	13.18				
01:45 pm	28.0	13.18				
		13.19				
01:46 pm	29.0	13.22				
	29.2	13.46				
01:47 pm	30.0					Increase rate
01:48 pm	1.0	13.57		3.80	650	Step 5
	1.8	13.59				
	2.0	13.57				
	2.2	13.59				
	3.0	13.59		3.80	650	
	4.1	13.62				
	4.3	13.59				
	5.1	13.58				
	5.3	13.60				
	6.1	13.60				
	7.9	13.62				
	8.1	13.61		3.80	650	
01:57 pm	10.1	13.60				
	12.1	13.61				
	14.1	13.61				
	16.1	13.62		3.80	650	
	18.1	13.61				
02:07 pm	20.1	13.63		3.80	650	
	22.1	13.63		3.80	650	
	24.1	13.64				
	26.1	13.63		3.80	650	
	27.1	13.62				
	28.2	13.64				
	29.2	13.60		3.80	650	
02:17 pm	30.0					Increase rate
02:18 pm	1.0	13.99		4.42	700	Step 6
	2.0	14.00				
	3.0	14.01		4.41	700	
	4.0	13.99				
	5.1	14.01				
	6.1	14.02				
	8.1	14.01				
02:27 pm	10.1	14.04				
	12.1	14.02		4.41	700	

WATER-LEVEL MEASUREMENTS (Concluded)
I-70 Well No. 6

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	14.1	14.07				
	16.1	14.06				
	18.1	14.07				
02:36 pm	20.1	14.05				
	22.1	14.06		4.41	700	
	24.1	14.07				
	25.1	14.09		4.42	700	
	26.1	14.08				
	27.1	14.09				
	28.2	14.10				
	29.0	14.09				
	29.2	14.10		4.43	700	
	29.6	14.08				
02:47 pm	30.0					Increase rate
02:48 pm	1.0	14.46				Step 7
	2.0	14.44				Valve adj prob
	3.0	14.48				
	4.1	14.48		5.08		
	5.1	14.32		4.80		
	6.1	14.38				
	8.1	14.39				
	10.0	14.39				
02:57 pm	10.1	14.42				
	12.1	14.42				
	14.1	14.44		4.90	735	Valve fully open
	15.9	14.42				
	16.1	14.44		4.94	740	Water sample collected,
	18.1	14.43		4.95	740	T=59°F
03:07 pm	20.1	14.43				BART samples collected
	22.1	14.44		4.95	740	
	24.1	14.46				
	25.1	14.43				
	26.1	14.45		4.95	740	
	27.1	14.45				
	28.2	14.45				
	29.0	14.46				
	29.2	14.45		4.95	740	
03:17 pm	30.0	14.46				End of test

DEWATERING WELL DATA

	Well No. I70 W8A		Piezometer No. P8A
Date Drilled:	April 1989		April 1989
Casing			
Top elevation:	382.2		-
Diameter:	16-in. SS		2-in. PVC
Length (ft):	14.85		na
Screen			
Bottom elevation:	306		na
Diameter:	16-in. SS		2-in. PVC
Length, lower (ft):	30		3
Slot size, lower:	0.055-in.		na
Length, upper (ft):	20		-
Slot size, lower:	0.020-in.		-
Measuring Point Elevation:	-383.5		na
Nonpumping Water Level			
Depth below temp. MP (ft):	11.10		-
Height of temp. MP (ft):	3.95		-
Depth below perm. MP (ft):	7.15		11.30
Elevation:	376.35		-
Date of Step Test:	10/1/91		-
Water Sample			
Time:	3:20 pm		-
Temperature:	61° F		-
Laboratory No.:	224907		-
Distance and Direction to Piez. from PW:			6.4 ft East
Time PW Off Before Step Test:			Not recorded

Notes: SWS 8-in. dia. orifice tube w/plate No. 4; 50-ft flexible hose; 1000-gal settling tank; McDAS w/15 psi transducer #5 and 6 psi transducer #1

SWS Crew: R. Olson, E. Sanderson

WATER-LEVEL MEASUREMENTS
I-70 Well No. 8A
Condition-Assessment Step Test

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
10/01/91						
01:25 pm			11.30			Solinst Dropline
01:26 pm		11.10				Solinst Dropline
01:33 pm	0.0	11.09	11.32			McDAS started
	1.2	11.10	11.37			Water Level Trend
	3.0	11.09	11.36			
	4.2	11.08	11.38			
	5.1	11.08	11.37			
	6.0	11.08	11.38			
	7.2	11.08	11.37			
	8.1	11.08	11.38			
	9.0	11.08	11.37			
01:43 pm	10.2	11.07	11.37			
	11.1	11.07	11.37			
	11.4	11.07	11.37			
01:45 pm	0.0					Pump On
01:46 pm	1.1	22.17	15.82	3.40	620	Step 1; Max rate
	2.0	21.96	15.90	3.22	600	Red water
	3.0	22.08	16.00			
	4.0	22.16	16.08			
	5.0	22.23	16.12			
	6.0	22.29	16.18			Water clear
	8.1	22.37	16.26			
01:55 pm	10.2	22.44	16.31	3.21	600	
	12.2	22.48	16.36			
	14.0	22.52	16.40			
	16.0	22.54	16.42	3.20		Adjust rate
	17.1	22.60	16.46	3.22	600	
	17.9	22.60	16.46			
02:05 pm	20.1	22.62	16.48			
	22.0	22.63	16.49			
	23.0	22.64	16.50	3.22	600	
	24.1	22.64	16.50			
	25.8	22.65	16.52			
	27.0	22.66	16.51			
	28.3	22.67	16.52			
	29.0	22.67	16.54	3.22	600	
	29.6	22.68	16.55			
02:15 pm	30.0					Reduce rate

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 8A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
02:16 pm	1.0	21.78	16.18	2.70	550	Step 2
	2.0	21.79	16.20			
	3.0	21.78	16.18			
	4.1	21.79	16.18			
	5.0	21.79	16.18			
	6.0	21.79	16.18			
	7.1	21.73	16.17	2.72		Adjust rate
	7.6	21.77	16.18	2.70	550	
	8.1	21.77	16.19			
02:25 pm	10.0	21.77	16.19			
	11.0	21.78	16.20	2.70	550	
	12.0	21.78	16.19			
	14.1	21.79	16.21			
	16.1	21.79	16.20			
	18.1	21.80	16.21			
02:35 pm	20.3	21.80	16.22			
	21.2	21.81	16.22	2.70	550	
	22.2	21.81	16.23			
	24.3	21.81	16.23			
	26.1	21.82	16.23			
	27.3	21.82	16.23	2.70	550	
	27.9	21.82	16.22			
	29.2	21.82	16.23			
02:45 pm	30.0					Reduce rate
02:46 pm	1.0	20.91	15.88	2.22	500	Step 3
	2.0	20.88	15.86			
	3.0	20.88	15.86			
	4.0	20.87	15.85			
	5.0	20.86	15.85			
	6.0	20.86	15.85	2.22	500	
	8.1	20.86	15.83			
02:55 pm	10.0	20.86	15.84			
	11.2	20.86	15.83	2.22	500	
	12.0	20.86	15.83			
	14.0	20.86	15.83			
	16.1	20.87	15.85			
	18.0	20.87	15.84	2.22	500	
03:05 pm	20.2	20.86	15.84			
	22.1	20.87	15.85			
	23.2	20.87	15.85	2.22	500	

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 8A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	24.2	20.88	15.85			
	26.0	20.88	15.85			
	27.2	20.87	15.85			
	27.8	20.88	15.85			
	29.1	20.79	15.81	2.22	500	
03:15 pm	30.0					Reduce rate
03:16 pm	1.0	19.95	15.49	1.81	450	Step 4
	2.0	19.93	15.47			
	3.0	19.92	15.46			
	4.0	19.90	15.45			Water sample collected,
	6.0	19.92	15.45	1.81	450	T=61°F
	7.1	19.89	15.45			BART samples collected
	8.1	19.91	15.46			
	9.1	19.93	15.47	1.81	450	
03:25 pm	10.0	19.94	15.47			
	12.0	19.91	15.44			
	14.0	19.93	15.45			
	16.1	19.94	15.46			
	16.9	19.95	15.46	1.82	450	
	18.0	19.96	15.47			
03:35 pm	20.3	19.98	15.48			
	22.2	19.96	15.46			
	24.3	19.96	15.47			
	24.9	19.99	15.47	1.82	450	
	26.0	19.95	15.46			
	27.3	19.99	15.48			
	27.9	19.99	15.48			
	29.2	19.96	15.48			
03:45 pm	30.0					Reduce rate
03:46 pm	1.0	19.05	15.11	1.42	400	Step 5
	2.0	19.04	15.10			
	3.0	19.03	15.09			
	4.0	19.00	15.07			
	5.0	18.99	15.07			
	6.0	18.98	15.07			
	8.1	19.00	15.07			
	9.1	19.00	15.07	1.42	400	
03:55 pm	10.2	19.00	15.07			
	12.2	18.99	15.05			
	13.9	18.99	15.05			

WATER-LEVEL MEASUREMENTS (Concluded)
I-70 Well No. 8A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	16.0	18.98	15.05			
	17.9	18.97	15.05			
	19.2	18.97	15.05	1.42	400	
04:05 pm	20.1	18.98	15.06			
	22.0	18.95	15.04			
	24.1	18.98	15.05			
	25.8	18.98	15.05			
	26.4	18.98	15.05			
	27.0	18.98	15.05	1.42	400	
	28.3	18.97	15.04			
	28.9	18.99	15.05			
	29.6	18.99	15.06			
04:15 pm	30.0					End of Test

DEWATERING WELL DATA

	Well No. I70 W9A		Piezometer No. I70 P9A
Date Drilled:	4/5/89		4/13/89
Casing			
Top elevation:	402.8		407.52
Diameter:	16-in. SS		2-in. PVC
Length (ft):	40.9		na
Screen			
Bottom elevation:	301.9		na
Diameter:	16-in. SS		2-in. PVC
Length, lower (ft):	40		3
Slot size, lower:	0.055-in.		na
Length, upper (ft)	20		-
Slot size, upper:	0.020-in.		-
Measuring Point Elevation:	404.05		407.52
Nonpumping Water Level			
Depth below temp. MP (ft):	30.05		-
Height of temp. MP (ft):	3.80		-
Depth below perm. MP (ft):	26.25		30.02
Elevation:	377.80		377.50
Date of Step Test:	7/23/92		-
Water Sample			
Time:	2:11 pm		-
Temperature:	61 ° F		-
Laboratory No.:	226027		-
Distance and Direction to Piez. from PW:			6.0 ft East
Time PW Off Before Step Test:			Not recorded

Notes: SWS 8-in. dia. orifice tube w/plate No. 4; McDAS w/transudcers #5 (W9A) and #1 (P9A); 50-ft flexible hose; 1000-gal settling tank. No sand in tank following test.

SWS Crew: R. Olson, E. Sanderson

WATER-LEVEL MEASUREMENTS
I-70 Well No. 9A
Condition-Assessment Step Test

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
07/23/92						
11:25 am	0.0		30.02			Solinst Dropline
11:27 am	0.0	30.05				Solinst Dropline
11:45 am	0.0	30.05	30.09			McDAS started
	1.0	30.05	30.16			Water Level Trend
	2.0	30.04	30.20			
	3.0	30.04	30.24			
	4.0	30.03	30.23			
11:50 am	5.0	30.03	30.20			
	6.0	30.03	30.22			
	7.0	30.03	30.23			
	8.0	30.03	30.23			
	9.0	30.02	30.24			
11:55 am	10.1	30.03	30.24			
	11.1	30.02	30.24			
	12.1	30.02	30.25			
	13.1	30.01	30.20			
	14.1	30.02	30.18			
	14.5	30.02	30.19			
12:00 pm	0.0					Pump On
12:01 pm	1.0	36.58	34.07	2.46	525	Step 1; Max rate
	2.0	36.10	33.88	2.25		Adjust rate
	3.0	36.07	33.86			
	4.0	36.10	33.93			
	5.0	36.13	33.97	2.23	500	
	6.0	36.13	33.98			
	8.0	36.14	34.03			
12:10 pm	10.0	36.18	34.04			
	12.0	36.23	34.08	2.22	500	
	14.0	36.24	34.08			
	16.0	36.27	34.10	2.22	500	
	18.0	36.29	34.14			
12:20 pm	20.0	36.30	34.16			
	22.0	36.32	34.19			
	24.0	36.34	34.20			
	25.0	36.34	34.21			
	26.0	36.34	34.21	2.21	500	
	27.0	36.35	34.17			
	28.0	36.35	34.15			

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 9A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	29.0	36.37	34.19	2.22	500	
	29.7	36.37	34.21			
12:30 pm	30.0					Reduce rate
12:31 pm	1.0	35.85	33.95	1.81	450	Step 2
	2.0	35.83	33.91			
	3.0	35.83	33.93	1.81	450	
	4.0	35.83	33.93			
	5.0	35.84	33.93			
	6.0	35.83	33.94			
	8.0	35.84	33.84			
12:40 pm	10.0	35.84	33.87	1.81	450	
	12.0	35.86	33.98			
	14.0	35.86	33.92			
	16.0	35.88	33.95			
	18.0	35.89	33.92	1.82	450	
12:50 pm	20.0	35.89	33.92			
	22.0	35.90	33.95			
	23.0	35.90	33.97	1.82	450	
	24.0	35.89	33.99			
	25.0	35.89	33.99			
	26.0	35.91	34.04			
	27.0	35.91	34.06			
	28.0	35.91	34.00			
	29.0	35.91	33.95	1.82	450	
	29.8	35.92	33.97			
01:00 pm	30.0					Reduce rate
01:01 pm	1.0	35.31	33.72	1.42	400	Step 3
	2.0	35.30	33.68			
	3.0	35.30	33.60			
	4.0	35.28	33.60			
	5.0	35.27	33.67			
	6.0	35.28	33.68	1.42	400	
	8.0	35.29	33.68			
01:10 pm	10.0	35.29	33.66	1.42	400	
	12.0	35.30	33.57			
	14.0	35.28	33.64			
	16.0	35.28	33.65			
	17.0	35.29	33.62	1.42	400	
	18.0	35.29	33.63			
01:20 pm	20.0	35.28	33.64			

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 9A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	22.0	35.28	33.62	1.42	400	
	24.0	35.28	33.58			
	25.0	35.29	33.55			
	26.0	35.30	33.57	1.42	400	
	27.0	35.29	33.62			
	28.0	35.29	33.64			
	29.0	35.30	33.67	1.42	400	
	29.7	35.29	33.68			
01:30 pm	30.0					Reduce rate
01:31 pm	1.0	34.75	33.40	1.09	350	Step 4
	2.0	34.73	33.39			
	3.0	34.72	33.35			
	4.0	34.71	33.34	1.10	350	
	5.0	34.72	33.33			
	6.0	34.70	33.32			
	8.0	34.71	33.32			
01:40 pm	10.0	34.70	33.32			
	12.0	34.70	33.31	1.09	350	
	14.0	34.69	33.30			
	16.0	34.70	33.29			
	18.0	34.69	33.20	1.10	350	
01:50 pm	20.0	34.71	33.23			
	22.0	34.70	33.32	1.09	350	
	24.0	34.70	33.29			
	25.0	34.70	33.29			
	26.0	34.70	33.28	1.10	350	
	27.0	34.70	33.27			
	28.0	34.70	33.25			
	29.0	34.71	33.25	1.09	350	
	29.7	34.71	33.26			
02:00 pm	30.0					Reduce rate
02:01 pm	1.0	34.10	32.92	0.79	300	Step 5
	2.0	34.09	32.93			
	3.0	34.09	32.93			
	4.0	34.09	32.93			
	5.0	34.09	32.94	0.79	300	
	6.0	34.08	32.93			
	8.0	34.09	32.94			
	9.0	34.08	32.93	0.79	300	
02:10 pm	10.0	34.09	32.92			

WATER-LEVEL MEASUREMENTS (Concluded)
I-70 Well No. 9A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	11.0	34.08	32.92			Water sample collected;
	12.0	34.08	32.92			T=61°F
	14.0	34.07	32.92			
	16.0	34.07	32.94	0.79	300	BART samples collected
	18.0	34.08	32.96			
	19.0	34.08	32.97	0.80	300	
02:20 pm	20.0	34.08	32.97			
	22.0	34.07	32.93			
	24.0	34.07	32.96			
	25.0	34.07	32.93	0.79	300	
	26.0	34.07	32.91			
	27.0	34.07	32.90			
	28.0	34.07	32.90			
	29.0	34.09	32.94			
02:30 pm	30.0	34.08	32.97	0.79	300	End of Test
						No sand observed in tank

DEWATERING WELL DATA

	Well No. I70 W11A	Piezometer No. I70 P11A
Date Drilled:	1/28/92	1992
Casing		
Top elevation:	392.1	-
Diameter:	16-in. SS	2-in. PVC
Length (ft):	39.1	na
Screen		
Bottom elevation:	303.0	na
Diameter:	16-in. SS	2-in. PVC
Length, lower (ft):	40	3
Slot size, lower:	0.055-in.	na
Length, upper (ft):	10	-
Slot size, upper:	0.020-in.	-
Measuring Point Elevation:	na	na
Nonpumping Water Level		
Depth below temp. MP (ft):	24.20	-
Height of temp. MP (ft):	6.05	-
Depth below perm. MP (ft):	18.15	28.23
Elevation:	-	-
Date of Step Test:	10/28/93	-
Water Sample		
Time:	1:25 pm	-
Temperature:	58.3° F	-
Laboratory No.:	227202	-
Distance and Direction to Piez. from PW:		12.2 ft South
Time PW Off Before Step Test:		Not recorded

Notes: SWS 8-in. dia. orifice tube w/plate No. 4. Using Omnidata w/transmitter No. 16(15 psi) and No. 4 (6 psi); using sand tank

SWS Crew: E. Sanderson, R. Olson

WATER-LEVEL MEASUREMENTS
I-70 Well No. 11A
Condition-Assessment Step Test

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
10/28/93						
11:05 am	0		28.23			Piez measured depth to water
11:06 am	0	24.20				PW measured depth to water
11:16am	0					
11:17am	0					
11:18am	0					
11:19 am	0		28.23			Piez measured depth to water
11:20 am	0		28.26			
11:22 am	0		28.26			
11:24 am	0		28.25			
11:26 am	0		28.25			
11:28 am	0		28.24			
11:30 am	0		28.24			
11:32 am	0		37.64			
11:34 am	0		28.24			
11:36 am	0		28.23			Transmitter 4 (6 psi) in piez
11:38 am	0		28.23			
11:39 am	0	24.20	28.23			Transmitter 16(15 psi) in PW
11:40 am	0	24.20	28.23			
11:42 am	0	24.20	28.23			PW measured depth to water
11:44 am	0	24.20	28.23			
11:46 am	0	24.19	28.23			
11:48 am	0	24.19	28.23			
11:50 am	0	24.18	28.23			
11:52 am	0	24.18	28.23			
11:54 am	0	24.18	28.23			
11:55 am	0	24.18	28.23			
11:56 am	0	24.18	28.23			
11:57 am	0	24.18	28.23			
11:58 am	0	24.18	28.22			
11:59 am	0	24.17	28.21			
12:00 pm	0	24.17	28.22			Pump On
12:01 pm	1	36.64	30.67	2.00	474	Step 1; Max Q
12:02 pm	2	35.88	30.66	1.80	450	
12:03 pm	3	35.91	30.69	1.81	451	
12:04 pm	4	35.93	30.71			
12:05 pm	5	35.95	30.72			
12:06 pm	6	35.97	30.74			
12:07 pm	7	35.98	30.75			

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 11A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
12:08 pm	8	36.00	30.77			
12:09 pm	9	36.01	30.78			
12:10 pm	10	36.03	30.80			
12:11 pm	11	36.04	30.81	1.80	450	
12:12 pm	12	36.05	30.82			
12:13 pm	13	36.05	30.83			
12:14 pm	14	36.06	30.84			
12:15 pm	15	36.07	30.85			
12:16 pm	16	36.07	30.85	1.80	450	
12:17 pm	17	36.08	30.85			
12:18 pm	18	36.08	30.86			
12:19 pm	19	36.10	30.87			
12:20 pm	20	36.11	30.88			
12:21 pm	21	36.11	30.89			
12:22 pm	22	36.12	30.90	1.80	450	
12:23 pm	23	36.13	30.90			
12:24 pm	24	36.13	30.90			
12:25 pm	25	36.13	30.90			
12:26 pm	26	36.12	30.89			
12:27 pm	27	36.13	30.89			
12:28 pm	28	36.14	30.90			
12:29 pm	29	36.15	30.90			
12:30 pm	30	36.15	30.90	1.80	450	Decrease rate
12:31 pm	1	34.84	30.66	1.41	399	Step 2
12:32 pm	2	34.84	30.65			
12:33 pm	3	34.84	30.66			
12:34 pm	4	34.84	30.65			
12:35 pm	5	34.83	30.65	1.41	399	
12:36 pm	6	34.84	30.66			
12:37 pm	7	34.85	30.66			
12:38 pm	8	34.84	30.65			
12:39 pm	9	34.85	30.65			
12:40 pm	10	34.85	30.66	1.42	400	
12:41 pm	11	34.85	30.66			
12:42 pm	12	34.86	30.66			
12:43 pm	13	34.86	30.66			
12:44 pm	14	34.86	30.66			
12:45 pm	15	34.86	30.67			
12:46 pm	16	34.87	30.67			
12:47 pm	17	34.87	30.68			

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 11A

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
12:48 pm	18	34.87	30.68			
12:49 pm	19	34.88	30.69			
12:50 pm	20	34.87	30.69			
12:51 pm	21	34.87	30.68			
12:52 pm	22	34.88	30.68			
12:53 pm	23	34.89	30.68			
12:54 pm	24	34.88	30.68			
12:55 pm	25	34.88	30.69	1.42	400	
12:56 pm	26	34.88	30.68			
12:57 pm	27	34.87	30.68			
12:58 pm	28	34.88	30.67			
12:59 pm	29	34.89	30.68			
01:00 pm	30	34.88	30.69	1.41	399	Decrease rate
01:01 pm	1	33.55	30.43	1.08	350	Step 3
01:02 pm	2	33.55	30.42			
01:03 pm	3	33.54	30.42			
01:04 pm	4	33.54	30.42			
01:05 pm	5	33.54	30.42			
01:06 pm	6	33.54	30.41			
01:07 pm	7	33.54	30.42			
01:08 pm	8	33.54	30.42	1.08	350	
01:09 pm	9	33.54	30.42			
01:10 pm	10	33.55	30.42			
01:11 pm	11	33.55	30.42			
01:12 pm	12	33.55	30.42			
01:13 pm	13	33.54	30.42			
01:14 pm	14	33.56	30.42			
01:15 pm	15	33.55	30.42			
01:16 pm	16	33.54	30.41			
01:17 pm	17	33.55	30.42			
01:18 pm	18	33.55	30.42			
01:19 pm	19	33.55	30.42			
01:20 pm	20	33.56	30.42	1.08	350	
01:21 pm	21	33.56	30.42			
01:22 pm	22	33.56	30.42			
01:23 pm	23	33.55	30.41			
01:24 pm	24	33.55	30.41			
01:25 pm	25	33.55	30.41			Water sample collected;
01:26 pm	26	33.56	30.41	1.08	350	T=58.3°F
01:27 pm	27	33.56	30.42			

WATER-LEVEL MEASUREMENTS (Concluded)
I-70 Well No. HA

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
01:28 pm	28	33.56	30.42			
01:29 pm	29	33.56	30.42			
01:30 pm	30	33.56	30.41			Decrease rate
01:31 pm	1	32.21	30.15	0.78	298	Step 4
01:32 pm	2	32.18	30.14			
01:33 pm	3	32.17	30.14			
01:34 pm	4	32.17	30.13			
01:35 pm	5	32.17	30.13			
01:36 pm	6	32.17	30.13			
01:37 pm	7	32.17	30.13	0.78	298	BART samples collected
01:38 pm	8	32.16	30.13			
01:39 pm	9	32.17	30.13			
01:40 pm	10	32.17	30.13			
01:41 pm	11	32.16	30.12			
01:42 pm	12	32.17	30.13			
01:43 pm	13	32.16	30.12			
01:44 pm	14	32.16	30.12			
01:45 pm	15	32.16	30.11			
01:46 pm	16	32.16	30.12	0.78	298	
01:47 pm	17	32.16	30.12			
01:48 pm	18	32.15	30.12			
01:49 pm	19	32.15	30.12			
01:50 pm	20	32.16	30.13			
01:51 pm	21	32.16	30.13	0.77	296	Increase rate
01:52 pm	22	32.24	30.13	0.78	298	
01:53 pm	23	32.20	30.13			
01:54 pm	24	32.22	30.13			
01:55 pm	25	32.21	30.12			
01:56 pm	26	32.20	30.12	0.78	298	
01:57 pm	27	32.20	30.12			
01:58 pm	28	32.22	30.13			
01:59 pm	29	32.22	30.14			
02:00 pm	30	32.22	30.14	0.78	298	End of Test

DEWATERING WELL DATA

	Well No. I70 Wl5	Piezometer No. I70 P15
Date Drilled:	1/28/92	1992
Casing		
Top elevation:	384.0	na
Diameter:	16-in. SS	2-in. PVC
Length (ft):	31.5	na
Screen		
Bottom elevation:	302.5	na
Diameter:	16-in. SS	2-in. PVC
Length, lower (ft):	40	3
Slot size, lower:	0.055-in.	na
Length, upper (ft):	10	-
Slot size, upper:	0.020-in.	-
Measuring Point Elevation:	na	na
Nonpumping Water Level		
Depth below temp. MP (ft):	12.96	-
Height of temp. MP (ft):	5.47	-
Depth below perm. MP (ft):	7.49	13.07
Elevation:	-	-
Date of Step Test:	10/15/93	-
Water Sample		
Time:	12:14 pm	-
Temperature:	57.7° F	-
Laboratory No.:	227163	-
Distance and Direction to Piez. from PW:		5.0 ft East
Time PW Off Before Step Test:		Not recorded

Notes: SWS 8-in. dia. orifice tube w/plate No. 4, manual data collection, only very slight trace of angular sand or gravel pack remained in sand tank following the test (no sample collected).

SWS Crew: E. Sanderson, R. Olson

WATER-LEVEL MEASUREMENTS
I-70 Well No. 15
Condition-Assessment Step Test

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
10/15/93						
09:47 am	0	12.96	13.07			Solinst Dropline
09:57 am	0	12.96	13.07			Water level trend
10:00 am	0					Pump On
10:01 am	1	25.78		2.65	545	Step 1; Max rate
	2	24.99				
	3	24.69	17.36	2.22	499	
	4	24.72	17.37			
	5	24.75				
	6	24.76	17.40			
	8	24.80	17.42			
10:10 am	10	24.82	17.46			
	12	24.84	17.46	2.21	498	Increase rate
	13			2.22	499	
	14	24.90	17.50			
	16	24.92	17.52			
	18	24.93	17.53			
10:20 am	20	24.95	17.53	2.22	499	
	22	24.98	17.54			
	24	24.97	17.55			
	26	24.99	17.56			
	27	24.99	17.57	2.22	499	
	28	24.99	17.57			
	29	24.99	17.57			
10:30 am	30	25.00				Reduce rate
10:31 am	1	23.86	17.21	1.81	451	Step 2
	2	23.88				
	3	23.88	17.21			
	4	23.89	17.21	1.81	451	
	5	23.89	17.21			
	6	23.90	17.22			
	8	23.91	17.23			
10:40 am	10	23.93	17.23			
	12	23.92	17.23			
	14	23.94	17.24	1.82	453	
	16	23.95	17.25			
	18	23.97	17.25	1.82	453	
10:50 am	20	23.97	17.26			
	22	23.98	17.26			

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 15

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	24	23.99	17.27	1.82	453	
	26	23.99	17.27			
	27	24.00	17.28			
	28	24.00	17.28			
	29	24.00	17.28			
11:00 am	30	24.01				Reduce rate
11:01 am	1	22.73	16.86	1.42	400	Step 3
	2	22.75	16.87			
	3	22.77	16.87			
	4	22.78	16.87			
	5	22.78	16.87	1.43	402	
	6	22.78	16.87			
	8	22.79	16.87			
11:10 am	10	22.79	16.87			
	12	22.81	16.88			
	14	22.81	16.88	1.43	402	Reduce rate slightly
	16	22.80	16.88	1.43	402	
	18	22.82	16.89			
11:20 am	20	22.83	16.90			
	22	22.84	16.90			
	24	22.84	16.90			
	26	22.85	16.90	1.44	403	
	27	22.85	16.90			
	28	22.86	16.91			
	29	22.86	16.91	1.44	403	
11:30 am	30	22.86				Reduce rate
11:31 am	1	21.74				Step 4
	2	21.53	16.46	1.08	350	
	3	21.56	16.48	1.08	350	
	4	21.56	16.47			
	5	21.56	16.47			
	6	21.58	16.48			
	8	21.57	16.48			
11:40 am	10	21.58	16.48	1.09	352	
	12	21.58	16.49			
	14	21.60	16.49	1.09	352	
	16	21.60	16.49			
	18	21.60	16.49			
11:50 am	20	21.61	16.49			
	22	21.60	16.49	1.09	352	

WATER-LEVEL MEASUREMENTS (Concluded)
I-70 Well No. 15

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	24	21.60	16.49			
	26	21.61	16.49			
	27	21.61	16.49			
	28	21.62	16.50	1.09	352	
	29	21.62	16.50			
12:00 pm	30	21.62				Reduce rate
12:01 pm	1	20.29				Step 5
	2	20.36	16.05	0.78	298	
	3	20.35	16.05	0.78	298	
	4	20.35	16.05			
	5	20.35	16.05			
	6	20.35	16.05	0.78	298	
	8	20.36	16.05			
12:10 pm	10	20.35	16.05			
	12	20.35	16.04			
	14	20.35	16.05			Water sample collected;
	16	20.35	16.05			T=57.7°F
	18	20.35	16.05			BART samples collected
12:20 pm	20	20.35	16.05	0.78	298	
	22	20.35	16.05			
	24	20.36	16.05			
	25	20.36	16.05			
	26	20.36	16.05			
	27	20.36	16.05			
	28	20.36	16.05			
	29	20.36	16.05			
12:30 pm	30	20.37	16.05			End of Test

DEWATERESfG WELL DATA

	Well No. I64 Wl	Piezometer No. I64 Pl
Date Drilled:	3/31/75	1975
Casing		
Top elevation:	398.8	406.6
Diameter:	16-in. SS	2-in. PVC
Length (ft):	34.6	na
Screen		
Bottom elevation:	303.9	na
Diameter:	16-in. SS	2-in. PVC
Length (ft):	60	3
Slot size:	0.080-in.	na
Measuring Point Elevation:	399.7	406.6
Nonpumping Water Level		
Depth below temp. MP (ft):	29.06	-
Height of temp. MP (ft):	7.9	-
Depth below perm. MP (ft):	21.16	26.97
Elevation:	378.54	379.63
Date of Step Test:	9/24/91	-
Water Sample		
Time:	4:54 pm	-
Temperature:	60° F	-
Laboratory No.:	224847	-
Distance and Direction to Piez. from PW:		5.0 ft South
Time PW Off Before Step Test:		Not recorded

Notes: SWS 8-in. dia. orifice tube w/plate No. 4; 1000-gal portable tank; 50-ft 6-in. dia. flexible hose; McDAS w/15 psi transducer #5 and 6 psi transducer #1

SWS Crew: R. Olson, E. Sanderson

WATER-LEVEL MEASUREMENTS
I-64 Well No. 1
Condition-Assessment Step Test

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
9/24/91						
02:50 pm		29.06	26.97			SolinstDL
03:10 pm	0.0	29.06	26.97			McDAS started
	1.2	29.05	27.00			
	2.1	29.05	27.01			
	3.0	29.06	27.02			
	3.9	29.05	27.01			
	5.1	29.05	27.01			
	6.0	29.05	27.02			
	6.9	29.05	27.02			
	7.2	29.05	27.02			
	8.1	29.05	27.02			
	9.0	29.05	27.02			
	9.6	29.05	27.02			
03:20 pm	0.0					Pump On
03:21 pm	1.0	33.22	27.03	3.5		Step 1
	2.0	33.11	27.03	3.22	600	
	3.0	33.14	27.03			
	4.1	33.17	27.04			
	5.0	33.19	27.05			
	6.0	33.21	27.04			
	8.0	33.23	27.04	3.22	600	
03:30 pm	10.0	33.26	27.05			
	12.0	33.28	27.04			
	14.1	33.30	27.04			
	16.2	33.31	27.05	3.20	600	Adjust rate
	17.0			3.22	600	
	18.1	33.32	27.04			
03:40 pm	20.3	33.34	27.05			
	22.3	33.35	27.05			
	23.8	33.36	27.05	3.22	600	
	26.1	33.37	27.05			
	27.4	33.37	27.05			
	28.0	33.38	27.06	3.22	600	
	28.6	33.38	27.05			
	29.3	33.38	27.05			
03:50 pm	30.0					Reduce rate
03:51 pm	1.0	33.05	27.06	2.70	550	Step 2
	2.0	33.05	27.06			

WATER-LEVEL MEASUREMENTS (Continued)
I-64 Well No. 1

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	3.0	33.05	27.07			
	4.0	33.05	27.07			
	4.1	33.04	27.07			
	5.0	33.05	27.07			
	6.0	33.06	27.07			
	7.1	33.05	27.07			
	8.1	33.05	27.07			
	9.1	33.05	27.07			
04:00 pm	10.0	33.05	27.07			
	12.0	33.06	27.07	2.70	550	
	14.0	33.06	27.07			
	16.1	33.06	27.08			
	18.0	33.07	27.08	2.70	550	
04:10 pm	20.2	33.07	27.09			
	22.1	33.07	27.09			
	24.2	33.08	27.08			
	26.0	33.08	27.09			
	27.2	33.08	27.09	2.70	550	
	27.8	33.07	27.09			
	29.1	33.08	27.10			
	29.8	33.08	27.10			
04:20 pm	30.0					Reduce rate
04:21 pm	1.0	32.75	27.10			Step 3
	2.0	32.74	27.10	2.22	500	
	3.0	32.73	27.10			
	4.1	32.73	27.09			
	5.0	32.72	27.10			
	6.0	32.74	27.09	2.22	500	
	8.1	32.73	27.10			
04:30 pm	10.0	32.73	27.10			
	12.0	32.73	27.10	2.22	500	
	14.0	32.74	27.10			
	16.1	32.72	27.10			
	18.0	32.74	27.11	2.22	500	
04:40 pm	20.2	32.74	27.11			
	22.2	32.74	27.11			
	23.2	32.74	27.12	2.22	500	
	24.3	32.73	27.11			
	24.9	32.74	27.12			
	25.4	32.73	27.11			

WATER-LEVEL MEASUREMENTS (Continued)
I-64 Well No. 1

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	26.0	32.74	27.11			
	27.2	32.74	27.11			
	27.9	32.74	27.11			
	28.5	32.73	27.11			
	29.2	32.74	27.11	2.22	500	
04:50 pm	30.0					Reduce rate
04:51 pm	1.0	32.42	27.12	1.81	450	Step 4
	2.0	32.41	27.11			
	3.0	32.41	27.11			
	4.1	32.40	27.12			Water sample collected,
	5.0	32.39	27.12			T=60°F
	6.0	32.38	27.13	1.78		Adjust rate
	7.1	32.41	27.13	1.81	450	
	8.1	32.39	27.13			
05:00 pm	10.0	32.38	27.14			
	12.0	32.37	27.14			
	14.0	32.38	27.13			
	15.0	32.37	27.13	1.77		Adjust rate
						BART samples collected
	17.0			1.81	450	
	16.1	32.38	27.13			
	18.0	32.40	27.13			
05:10 pm	20.2	32.41	27.13			
	22.2	32.41	27.13			
	24.3	32.41	27.13			
	26.0	32.41	27.13	1.81	450	
	27.3	32.41	27.14			
	27.9	32.41	27.14			
	29.2	32.42	27.14			
05:20 pm	30.0					Reduce rate
05:21 pm	1.0	32.07	27.14	1.42	400	Step 5
	2.0	32.06	27.14			
	3.0	32.06	27.14			
	4.1	32.06	27.14			
	5.0	32.06	27.14	1.42	400	
	6.0	32.06	27.14			
	8.1	32.07	27.15			
05:30 pm	10.0	32.06	27.15	1.42	400	
	12.0	32.07	27.15			
	14.1	32.06	27.15			

WATER-LEVEL MEASUREMENTS (Concluded)
I-64 Well No. 1

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	16.2	32.06	27.15	1.42	400	
	18.1	32.06	27.16			
05:40 pm	20.3	32.05	27.15			
	22.2	32.06	27.15			
	24.4	32.06	27.15			
	26.1	32.06	27.16	1.42	400	
	27.3	32.07	27.14			
	28.0	32.06	27.14			
	29.3	32.07	27.14	1.42	400	
05:50 pm	30.0	32.07	27.14			End of test

DEWATERING WELL DATA

	Well No. 25th St.	Wl	Piezometer No. 25th St. Pl
Date Drilled:	1975		1975
Casing			
Top elevation:	398.85		407.3
Diameter:	16-in. SS		2-in. PVC
Length (ft):	33.55		na
Screen			
Bottom elevation:	305.30		na
Diameter:	16-in. SS		2-in. PVC
Length (ft):	60		3
Slot size:	0.080-in.		na
Measuring Point Elevation:	399.7		407.3
Nonpumping Water Level			
Depth below temp. MP (ft):	12.23		-
Height of temp. MP (ft):	7.7		-
Depth below perm. MP (ft):	4.53		11.79
Elevation:	395.17		395.51
Date of Step Test:	9/4/91		-
Water Sample			
Time:	4:38 pm		-
Temperature:	61° F		-
Laboratory No.:	224802		-
Distance and Direction to Piez. from PW:			3.8 ft Southeast
Time PW Off Before Step Test:			Not recorded

Notes: SWS 8-in. dia. orifice tube w/plate No. 4.
Water-level data collected w/solinst dropline and steel tape.
Settling tank not used.

SWS Crew: R. Olson, E. Sanderson

WATER-LEVEL MEASUREMENTS
25th Street Well No. 1
Condition-Assessment Step Test

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
09/04/91						
03:25 pm	0					Pump Off
03:40 pm	0	12.25	11.74			Solinst dropline readings
03:50 pm	0	12.23	11.75			Water level trend
03:54 pm	0	12.25				
03:56 pm	0		11.79			Piez steel tape rdg
03:58 pm	0	12.23				
04:00 pm	0					Pump On
04:03 pm	3			0.49	235	A little higher Q at first
04:05 pm	5	19.62				Will conduct only a draw-
04:07 pm	7		11.80			down test due to low rate.
04:08 pm	8			0.49	235	
04:10 pm	10	19.60				
04:11 pm	11		11.84			
04:16 pm	16			0.48	235	
04:17 pm	17	19.60				
04:18 pm	18		11.86			
04:25 pm	25	19.66		0.48	235	
04:26 pm	26		11.92			
04:30 pm	30	19.67				
04:31 pm	31		11.94			
04:35 pm	35					BART samples collected
04:38 pm	38					Water sample collected, T=61°F
						End of drawdown test

DEWATERING WELL DATA

	Well No. 25th St. W4	Piezometer No. 25th St. P4
Date Drilled:	7/22/75	1975
Casing		
Top elevation:	391.46	401.5
Diameter:	16-in. SS	2-in. PVC
Length (ft):	27.85	na
Screen		
Bottom elevation:	301.26	na
Diameter:	16-in. SS	2-in. PVC
Length (ft):	60	3
Slot size:	0.080-in.	na
Measuring Point Elevation:	392.4	401.5
Nonpumping Water Level		
Depth below temp. MP (ft):	10.30	-
Height of temp. MP (ft):	9.3	-
Depth below perm. MP (ft):	1.0	Plugged
Elevation:	391.4	-
Date of Step Test:	11/19/91	-
Water Sample		
Time:	2:15 pm	-
Temperature:	58° F	-
Laboratory No.:	225122	-
Distance and Direction to Piez. from PW:		4.5 ft South
Time PW Off Before Step Test:		Not recorded

Notes: SWS 8-in. dia. orifice tube w/plate No. 4; McDAS w/transducers; settling tank used; sample of fine sand collected after step test

SWS Crew: E. Sanderson, D. Jurss

WATER-LEVEL MEASUREMENTS
25th St. Well No. 4
Condition-Assessment Step Test

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
11/19/91						
11:00 am	0.0	10.30				Plugged Solinst dropline
11:37 am	0.0	10.30				McDAS started
	1.0	10.30				
	2.0	10.30				
	3.0	10.30				
	4.0	10.29				
	5.1	10.30				
	6.1	10.29				
	7.1	10.29				
	8.1	10.29				
	9.1	10.29				
	10.1	10.29				
	11.1	10.29				
	12.1	10.28				
11:50 am	13.1	10.28				
	14.1	10.28				
	15.1	10.27				
	16.1	10.27				
	17.1	10.27				
	18.1	10.27				
	19.1	10.27				
	20.1	10.27				
	21.1	10.27				
	22.1	10.26				
12:00 pm	23.1	10.27				
	24.1	10.27				
	25.1	10.26				
	26.1	10.26				
	27.1	10.26				
	28.1	10.26				
	29.1	10.26				
	30.2	10.26				
	31.2	10.26				
12:10 pm	32.8	10.26				Pump On; Step 1
12:11 pm	1.0	17.88		6.4		Maximum rate
	2.0	17.86				Adjusting rate
	3.0	17.73		5.80	800	
	4.0	17.75				

WATER-LEVEL MEASUREMENTS (Continued)
25th St. Well No. 4

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	5.0	17.77				
	6.1	17.78				
	8.1	17.82				
12:20 pm	10.1	17.84		5.80	800	Reddish water at first
	12.1	17.86				
	14.1	17.86				
	16.1	17.88				
	17.0			5.80	800	
	18.1	17.89				
12:30 pm	20.1	17.90				
	22.1	17.91				
	23.0			5.80	800	
	24.1	17.92				
	26.1	17.92				
	27.0			5.80	800	
	28.1	17.93				
	29.1	17.92				
12:40 pm	29.7	17.93				Reduce rate
12:41 pm	1.0	17.49				Step 2
	2.0	17.48		5.08	750	
	3.0	17.48				
	4.0	17.49		5.08	750	
	4.8	17.48				
	5.0	17.47				
	5.3	17.48				
	6.1	17.48				
	7.1	17.48		5.08	750	
	7.3	17.49				
	8.1	17.50				
	8.3	17.50				
	9.1	17.50				
	9.9	17.50				
12:50 pm	10.1	17.49				
	10.3	17.50				
	11.9	17.50				
	12.1	17.49		5.08	750	
	12.3	17.49				
	14.1	17.50				
	16.1	17.51				
	17.0			5.08	750	

WATER-LEVEL MEASUREMENTS (Continued)
25th St. Well No. 4

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	18.1	17.51				
	19.9	17.52				
01:00 pm	20.1	17.52		5.08	750	
	20.3	17.51				
	22.1	17.52				
	22.3	17.52				
	24.1	17.52				
	25.0			5.08	750	
	26.1	17.53				
	28.1	17.53				
	28.9	17.53				
	29.1	17.54		5.08	750	
01:10 pm	29.8	17.53				Reduce rate
01:11 pm	1.0	17.08		4.41	700	Step 3
	2.0	17.07				
	2.8	17.08				
	3.0	17.09				
	3.2	17.08				
	4.0	17.09				
	4.2	17.09				
	5.1	17.08				
	5.9	17.08				
	6.1	17.07		4.41	700	
	6.3	17.08				
	8.1	17.08				
01:20 pm	10.1	17.08		4.41	700	
	12.1	17.09				
	14.1	17.09				
	15.0			4.41	700	
	15.9	17.09				
	16.1	17.08				
	18.1	17.09				
	19.9	17.09				
01:30 pm	20.1	17.10		4.41	700	
	22.1	17.10				
	24.1	17.10				
	26.1	17.10		4.41	700	
	28.1	17.10				
	29.1	17.10		4.41	700	
01:40 pm	29.8	17.10				Reduce rate

WATER-LEVEL MEASUREMENTS (Continued)
25th St. Well No. 4

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	0.8	16.66				
01:41 pm	1.0	16.65				Step 4
	1.2	16.66				
	2.0	16.63		3.80	650	
	3.0	16.63				
	4.0	16.62		3.80	650	
	5.0	16.62				
	6.1	16.63				
	8.1	16.63		3.80	650	
01:50 pm	10.1	16.63				
	12.1	16.63				
	14.1	16.64		3.80	650	
	15.9	16.64				
	16.1	16.63				
	16.3	16.64				
	18.1	16.64				
	19.9	16.63				
02:00 pm	20.1	16.65		3.80	650	
	20.3	16.64				
	21.9	16.64				
	22.1	16.63				
	22.3	16.64				
	24.1	16.64				
	25.0			3.80	650	
	26.1	16.64				
	28.1	16.65				
	28.3	16.64				
	29.1	16.64		3.80	650	
02:10 pm	29.7	16.65				Reduce rate
02:11pm	1.0	16.18		3.22	600	Step 5
	2.0	16.18				
	3.0	16.19				
	4.0	16.18				
	5.0	16.18		3.22	600	Water sample collected,
	6.1	16.18				T=58°F
	7.0			3.22	600	
	8.1	16.18				
02:20 pm	10.1	16.19				
	12.1	16.19				
	14.1	16.20		3.22	600	

WATER-LEVEL MEASUREMENTS (Concluded)
25th St. Well No. 4

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	16.1	16.20				BART samples collected
	18.1	16.21				
02:30 pm	20.1	16.21				
	22.1	16.22		3.22	600	
	24.1	16.21				
	26.1	16.22				
	28.1	16.22				
	29.1	16.22		3.22	600	
02:40 pm	30.1	16.22				End of test

DEWATERING WELL DATA

	Well No. 25th St. W9	Piezometer No. 25th St. P9
Date Drilled:	3/26/74	1974
Casing		
Top elevation:	408.5	414.7
Diameter:	16-in. SS	2-in. PVC
Length (ft):	47	na
Screen		
Bottom elevation:	301.41	na
Diameter:	16-in. SS	2-in. PVC
Length (ft):	60	3
Slot size:	0.080-in.	na
Measuring Point Elevation:	409.4	414.7
Nonpumping Water Level		
Depth below temp. MP (ft):	20.04	-
Height of temp. MP (ft):	5.1	-
Depth below perm. MP (ft):	14.94	20.14
Elevation:	394.46	394.56
Date of Step Test:	9/18/91	-
Water Sample		
Time:	12:55 pm	-
Temperature:	59° F	-
Laboratory No.:	224803	-
Distance and Direction to Piez. from PW:		5 ft North
Time PW Off Before Step Test:		na

Notes: SWS 8-in. dia. orifice tube w/plate No. 4; 50-ft of 6-in. hose; 1000-gal settling tank
No sand in tank at end of test.
About 1 -2 cups of encrustation particles (fine and coarse) present in tank.

SWS Crew: E. Sanderson, S. Wilson

WATER-LEVEL MEASUREMENTS
25th Street Well No. 9
Condition-Assessment Step Test

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
09/18/91						
09:15 am	0.0					Pump on for opn check
09:17 am	0.0					Pump off
09:35 am	0.0	20.04				Solinst Dropline
09:40 am	0.0		20.14			Solinst Dropline
10:11 am	0.0	20.06	20.18			McDAS started
	1.0	20.05	20.18			Water Level Trend
	2.0	20.05	20.17			
	3.0	20.05	20.16			
10:15 am	4.0	20.05	20.16			
	5.0	20.05	20.15			
	6.0	20.05	20.15			
	7.0	20.05	20.15			
	8.0	20.04	20.14			
	9.0	20.04	20.14			
	9.8	20.04	20.14			
10:21 am	0.0					McDAS problem; data lost
10:40 am	0.0					Pump On
10:41 am	1.0	24.61	23.03	3.00	580	Step 1; Max rate
	2.0	24.65	23.13	2.70	550	Adjust rate
	3.0	24.50	23.01			Water very red
	4.0	24.50	23.02			
	5.0	24.52	23.05			
	6.0	24.53	23.06			
	8.0	24.57	23.09	2.70	550	
10:50 am	10.0	24.57	23.11			
	11.0	24.58	23.11	2.70	550	
	12.0	24.60	23.13			
	14.0	24.62	23.15			
	16.0	24.62	23.16	2.70	550	Water still red
	18.0	24.63	23.17			
11:00 am	20.0	24.63	23.18			
	22.0	24.66	23.19	2.67		Adjust rate
	23.0	24.68	23.21	2.70	550	
	24.0	24.69	23.22			
	25.0	24.68	23.22			
	26.0	24.69	23.23			
	27.0	24.69	23.23			
	28.0	24.71	23.23			

WATER-LEVEL MEASUREMENTS (Continued)
25th Street Well No. 9

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	29.0	24.71	23.23			
	29.4	24.66	23.23			
11:10 am	30.0					Reduce rate
11:11 am	1.0	24.30	22.98	2.22	500	Step 2
	2.0	24.30	22.97			
	3.0	24.28	22.97			
	4.0	24.28	22.96			
	5.0	24.27	22.96	2.20		Adjust rate
	6.0	24.32	22.99	2.22	500	
	8.0	24.33	22.99			
11:20 am	10.0	24.31	23.00	2.22	500	Water still red in color,
	12.0	24.28	22.99			but less so
	14.0	24.32	22.99			
	16.0	24.30	22.99	2.22	500	
	17.8	24.31	23.00			
	18.0	24.34	22.99			
	18.2	24.31	22.99			
11:30 am	20.0	24.33	23.00	2.22	500	Water cloudy
	22.0	24.32	23.01			
	24.0	24.32	23.01			
	25.0	24.33	23.00			
	26.0	24.32	23.01			
	27.0	24.31	23.01			
	28.0	24.30	23.00	2.22	500	
	29.0	24.31	23.00			
	29.8	24.32	23.01			
11:40 am	30.0					Reduce rate
11:41 am	1.0	23.94	22.77	1.81	450	Step 3
	2.0	23.93	22.77			
	3.0	23.93	22.77			
	4.0	23.95	22.77			
	5.0	23.94	22.76			
	6.0	23.91	22.76	1.80		Adjust rate
	7.0	23.95	22.78	1.82	450	
	8.0	23.96	22.76			
11:50 am	10.0	23.98	22.76			
	12.0	23.92	22.77	1.81	450	Water clear
	14.0	23.94	22.77			
	16.0	23.96	22.76			
	18.0	23.93	22.76	1.81	450	

WATER-LEVEL MEASUREMENTS (Continued)
25th Street Well No. 9

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
12:00 pm	20.0	23.94	22.76			
	22.0	23.94	22.77	1.81	450	
	24.0	23.93	22.75			
	25.0	23.95	22.76			
	26.0	23.94	22.76			
	27.0	23.94	22.76			
	28.0	23.95	22.77	1.81	450	
	29.0	23.95	22.77			
	29.8	23.94	22.78			
12:10 pm	30.0					Reduce rate
12:11pm	1.0	23.56	22.53	1.42	400	Step4
	2.0	23.55	22.53			
	3.0	23.54	22.53	1.41		Adjust rate
	4.0	23.54	22.53			
	5.0	23.56	22.53			
	6.0	23.53	22.53	1.42	400	
	8.0	23.54	22.52			
12:20 pm	10.0	23.55	22.50	1.42	400	
	12.0	23.53	22.49			
	14.0	23.54	22.50			
	16.0	23.54	22.49			
	18.0	23.53	22.48			
12:30 pm	20.0	23.54	22.48	1.42	400	
	22.0	23.52	22.48			
	24.0	23.53	22.49			
	25.0	23.52	22.49	1.42	400	
	26.0	23.51	22.48			
	27.0	23.53	22.48			
	28.0	23.52	22.48			
	29.0	23.53	22.48			
	29.6	23.51	22.47			
12:40 pm	30.0					Reduce rate
12:41 pm	1.0	23.16	22.24	1.09	350	Step 5
	2.0	23.13	22.24			
	3.0	23.12	22.24			
	4.0	23.14	22.23			
	5.0	23.12	22.24			
	6.0	23.12	22.24	1.07		Adjust rate
	7.0	23.15	22.25	1.09	350	
	8.0	23.17	22.25			

WATER-LEVEL MEASUREMENTS (Concluded)
25th Street Well No. 9

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
12:50 pm	10.0	23.13	22.24	1.09	350	
	12.0	23.15	22.25			
	14.0	23.12	22.25			
	15.0	23.14	22.24			Water sample collected,
	16.0	23.13	22.25			T=59°F
	17.0	23.15	22.26	1.09	350	
	18.0	23.15	22.26			
01:00 pm	20.0	23.14	22.25			BART samples collected
	22.0	23.14	22.25	1.09	350	
	24.0	23.15	22.25			
	25.0	23.14	22.24			
	26.0	23.15	22.23			
	27.0	23.14	22.23			
	28.0	23.12	22.23			
	29.0	23.14	22.23	1.09	350	
	29.8	23.15	22.22			
01:10 pm	30.0					End of Test

DEWATERING WELL DATA

	Well No. Venice W2	Piezometer No. Venice P2
Date Drilled:	1982	1982
Casing		
Top elevation:	405.3	410.3
Diameter:	16-in. SS	2-in. PVC
Length (ft):	28.9	na
Screen		
Bottom elevation:	325.5	na
Diameter:	16-in. SS	2-in. PVC
Length (ft):	50.9	3
Slot size:	0.080-in.	na
Measuring Point Elevation:	405.55	410.30
Nonpumping Water Level		
Depth below temp. MP (ft):	16.96	-
Height of temp. MP (ft):	5.4	-
Depth below perm. MP (ft):	11.56	16.47
Elevation:	393.99	393.83
Date of Step Test:	10/2/91	-
Water Sample		
Time:	2:51 pm	-
Temperature:	59.5° F	-
Laboratory No.:	224908	-
Distance and Direction to Piez. from PW:		6.1 ft West
Time PW Off Before Step Test:		Not recorded

Notes: SWS 8-in. dia. orifice tube w/plate No. 4; 1000-gal portable settling tank;50-ft 6-in. dia. flexible hose; McDAS w/15 psi transducer #5 and 6 psi transducer #1

SWS Crew: E. Sanderson, R. Olson

WATER-LEVEL MEASUREMENTS
Venice Well No. 2
Condition-Assessment Step Test

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
10/2/91						
10:40 am	0.0	17.22				SolinstDL
10:53 am	0.0	17.04				Diff location
10:53 am	0.0		16.47			
						McDAS down; low voltage
11:39 am	0.0	16.96	16.47			DL
11:42 am	0.0	16.97	16.46			McDAS started
	1.2	16.96	16.45			WL Trend
	2.1	16.97	16.45			
	3.0	16.97	16.45			
	3.9	16.96	16.45			
	5.1	16.97	16.45			
	6.0	16.95	16.43			
	6.9	16.96	16.42			
11:50 am	8.1	16.96	16.43			
	9.0	16.95	16.43			
	9.9	16.94	16.44			
	11.1	16.95	16.44			
	12.0	16.97	16.46			
	12.9	16.98	16.46			
	14.1	16.97	16.44			
	15.0	16.97	16.43			
	15.9	16.96	16.42			
	17.1	16.96	16.44			
	17.7	16.95	16.43			
12:00 pm						Pump On
12:01pm	1.0	23.64	20.12	5.45		Step 1
	2.0	23.78	20.38	5.08	750	Water cloudy
	3.0	24.02	20.61			
	4.0	24.11	20.69			
	5.0	24.17	20.80			
	6.0	24.35	20.89			
	7.0	24.37	20.99	5.05		Adjust rate
	7.5	24.41	21.04	5.08	750	
	7.9	24.45	21.06			
12:10pm	10.2	24.55	21.17			
	12.2	24.66	21.24	5.05		Adjust rate
	13.0	24.67	21.27	5.05		
	14.0	24.71	21.31	5.08	750	Water still cloudy

WATER-LEVEL MEASUREMENTS (Continued)
Venice Well No. 2

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	16.0	24.78	21.34			
	17.9	24.80	21.43			
	19.2	24.79	21.43	5.08	750	Water still cloudy
12:20 pm	20.1	24.84	21.46			
	22.1	24.85	21.51			
	24.2	24.91	21.54			
	25.9	24.90	21.56			
	27.1	24.94	21.56	5.07	750	
	28.4	24.95	21.60			
	29.0	24.98	21.61			
	29.7	25.03	21.63			
12:30 pm	30.0					Reduce rate
12:31 pm	1.0	24.59	21.42	4.41	700	Step 2
	2.0	24.58	21.41			
	3.0	24.51	21.39			
	4.0	24.53	21.40			
	5.0	24.60	21.42			
	6.0	24.54	21.41			
	8.1	24.60	21.44			
	8.9	24.62	21.44	4.40	700	Water clear
12:40 pm	10.0	24.62	21.44			
	12.0	24.62	21.44			
	13.1	24.60	21.40	4.41	700	
	14.0	24.63	21.41			
	16.1	24.67	21.54			
	18.0	24.62	21.55			
12:50 pm	20.2	24.66	21.55			
	21.1	24.67	21.55	4.40	700	
	22.1	24.62	21.54			
	24.2	24.64	21.54			
	25.9	24.69	21.57	4.40	700	
	27.2	24.71	21.57			
	27.8	24.75	21.55			
	28.5	24.76	21.57			
	29.1	24.78	21.60			
	29.8	24.77	21.61			
01:00 pm	30.0					Reduce rate
01:01 pm	1.0	24.36	21.40	3.80	650	Step 3
	2.0	24.36	21.39			
	3.0	24.36	21.39			

WATER-LEVEL MEASUREMENTS (Continued)
Venice Well No. 2

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	4.0	24.34	21.39			
	5.0	24.36	21.38			
	6.0	24.34	21.38			
	7.1	24.36	21.39	3.78		Adjust rate
	8.1	24.37	21.38	3.80	650	
01:10 pm	10.0	24.36	21.29			
	12.0	24.37	21.32			
	14.1	24.39	21.34			
	16.1	24.40	21.37			
	18.1	24.40	21.48	3.80	650	
01:20 pm	19.8	24.40	21.47			
	22.2	24.41	21.45			
	23.8	24.40	21.44			
	24.9	24.41	21.44	3.80	650	
	26.1	24.40	21.43			
	27.3	24.40	21.41			
	27.9	24.40	21.38			
	29.2	24.42	21.39			
01:30 pm	30.0			3.80	650	Reduce rate
01:31 pm	1.0	23.99	21.13			Step 4
	2.0	23.98	21.18	3.22	600	
	3.0	23.95	21.20	3.22	600	
	4.0	23.95	21.20			
	5.0	23.93	21.16			
	6.0	23.95	21.15			
	8.0	23.93	21.18	3.23	600	
01:40 pm	10.0	23.93	21.14			
	12.0	23.93	21.07			
	14.1	23.95	21.09			
	15.1	23.95	21.16	3.23	600	
	16.1	23.94	21.20			
	18.1	23.93	21.20			
01:50 pm	19.8	23.94	21.17	3.24		Adjust rate
	21.0					Water sample collected, T=59.5°F
	22.2	23.91	21.13	3.22	600	
	23.8	23.91	21.14			
	24.9	23.91	21.14	3.22	600	
	26.1	23.91	21.15			
	27.3	23.91	21.15			

WATER-LEVEL MEASUREMENTS (Concluded)
Venice Well No. 2

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	27.9	23.91	21.14			
	28.6	23.92	21.13			
	29.2	23.91	21.13	3.22	600	
02:00 pm	30.0					Reduce rate
02:01 pm	1.0	23.50	20.91	2.70	550	Step 5
	2.0	23.47	20.89			
	3.0	23.46	20.88			
	4.0	23.45	20.88			
	5.0	23.44	20.88			
	6.0	23.42	20.85	2.70	550	
	8.1	23.42	20.83			BART samples collected
	9.1	23.41	20.84	2.71	550	
02:10 pm	10.0	23.41	20.84			
	12.0	23.41	20.84			
	14.0	23.41	20.83			
	16.1	23.41	20.83			
	17.2	23.39	20.81	2.70	550	
	18.0	23.40	20.81			
02:20 pm	20.2	23.40	20.83			
	22.1	23.41	20.82			
	24.2	23.40	20.77			
	25.4	23.39	20.81	2.70	550	
	25.9	23.39	20.82			
	27.2	23.39	20.85			
	27.8	23.39	20.84			
	29.1	23.39	20.83			
	29.8	23.39	20.82			
02:30 pm	30.0			2.70	550	End of Test

DEWATERING WELL DATA

	Well No. Venice W3	Piezometer No. Venice P3B
Date Drilled:	1982	1990
Casing		
Top elevation:	402.3	408.4
Diameter:	16-in. SS	2-in. PVC
Length (ft):	26.7	na
Screen		
Bottom elevation:	324.7	na
Diameter:	16-in. SS	2-in. PVC
Length (ft):	50.9	3
Slot size:	na.	na
Measuring Point Elevation:	402.55	408.4
Nonpumping Water Level		
Depth below temp. MP (ft):	12.63	-
Height of temp. MP (ft):	6.0	-
Depth below perm. MP (ft):	6.63	11.31
Elevation:	395.92	397.09
Date of Step Test:	12/16/91	-
Water Sample		
Time:	3:35 pm	-
Temperature:	59° F	-
Laboratory No.:	225267	-
Distance and Direction to Piez. from PW:		7.1 ft East
Time PW Off Before Step Test:		Not recorded

Notes: SWS 8-in. dia. orifice tube w/plate No. 4; 1000-gal portable tank; 50-ft 6-in. dia. flexible hose; McDAS w/15 psi transducer #5 and 6 psi transducer #1; measurements from well pit cover

SWS Crew: R. Olson, E. Sanderson

WATER-LEVEL MEASUREMENTS
Venice Well No. 3
Condition-Assessment Step Test

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
12/16/91						
12:40 pm		12.63				Solinst dropline
12:45 pm			11.31			Solinst dropline
01:00 pm	0.0	12.66	11.33			McDAS started
	1.2	12.65	11.32			Water level trend
	2.1	12.65	11.32			
	3.0	12.65	11.32			
	4.2	12.65	11.32			
	5.1	12.65	11.32			
	6.0	12.65	11.32			
	8.1	12.64	11.31			
01:10 pm	10.2	12.64	11.33			
	12.0	12.64	11.32			
	14.1	12.64	11.32			
	16.2	12.64	11.31			
	18.0	12.64	11.32			
01:20 pm	20.1	12.64	11.32			
	21.9	12.64	11.32			
	22.2	12.63	11.31			
	24.0	12.63	11.31			
	26.1	12.63	11.31			
	28.2	12.63	11.31			
01:30 pm	29.4	12.63	11.31			Pump On
01:31pm	1.0	19.44	15.36	6.35		Step 1
	2.0	19.83	15.67	5.80	800	
	3.0	19.71	15.64			
	4.0	19.81	15.74	5.78		
	5.0			5.80	800	
	6.1	20.06	15.90			
	8.1	20.16	16.01			
	9.2	20.20	16.05	5.79	800	
01:40 pm	10.1	20.25	16.08			
	11.1	20.30	16.12			
	12.1	20.51	16.15			
	13.1	20.58	16.18	5.79	800	
	14.1	20.57	16.19			
	16.1	20.63	16.24			
	18.1	20.67	16.29			
01:50 pm	20.1	20.70	16.33	5.76		Adjust rate

WATER-LEVEL MEASUREMENTS (Continued)
Venice Well No. 3

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	21.1	20.70	16.35	5.80	800	
	22.1	20.75	16.36			
	24.1	20.77	16.39			
	26.0	20.82	16.39			
	27.0	20.81	16.43			
	27.9	20.85	16.45			
	28.0	20.90	16.45			
	28.1	20.85	16.45			
	28.9	20.85	16.46			
	29.0	20.88	16.46			
	29.1	20.85	16.46			
02:00 pm	29.7	20.86	16.46	5.79	800	Decrease rate
02:01 pm	1.0	20.47	16.24	5.08	750	Step 2
	2.0	20.45	16.24			
	3.0	20.43	16.25			
	4.0	20.46	16.25	5.08	750	
	5.1	20.47	16.25			
	6.1	20.46	16.26			
	8.1	20.48	16.27			
02:10 pm	10.1	20.49	16.29			
	12.1	20.51	16.31			
	14.1	20.53	16.32			
	16.0	20.40	16.33			
	18.0	20.40	16.33	5.08	750	
	20.0	20.37	16.34			
02:20 pm	20.1	20.38	16.35			
	22.0	20.39	16.36			
	22.1	20.38	16.36			
	24.0	20.40	16.37			
	25.9	20.40	16.37			
	26.0	20.42	16.39			
	27.0	20.41	16.39			
	28.0	20.43	16.40			
	29.0	20.43	16.40	5.08	750	
	29.6	20.44	16.41			
02:30 pm	29.7	20.43	16.41			Decrease rate
02:31 pm	1.0	20.01	16.18	4.41	700	Step 3
	2.0	19.99	16.16			
	3.0	19.99	16.15			
	4.0	19.98	16.15			

WATER-LEVEL MEASUREMENTS (Continued)
Venice Well No. 3

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	5.1	19.98	16.16			
	6.1	19.97	16.15			
	7.1	19.97	16.15	4.40	700	Adjust rate
	8.0	20.00	16.16	4.41	700	
02:40 pm	10.0	19.99	16.16			
	12.0	20.00	16.16			
	14.0	20.00	16.16			
	16.0	20.00	16.16			
	17.0	20.01	16.18	4.41	700	
	18.0	20.00	16.18			
02:50 pm	20.0	20.02	16.19			
	22.0	20.02	16.19			
	23.0			4.41	700	Phosphate(?) foam
	24.0	20.02	16.19			on top of tank
	26.0	20.03	16.20			
	27.0	20.03	16.21			
	28.0	20.04	16.21			
	29.0	20.03	16.22			
03:00 pm	29.7	20.04	16.21	4.41	700	Decrease rate
03:01 pm	1.0	19.62	15.97	3.80	650	Step 4
	2.0	19.61	15.95	3.81	650	
	3.0	19.59	15.94			
	4.0	19.60	15.95			
	5.1	19.61	15.97			
	6.1	19.60	15.96			
	8.0	19.57	15.92	3.80	650	Adjust rate
	8.1	19.59	15.94			
03:10 pm	10.0	19.57	15.94			
	10.1	19.58	15.94			
	12.0	19.58	15.94			
	14.0	19.58	15.95			
	16.0	19.58	15.95			
	17.0	19.58	15.95	3.80	650	
	18.0	19.58	15.95			
03:20 pm	20.0	19.58	15.95			
	22.0	19.59	15.94	3.80	650	
	24.0	19.59	15.95			
	26.0	19.59	15.96			
	27.1	19.59	15.96			
	28.0	19.59	15.96			

WATER-LEVEL MEASUREMENTS (Concluded)
Venice Well No. 3

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	29.1	19.59	15.96	3.80	650	Water cloudy
03:30 pm	29.8	19.60	15.96			Decrease rate
03:31 pm	1.0	19.17	15.72	3.22	600	Step 5
	2.0	19.15	15.70			
	3.0	19.16	15.70			
	4.0	19.14	15.70			
	5.0	19.14	15.70			Water sample collected,
	6.0	19.13	15.69			T=59°F
	8.0	19.13	15.69			BART samples collected
03:40 pm	10.0	19.14	15.68			
	12.0	19.13	15.68	3.22	600	
	14.0	19.13	15.68			
	16.0	19.13	15.69			
	18.0	19.14	15.69			
03:50 pm	20.0	19.13	15.69	3.22	600	
	22.0	19.13	15.69			
	24.0	19.14	15.70			
	25.0	19.13	15.69			
	26.0	19.13	15.69			
	27.0	19.13	15.69	3.22	600	
	28.0	19.13	15.69			
	29.0	19.13	15.69			
04:00 pm	30.0	19.13	15.69			End of step test

DEWATERING WELL DATA

	Well No. Venice W5	Piezometer No. Venice P5
Date Drilled:	1982	1982
Casing		
Top elevation:	400.8	407.21
Diameter:	16-in. SS	2-in. PVC
Length (ft):	21.3	na
Screen		
Bottom elevation:	328.6	na
Diameter:	16-in. SS	2-in. PVC
Length (ft):	50.9	3
Slot size:	0.080-in.	na
Measuring Point Elevation:	401.05	407.21
Nonpumping Water Level		
Depth below temp. MP (ft):	14.51	-
Height of temp. MP (ft):	6.4	-
Depth below perm. MP (ft):	8.11	14.18
Elevation:	392.94	393.03
Date of Step Test:	3/24/92	-
Water Sample		
Time:	2:58 pm	-
Temperature:	60° F	-
Laboratory No.:	225674	-
Distance and Direction to Piez. from PW:		4.3 ft Southwest
Time PW Off Before Step Test:		Not recorded

Notes: SWS 8-in. dia. orifice tube w/plate No. 4
McDAS w/ transducers #5 (W5) and #1 (P5)
No sand observed in portable tank

SWS Crew: R. Olson, E. Sanderson

WATER-LEVEL MEASUREMENTS
Venice Well No. 5
Condition-Assessment Step Test

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
03/24/92						
11:28 am	0.0		14.31			Solinst Dropline
11:30 am	0.0					Pump on for opn check
11:32 am	0.0					Pump off
12:09 pm	0.0		14.18			Solinst Dropline
12:10 pm	0.0	14.51				Solinst Dropline
12:22 pm	0.0	14.50	14.19			McDAS started
	0.9	14.49	14.20			
	2.1	14.49	14.21			
	3.0	14.49	14.21			
	3.9	14.48	14.22			
	5.1	14.49	14.22			
	6.0	14.48	14.23			
12:30 pm	8.1	14.48	14.24			
	9.9	14.48	14.25			
	12.0	14.48	14.26			
	14.1	14.47	14.27			
	15.9	14.47	14.27			
12:40 pm	18.0	14.47	14.28			
	20.1	14.47	14.28			
	21.9	14.46	14.28			
	24.0	14.46	14.29			
	26.1	14.46	14.30			
	27.0	14.46	14.30			
	27.9	14.46	14.30			
12:50 pm	0.0					Pump On
12:51 pm	1.0	20.02	14.44	5.3	760	Step 1; Max rate
	2.0	20.22	14.62	5.08	750	Reddish water
	3.0	20.42	14.80			Air relief valve leaking
	4.0	20.53	14.99			about 10 gpm
	5.0	20.61	15.16	5.06		
	6.0	20.68	15.33	5.08	750	
	8.0	20.80	15.66			
01:00 pm	10.0	20.89	15.96			
	12.0	20.93	16.23			
	13.0	20.97	16.35	5.08	750	
	14.0	21.00	16.48			
	16.0	21.05	16.71			
	18.0	21.09	16.93			

WATER-LEVEL MEASUREMENTS (Continued)
Venice Well No. 5

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
01:10pm	20.0	21.11	17.12			
	22.0	21.14	17.29			
	24.0	21.19	17.45	5.07	750	
	25.0	21.19	17.53			
	26.0	21.21	17.61			
	27.0	21.22	17.68			
	28.0	21.23	17.74			
	29.0	21.24	17.80	5.08	750	
	29.7	21.25	17.84			
01:20 pm	30.0					Reduce rate
01:21 pm	1.0	20.88	17.91			Step 2
	2.0	20.87	17.96	4.41	700	Piezometer water level
	3.0	20.86	18.00			still declining;
	4.0	20.87	18.05			Piezometer partially
	5.0	20.88	18.08			plugged
	6.0	20.87	18.12			
	7.0	20.89	18.16	4.44		Adjust rate
	8.0	20.90	18.20	4.41	700	
01:30 pm	10.0	20.89	18.26			
	12.0	20.92	18.32	4.41	700	
	14.0	20.92	18.38			
	16.0	20.93	18.43			
	18.0	20.94	18.48	4.41	700	
01:40 pm	20.0	20.96	18.53			
	22.0	20.97	18.58	4.41	700	
	24.0	20.97	18.61			
	25.0	20.98	18.63			
	26.0	20.99	18.65			
	27.0	21.00	18.67	4.42	700	
	28.0	21.00	18.70			
	29.0	21.00	18.72			
	29.7	21.00	18.73			
01:50 pm	30.0					Reduce rate
01:51pm	1.0	20.61	18.74	3.79	650	Step 3
	2.0	20.59	18.74			
	3.0	20.58	18.75	3.79	650	
	4.0	20.58	18.75			
	5.0	20.58	18.76			
	6.0	20.58	18.77			
	8.0	20.58	18.78			

WATER-LEVEL MEASUREMENTS (Continued)
Venice Well No. 5

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
02:00 pm	10.0	20.57	18.79	3.80	650	
	12.0	20.58	18.80			
	14.0	20.59	18.81			
	15.0	20.60	18.81	3.80	650	
	16.0	20.60	18.82			
	18.0	20.60	18.83			
02:10 pm	20.0	20.61	18.84			
	22.0	20.61	18.85			
	23.0	20.61	18.86	3.80	650	
	24.0	20.61	18.86			
	25.0	20.61	18.86			
	26.0	20.61	18.86			
	27.0	20.62	18.87			
	28.0	20.62	18.87			
	29.0	20.62	18.88	3.80	650	
	29.7	20.63	18.88			
02:20 pm	30.0					Reduce rate
	1.0	20.26	18.88	3.22	600	Step 4
	2.0	20.24	18.88	3.22	600	
	3.0	20.23	18.88			
	4.0	20.23	18.87			
	5.0	20.23	18.87			
	6.0	20.22	18.87			
	8.0	20.21	18.86	3.22	600	
02:30 pm	10.0	20.22	18.85			
	12.0	20.22	18.84			
	14.0	20.22	18.84			
	16.0	20.21	18.84	3.22	600	
	18.0	20.21	18.82			
02:40 pm	20.0	20.21	18.82			
	22.0	20.22	18.81	3.22	600	
	24.0	20.22	18.82			
	25.0	20.22	18.81			
	26.0	20.21	18.81			
	27.0	20.22	18.81			
	28.0	20.23	18.80	3.22	600	
	29.0	20.22	18.80			
	29.8	20.23	18.80			
02:50 pm	30.0					Reduce rate
02:51 pm	1.0	19.83	18.79	2.70	550	Step 5

WATER-LEVEL MEASUREMENTS (Concluded)
Venice Well No. 5

Hour	*Time (min)*	*Adjusted depth to water in well (ft)*	*Adjusted depth to water in piezometer (ft)*	*Orifice tube piez. (ft)*	*Pumping rate (gpm)*	*Remarks*
	2.0	19.83	18.77			
	3.0	19.83	18.76			
	4.0	19.83	18.75			
	5.0	19.82	18.73	2.70	550	
	6.0	19.82	18.72			
	8.0	19.80	18.71			Water sample collected;
03:00 pm	10.0	19.81	18.68			T=60°F
	12.0	19.81	18.65			
	14.0	19.80	18.64	2.70	550	
	16.0	19.80	18.63			
	18.0	19.80	18.61			BART samples collected
03:10 pm	20.0	19.80	18.59	2.70	550	
	22.0	19.80	18.58			
	24.0	19.80	18.57			
	25.0	19.80	18.57			
	27.0	19.81	18.56			
	28.0	19.81	18.56			
	29.0	19.80	18.56			
03:20pm	30.0	19.81	18.56			End of Test

Appendix B.

Chemical Quality of Ground Water
from IDOT Dewatering Wells
FY 92 (Phase 9)

Appendix B. Chemical Quality of Ground Water at IDOT Dewatering Sites
FY92 (Phase 9)

Site	I-70	I-70	I-70	I-70
Well No.	1A	2A	3A	5
Section Location T2N, R9W, St. Clair Co.	7.7b	7.7b	7.7b	7.7b
Date Collected	4/26/95	11/16/93	10/29/93	10/14/93
Laboratory No.	228642	227238	227203	227164
Iron (Fe), mg/l	11.33	14.00	12.83	13.36
Manganese (Mn), mg/l	1.49	1.35	0.83	0.54
Calcium (Ca), mg/l	232	228	175	163
Magnesium (Mg), mg/l	48.7	49.6	41.0	43.4
Sodium (Na), mg/l	182	176	38.5	61.7
Silica (SiO_2), mg/l	33.3	36.9	35.0	37.1
Fluoride (F), mg/l	0.3	0.4	0.3	0.3
Nitrate (NO,), mg/l	0.20	0.03	<0.02	0.3
Chloride (Cl), mg/l	192	200	53.1	106
Sulfate (SO_4), mg/l	369	299	175	151
Aluminum (Al), mg/l	<0.017	0.02	0.02	<0.017
Arsenic (As), mg/l	<0.11	<0.11	<0.11	<0.11
Barium (Ba), mg/l	0.11	0.12	0.08	0.10
Beryllium (Be), mg/l	<0.003	-	-	-
Boron (B), mg/l	1.07	1.03	0.1	0.10
Cadmium (Cd), mg/l	<0.017	<0.017	<0.017	<0.017
Chromium (Cr), mg/l	<0.007	0.02	<0.007	0.01
Copper (Cu), mg/l	<0.007	<0.01	<0.01	<0.01
Lead (Pb), mg/l	<0.066	<0.063	<0.063	<0.063
Nickel (Ni), mg/l	<0.031	<0.031	<0.031	<0.031
Potassium (K), mg/l	9.2	12.6	9.8	5.9
Selenium (Se), mg/l	<0.18	<0.18	<0.18	<0.18
Silver (Ag), mg/l	<0.014	<0.014	<0.014	<0.014
Zinc (Zn), mg/l	<0.02	<0.02	<0.02	<0.02
Alkalinity (as CaCO,), mg/l	510	482	374	404
Hardness (as CaCO,), mg/l	779	773	605	585
Total dissolved minerals, mg/l	1446	1308	877	833
Turbidity (lab), NTU	128	116	75	167
Color, PCU	37	<5	5	<5
Odor	Musty	None	None	None
pH (lab)	7.3	7.5	7.4	7.3
Temperature, °F	59.4	60	57.9	58.5

< = Below detection limit (i.e. <1.0 = less than 1.0 mg/l)
mg/l = milligrams per liter
- = Concentration not determined

Appendix B. (Continued)

Site	I-70	I-70	I-70	I-70
Well No.	6	8A	9A	11A
Section Location T2N, R9W, St. Clair Co.	7.7b	7.7b	7.7b	7.7b
Date Collected	10/29/91	10/01/91	7/23/92	10/28/93
Laboratory No.	225019	224907	226027	227202
Iron (Fe), mg/l	11.52	12.70	16.96	13.04
Manganese (Mn), mg/l	0.47	1.03	0.60	0.48
Calcium (Ca), mg/l	158	201	232	175
Magnesium (Mg), mg/l	40.7	42.9	55.5	44.7
Sodium (Na), mg/l	55.0	104	76.6	34.3
Silica (SiO_2), mg/l	30.7	27.0	36.4	37.2
Fluoride (F), mg/l	0.3	0.5	0.7	0.4
Nitrate (NO,), mg/l	<0.1	<0.1	0.3	<0.02
Chloride (Cl), mg/l	81.0	144	64.0	38.7
Sulfate (SO_4), mg/l	218	317	441	192
Aluminum (Al), mg/l	-	-	0.027	0.02
Arsenic (As), mg/l	-	-	<0.11	<0.11
Barium (Ba), mg/l	-	-	0.088	0.10
Beryllium (Be), mg/l	-	-		
Boron (B), mg/l	-	-	0.76	0.17
Cadmium (Cd), mg/l	-	-	<0.017	<0.017
Chromium (Cr), mg/l	-	-	<0.007	<0.007
Copper (Cu), mg/l	-	-	<0.006	<0.01
Lead (Pb), mg/l	-	-	<0.066	<0.063
Mercury (Hg)	-	-	<0.05	
Nickel (Ni), mg/1	-	-	<0.031	<0.031
Potassium (K), mg/1	7.8	-	10.1	10.2
Selenium (Se), mg/1	-	-	<0.18	<0.18
Silver (Ag), mg/1	-	-	<0.014	<0.014
Zinc (Zn), mg/1	-	-	<0.02	<0.02
Alkalinity (as $CaCO_3$), mg/1	363	447	477	399
Hardness (as $CaCO_3$), mg/1	562	678	807	620
Total dissolved minerals, mg/1	839	1198	1238	912
Turbidity (lab), NTU	100	100	75	72
Color, PCU	<1	<1	5	6
Odor	Musty	Musty	None	None
pH (lab)	7.7	7.4	7.4	7.4
Temperature, °F	59	61	57.9	58.3

< = Below detection limit (i.e. <1.0 = less than 1.0 mg/1)
mg/1 = milligrams per liter
- = Concentration not determined/Information not available

Appendix B. (Continued)

Site	I-70	I-64	25th St.	25th St.
Well No.	15	1	1	4
Section Location T2N, R9W, St. Clair Co.	7.7b	7.7a	17.6e	17.6d
Date Collected	10/15/93	9/24/91	9/4/91	11/19/91
Laboratory No.	227163	224847	224802	225122
Iron (Fe), mg/l	18.84	16.00	15.10	9.04
Manganese (Mn), mg/l	0.75	0.53	0.55	0.56
Calcium (Ca), mg/l	229	235	200	175
Magnesium (Mg), mg/l	63.8	57.3	55.7	47.3
Sodium (Na), mg/l	111	229	262	75.0
Silica (SiO_2), mg/l	34.4	35.1	34.0	36.4
Fluoride (F), mg/l	0.3	1.0	0.8	0.4
Nitrate (NO_3), mg/l	0.2	<0.1	<0.1	<0.1
Chloride (Cl), mg/l	140	73.0	28.9	34
Sulfate (SO_4), mg/l	265	685.0	850	353
Aluminum (Al), mg/l	<0.017	-	-	-
Arsenic (As), mg/l	<0.11	-	-	-
Barium (Ba), mg/l	0.14	-	-	-
Beryllium (Be), mg/l		-	-	-
Boron (B), mg/l	0.51	-	-	-
Cadmium (Cd), mg/l	<0.017	-	-	-
Chromium (Cr), mg/l	0.01	-	-	-
Copper (Cu), mg/l	<0.01	-	-	-
Lead (Pb), mg/l	<0.063	-	-	-
Nickel (Ni), mg/l	<0.031	-	-	-
Potassium (K), mg/l	8.5	-	-	-
Selenium (Se), mg/l	<0.18	-	-	-
Silver (Ag), mg/l	<0.014	-	-	-
Zinc (Zn), mg/l	<0.02	-	-	-
Alkalinity (as $CaCO_3$), mg/l	593	504	419	397
Hardness (as CaCO,), mg/l	834	822	728	631
Total dissolved minerals, mg/l	1234	1708	1777	993
Turbidity (lab), NTU	196	20	90	100
Color, PCU	6	<1	<1	<1
Odor	None	Musty	None	None
pH (lab)	7.3	7.9	7.6	7.4
Temperature, °F	57.7	60	61	-

< = Below detection limit (i.e. <1.0 = less than 1.0 mg/1)
mg/1 = milligrams per liter
- = Concentration not determined/Information not available

Appendix B. (Concluded)

Site	25th St.	Venice	Venice	Venice
Well No.	9	2	3	5
Section Location T2N, R9W, St. Clair Co.	17.6d	Madison Co. T3N, R10W 35.4g	35.3g	35.3g
Date Collected	9/18/91	10/2/91	12/16/91	3/24/92
Laboratory No.	224803	224908	225267	225674
Iron (Fe), mg/l	12.20	17.20	8.28	17.60
Manganese (Mn), mg/l	0.54	0.65	0.39	0.56
Calcium (Ca), mg/l	156	193	182	198
Magnesium (Mg), mg/l	45.8	42.2	46.9	50.9
Sodium (Na), mg/l	58.6	34.9	34.0	47.7
Silica (SiO_2), mg/l	34.0	30.8	39.6	34.9
Fluoride (F), mg/l	0.3	0.4	0.3	0.5
Nitrate (NO,), mg/l	<0.1	<0.1	<0.1	0.1
Chloride (Ci), mg/l	28.9	53.1	73.6	124
Sulfate (SO_4), mg/l	325	273	249	490
Aluminum (Al), mg/l	-	-	-	-
Arsenic (As), mg/l	-	-	-	-
Barium (Ba), mg/l	-	-	-	-
Beryllium (Be), mg/l	-	-	-	-
Boron (B), mg/l	-	-	-	-
Cadmium (Cd), mg/l	-	-	-	-
Chromium (Cr), mg/l	-	-	-	-
Copper (Cu), mg/l	-	-	-	-
Lead (Pb), mg/l	-	-	-	-
Nickel (Ni), mg/l	-	-	-	-
Potassium (K), mg/l	-	-	-	-
Selenium (Se), mg/l	-	-	-	-
Silver (Ag), mg/l	-	-	-	-
Zinc (Zn), mg/l	-	-	-	
Alkalinity (as $CaCO_3$), mg/l	369	445	399	418
Hardness (as $CaCO_3$), mg/l	578	655	647	703
Total dissolved minerals, mg/l	911	984	890	982
Turbidity (lab), NTU	50	100	50	200
Color, PCU	<1	<1	<1	<1
Odor	None	Musty	Musty	Musty
pH (lab)	7.6	7.5	7.3	8.0
Temperature, °F	59	59.5	59	60

< = Below detection limit (i.e. <1.0 = less than 1.0 mg/1)
mg/1 = milligrams per liter
- = Concentration not determined/Information not available

Appendix C.

Results of Step Tests on Dewatering Wells
FY 84 - FY 92 (Phases 1-9)

Appendix C. Results of Step Tests on Dewatering Wells
FY 84 - FY 92 (Phases 1-9)

Well	*Date of test*	*Well loss @ 600 gpm (ft)*	*Drawdown @ 600 gpm (ft)*	*Well loss portion (%)*	*Observed specific capacity (gpm/ft)*	*Δh* @ 600 gpm (ft)*	*Observed Q_{max} (gpm)*	*Remarks*
I-70								
No. 1	8/15/84	**	18.1 e	**	33.1 e	12.8 e	328	PreTreat
No. 1	8/14/85	**	8.89 e	**	67.5 e	3.3 e	390	PostTreat
No. 1	5/17/89	3.31 e	14.68 e	22.5	40.9 e	8.5 e	250	
No. 1A	4/26/95	0.92	14.98 e	6.1	40.8	8.7 e	445	Initial test-New well
No. 2	7/19/83	**	11.9 e	**	50.4 e	7.9 e	500	PreTreat
No. 2	8/15/85	**	8.32 e	**	72.1 e	P	410	PostTreat
No. 2	6/20/88	**	11.98 e	**	50.1 e	P	365	PreTreat
No. 2	2/1/89	0.19e	8.31 e	2.3	72.2 e	P	270	Post Treat; Piezometer partially plugged
No. 2A	11/16/93	1.78 e	20.82 e	8.5	29.7	14.0 e	438	Initial test-New well
No. 3	6/28/83	**	8.53	**	70.9	5.65		
No. 3	6/24/86	1.11	7.47	14.9	80.3	3.64	610	PreTreat
No. 3	1/14/87	0.82	6.09	13.5	98.5	2.40	620	PostTreat
No. 3	12/11/89	0.46	13.4 e	3.4	44.9	7.3 e	530	PreTreat
No. 3	4/17/90	4.8 e	8.7 e	54.5	84.0	2.9 e	440	PostTreat
No. 3A	10/29/93	1.34 e	15.25 e	8.8	40.0	7.7 e	540	Initial test-New well
No. 4	8/16/84	0.07	9.33	0.8	64.3	P		PreTreat
No. 4	1/8/87	**	5.89	**	101.9	P	660	PostTreat
No. 5	7/10/84	0.89	6.53	13.6	91.9	2.11	740	
No. 5	1/13/87	**	7.98	**	75.2	4.76	665	PostTreat
No. 5	2/2/89	0.71	6.23	11.4	96.3	P	650+	PostTreat
No. 5	10/14/93	1.19e	13.67 e	8.7	44.8	P	500	
No. 6	7/19/85	0.23	5.39	4.3	111.3	P	625	

Appendix C. (Continued)

Well	Date of test	Well loss @ 600 gpm (ft)	Drawdown @ 600 gpm (ft)	Well loss portion (%)	Observed specific capacity (gpm/ft)	Δh* @ 600 gpm (ft)	Observed Q_{max} (gpm)	Remarks
I-70 (Cont'd)								
No. 6	8/1/90	--	--	--	16.1		145	
No. 6(T)	10/29/91	0.19	4.93	3.8	121.7	-	750	Piez. buried
No. 7	6/30/83	1.88	18.55	10.1	32.3	15.0		Replaced 11/86
No. 7A	7/23/87	**	8.39	**	71.5	2.13	770	
No. 7A	6/15/89	2.25	11.43	19.7	52.5	8.97 e	520	
No. 7A	6/27/90	6.8 e	26.7 e	25.3	24.6	13.2 e	425	PreTreat
No. 7A	8/6/91	0.32	8.58	3.7	69.9	1.4	625	PostTreat
No. 8	8/1/84	2.68	13.54	19.8	44.3	9.94	625	PreTreat
No. 8	12/5/85	0.07	6.83	1.0	87.8	2.21	750	PostTreat
No. 8	6/22/88	**	12.62	**	47.5 e	8.22	600	
No. 8A	10/4/89	**	6.10	**	98.4	1.38	778	
No. 8A	10/1/91	0.29	11.61	2.5	51.7	6.4	620	
No. 9	6/28/84	**	9.46	**	63.4	5.94	630	
No. 9A	10/3/89	**	6.04 e	**	99.4 e	1.72 e	523	
No. 9A	6/26/90	0.4 e	6.2 e	6.3	97.1	2.1 e	575	
No. 9A	4/26/91	**	5.95 e	--	100.8	2.7 e	535	
No. 9A	7/23/92	0.24 e	7.8 e	3.1	78.7	2.9 e	525	
No. 10	7/31/84	5.97 e	16.93 e	35.3	35.4 e	P	480	PreTreat
No. 10	9/4/85	0.66	6.61 e	10.0	90.8	P	490	PostTreat
No. 10	8/13/87	1.07	18.98 e	5.6	31.6e	10.4 e	390	PreTreat
No. 10	1/30/89	1.74 e	11.51 e	15.1	52.1 e	4.34 e	370	PostTreat
No. 10	2/7/91	--	19.3 e	--	31.1	P	270	PreTreat; Drawdown test only
No. 10	8/8/91	0.95	9.4 e	10.0	65.2	P	450	PostTreat

Appendix C. (Continued)

Well	Date of test	Well loss @ 600 gpm (ft)	Drawdown @ 600 gpm (ft)	Well loss portion (%)	Observed specific capacity (gpm/ft)	Δh*@ 600 gpm (ft)	Observed Q_{max} (gpm)	Remarks
I-70 (Cont'd)								
No. 11	8/2/84	1.58 e	15.55 e	10.2	38.6 e	13.35 e	555	PreTreat
No. 11	9/5/85	**	5.63	**	106.6	P		PostTreat
No. 11	8/12/87	**	11.56 e	**	51.9e	P	550	PreTreat
No. 11	1/31/89	0.03	6.62 e	0.5	90.6 e	P	570	PostTreat; Piezometer partially plugged
No. 11A	10/28/93	0.40 e	16.09 e	2.5	37.6	12.5 e	474	Initial test-New well
No. 12A	6/16/83	0.20	3.82	5.2	157.1	P		
No. 12A	7/30/86	**	13.3 e	**	45.1	P	450	PreTreat
No. 12A	11/16/87	1.45	2.36	61.4	254.2	P	750	PostTreat
No. 12A	5/15/91	1.09	4.7 e	23.2	132.6	2.0 e	520	
No. 13	4/25/91	0.47	7.57 e	6.2	79.9	2.9 e	560	New well, initial test
No. 14	12/20/90	0.13	5.93	2.2	100.5	3.0	750	New well, initial test
No. 15	10/15/93	2.95 e	14.88 e	19.8	41.5	9.1 e	545	Initial test-New well
I-64								
No. 1	7/21/87	**	4.13	**	145.3	0.85	660	
No. 1	9/24/91	0.12	4.33	2.8	138.6	P	630	
No. 2	7/25/85	0.09	5.32 e	1.7	112.8	5.22	550	
No. 3	6/26/84	0.52	10.73 e	4.8	55.9 e	P	525	PreTreat
No. 3	6/21/88	0.68 e	5.68 e	12.0 e	105.6 e	P	555	PostTreat
No. 4	7/15/85	0.66	4.40	15.0	136.4	P		
No. 9	10/5/83	0.37	6.22	5.9	96.5	2.3		
No. 10	7/11/84	**	7.46	**	80.4	2.73	605	

Appendix C. (Continued)

Well	Date of test	Well loss @ 600 gpm (ft)	Drawdown @ 600 gpm (ft)	Well loss portion (%)	Observed specific capacity (gpm/ft)	Δh* @ 600 gpm (ft)	Observed Q_{max} (gpm)	Remarks
I-64 (Cont'd)								
No. 11	8/14/84	**	7.22 e	**	83.1 e	3.2 e	520	
No. 11	6/16/89	0.52	7.45 e	7.0	80.5 e	P	505	
No. 12	7/18/85	0.17	6.22 e	2.8	96.5	1.62 e	590	
No. 13	7/12/84	**	6.44	**	93.2	2.65	600	
No. 14	8/3/90	0.31	4.71 e	6.5	128.2	P	585	Initial test
No. 15	6/29/83	0.73	9.94	7.3	60.4	4.6		PreTreat
No. 15	8/13/85	0.71	7.24	9.8	82.9	2.97	615	PostTreat
No. 15	7/22/87	0.84 e	6.94 e	12.1 e	86.5 e	2.52	570	
25th St.								
No. 1	8/11/89	1.0 e	3.6 e	27.2	184.7	P	375	
No. 1	9/4/91				31.6	P	235	Drawdown test only
No. 2	7/20/83	0.54	5.69	9.5	105.4	1.1		
No. 2	8/9/89	**	10.3 e	**	58.3 e	--	550	PreTreat; Δh elevation data not available
No. 2	4/18/90	0.45	4.87	9.3	120.4	0.6	795	PostTreat
No. 3	9/6/85	0.03	4.89	0.6	122.7	1.75		
No. 3	9/7/89	0.80 e	14.9 e	5.4	40.9	4.5 e	560	PreTreat
No. 3	12/19/90	0.28	10.29	2.7	58.1	3.0	650	PreTreat
No. 3	5/14/91	0.17	5.59	3.0	106.5	0.9	780	PostTreat
No. 4	8/2/90	1.86	10.87	17.1	55.2	--	635	Initial test
No. 4(T)	11/19/91	0.62	4.75	13.1	119.9	P	840	
No. 5	5/16/89	0.47 e	23.28 e	0.02	25.8 e	15.2 e	352	PreTreat
No. 5	4/19/90	**	4.92	**	122.0	1.0	790	PostTreat
No. 6	6/27/84	0.14	9.44	1.5	63.6	P	775	PreTreat

Appendix C. (Continued)

Well	Date of test	Well loss @ 600 gpm (ft)	Drawdown @ 600 gpm (ft)	Well loss portion (%)	Observed specific capacity (gpm/ft)	Δh*@ 600 gpm (ft)	Observed Q_{max} (gpm)	Remarks
25th St. (Cont'd)								
No. 6	1/7/87	0.23	4.38	5.3	137.0	P	775	PostTreat
No. 6	2/8/91	**	4.96	**	122.5	1.9	810	
No. 7	3/21/91	1.56	5.15	30.3	110.8	P	735	Initial test
No. 8	6/15/83	0.11	4.70	2.3	127.7	1.5		
No. 8	4/24/91	--	13.2 e	--	45.5	9.5 e	255	Drawdown test only
No. 9	6/25/86	**	5.55 e	**	110.4	2.04 e	520	
No. 9	9/18/91	0.66 e	5.10e	12.9	117.6	1.8 e	580	
No. 10	7/26/85	**	9.56	**	62.8	3.59		PreTreat
No. 10	11/18/87	0.43	6.24	6.9	96.2	2.06	800	PostTreat
Venice								
No. 1	11/30/83	2.29	18.33 e	12.5	32.7	10.9 e	500	PreTreat
No. 1	12/4/85	0.39	7.89	4.9	74.5	2.33	870	PostTreat
No. 1	9/6/89	0.81	6.94	11.7	85.1	1.9	740	
No. 2	11/17/83	0.05	4.70	1.0	127.7	1.2		
No. 2	9/5/89	12.49	44.70 e	27.9	13.4 e	33.3 e	200	PreTreat; Water level below intake
No. 2	5/8/90	**	6.34	**	94.7	2.4	730	PostTreat
No. 2	10/2/91	1.30	6.14	21.1	92.8	2.3	780	
No. 3	11/28/83	**	9.20	**	65.2	4.2		PreTreat
No. 3	1/6/87	0.35	7.60	4.6	78.3	P	775	PostTreat
No. 3	12/5/90	**	9.54	**	62.9	6.1	700	
No. 3(T)	12/16/91	**	6.26 e	**	97.2	2.3	840	

Appendix C. (Concluded)

Well	*Date of test*	*Well loss @ 600 gpm* ***(ft)***	*Drawdown @ 600 gpm* ***(ft)***	*Well loss portion (%)*	*Observed specific capacity (gpm/ft)*	*Δh* @ 600 gpm* ***(ft)***	*Observed* Q_{max} *(gpm)*	*Remarks*
Venice (Cont'd)								
No. 4	12/1/83	0.39	5.15	7.6	116.5	2.3		
No. 4	12/6/90	--	30.0 e	--	20.0	26.0 e	262	PreTreat; Drawdown test only
No. 4	9/17/91	0.66	5.86	11.3	102.4	2.7	795	PostTreat
No. 5	11/15/83	0.16	4.98	3.2	120.5	1.9		
No. 5	12/7/89	4.3 e	13.7 e	31.4	43.8	9.6 e	500	PreTreat
No. 5	5/2/90	**	5.38	**	109.7	1.6	740	PostTreat
No. 5	3/24/92	0.73	5.28	13.8	110.5	P	760	
No. 6	11/29/83	0.16	7.82	2.0	76.7	6.1		PreTreat
No. 6	11/17/87	3.18	4.13	77.0	145.3	2.61	800	PostTreat
No. 6A	3/20/91	1.89	6.84 e	27.6	78.6	3.7	900	New well, initial test
No. 7	2/27/91	**	7.48	**	80.2	14.3	895	New well, initial test

Notes:

* -Head difference between pumped well and adjacent piezometer.

**-Coefficient immeasurable. Turbulent well loss negligible over the pumping rates tested.

e-Estimate based on interpolated values adjusted to 600 gpm

P-Piezometer plugged or partially plugged

Appendix D.

Well Rehabilitation Field Notes
FY 92 (Phase 9)

WELL REHABILITATION FIELD NOTES

WELL SITE: I-70 Well 6 OBSERVER: Edgar Nelson

CONTRACTOR: Layne-Western Company, Inc.

MEASURING POINT: Not recorded (NR)

MEASURING EQUIP.: Contractor's 6x5 inch orifice tube, electric dropline (ROCTEC)

1. SPECIFIC CAPACITY TEST DATE: 9/16/91

Time	Depth (ft)	Drawdown (ft)	Piez. tube (in.)	Pumping rate (gpm)	Remarks
2:54 pm	13.50				
3:02	13.50				Pump on-SWL
3:16	34.58		23.5	604	
3:30	34.45		23.5	603	
3:44	34.42		23.5	603	
4:00	34.70	21.20	23.5	603	PWL
4:05	34.40	20.90	23.5	603	

Note: All specific capacity tests--static water level (SWL) measured after minimum 30 min. period of well inactivity. Minimum period of pumpage for drawdown measurements is 60 min.

60 min. specific capacity: 603/21.20=28.4 gpm/ft 603/20.9=28.7 gpm/ft

Comments: Sonar jet treatment to follow

2. DOUBLE SONAR JET TREATMENT DATE: 9/16/91

A. UNDERWATER VIDEO INSPECTION

B. DOUBLE SONAR JET TREATMENT

C. UNDERWATER VIDEO INSPECTION

3. SPECIFIC CAPACITY TEST DATE: 9/18/91

Time	Depth (ft)	Drawdown (ft)	Piez. tube (in.)	Pumping rate (gpm)	Remarks
9:55 am	13.55				SWL
10:05	18.00	4.45	6.0	305	Well 5 on
10:15	18.10	4.55	6.0	305	Q/s=66.4 gpm/ft
10:20	22.00	8.45	23.5	603	Cloudy
10:30	22.07	8.52	23.5	603	
10:45	22.00	8.45	23.5	603	Q/s=71.4 gpm/ft
11:05	29.95	16.40	57.0	940	
11:20	29.97	16.42	57.0	940	Q/s=57.2 gpm/ft

60 min. specific capacity: 57.2 gpm/ft

4. 400 LBS POLYPHOSPHATE APPLICATION DATE: 9/18/91

A. INITIAL CHLORINATION

Quantity: 2500 gal Strength: 500 mg/l

Time - initial: NR Injection rate: NR
- complete:

B. POLYPHOSPHATE INJECTION, 400 lbs total

		Batch 1	Batch 2
Phosphate:		200 lbs	200 lbs
Quantity	H_2O:	1800 gals	1800 gals
Time - initial:		NR	NR
- complete:		NR	NR
Injection rate:		423.5 gpm	642.9 gpm

C. DISPLACEMENT, 16,000 gallons chlorinated water (500 mg/1)

Time - initial/complete	Quantity (gal)	Q (gpm)
NR/12:30 pm	NR	NR

Comments: Surged well after 1 hour contact time from 1:30-2:30 pm.

D. PUMPED TO WASTE

Time - initial: 2:30 pm
- complete: 7:30 pm

Q: 603 gpm Quantity: 180,900 gal

5. SPECIFIC CAPACITY TEST DATE: 9/19/91

Time	Depth (ft)	Drawdown (ft)	Piez. tube (in.)	Pumping rate (gpm)	Remarks
8:10 am	13.67				SWL
9:15	13.65		23.5	603	Pump on, I-70 Well 5 running
9:30	18.98	5.31	23.5	603	
9:45	19.07	5.40	23.5	603	
10:00	19.11	5.44	23.5	603	
10:15	19.17	5.50	23.5	603	PWL

60 min. specific capacity: 603/5.50=109.6gpm/ft

6. ACIDIZATION - INHIBITED MURIATIC ACID DATE: 9/19/91

A. ACID INJECTION

Acid strength: 20 Baume Quantity: 1000 gal

Time - initial: 12:00 pm Q: NR
- complete: 1:00 pm

Comments: Acid allowed 1 hour stand time before displacement

B. DISPLACEMENT, 4000 gallons nonchlorinated water

Time - initial/complete	Quantity (gal)	Q (gpm)
NR	NR	NR

Comments: Set 2 hours

C. PUMPED TO WASTE

Time - initial: 3:30 pm
- complete: 6:30 pm

Q: 603 gpm Quantity: 72,360 gal

Comments: Surged for 1 hour and pumped to waste for 2 hours until clear

7. SPECIFIC CAPACITY TEST DATE: 9/20/91

Time	Depth (ft)	Drawdown (ft)	Piez. tube (in.)	Pumping rate (gpm)	Remarks
8:25 am	13.65				SWL
8:45	13.65				
8:50			23.5	603	Started test - Well 5 operating
9:05	18.47	4.82	23.5	603	
9:20	18.55	4.90	23.5	603	
9:35	18.58	4.93	23.5	603	
9:50	18.62	4.97	23.5	603	PWL

60 min. specific capacity: 603/4.97=121.3 gpm/ft

8. 600 LBS POLYPHOSPHATE APPLICATION DATE: 9/20/91

A. INITIAL CHLORINATION

Quantity: 2500 gal Strength: 500 mg/l

Time - initial: NR Injection rate: NR
- complete: NR

B. POLYPHOSPHATE INJECTION, 600 lbs total

		Batch 1	Batch 2	Batch 3
Phosphate:		200 lbs	200 lbs	200 lbs
Quantity	H_2O:	1800 gal	1800 gal	1800 gal
Injection time:		1.8 min	1.1 min	1.0 min.
Injection rate:		1007 gpm	1637 gpm	1762 gpm

C. DISPLACEMENT, 30,000 gallons chlorinated water (500 mg/l)

Time - initial/complete	Quantity (gal)	Q (gpm)
NR/12:00 pm	NR	NR

Comments: Set 1 hour (12:00 pm-1:00 pm), surged 1 hour (1:00 pm-2:00 pm)

D. PUMPED TO WASTE

Time - initial: 2:00 pm
-complete: 7:00 pm

Q: 603 gpm Quantity: 180,900 gal

9. SPECIFIC CAPACITY TEST DATE: 9/23/91

Time	Depth (ft)	Drawdown (ft)	Piez. tube (in.)	Pumping rate (gpm)	Remarks
8:49 am	13.60		23.5	603	Started test, Well 5 pumping, SWL
8:55			23.5	603	
9:05	18.12		23.5	603	
9:20	18.20		23.5	603	
9:35	18.24		23.5	603	PWL
9:50	18.30	4.70	23.5	603	
9:55	18.30	4.70			

60 min. specific capacity: 603/4.70=128.3 gpm/ft

WELL REHABILITATION FIELD NOTES

WELL SITE: 25th St. Well 4 OBSERVER: Al Brown

CONTRACTOR: Layne-Westem Company, Inc.

MEASURING POINT: Not recorded (NR)

MEASURING EQUIP.: Contractor's 6x5 inch orifice tube, electric dropline (ROCTEC)

1. SPECIFIC CAPACITY TEST DATE: 10/8/91

Time	Depth (ft)	Drawdown (ft)	Piez. tube (in.)	Pumping rate (gpm)	Remarks
2:05 PM	11.00				SWL
2:20	24.25		23.5	603	Started test, Well 7 running
2:35	24.65		23.5	603	
2:50	24.67		23.5	603	
3:05	24.67		23.5	603	
3:20	24.67	13.67			PWL

Note: All specific capacity tests--static water level (SWL) measured after minimum 30 min. period of well inactivity. Minimum period of pumpage for drawdown measurements is 60 min.

60 min. specific capacity: 44.1 gpm/ft

Comments:

2. 400 LBS POLYPHOSPHATE APPLICATION DATE: 10/9/91

A. INITIAL CHLORINATION

Quantity: 2500 gal Strength: 500 mg/l

Time - initial: NR Injection rate: NR
- complete: NR

B. POLYPHOSPHATE INJECTION, 400 lbs total

		Batch 1	Batch 2
Phosphate:		200 lbs	200 lbs
Quantity	H_2O:	1800 gal	1800 gal
Time - initial:		NR	NR
- complete:		NR	NR
Injection rate:		1000 gpm	

C. DISPLACEMENT, 16,000 gallons chlorinated water (500 mg/l)

Time - initial/complete	Quantity (gal)	Q (gpm)
NR/9:20 am	8 tanks©2000 Gl=16,000 gal	NR

Comments: Reaction time 70 minutes (9:20-10:30 am), surging 1 hour (10:30-11:30 am)

D. PUMPED TO WASTE

Time - initial: 11:30 am
- complete: 4:30 pm

Q: 603 gpm Quantity: 180,900 gal

Comments: Specific capacity test conducted at the end of pumping period.

3. SPECIFIC CAPACITY TEST DATE: 10/9/91

Time	Depth (ft)	Drawdown (ft)	Piez. tube (in.)	Pumping rate (gpm)	Remarks
3:00 pm	19.63		23.5	603	
3:30	19.63		23.5	603	
4:00	19.60		23.5	603	
4:30	19.60		23.5	603	Pump off, PWL
4:45	11.65				
5:00	11.55	8.05			SWL

60 min. specific capacity: 603/8.05=74.9 gpm/ft

4. ACIDIZATION - INHIBITED MURIATIC ACID DATE: 10/10/91

A. ACID INJECTION

Acid strength: 20 Baume Quantity: 1000 gal

Time - initial: NR Q: NR
-complete: NR

Comments: Acid gravity fed into well and allowed 1 hour (9:30-10:30 am) contact time before displacement.

B. DISPLACEMENT, 5000 gallons nonchlorinated water

Time - initial/complete	Quantity (gal)	Q (gpm)
NR	NR	NR

Comments: Allowed 2 hours (10:30-12:30 pm) contact time following displacement before pumping to waste.

C. PUMPED TO WASTE

Time - initial: 12:30 pm
- complete: 3:30 pm

Q: 603 gpm Quantity: 108,540 gal

5. SPECIFIC CAPACITY TEST DATE: 10/10/91

Time	Depth (ft)	Drawdown (ft)	Piez. tube (in.)	Pumping rate (gpm)	Remarks
2:30 pm	19.10		23.5	603	
2:45	19.20		23.5	603	
3:00	19.10		23.5	603	
3:15	19.10		23.5	603	
3:30	19.10		23.5	603	Pump off - PWL
3:34	11.90				
4:00	11.90	7.2			SWL

60 min. specific capacity: 603/7.2=83.8 gpm/ft

6. 600 LBS POLYPHOSPHATE APPLICATION DATE: 10/11/91

A. INITIAL CHLORINATION

Quantity: 2500 gal Strength: 500 mg/l

Time - initial: NR Injection rate: NR
- complete: NR

B. POLYPHOSPHATE INJECTION, 600 lbs total

		Batch 1	Batch 2	Batch 3
Phosphate:		200 lbs	200 lbs	200 lbs
Quantity	H_2O:	1800 gal	1800 gal	1800 gal
Injection time:		62 sec	64 sec	61 sec
Injection rate:		1742 gpm	1688 gpm	1770 gpm

C. DISPLACEMENT, 30,000 gallons chlorinated water (500 mg/l)

Time - initial/complete	Quantity (gal)	Q (gpm)
NR/10:15 am	NR	NR

Comments: Allowed 1 hour (10:15-11:15 am) contact time following displacement before pumping to waste.

D. PUMPED TO WASTE

Time - initial: 11:30 am
- complete: 5:00 pm

Q: 603 gpm Quantity: 360,000 gal

Comments: Surged, backflushed, and pumped to waste during this time.

7. SPECIFIC CAPACITY TEST DATE: 10/11/91

Time	Depth (ft)	Drawdown (ft)	Piez. tube (in.)	Pumping rate (gpm)	Remarks
4:15 pm	17.95		23.5	603	
4:30	18.00		23.5	603	
4:45	18.00		23.5	603	
5:00	18.00		23.5	603	Pump off-PWL
5:15	12.07				Recovery
5:24	12.05				
5:30	12.00	6.0			SWL

60 min. specific capacity: 100.5 gpm/ft

WELL REHABILITATION -- 25th Street Well 4 (Continued)

8. 600 LBS POLYPHOSPHATE APPLICATION DATE: 10/15/91

A. INITIAL CHLORINATION

Quantity: 2500 gal Strength: 500 mg/l

Time - initial: NR Injection rate: NR
- complete: NR

B. POLYPHOSPHATE INJECTION, 600 lbs total

		Batch 1	Batch 2	Batch 3
Phosphate:		200 lbs	200 lbs	200 lbs
Quantity	H_2O:	1800 gal	1800 gal	1800 gal
Time - initial:		NR	NR	NR
-complete:		NR	NR	NR
Injection rate:		1750± gpm		

C. DISPLACEMENT, 54,000 gallons chlorinated water (500 mg/l)

Time - initial/complete	Quantity (gal)	Q (gpm)
NR/10:00 am	54,000 gal	NR

Comments: Allowed 1 hour (10:00-11:00 am) contact time following displacement before pumping to waste.

D. PUMPED TO WASTE

Time - initial: 11:00 am
- complete: 5:00 pm

Q: 603 gpm Quantity: NR

Comments: Surged and pumped to waste during this time period.

WELL REHABILITATION -- 25th Street Well 4 (Concluded)

9. SPECIFIC CAPACITY TEST DATE: 10/15/91

Time	Depth (ft)	Drawdown (ft)	Piez. tube (in.)	Pumping rate (gpm)	Remarks
4:00 pm	17.72		23.5	603	
4:15	17.74		23.5	603	
4:30	17.74		23.5	603	
4:45	17.74		23.5	603	
5:00	17.74		23.5	603	Pump off - PWL
5:15	12.52				
5:30	12.40	5.34			SWL

60 min. specific capacity: 112.9 gpm/ft

WELL REHABILITATION FIELD NOTES

WELL SITE: Venice Well 3 OBSERVER: Edgar Nelson

CONTRACTOR: Layne-Western Company, Inc.

MEASURING POINT: Not recorded (NR)

MEASURING EQUIP.: Contractor's 6x5 inch orifice tube, electric dropline (ROCTEC)

1. SPECIFIC CAPACITY TEST DATE: 9/24/91

Time	Depth (ft)	Drawdown (ft)	Piez. tube (in.)	Pumping rate (gpm)	Remarks
9:45 am	16.27		23.5	603	Pump on-SWL
10:00	28.00		23.5	603	
10:15	28.24		23.5	603	
10:30	28.36		23.5	603	
10:45	28.45	12.18	23.5	603	PWL

Note: All specific capacity tests-static water level (SWL) measured after minimum 30 min. period of well inactivity. Minimum period of pumpage for drawdown measurements is 60 min.

60 min. specific capacity: 49.5 gpm/ft

2. 400 LBS POLYPHOSPHATE APPLICATION DATE: 9/25/91

A. INITIAL CHLORINATION

Quantity: 2500 gal Strength: 500 mg/l

Time - initial: NR Injection rate: NR
- complete: NR

B. POLYPHOSPHATE INJECTION, 400 lbs total

		Batch 1	Batch 2
Phosphate:		200 lbs	200 lbs
Quantity	H_2O:	1800 gal	1800 gal
Time - initial:		NR	NR
- complete:		NR	NR
Injection rate:		600 gpm±	

C. DISPLACEMENT, gallons chlorinated water (500 mg/l)

Time - initial/complete	Quantity (gal)	Q (gpm)
NR/12:30 pm	2000	16,000

Comments: 8 tanks @ 2000 gal = 16,000. Allowed 1 hour (12:30-1:30 pm) contact time, then surged for 1 hour (1:30-2:30 pm) before pumping to waste.

D. PUMPED TO WASTE

Time - initial: 2:30 pm
- complete: 7:30 pm

Q: 1000+gpm Quantity: 300,000 gal

3. SPECIFIC CAPACITY TEST DATE: 9/26/91

Time	Depth (ft)	Drawdown (ft)	Piez. tube (in.)	Pumping rate (gpm)	Remarks
9:00 am	17.12		23.5	603	Started test - SWL
9:15	25.00		23.5	603	
9:30	25.22		23.5	603	
9:45	25.32		23.5	603	
10:00	25.40	8.28	23.5	603	

60 min. specific capacity: 72.8 gpm/ft

4. ACIDIZATION - INHIBITED MURIATIC ACID DATE: 9/26/91

A. ACID INJECTION

Acid strength: 20° Baume Quantity: 1000 gal

Time - initial: -
-complete: 1 hour

Q: NR

Comments: 1 hour contact time (10:45-11:45 am) before displacing acid.

B. DISPLACEMENT, 5000 gallons nonchlorinated water

Time - initial/complete	Quantity (gal)	Q (gpm)
NR/12:00 pm	NR	NR

Comments: 2-3 hours contact time (12:00-2:00 pm) following displacement before pumping to waste.

C. PUMPED TO WASTE

Time - initial: -
- complete: 5:30 pm

Q: 1000 gpm Quantity: 180,000 gal

Comments: Pumped to waste for 3 hours.

5. SPECIFIC CAPACITY TEST DATE: 9/26/91

Time	Depth (ft)	Drawdown (ft)	Piez. tube (in.)	Pumping rate (gpm)	Remarks
4:25 pm	25.00		23.5	603	Foamy, low pH
5:00	25.20		23.5	603	pH=6, clearer
5:15	25.20		23.5	603	
5:30	25.20		23.5	603	Pump off - PWL - pH=6
6:10	17.60	7.6			SWL

60 min. specific capacity: 79.3 gpm/ft

6. 600 LBS POLYPHOSPHATE APPLICATION DATE: 9/27/91

A. INITIAL CHLORINATION

Quantity: 2500 gal Strength: 500 mg/l

Time - initial: NR Injection rate: NR
-complete: NR

B. POLYPHOSPHATE INJECTION, 600 lbs total

	Batch 1	Batch 2	Batch 3
Phosphate:	200 lbs	200 lbs	200 lbs
Quantity H_2O:	1800 gal	1800 gal	1800 gal
Time - initial:	NR	NR	NR
-complete:	NR	NR	NR
Injection rate:	1200 gpm±		

C. DISPLACEMENT, 30,000 gallons chlorinated water (500 mg/l)

Time - initial/complete	Quantity (gal)	Q (gpm)
NR/10:45am	NR	1200±

Comments: Allowed 1 hour contact time following displacement before surging and pumping to waste.

D. PUMPED TO WASTE

Time - initial: -
- complete: 5:30 pm

Q: 1000±gpm Quantity: 360,000 gal

Comments: Surged and pumped to waste for 6 hours.

7. SPECIFIC CAPACITY TEST DATE: 9/27/91

Time	Depth (ft)	Drawdown (ft)	Piez. tube (in.)	Pumping rate (gpm)	Remarks
4:00 pm	24.10		23.5	603	
4:15	24.10		23.5	603	
4:30	24.10		23.5	603	
4:45	24.10		23.5	603	
5:00	24.10		23.5	603	
5:15	24.10		23.5	603	
5:30	24.10		23.5	603	PWL Pump off
5:45	18.00				
6:00	17.94	6.16			SWL

60 min. specific capacity: 97.9 gpm/ft

8. 600 LBS POLYPHOSPHATE APPLICATION DATE: 9/30/91

A. INITIAL CHLORINATION

Quantity: 2500 gal Strength: 500 mg/l

Time - initial: NR Injection rate: NR
- complete: NR

B. POLYPHOSPHATE INJECTION, 600 lbs total

		Batch 1	Batch 2	Batch 3
Phosphate:		200 lbs	200 lbs	200 lbs
Quantity	H_2O:	1800 gal	1800 gal	1800 gal
Time - initial:		NR	NR	NR
-complete:		NR	NR	NR
Injection rate:		NR	NR	NR

C. DISPLACEMENT, 54,000 gallons chlorinated water (500 mg/l)

Time - initial/complete	Quantity (gal)	Q (gpm)
NR	NR	NR

Comments: Allowed 1 hour contact time and surged well for 1 hour before pumping to waste.

D. PUMPED TO WASTE

Time - initial: -
- complete: 7:00 pm

Q: 603 gpm Quantity: 217,080 gal

Comments: Pumped to waste for 6 hours.

9. SPECIFIC CAPACITY TEST DATE: 9/30/91

Time	Depth (ft)	Drawdown (ft)	Piez. tube (in.)	Pumping rate (gpm)	Remarks
5:30 pm	22.30		23.5	603	
6:00	22.30		23.5	603	
6:15	22.30		23.5	603	
6:30	22.30		23.5	603	
6:45	22.30		23.5	603	
7:00	22.30		23.5	603	Pump off -PWL
7:15	16.80				
7:30	16.80	5.50			SWL

60 min. specific capacity: 109.6 gpm/ft

10. 400 LBS POLYPHOSPHATE APPLICATION DATE: 10/1/91

A. INITIAL CHLORINATION

Quantity: 2500 gal Strength: 500 mg/1

Time - initial: NR Injection rate: NR
- complete: NR

WELL REHABILITATION -- Venice Well 3 (Concluded)

B. POLYPHOSPHATE INJECTION, 400 lbs total

		Batch 1	Batch 2
Phosphate:		200 lbs	200 lbs
Quantity	H_2O:	1800 gal	1800 gal
Time - initial:		NR	NR
- complete:		NR	NR
Injection rate:		NR	NR

C. DISPLACEMENT, 16,000 gallons chlorinated water (500 mg/l)

Time - initial/complete	Quantity (gal)	Q (gpm)
NR/9:00 am	NR	NR

Comments: Allowed 1 hour (9:00-10:00 am) contact time before surging and pumping to waste.

D. PUMPED TO WASTE

Time - initial: -
- complete: 5:00 pm

Q: 603 gpm Quantity: NR

Comments: Surged and pumped to waste for 6 hours.

11. SPECIFIC CAPACITY TEST DATE: 10/1/91

Time	Depth (ft)	Drawdown (ft)	Piez. tube (in.)	Pumping rate (gpm)	Remarks
4:00	22.00		23.5	603	
4:15	22.00		23.5	603	
4:30	22.10		23.5	603	
4:45	22.10		23.5	603	
5:00	22.10	5.4			Pump off-PWL
5:01	17.30				
5:31	16.70				SWL

60 min. specific capacity: 111.7 gpm/ft

Appendix E.

IDPH Well Construction Reports
for New I-70 Dewatering Wells and
Water Well Sealing Forms for Replaced Wells

Il[redacted]pt. [redacted]ubli[redacted]alth
Yellow Copy: Well Contractor
Golden Copy: Well Owner

Well Construction Report

COPY

THIS FORM MUST BE COMPLETED WITHIN 30 DAYS
OF WELL COMPLETION AND SENT TO
THE ILLINOIS DEPARTMENT OF PUBLIC HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
525 WEST JEFFERSON STREET
SPRINGFIELD, ILLINOIS 62761

well # W-1 A

1. Type of Well
   a. Bored____ Hole Diam. 42 in. Depth 114 ft
   Buried Slab: Yes___ No ✓
   b. Driven____ Drive Pipe Diam.____in. Depth____ft
   c. Drilled ✓ Finished in Drift ✓ In Rock____

d. Grout:	(KIND)	FROM (Ft.)	TO (Ft.)
	neat cement	7'	54'

2. Well furnishes water for human consumption? Yes___ No ✓
3. Date well drilled Began const Oct 13 91 finished 4,6,92
4. Permanent pump installed? Yes ✓ Date 2 10 92 No___
   Manufacturer_____ Type SUBMERSIBLE
   Location in well
   Capacity 600 gpm. Depth of setting 60' ft.
5. Well top sealed? Yes ✓ No___ Type plate
6. Pitless adapter installed? Yes___ No ✓
   Manufacturer_____ Model No._____
   How attached to casing?_____
7. Well disinfected? Yes ✓ No___
8. Pump and equipment disinfected Yes ✓ No___

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IMPORTANT NOTICE

This State Agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosiure of this information is mandatory. This form has been approved by the Forms Management Center.

PRESS FIRMLY WITH BLACK PEN OR TYPE
Do Not Use Felt Pen

IL482-0126

GEOLOGICAL AND WATER SURVEYS WELL RECORD

9. Driller GARY SISK License No. 102-003365
10. Well Site Address I-70 & 55
11. Property Owner ILL DEPT TRANS. Well No. W-1A
12. Permit No. 021180 Date Issued 10 18 91
13. Location: see drawing separate sheet
    County St Clair
    Sec. 77
    Twp. 02N
    Rge. 09W

Show location in section plat

14. Water from sand at depth 60 ft to 114 ft

15. Casing and Liner Pipe			
Diam.(in)	Kind and Weight	From (ft)	To (ft)
42"	STAINLESS .250	7'	64

16. Screen: Diam. 16 in, Length 50' in, Slot Size .070
17. Size hole below casing 42" in. 18. Ground Elev.____ft msl.
19. Static level 34 ft below ~~casing~~ SURFACE top which is 7 ft. ~~above~~ BELOW ground level. Pumping level 40 ft, pumping gpm for 1 hours.

20. Earth Materials Passed Through	Depth of Top	Depth of Bottom
SILT and fine sand	0	38
~~fine~~ medium fine sand	38	68
coarse sand & cobbles	68	95
cobbles to Boulders	95	114
limestone	114	

Continue on separate sheet if necessary.

Signed Gary Sisk Date 4 10 92

Ill. Dept. of Public Health
Yellow Copy: Well Contractor
Golden Copy: Well Owner

Well Construction Report

COPY

THIS FORM MUST BE COMPLETED WITHIN 30 DAYS
OF WELL COMPLETION AND SENT TO
THE ILLINOIS DEPARTMENT OF PUBLIC HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
525 WEST JEFFERSON STREET
SPRINGFIELD, ILLINOIS 62761

well # W.2 A

1. Type of Well
   a. Bored____ Hole Diam. 42" in. Depth 113 ft
   Buried Slab: Yes___ No✓
   b. Driven____ Drive Pipe Diam.____in. Depth____ft
   c. Drilled✓ Finished in Drift✓ In Rock____

d. Grout:	(KIND)	FROM (Ft.)	TO (Ft.)
	Neat cem	7'	54'

2. Well furnishes water for human consumption? Yes___ No✓
3. Date well drilled Began Const. Jan 21 92 finished 4,6,92
4. Permanent pump installed? Yes ✓ Date 2 11 92 No___
   Manufacturer_____ Type SUBMERSIBLE
   Location in well
   Capacity 600 gpm. Depth of setting 60' ft.
5. Well top sealed? Yes✓ No___ Type Plate
6. Pitless adapter installed? Yes___ No✓
   Manufacturer_____ Model No._____
   How attached to casing?_____
7. Well disinfected? Yes✓ No___
8. Pump and equipment disinfected Yes✓ No___

180

IMPORTANT NOTICE

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PRESS FIRMLY WITH BLACK PEN OR TYPE
Do Not Use Felt Pen

IL482-0126

GEOLOGICAL AND WATER SURVEYS WELL RECORD

9. Driller GARY SISK License No. 102-093765
10. Well Site Address I 70 & 55
11. Property Owner ILL. DEP. TRANS. Well No. W-2 A
12. Permit No. 02 11 79 Date Issued 10 18 91
13. Location: see drawing separate sheet
    County ST CLAIR
    Sec. 17
    Twp. 2 N
    Rge. 9 W

Show location in section plat

14. Water from SAND at depth 60' ft to 113 ft

15. Casing and Liner Pipe

Diam.(in)	Kind and Weight	From (ft)	To (ft)
16"	STAINLESS .250	7'	63'

16. Screen: Diam. 16" in, Length 50' in, Slot Size .070
17. Size hole below casing 42 in 18. Ground Elev._____ ft msl.
19. Static level 34 ft below ~~casing~~ SURFACE top which is 7 ft. ~~above~~ BELOW ground level. Pumping level 39 ft, pumping gpm for 1 hours.

20. Earth Materials Passed Through	Depth of Top	Depth of Bottom
SILT & FINE SAND	0	37
medum fine sand	37	67
coarse sand & cobbles	67	94
cobbles to Boulders	94	113
limestone	113	

Continue on separate sheet if necessary.

Signed Gary Sisk Date 4 10 92

Il[redacted]pt. [redacted]ubli[redacted]lth[redacted]
Yellow Copy: Well Contractor
Golden Copy: Well Owner

Well Construction Report

COPY

THIS FORM MUST BE COMPLETED WITHIN 30 DAYS
OF WELL COMPLETION AND SENT TO
THE ILLINOIS DEPARTMENT OF PUBLIC HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
525 WEST JEFFERSON STREET
SPRINGFIELD, ILLINOIS 62761

#W 34

1. Type of Well
   a. Bored____ Hole Diam. 42 in. Depth____ft
   Buried Slab: Yes___ No✓
   b. Driven____ Drive Pipe Diam.____in. Depth____ft
   c. Drilled✓ Finished in Drift✓ In Rock____

d. Grout:	(KIND)	FROM (Ft.)	TO (Ft.)
	BENTONITE	7'	45'

2. Well furnishes water for human consumption? Yes___ No✓
3. Date well drilled Began 4-7-92 finish 4-6-92
4. Permanent pump installed? Yes ✓ Date 2 12 92 No
   Manufacturer_____ Type submersible
   Location in well
   Capacity 600 gpm. Depth of setting 55' ft.
5. Well top sealed? Yes✓ No___ Type Plate
6. Pitless adapter installed? Yes___ No✓
   Manufacturer_____ Model No._____
   How attached to casing?_____
7. Well disinfected? Yes✓ No___
8. Pump and equipment disinfected Yes✓ No___

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IMPORTANT NOTICE

This State Agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosiure of this information is mandatory. This form has been approved by the Forms Management Center.

PRESS FIRMLY WITH BLACK PEN OR TYPE
Do Not Use Felt Pen

IL482-0126

GEOLOGICAL AND WATER SURVEYS WELL RECORD

9. Driller GARY SISK License No. 10200336 5
10. Well Site Address I 70 & 55
11. Property Owner ILL. DEPT. TRANS. Well No. W 34
12. Permit No. 02 11 81 Date Issued 10, 18 91
13. Location: see Drawing separate sheet
    County ST CLAIR
    Sec. 27
    Twp. 2 N
    Rge. 9 W

Show location in section plat

14. Water from sand at depth 56 ft to 106 ft

15. Casing and Liner Pipe			
Diam. (in)	Kind and Weight	From (ft)	To (ft)
16"	STAINLESS .250	7	56

16. Screen: Diam. 16" in, Length 50' in, Slot Size .050
17. Size hole below casing 42 in. 18. Ground Elev._____ ft msl.
19. Static level 23 ft below ~~casing top~~ SURFACE which is 7 ft. ~~above~~ BELOW ground level. Pumping level 30 ft, pumping gpm for 1 hours.

20. Earth Materials Passed Through	Depth of Top	Depth of Bottom
silt & fine sand	0	27
medium fine sand	27	57
coarse sand & cobbles	57	84
cobbles & Boulders	84	106
limestone	106	

Continue on separate sheet if necessary.

Signed Gary Sisk Date 4, 10, 92

Ill. Dept. of Public Health
Yellow Copy: Well Contractor
Golden Copy: Well Owner

Well Construction Report

COPY

THIS FORM MUST BE COMPLETED WITHIN 30 DAYS
OF WELL COMPLETION AND SENT TO
THE ILLINOIS DEPARTMENT OF PUBLIC HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
525 WEST JEFFERSON STREET
SPRINGFIELD, ILLINOIS 62761

#11A

1. Type of Well
   a. Bored____ Hole Diam. 42" in. Depth 100 ft
   Buried Slab: Yes___ No___
   b. Driven____ Drive Pipe Diam.____in. Depth____ft
   c. Drilled ✓ Finished in Drift ✓ In Rock____

d. Grout:	(KIND)	FROM (Ft.)	TO (Ft.)
	neat cont	7	35

2. Well furnishes water for human consumption? Yes___ No ✓
3. Date well drilled Began Cut Feb 4 92 finished 4 6,92
4. Permanent pump installed? Yes ✓ Date_____ No___
   Manufacturer_____ Type submersible
   Location in well
   Capacity 600 gpm. Depth of setting 55' ft.
5. Well top sealed? Yes ✓ No___ Type plate
6. Pitless adapter installed? Yes___ No ✓
   Manufacturer_____ Model No._____
   How attached to casing?_____
7. Well disinfected? Yes ✓ No___
8. Pump and equipment disinfected Yes ✓ No___

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IMPORTANT NOTICE

This State Agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosiure of this information is mandatory. This form has been approved by the Forms Management Center.

PRESS FIRMLY WITH BLACK PEN OR TYPE
Do Not Use Felt Pen

GEOLOGICAL AND WATER SURVEYS WELL RECORD

9. Driller GARY SICK License No. 10209365
10. Well Site Address I70 & 55
11. Property Owner ILL. DEPT. TRANS Well No. 11 A
12. Permit No. 021183 Date Issued 10 18 91
13. Location: see drawing seperate sheet
    County St Clair
    Sec. 27
    Twp. 2 N
    Rge. 9 W

Show location in section plat

14. Water from SAND at depth 50 ft to 100 ft

15. Casing and Liner Pipe			
Diam.(in)	Kind and Weight	From (ft)	To (ft)
16"	STAINLESS .250	7	50

16. Screen: Diam. 16 in, Length 50 ft, Slot Size .050
17. Size hole below casing 42 in, 18 Ground Elev._____ ft msl.
19. Static level 25 ft below casing top which is 7 ft. above BELOW ground level. Pumping level 35 ft, pumping gpm for 11 hours.

20. Earth Materials Passed Through	Depth of Top	Depth of Bottom
silty fine sand	0	20
medium fine sand	20	50
Coarse sand & Cobbles	50	80
Cobbles to Boulders	80	100
limestone	100	

Continue on separate sheet if necessary.

Signed Gary Sick Date 4 10 92

IL482-0126

White [redacted] Pink [redacted]es:
Ill. Dept. of Public Health
Yellow Copy: Well Contractor
Golden Copy: Well Owner

COPY

Well Construction Report

THIS FORM MUST BE COMPLETED WITHIN 30 DAYS
OF WELL COMPLETION AND SENT TO
THE ILLINOIS DEPARTMENT OF PUBLIC HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
525 WEST JEFFERSON STREET
SPRINGFIELD, ILLINOIS 62761

W 15

1. Type of Well
   a. Bored____ Hole Diam. 42 in. Depth 90 ft
   Buried Slab: Yes___ No✓
   b. Driven____ Drive Pipe Diam.____in. Depth____ft
   c. Drilled✓ Finished in Drift✓ In Rock____

d. Grout:	(KIND)	FROM (Ft.)	TO (Ft.)
	neat cent	7'	40

2. Well furnishes water for human consumption? Yes___ No✓
3. Date well drilled Began 1,25,92 finished 4 6 92
4. Permanent pump installed? Yes✓ Date 2 12 92 No___
   Manufacturer_____ Type submersible
   Location in well
   Capacity 600 gpm. Depth of setting 50 ft.
5. Well top sealed? Yes✓ No___ Type Plate
6. Pitless adapter installed? Yes___ No✓
   Manufacturer_____ Model No._____
   How attached to casing?_____
7. Well disinfected? Yes✓ No___
8. Pump and equipment disinfected Yes✓ No___

IMPORTANT NOTICE

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PRESS FIRMLY WITH BLACK PEN OR TYPE
Do Not Use Felt Pen

IL482-0126

GEOLOGICAL AND WATER SURVEYS WELL RECORD

9. Driller GARY SISK License No. 102003365
10. Well Site Address I 70 & 55
11. Property Owner ILL. DEPT. TRANS. Well No. W 15
12. Permit No. 621162 Date Issued 10, 18, 91
13. Location: see drawing seperate sheet
    County St Clair
    Sec.____ Twp.____ Rge.____

Show location in section plat

14. Water from sand at depth 40 ft to 100 ft

15. Casing and Liner Pipe			
Diam.(in)	Kind and Weight	From (ft)	To (ft)
16"	STAINLESS .250	7	50

16. Screen: Diam. 16 in, Length 50 in, Slot Size .050
17. Size hole below casing 42 in. 18. Ground Elev._____ ft msl.
19. Static level 14 ft below SURFACE casing top which is 7 ft. above BELOW ground level. Pumping level 24 ft, pumping gpm for 1 hours.

20. Earth Materials Passed Through	Depth of Top	Depth of Bottom
silt to fine sand	0	15
medium fine sand	15	45
coarse sand to cobbles	45	75
Cobbles to Boulders	75	90
limestone	90	

Continue on separate sheet if necessary.

Signed Gary Sisk Date 4, 10, 92

183

WATER WELT, SEALING FORM

ILLINOIS DEPARTMENT OF PUBLIC HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
525 WEST JEFFERSON STREET
SPRINGFIELD, ILLINOIS 62761

RETURN ALL COPIES TO IDPH

TYPE OR PRESS FIRMLY

This form shall be submitted to this Department not more than 30 days after a potable water well, boring or monitoring well is sealed. Such wells are to be sealed not more than 30 days after they are abandoned in accordance with the sealing requirements in the Water Well Construction Code.

1. Ownership (Name of Controlling Party) ILL. DEP. TRANSPORTATION

2. Well Location: # W-1 Poplar St. Complex E, ST LOUIS ST CLAIR
   Address - Lot Number / City / County

   General Description: Section 77 Township 2 (N)(S) Range 10 (E)(W)
   NA Quarter of the NA Quarter of the NA Quarter NA

3. Year Drilled NA

4. Drilling Permit No.(and date, if known) N.A.

5. Type of Well: Bored _____ Drilled _____ Other _____

6. Total Depth 109 Diameter (inches) 16"

7 Formation clear of obstruction ✓ yes _____ no

8. DETAILS OF PLUGGING

   Filled with Pea gravel from 109 to 43 ft.
   (cement or other materials)
   Kind of plug neat cement from 43 to 7 ft.
   Filled with dirt fill in Concret Bot from 7 to 0 ft.
   Kind of plug _____ from _____ to _____ ft.
   Filled with _____ from _____ to _____ ft.
   Kind of plug _____ from _____ to _____ ft.

9. CASING RECORD
   Upper 3 feet of casing removed _____ Yes ✓ No
   Top of Casing is 7' down in P.I.
   If well casing consists of brick, stone, concrete blocks, porous tile, or other porous material, casing was removed to a depth of 10 feet below the surface _____ Yes _____ No.

10. Date well was sealed: Month 4 Day 8 Year 92.

11. Licensed water well driller or other person approved by the Department performing well sealing:
    GARY SISK — 102-003365
    Name / Complete License Number
    26911 E 24 Hi — BUCKNER — MO 64016
    Address / City / State/Zip

8/88

This State Agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosure of this information is mandatory. This form has been approved by the forms Management Center.

IL 482-0631

WATER WELL SEALING FORM

ILLINOIS DEPARTMENT OF PUBLIC HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
525 WEST JEFFERSON STREET
SPRINGFIELD, ILLINOIS 62761

RETURN ALL COPIES TO IDPH

TYPE OR PRESS FIRMLY

This form shall be submitted to this Department not more than 30 days after a potable water well, boring or monitoring well is sealed. Such wells are to be sealed not more than 30 days after they are abandoned in accordance with the sealing requirements in the Water Well Construction Code.

1. Ownership (Name of Controlling Party) ILL. DEP. TRANSPORTATION
POPLAR ST. COMPLEX

2. Well Location: # W-2 (Address - Lot Number) E. ST. LOUIS (City) ST CLAIR (County)

General Description: Section 27 Township 2 (N)(S) Range 9 (E)(W)
NA Quarter of the NA Quarter of the NA Quarter NA Quarter

3. Year Drilled NA

4. Drilling Permit No.(and date, if known) NA

5. Type of Well: Bored _____ Drilled _____ Other _____

6. Total Depth 105 Diameter (inches) 16"

7 Formation clear of obstruction ✓ yes _____ no

8. DETAILS OF PLUGGING

Filled with PEA GRAVEL from 105 to 90 ft.
(cement or other materials)
Kind of plug neat cement from 40 to 7 ft.
Filled with dirt filled in Concrete Box from 7 to 0 ft.
Kind of plug _____ from _____ to _____ ft.
Filled with _____ from _____ to _____ ft.
Kind of plug _____ from _____ to _____ ft.

9. CASING RECORD
Upper 3 feet of casing removed _____ Yes ✓ No
top of casing was 7' down in Pit
If well casing consists of brick, stone, concrete blocks, porous tile, or other porous material, casing was removed to a depth of 10 feet below the surface _____ Yes _____ No.

10. Date well was sealed: Month 4 Day 8 Year 92.

11. Licensed water well driller or other person approved by the Department performing well sealing:
GARY SISK (Name) 102 003365 (Complete License Number)
26911 E 24 HI (Address) BUCKNER (City) MO 64016 (State/Zip)

8/88 This State Agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosure of this information is mandatory. This form has been approved by the forms Management Center. IL 482-0631

WATER WELL SEALING FORM

ILLINOIS DEPARTMENT OF PUBLIC HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
525 WEST JEFFERSON STREET
SPRINGFIELD, ILLINOIS 62761

RETURN ALL COPIES TO IDPH

TYPE OR PRESS FIRMLY

This form shall be submitted to this Department not more than 30 days after a potable water well, boring or monitoring well is sealed. Such wells are to be sealed not more than 30 days after they are abandoned in accordance with the sealing requirements in the Water Well Construction Code.

1. Ownership (Name of Controlling Party) ILL. DEPT. TRANSPORTATION POPLAR ST. COMPLEX

2. Well Location: # W-3 (Address - Lot Number) E. ST. LOUIS (City) ST. CLAIR (County)

   General Description: Section 77 Township 2 (N)(S) Range 9 (E)(W)
   NA Quarter of the NA Quarter of the NA Quarter NA

3. Year Drilled NA

4. Drilling Permit No.(and date, if known) NA

5. Type of Well: Bored _____ Drilled _____ Other _____

6. Total Depth 100 Diameter (inches) 16"

7 Formation clear of obstruction ✓ yes _____ no

8. DETAILS OF PLUGGING

   Filled with Pea gravel (cement or other materials) from 100 to 33 ft.

   Kind of plug neat cement from 33 to 7 ft.

   Filled with dirt filled in Concrete Box from 7 to 0 ft.

   Kind of plug _____ from _____ to _____ ft.

   Filled with _____ from _____ to _____ ft.

   Kind of plug _____ from _____ to _____ ft.

9. CASING RECORD

   Upper 3 feet of casing removed _____ Yes ✓ No
   Top of casing was 7' down in Pit

   If well casing consists of brick, stone, concrete blocks, porous tile, or other porous material, casing was removed to a depth of 10 feet below the surface _____ Yes _____ No.

10. Date well was sealed: Month 4 Day 8 Year 92.

11. Licensed water well driller or other person approved by the Department performing well sealing:

    GARY SISK (Name) 102-003365 (Complete License Number)

    2691 E 24 HI (Address) BUCKNER (City) MO 64016 (State/Zip)

8/88

This State Agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosure of this information is mandatory. This form has been approved by the Forms Management Center.

IL 482-0631

WATER WELL SEALING FORM

ILLINOIS DEPARTMENT OF PUBLIC HEALTH
DIVISION OF ENVIRONMENTAL HEALTH
525 WEST JEFFERSON STREET
SPRINGFIELD, ILLINOIS 62761

RETURN ALL COPIES TO IDPH

TYPE OR PRESS FIRMLY

This form shall be submitted to this Department not more than 30 days after a potable water well, boring or monitoring weil is sealed. Such wells are to be sealed not more than 30 days after they are abandoned in accordance with the sealing requirements in the Water Well Construction Code.

1. Ownership (Name of Controlling Party) IL. DEPT. TRANSPORTATION

2. Well Location: PEARL ST. COMPLEX 2 W-11 E ST LOUIS ST. CLAIR
   Address - Lot Number / City / County

   General Description: Section 27 Township 2 (N)(S) Range 9 (E)(W)
   NA Quarter of the NA Quarter of the NA Quarter NA

3. Year Drilled N.A

4. Drilling Permit No.(and date, if known) NA

5. Type of Well: Bored _____ Drilled _____ Other _____

6. Total Depth 95' 6" Diameter (inches) 16"

7 Formation clear of obstruction ✓ yes _____ no

8. DETAILS OF PLUGGING

   Filled with PEA GRAVEL from 95 6" to 35 ft.
   (cement or other materials)
   Kind of plug NEAT CEMENT from 35 to 7 ft.
   Filled with dirt FILLED in Concrete Box from 7 to 0 ft.
   Kind of plug _____ from _____ to _____ ft.
   Filled with _____ from _____ to _____ ft.
   Kind of plug _____ from _____ to _____ ft.

9. CASING RECORD
   Upper 3 feet of casing removed _____ Yes ✓ No
   top of casing 7' down in pit
   If well casing consists of brick, stone, concrete blocks, porous tile, or other porous material, casing was removed to a depth of 10 feet below the surface _____ Yes _____ No.

10. Date well was sealed: Month 11 Day 6 Year 92.

11. Licensed water well driller or other person approved by the Department performing well sealing:
    [illegible] 102-003365
    Name / Complete License Number
    [illegible] ROCKFORD [illegible]
    Address / City / State/Zip

8/88

This State Agency is requesting disclosure of information that is necessary to accomplish the statutory purpose as outlined under Public Act 85-0863. Disclosure of this information is mandatory. This form has been approved by the Forms Management Center.

IL 482-0631

Appendix F.

Sieve Data for Aquifer and Gravel Pack Samples
Related to Dewatering Wells Constructed
During FY 92 (Phase 9)

Appendix F. Sieve Data for Aquifer and Gravel Pack Samples Related to New Dewatering Wells

I-70 Well 1A Sieve Results (Cumulative percent retained)

Depth (ft)	U.S. Sieves																	
	2.0	1.0	0.75	0.5	0.375	#4	#8	#10	#12	#16	#20	#30	#40	#50	#60	#70	#100	#200	PAN
60							0.3		0.8		3.7	6.7	11.8	18.7	28.3	50.3	83.4	97.8	100
65										0.1	0.2	0.5	1.1	2.9	8.2	26.7	78.2	97.0	100
70						5.6		12.8		23.6	38.6	59.3	72.7	80.6	86.5	91.7		99.7	100
75					8.1		13.6		15.6		22.7	30.9	44.8	59.1	76.5	90.1		99.3	100
80						4.7		6.1		8.8		20.4	29.7	41.8	65.4	84.2	96.9	99.4	100
85						2.8	7.1		10.6	15.9	25.5	49.2	85.5	95.5		99.0		99.8	100
*85						0.6		3.0	3.8	7.4	14.4	38.3	81.6	92.9		96.7		99.8	100
*90						1.0		1.7		2.4		6.9	15.5	20.1	29.2	73.2	95.4	99.0	100
95							1.0		1.4		2.4	3.5	5.7	9.2	21.7	64.1	92.4	99.2	100
100						2.8		5.7		7.6	9.3	15.1	54.0	84.1	90.4	93.6		99.3	100
*105						4.9		7.9		10.1	12.7	19.5	42.3	64.8	79.7	89.8		98.8	100
**110					7.5	19.5	29.3		32.8		41.2	51.0	70.7	85.1		95.0		99.4	100
*110	11.5	26.3		38.9		50.8		58.1		61.2		70.0		90.9		96.9		99.7	100
**114					7.4	20.6	31.9		36.5		46.4	53.7	65.6	75.9		87.0		98.5	100
*114		9.5	36.2		45.9	53.6		61.8		65.7		73.0		85.9		92.4		99.1	100
Gravel Packs:																			
Type A							0.5	15.4	46.3	94.7	99.1	99.6	99.7		99.8		99.9	100	100
Type C	Sample not collected																		

* - Bucket sample

** - Bucket sample without cobbles

Appendix F. (Continued)

I-70 Well 2A Sieve Results (Cumulative percent retained)

Depth (ft)	U.S. Sieves																		
	2.0	1.0	0.75	0.5	0.375	#4	#8	#10	#12	#16	#20	#30	#40	#50	#60	#70	#100	#200	PAN
30								3.2		5.9	10.0	16.7	24.0	32.0	36.9	42.9	81.3	97.1	100
35								0.4		1.0	2.0	3.5	5.3	6.6	7.3	8.4	58.7	94.9	100
60								1.0		2.1	3.2	4.5	6.6	15.4	34.2	59.3	85.7	96.2	100
65							6.0		10.7	17.5	26.4	36.0	42.3		46.6	49.2	63.3	91.7	100
70						5.0	15.3		22.2	31.2	40.5	53.6	68.5	78.2		87.0		89.7	100
75							3.2		4.4		10.3	18.3	31.6	49.6	77.6	91.5	98.2	99.9	100
80							3.5		4.8		9.6	14.8	24.8	38.5	64.3	82.7	95.5	98.6	100
85						11.7		21.2		27.0		40.8	53.1	61.9	71.3	81.0	93.7	97.7	100
90							1.5		1.8		2.9	4.4	9.3	13.1	29.6	66.0	96.8	99.5	100
95					6.0	17.1	32.7		41.9	51.7	59.0		73.9		79.5		89.0	97.2	100
100							0.5		0.7		2.5	13.3	67.2	92.3	95.5	96.6	98.4	99.6	100
105								6.8		9.5	14.8	28.3	54.0	76.3	82.3	87.6	95.9	99.0	100
110							22.2		25.8		35.5	44.5	58.2	69.6	76.5	82.4	91.5	98.2	100
Gravel Packs:																			
Type A							0.5	16.4	48.8	96.6	99.6	99.9	99.9		99.9		100	100	100
Type C									0.0	1.9	34.1	85.0	98.6	99.7	99.8	99.8	99.9	100	100
Concrete Sand								0.4		2.0	6.3	18.8	42.3	63.2	71.4	78.6	92.3	99.1	100

I-70 Well 3A Sieve Results (Cumulative percent retained)

Depth (ft)	U.S. Sieves																	
	2.0	1.0	0.75	0.5	0.375	#4	#8	#10	#12	#16	#20	#30	#40	#50	#60	#70	#100	#200	PAN
45										0.0	0.1	0.2	0.6	3.2	11.1	29.7	69.5	93.2	100
50						10.4	33.8	40.9	46.8	62.4	74.9	82.0		91.4		95.0		98.8	100
55								0.7		1.7	2.8	3.9	9.8	60.9	75.6	88.9	96.1	97.8	100
60							2.0		3.4	6.2	11.0	20.0	34.6	59.9	81.0	92.0		99.3	100
65						2.6		7.3		11.9	16.7	23.5	33.9	51.0	71.2	84.5		95.5	100
70						1.9		7.0		13.2		26.3	32.6	40.2	49.1	60.0	82.8	96.2	100
75							4.0		7.2	12.3	19.7	30.4	41.6		50.2	61.1	87.9	99.2	100
80							0.8		1.7		9.6	24.5	57.1	72.5	77.6	83.9	94.7	98.4	100
85						9.4	22.8		31.1	42.0	55.3	76.7	92.1	96.2		98.6		99.9	100
90							4.6	7.3	9.9	21.8	42.9	66.8	86.4	96.1		98.4		99.9	100
95								0.1		0.3	0.6	4.3	54.0	88.2	96.0	98.1	99.3	99.3	100
100			5.7		9.1		13.4		14.6		22.7	37.3	65.9	89.7		98.1		99.2	100
Gravel Packs:																			
Type A							0.8	29.5	66.1	97.9	99.6	99.8	99.9		99.9		99.9	100	100
Type B							0.2	2	6.9	61.5	91.2	98.5	99.8	99.9		100		100	100

Appendix F. (Continued)

I-70 Well 11A Sieve Results (Cumulative percent retained)

Depth (ft)	U.S. Sieves																		
	2.0	1.0	0.75	0.5	0.375	#4	#8	#10	#12	#16	#20	#30	#40	#50	#60	#70	#100	#200	PAN
30					4.4		6.0		6.8	8.1	9.5	11.2		13.8		15.1	24.7	81.6	100
35						3.4		10.0		17.4	26.9	41.5	57.2	67.7		80.5	91.0	97.4	100
40						3.7		12.2		20.9	27.9	36.9	57.8	80.5	87.2	90.6		98.8	100
45						1.7		3.0		4.9	7.2	10.8	15.3		19.9	23.4	55.3	96.0	100
50							3.0		5.9	11.4	20.9	36.6	52.4	59.0		68.1	80.9	97.0	100
55						1.8		6.8		14.5	24.4	39.8	60.0	74.1	82.8	89.2		99.4	100
60					12.1	19.3	30.3		37.1	45.5	55.8	66.2		80.4		86.0		98.0	100
65					9.4	17.7		31.9		43.1	55.4	72.5	88.0	93.4		96.3		99.0	100
70					10.4	18.4	31.9		41.6	55.4	71.2	85.6		97.0		97.8		99.3	100
75							3.3		5.7	11.4	24.4	53.5	81.3	89.6	93.7	96.4		98.9	100
80					8.9	18.1	37.6		51.2	66.5	76.8	82.6		88.2		95.6		99.7	100
85			16.8		24.1		35.6		40.9	48.7	57.8	69.5		85.6		91.2		94.6	100
90							2.4		2.6		5.0	15.4	53.0	80.1	89.6	93.8	97.7	99.1	100
Gravel Packs:																			
Type A							1.0	23.5	58.8	97.6	99.7	99.9	99.9	99.9		100		100	100
Type C										2.1	32.6	83.9	98.9	99.8	99.9	99.9	99.9	100	100

I-70 Well 15 Sieve results (Cumulative percent retained)

Depth (ft)	U.S. Sieves																	
	2.0	1.0	0.75	0.5	0.375	#4	#8	#10	#12	#16	#20	#30	#40	#50	#60	#70	#100	#200	PAN
15								1.6		2.5	3.7	5.7	10.3	23.3	38.1	57.4	84.9	93.4	100
20		19.0					19.9		20.5		23.0		27.1	32.3	40.3	50.3	73.8	96.0	100
25								2.2		3.8	5.5	8.3	11.9	17.8	29.3	43.0	61.6	85.7	100
*30							25.0	28.0	30.3	37.5	49.4	67.7	86.1	94.1		97.8		99.5	100
35								1.6		3.4	10.2	38.2	77.3	91.7	95.5	97.5	99.1	99.8	100
40								0.7		1.4	3.0	8.2	19.1	34.5	47.2	65.0	83.7	98.5	100
45								3.7		8.5	15.7	29.7	52.9	65.6	68.7	71.7	81.8	98.9	100
50							27.9	33.4	37.2	48.4	60.1	73.0	84.6	91.3		96.5		99.8	100
55							48.5	52.6	55.4	64.0	74.0	84.3	91.1		94.4	97.5		99.8	100
*60							25.0	28.0	30.3	37.5	49.4	67.7	86.1	94.1		97.8		99.5	100
65								5.2		9.0	13.2	20.9	34.0	53.7	69.2	81.1	92.7	99.3	100
70								8.7		19.2	28.1	35.3	44.9	59.9	71.5	80.9	91.7	98.9	100
75							4.1		6.7	12.4	23.6	50.1	76.6	88.0	91.7	94.4		99.6	100
80							14.5		16.4	19.6	25.6	41.2	67.0	84.4	91.0	94.4		99.6	100
85								0.7		2.6	8.2	25.8	54.9	76.3	86.0	91.2	96.3	99.4	100
* - Identical data reported																			
Gravel Packs:																			
Type A							0.4	15.5	48.3	95.9	99.2	99.6	99.7	99.8		99.9		100	100
Type C									0.0	2.9	36.4	84.8	98.8	99.8	99.9	99.9	100	100	100

Appendix G.

Sieve Data for Material Pumped
from Dewatering Wells
FY 92 (Phase 9)

Appendix G. Sieve Data for Material Pumped from Dewatering Wells (Cumulative Percent Retained)

Site	**I-70**	**I-70**	**I-64**	**25th St**	**Venice**
Well	6	8A	1	**4**	**2**
Date collected	10/29/91	10/1/91	9/24/91	11/19/91	10/2/91
Sample no.	PS 10071	PS 9204	PS 9207	PS 10070	PS 9206
Sample wt. (gm)	8.58	6.26	11.10	145.96	15.20
U.S. Sieve No./ Sieve opening (mm)					
10 (2.000)	10.02	1.44*	11.08*	0.77	0.66
18(1.000)	22.96	9.91	19.55*	3.52	1.51
35 (0.500)	73.43	34.99	25.41	5.31	2.24
60 (0.250)	97.20	70.63	30.91	53.90	4.93
120(0.125)	99.30	96.03	75.24	94.59	93.61
230 (0.063)	99.42	99.39	99.12	99.85	99.72
Pan	99.42	-	-	99.96	-

*Majority of this separate appears to be rust or iron particles that could not be removed from the sample.

Appendix H.

Chemical Quality Data
FY 84 - FY 92 (Phases 1-9)

Appendix H. Chemical Quality Data, FY 84 - FY 92 (Phases 1-9)

Well	Dale	Lab No.	Iron Fe (mg/1)	Manganese Mn (mg/l)	Calcium Ca (mg/1)	Magnesium Mg (mg/1)	Sodium Na (mg/1)	Silica SiO2 (mg/1)	Nitrate NO3-N (mg/l)	Chloride Cl (mg/l)	Sulfate SO4 (mg/1)	Alkalinity CaCO3 (mg/l)	Hardness CaCO3 (mg/1)	TDS (mg/1)
I-70 Site														
1	08/15/84	220249	1020		201	45.0	124.0	29.8	3.7	136	320	480	687	1203
1	08/14/85	221273	10.98		218	48.0	112.0	23	2.9	140	360	488	741	1279
1	05/17/89	223086	6.02	1.40	177	37.6	118.0	28.6	1.6	85	347	479	5%	1046
1A	04/26/95	228642	1133	1.49	232	48.7	182	333	020	192	369	510	779	1446
2	07/19/83	218825	11.90		180	40.0	127.0	31.4		131	290	464	614	1105
2	08/15/85	221272	5.55		182	42.4	124.0	20		140	360	464	628	1159
2	06/20/88	222598	1120	120	177	40.0	110.0	30.9	0.4	138	246	465	606	1088
2	02/01/89	222892	10.60	0.61	160	45.0	68.9	28.9	02	128	261	395	584	967
2A	11/16/93	227238	14.00	135	228	49.6	176	36.9	0.03	200	299	482	773	1308
3	06/28/83	218685	14.40		224	522	112.0	32.8		198	307	440	774	1238
3	06/24/86	221686	14.80	0.86	162	40.0	180.0	31.6		230	300	444	569	1250
3	01/14/87	221954	8.70	0.81	211	40.8	99.0	31.6		154	266	416	694	1074
3	12/11/89	223290	7.57	0.76	162	38.8	332	32		69	222	385	564	826
3	04/17/90	223481	6.11	0.71	156	352	452			87	188	369	534	834
3A	10/29/93	227203	12.83	0.83	175	41.0	38.5	35.0	<0.02	53.1	175	374	605	877
4	08/17/84	220250	920		197	462	62.8	29.7	0.7	125	247	408	632	982
4	01/08/87	221949	6.90	0.95	219	40.0	33.6	29.6	0.9	79	221	369	711	854
5	07/10/84	220112	11.60		148	372	293	32		84	169	336	524	775
5	01/13/87	221953	7.50	0.88	187	38.8	332	31.1	12	83	195	360	626	787
5	02/02/89	222891	7.73	1.07	175	382	124.0	30		113	305	495	594	1099
5	10/14/93	227164	1336	034	163	43.4	61.7	37.1	03	106	151	404	585	883
6	08/01/90	223646	10.80	0.44	152	403	553		03	58	242	355	546	858
6	10/29/91	225019	11.52	0.47	158	40.7	55.0	30.7	<0.1	81.0	218	363	562	839
7	06/30/83	218687	12.10		189	41.8	51.7	31.1		77	285	367	643	936
7A	07/23/87	222215	830	0.63	152	36.8	50.8	33.8		98	244	355	531	926
7A	06/27/90	223575	10.70	0.87	220	492	78.9			76	403	461	751	1198
7A	08/06/91	224511	12.10	0.79	196	43.0	77.9	34.1		98	304	429	666	1075
8	08/01/84	220187	13.50		210	443	69.6	30.4		89	332	438	707	1076
8	12/05/85	221485	1220		193	432	65.8	29.8		87	310	412	659	1011
8	06/22/88	222600	15.50	0.80	210	463	432	31		57	317	451	715	1089
8A	10/04/89	223203	1039	0.95	208	42.7	72.4	30.8		103	322	457	695	1055
8A	10/01/91	224907	12.70	1.03	201	42.9	104.0	27.0	<0.1	144	317	447	678	1198
9	06/28/84	220091	1220		178	43.4	81.5	322	0.4	108	320	376	623	1082
9A	10/03/89	223202	10.90	0.67	231	49.6	41.0	333		63	378	466	780	1099
9A	06/26/90	223574	16.60	0.70	232	54.9	230.0			71	694	522	805	1642
9A	04/26/91	224140	1524	0.59	224	50.8	40.8	372		58	356	440	768	1112
9A	07/23/92	226027	16.96	0.60	232	553	76.6	36.4	03	64.0	441	477	807	1238
10	07/31/84	220186	13.10		202	512	47.9	33.3		67	332	424	715	1042
10	09/04/85	221318	16.10		234	58.4	50.4			57	450	432	824	1181
10	08/13/87	222254	1130	0.60	218	54.4	44.4	36.5	02	68	376	424	768	1132
10	01/30/89	222889	11.42	0.56	189	47.0	38.8	33.7		63	354	436	665	1024
10	02/07/91	223980	12.65	0.54	225	56.6	60.4			73	455	424	794	1242
10	08/08/91	224512	1420	034	198	50.4	65.4	35.7		78	399	388	701	1150
11	08/02/84	220188	13.10		169	43.0	473	31.8		72	270	362	599	893
11	09/05/85	221319	15.90		204	533	65.4			57	420	396	728	1127
11	08/12/87	222253	9.00	0.50	170	44.8	55.6	28.6	02	102	271	349	608	930
11	0101/89	222890	9.11	0.55	154	43.0	39.9	32.6		73	300	346	561	889
11A	10/28/93	227202	13.04	0.48	175	44.7	34.3	372	<0.02	38.7	192	399	620	912
12A	06/16/83	218640	13.80		167	46.6	49.4	30.7		67	350	352	608	971
12A	07/30/86	221717	18.10	0.69	172	47.0	86.0	34.4		185	250	360	622	1050
12A	11/16/87	222342	830	0.50	158	43.6	623	27.3		113	222	316	574	816
12A	05/15/91	224201	11.84	0.48	131	43.8	92.4	33.4	02	158	224	341	507	987
13	04/25/91	224138	9.72	0.46	147	37.0	332	36.8	0.1	39	184	322	519	736
14	12/20/90	223933	8.36	0.97	166	38.7	42.9	26.9	0.6	77	220	368	573	835
15	10/15/93	227163	18.84	0.75	229	63.8	111	34.4	02	140	265	593	834	1234
	Average		11.68	0.76	190	45.1	76.7	31.8	0.6	101	302	416	658	1048
	Minimum		535	0.44	131	352	293	20.0	<0.02	39	151	316	507	736
	Maximum		18.84	1.49	234	63.8	230.0	372	3.7	230	694	593	834	1642
	No. of samples		55	39	55	55	55	48	24	55	55	55	55	55

Fluoride F (mg/l)	Aluminum Al (mg/l)	Arsenic As (mg/l)	Barium Ba (mg/l)	Beryllium Be (mg/l)	Boron B (mg/l)	Cadmium Cd (mg/l)	Chromium Cr (mg/l)	Copper CU (mg/l)	Lead Pb (mg/l)	Mercury Hg (mg/l)	Nickel Ni (mg/l)	Potassium K (mg/l)	Selenium Se (mg/l)	Silver (mg/l)	Zinc Zn (mg/l)	Well
	I-70 Site															
																1
																1
0.3	<0.017	<0.11	0.11	<0.003	1.07	<0.017	<0.007	<0.007	<0.066		<0.031	92	<0.18	<0.014	<0.02	1A
																2
																2
																2
																2
0.4	0.02	<0.11	0.12		1.03	<0.017	0.02	<0.01	<0.063		<0.031	12.6	<0.18	<0.014	<0.02	2A
																3
																3
																3
																3
0 3	0.02	<0.11	0.08		0.1	<0.017	<0.007	<0.01	<0.063		<0.031	9.8	<0.18	<0.014	<0.02	3A
																4
																4
																5
																5
																5
0 3	<0.017	<0.11	0.10		0.10	<0.017	0.01	<0.01	<0.063		<0.031	5.9	<0.18	<0.014	<0.02	5
																6
0 3												7.8				6
																7
																7A
																7A
																7A
																8
																8
																8
																8A
0.5																8A
																9
																9A
																9A
																9A
0.7	0.027	<0.11	0.09		0.76	<0.017	<0.007	<0.006	<0.066	<0.05	<0.031	10.1	<0.18	<0.014	<0.02	9A
																10
																10
																10
																10
																10
																10
																11
																11
																11
																11
0.4	0.02	<0.11	0.10		0.17	<0.017	<0.007	<0.01	<0.063		<0.031	102	<0.18	<0.014	<0.02	11A
																12A
																12A
																12A
																12A
																13
																14
0 3	<0.017	<0.11	0.14		Oil	<0.017	0.01	<0.01	<0.063		<0.031	8.5	<0.18	<0.014	<0.02	15
0.4	0.02	<0.11	0.11		053	<0.017					<0.031	9.3	<0.18	<0.014	<0.02	
0 3	<0.017		0.08		0.10		<0.007	<0.006	<0.063			5.9				
0.7	0.03		0.14		1.07		0.02	<0.01	<0.066			12.6				
9	7	7	7	1	7	7	7	7	7	1	7	8	7	7	7	

Appendix H. (Continued)

Well	Date	Lab No.	Iron Fe (mg/l)	Manganese Mn (mg/l)	Calcium Ca (mg/l)	Magnesium Mg (mg/l)	Sodium Na (mg/l)	Silica SiO2 (mg/l)	Nitrate NO3-N (mg/l)	Chloride Cl (mg/l)	Sulfate SO4 (mg/l)	Alkalinity CaCO3 (mg/l)	Hardness CaCO3 (mg/l)	TDS (mg/l)
I-64 Site														
1	07/21/87	222213	1230	0.47	221	57.6	40.4	31.9		61	411	456	788	1183
1	09/24/91	*224847	16.00	033	235	573	229	35.1	<0.1	73.0	685.0	504	822	1708
2	07/25/85	221219	16.60		228	56.8	33.1	35.6		50	410	428	802	1098
3	06/26/84	220089	20.00		227	61.8	87.1	33		55	625	428	821	1448
3	06/21/88	222599	18.40	0.60	258	62.0	64.8	33.4	0.4	64	516	461	899	1439
6	07/21/83	218827	17.60		225	60.3	85.4	33.8		45	580	424	809	1323
9	10/05/83	219087	12.90		202	53.8	29.8	32.9	03	41	350	412	725	974
10	07/11/84	220113	18.70		277	74.1	222.0	32.8		390	636	424	998	1997
11	08/14/84	220248	15.90		220	54.1	45.6	35.2	03	61	358	448	771	1111
11	06/16/89	223066	15.00	0.56	215	443	443	33.4		60	376	501	761	1198
13	07/12/84	220114	15.80		204	533	29.8	34.7	23	50	361	412	729	1080
14	08/03/90	223648	1235	0.52	213	475	269.0		03	61	713	512	727	1762
15	06/29/83	218686	20.00		260	60.8	75.2	35.4		57	585	416	899	1388
15	08/13/85	221271	17.90		254	62.4	119.0	305		59	710	420	890	1580
15	07/22/87	222214	14.00	0.60	243	64.0	166.0	33.6		62	787	456	870	1750
		•224847 Fluoride = 1.0 mg/l												
	Average		1623	055	232	58.0	102.7	33.7	0.6	79	540	447	821	1403
	Minimum		1230	0.47	202	443	29.8	305	<0.1	41	350	412	725	974
	Maximum		20.00	0.60	277	74.1	269.0	35.6	23	390	787	512	998	1997
	No. of samples		15	6	15	15	15	14	6	15	15	15	15	15

Appendix H. (Continued)

Well	Date	Lab No.	Iron Fe (mg/1)	Manganese Mn (mg/l)	Calcium Ca (mg/1)	Magnesium Mg (mg/l)	Sodium Na (mg/1)	Silica SiO2 (mgn)	Nitrate NO3-N (mg/1)	Chloride Cl (mg/1)	Sulfate SO4 (mg/l)	Alkalinity CaCO3 (mg/l)	Hardness CaCO3 (mg/l)	TVS (mg/l)
25th Street Site														
1	02/11/89	223141	830	0.66	166	46.8	120.0		02	34	548	415	607	1226
1	09/04/91	*224802	15.10	055	200	55.7	262.0	34.0	<0.1	28.9	850	419	728	1777
2	08/09/89	223142	8.10	052	205	59.9	251.0		02	37	928	451	758	1816
2	04/18/90	223480	5.40	039	240	68.8	226.0			35	972	451	882	1891
3	09/06/85	221320	17.90		222	61.9	143.0			38	680	404	808	1484
3	09/07/89	223167	14.90	0.62	246	66.9	254.0	32.1		47	939	474	889	1925
3	05/14/91	224200	22.90	0.72	179	73.1	314.0	35.7		49	1171	477	747	2335
3	12/19/90	223932	1830	0.69	239	652	220.0	312		33	911	449	864	1911
4	08/02/90	223647	14.90	0.62	250	66.8	276.0		0.1	39	944	457	898	2032
4	11/19/91	•225122	9.04	056	175	473	75.0	36.4	<0.1	34	353	397	631	993
5	05/16/89	223085	8.90	0.57	137	38.9	15.7	32.1		24	181	369	502	688
5	04/19/90	223479	4.90	0.49	129	35.4	165			23	160	360	467	661
6	06/27/84	220090	1050		132	38.0	142	34		24	176	334	486	663
6	01/07/87	221948	8.40	036	152	38.0	152	333		26	167	334	536	644
6	02/08/91	223981	930	039	139	392	15.1			32	201	331	508	683
7	03/21/91	224038	1220	0.45	145	43.1	223	33.4		48	191	331	539	738
8	06/15/83	218639	9.10		124	38.7	16.6	33.4		21	185	356	469	659
8	04/24/91	224139	11.90	0.78	134	39.1	17.4	38.1	02	31	122	351	495	612
9	06/25/86	221687	18.90	0.82	123	42.0	175	325		21	190	352	480	688
9	09/18/91	*224803	1220	054	156	45.8	58.6	34.0	<0.1	28.9	325	369	578	911
10	07/26/85	221220	16.50		193	53.6	179.0	33.9		30	660	412	702	1408
10	11/18/87	222344	450	050	176	525	153.0	32.7	02	39	571	406	655	1332
		•224802 Fluoride = 0.8 mg/1				*225122 Fluoride = 0.4 mg/1				*224803 Fluoride = 03 mg/1				
	Average		11.92	057	176	50.8	121.9	33.8	0.1	33	519	395	647	1231
	Minumum		450	036	123	35.4	142	312	<0.1	21	122	331	467	612
	Maximum		22.90	0.82	250	73.1	314.0	38.1	02	49	1171	477	898	2335
	No. of samples		22	18	22	22	22	15	8	22	22	22	22	22

Appendix H. (Concluded)

Venice Site

Well	Date	Lab No.	Iron Fe (mg/l)	Manganese Mn (mg/l)	Calcium Ca (mg/l)	Magnesium Mg (mg/l)	Sodium Na (mg/l)	Silica SiO2 (mg/l)	Nitrate NO3-N (mg/l)	Chloride Cl (mg/l)	Sulfate SO4 (mgn)	Alkalinity CaCO3 (mg/l)	Hardness CaCO3 (mg/l)	TDS (mg/l)
1	11/30/83	219239	25.70		256	612	38.3	26.7		66	465	444	890	1241
1	12/04/85	221486	17.80		226	60.8	36.8	33		59	460	420	814	1169
1	09/06/89	223166	1736	035	220	53.6	352	31.4		43	372	475	769	1114
2	11/17/83	219213	21.60		261	542	30.1	31.8	0.8	42	440	476	874	1195
2	09/05/89	223165	23.80	0.60	199	50.9	39.6	32.6		50	328	470	706	1002
2	05/08/90	223505	15.10	0.66	193	44.9	35.8			44	297	462	666	970
2	10/02/91	*224908	17.20	0.65	193	422	34.9	30.8	<0.1	53.1	273	445	655	984
3	11/28/83	219237	20.10		216	51.7	65.1	26.6	03	79	325	472	752	1097
3	01/06*7	221947	1530	036	253	52.0	392	343		55	343	469	845	1060
3	12/05/90	223911	17.10	035	194	46.7	493	37.9		57	218	461	676	972
3	12/16/91	*225267	8.28	039	182	46.9	34.0	39.6	<0.1	73.6	249	399	647	890
4	12/01/83	219241	20.70		208	52.8	50.0	253	0.6	86	330	424	735	1054
4	12/06/90	223912	10.93	032	196	47.9	40.9	34.6		62	284	417	686	950
4	09/17/91	224804	15.00	0.45	180	452	443	323		85	311	400	635	999
5	11/15/83	219212	2030		224	55.8	383	31.8		65	380	428	788	1104
5	12/07/89	223289	11.00	032	185	50.6	44.7	31.6		68	313	425	670	990
5	05/02/90	223504	15.10	038	187	50.9	502			74	314	443	676	1011
5	03/24/92	*225674	17.60	036	198	50.9	47.7	34.9	0.1	124	490	418	703	982
6	11/29/83	219238	22.70		226	56.0	38.1	24.4		62	410	402	794	1138
6	11/17/87	222343	9.60	0.40	196	55.4	413	33.8		55	419	387	717	1087
6A	03/20/91	224037	15.40	0.48	184	482	45.6	332		62	284	400	657	958
7	02/27/91	224009	18.08	0.72	223	46.7	38.4	34.4		25	300	432	748	1000
		Average	17.08	035	209	512	41.7	32.1	03	63	346	435	732	1044
		Minimum	8.28	039	180	422	30.1	24.4	<0.1	25	218	387	635	890
		Maximum	25.70	0.72	261	612	65.1	39.6	0.8	124	490	476	890	1241
		No. of samples	22	15	22	22	22	20	6	22	22	22	22	22

•224908 1Fluoride = 0.4 mg/l •225267 Fluoride = 03 mg/l •225674 Fluoride = 05 mg/l

Appendix I.

Dewatering Well Ground-Water Levels and Operation
FY 92 (Phase 9)

Appendix I. Dewatering Well Ground-Water Levels and Operation, FY 92 (Phase 9)

I-70 Site

Well Piez	MP Elev	Temp MP	August 26,1991 GW Elev	August 26,1991 Pump Δh	October 28,1991 GW Elev	October 28,1991 Pump Δh	December 17,1991 GW Elev	December 17,1991 Pump Δh	February 13,1992 GW Elev	February 13,1992 Pump Δh	April 27,1992 GW Elev	April 27,1992 Pump Δh	July 9,1992 GW Elev	July 9,1992 Pump Δh
W 1	410.8	416.6	380.9	Off	384.9	Off	379.4	Off	380.4	Off	Abandoned			
P 1	416.1										Abandoned			
W 1A	*											nr		On
P 1A	*										35.71		46.18	
W 2	406.5	414.9	378.2	Off	383.6	Off	376.9	Off	375.5	Off	Abandoned			
P 2	414.6										Abandoned			
W 2A	*											Off		On
P 2A	*										35.67		46.26	
W 3	398.2	405.6	377.2	Off	381.2	Pmp Out	375.7	Pmp Out	Abandoned					
P 3	406.7								Abandoned					
W 3A												Off		On
P 3A	*										28.82		40.80	
W 4	389.1	396.6	372.4	On	373.4	On	368.2	On	378.2	Off	375.4	On	372.2	Off
P 4	398.9		374.4	2.0	377.7	4.3	372.7	4.5	378.2		377.1	1.7		
W 5	385.9	391.1	370.5	On	370.7	On	366.0	On	368.8	On	365.5	On	373.1	Off
P 5	391.1		380.4	9.9	Buried		380.0	14.0	379.6	10.8	378.7			
W 6	386.6	391.7	380.8	Off	382.3	Off	379.1	Off	381.1	Off	381.6	Off	374.5	Off
P 6	391.9													
W 7A	*		20.72	On	6.09	Off	22.47	On	21.70	On	22.66	On	15.11	Off
P 7A	*		19.48				20.96		20.12		20.69			
W 8A	*		21.84	On	5.94	Off	23.54	On	22.12	On	24.04	On	13.34	Off
P 8A	*		16.56				17.30		15.57		16.38			
W 9A		407.8	368.4	On	382.0	Off	366.8	On	366.6	On	366.6	On	373.4	Off
P 9A	407.5		370.6	2.1	382.2		369.3	2.5	371.1	4.5	370.8	4.2		
W 10	401.5	410.2	366.6	On	Buried due to		365.3	On	366.2	On	Buried due to		Buried due to	
P 10	409.8		Plugged		construction		Plugged		Plugged		construction		construction	
W 11	396.9	402.7	378.8	Off	382.2	Off	377.3	Off	379.4	Off	Abandoned			
P 11	403.2										Abandoned			

* Measuring point elevations not available; depths to water recorded

Appendix I. (Continued)

I-70 Site (Continued)

Well Piez	MP Elev	Temp MP	August 26,1991 GW Elev	August 26,1991 Pump Δh	October 28,1991 GW Elev	October 28,1991 Pump Δh	December 17,1991 GW Elev	December 17,1991 Pump Δh	February 13,1992 GW Elev	February 13,1992 Pump Δh	April 27 1992 GW Elev	April 27 1992 Pump Δh	July 9, 1992 GW Elev	July 9, 1992 Pump Δh
W 11A	*											Off		On
P 11A	*										26.12		35.82	
W 12A		395.8	379.8	Off	382.6	Off	379.2	Off	380.9	Off	381.4	Off	375.3	Off
P 12A	395.8													
W 13	397.0	407.0	375.7		381.7	Off	374.3	Off	376.6	Off	376.7	Off	364.0	On
P 13	407.2													
W 14	382.5	391.0	371.6	On	373.0	On	368.5	On	378.7	Off		Off	372.9	Off
P 14	390.8		375.0	3.4	377.5	4.5	373.0	4.5						
W 15												Off		On
P 15											10.83		20.75	
RW	390.6		374.0		381.8						374.9		371.5	

* Measuring point e evations not available; depths t o water recorded

Appendix I. (Continued)

I-64 Site (Westbound)

Well Piez	MP Elev	Temp MP	August 27,1991 GW Elev	August 27,1991 Pump Δh	October 28, 1991 GW Elev	October 28, 1991 Pump Δh	December 17, 1991 GW Elev	December 17, 1991 Pump Δh	February 13, 1992 GW Elev	February 13, 1992 Pump Δh	April 28 1992 GW Elev	April 28 1992 Pump Δh	July 8, 1992 GW Elev	July 8, 1992 Pump Δh
W 1	399.7	407.6	379.2	Off	384.0	Off	378.0	Off	379.1	Off	379.5	Off	377.0	Off
P 1	406.6													
W 2	397.1	402.1	383.6	Off	385.5	Off	382.5	Off	383.1	Off	383.7	Off	380.7	Off
P 2	401.5													
W 3	394.6	402.1	385.4	Off	386.5	Off	384.4	Off	384.8	Off	385.3	Off	382.6	Off
P 3	400.0													
W 4	394.0	400.2	386.5	Off	387.2	Off	385.5	Off	385.8	Off	386.3	Off	383.7	Off
P 4	399.4													
W 5	396.5	401.1	387.8	Off	388.1	Off	386.8	Off	386.9	Off	387.4	Off	384.9	Off
P 5	400.2													
W 6	394.3	400.2	389.0	Off	389.0	Off	388.1	Off	388.1	Off	388.5	Off	383.2	On
P 6	399.9												384.1	0.9
W 7	392.2	398.0	389.8	Off	389.5	Off	388.9	Off	388.9	Off	389.2	Off	386.8	Off
P 7	397.6													
W 8	396.7	405.5	390.3	Off	390.0	Off	389.6	Off	389.5	Off	389.8	Off	386.1	On
P 8	404.9												Plugged	
W 9	391.4	397.4	390.5	Off	390.1	Off	389.7	Off	389.6	Off	389.9	Off	387.9	Off
P 9	397.0													
W 10	395.4	404.7	391.4	Off	391.0	Off	390.7	Off	390.6	Off	390.8	Off	389.3	Off
P 10	404.6													
RW 1	403.0		386.1		386.8						385.8		383.0	

Appendix I. (Continued)

I-64 Site (Eastbound)

Well Piez	MP Elev	Temp MP	August 27,1991 GW Elev	August 27,1991 Pump Δh	October 28,1991 GW Elev	October 28,1991 Pump Δh	December 17,1991 GW Elev	December 17,1991 Pump Δh	February 13,1992 GW Elev	February 13,1992 Pump Δh	April 28 1992 GW Elev	April 28 1992 Pump Δh	July 8, 1992 GW Elev	July 8, 1992 Pump Δh
W 11	397.0	402.8	382.8	Off	385.4	Off	381.7	Off	382.3	Off	382.8	Off	380.4	Off
P 11	402.5													
W 12	395.2	401.6	384.6	Off	386.2	Off	383.5	Off	383.9	Off	384.5	Off	382.0	Off
P 12	401.5													
W 13	394.3	399.1	386.3	Off	387.1	Off	385.2	Off	385.5	Off	386.0	Off	383.6	Off
P 13	399.1													
W 14	396.0	400.5	387.4	Off	387.8	Off	386.4	Off	386.6	Off	387.1	Off	384.7	Off
P 14	399.7		387.7											
W 15	395.1	400.5	388.7	Off	388.7	Off	387.7	Off	387.7	Off	388.2	Off	385.7	Off
P 15	399.7													
W 16	393.7	399.8	389.5	Off	389.3	Off	388.6	Off	388.6	Off	388.9	Off	386.1	Off
P 16	398.8													
W 17	392.1	398.0	390.1	Off	389.8	Off	389.3	Off	389.2	Off	389.5	Off	387.4	Off
P 17	397.8													
W 18	391.3	396.6	388.3	On	387.8	On	387.2	On	386.8	On	386.7	On	384.3	On
P 18	396.4		390.0	1.7	389.1	1.3	389.9	2.7	388.7	1.9	388.9	2.2	388.2	3.9
W 19	391.8	397.0	390.8	Off	390.4	Off	390.0	Off	389.9	Off	390.2	Off	388.5	Off
P 19	397.0													
W 20	395.4	405.3	391.9	Off	391.5	Off	391.2	Off	391.1	Off	391.3	Off	390.0	Off
P 20	404.7													
RW 2	398.2		390.5		390.1						389.9		388.3	

Appendix I. (Continued)

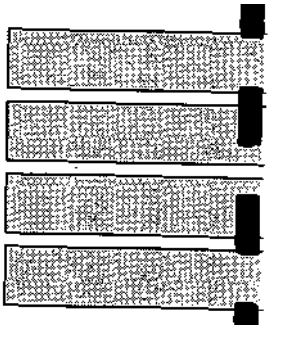
25th Street Site

Well Piez	MP Elev	Temp MP	August 27,1991 GW Elev	August 27,1991 Pump Δh	October 28,1991 GW Elev	October 28,1991 Pump Δh	December 17,1991 GW Elev	December 17,1991 Pump Δh	February 13,1992 GW Elev	February 13,1992 Pump Δh	April 28,1992 GW Elev	April 28,1992 Pump Δh	July 9, 1992 GW Elev	July 9, 1992 Pump Δh
W 1	399.7	407.4	394.7	Off	385.2	On	385.5	On	385.2	On	385.0	On	383.4	On
P 1	407.3				389.8	4.6	390.3	4.8	390.0	4.8	388.9	3.9	387.4	4.0
W 2	394.6	402.8	395.0	Off	391.7	Off	392.7	Off	392.5	Off	390.4	Off	389.5	Off
P 2	401.9													
W 3	390.4	400.3	395.1	Off	391.7	Off	393.3	Off	393.1	Off	389.5	Off	388.7	Off
P 3	400.2													
W 4	392.4	401.6	394.9	Off	391.6	Off	393.4	Off	393.3	Off	386.6	On	385.6	On
P 4	401.5										Plugged		Plugged	
W 5	396.2	404.2	394.7	Off	391.7	Off	393.4	Off	393.3	Off	387.2	On	386.2	On
P 5	403.8										387.7	0.5	Plugged	
W 6	396.5	405.4	395.0	Off	391.6	Off	393.7	Off	393.5	Pmp Out	389.1	Pmp Out	388.2	Pmp Out
P 6	404.5													
W 7	392.6	402.9	395.0	Off	386.4	On	393.5	Off	393.3	Off	382.7	On	380.0	On
P 7	402.0				Plugged						Plugged		Plugged	
W 8	390.8	401.0	395.1	Off	391.4	Off	393.2	Off	393.0	Off	389.0	Off	388.0	Off
P 8	400.5													
W 9	409.4	414.5	395.2	Off	386.8	On	387.4	On	386.1	On	384.5	On	383.6	On
P 9	414.7				388.6	1.8	389.4	2.0	389.2	3.1	387.8	3.3	386.9	3.3
W 10	398.6	407.5	395.2	Off	392.0	Off	392.7	Off	392.5	Off	391.2	Off	390.3	Off
P 10	406.1													
RW	401.4		394.9		390.8						389.7		388.9	

Appendix I. (Concluded)

Venice Site

Well Piez	MP Elev	Temp MP	August 26,1991 GW Elev	August 26,1991 Pump Δh	October 28,1991 GW Elev	October 28,1991 Pump Δh	December 16,1991 GW Elev	December 16,1991 Pump Δh	February 13,1992 GW Elev	February 13,1992 Pump Δh	April 28, 1992 GW Elev	April 28, 1992 Pump Δh	July 9, 1992 GW Elev	July 9, 1992 Pump Δh
W 1	405.6	411.6	389.1	Off	393.8	Off	395.4	Off	394.9	Off	396.0	Off	392.5	Off
P 1	411.2													
W 2	405.6	411.0	391.6	Off	394.0	Off	395.3	Off	395.0	Off	395.6	Off	392.2	Off
P 2	410.3													
W 3	402.6	408.6	381.8	On	394.5	Off	396.0	Off	395.4	Off	388.7	On	385.3	On
P 3	408.4		391.0	9.2							391.7	3.0	388.8	3.5
W 4	403.1	408.1	392.0	Off	394.4	Off	393.8	Off	395.3	Off	389.2	On	385.4	On
P 4	407.2										389.8	0.6	386.9	1.5
W 5	401.1	407.4	392.6	Off	394.3	Off	394.7	Off	394.5	Off	393.7	Off	391.0	Off
P 5	407.2													
W 6	402.1		Abandoned	10/90										
P 6	407.9		Abandoned											
W 6A	400.8	408.4	392.7	Off	394.6	Off	394.7	Off	395.5	Off	394.3	Off	391.4	Off
P 6A	408.6													
W 7	399.3	407.5	378.2	On	389.8	Off	391.1	Off	390.9	Off	391.9	Off	388.4	Off
P 7	409.1		385.6	7.4										
RW	407.3		391.9		394.1						393.4		390.9	



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