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John W. Zavitz, Esq.
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Re: **City of Albuquerque v. Sparton Technology, Inc. (97-0206-LH); State of New Mexico v. Sparton Technology, Inc. (97-0208-JC); and U.S.A. v. Sparton Technology, Inc. (97-210 M/DJS)**

Dear Mr. Zavitz:

Enclosed to be included in your Motion packet, please find an original and two copies each of **Defendant Sparton Technology, Inc.'s Response to Motion for Preliminary Injunction** and **Exhibits Submitted in Support of Defendant Sparton Technology, Inc.'s Motion for Preliminary Injunction.**

Sincerely yours,

RODEY, DICKASON, SLOAN, AKIN & ROBB, P.A.

By James P. Fitzgerald
James P. Fitzgerald

JPF/jkj
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Cover Letter & Response to
Motion for Preliminary
Injunction & Exhibits

OGC-002393 - OGC-002533

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IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW MEXICO

THE CITY OF ALBUQUERQUE, and THE BERNALILLO COUNTY COMMISSIONERS, Plaintiffs, v. SPARTON TECHNOLOGY, INC., Defendant.	§ § § §

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I.
INTRODUCTION

A. Factual Background

From 1961 through approximately 1993, Sparton Technology, Inc. ("Sparton") manufactured, at a plant located at 9621 Coors Road, N.W. (the "Coors Road Plant"), switches and other electronic components, for nuclear devices used by the federal government in winning the "Cold War."[1] In manufacturing these switches, and other electronics components, Sparton was required by the United States Government to use various solvents as degreasers to clean the materials used in the assembling of finished products. Solvents used as degreasers became contaminated with the dirt they were designed to remove from parts. Once they became so dirty that they no longer served the purpose for which they were intended, they became "spent" and needed to be discarded. For many years, and in keeping with standard industry practice, Sparton stored these "spent solvents" in an outdoor sump on its property. Mico Aff. ¶¶ 3 & 4; EPA Exh. 0.

Effective November 19, 1980, regulations issued under the Resource Conservation and Recovery Act ("RCRA"), 42 U.S.C §§ 6901-6992K, became applicable to the disposal of "spent solvents." 45 Fed. Reg. 33108 (May 19, 1980). As part of that regulatory program, Sparton was required to notify the United States Environmental Protection Agency ("EPA") about its handling of "spent solvents." *Id.* at 33154. That notification then triggered additional obligations on the part of Sparton to investigate what impact past practices related to discarding those "spent solvents" may have had on the environment. EPA Exh. H. As part of that process, Sparton, in coordination with the EPA, began an investigation of the quality of groundwater under its property, and discovered in 1984 that the types of solvents it had used as degreasers were found in the groundwater under its property. EPA Exh. L.

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[1] The plant is currently used as a small machine shop, with two employees and a church. Affidavit of Richard Mico ("Mico Aff.") ¶ 3 (Exh. "A").

As a result of that finding, Sparton entered into an Administrative Order on Consent ("AOC") with EPA that was effective on October 1, 1988. Mico Aff. ¶ 7. Under the AOC, Sparton was required to investigate the extent of impacts associated with its waste handling practices for "spent solvents" and then propose a plan for dealing with any impacts found to exist. EPA Exh. S. The activities of Sparton under the AOC were conducted with the involvement of and subject to review by EPA and to a more limited extent by the New Mexico Environment Department ("NMED"). Sparton fulfilled all of its commitment under the AOC in a timely fashion. Mico Aff. ¶ 7.

The first study provided to EPA was a RCRA Facility Investigation, submitted in draft form in 1989 and approved by EPA in July 1992. Sparton also submitted a report evaluating the effectiveness of a system it had put in place in to restrict further migration of solvents into groundwater off of its site. That report was submitted to EPA in October 1989 and approved by EPA in June 1996. Finally, Sparton submitted a Draft Corrective Measures Study ("CMS") to EPA in November 1992, which outlined the company's proposal for dealing with both on-site and off-site impacts associated with its prior manufacture of switches and other electronic components. EPA submitted final comments to Sparton on that draft in March 1996. Sparton submitted its draft final CMS Report to EPA on May 13, 1996. Mico Aff. ¶ 8.

The 8 years of work conducted by Sparton, with EPA approval, reveal that solvents moved through the soil at its plant, reached groundwater under that plant and then were carried off-site with groundwater as it flowed to the northwest away from the Coors Road Plant. As of July 1996, spent solvents have been found approximately 900 yards, northwest of the Coors Road Plant, within the top 50 to 100 feet of the groundwater environment, and moving in a generally northwesterly direction at a rate of approximately 100 feet per year. Affidavit of

Pierce L. Chandler, Jr. ("Chandler Aff.") ¶ 4 (Exh. "B"); Affidavit of Steven P. Larson ("Larson Aff.") ¶ 5 (Exh. "C"); EPA Exh. 3.

No drinking water wells are completed in that part of the groundwater that has been impacted by solvents associated with the Coors Road Plant. Deposition of Norman Gaume ("Gaume Depo.") at 82-84.[2] The City of Albuquerque has no permit to complete wells in the groundwater that has been impacted and has no applications for permits for such wells. *Id.* The nearest City of Albuquerque public water supply wells are approximately 3.5 miles to the southwest of the impacted groundwater and not in the direction of the flow path of the solvents. Chandler Aff. ¶ 6. There is no city-owned infrastructure in the vicinity of the impacted groundwater for delivery water to customers, and, therefore the city could not transfer water produced from wells in the impacted area to its customers. Gaume Depo. at ¶ 84-85. Of course, it would be surprising for any city water infrastructure to be in the area, given that it is part of New Mexico Utilities franchise area. Gaume Depo. at 78-79; Chandler Aff. ¶ 6. The most recent city study on locating future public water supply wells establishes that the City of Albuquerque does not intend, at least through the year 2060, to place any public water supply wells in the impacted area or within the current flow path of the impacted groundwater.[3] *Id.* at ¶¶ 7-8. There is a public water supply well approximately two miles away from the impacted groundwater (owned by New Mexico Utilities, which is <u>not</u> a plaintiff in any of these lawsuits). *Id.* at ¶ 13. If nothing is done to contain the impacted groundwater, solvents would not reach that well for at least 100 years, if at all, and then probably at concentrations below drinking water standards. *Id.*

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[2] All of the noted pages of Mr. Gaume's deposition are included in Exhibit "D."

[3] A 1982 master plan for City of Albuquerque water supply, which was never adopted by the City Council, produced by a private consultant, and serves as a guide subject to revision, appears to have been superseded. Gaume Depo. at 70-71; 104.

Notwithstanding the absence of any current or future threat to any public water supply well from the impacted groundwater, Sparton in July of 1996 offered to take steps to prevent further movement of solvents in groundwater found off-site, to enhance the containment of solvents in groundwater found on-site, and to remove any solvents that may remain in the soil above the groundwater on its property to levels acceptable to EPA and NMED. Mico Aff. ¶ 10. Sparton has been unable to implement that proposal because, notwithstanding the 8 years of study that have already gone on, EPA and NMED believe further investigation is required, and because EPA and NMED have failed to issue necessary authorizations allowing Sparton to discharge recovered and treated groundwater to the nearby Calabacillas Arroyo. Mico Aff. ¶ 12; Affidavit of Maria O'Brien ("O'Brien Aff.") ¶ 2-8 (Exh. "E"); Affidavit of Pete Metzner ("Metzner Aff.") ¶ 1-7 (Exh. "F"). Sparton's consultants have determined that discharge into the Arroyo at rates necessary to achieve containment would not reach the Rio Grande. Instead the discharged water would work its way back to the groundwater from which it had been removed.

B. **Legal Background**

The EPA, NMED, the City of Albuquerque, and the County of Bernalillo filed, on February 19, 1997, an action alleging that the groundwater Sparton had impacted presents an "imminent and substantial endangerment" to human health and the environment. The relief sought through these lawsuits is an order directing Sparton to take actions necessary to deal with that alleged endangerment. These actions are brought more than 13 years after EPA and NMED were first aware of impacts to groundwater, and at least 6 years after the City of Albuquerque became aware of the situation. EPA Exh. L; Gaume Depo. at 138.

At the same time that these lawsuits were brought, there was pending before EPA Region 6 in Dallas an administrative proceeding involving an order issued by EPA Region 6,

purportedly under the authority of § 3008(h) of RCRA, 42 U.S.C. § 6928(h). The order directs Sparton to take specified actions to address the same impacted groundwater identified in these lawsuits. An administrative hearing on that order was held on March 27, 1997. It is anticipated that, unless that proceeding is enjoined, EPA will issue a decision on what remedy Sparton should implement. The relief sought in the administrative proceeding is essentially identical to what is sought in these lawsuits.

Finally, there is pending in federal court in Dallas an action by Sparton against EPA, alleging that the agency violated the AOC in the way it identified a remedy to address the impacted groundwater associated with the Coors Road Plant. *See* Sparton's pending Motion to Stay, Dismiss or Transfer Venue. The relief sought in the Dallas Litigation is an order prohibiting EPA from continuing to proceed with the administrative proceeding and directing EPA to follow its commitments under the AOC. *Id.* The outcome of that case will directly impact what relief the Court might be able to order in these lawsuits. *Id.*

C. **Relief Sought**

In its motion for preliminary injunction, EPA does not request that Sparton take any action that immediately contains the impacted groundwater or removes constituents of concern. Instead, the agency wants additional testing to be completed. While EPA believes such testing would cost between $300,000 and $350,000 and could be completed within 60 days, Sparton's consultant has estimated that the investigation will cost more than $500,000 and require at least 168 days to complete. Affidavit of Gary Richardson ("Richardson Aff.") ¶ 7 (Exh. "G"). Additionally, Sparton's hydrogeologist is of the view that the further investigations sought by EPA are a waste of time and money. Larson Aff. ¶¶ 4-18. The work that has been done over the last 8 years is more than sufficient for purposes of designing and operating the containment system that EPA wants installed after further testing is complete. *Id.*

II.

ARGUMENT AND AUTHORITIES[4]

A. EPA's Proposed Affirmative Relief Is Not the Proper Subject of a Preliminary Injunction.

1. Preliminary Injunctive Relief Is Disfavored When There Is No Ongoing Conduct of the Defendant to Stop.

The environmental impacts complained of in this action were caused by a manufacturing process that Sparton no longer uses. Mico Aff. ¶ 6. Sparton has not engaged in the activities resulting in these environmental impacts since the end of 1986. *Id.* ¶ 5. Thus, although Sparton's activities resulted in the contamination EPA complains of, the contamination now expands entirely independently of any ongoing Sparton activities. Chandler Aff. ¶ 5. Instead, physical and chemical processes, which Sparton is not controlling, determine the movement of solvents in the groundwater. *Id.* Under these circumstances, the affirmative relief EPA seeks is not the proper subject of a preliminary injunction.

For example, in *Brown v. Kerr-McGee Chemical Corp.*, the Seventh Circuit acknowledged that a preliminary injunction would not have been available to adjacent property owners seeking to compel Kerr-McGee to remove hazardous waste to a safe distance.[5] Although normally the property owners' failure to seek a preliminary injunction would indicate a lack of irreparable harm, no preliminary injunctive relief could have been granted in the case, because Kerr-McGee was no longer creating and dumping hazardous waste on the site.[6] The court

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[4] Attached as Exhibit "H" are Sparton's objections to the EPA's Exhibits to the Motion for Preliminary Injunction. If those objections are sustained, virtually all support for the Motion for Preliminary Injunction is inadmissible, requiring summary denial of the request.

[5] 767 F.2d 1234, 1240 (7th Cir. 1985), *cert. denied*, 475 U.S. 1066.

[6] *Id.* at 1239-40.

concluded it would have been "irrational" for a district court to enter a preliminary injunction ordering Kerr-McGee to remove hazardous wastes from the site:

> The present case differs in that here preliminary injunctive relief was impractical. Plaintiffs claim that toxic wastes on Kerr-McGee's property have caused, and continue to cause, serious, perhaps irreparable, harm to plaintiffs' health and to their property. If Kerr-McGee were still creating and dumping toxic wastes on the site, plaintiffs could request a preliminary injunction enjoining Kerr-McGee from further dumping. But plaintiffs admit that Kerr-McGee has not operated the factory since 1973, and it would be irrational for a district court to enter a *preliminary* injunction ordering Kerr-McGee to remove all toxic wastes from the West Chicago site.[7]

Preliminary relief is normally not available when the non-movant is no longer engaging in the alleged injurious conduct.[8] As a result, a preliminary injunction may not be used to force Sparton to study environmental impacts to which Sparton is no longer contributing.

2. Preliminary Injunctive Relief That Compels Action Is Disfavored Because Of The Difficulty In Determining And Fashioning An Appropriate Remedy And The Need For Continuing Supervision.

Through its motion, EPA asks this Court to decide what further testing, if any, is necessary, not to correct impacts to groundwater associated with Sparton's Coors Road Plant, but to better understand them. Sparton's hydrogeologist, Steven P. Larson, argues the testing EPA proposes is generally unnecessary. Larson Aff. ¶¶ 4-18. The impacts to groundwater are already sufficiently understood to move forward with corrective action. *Id.* Without the benefit of a fully developed record, the Court is asked to decide between these conflicting views of

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[7] *Id.* (citing *Triebwasser & Katz v. American Telephone & Telegraph Co.*, 535 F.2d 1356, 1360 (2d Cir. 1976)).

[8] *See Hutchinson v. Pfeil*, 105 F.3d 566, 570 (10th Cir. 1997) (citing *Brown v. Kerr-McGee Chem. Corp.* and *Volvo N. Am. Corp. v. M.I.P.T.C.*, 839 F.2d 69, 74 (2d Cir. 1988)).

experts. In similar situations other courts have declined such an invitation, as should this Court.[9]

Granting a preliminary injunction will also require on-going supervision. What happens if well locations need to be changed? What if the results are not what EPA expects? Can Sparton be required to spend more money than estimated by EPA? What if additional time is necessary to complete any work plan? The need for a court to address such concerns on an on-going basis has caused other courts to decline to order affirmative relief through a preliminary injunction.[10]

3. EPA's Request For Affirmative Relief Is Premature.

Traditionally, the purpose of a preliminary injunction is only to preserve the status quo until trial.[11] The status quo is not defined by the parties' existing legal rights. Instead, it represents existing circumstances, regardless of whether what exists is in accord with the parties' legal rights.[12] Consequently, a request for a preliminary injunction that would alter the status quo "confuses 'what should be' with 'what is'."[13] Unless a movant seeking to alter the status quo can show that something new is happening to merit extraordinary relief, the movant fails

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[9] *See, e.g., Friends of the Earth v. Wilson*, 389 F. Supp. 1394, 1395-96 (S.D.N.Y. 1974) (denying mandatory preliminary injunction requiring defendants to comply with air quality implementation plan because of highly technical nature of both proof and remedy sought and because court should not grant relief requiring continuous judicial supervision).

[10] *See SCFC ILC*, 936 F.2d at 1099 (observing that court should deny affirmative preliminary relief when it will place the issue in court in the position of having to provide ongoing supervision to assure that the non-movant is abiding by the injunction).

[11] *SCFC ILC, Inc. v. Visa USA, Inc.*, 936 F.2d 1096, 1099 (10th Cir. 1991).

[12] *Id.* at 1100; Here the status quo is the presence of solvents in groundwater, advancing at a rate of approximately 100 feet per year. That is the existing circumstance. Whether it should continue depends on a final determination of what legal responsibility Sparton has to address that situation.

[13] *Id.*

to meet its burden of proof as to preliminary relief, even if the movant establishes there is some merit to its case.[14]

In this matter, EPA asks this Court to alter the status quo by compelling Sparton to expand upon over 8 years of completed study. EPA does not show, however, that something new is happening to require such immediate extraordinary relief. In fact, the solvents in the groundwater are behaving today as they have for the past 13 years. Today, as for the past 13 years, no drinking water wells are completed in the impacted groundwater, nor are there any plans to complete such wells. Conditions that have existed over the past 13 years have not previously prompted the Plaintiffs to seek an injunction. In fact, as discussed below, EPA brings this action after knowing for 13 years that this contamination had occurred and is spreading. Moreover, EPA's request would not alter the status quo in a way that would abate or reverse these environmental impacts. The study requested would gather only substantially duplicative information about the extent of the environmental impacts. Larson Aff. ¶¶ 4-18. Because the proposed affirmative relief sought by EPA will not by itself correct the alleged imminent endangerment, the study could as easily be done in conjunction with any clean-up efforts required after a trial on the merits.

For example, in *United States v. Price*, the District Court of New Jersey denied the United States a mandatory preliminary injunction requiring a landfill owner to remedy hazards posed by chemical dumping that had occurred at the landfill ten years earlier.[15] In that case, EPA sought two forms of preliminary injunctive relief against the landfill owner: (1) that the owner be compelled to fund a study to determine the extent of the problem posed by leachate from the landfill; and (2) that owner be required to provide an alternate water supply to private

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[14] *Bell Atl. v. Hitachi Data Sys.*, 856 F. Supp. 524, 525 (N.D. Cal. 1993).

[15] 523 F. Supp. 1055, 1068 (D.N.J. 1981), *aff'd*, 688 F.2d 204 (3d Cir. 1982).

well owners whose wells had been contaminated.[16] Although the court agreed that a thorough study of the problem was essential and should be done immediately, the court refused to order the landfill owner to fund a study as a form of preliminary injunctive relief.[17] Furthermore, because the landfill owner was no more able than the homeowners or the EPA to provide an alternate water supply, EPA's second request for preliminary relief -- compelling defendants to provide an alternate water supply to homeowners whose wells had been contaminated -- merely sought to shift the cost of remediation prior to a determination of the merits. Therefore, the EPA's request was not an appropriate matter for preliminary injunctive relief.[18]

B. Even If The Affirmative Relief EPA Requests Were Properly the Subject Of A Preliminary Injunction, EPA Has Not Met Its Burden Of Proof.

As EPA recognizes, to obtain preliminary injunctive relief it must establish:

(1) a substantial likelihood that the movant will eventually prevail on the merits;

(2) a showing that the movant will suffer irreparable injury unless the injunction issues;

(3) proof that the threatened injury to the movant outweighs whatever damage the proposed injunction may cause the opposing party; and

(4) a showing that the injunction, if issued, would not be adverse to the public interest.[19]

A preliminary injunction is an extraordinary and drastic remedy that should not be granted unless the movant makes a clear showing that its right to relief is unequivocal.[20] In addition, when the movant seeks a mandatory, as opposed to a prohibitory injunction, the burden of proof is

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[16] *Id.* at 1066.

[17] *Id.* at 1067.

[18] *Id.* at 1068.

[19] *SCFC ILC*, 936 F.2d at 1098.

[20] *See id.*

heightened.[21] The movant must show that the four factors listed above weigh "heavily and compellingly" in the movant's favor.[22]

1. There Is No Substantial Likelihood EPA Will Prevail On the Issue Of Whether An Imminent And Substantial Endangerment Exits.

a. It is the province of the court to determine whether the Sparton site poses an imminent and substantial endangerment.

The interpretation of a statute presents a question of law, and "[i]t is emphatically the province and duty of the judicial department to say what the law is." *Marbury v. Madison*, 5 U.S. (1 Cranch) 137, 177 (1803). The determination of whether a given set of facts constitutes an "imminent and substantial endangerment" is a question of law. *United States v. Conservation Chem. Co.*, 619 F. Supp. 162, 197 (W.D.Mo. 1985); *see, e.g., Brock v. Louvers & Dampers, Inc.*, 817 F.2d 1255, 1258 (6th Cir. 1987) (courts may not abdicate their ultimate responsibility to determine congressional intent).

b. Any determination by EPA or NMED regarding an imminent and substantial endangerment is a litigation position to be accorded no deference by this Court.

Plaintiffs include with their motion one document prepared by EPA and another by NMED that purport to "find" that the Sparton site constitutes an imminent and substantial endangerment.[23]

EPA's Determination is entitled to no deference because it is incomplete and inconsistent with EPA's guidelines for assessing endangerment under RCRA section 7003. Absent from the

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[21] *Id.*

[22] *Id.* at 1098-99.

[23] "Determination of Imminent and Substantial Endangerment Pursuant to Section 7003 of RCRA and Section 1431 of the SDWA," issued February 14, 1997, by EPA, EPA Exh. 1, Attachment AA (the "EPA's Determination"); "Finding of Imminent and Substantial Endangerment," issued February 14, 1997 by the New Mexico Office of the Natural Resource Trustee and the New Mexico Environment Department, EPA Exh. 4 (the "State's Finding").

Determination are most of the key steps in EPA's process of deciding whether a site poses an imminent and substantial endangerment. *See* Endangerment Assessment Handbook §§ 3.2, 3.3 and 3.4, OSWER Directive 9850.2 at 3-3 through 3-9, 1986 WL 263585 at *13-*15. There is no identification of exposure routes, analysis of exposed populations (human populations, sensitive subsets of human population and/or fish and wildlife populations which may be at risk) or calculation of exposure level and dose incurred (yields a qualitative or quantitative estimate of the expected exposure levels resulting from actual or potential releases of contaminants from the site). Endangerment Assessment Handbook § 3.2, OSWER Directive 9850.2 at 3-3, 3-4, 1986 WL 263585 at *13, *14. Nor is there a toxicity assessment, which is designed to determine the nature and extent of health and environmental hazards associated with exposure to the contaminants present at the site, consisting of a toxicological evaluation and a dose-response assessment. *Id.* § 3.3 at 3-4 through 3-6, 1986 WL 263585 at *14-*15. Finally, no risk characterization is presented, which estimates "the incidence of an adverse health or environmental effect under the various conditions of exposure defined in the exposure assessment." *Id.* § 3.4 at 3-6 through 3-10, 1986 WL 263585 at *15-*16.

Because EPA's Determination fails to address these key issues, which the agency itself has set forth as critical factors in determining if an "imminent and substantial endangerment" exists, it is entitled to no deference by this Court.[24]

More significantly, neither the EPA Determination nor the State's Finding were developed as part of an agency rulemaking or adjudication. They are informal pronouncements prepared by Plaintiffs in anticipation of this litigation. Stated somewhat differently, neither

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[24] The State's Finding is also entitled to no deference or weight. Whether a situation constitutes "imminent and substantial endangerment" under the RCRA citizen's suit provision is an element a citizen must prove to obtain injunctive relief. Congress did not delegate to either EPA or to citizen's the authority to make such determinations. It is a question of law for the court's determination. *Conservation Chemical*, 619 F.Supp. at 197. Further, the State's Finding is devoid of any reasoned risk assessment supporting the conclusions reached. Therefore, it is entitled to no deference or weight other than that usually accorded the argument of parties.

"determination" has been the subject of notice and comment. Prior to this lawsuit, Sparton has never had an opportunity to challenge the unsupported findings in these documents.

Not coincidentally both "determinations" were completed days before these lawsuits were filed. There can be little doubt they were developed to aid the litigation. As mere litigation positions, the Court is not bound by these "findings" and should accord them no more deference than that usually accorded arguments presented by any litigant. *Massachusetts v. Blackstone Valley Elec. Co.*, 67 F.3d 981, 991 (1st Cir. 1995); *see also,* Davis and Pierce, *Administrative Law Treatise*, § 3.5 at 119-20 (3d ed. 1994) (explaining that the deference courts accord agency interpretations of statutes as set forth in legislative rulemaking, which is commonly called *Chevron* deference, is not applicable to agency policy decisions announced in formats Congress has not authorized for that purpose, such as litigation positions and agency guidance documents).

c. Plaintiffs have failed to make a *prima facie* case showing a reasonable probability that they will be entitled to relief.

In order to prevail on their motion for preliminary injunction, the EPA must make a *prima facie* case showing there is a reasonable probability that ultimately it will be entitled to relief. *Crowther v. Seaborg*, 415 F.2d 437 (10th Cir. 1969). One of the elements EPA must demonstrate to establish a *prima facie* case of liability under sections 7002 or 7003 RCRA[25]

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[25] RCRA section 7002(a)(1)(B) provides as follows:

> any person may commence a civil action on his own behalf--
>
> . . .
>
> (B) against any person ... including any past or present generator, past or present transporter, or past or present owner or operator of a treatment, storage, or disposal facility, who has contributed or who is contributing to the past or present handling, storage, treatment, transportation, or disposal of any solid or hazardous waste *which may present an imminent and substantial endangerment to health or the environment* ...

RCRA § 7002(a)(1)(B), 42 U.S.C. § 6972(a)(1)(B) (emphasis added).

RCRA 7003(a) provides as follows:

> [U]pon receipt of evidence that the past or present handling, storage, treatment, transportation or disposal of any solid waste or hazardous waste *may present an*

or the emergency powers provision of the Safe Drinking Water Act ("SDWA"),[26] are conditions that present or may present an "imminent and substantial endangerment."[27] *United States v. Aceto Agr. Chemicals Corp.*, 872 F.2d 1371, 1382-83 n.9 (8th Cir. 1989) (*prima facie* case under RCRA § 7003); *Foster v. United States*, 922 F. Supp 642, 660 (D.D.C. 1996) (*prima facie* case under RCRA § 7002). As set forth in detail below, EPA has failed to meet this burden.

The imminent and substantial endangerment language "is plainly intended by Congress to limit the reach of RCRA to sites where the potential for harm is great." *United States v. Aceto Agr. Chemicals Corp.*, 872 F.2d 1373, 1383 (8th Cir. 1989). An endangerment is "imminent" if it "'threaten[s] to occur immediately.'" *Meghrig v. KFC Western, Inc.*, 116 S. Ct. 1251, 1255 (1996) (quoting Webster's New International Dictionary of English Language 1245 (2d ed. 1934)). An endangerment is "substantial" if "there is reasonable cause for concern

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> *imminent and substantial endangerment to health or the environment*, the Administrator may bring suit on behalf of the United States in the appropriate district court against any person ... who has contributed or who is contributing to such handling, storage, treatment, transportation or disposal ... to restrain such person from such handling, storage, treatment, transportation, or disposal, to order such person to take such other action as may be necessary, or both.

RCRA § 7003(a) (emphasis added), 42 U.S.C. § 6973(a).

[26] SDWA section 1431 provides as follows:

> [T]he Administrator, upon receipt of information that a contaminant which is present in or is likely to enter a public water system or an underground source of drinking water *may present an imminent and substantial endangerment to the health of persons* ... may take such actions as he may deem necessary in order to protect the health of such persons.

SDWA § 1431(a), 42 U.S.C. § 300i.

[27] There are other elements of a *prima facie* case under RCRA, but Sparton does not dispute they exist. The other elements of a *prima facie* case under section 1431 of the SDWA, are in dispute. These include: (1) is the contamination present in or is it likely to enter a public water system or an underground source of drinking water and (2) have the appropriate state and local authorities failed to act to protect the health of such persons. SDWA § 1431. Because EPA has failed to advance proof on these issues, and because the "imminent and substantial endangerment" showing under the two statutes is essentially the same, this part of the brief will focus only on the RCRA claim.

that someone or something may be exposed to a risk of harm ... if remedial action is not taken." *Foster*, 922 F. Supp. at 661; *Conservation Chem. Co.*, 619 F. Supp. at 194 (emphasis added).

Courts have consistently held that contamination does not present an imminent and substantial endangerment to human health or the environment where there is no present completed exposure pathway of contamination to someone or something. In *Meghrig v. KFC Western, Inc.*, the Supreme Court denied a claim for clean up costs under RCRA section 7002(a)(1)(B), stating that the "language" implies that there must be a threat which is present *now*, although the impact of the threat may not be felt until later.'" *KFC Western*, 116 S. Ct. at 1255 (emphasis in original). As support for this conclusion, the Supreme Court relied upon *Price v. United States Navy*, 39 F.3d 1011, 1019 (1994), where the presence of lead-contaminated soil under plaintiff's home was found not to be an imminent and substantial threat because the foundations and driveways acted as effective barriers, blocking the only pathway to the contamination. *Price*, 39 F.3d at 1020.

Likewise, in *Davies v. National Co-op. Refinery Ass'n*, the court found no "substantial endangerment" even where the plaintiffs' water wells were contaminated, because the plaintiffs and other "receptors" were aware of the contamination and were using an alternative water supply. *Davies v. National Co-op. Refinery Ass'n*, 1996 WL 529208, *2 (D.Kan. 1996). Relying on *Price*, the court explained that the ***risk of exposure*** is part of the equation in determining what constitutes an imminent endangerment to health. *Id.* Although there was a pathway of exposure to the contamination through the plaintiffs' well, the *Davies* court found that the "imminent risk" to the plaintiffs' health was diminished by the alternative water supply.[28]

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[28] *But cf. U.S. v. Waste Indus., Inc.*, 734 F.2d 159, 162-63 (4th Cir. 1984). In *Waste Industries* the court found an imminent and substantial endangerment where the county had provided another drinking water source. In this early (1984) case, as well as others the Plaintiffs cite, the court did not factor in the risk of exposure. The court discusses risks posed by trichloroethylene and other chlorinated solvents, stating that they "pose an

The court reached a similar conclusion in *Foster v. United States*. 922 F.Supp. 642, 660 (D. D.C. 1996), which relied on *Price* and *Conservation Chemical* in finding there was no imminent and substantial endangerment where the risks to human health and the environment posed by contaminated soil and groundwater "appear small and manageable." *Foster*, 922 F. Supp. at 662. In *Foster*, there was no present exposure pathway because contaminated soil was covered with asphalt pavement and contaminated groundwater was not used. *Id.* at 650, 660-662. According to the *Foster* court, "[w]hile there can be no question that the levels of contamination present at the site may warrant future response action, the plaintiff cannot establish either a current risk of "'substantial or serious' threatened harm, or 'some necessity for action.'" *Id.*

In this case, Plaintiffs appear to take the position that the mere presence of contaminants in soil or groundwater is sufficient to constitute "imminent and substantial endangerment." However, the courts no longer support that position. To constitute "endangerment" or a "risk of harm", there must be a complete exposure pathway to the contaminants. Further, exposure alone does not cause "harm." If residents are exposed to water that is contaminated in excess of drinking water standards, they have an increased "risk of harm" or threatened harm, not actual harm. The harm, if it develops at all, may take years to appear. It follows that if there is no possibility of exposure to the contamination, there is no risk of harm. *Price*, 39 F.3d at 1020; *Davies*, 1996 WK 529208 at *2, and *Foster*, 922 F. Supp. at 660-62.

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unacceptably high risk of neurological damage in children and cancer in humans of any age," Id. at 162. This, of course, assumes that children and humans come in contact with the contaminated water, i.e., that there is a completed exposure pathway. There is no discussion in *Waste Industries* about the need for an exposure pathway to be complete before an "imminent and substantial endangerment" exists. The absence of any teaching on that issue is not surprising given that the main thrust of the appeal was whether RCRA § 7003 is applicable to inactive "disposal," and whether § 7003 is limited to emergency situations. Whether the site posed a risk of endangerment was not at issue.

In each case cited by EPA, in which a court granted relief under RCRA § 7002 or § 7003, ***there was an existing exposure pathway*** to human or environmental receptors.[29] *Dague v. City of Burlington*, 935 F.2d 1343, 1356 (2d Cir. 1991) (landfill posed imminent and substantial endangerment where monitoring indicated leachate was leaking into soil, groundwater, and surface waters of the Interval wetland, and the leachate was toxic to freshwater aquatic life, including one vertebrate in the food chain); *U.S. v. Waste Indus., Inc.*, 734 F.2d 159, 162 (4th Cir. 1984) (contamination from landfill operations was present in residential wells at levels sufficient to adversely affect human health and the environment); *Morris v. Primetime Stores of Kansas, Inc.*, 1996 WL 563845, *4 (D. Kan. 1996) (gasoline seepage under plaintiffs' homes posed such an exposure threat that the state prohibited plaintiffs from occupying their homes); *United States v. Valentine*, 856 F. Supp. 621 (D.Wyo. 1994) (site may pose an imminent and substantial endangerment where toxins in open, unlined pits and leaking above-ground tanks posed significant health risks to birds and other wildlife); *Lincoln Properties, Ltd. v. Higgins*, 1993 WL 217429, *13-14 (E.D.Cal. 1993) (groundwater contamination was above state action levels in one county well and had already forced the abandonment of that well and three other county wells); *Conservation Chem. Co.*, 619 F. Supp. at 197-202 (contaminated groundwater from the site was discharging 22,000 pounds of hazardous substances into the Missouri and Blue rivers each year, and those rivers were exposure pathways for human and environmental receptors). Other cases Plaintiffs cite are silent with respect to the issue of

[29] As discussed in footnote 28, none of these cases survive the finding of *KFC* that an actually, as opposed to a potentially, completed pathway of exposure must exist for an "imminent and substantial endangerment" to be found.

imminent and substantial endangerment. *See U.S. v. Northeastern Pharmaceutical & Chem. Co., Inc.*, 810 F.2d 726, 730 and 745 (8th Cir. 1986).[30]

In spite of the case law to the contrary, Plaintiffs rest their case solely on the fact that contamination is present in groundwater at concentrations that exceed federal and state drinking water standards.[31] Plaintiffs acknowledge that the contamination is approximately two miles from the closest downgradient drinking water well and is moving toward the well at a rate of 100 to 300 feet per year, but do not point to any currently completed exposure pathway to human or environmental receptors. Thus, there is no current risk of harm and certainly no "imminent and substantial" endangerment because there is no completed exposure pathway to the contaminated portion of the aquifer.

A finding of no imminent and substantial endangerment is consistent with the analysis of Sparton's expert. In his affidavit, Dr. Glenn C. Millner explains in great detail why the site does not present an imminent and substantial endangerment to human health or the environment. Affidavit of Glenn C. Millner ("Millner Aff.") ¶¶ 7-25 (Exh. "I"). Reduced to its essentials, Dr. Millner's opinion is that: (1) because no one is currently drinking the water, there is no "imminent or substantial endangerment"; (2) even if at some future time the impacted water serves as a water supply source, the concentrations of constituents of concern do not necessarily provide a threat to health; (3) the impacted groundwater has quality problems independent of the impacts from the Sparton Plant that could preclude its use as a public water supply; and (4) EPA

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[30] *See Furrer v. Brown*, 62 F. 3rd 1092, 1101 (8th Cir. 1995) (explaining that the parties did not raise the issue of RCRA section 7003 jurisdiction in *U.S. v. Northeastern Pharmaceutical & Chem. Co.*, but simply assumed jurisdiction *sub silentio* to deal with the merits of EPA's claims to recover cleanup costs under that section).

[31] In his affidavit, Norman Gaume expressed concern that these impacts were in a "crucial area for groundwater protection." At his deposition Mr. Gaume had to admit the report he references specifies <u>all</u> groundwater in areas where the city might drill as crucial. Gaume Depo. at 59, 61-62. Yet other areas of contamination have not generated the same interest from the City as has Sparton's situation.

has failed to identify any endangerment to any ecological receptors, habitats, or ecosystems. *Id.*

Dr. Millner's position is supplemented by the affidavit of Pierce Chandler that establishes no City of Albuquerque public water supply wells are or will be in the flow path of the impacted groundwater through at least 2060. Chandler Aff. ¶ 12. The closest down-gradient public water supply well, owned and operated by an entity that is not even a plaintiff in this proceeding, will not be affected by any of the contaminants of concern for more than a hundred years, if ever. *Id.* ¶ 13.

That the city believes, notwithstanding these facts, that an "imminent and substantial endangerment" is presented to its public water supply wells is curious indeed. For instance, several city public water supply wells have been abandoned and others threatened by contaminants being found in the recovered water. Gaume Depo. at 50-51. Yet the city has not seen fit to identify those situations, caused by entities other than Sparton, as presenting an "imminent and substantial endangerment." Gaume Depo. at 51-52. Certainly if conduct by a party that contaminates a city water supply well is <u>not</u> an "imminent and substantial endangerment," then conduct by Sparton that does not even threaten a city public water supply well, should not present an "imminent and substantial endangerment."

Nor do the impacts to groundwater from the Coors Road Plant present any risk to a recharge area, as suggested by Norman Gaume in his affidavit. At his deposition Mr. Gaume testified that his views on that subject are based on what others have told him about where a "recharge reach" <u>may be</u> located. Gaume Depo. at 140. But the possible "recharge reach" others told Mr. Gaume might exist is outside of the impacted groundwater associated with Sparton's Coors Road Plant, and clearly not threatened. Chandler Aff. ¶ 14. In fact,

development of that potential recharge reach, if it occurs at all, is years away. Gaume Depo. at 144-146.

In short, no animate object is currently threatened by the impacted groundwater. No public water supply well is affected or threatened. No "recharge reach" is affected or threatened. There is no imminent and substantial endangerment.[32]

2. EPA Cannot Carry Its Burden Of Proof As To Irreparable Harm.

The basis for injunctive relief in federal court has always been irreparable injury and the inadequacy of legal remedies.[33] In this case, however, the EPA's own actions demonstrate the

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[32] Mr. Gaume admitted as much in his deposition through the following exchange at:

> Q. Did you attend a May 28th, 1996, forum on groundwater in the Albuquerque Basin sponsored by Senator Domenici?
> A. I probably did. I --
> Q. Well, weren't you, in fact, a panelist at that program?
> A. Oh, at the -- yes.
> Q. You were asked to come and speak. It was a panel and people, the public, was invited to talk about the Albuquerque groundwater basin?
> A. That's correct.
> Q. That meeting occurred on May 28th, 1996?
> A. If you say so.
> Q. You were asked at that meeting about the Sparton -- impacts to groundwater associated with the Sparton plant, weren't you?
> A. Yes.
> Q. You were asked at that meeting about whether the Sparton -- the impact to groundwater associated with Sparton presented any threat to the city water supply, weren't you?
> A. There was a question about that, yes.
> Q. What was your answer?
> A. I don't remember the specific question and I don't remember my answer.
> Q. Okay. You don't recall stating, in response to that question, that, quote, "No imminent threat to any wells -- there is not imminent threat to any wells. Our customers don't need to worry"?
> A. I may well have said that.

Gaume Depo. at 162-163.

Additionally, it is interesting that someone who claims to be concerned about threats presented to the city water supply by the impacted groundwater, does not know how close the nearest city well is to the impacted water, whether the nearest wells are sampled on a more rigorous basis than other city wells because of a potential threat, whether the impacted groundwater could still produce water suitable for human consumption, or whether the impacted groundwater, in the absence of solvents, would produce water of a quality the city would find acceptable.' Gaume Depo. at 82, 132, 133, 135, 158-159, 181-182.

[33] *See Weinberger v. Romero-Barcelo*, 456 U.S. 305, 312, 102 S. Ct. 1798, 1803 (1982).

absence of irreparable harm. EPA has had notice for 13 years that Sparton's former manufacturing process caused unintended environmental impacts. For 13 years, the status quo has remained unchanged; the contaminated groundwater, which is miles from any existing or proposed drinking water source, is expanding at a rate of approximately 100 feet per year. Despite 13 years' notice of this condition, EPA only now seeks preliminary injunctive relief to compel Sparton to conduct further study. Several courts have determined that where a movant has failed for a significant period of time to prevent a situation from continuing, imminent irreparable injury is presumptively absent.[34] In this case, EPA's delay in seeking injunctive relief demonstrates that the status quo can be maintained until the conclusion of the case.

Additionally, EPA claims it has a legal remedy, one that it has invoked--namely issuance of an order to Sparton, under § 3008(h) of RCRA, requiring action be undertaken to address the impacts to groundwater. According to EPA, Sparton should be able to restore the groundwater. If that position is correct, then testing, if necessary, can await identification of a final remedy. Even if contaminants have migrated, they can still be addressed through the legal remedies available to EPA.

3. The Balance Of Hardships Test Weighs Against Granting EPA's Request For A Preliminary Injunction.

This test, which requires that the relevant harms to the plaintiffs and defendant be compared, is typically given more weight than the other criteria for issuing a preliminary injunction.[35] Here that comparison leaves no doubt that no injunction should issue. EPA's proposed study will cost Sparton approximately $530,000. Richardson Aff. ¶ 7. On the other hand, if the injunction does not issue there is no harm to the plaintiffs because the contaminants

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[34] *Hutchinson*, 105 F.3d at 570; *see, e.g.*, *Brown*, 767 F.2d at 1240 ("We agree that a party's failure to seek preliminary injunctive relief is a good indication that the status quo can be maintained until the ultimate conclusion of the litigation."); *United States v. Wade*, 713 F.2d 49, 53 (3d Cir. 1983).

[35] *Hughes Network Sys. v. Interdigital Communications Corp.*, 17 F.3rd 691, 693 (4th Cir. 1994).

will continue to migrate whether or not the testing is done. Thus the additional groundwater that will be impacted will be the same whether or not an injunction is granted. Only implementing a containment well will stop the migration of contaminants above drinking water limits, and the Plaintiffs have not yet allowed that action to proceed.[36] Mico Aff. ¶ 12; O'Brien Aff. ¶ 2-8; Metzner Aff. ¶ 1-7.

Moreover, if Sparton were compelled to build the wells EPA proposes, Sparton would have no way to recover its costs if EPA did not prevail on the merits. Federal Rule of Civil Procedure 65(c) specifically exempts the United States or an agency thereof from being required to give security upon applying for preliminary injunctive relief.[37]

4. Granting the Relief Requested By EPA Will Disserve the Public Interest.

The additional investigation sought by EPA will serve only to delay the initiation of activity that will prevent additional groundwater from being impacted by solvents above drinking water standards. While Sparton does not believe that the impacted groundwater presents any risk to human health or the environment, it has committed to take appropriate action to limit the spread of the impacts. Sparton's hydrogeologist, Steve P. Larson, explains in detail in his affidavit why further testing and investigation is unnecessary before implementing a program to contain the impacted groundwater. Larson Aff. ¶¶ 4-18. Further testing only allows the area of impact to increase. Installing a containment well now will stop the further spread of solvents above drinking water limits. It seems self-evident that further testing would disserve the public

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[36] *See, e.g., American Hosp. Supply Corp. v. Hospital Prod. Ltd.*, 780 F.2d 589, 597 (7th Cir. 1986) (holding that the fact that preliminary injunction may precipitate defendant's bankruptcy ought to be considered in deciding whether to grant injunction); *Allison v. Froehlke*, 470 F.2d 1123, 1128 (5th Cir. 1972) (holding that trial court properly denied preliminary injunction when granting injunction would cause irreparable injury to defendants at rate of $49,000 per month in increased construction costs); *Sierra Club v. Resor*, 329 F. Supp. 890, 892 (W.D. Wisc. 1971) (denying preliminary injunction that might result in as much as a one-year delay in completing construction of dam).

[37] *Contrast Ohio Oil Co. v. Conway*, 279 U.S. 813, 815, 49 S. Ct. 256, 257 (1929) (observing that when expense to non-movant may be recovered through bond, preliminary injunction will usually issue).

interest, while moving forward now to contain the impacted area would serve the public interest. Unfortunately, for reasons that are not at all clear, the plaintiffs have been unwilling to grant Sparton authorization necessary to implement containment. By granting the requested relief, the court would only encourage further delays of the type that have resulted in over 8 years being consumed to study conditions at the site and propose a remedy. Such delay would appear to be contrary to the public interest and should not be encouraged.

The attached affidavits of Richard Mico, Vice President and General Manager of Sparton, Maria O'Brien, local counsel for Sparton, and Pete Metzner, local consultant for Sparton, detail the company's efforts to move forward on containment and the lack of cooperation from certain regulatory authorities. Sparton believes it is not unfair to infer that certain regulatory agencies are operating from a political agenda, instead of on the basis of legitimate technical concerns about how to address the impacted groundwater.

III.
CONCLUSION

Based on the foregoing, Sparton requests that the Motion for Preliminary Injunction be denied.

Respectfully submitted,

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By_____

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ATTORNEYS FOR DEFENDANT

CERTIFICATE OF SERVICE

On the 15th day May, 1997, an original and two copies of the foregoing document was hand-delivered to Plaintiff United States of America, with copies hand-delivered to all other counsel of record.

James P. Fitzgerald

COPY

IN THE UNITED STATES DISTRICT COURT FOR THE
DISTRICT OF NEW MEXICO

United States of America,	)	
	)	
Plaintiff,	)	Civil Action No.
	)	CIV 97 0210-M
v.	)	
	)	
Sparton Technology, Inc.,	)	
	)	
Defendant.	)	
The City of Albuquerque &	)	
The Bernalillo County Commissioners,	)	
	)	
Plaintiffs,	)	Civil Action No.
	)	CIV 97 0206-LH
v.	)	
	)	
Sparton Technology, Inc.,	)	
	)	
Defendant.	)	
State of New Mexico,	)	
New Mexico Environment Department, &	)	
New Mexico Office of the Natural	)	
Resources Trustee,	)	
	)	
Plaintiffs,	)	Civil Action No.
	)	CIV 97 0208-JC
v.	)	
	)	
Sparton Technology, Inc.,	)	
	)	
Defendant.	)	

PLAINTIFFS' JOINT OPPOSED MOTION FOR PRELIMINARY INJUNCTION AND MEMORANDUM IN SUPPORT

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H.R. Rep. No. 198, 98th Cong. at 48 (1984),
reprinted in 1984 U.S.C.C.A.N. 5576, 5607 9,18

S. Rep. No. 284, 98th Cong. at 56-57 (1983) 11,14

RULES & REGULATIONS

40 C.F.R. § 24.02(a) 6

40 C.F.R. § 144.3 20

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Fed. R. Civ. P. 65 1,6

INTRODUCTION

Plaintiffs in the above captioned actions hereby move for a preliminary injunction pursuant to Federal Rule of Civil Procedure 65. This Motion and Memorandum in Support is submitted by the City of Albuquerque and the Bernalillo County Commissioners ("the Municipal Plaintiffs"); the State of New Mexico, the New Mexico Environment Department ("NMED"), and the New Mexico Office of the Natural Resources Trustee ("ONRT") ("the State Plaintiffs"); and the United States (collectively "Plaintiffs"). Plaintiffs' Motion seeks to compel defendant Sparton Technology, Inc. ("Sparton") to perform certain actions which are necessary to abate an "imminent and substantial endangerment" to human health and the environment presented by groundwater contaminated with hazardous waste emanating from Sparton's plant on Coors Road in Albuquerque, New Mexico ("the Sparton facility").

The United States' action was commenced on behalf of the U.S. Environmental Protection Agency under the Resource Conservation and Recovery Act ("RCRA") Section 7003, 42 U.S.C. § 6973, and Safe Drinking Water Act ("SDWA") Section 1431, 42 U.S.C. § 300i.[1] The State and Municipal Plaintiffs commenced their actions under RCRA Section 7002, 42 U.S.C. § 6972.[2] An opposed motion to consolidate these actions was served on Sparton on March 18, 1997 and is pending under Local Rule 7.3(a).

The actions allege that solid and hazardous waste from Sparton's facility has entered the soil and groundwater and created a plume of groundwater contaminants which is migrating off-

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[1]No. CIV-97-02100M (filed February 19, 1997).

[2]Nos. Civ-97-02089-JC and CIV-97-0207-LH (both filed February 19, 1997).

site. The groundwater through which the contaminant plume is spreading is part of an aquifer that is the sole source of drinking water for the City of Albuquerque, and the Plaintiffs filed these actions in order to protect that drinking water supply.

In this Motion, the Plaintiffs ask this Court to order Sparton to take the first, critical steps needed to abate the imminent and substantial endangerment, namely: 1) to install monitoring wells and 2) to conduct an aquifer pump test to gather data concerning underground conditions. These measures are urgently needed to design a containment system to prevent further migration of the contaminated groundwater. These steps are more particularly described in Attachment A to the Plaintiffs' proposed Order.

The relief sought in this motion is distinct from the administrative order issued by EPA on September 16, 1996 ("the 1996 AO") pursuant to RCRA Section 3008(h), 42 U.S.C. § 6928, requiring Sparton to perform a "corrective action" for the Sparton facility, which would provide a full remedy for the soil and groundwater contamination caused by Sparton. Sparton is currently contesting the 1996 AO through an administrative hearing process. If, at the end of that process, the 1996 AO is affirmed and Sparton does not comply with the order, the United States will amend the complaint to add a claim under RCRA Section 3008(h) for enforcement of the administrative order.

While implementation of much of the final remedy set forth in the 1996 AO can await completion of the administrative process, a system to prevent further expansion of the contaminant plume must be installed as soon as possible. Every hour that goes by means that another 500 to 4,000 gallons of groundwater become contaminated by the ever expanding plume. Current data about the contaminant plume leaves great uncertainties regarding the size,

volume and location of the plume. This preliminary injunction motion addresses the urgent need for Sparton to immediately acquire additional information that will further describe and delineate the plume, so that a proper containment system can be designed to protect public health and the environment.

STATEMENT OF FACTS

I. THE SPARTON FACILITY: DESCRIPTION AND OPERATIONS

The Sparton facility is located at 9261 Coors Road NW in Albuquerque, New Mexico. The facility is approximately one half mile west of the Rio Grande River and sits approximately sixty to seventy-five feet above the groundwater table. The groundwater underlying the facility is a part of the Santa Fe Group of aquifers, which is the sole source of drinking water for the Albuquerque municipal area. The groundwater under the Sparton facility flows generally in a northwest direction-- towards a municipal water well. Residential developments, both existing and planned, are located on the hills to the west of the facility. Declaration of Vincent E. Malott ("Malott Decl.") ¶ 5, 6, 7, & 25 (Exh. 1); Affidavit of Norman Gaume ("Gaume Aff.") ¶¶ 4 & 8 (Exh. 2); Affidavit of Dr. Robert Morrison ¶ 3 (Exh. 3); Answer in No. CIV 97-0210M ¶ 11,12, & 13.

Manufacturing operations at the Sparton facility extended from 1961 to 1994.[3] Sparton's operations generated aqueous plating wastes containing heavy metals and waste solvents. From approximately 1961 to 1983, hazardous wastes were stored in surface

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[3]The name of the company was originally Sparton Southwest, Inc. On March 14, 1983, Sparton Southwest, Inc. amended its corporate charter to change its name to Sparton Technology, Inc. Malott Decl. ¶ 15 (Exh. 1). Since the corporation merely changed its name, all statements by Sparton Southwest, Inc. apply equally to Sparton Technology, Inc.

impoundments and in a sump. Until 1981, Sparton also stored drums containing hazardous wastes on the ground. Malott Decl. ¶¶ 27 & 21 (Exh. 1); Answer in No. CIV-97-0210-M ¶ 18.

II. REGULATORY HISTORY AND SITE INVESTIGATIONS

Pursuant to RCRA requirements, in 1980 and 1983, Sparton submitted various notices and applications to EPA stating that it generated, treated, stored, or disposed of hazardous wastes at its facility. On February 22, 1984, Sparton and EPA signed an Administrative Order on Consent in which Sparton agreed to maintain a groundwater monitoring program which complied with EPA regulations. Once implemented, the monitoring program showed that hazardous wastes from the Sparton facility had been released into the groundwater under the facility. Malott Decl. ¶¶11-19; Answer in No. CIV-97-0210-M ¶¶ 18-19.

On October 1, 1988, Sparton and EPA signed a second Administrative Order On Consent ("the 1988 AOC") requiring Sparton to (1) install an on-site groundwater recovery system, (2) conduct a RCRA facility investigation of groundwater contamination, and (3) conduct a Corrective Measures Study ("CMS") of clean-up alternatives. Sparton complied with the first requirement of the 1988 AOC by completing installation of the on-site ground water recovery system in 1988.[4] Malott Decl. ¶¶ 25-26 (Exh. 1); Answer in No. CIV-97-0210-M ¶¶ 20-21.

On May 14, 1992, Sparton submitted a RCRA facility investigation report showing

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[4]While EPA has determined that the on-site recovery system has not been shown to address groundwater beyond the borders of the facility, it remains in operation. Malott Decl. ¶ 31 (Exh. 1).

inorganic and organic contaminants in the on and off-site groundwater including trichloroethylene ("TCE") and chromium. The data showed that, as of 1992, contaminated groundwater was moving northwesterly and extended at least 2,100 feet from the facility and at least seventy feet below the water table. The report did not determine the full depth of the plume or the exact location of its leading edge. Malott Decl. ¶ 27 (Exh. 1); Morrison Aff. ¶ 7 (Exh. 3).

On May 13, 1996, Sparton submitted its Corrective Measures Study report under the 1988 AOC. In the report, Sparton recommended a limited corrective action for the site and did not propose any off-site extraction wells to contain the plume. EPA approved Sparton's study on June 24, 1996 but included a detailed, nineteen page discussion challenging the methodology and analysis in the CMS. Malott Decl. ¶¶ 29-31 (Exh. 1).

Also on June 24, 1996, pursuant to RCRA Section 3008(h), 42 U.S.C. § 6928(h), EPA issued a RCRA Corrective Action Final Decision which selected a more comprehensive remedy than Sparton had suggested. EPA's selected corrective action consists of:

- Continued operation of the on-site ground water extraction and treatment systems;
- Further characterization of the extent (including depth and size) of contamination in the ground water and vadose (subsurface area above the water table) zone;
- After characterization, installation of additional groundwater extraction wells at the leading edge of the plume. Additional extraction wells would later be installed within the plume to remove contaminants and restore the ground water. Water from the extraction wells would be treated and disposed; and
- Installation and operation of an on-site soil vapor extraction ("SVE") system to extract volatile organic contaminants remaining in the soil.

Mallot Decl. ¶ 32 (Exh. 1). EPA's selected remedy differs from the remedy set forth in Sparton's CMS in that it calls for further efforts to locate the leading edge of the plume and for

the installation of off-site extraction wells both to contain and clean-up the contaminated groundwater plume. The number of additional extraction wells needed to accomplish that objective was not specified because there is not sufficient data to determine that number at present.[5]

On September 16, 1996, after unsuccessfully attempting to reach an agreement with Sparton to implement its selected corrective action, EPA issued an administrative order to Sparton pursuant to RCRA Section 3008(h), 42 U.S.C. 6928(h) ("the 1996 AO"). The 1996 AO requires Sparton to implement the corrective action selected by EPA in June 1996. Sparton filed an administrative appeal on October 18, 1996.[6] An administrative hearing was held on March 27, 1997. Malott Decl. ¶ 33 (Exh. 1). Under the applicable regulations, the 1996 AO will not become a final, enforceable order until the administrative process is completed. 40 C.F.R. § 24.02(a). Since it is uncertain when the administrative process will be completed, injunctive relief ordered by this Court is the only vehicle whereby immediate action can be secured.

During the fall of 1996, Plaintiffs attempted to reach an agreement with Sparton to

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[5]On August 7, 1996, Sparton sued the EPA regarding the 1996 Corrective Action Decision. Sparton Technology, Inc. v. United States Environmental Protection Agency, No. 3-96CV2229-G (N.D. Tex.). The United States moved to Dismiss the complaint on November 15, 1996. On February 27, 1997 Sparton moved to amend its complaint to add, inter alia, a claim seeking a stay of the administrative action. The United States moved to dismiss the amended complaint on March 20, 1997. These motions are pending. On March 20, 1997, Sparton filed a motion for preliminary injunction seeking to stay an administrative hearing scheduled for March 27, 1996. On March 26, 1997, that motion was denied.

[6]Hearing procedures applicable to administrative orders under RCRA Section 3008(h) are governed by regulations at 40 C.F.R. Part 24. These regulations do not provide for immediate injunctive relief equivalent to a preliminary injunction under FRCP 65..

conduct the aquifer pump test and install the additional monitoring wells sought in this motion. No agreement was reached.

III. IMMINENT AND SUBSTANTIAL ENDANGERMENT DETERMINATIONS

On February 14, 1997, EPA issued a determination that the contaminant plume emanating from the Sparton facility may present an "imminent and substantial" endangerment to public health and the environment. Malott Decl. ¶ 36 (Exh. 1). EPA's determination was based on the following findings:

- Contaminants present in the soil at the site include: Trichloroethylene ("TCE"), 1,1,1-trichloroethane, 1,1-Dichloroethylene, and tetrachloroethylene.
- Contaminants present in the groundwater at the site include: trichloroethylene ("TCE"), 1,1,1-trichloroethane, methylene chloride, 1,1-dichloroethylene, tetrachloroethylene, toluene, benzene, and chromium.
- The contaminant plume from the Sparton facility is located in the Santa Fe Group aquifer which is the sole source of drinking water for the City of Albuquerque and Bernalillo County.
- A drinking water well, New Mexico Utilities Well No. 2, is located approximately two miles from the leading edge of the contaminant plume and the direction of groundwater flow is towards the well.
- The plume of contaminated groundwater extends approximately one-half mile northwest of the facility and reaches a depth of at least seventy feet.
- The contaminant plume is flowing with the groundwater in a northwesterly direction at a rate of approximately 100 to 300 feet per year.
- The contaminants in the groundwater far exceed federal drinking water standards and state groundwater standards. See Table E in Malott Decl. ¶ 36.

As shown in Table E of the Malott Declaration, the groundwater contaminants from the

Sparton facility far exceed federal safe drinking water and state groundwater standards[7] and render the affected portion of the Santa Fe aquifer unfit for drinking purposes. Based upon this, EPA concluded that the contaminant plume emanating from the Sparton facility may present an imminent and substantial endangerment to human health and the environment pursuant to Section 7003 of RCRA, 42 U.S.C. § 6973 and Section 1431 of the SDWA, 42 U.S.C. § 300i. Malott Decl. ¶ 36 (Exh. 1).

Based on similar information, on February 14, 1997, NMED and ONRT jointly issued a determination that the Sparton facility may present an imminent and substantial endangerment to health or the environment within the meaning of RCRA Section 7002, 42 U.S.C. § 6972, and analogous state law. (Exh. 4).

ARGUMENT

I. THE COURT SHOULD ISSUE A PRELIMINARY INJUNCTION

Traditionally, courts apply a four-part test when considering applications for preliminary injunctive relief. Under that test, the movant must establish:

(1) substantial likelihood that the movant will prevail on the merits;

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[7]The federal regulations were promulgated pursuant to the SDWA at 40 C.F.R. Part 141. Those regulations set forth Maximum Contaminant Levels Goals ("MCLGs") and Maximum Contaminant Levels ("MCLs") for certain contaminants in water. MCLGs are the level at which the agency has determined that "no known or anticipated adverse effects on the health of persons occur and which allow an adequate margin of safety." 42 U.S.C.A. § 300g-1(b)(4(A) (1996). MCLs are enforceable standards for public water supply systems which are set as close to the MCLGs as feasible. In determining feasibility, the EPA considers the level that can be achieved using the best available treatment technology considering cost. Id. at § 300g-1(b)(4)(B). The New Mexico Water Quality Control Commission ("WQCC") has also promulgated regulations establishing the maximum allowable concentration of contaminants in groundwater. 20 NMAC 6.2, Section 3103.

(2) that the movant will suffer irreparable injury if the injunction is not issued;

(3) that the threatened injury to the movant outweighs any damage that the injunction would cause to the opposing party; and

(4) that the injunction would not adversely affect the public interest.

Lundgrin v. Claytor, 619 F.2d 61, 73 (10th Cir. 1980).[8] We demonstrate below that all four prongs of this test are met in this case.

A. There Is More Than A Substantial Likelihood That The United States Will Prevail On The Merits

There is more than a substantial likelihood that Plaintiffs will prevail on the merits in this action. In their Complaints, the Plaintiffs claim:

(1) Sparton is liable to take actions necessary to abate the imminent and substantial endangerment at the Sparton facility under RCRA Sections 7002 and 7003, 42 U.S.C. §§ 6972 and 6973;

and the United States further claims:

(2) Sparton is liable to take all actions necessary to protect the health of persons from the imminent and substantial endangerment resulting from contaminants present in the

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[8]Several decisions in this Circuit have dispensed with the showing of irreparable harm in cases involving statutory violations or statutes specifically authorizing injunctive relief. See Mical Communications, Inc. v. Sprint Telemedia, Inc., 1 F.3d 1031, 1036 (10th Cir. 1993) (in action under the federal Communications Act, "[w]hen the evidence shows that the defendants are engaged in, or about to be engaged in, the act or practices prohibited by a statute which provides for injunctive relief to prevent such violations, irreparable harm to the plaintiffs need not be shown"); Country Kids 'N City Slicks, Inc. v. Sheen, 77 F.3d 1280, 1288-89 (10th Cir. 1996) (in a copyright infringement case, "because the financial impact of copyright infringement is hard to measure and often involves intangible qualities such as customer goodwill, we join the overwhelming majority of our sister circuits and recognize a presumption of [irreparable] injury at the preliminary injunction stage once a copyright infringement plaintiff has demonstrated a likelihood of success on the merits."). However, see Amoco Production Co. v. Village of Gambell, 480 U.S. 531 (1987) (irreparable harm could not be presumed from agency's failure to comply fully with statutory requirements for environmental impact assessment).

groundwater pursuant to SDWA Section 1431, 42 U.S.C. § 300i.

While the actions which would be required of Sparton under each of these claim are essentially identical, Plaintiffs are substantially likely to prevail on all claims.

1. Plaintiffs Are Substantially Likely To Prevail Upon Their Claims Under The Resource Conservation And Recovery Act

Plaintiffs are substantially likely to prevail upon their claims under RCRA Sections 7002 and 7003, 42 U.S.C. §§ 6972 and 6973.[9] RCRA Section 7003(a) states:

> [U]pon receipt of evidence that the past or present handling, storage, treatment, transportation or disposal of any solid waste or hazardous waste may present an imminent and substantial endangerment to health or the environment, the Administrator may bring suit on behalf of the United States in the appropriate district court against any person (including . . . any past or present owner or operator of a treatment, storage, or disposal facility) who has contributed or is contributing to such handling, storage, treatment, transportation, or disposal to restrain such person . . . [or] to order any person to take such other action as may be necessary, or both . . . .

42 U.S.C. § 6973(a). In enacting Section 7003, Congress "intended to confer upon the courts the authority to grant affirmative equitable relief to the extent necessary to eliminate any risks posed by toxic wastes." U.S. v. Price, 688 F.2d. 204, 214 (3rd Cir. 1982). "Congress broadly drafted these provisions to give appropriate government officials the right to seek judicial relief, or take other appropriate action to avert imminent and substantial threats to the environment or public health." U.S. v. Reilly Tar & Chem. Corp., 546 F. Supp. 1100, 1107 (D. Minn. 1982).

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[9]The Tenth Circuit has held that if a movant satisfies elements two (2) through four (4) of the preliminary injunction standard, the movant may prevail by showing "questions going to the merits so serious, substantial, difficult and doubtful, as to make them fair ground for litigation." Resolution Trust Corp. v. Cruce, 972 F.2d 1195, 1199 (10th Cir. 1992) (quoting Tri-State Generation v. Shoshone River Power, Inc. 805 F.2d 351, 358 (10th Cir. 1986).

In language virtually identical to that in Section 7003, RCRA Section 7002(a) states:

> [A]ny person may commence a civil action on his own behalf--
> (1) . . .
> (B) against any person, . . . including . . . any past or present owner or operator of a treatment, storage, or disposal facility, who has contributed or who is contributing to the past or present handling, storage, treatment, transportation, or disposal of any solid or hazardous waste which may present an imminent and substantial endangerment to health or the environment.

42 U.S.C. § 6972(a). In enacting this provision, Congress intended to provide citizens with a cause of action identical to that under RCRA Section 7003:

> These amendments are intended to allow citizens exactly the same broad substantive and procedural claims for relief which is already available to the United States under section 7003. . . . Any differences in language between these amendments and section 7003 are not intended to reflect a difference in such claims, but merely to clarify that citizens will have the same claims presently available to the United States.

S. Rep. No. 284, 98th Cong. at 56-57 (1983), reprinted in 2 A Legislative History Of The Solid Waste Disposal Act as Amended at 2082-83 (1991). Accordingly, the courts have interpreted RCRA Sections 7002 and 7003 as having identical scope.

Under Sections 7002 and 7003, "past operators, generators and transporters may be held to a standard of strict liability for their activities." U.S. v. Conservation Chem. Co., 619 F. Supp. 162, 198 (W.D. Mo. 1985). This holding is consistent with legislative intent underlying the 1984 amendments to RCRA. The House Committee on Energy and Commerce stated "[t]he [1984] amendments clearly provide that anyone who has contributed or is contributing to the creation, existence, or maintenance of an imminent and substantial endangerment is subject to the equitable authority of Section 7003, without regard to fault or negligence." H.R. Rep. No. 198, 98th Cong. at 48 (1984), reprinted in 1984 U.S.C.C.A.N.

5576, 5607.

In order to establish that Sparton is liable under RCRA Sections 7002 and 7003, the Plaintiffs need only establish (1) that handling, storage, treatment, transportation or disposal of solid waste or hazardous waste at the Sparton facility (2) may present an imminent and substantial endangerment to health or the environment and (3) Sparton contributed to such handling storage, treatment, transportation or disposal of solid waste or hazardous waste. 42 U.S.C. §§ 6972(a) & 6973(a). See, U.S. v. Aceto Agr. Chemicals Corp., 872 F.2d 1373, 1382 n. 9 (8th Cir. 1989).

a. Solid or hazardous wastes were handled, stored, treated, transported or dispose of at the Sparton facility

There is no question that hazardous wastes were handled, stored, treated, transported, and/or disposed of at the Sparton facility from 1961 through at least 1983. EPA has promulgated regulations defining hazardous wastes. 40 C.F.R. Part 261.[10] Under these regulations, hazardous wastes include all solid wastes listed in 40 C.F.R. Part 261, Subpart D ("listed hazardous wastes").

Sparton admits that it generated and stored solid and hazardous wastes at its facility. Malott Decl. ¶¶ 9-14 (Exh. 1); Answer in action No. CIV-97-0210-M ¶ 18. Among the numerous hazardous wastes which Sparton notified EPA it handled were: F002 (spent halogenated solvents) and F005 (spent non-halogenated solvents).[11] Malott Decl. ¶¶ 10-14

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[10]Hazardous wastes under 40 C.F.R. Part 261 are hazardous wastes for puposes of RCRA Sections 7002 and 7003. U.S. v. Valentine, 856 F. Supp. 621, 627 (D. Wyo. 1994).

[11]These waste codes describe listed hazardous wastes that can contain constituents including tetrachloroethylene, trichloroethylene (TCE), methylene chloride, and 1,1,1-trichloroethane.

(Exh. 1). Sparton also admits in its Answer that the hazardous wastes stored at its facility have been released to the environment. Answer in No. CIV-97-0210-M ¶ 19.

The hazardous wastes identified by Sparton as being handled at the Sparton facility can contain exactly the same substances, including TCE, as those detected in the plume of contamination emanating from its facility. Malott Decl. ¶ 9 & 12 (Exh. 1). This is consistent with Sparton's submissions to EPA which state that Sparton placed spent solvents into an on-site sump and that the sump is the source of contamination. Malott Decl. ¶ 27 (Exh. 1). Thus, there can be no question that solid and hazardous wastes handled by Sparton contributed to the contamination emanating from the Sparton facility.

b. There is an imminent and substantial endangerment to health or the environment at the Sparton facility

Originally enacted in 1976, Section 7003 allowed EPA to seek injunctive relief based on evidence that the handling of waste "is presenting" an imminent and substantial endangerment. In order to "enhance[] the ability of the Administrator to take precautionary measures," the 1980 amendments to RCRA permitted the EPA to act upon evidence that the handling of waste "may present" an endangerment. 126 Cong. Rec. 3345 (1980) (statement of Rep. Florio). Congress adopted similar language in Section 7002.

Congress intended Sections 7002 and 7003 to be interpreted broadly. The report of the Senate Committee on the 1984 amendments to RCRA stated that when evaluating a claim of endangerment, "risk may be assessed from suspected, but not completely substantiated, relationships between facts, from trends among facts, from theoretical projections, from

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40 C.F.R. § 261.31.

imperfect data, or from probative preliminary data not yet certifiable as 'fact.'" S. Rep. No. 284, 98th Cong., 1st Sess. at 59 (1984), reprinted in 2 A Legislative History Of The Solid Waste Disposal Act as Amended at 2082-83 (1991).

Judicial interpretations of the RCRA endangerment standard have been consistent with the legislative history. For example, in U.S. v. Valentine, 856 F. Supp. 621 (D. Wyo. 1994), a district court in the Tenth Circuit held that EPA need only find that there "may" be an endangerment. Id. at 626 (emphasis in original). The same court held that "[a]n endangerment is not actual harm, but a threatened or potential harm." Id.[12]

Congress also intended that courts construed the term "imminent" broadly. As noted by the Senate Report for the Hazardous and Solid Waste Amendments:

> [An] endangerment is "imminent" and actionable when it is shown that it presents a threat to human health or the environment, even if it may not eventuate or be fully manifest for a period of years--as may be the case with drinking water contamination, cancer, and many other effects.

S. Rep. No. 284, 98th Cong., 1st Sess. at 59 (1984), reprinted in 2 Legislative History of the Solid Waste Disposal Act as Amended 2085 (emphasis added)).

In Meghrig v. KFC Western, Inc., 116 S. Ct. 1251 (1996), the Supreme Court recently addressed the meaning of "imminent" under RCRA noting that "imminent" can refer to the risk of future harm. Specifically, the Court held that "§ 6972(a) was designed to provide a remedy

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[12]See also Price v. U.S. Navy, 39 F.3d 1011, 1019 (9th Cir. 1994) ("'endangerment' means a threatened or potential harm and does not require proof of actual harm"); U.S. v. Waste Indus., Inc., 734 F.2d 159, 164 (4th Cir. 1984); Dague v. City of Burlington, 935 F.2d 1343, 1355 (2d Cir. 1991); U.S. v. Waste Indus. Inc., 734 F.2d 159, 165 (4th Cir. 1984); U.S. v. Conservation Chem. Co., 619 F. Supp. 162, 193-195 (D.C. Mo. 1985); Lincoln Properties, Ltd v. Higgins, 1993 WL 217429, *12 (E.D. Cal. 1993).

that ameliorates present or obviates the risk of future 'imminent' harms . . . ." Id. at 1255.[13] The Valentine court held that "[a]n endangerment need be neither immediate nor tantamount to an emergency to be imminent and warrant relief." and that an endangerment is "imminent" if "factors giving rise to it are present, even though the harm may not be realized for years." Valentine, 856 F. Supp. 627. See also U.S. v. Conservation Chem. Co., 619 F. Supp. 162, 194 (W.D. Mo. 1985).

Courts have also construed the term "substantial" broadly in the context of RCRA. For example, the Valentine court held that:

> The United States need not quantify the endangerment to prove that it is substantial. It is sufficient to demonstrate that there exists reasonable cause for concern for the integrity of the public health or the environment.

U.S. v. Valentine, 856 F. Supp. at 626; see also Lincoln Properties, Ltd. v. Higgins, 1993 WL 217429, *12 (E.D. Cal. 1993); U.S. v. Conservation Chem., 619 F. Supp. at 194.

Both EPA and the State have determined that the presence of solid or hazardous wastes in the soil and groundwater at the Sparton facility "may present an imminent and substantial endangerment to health or the environment" within the meaning of RCRA Sections 7002 and 7003, 42 U.S.C. § 6972 and 6973. (Exh 1, Attachment __ & Exh. 4) Sparton's own studies

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[13]Unlike the instant case, Mehrig involved a claim by a private party for recovery of costs related to a successful, completed cleanup action. Noting that the contamination at issue in the Mehrig case had already been cleaned up, the Court held that the endangerment at issue could not be imminent. Id. See also Price v. U.S. Navy, 39 F.3d 1011, 1019 (9th Cir. 1994) (holding that "[a] finding of 'imminency' does not require a showing that actual harm will occur immediately so long as the risk of threatened harm is present . . . ."); Ottati & Goss, 630 F. Supp. 1361, 1394 and 1400 (D.N.H. 1985) (defining "imminence" as "any point in a chain of events which may ultimately result in harm to the public. It is not necessary that the final anticipated injury actually have occurred prior to the determination that an 'imminent hazard' exists."); Environmental Defense Fund v. EPA, 465 F.2d 528, 535 (D.C. Cir. 1972)).

show that hazardous wastes, including TCE, are present in Albuquerque's drinking water aquifer at levels significantly above federal and state water standards. Malott Decl. ¶¶ 27 and 34 (Exh. 1). For example, the groundwater contains concentrations of 7,600 parts per billion ("ppb") TCE beneath the facility and 3,200 ppb TCE near the center of the plume compared to a federal MCLG of zero.[14] In addition, significant concentrations of 1,1,1-trichloroethane, 1,1-dichloroethane and tetrachloroethylene are present in the groundwater. Malott Decl. ¶ 36 (Exh. 1).

Many courts have found that contamination of groundwater may present an imminent and substantial endangerment to public health and the environment. See U.S. v. Northeastern Pharmaceutical & Chem. Co., Inc., 810 F.2d 726, 730 and 745 (8th Cir. 1986) (holding defendants liable under RCRA Section 7003 at site where groundwater was contaminated; groundwater contamination more fully described in the district court opinion at 579 F. Supp. 823, 832-33 (D. Mo. 1984)); U.S. v. Waste Indus., Inc., 734 F.2d 159, 167 (4th Cir. 1984) (reversing dismissal under FRCP 12(b)(6) of claim under Clean Water Act of endangerment from groundwater contamination); Morris v. Primetime Stores of Kansas, Inc., 1996 WL 563845, *4 (D. Kan. 1996) (gasoline seepage contaminated groundwater creating an imminent and substantial endangerment); Lincoln Properties, Ltd. v. Higgins, 1993 WL 217429, *13-14 (granting relief under RCRA Section 7002 based on finding harm to groundwater); U.S. v. Conservation Chem. Co., 619 F. Supp. at 197-202 (granting relief under Section 7003 where

[14]The federal drinking water standards known as "MCLGs" represent the level at which the EPA has determined that "no known or anticipated adverse effects on the health of persons occur and which allow an adequate margin of safety." 42 U.S.C.A. § 300g-1(b)(4)(A) (1996).

groundwater was contaminated).

The contamination from the Sparton facility clearly endangers public health and the environment. Groundwater is an important resource nationally, and it is particularly precious in the arid region of New Mexico. Indeed, the Groundwater Protection Policy and Action Plan for the City of Albuquerque has proposed placing wells in the vicinity of the Sparton facility. New Mexico Utilities, a private utility that supplies water in the area of the Sparton facility, has been issued a permit to install a well in the area of the Sparton plume. But for the contamination, this groundwater would be suitable for drinking. Gaume Aff. ¶ 2-7 (Exh. 2). As hazardous wastes continue to spread from the Sparton facility, more and more of this precious groundwater will be contaminated. According to the best estimate based on available data, each hour up to an additional 4,000 gallons of previously clean groundwater may become contaminated. Morrison Affidavit ¶ 4 (Exh. 3).

This imminent threat to the City of Albuquerque's drinking water aquifer clearly presents "an imminent and substantial endangerment to public health or the environment" within the meaning of RCRA Sections 7002 and 7003.

c. Sparton is a person who has contributed to the handling, storage, treatment, transportation, or disposal of hazardous wastes at the Sparton facility.

Under Sections 7002 and 7003, the scope of liability is broad. Where past or present disposal of hazardous wastes may present an endangerment, EPA or a citizen may bring an action to abate the endangerment against "any person (including any past or present generator . . . or past or present owner or operator of a treatment, storage, or disposal facility) who has contributed . . . to such . . . disposal." RCRA Section 7003(a), 42 U.S.C. § 6973(a). RCRA

Section 7002 contains virtually identical language. 42 U.S.C. § 6972(a). In U.S. v. Aceto Agric. Chems. Corp., 872 F.2d 1373 (8th Cir. 1989), the court found that "[t]he relevant legislative history supports a broad, rather than a narrow, construction of the phrase 'contributed to.'" Id. at 1384. The Aceto court then held that "[a]lthough the phrase 'contributing to' is not defined by the statute, its plain meaning is 'to have a share in any act or effect.'" Id., at 1384. See also U.S. v. Ottati & Goss, Inc., 630 F. Supp. 1361, 1393 (D.N.H. 1985).

A showing that a party owned or operated a facility where hazardous waste was disposed is equivalent to showing that the party "contributed to" disposal of the hazardous waste. As a practical matter, any party owning or operating a facility where hazardous waste was disposed will necessarily "have a share in" that disposal.[15] Sparton is both the past and present owner and past operator of the Sparton facility. Answer in No. CIV-97-0210-M ¶ 18; Malott Decl.¶15 &29 (Exh. 1). In its submissions to EPA, Sparton unequivocally states that its operations involved the generation of aqueous plating wastes and spent solvents. Sparton also states that it placed these wastes in sumps, ponds, and drums. Malott Decl. ¶¶ 10-14, & 27, 29 (Exh. 1). Thus, Sparton is a person[16] who has contributed to disposal of hazardous wastes

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[15]The legislative history reveals that Congress equated owner/operator status with contributing to disposal. Discussing the 1984 amendments to RCRA Section 7003, the Report of the House Energy and Commerce Committee states:

> The amendments clearly provide that anyone who has contributed or is contributing to the creation, existence, or maintenance of an imminent and substantial endangerment is subject to the equitable authority of Section 7003, without regard to fault or negligence. Such persons include . . . past and present owners and operators or [sic] waste treatment, storage, or disposal facilities . . . .

H.R. Rep. No. 198, 98th Cong. 48, reprinted in 1984 U.S.C.C.A.N. 5576, 5606.

[16]Section 1004(15) of RCRA, 42 U.S.C. § 6903(15), includes corporations in its definition

at the Sparton facility, and, therefore, falls squarely within the category of persons who are expressly liable under RCRA Sections 7002 and 7003.

2. The United States Is Substantially Likely To Prevail Upon Its Claim Under The Safe Drinking Water Act

For the same reasons set forth above, the United States is substantially likely to prevail upon its claim under the SDWA Section 1431, 42 U.S.C. § 300i. SDWA Section 1431 is similar to RCRA Section 7003 in that both sections authorize the EPA to seek injunctive relief to abate an imminent and substantial endangerment to the public health. Section 1431 of the SDWA, 42 U.S.C. § 300i, provides, in pertinent part:

> [T]he Administrator, upon receipt of information that a contaminant which is present in or is likely to enter a public water system or an underground source of drinking water may present an imminent and substantial endangerment to the health of persons, and that appropriate State and local authorities have not acted to protect the health of such persons, may take such actions as he may deem necessary in order to protect the health of such persons . . . . The actions which the Administrator may take include (but shall not be limited to) (1) issuing such orders as may be necessary...and (2) commencing a civil action for appropriate relief including a restraining order or permanent or temporary injunctions.

42 U.S.C. § 300i(a).

As explained above, contaminants from the Sparton facility are present in the Santa Fe Group aquifer system which supplies drinking water to the City of Albuquerque, and may present an imminent and substantial endangerment to the health of persons. The substances identified in Malott Declaration Table E are "contaminants" present in the groundwater at the

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of "person." The Defendant is a corporation organized under the laws of the State of New Mexico. Answer in CIV-97-0210-M ¶4 As such, it is a "person" within the meaning of RCRA.

Sparton facility.[17]

Although there is no case law interpreting the meaning of "imminent and substantial endangerment" under the SDWA alone, courts have looked to interpretations of RCRA and other endangerment provisions of federal environmental statutes when interpreting the SDWA. In a case involving allegations of imminent and substantial endangerment, the Second Circuit held that "[t]he similarity between the CWA [Clean Water Act] and the later enacted SDWA and RCRA leads us to read all three acts in a similar manner." U.S. v. Hooker Chems. & Plastics Corp., 749 F.2d 968, 981-82 (2d Cir. 1984). See also U.S. v. Price, 688 F.2d 688, 211 (3d Cir. 1982) (noting the similarity in Congressional intent underlying RCRA Section 7003 and SDWA Section 1431). Applying the broad judicial interpretations of the "imminent and substantial endangerment" provisions of RCRA Sections 7002 and 7003 discussed above, it is apparent that the "endangerment" to public health presented by the Sparton contamination is "imminent and substantial." The public water supply already is impacted and more and more of that supply is being lost, perhaps irretrievably, each day. If not contained, the plume of contamination will continue to spread and could become a direct threat to the health of anyone who may use the groundwater in this area.

In the "Determination of Imminent and Substantial Endangerment," EPA specifically

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[17]The term contaminants is broadly defined by the SDWA to mean "any physical, chemical, biological, or radiological substance or matter in water." 42 U.S.C. § 300g. The term "underground source of drinking water" is defined as "an aquifer or its portion . . (a)(1) which supplies any public water system; or (2) which contains a sufficient quantity of groundwater to supply a pubic water system and (i) currently supplies drinking water for human consumption; or (ii) contains fewer than 10,000 mg/l total dissolved solids. 40 C.F.R. § 144.3. The aquifer contaminated by the Sparton plume qualifies under this definition. Malott Affidivit (Exh. 1) at ¶ 35.

found that the contamination present at the Sparton facility presents an imminent and substantial endangerment to the health of persons within the meaning of SDWA Section 1431. Malott Decl., Attachment AA ¶ 57 (Exh 1). In that same document, EPA found that in response to the 1988 AOC issued by EPA under RCRA Section 3008(h), state and local agencies had taken no governmental action to protect the health of persons from contaminants emanating from the Sparton site. Id. at ¶ 45. Together, these findings satisfy the prerequisites to filing an action for injunctive relief under SDWA Section 1431.

B. Preliminary Injunction Is Necessary to Prevent Irreparable Harm

For the same reasons that the Plaintiffs believe that there is an "imminent and substantial endangerment" to health and the environment from the Sparton contaminant plume, we believe that the public will suffer irreparable injury unless this Court issues the requested preliminary injunction. The environmental harm described in Section I(A)(1)(b) above is precisely the type of harm that courts have found to be irreparable. In Amoco Production Co. v. Village of Gambell, 480 U.S. 531, 544-45 (1987), the Court held that "[e]nvironmental injury by its nature can seldom be adequately remedied by money damages and is often permanent or at least of long duration, i.e., irreparable." Id. at 545. See also Sierra Club v. Hodel, 848 F.2d 1068, 1097 (10th Cir. 1988) (holding that continuation of construction activities prior to completion of environmental studies required by federal law would constitute irreparable harm); Provo River Coalition v. Pena, 925 F. Supp. 1518, 1524 (D. Utah 1996) (holding that construction activities which would permanently alter Provo Canyon constitute irreparable injury).

The continued expansion of the Sparton contaminant plume presents a particular threat

of irreparable harm because clean-up of contaminated groundwater is difficult and uncertain. Although it is a goal of EPA's selected remedy to restore the groundwater to comply with drinking water standards, the success of restoration is not guaranteed. At a minimum, aquifer restoration is a time-consuming process. Morrison Aff. ¶ 5 (Exh. 3); Malott Decl. ¶ 32 (Exh. 1). Given the difficulties and length of time involved in groundwater cleanup, there clearly is a threat of irreparable harm if the Sparton contaminant plume is permitted to continue to expand.

C. The Threatened Injury To Public Health and The Environment Outweighs The Burden On Sparton Should The Preliminary Injunction Issue

The "balancing of equities" test is intertwined with the nature of the injury and with the public interest. In cases involving environmental harm, the balance of harms generally favors the environment: "If . . . [environmental] injury is sufficiently likely, the balance of harms will usually favor the issuance of an injunction to protect the environment." Amoco, 480 U.S. at 545.[18] In Sharp v. 251st. Street Landfill, Inc., 810 P.2d 1270, 1280-81 (Okla. 1991), which involved potential groundwater contamination from a landfill, the Supreme Court of Oklahoma found that "groundwater contamination is a type of environmental damage" which is difficult to remediate. Id. The court then held that the balance of equities favored the movants "due to the potential long-term effects contamination may have to their water sources and granting the

[18]Where the public interest is at stake, that interest generally outweighs other interests. U.S. v. San Francisco, 310 U.S. 16, 30-31 (1940) (where United States sought injunctive relief to enforce the Raker Act [1913 federal statute granting certain public rights of way], the Court upheld relief without balancing the equities); Associated Sec. Corp. v. S.E.C., 283 F.2d 773, 775 (10th Cir. 1960) ("[T]he necessity of protection of the public far outweighs any personal detriment resulting from the impact of applicable laws.").

injunction was not adverse to the public interest." Id. The court upheld a preliminary injunction enjoining construction and operation of a solid waste landfill.

In this case, the public interest in protecting a precious drinking water aquifer far outweighs the potential harm to the defendant of performing the limited testing and monitoring actions that are requested in the Plaintiffs' Motion. Moreover, in this case there is no potential harm to the defendant. Since Sparton is required by law to take corrective action for the hazardous wastes released from its facility (42 U.S.C. § 3008(h)), there is little question that Sparton is ultimately going to be required, at a minimum, to take the investigatory actions requested by the Plaintiffs in this motion. This motion merely seeks to compel Sparton to take those actions sooner. The only possible detriment to Sparton is having to expend these funds sooner rather than later.[19] It is estimated that the cost of the actions which the United States seeks to compel Sparton to take is $300,000 to $350,000. Morrison Aff. ¶ 8 (Exh. 3).

D. The Public Interest Favors Granting The Preliminary Injunction

As held by the Supreme court in Weinberger v. Romero-Barcelo, 456 U.S. 305, 312 (1982), "[C]ourts of equity should pay particular regard for the public consequences in employing the extraordinary remedy of injunction." The Supreme Court has recognized that preventing further environmental harm is within the public interest. Keystone Bituminous

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[19] A private interest in avoiding--or, in this case, delaying--expense is far outweighed by the public interest in protecting its drinking water supply. See U.S. v. Price, 688 F.2d 204, 212-13 (3rd Cir. 1982) ("even though funding a diagnostic study would require payments of money, it may still be an appropriate form of preliminary relief if the traditional balancing process tips decidedly in favor of plaintiff. . . . The mere fact "that an injunction may require the payment or expenditure of money does not necessarily foreclose the possibility of equitable relief. . . . [I]t is not unusual for a defendant in equity to expend money in order to obey or perform the act mandated by an injunction.")

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Ass'n v. DeBenedictis, 480 U.S. 470, 505 (1987) (upholding a Pennsylvania law that imposed liability on coal companies in order to deter certain mining practices determined to damage surface lands). Similarly, in Nat'l Indian Youth Council v. Andrus, 623 F.2d 694, 696 (10th Cir. 1980), the court considered "the public interest in protecting the environment" when upholding a district court's denial of a preliminary injunction. See also, Wyoming Outdoor Coordinating Council v. Butz, 484 F.2d 1244, 1250 (10th Cir. 1973) (declaring that the "public interest in preserving the character of the environment is one that [a movant] may seek to protect by obtaining equitable relief.").

In this case, the public has a strong interest in protecting its precious drinking water aquifer. Unlike Romero-Barcelo, no public interest would be adversely affected in this action.[20] In this case, the public interest falls only on one side--supporting issuance of the preliminary injunction to protect the aquifer.

II. THE RELIEF REQUESTED BY THE PLAINTIFFS

The Supreme Court has held that a district court has the discretion to "order that relief it considers necessary to secure prompt compliance with the [law]." Weinberber v. Romero-Barcelo, 456 U.S. 305, 320 (1982) (interpreting the injunctive relief provisions of the Clean Water Act).[21] The injunctive relief requested by the Plaintiffs will protect the public health and

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[20]The two public interests at stake in Romero-Barcelo were the Navy's interest in continuing weapons training and the Clean Water Act's stated objective to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Romero-Barcelo, 456 U.S. at 307 and 314. Unlike the Navy, Sparton has no ongoing operations with which the requested injunction would interfere.

[21] As held in Virginian R. Co. v. Railway Employees, 300 U.S. 515, 552 (1937) "Courts of equity may, and frequently do, go much farther both to give and withhold relief in

the groundwater of the citizens of Albuquerque. The actions which the Plaintiffs ask this Court to order Sparton to take are needed to abate the endangerment to public health and the environment created by the plume of contaminants emanating from the Sparton facility. These actions are the essential, first steps towards stopping the further spread of contaminants from the Sparton facility. Until Sparton takes these actions, it will not be possible to install an effective containment system to stop the spread of contamination from the Sparton facility.

In his attached affidavit, Dr. Robert Morrison, an experienced hydrogeologist and soil physicist, states that the groundwater contaminant plume will continue to expand unless it is contained. Dr. Morrison explains that a standard method to prevent the further spread of contamination is to construct a system to hydraulically contain the plume — known as a "containment system." A containment system generally includes one or more extraction wells designed to capture contaminated groundwater — known as the "capture zone" — before it can migrate further. Before one can accurately design a containment system to capture the leading edge of the contaminant plume, data which is currently lacking in this case is needed in order to more clearly define the contours of the capture zone as well as the size and location of the leading edge of the plume. To obtain this critical information, Dr. Morrison has determined that Sparton needs to perform two actions immediately: 1) conduct an aquifer pump test, and 2) install additional monitoring wells. These two actions are the steps that the Plaintiffs ask the

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furtherance of the public interest than they are accustomed to go when only private interests are involved." Accord S.E.C. v. Crofter's Inc., 351 F. Supp. 236, 263 (S.D. Ohio 1972) ("in actions brought by a government agency to enforce by injunction compliance with a statute administered by the agency, courts go much further to give relief than they are accustomed to go when only private interests are involved.") (quoting Fed'l Trade Comm'n v. Rhodes Pharmacal Co., 161 F.2d 744 (7th Cir. 1951)).

Court in this motion to order Sparton to undertake without delay.

A. The Aquifer Pump Test

As explained in Dr. Morrison's affidavit, an aquifer pump test, standard in the environmental and water well industry, is the most reliable method for obtaining data needed to correctly calculate the capture zone of the contaminated groundwater for a given extraction well. Specifically, an aquifer pump test will provide information on certain hydraulic parameters of the aquifer (see Morrison Aff., Attach B, p. 2) which can be used to estimate the size and location of the capture zone. Once the capture zone for a given extraction well is determined, the well can be installed for the purpose of capturing the leading edge of the plume, and the spread of the contaminant plume can be contained. Dr. Morrison proposes that Sparton install one pumping well and three observation wells in locations described in the Proposed Well Locations map accompanying the Workplan (Attachment B to Morrison Aff. (Exh. 3)), in order to conduct the necessary pump tests.

B. Monitoring Wells

As explained in Dr. Morrison's affidavit and the attached Workplan, some information is already known about the size and location of the contaminant plume. Current data shows that the plume extends approximately 2,600 feet northwest of the Sparton facility, is about 1,500 feet wide, and extends up to 265 feet below ground level. More information about the size and location of the plume, however, needs to be obtained in order to design a proper containment system to stop the spread of the contamination.

In this regard, Dr. Morrison has determined that five monitoring wells, in addition to the existing wells at the site, are needed to determine the vertical and horizontal extent (depth

and width) of the contaminant plume near the leading edge. This critical information, which is currently lacking, will help to better identify the size and location of the plume's leading edge and therefore to define the volume of the contaminated groundwater to be extracted as part of the containment system. As described in the Workplan, and the accompanying Proposed Well Locations map of the area, the five additional monitoring wells will be located in strategic locations downgradient from the Sparton facility close to what we presently believe to be the leading edge of the plume.

The information expected to be derived from the monitoring wells and aquifer pump test described above, will provide the data needed to properly design a containment system to capture the leading edge of the groundwater plume. Installation of the wells and performance of the pump test should take no more than 60 days, at a cost of approximately $300,000 to $350,000. By requiring Sparton to immediately install the additional monitoring wells and perform the aquifer pump test, this Court will go a long way to help stop the spread of the contaminant plume that threatens public health and the environment.

CONCLUSION

For all of the reasons set forth herein, Plaintiffs respectfully request that this Court issue a preliminary injunction against the Defendant requiring Sparton to take the actions specified in the Plaintiffs' proposed Order.

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The information expected to be derived from the monitoring wells and aquifer pump test described above, will provide the data needed to properly design a containment system to capture the leading edge of the groundwater plume. Installation of the wells and performance of the pump test should take no more than 60 days, at a cost of approximately $250,000 to $300,000. By requiring Sparton to immediately install the additional monitoring wells and perform the aquifer pump test, this Court will go a long way to help stop the spread of the contaminant plume that threatens public health and the environment.

CONCLUSION

For all of the reasons set forth herein, Plaintiffs respectfully request that this Court issue a preliminary injunction against the Defendant requiring Sparton to take the actions specified in the Plaintiffs' proposed Order.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that I have caused copies of the foregoing "Plaintiffs' Joint Opposed Motion for Preliminary Injunction And Memorandum in Support" and Plaintiff's "Opposed Motion For Leave Exceed Page Limit For Exhibits" by the indicated method this 15 day of ~~March~~ April 1997 to counsel for defendant at the following addresses:

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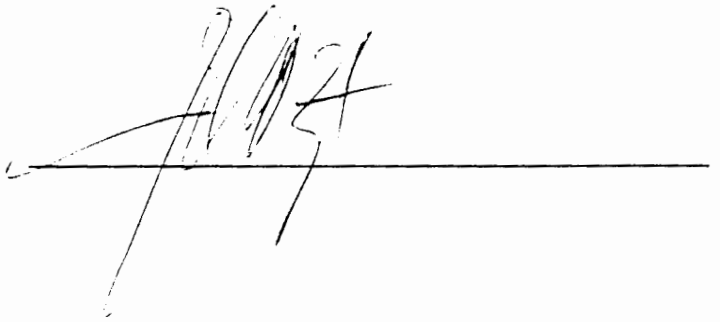

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COPY

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW MEXICO

THE CITY OF ALBUQUERQUE, and THE BERNALILLO COUNTY COMMISSIONERS, Plaintiffs, v. SPARTON TECHNOLOGY, INC., Defendant.	§ § § §

EXHIBIT A: AFFIDAVIT OF RICHARD MICO

EXHIBIT B: AFFIDAVIT OF PIERCE L. CHANDLER, JR.

EXHIBIT C: AFFIDAVIT OF STEVEN P. LARSON

EXHIBIT D: EXCERPTS FROM DEPOSITION TESTIMONY OF NORMAN GAUME

EXHIBIT E: AFFIDAVIT OF MARIA O'BRIEN

EXHIBIT F: AFFIDAVIT OF PETER H. METZNER

EXHIBIT G: AFFIDAVIT OF GARY L. RICHARDSON

EXHIBIT H: SPARTON'S OBJECTIONS TO PLAINTIFFS' EXHIBITS

EXHIBIT I: AFFIDAVIT OF GLENN C. MILLNER, PH.D.

Respectfully submitted,

RODEY, DICKASON, SLOAN, AKIN & ROBB, P.A.

By_____

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ATTORNEYS FOR DEFENDANT

CERTIFICATE OF SERVICE

On the 15th day May, 1997, an original and two copies of the foregoing document was hand-delivered to Plaintiff United States of America, with copies hand-delivered to all other counsel of record.

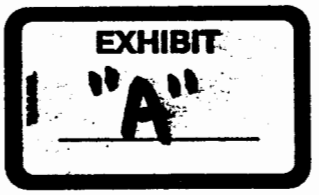
James P. Fitzgerald

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW MEXICO

THE CITY OF ALBUQUERQUE, AND THE BERNALILLO COUNTY COMMISSIONERS, Plaintiffs, v. SPARTON TECHNOLOGY, INC., Defendant,	§ § § § § § § § § § § § § §	CIVIL ACTION NO. CIV-97-0206-LH
STATE OF NEW MEXICO, THE NEW MEXICO ENVIRONMENT DEPARTMENT, and THE NEW MEXICO OFFICE OF THE NATURAL RESOURCES TRUSTEE, Plaintiffs, v. SPARTON TECHNOLOGY, INC., Defendant,	§ § § § § § § § § § § § § §	CIVIL ACTION NO. CIV-97-0208-JC
UNITED STATES OF AMERICA, Plaintiff, v. SPARTON TECHNOLOGY, INC., Defendant,	§ § § § § § § § § § § § §	CIVIL ACTION NO. CIV-97-0210M

AFFIDAVIT OF RICHARD MICO

THE STATE OF NEW MEXICO §
§
COUNTY OF SANDOVAL §



BEFORE ME, the undersigned authority personally appeared Richard Mico, who after being sworn, deposed and stated as follows:

1. My name is Richard Mico, I am over the age of 18 years, I have never been convicted of a crime of moral turpitude, I am fully competent to make this affidavit and all the facts and matters stated herein are within my personal knowledge and are true and correct.

2. I am Vice President and General Manager for Sparton Technology, Inc. ("Sparton"). I have been employed by Sparton since July 1979. I have held this position since then.

3. Sparton owns property at 9621 Coors Road NW, Albuquerque, New Mexico (the "Coors Road Plant"). The improvements at the property supported a manufacturing operation, from 1961 through approximately the end of 1993, involving the fabrication of switches and other electronic components used in nuclear devices the federal government needed during the "Cold War." Currently, the improvements are used as a machine shop and a church.

4. Solvents were used in the manufacture of switches and other electric components, as "degreasers" to remove dirt and other contaminants on materials used in and made during the fabrication process. The specifications regarding the fabrication of the switches and other electronic components, including how they were to be cleaned and what solvents were to be used as "degreasers," were dictated by the United States Government.

5. In the 1980s, it was discovered by Sparton that the methods the company used to handle and dispose of spent solvents, which practices were standard in the industry at the time, had resulted in releases to groundwater. No later than the end of 1986, Sparton discontinued waste management procedures that might result in the introduction of hazardous

waste or hazardous waste constituents into the soil or groundwater at its Coors Road Plant. Since at least that time, Sparton has not introduced additional material into the soil or ground water at its Coors Road Plant.

6. The current operation of a machine shop at the Coors Road Plant involves two employees. That operation does not involve the use of the same solvent required by the United States Government when switches and other electronic components were fabricated at the Coors Road Plant. Wastes generated at the machine shop are also handled in an entirely different fashion than when switches and other electronic components were fabricated at the Coors Road Plant. For instance, all liquid wastes are accumulated in drums that remain inside the building for less than ninety days, before being shipped off-site for disposal.

7. Upon discovery that groundwater had been impacted, Sparton advised appropriate authorities, and entered into extended discussions with various regulatory agencies that eventually resulted in an Administrative Order on Consent (the "AOC") between Sparton and EPA. The AOC became effective October 1, 1988. Sparton has timely satisfied all of its obligations under the AOC. At no time has Sparton ever received notice from EPA that it was not in compliance with the AOC, nor has EPA ever sought to impose or request from Sparton stipulated penalties for any alleged violation of the AOC.

8. On May 13, 1996, a draft correct measure study ("CMS") was submitted to EPA Region 6 on behalf of Sparton.

9. Sometime after June 24, 1996, I received from EPA, Region 6, a letter informing me that the draft CMS had been "approved with concerns." Attached to that letter was a copy of a final decision, signed by Samuel Coleman of the EPA, Region 6, selecting a remedy different from what Sparton had recommended in its draft CMS.

10. In July of 1996, a proposal was made to the New Mexico Environment Department ("NMED") on behalf of Sparton to undertake the following actions to deal with impacts to groundwater associated with the Coors Road Plant: (i) installation of a containment well to prevent movement of constituents of concern in the groundwater above drinking water limits in a way that would enlarge the amount of impacted groundwater; (ii) enhancement of a system for containing constituents of concern in the groundwater to Sparton's property; and (iii) installation of a vapor extraction system to remove constituents of concern that were above the groundwater but might impact the groundwater.

11. Over the next several months, more formal versions of that proposal were submitted to NMED and EPA Region 6.

12. Since December of 1996, Sparton has been ready, willing and able to implement the proposal it made to NMED and EPA. EPA and the state of NMED have refused to issue authorizations to discharge recovered and treated groundwater to the Calabacillas Arroyo. Without such authorization, there is no cost-effect mechanism for disposal of recovered and treated groundwater resulting from Sparton's proposal.

Richard D. Mico

Richard Mico

SWORN TO AND SUBSCRIBED TO BEFORE ME this 14th day of May, 1997, to certify which witness my hand and seal of office.

Jonene B. Bender

Notary Public, State of New Mexico

My Commission Expires:

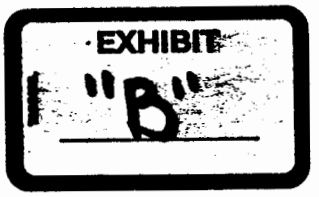
1-14-2001

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW MEXICO

THE CITY OF ALBUQUERQUE, and THE BERNALILLO COUNTY COMMISSIONERS, Plaintiffs, v. SPARTON TECHNOLOGY, INC., Defendant.	§ § § § § § § § § § § §	CIVIL ACTION NO. CIV-97-0206-LH
STATE OF NEW MEXICO, THE NEW MEXICO ENVIRONMENT DEPARTMENT, and THE NEW MEXICO OFFICE OF THE NATURAL RESOURCES TRUSTEE, Plaintiffs, v. SPARTON TECHNOLOGY, INC., Defendant.	§ § § § § § § § § § § §	CIVIL ACTION NO. CIV-97-0208-JC
UNITED STATES OF AMERICA, Plaintiff, v. SPARTON TECHNOLOGY, INC., Defendant.	§ § § § § § § § §	CIVIL ACTION NO. CIV-97-0210-M

AFFIDAVIT OF PIERCE L. CHANDLER, JR.

BEFORE ME, the undersigned authority personally appeared Pierce L. Chandler, Jr., who after being sworn, deposed and stated as follows:



1. My name is Pierce L. Chandler, Jr., I am over the age of 18 years, I have never been convicted of a crime of moral turpitude, I am fully competent to make this affidavit, I have personal knowledge of the facts and matters stated and they are all true and correct.

2. Attached as Exhibit "E" to this affidavit is a current version of my curriculum vitae.

3. I was the principal investigator and author of the RCRA Facility Investigation (RFI) Report (Sparton, 1992), the Corrective Measures Study ("CMS") Report (Sparton 1996), and the Effectiveness of the Groundwater Recovery Wells System in the Upper Flow Zone ("Effectiveness") Report (Sparton 1995).

4. Based on my involvement in these investigations, I have determined that the horizonal extent of TCE above 5 ppb, as of July 1996, associated with Sparton's Coors Road Plant ("TCE Plume") is as depicted on Exhibit "A" to this affidavit.

5. I have also determined that as of July 1996, the TCE Plume is expanding to the northwest at the rate of approximately 100 feet per year, as a result of physical and chemical process independent of any current activity of Sparton. For example, gravity, pressure, and subsurface geology all effect the rate of groundwater flow, which effects the movement of TCE. Chemical processes, such as diffusion and sorption, also impact the movement of TCE.

6. In addition to describing the TCE Plume, Exhibit "A" depicts: (1) the direction of groundwater flow in the vicinity of the TCE Plume (the arrows), which is to the northwest; (2) the proximity of public water supply wells, as of 1993, to the TCE Plume; and (3) the New Mexico Utility ("NMU") service area as of 1996.

7. Exhibit "B," attached to this affidavit, describes: (1) the TCE Plume as of July 1996; (2) the direction of groundwater flow in the vicinity of the TCE Plume (the arrows), which is to the northwest; (3) the proximity of the City of Albuquerque public water supply wells as of 2035; (4) the location of NMU public water supply wells as of 1996; and (5) the NMU service area as of 1996.

8. Exhibit "C," attached to this affidavit, describes: (1) the TCE Plume as of July 1996; (2) the direction of groundwater flow in the vicinity of the TCE Plume (the arrows), which is to the northwest; (3) the proximity of the City of Albuquerque water supply wells as of 2060; (4) the proximity of NMU public water supply wells as of 1996; and (5) the NMU service area as of 1996.

9. The location of the City of Albuquerque water supply wells depicted on Exhibit "A" is taken from *"Simulation of Ground-Water Flow in The Albuquerque Basin, Central New Mexico, 1901-1994, With Projections To 2020"* prepared by the United States Geological Survey in cooperation with the City of Albuquerque Public Works Department. (U.S.G.S. WRI Report 94-4251, 1995)

10. The acknowledgements section of that report states that Norman Gaume, with the City of Albuquerque, was a member of the technical review team that met monthly from 1993 through 1995 to provide advice and constructive criticism on the report.

11. The location of the City of Albuquerque public water supply wells described in Exhibits "B" and "C" is taken from report titled *"Albuquerque Water Resources Management Strategy San Juan - Chama Diversion Project Options,"* prepared by CH2M Hill for the City of Albuquerque Public Works Department and issued in July of 1995. This report represents

the City of Albuquerque's most recent statement on where new public water supply wells will be located.

12. The information from the reports referenced in paragraphs 9 and 11 demonstrates that as of 1993, there were no City of Albuquerque public water supply wells within 3 miles of the TCE Plume; and that through the year 2060 no City of Albuquerque public water supply wells are or will be in the current flow path of the TCE Plume. Those exhibits also demonstrate that the nearest City of Albuquerque public water supply well to the TCE Plume by the year 2060 will be a well approximately 1.5 miles to the southwest of the TCE Plume and not within the current flow path of the TCE Plume.

13. Exhibit "A" also demonstrates that the nearest NMU public water supply well is slightly more than two miles northwest of the leading edge of the TCE Plume. The current size of the plume reflects movement over approximately the past 30 years. If the plume continues to expand as it has in the past, it will not reach the nearest New Mexico Utilities well for at least 100 years.

14. Attached to my affidavit as Exhibit "D" is a map depicting the proximity of the Calabacillas Arroyo to the TCE Plume. I have reviewed portions of the transcript of the deposition of Norman Gaume in which he stated that the bed and banks of the Calabacillas Arroyo present a potential recharge reach. I have colored in red where Mr. Gaume believes a recharge reach may be located. The TCE Plume is colored in blue. The potential recharge reach is not in the current flow path of the TCE Plume, but is instead over 400 feet to the side and northeast of the TCE Plume at the point of nearest proximity.

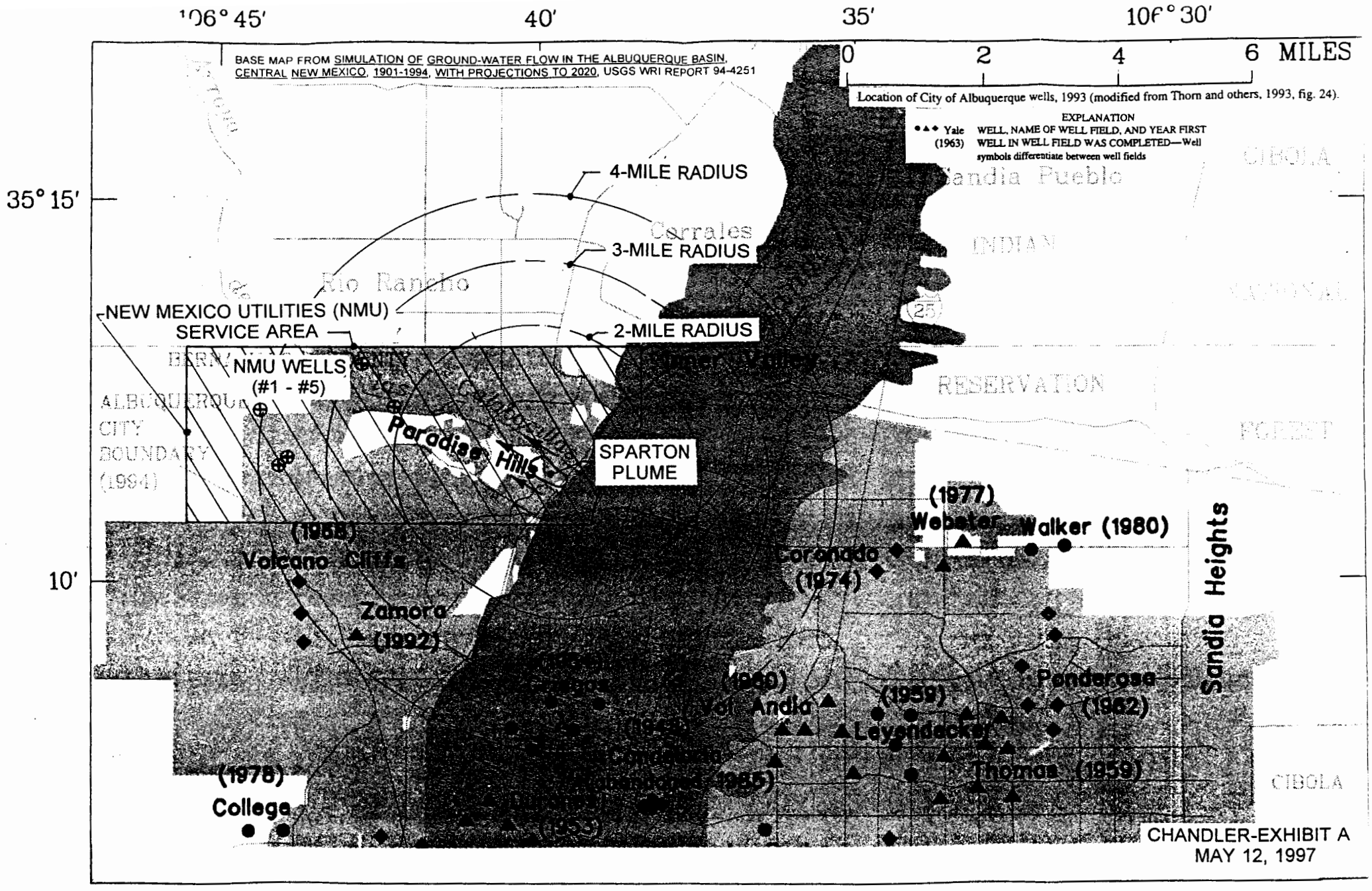
FURTHER AFFIANT SAYETH NOT.

Pierce L. Chandler, Jr.

SUBSCRIBED AND SWORN TO ME, on the 13th day of May, 1997, to certify which, witness my hand and official seal.

Gabrielle Luke
Notary Public, in and for the
State of Texas

GABRIELLE LUKE
Notary Public, State of Texas
My Commission Expires 1-10-[illegible]



CHANDLER-EXHIBIT A
MAY 12, 1997

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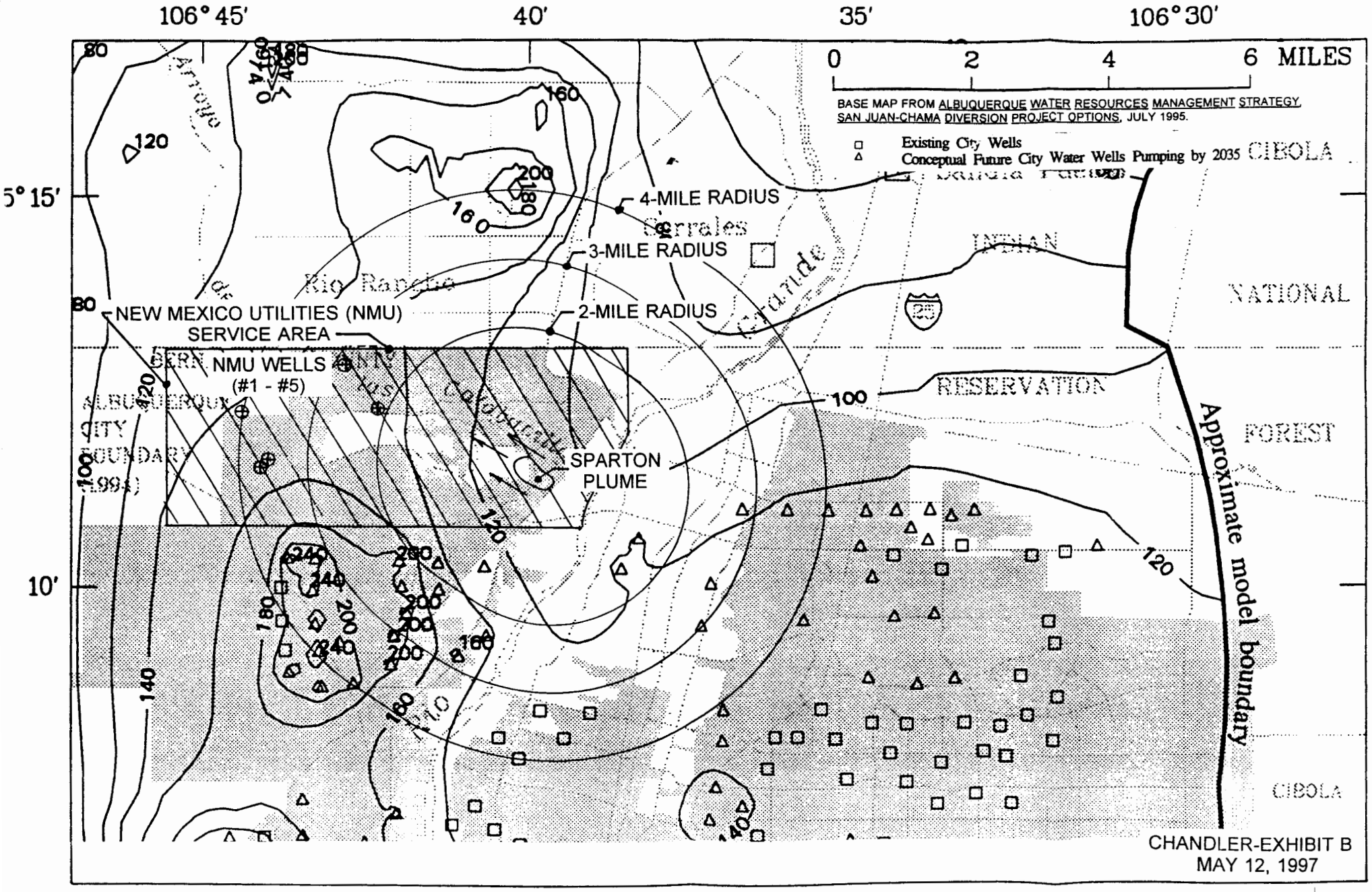

CHANDLER-EXHIBIT B
MAY 12, 1997

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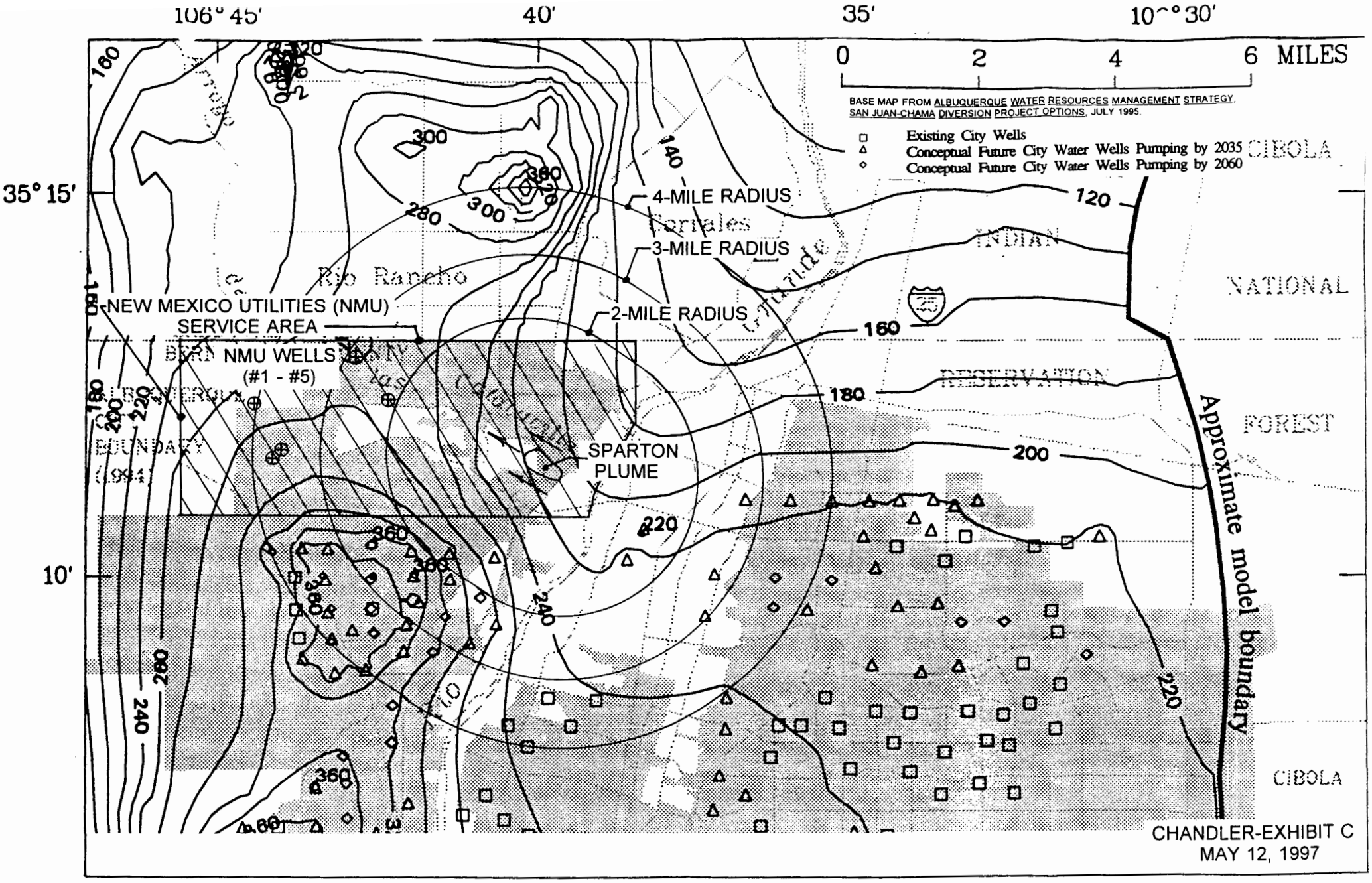

CHANDLER-EXHIBIT C
MAY 12, 1997

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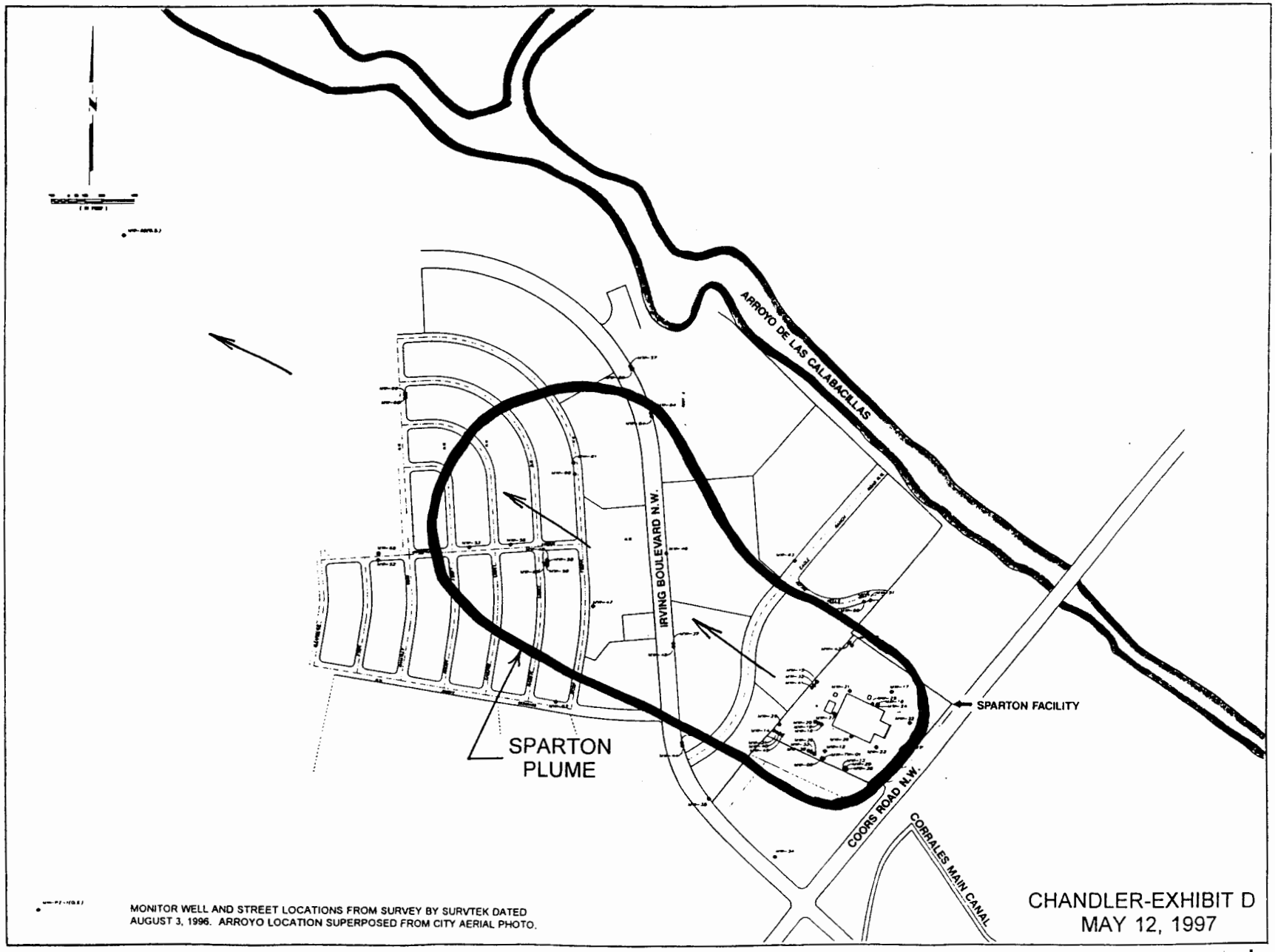

CHANDLER-EXHIBIT D
MAY 12, 1997

OGC-002409

EXHIBIT E

CURRICULUM VITAE

Pierce L. Chandler, Jr.
Senior Project Manager
Black & Veatch, Dallas, TX

Professional Registration: Texas Registered Professional Engineer since 1972

Education: B.S., Aerospace Engineering, University of Texas at Arlington, 1967
M.S., Civil Engineering, Texas A&M University, 1971

Experience Summary:

Mr. Chandler has over 20 years of solid/hazardous waste engineering experience. His experience covers both investigation and remediation of soil, soil gas, and groundwater contamination at existing facilities and siting, design, permitting, and construction of new disposal/treatment facilities.

Mr. Chandler also has over 20 years' experience as a principal professional in hydrogeologic investigation, characterization, reporting, and expert testimony. This experience has covered: investigative work plan development; intrusive exploration; geophysical exploration; in situ testing; pump testing; laboratory testing; evaluation and analysis of hydrogeologic data; design of groundwater control, protection, and monitoring systems; construction and operation of these systems; groundwater modeling, and groundwater remediation. In addition to this extensive experience, Mr. Chandler has been an Adjunct Professor for Environmental Hydrogeology in the Geoscience Graduate School at the University of Texas at Dallas since 1987. He has also taught hydrogeology at Brookhaven College and in Texas-Department-of-Health-sponsored short courses at Texas Tech and the University of Texas at Arlington. He is a recognized authority on hydrogeology and regularly consults with industry and regulatory agencies in a QA/QC capacity.

Relevant Project Experience:

Project, Client, Location	Position	Responsibilities
RCRA Corrective Action for Sparton Technologies, Inc., Albuquerque, New Mexico	Principal Author and Project Manager	Provided in-field supervision of field investigation. Responsible for detailed hydrogeologic/contamination characterization including fate and transport in the RFI report approved by EPA. Principal author of subsequent Corrective Measures Study and Interim Measures Reports approved by EPA.
RCRA Corrective Action at chemical distribution facility Van Waters and Rogers Spokane, Washington	Project Manager and Principal Investigator	Facility is located over a "sole-source aquifer". Technical negotiation for 3013 and 3008 (h) Consent Orders. Designed and negotiated EPA-approved investigative work plans, conducted extensive investigation of soil and ground water contamination including in-field supervision. Principal author for hydrogeologic characterizations approved by EPA. Designed and implemented corrective measures that successfully remediated solvent contamination of soil and groundwater to allow clean closure.
RCRA Facilities Investigation (RFI) for eighteen potentially contaminated solid waste management units (SWMU's) at NAS Cecil Field, Florida	Project Manager and Principal Investigator	Managed RFI including site reconnaissance; surface geophysical surveys; soil borings; monitor well installation; soil, sediment, and groundwater sampling; and laboratory analysis. Provided hydrogeologic and contaminant characterization for each SWMU and evaluated contaminant mitigation, fate and transport. Principal author of RFI report approved by EPA and State of Florida.
Geotechnical and hydrogeologic investigation for Texas Utilities Services, Inc.'s Hazardous Waste Facility at Monticello Steam Electric Station	Project Manager and Principal Investigator	Site is located adjacent to a public water supply reservoir. Prepared investigative plan and provided detailed hydrogeologic characterization of project site. Designed groundwater monitoring and protection system including soil-bentonite slurry wall. Supervised construction and sub-sequent groundwater monitoring.
Hydrogeologic and geotechnical investigation for Southside Sludge Management Facility, Dallas, Texas	Project Manager and Principal Investigator	This facility processes entire Dallas wastewater sludge production. Designed investigation, supervised field and laboratory studies, and characterized site hydrogeology. Utilized characterization to design groundwater protection system consisting of multiple soil-bentonite slurry trenches.
U.S. versus Marine Shale Processors, Federal District Court, Louisiana	Expert Witness	Expert witness for USDOJ/EPA on site characterization during penalty phase of enforcement trial.

Project, Client, Location	Position	Responsibilities
Technical review and technical support for U.S. EPA for corrective action at various RCRA/ CERCLA Facilities.	Senior Consultant	Facilities include five industrial manufacturing plants, two hazardous waste disposal sites, and five military bases.
Dye Tracer Study, March AFB, California	Technical Consultant	Designed and implemented a dye tracer study that successfully demonstrated the performance of the Underdruck-Vendampfer-Bannon (UVB) in situ groundwater treatment system. The UVB was installed at March AFB, California, as part of the U.S. EPA Superfund Innovative Technology Evaluation (SITE) program. The dye tracer study used multiple dyes in both converging and diverging tests to demonstrate the radius of influence and recirculation produced by the UVB.
Study reviewing current practices and conditions at construction/demolition landfills, Kansas Department of Health and Environment	Principal Investigator	Designed and conducted study which included site reconnaissance, records review, and summary report/ evaluation of 12 operating sites.
Hydrogeologic and contaminant characterization for a major chemical manufacturing facility near Houston, Texas	Project Manager and Co-Author	Prepared characterization covering three recognized aquifers underlying the project site and including analysis of multiple pumping tests.
Conceptual design and permit application for a 670-acre municipal solid waste landfill expansion, Waste Management of Texas, Ferris, Texas	Project Manager and Principal Investigator	Expansion will have a solid waste capacity of 26 million tons and includes a composite liner, leachate collection system, and gas recovery system. Determined scope of investigation, participated in and supervised field and laboratory work, evaluated results with particular emphasis on hydrogeologic characterization, prepared landfill design and authored permit application. Represented Applicant in contested public hearings which resulted in permit issuance. Project began operation June 1, 1995.
Design and permit application for a 170-acre landfill redevelopment, North Texas Municipal Water District, McKinney, Texas	Project Manager and Principal Investigator	Redevelopment will have a capacity of 5 million tons and includes a constructed clay liner as part of a performance-based design. Designed investigation, participated in, and supervised field and laboratory investigation, characterized and reported site hydrogeology, and designed groundwater protection system. Represented applicant in contested public hearing resulting in a permit grant. Project began operation June 2, 1995.

Project, Client, Location	Position	Responsibilities
Study of a regional landfill, Gulf Coast Waste Disposal Authority, Chambers County, Texas	Project Manager	Conducted study including evaluation of current operation and recommendations for increasing landfill efficiency and complying with Subtitle "D" requirements. Further, the study included assessment of the potential for a regional landfill operation, recommendations for method of financing solid waste disposal, and evaluation of an incinerator alternative.
USEPA OERR	Principal Co-Author	Co-Author of in-depth evaluation of subsurface barriers (in progress). Report will be a companion volume to EPA's previous Evaluation of Groundwater Extraction Remedies.

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW MEXICO

THE CITY OF ALBUQUERQUE, and THE BERNALILLO COUNTY COMMISSIONERS, Plaintiffs, vs. SPARTON TECHNOLOGY, INC., Defendant,	CIVIL ACTION NO. CIV-97-0206-LH
STATE OF NEW MEXICO, THE NEW MEXICO ENVIRONMENT DEPARTMENT, and THE NEW MEXICO OFFICE OF THE NATURAL RESOURCES TRUSTEE, Plaintiffs, vs. SPARTON TECHNOLOGY, INC. Defendant.	CIVIL ACTION NO. CIV-97-0208JC
UNITED STATES OF AMERICA, Plaintiff, vs. SPARTON TECHNOLOGY, INC. Defendant.	CIVIL ACTION NO. CIV-97-0210-M

AFFIDAVIT OF STEVEN P. LARSON

STATE OF MARYLAND)
)
COUNTY OF MONTGOMERY)

BEFORE ME, the undersigned authority personally appeared Steven P. Larson, who after being sworn, deposed and stated as follows:

EXHIBIT "C"

1. My name is Steven P. Larson. I am over the age of 18 years, I have never been convicted of a crime of moral turpitude, I am fully competent to make this affidavit, and the following represent my opinions and conclusions on whether sufficient information currently exists with respect to impacted groundwater associated with a manufacturing plant operated by Sparton Technology, Inc., at 9621 Coors Road, Northwest, Albuquerque, New Mexico to install a well to prevent the movement of constituents of concern above drinking water limits thereby expanding the groundwater that has been impacted. The facts or data upon which I base my opinions and conclusion are of a type reasonably relied upon by experts in my field, hydrogeology, in forming opinions or conclusions.

2. Attached as Exhibit "A" to this affidavit is a current version of my curriculum vitae. Over the past 17 years I have developed, designed, monitored, and evaluated the operation of containment and/or extraction systems involving various constituents of concern that have impacted groundwater. I have also developed and supervised various investigation programs to delineate the vertical and horizontal extent of impacts to groundwater from constituents of concern. I have testified as an expert witness on matters related to soil and groundwater contamination in trials before federal district courts in Missouri, California, Tennessee, Oklahoma, New York, Nebraska, and Pennsylvania, and before state courts in Iowa and Delaware.

3. In preparing this Affidavit I reviewed the following material:

I. Memorandum Regarding Sparton Technology, Inc.'s Position on The Facts, the Law, and the Relief Sought by EPA, February 1997, and attachments:
   - A. Report of Pierce L. Chandler, Jr., on Geology/Hydrogeology Characterization, Contaminant Plume Characterization, Risk Assessment, and Aquifer Restoration, Sparton Technology Coors Road Facility; Albuquerque, New Mexico. February 4, 1997.
   - B. Report of W. Peter Balleau, CPG, P.Hg., on Sparton Technology, Inc. Site Impact on Groundwater-Resource Availability. February 3, 1997.
   - C. Report of Gary L. Richardson, P.E. on the Use of Injection Wells at Groundwater Remediation Sites. February 3, 1997.
   - E. Initial Administrative Order Under Section 3008(H) of the Resource Conservation and Recovery Act.

II. Additional Information in Support of Sparton Technology, Inc.'s Position on the Facts, the Law, and the Relief Sought by EPA, March 1997, with attachments:
   - A. Report of Pierce L. Chandler, Jr., in Technical Reply to EPA's Position Statement Responding to the Memorandum Regarding Sparton Technology, Inc.'s Position on the Facts, the Law, and the Relief Sought by EPA, dated February 4, 1997.
   - B. Report to Sparton Technology, Inc. by Sheehan, Sheehan & Stelzner.

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C. Letter from: New Mexico Utilities, Inc. to: Sheehan, Sheehan & Stelzner. Re: No plans to drill any wells in the immediate vicinity of the Sparton Facility, February 5, 1997.

D. Report of Gary L. Richardson, P.E. in Technical Reply to EPA's Responses to the Memorandum Regarding Sparton Technology, Inc.'s Position on the Facts, the Law, and the Relief Sought by EPA dated February 4, 1997, March 14, 1997.

E. Report of W. Peter Balleau, CPG, P.Hg., on Sparton Technology, Inc. Site Impact on Potential Calabacillas Recharge Reach., March 14, 1997.

III. Plaintiffs' Joint Opposed Motion for Preliminary Injunction and Memorandum in Support, April 1997, and attachments:.

1. Declaration of Vincent E. Malott in Support of the Joint Motion for Preliminary Injunction, Dated on or about March 31, 1997, with attachments:

A. Hazardous Waste Facility Post Closure Care Plan, Coors Road Plant; Albuquerque, NM. Prepared for: Sparton Corporation, Prepared by: Harding Lawson Associates. December 17, 1985.

B. "Geohydrologic Framework and Hydrologic Conditions in the Albuquerque Basin, Central New Mexico", by: Conde r. Thorn, Douglas P. McAda, and John Michael Kernodle. U.S.G.S. WRI 93-4149. Albuquerque, NM. 1993.

C. EPA Notification of Hazardous Waste Activity. August 12, 1980.

D. EPA General Information Sheet, and Hazardous Waste Permit Application.

E. Revised EPA Hazardous waste Permit Application.

F. Letter from: Sparton Southwest, to: USEPA, region 6, re: Proposed Changes during Interim Status. July 21, 1983.

G. Information sheet including: customer Service, Summary Analysis, Payment summary, and History.

H. Letter from: USEPA, to: Sparton Southwest, Inc. re: This warning letter issued pursuant of the Solid Waste Disposal Act. February 1, 1983.

I. Letter from: Sparton Southwest, Inc. to: USEPA re: response to the warning letter. March 2, 1983.

J. Letter from: USEPA to: Sparton Southwest, Inc. Re: Compliance order and notice of Opportunity for Hearing. June 24, 1983.

K. Letter from: USEPA, to: Sparton southwest, Inc. Re: Consent Agreement and Final Order. February 22, 1984.

L. Investigation of Soil and Groundwater Contamination Prepared for: Sparton Corp., Prepared by: Harding Lawson Assoc. March 19, 1984.

M. Hydrogeologic Characterization and Remedial Investigation. Prepared for: Sparton, Corp. Prepared by: Harding Lawson Assoc. March 13, 1985.

N. Letter from: Sparton Tech, Inc. to: State of NM. Re; Revised closure plan and Post closure Care Plan. December 19, 1985.

O. Pond and Drum Storage areas Closure Plan. Prepared for; Sparton Corp, Prepared by: Harding Lawson Assoc. December 19, 1985.

P. Letter from: State of NM, to: Sparton Technology, Inc. Re: Closure Plan Modifications. June 16, 1986.

Q. Soil Investigation of the unsaturated and Upper Saturated Zones. Prepared for; Sparton Technology, Prepared by: Harding Lawson. June 30, 1986.

R. Letter from: Sparton technology, to State of New Mexico, re: Certification of Closure for the New Drum Storage Area. November 17, 1986.

S. FINAL administrative order on Consent.

T. Letter from: Black & Veatch, to: USEPA, re; Revisions to Report of Effectiveness of the Groundwater Recovery Well System in the Upper Flow Zone. February 28, 1995.

U. RCRA Facility Investigation. Prepared for: Sparton Tech, Inc. Prepared by: Harding Lawson Assoc. December 14, 1990, revised by: HDR Engineering, Inc. in conjunction with Metric Corp. May 1, 1992.

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V. USEPA Region 6 announces a Public Hearing and Public Comment Period for the Sparton technology Coors road Facility RCRA Statement of Basis.

W. Letter from: Black & Veatch, to: USEPA, re; Draft Final Corrective Measures Study Report. May 13, 1996.

X. Technical Review, Final Corrective Measures Study Report, RCRA Corrective Action. June 20, 1996.

Y. Final Decision, RCRA Corrective Action. June 24, 1996.

Z. Letter from: USEPA, to: Sparton Technology, Inc. re: Initial Administrative Order of RCRA Sparton Technology, Inc. September 16, 1996.

AA. Determination of Imminent and Substantial Endangerment.

AB. Protective Response and Request for Hearing.

AC. Analytical Report for the State of NM, Dept of Health. November 15, 1996.

2. Affidavit of Norman Gaume.

3. Affidavit of Robert D. Morrison.

Exhibit B. Work plan for Sparton Coors road Facility, Albuquerque, NM. March 28, 1997.

4. Findings of Imminent and Substantial Endangerment.

IV. Deposition of Robert D. Morrison, Ph.D. May 2, 1997.

V. Various Information and Data concerning groundwater conditions at and near the Sparton Technology Site Supplied by Pierce L. Chandler, Jr., 1997.

VI. Proposal: Aquifer Testing/Extraction Demonstration/ Additions to Monitoring Network; Prepared for: Sparton Technology, Inc. Prepared by: Black & Veatch and Metric Corp. Revised, Dec. 6, 1996 and Revised, January 17, 1997.

VII. "Simulation of Ground-Water Flow in the Albuquerque Basin, Central New Mexico, 1901 - 1994, with Projections to 2020", by: John Michael Kernodle, Douglas P. McAda, and Conder. Thorn. USGS WRI 94-4251. 1995.

4. EPA has indicated that 5 additional monitoring wells are necessary to define the vertical and horizontal extent of the leading edge of the plume before proceeding with a containment remedy. Based on the data from existing monitoring wells over the past several years, it is clear that 5 new monitoring wells are not necessary in order to proceed. Furthermore, the locations proposed by EPA for the additional monitoring wells are not likely to provide information that will improve the definition of the extent of TCE contamination that exceeds 5 ppb and thus improve the ability to locate or design an extraction well.

5. The existing data demonstrate several important facts. First, the contaminant plume is migrating in a west-northwest direction at a rate of about 100 feet/year. This direction and rate are consistent with the hydrogeologic data (water level gradients and aquifer transmissivity) that have been collected at the site. Second, the leading edge of the plume (concentrations exceeding 5 ppb of TCE) reached wells MW 60 and 61 near the end of 1993 or the beginning of 1994 and extended

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to well MW 65 at the end of 1996. Third, almost all of the contamination is migrating within the uppermost 50 to 100 feet of the groundwater environment. Fourth, the transmissivity of the upper parts (50 to 60 feet) of the groundwater environment and the groundwater flow in this interval have been clearly established from testing at well PW-1 and measurements of groundwater levels.

6. The likely performance of a containment well can be reasonably inferred from the available data. The testing at well PW-1 has clearly shown that the transmissivity of the uppermost 50 to 75 feet of the groundwater environment is about 18,000 gpd/ft and that a single well can produce more than 180 gpm. The test also demonstrated that response to pumping 180 gpm was readily apparent at distances of more than 350 feet from the pumping well within one day. This extent of observable response would have continued to expand to greater distances if pumping had continued. Thus, the likely performance and impact of a containment well in this hydrogeologic environment has been demonstrated.

7. The hydrogeologic conditions near the leading edge of the groundwater contamination are likely to be similar to those found near PW-1. Water level data show that groundwater flow is toward the northwest in a direction consistent with the orientation of the TCE contamination. Since there are no apparent sources of unusually high groundwater recharge along this path of groundwater flow, the fundamental laws of mass conservation demonstrate that the rate of groundwater flow near the downgradient margin of the TCE contamination will be similar to the rate indicated by the transmissivity conditions near PW-1. In other words, the groundwater flow beneath the Sparton site flows to the northwest at a rate determined by the aquifer transmissivity and the water level gradient, both of which have been determined. This rate will not increase or decrease unless water is added (via recharge for example) or taken away (via pumping for example) or unless the groundwater flow pattern is converging or diverging. Since there is no evidence of significant recharge or pumping to the northwest of the Sparton site and since the water level data do not show any significant convergence for divergence of the groundwater flow pattern, one can expect that the rate of groundwater flow northwest of the site will be similar to the rate beneath the site. Consequently, the existing data and evaluations provide a sufficient basis for implementation of a containment well. Subsequent monitoring data can be used to confirm the performance or to make necessary

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adjustments.

8. Based on the available facts and information, a reasonable estimate can be made as to the extent of the TCE contamination. The testing at well PW-1 and the measurements of groundwater levels provide a reasonable estimate of the rate of groundwater flow within the zone of contamination. The testing at PW-1 has also demonstrated that a single well can produce at least 180 gpm, which is more than what is likely to be necessary to intercept the contaminated groundwater. Thus, all the ingredients are available for locating and designing an extraction well and necessary adjustments can be made based on monitoring of the well performance.

9. The locations for additional monitoring wells proposed by the EPA are not likely to provide information that will improve our ability to locate or design the extraction well. The available data demonstrate that contamination progressed beyond monitoring wells 53, 60 and 61 sometime after June of 1991 and has not yet reached monitoring wells 68 and 69 which are directly along the trajectory of contaminant migration. Thus, the current extent of contamination is located somewhere between these two sets of wells.

10. EPA proposes to put additional monitoring wells between existing wells in areas where contamination is not likely to have reached. Consequently, while these wells might confirm that contamination is not present, it will not help to improve the delineation or estimation of the extent of contamination exceeding the MCL of 5 ppb for TCE. Since the placement of the extraction well would be based, at least in part, on this estimated extent, the additional wells are not likely to provide information that will improve our ability locate or design the extraction well.

11. A similar situation exists with regard to the additional deep monitoring well proposed by EPA near monitoring wells 60 and 61. Assuming the well is constructed like other deep wells, such as monitoring well 67, it would likely demonstrate that contamination has not reached that depth. This information, again, would not provide for a more precise delineation of the extent of TCE contamination exceeding 5 ppb. More importantly, however, is the fact that information on the vertical extent of contamination at the location of the extraction well can be collected when the well is constructed by sampling at different depth intervals during the drilling process. Consequently, the proposed additional deep monitoring well is not likely to provide information that

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will improve the design of the extraction well and such information can be obtained as part of the drilling process.

12. As described above, the available hydrogeologic information and monitoring data provide a sufficient basis for proceeding with implementation of a containment well. Based on the available information, a tentative well location for the containment well can be selected. Drilling and testing at the selected location can be conducted to verify the selected location as suitable for containment purposes and to determine the depth of contamination. Based on the results of the drilling and testing program, an additional well may be required to provide performance monitoring for the containment well. The need for such a monitoring well would depend on the exact location of the containment well relative to existing monitoring wells. Since the exact location of the containment well can be affected by logistic and access considerations, the need for an additional well cannot be evaluated at the present time. Also, depending upon the proximity of the selected containment well location to nearby existing monitoring wells, one or two piezometers may be necessary to provide water level data necessary for evaluating performance of the containment well. It should be noted that, given the available data, clusters of monitor wells or piezometers (one at the water table and one at greater depth) are no longer necessary since the containment would focus on all of the groundwater contamination within the upper 50 to 100 feet of the groundwater environment.

13. It is worth noting that some of the consultants retained by the EPA seem to share a similar view regarding the location and design of a containment well. In the deposition of R. Morrison, an EPA consultant, exhibits were produced that included notes regarding a conference call discussion among various EPA consultants related to technical issues of locating and designing a containment well (Morrison Deposition, May 2, 1997). Among those notes were the following statements.

> *"Horizontal extents of the plume look well enough defined, for purposes of containment. At large extraction rates, capture zone should be very wide."*

Furthermore, Mr. Morrison's staff made numerous analyses to evaluate the size of the capture zone

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that would be created under a range of conditions and assumptions that included conditions comparable to those observed in the testing at well PW-1. Although Mr. Morrison had difficulty understanding his staff's calculations, the results are quite clear. Pumping rates of 100 to 200 gpm will produce a broad capture zone that would completely envelop the estimate extent of TCE contamination. These statements and analyses are consistent with the conclusions described previously and reflect a conclusion that data are sufficient to proceed and that the size of the capture zone can be increased significantly, if necessary, by increasing the extraction rate from the containment well.

14. The EPA's specifications for conducting pumping tests on the containment well are excessive. This conclusion is based on several facts. First, a pumping test has already been conducted on a well (PW-1) near the Sparton facility that would be virtually identical to the test on the containment well. Results of this test demonstrated that pumping at a rate of 180 gallons per minute for about 25 hours produced clearly discernable drawdown data extending more than 350 feet from the pumping well. Furthermore, as the pumping time is extended, the aerial extent of discernible drawdown will continue to increase. The data from this test also demonstrate that the pumping rate necessary to intercept the contaminated groundwater flow will be about 85 to 130 gallons per minute. Consequently, significant information about aquifer properties is already available.

15. EPA proposes to conduct a step-drawdown test on the containment well at rates up to 600 gallons per minute. This test would be in addition to a long-term constant rate test. The step-drawdown test, however, will provide little useful information that would not be provided by the constant rate test and only adds to the cost and logistical difficulty of handling large amounts of water on a temporary basis. The principal use of a step-drawdown test is to provide information on well efficiency. However, well efficiency would only be important if the well yield was insufficient to provide the pumping rate necessary for capture. If that were the case, additional extraction wells might be necessary to provide the necessary pumping. The test at well PW-1 clearly shows that the well yield is likely to substantially exceed the pumping rate required for capture. Thus, the utility of a step-drawdown test is marginal, at best.

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16. A step-drawdown test can provide information about aquifer transmissivity. However, since a constant rate test would be used to determine transmissivity of the groundwater environment and the transmissivity value will be a determining factor in selecting an operational pumping rate for the containment well, the utility of data from the step-drawdown test is extremely limited. Also, the same information can be obtained by conducting the step-drawdown test at lower pumping rates than those proposed by the EPA. Given the logistical difficulties of handling large volumes of pumped water before a permanent disposal arrangement is available and the marginal value of the data from the step-drawdown test, pumping at rates up to 600 gpm or for extended periods prior to the availability of permanent water disposal is not justified.

17. The need for piezometers associated with the containment well will depend upon the selected location. Since the effects of pumping will be discernible over a large area, the existing monitoring wells can serve to monitor and document these effects. Consequently, it is likely that only one or two piezometers would be necessary to provide the water level data necessary to sufficiently document the effectiveness of the containment well.

18. The available data and information concerning hydrogeologic conditions and the extent and progression of TCE contamination provide a reasonable basis for locating and implementing a containment well program. The installation of five additional monitoring wells at a few locations will not significantly change the process of locating and designing a containment well. Uncertainties will continue to exist even with additional wells and this uncertainty will always be a consideration in the location and design of the containment well. Furthermore, once the containment well is installed and operating, its performance can be evaluated from monitoring data and adjustments, such as increasing or decreasing the pumping rate, can be made to insure that sufficient interception/capture is being accomplished.

Steven P. Larson

OGC-002422

SUBSCRIBED TO AND SWORN TO BEFORE ME this 13th day of May, 1997, to certify which witness my hand and seal of office.

Michelle Trout

Michelle Trout, Notary Public
State of Maryland, County of Montgomery

My Commission Expires: 7/1/2000

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A. Yes.
Q. --- how many?
A. I don't know.
Q. Less than five?
A. I don't know, Mr. Harris, but I think it would be more than five.
Q. Less than 10?
A. Yes.
Q. Do you know how many public water-supply wells the City currently has in service?
A. The latest figure that I have that I've seen is 92.
Q. Has the City had to take any public water-supply wells out of service because of groundwater contamination?
A. Yes.
Q. How many?
A. I can think of six.
Q. And none of those six wells had to be taken out of service because of any activities of Sparton's, correct?
A. That's correct.
Q. How many City public water-supply wells have been affected by groundwater contamination, directly affected in the sense that you were seeing

EXHIBIT "D"

1 contaminants in the water being recovered, but not at
2 levels that would require you to shut that well down?
3 A. If I may, I would like to answer that
4 question by telling you about the wells that I'm aware
5 of.
6 Q. That's all I can expect you to answer.
7 A. So these are wells that have been affected,
8 but are still in service.
9 Q. Yes, sir.
10 A. Miles Well Number 1, Volandia Well Number
11 6. There are other wells that I cannot name within
12 the City water system where small amounts of solvents
13 and other contaminants have been detected. They
14 include wells in the San Jose Well Field and other
15 well fields that I do not recall.
16 Q. Can you give me an approximation of the
17 number of well fields that we're talking about?
18 A. Less than 10.
19 Q. You have not seen any effects to wells in
20 the Zamora field or in the Volcano Cliffs field from
21 solvents or other contaminants?
22 A. No, not that I'm aware of.
23 Q. Any of the wells that you've identified as
24 well fields that you have been -- identified as being
25 affected by contaminants, have any of those been

1 impacted by Sparton's activities?
2 A. No.
3 Q. Is the only Imminent and Substantial
4 Endangerment Notice that the City has given to EPA
5 been -- involved the Sparton plant?
6 MR. O'DEA: I'm going to just reiterate our
7 standing objection to the relevancy of this whole line
8 of questioning. Go ahead.
9 MR. HARRIS: Okay.
10 A. That's the only one I'm aware of.
11 Q. Has the City gone to court with anybody
12 about groundwater impacts other than Sparton?
13 A. I would like to confer with my attorney.
14 Q. Sure.
15 (Witness confers with Mr. O'Dea.)
16 Q. You've had a chance to talk with Mr. O'Dea?
17 A. Yes, I did.
18 Q. Okay.
19 A. He reminded me that the City did file a
20 Notice of Imminent and Substantial Endangerment
21 associated with the GTE-Siemens case.
22 Q. Any others?
23 A. Not that I'm aware of.
24 Q. I think I had a question out to you about
25 whether the City has gone to court with anybody other

A. Yes, they do.

Q. And you don't consider the federal government or the Air Force Base to be either public or private water supply?

A. Certainly Kirtland Air Force Base operates a public water supply.

Q. So it does, in fact, meet one of the criteria for "crucial area"?

A. No.

Q. Well, I'm confused, Mr. Gaume. One of the criteria is areas used or likely to be used for public and private water supply.

A. The scope of this effort was to protect wells that are -- were under the -- that would supply the residents of the city and the county with the exclusion of the areas that are under the jurisdiction of the federal government or the pueblo sovereign nations, and we did not, in the development of this policy, extend the policy to cover those lands, on Kirtland Air Force Base, nor on Isleta Pueblo, nor on Sandia Pueblo, even if they did meet one or more of the listed criteria.

Q. You'd agree with me, however, that the definition of "crucial area" included on Exhibit 103 doesn't set forth what you've just shared with me?

A. That's correct.

Q. Turning back to Exhibit 103, we've already talked that the white area to the west of Albuquerque is entirely outside of the City's service area, correct?

A. Yes.

Q. There are two other large white areas. One is on the north, just to the east of Interstate 25. Is that part of pueblo, Indian tribe, land?

A. Yes, it is.

Q. So that would also be outside of the City's service area?

A. Yes, it is.

Q. There's also a white area to the south and to the -- again, to the east of Interstate 25. Is that area owned by or maintained by the pueblo -- a pueblo?

A. The white area to the south of Albuquerque, I believe, is a combination of Kirtland Air Force Base and the Pueblo of Isleta lands.

Q. That, again, would be outside of the City's service area?

A. Yes.

Q. Let me restate my question, Mr. Gaume. Exhibit 103 shows virtually all of the Albuquerque

1 Basin, using your definition, that's within the City's
2 service area as being a crucial area?
3 A. Yes.
4 Q. Now, there's another concept that's set
5 forth in the Protection Policy and Action Plan talking
6 about wellhead protection areas, correct?
7 A. Yes.
8 Q. The wellhead protection area is the same --
9 the definition for that contained in the report is the
10 same as set forth on Exhibit 102, 10-year -- service
11 area over the 10-year capture zone?
12 A. That is one of the definitions.
13 Q. Is that not the definition that was used in
14 the Protection Policy and Action Plan?
15 A. That is the definition -- that is a part of
16 the definition that is in the policy document adopted
17 by the City Council.
18 Q. Is there any significant difference between
19 the definition -- the complete definition and the
20 definition that's set -- or the description that's
21 included in Exhibit 102?
22 A. There is an important distinction, in that
23 the immediate vicinity of a public water supply well,
24 defined as a 200-foot radius, has special protection
25 afforded to reflect requirements of the New Mexico

1 A. No.
2 Q. That plan was actually put together by a
3 private consulting firm, correct?
4 A. Yes.
5 Q. To your knowledge, that plan was never
6 formally presented and adopted by the City Council?
7 A. That's what I understand.
8 Q. You would agree with me, would you not, that
9 understanding of the Albuquerque Basin, as you've
10 defined it, has changed dramatically since that report
11 was authored in 1982?
12 A. Mr. Harris, I wouldn't phrase it that way,
13 but certainly the understanding of the groundwater
14 system that Albuquerque relies on has changed
15 substantially since the Master Plan was developed.
16 (Gaume Exhibit 106 marked.)
17 Q. Let me show you what I've marked as Exhibit
18 106, which is page 10 and Figure 3 from the 1982
19 plan. Would you still -- would you characterize the
20 depiction of the basin in that figure as accurate
21 based upon knowledge that's been developed over the
22 last 15 years.
23 A. I have not previously reviewed this. I'll
24 need to review it.
25 Q. Have you previously read the 1982 plan from

1 cover to cover?
2 A. No.
3 Q. Have you even read any portions of the plan?
4 A. I've used the maps and the exhibits.
5 Q. There are two parts to the plan. There's a
6 narrative section, which is Volume 1, and there's a
7 map, which is -- or a series of maps which are Volume
8 2. Prior to today, had you ever read any portion of
9 Volume 1?
10 A. I've glanced through it. I never have used
11 it in my work or studied it.
12 Q. Okay.
13 A. This appears to be very generalized, and I
14 don't -- you know, a conceptually accurate depiction
15 of the hydrologic system in the Albuquerque area.
16 Q. You'd agree, then, that channel seepage from
17 the Rio Grande still recharges, for instance, wells in
18 the Volcano Cliffs area?
19 A. Yes.
20 Q. Was it a --
21 A. Mr. Harris, let me clarify that statement.
22 There certainly is a flow path from the river to the
23 wells based on the scientific work that's been done by
24 areas. The new information is that the amount of flow
25 is limited, and it may take longer than what was

1 Paseo Del Norte is shown on Exhibit 107, is it not?
2 A. It is.
3 Q. All right. Could you mark for me, then, the
4 approximate northern limit of the City of
5 Albuquerque's service area for me on the west side of
6 the Rio Grande?
7 A. (Witness complies.)
8 Q. Does that -- did you stop that line there
9 for a purpose or would it continue to the end of the
10 map?
11 A. I believe it would continue to the end of
12 the map and I'll so mark it.
13 Q. If you would mark, then, on Exhibit 107, to
14 the south of that, "City of Albuquerque service area,"
15 I would appreciate it.
16 A. (Witness complies.)
17 Q. The area to the north of the line, in
18 yellow, whose service area is that?
19 A. It is within the franchise area of New
20 Mexico Utilities.
21 Q. Does "franchise area" mean something
22 different to you than service area or do you use those
23 two --
24 A. Service area.
25 Q. Can we use those terms interchangeably? Do

they mean the same thing to you, Mr. Gaume?

A. Let's use "service area."

Q. What's the difference in your mind between franchise area and service area?

MR. O'DEA: That may call for a legal opinion that he may not be able to adequately respond to.

MR. HARRIS: That's fine.

Q. Just tell me what your understanding is of the difference.

A. Well, the service area is the area that's served by the existing system. The franchise area is the area where New Mexico Utilities has a state government permit to provide service, a license, permit, something of that nature.

Q. Okay. I'm sorry. Let me just make sure I'm understanding. You're saying that the franchise area, at least as you understand it, is the area where an entity is authorized to provide water by the state?

A. Yes.

Q. And then how does that differ from your understanding of the term "service area"?

A. Well, the service area of New Mexico Utilities doesn't encompass the entire franchise area, which is not fully developed.

1 MR. HARRIS: Move to strike as
2 nonresponsive.
3 Q. My question was just your understanding, if
4 you have one, as to whether the City can serve
5 customers in somebody else's franchise area.
6 A. I don't know.
7 Q. Could you locate for me on Exhibit 107 where
8 the nearest City of Albuquerque public water-supply
9 well is located?
10 A. No, I can't.
11 Q. Why is that?
12 A. Because I don't have the locations
13 memorized.
14 Q. Well, are they anywhere on -- could they be
15 anywhere on Exhibit 107?
16 A. I don't believe they are.
17 Q. Are you aware of any permits that the City
18 of Albuquerque has from the State Engineer's Office to
19 locate wells anywhere in the area depicted on Exhibit
20 107?
21 A. No.
22 Q. Are you aware of any applications the City
23 of Albuquerque has filed with the State Engineer's
24 Office to locate wells anywhere in the area depicted
25 on Exhibit 107?

A. No.

Q. What would be the closest permitted City of Albuquerque public water-supply well to the plume, the Sparton plume depicted on Exhibit 107?

A. I believe it is one of the Zamora wells.

Q. Those wells, if the other drawing on Exhibit 102 is accurate, are approximately five to six miles south-southwest of the Sparton plume?

A. Those are the Volcano Cliffs wells.

Q. Right, and I thought you -- I understood you to tell me that the Zamora wells were generally to the east, but in the same north/south configuration.

A. That's correct.

Q. Well, based on that and looking at Exhibit 102, would you agree that the Zamora wells would be, again, approximately five to six miles south-southwest of the Sparton plant?

A. I wouldn't agree to that. We would need to plot them on a map and measure it. The Zamora wells are located east of the Volcano Cliffs wells, and, you know, a line drawn from the northernmost Volcano Cliffs wells to the Sparton site is basically directed to the east.

The Zamora wells are closer, and to the extent that they're along that line, they're going to

be less -- it will be less than five to six miles.

Q. You just don't know how much, sitting here today?

A. Right.

Q. Can you show me, on Exhibit 107, where the -- well, strike that. Let me ask the question this way. Does the City of Albuquerque have any water pipelines installed north of the line that you've drawn on Exhibit 107 to delineate the northernmost boundary of the City of Albuquerque service area west of the Rio Grande?

A. Mr. Harris, I am not sure as to the exact alignment of the service area boundary. The City has no lines installed to the north of its exact service area boundary, wherever that may be.

Q. I understand. This is not a trick question, Mr. Gaume. I'm just trying to get some information from you. You told me basically that Paseo Del Norte provided the northernmost boundary for the service area, correct, and all you did was then draw a line further to the west consistent with your understanding of where you thought that service area was?

A. The generalized boundary, that's correct.

Q. It may be a few feet or -- it may be a few hundred feet north or south of that location, I

1 recognize that, but you're telling me today that
2 regardless of exactly where that line is located, the
3 City has no infrastructure north of the service area
4 line?
5 A. The City has sewer infrastructure.
6 Q. I'm sorry, no water infrastructure.
7 A. That's correct.
8 Q. New Mexico Utilities does, however, have
9 water infrastructure and does supply water north of
10 the -- wherever that line is between -- that demarks
11 the northern boundary of the City's service area?
12 A. Yes.
13 Q. Are you involved at all in the permitting
14 process for the City of Albuquerque when the City
15 applies for a permit to drill and complete a new
16 public water-supply well?
17 A. Yes.
18 Q. If the City attempted to -- or if the City
19 filed a permit to construct a well north of its
20 current service area, who would you expect to protest
21 such an application?
22 MR. O'DEA: That calls for some
23 speculation.
24 Q. Well, I don't want you to speculate,
25 Mr. Gaume, but if you've had some involvement in the

1 Q. Any other park land you're aware of on
2 Exhibit -- that would be shown on Exhibit 107, Mr.
3 Gaume?
4 A. I'm not aware of any other specific
5 properties.
6 Q. Okay.
7 A. I might also add, though, Mr. Harris, that
8 another common utility practice is to locate wells on
9 school property.
10 Q. You would have to, however, reach an
11 agreement with the school district to do that?
12 A. Of course.
13 Q. You would agree with me, wouldn't you, Mr.
14 Gaume, that the 1982 Master Plan was a guide subject
15 to revision depending upon changes and conditions and
16 developments understanding about water usage in
17 aquifers in the Albuquerque area?
18 A. Yes.
19 Q. Certainly, if it says you have to -- that
20 there are seven wells to locate at a particular point,
21 that doesn't mean that the City is necessarily going
22 to put in seven wells at that location?
23 A. That's correct.
24 Q. You mentioned to me that there was a -- not
25 a recision, but some document that the City Council

that well, and I may not be correct, and feel free to jump in. I'm sure you will if I'm not saying it correctly.

You could have portions of the drawdown area that were above MCLs for a particular constituent, but once that water is combined with other water, as long as it's below the MCLs at the wellhead, then the City's surveillance would show that that well was producing appropriate quality of water?

A. No, and the City's program could show nothing else.

Q. I understand.

A. But your earlier question said something about the City's interest or the City's policy, and I wanted to make sure that I objected to that characterization. The City has substantial concerns besides the quality of water produced from particular wells.

Q. But you would agree with me that a portion of water produced by a well could be above MCLs and still produce water of a quality that the City would be willing to provide to consumers?

A. Yes.

Q. From the water -- from the City's perspective, as long as the quality of the water at

1 the wellhead meets the requirements of the MCLs, it's
2 appropriate to provide to consumers?
3 A. Yes.
4 Q. If you were -- if the City were asked to try
5 and determine whether water, groundwater, was going to
6 produce an appropriate quality of water at the
7 wellhead, how would you -- has the City ever attempted
8 to run that type of analysis?
9 A. As I said earlier in the deposition, Mr.
10 Harris, the City has attempted to site its wells away
11 from known contamination sources, and it has not sited
12 wells in one area where naturally-occurring arsenic
13 concentrations are known to be high.
14 Other than that, the water quality under --
15 or underlying the city in any particular well site has
16 not been a factor in well siting, and we have not
17 attempted to run calculations that would -- that would
18 give us an indication of water quality produced by a
19 well that might intercept a plume of contamination,
20 because we locate our wells away from contamination.
21 Q. Would you agree that nitrate is a toxic
22 contaminant?
23 A. It is a contaminant regulated by federal and
24 state drinking water standards.
25 Q. So you agree with the statement or

1 produce water that complies with federal and state
2 drinking water standards, and that is done by
3 comparing the quality of water that's in question with
4 those numeric standards.
5 If the numeric standards are exceeded, the
6 water is not suitable as public water supply and we do
7 not furnish it to our customers.
8 MR. HARRIS: Move to strike as
9 nonresponsive.
10 Q. Try and listen to my question, Mr. Gaume.
11 You do not, by background, training or experience,
12 have the ability to sit down and take a look at the
13 concentration of different substances in the
14 groundwater and, from that, be able to predict either
15 the quality of the water that will be produced at the
16 wellhead or whether, as produced, that water is unfit
17 for human consumption?
18 A. That's correct.
19 MR. HARRIS: Can we take a short break?
20 MR. O'DEA: Sure.
21 (Recess taken.)
22 (Gaume Exhibit 109 marked.)
23 Q. Mr. Gaume, let me hand you what I've marked
24 as Exhibit 109 that was a document we discussed a
25 little bit earlier today. To your knowledge, Exhibit

1 any concerns with it, you would have identified those
2 to the author at some point?
3 A. Yes.
4 Q. So you would be generally familiar with the
5 contents of this document, Exhibit 111?
6 A. Yes.
7 Q. And --
8 A. Excuse me.
9 Q. Sure.
10 (Mr. O'Dea confers with witness.)
11 Q. I direct your attention to page A-11, which
12 is Bates number 3066 of Exhibit 111. Can you find a
13 reference there to the Sparton site?
14 A. Yes.
15 Q. So perhaps as early as May of '91 and no
16 later than March of '93, the City had information
17 about the existence of the Sparton site?
18 A. Obviously.
19 Q. How many public water-supply wells are shown
20 as being impacted in that report by the Sparton plant?
21 A. Zero.
22 Q. How many private water-supply wells are
23 being shown as impacted by the report?
24 A. Zero.
25 Q. Even today, you're not personally aware of

1 believe that there may be something called a recharge
2 reach or corridor or window associated with the
3 Calabacillas Arroyo. Am I correct about that?
4 A. From the information that I have read in
5 reports, yes, I believe that that recharge window
6 exists.
7 Q. Again, by your background, training and
8 experience, you are not in a position to reach an
9 independent opinion or conclusion as to whether such a
10 geological feature is found in conjunction with the
11 Calabacillas Arroyo?
12 A. That's correct. I get all of my information
13 from reading reports prepared by others.
14 Q. In this case, what report, if any, are you
15 relying upon?
16 A. I'm relying on the Middle Rio Grande Water
17 Assessment, Final Report, 1977 (sic), and on
18 predecessor drafts of this document.
19 Q. And you don't have any personal basis for
20 evaluating whether the conclusions in that report are
21 accurate or inaccurate?
22 A. That's correct. I don't have scientific
23 training in the disciplines that are required to reach
24 these conclusions.
25 Q. Based upon your review of that particular

1 anybody with a geology background?
2 A. The New Mexico Bureau of Mines and Mineral
3 Resources produced a report on the drilling of the
4 well. There is no interpretive report of that
5 information that exists at this time.
6 Q. And you've not asked anybody to do any
7 interpretive work on the results of the test?
8 A. No.
9 Q. Was it your office that authorized that
10 drilling be done?
11 A. Yes.
12 Q. And you authorized that drilling to be done
13 at a time that you knew about the existence of the
14 Sparton contamination?
15 A. Yes.
16 Q. Is it your understanding that in order for
17 aquifer recharge to occur in New Mexico, it would be
18 necessary that the legislature develop some new laws?
19 A. Yes.
20 Q. Has anybody started to do that yet?
21 A. Yes.
22 Q. Was anything done in the last legislative
23 session?
24 A. Yes.
25 Q. What was done?

A. A bill prepared for the City of Albuquerque was introduced and was considered in the Senate -- in a Senate committee.

Q. Has the legislature adjourned for the year?

A. Yes.

Q. So no final action was taken on that proposal?

A. That's correct.

Q. Would state and federal permits be needed to undertake aquifer recharge?

MR. O'DEA: Objection.

Q. To your understanding. Is it -- again, I'm just trying to get your understanding, Mr. Gaume, as somebody that has been involved in this program, as to whether state and federal permits would be necessary to undertake aquifer recharge.

MR. DONNELLAN: Object on the grounds that it calls for a legal conclusion. The witness' understanding of laws aren't relevant here.

Q. You can go ahead and answer.

A. The legislation that was prepared for the City and was considered by the legislature this year would require a permit from the State Engineer's Office to engage in a recharge project, a recharge and recovery project.

1 Q. Do you have any understanding as to whether
2 an underground injection control permit would be
3 needed for such activity?
4 MR. DONNELLAN: Same objection. I'll state
5 it to this entire line of questioning.
6 MR. HARRIS: That's fine.
7 A. No, I don't have an understanding.
8 Q. Has the City Council authorized the
9 expenditure of any funds in connection with aquifer
10 recharge?
11 A. No.
12 Q. Is it your understanding, based on
13 discussions with others, that a properly run
14 containment system for the Sparton plume would allow
15 recharge to go forward in the vicinity of the
16 Calabacillas Arroyo, if that is possible at all?
17 MR. DONNELLAN: Objection if you're asking
18 for an opinion. If you're asking him for
19 interpretation of some documents, please refer --
20 MR. HARRIS: I'm just asking if anybody has
21 told him that.
22 A. I've read that in a report prepared for
23 Sparton by Pete Balleau.
24 Q. Has anybody besides -- has anybody -- have
25 you gotten the information from anybody else

1 information on different hardness characteristics or
2 nitrate concentrations, just by looking at that in the
3 groundwater, by virtue of your background, training
4 and experience, you could not opine that that water
5 will produce good quality water for the City?
6 A. Mr. Harris, as I stated, I can tell you
7 whether or not water meets drinking water standards.
8 I can't --
9 Q. At the well?
10 A. -- calculate -- pardon me?
11 Q. At the well?
12 A. In the results from the sample, yes.
13 Produced water from a well taking into account flow
14 paths, no.
15 Q. So my question, Mr. Gaume, was you -- well,
16 first of all, let me back up. What I hear you saying
17 is that the City typically, as a matter of policy,
18 doesn't look at the concentration of different
19 constituents in the groundwater before deciding
20 whether to produce from that formation or not.
21 A. That's correct, and that -- that's correct.
22 Q. And then -- so to build on that a little
23 bit, you're also telling me that you, by virtue of
24 your background, training and experience, are also not
25 in a position to be able to opine as to whether a

1 particular area of groundwater, both surface, areal
2 extent and depth would produce good quality water for
3 the City of Albuquerque?
4 A. I guess you're right.
5 Q. Who did you meet with in preparation for
6 your deposition today?
7 A. Mr. O'Dea, Mr. Donnellan, Rosemary.
8 Q. Anybody else?
9 A. I met briefly yesterday with Mr. Bitner.
10 Q. What did you and Mr. Bitner discuss?
11 MR. DONNELLAN: Objection.
12 MR. O'DEA: Don't answer that.
13 Q. Was counsel present during that discussion?
14 A. No.
15 Q. What factual information -- well, would you
16 refuse to answer the question of what you and Mr.
17 Bitner discussed on advice of your counsel?
18 A. If I was advised not to answer, I would not
19 answer.
20 Q. I think he advised -- I'll ask the question
21 again. Would you tell me what you and Mr. Bitner
22 talked about yesterday?
23 MR. O'DEA: The substance of that
24 conversation is covered under the work-product
25 privilege and I direct him not to answer.

1 Q. (By Mr. Harris) Mr. Gaume, the contract you
2 said that Mr. Gurule had signed with CH2M Hill, was
3 that contract specifically for work associated with
4 Sparton or was it a general consulting agreement with
5 CH2M Hill, between CH2M Hill and the City of
6 Albuquerque?
7 A. It was a supplement specifically dealing
8 with Sparton to a contract with CH2M Hill associated
9 with water-supply planning.
10 Q. Who developed -- did you develop the scope
11 of work in that contract?
12 (Witness confers with Mr. O'Dea.)
13 Q. Have you had a chance to talk to your
14 counsel about --
15 A. Mr. O'Dea developed the scope of work.
16 Q. Did you attend a May 28th, 1996, forum on
17 groundwater in the Albuquerque Basin sponsored by
18 Senator Domenici?
19 A. I probably did. I --
20 Q. Well, weren't you, in fact, a panelist at
21 that program?
22 A. Oh, at the -- yes.
23 Q. You were asked to come and speak. It was a
24 panel and people, the public, was invited to talk
25 about the Albuquerque groundwater basin?

A. That's correct.

Q. That meeting occurred on May 28th, 1996?

A. If you say so.

Q. Is that your best -- do you have any reason to disagree with me?

A. I don't remember.

Q. Excuse me?

A. I don't remember the date.

Q. You were asked at that meeting about the Sparton -- impacts to groundwater associated with the Sparton plant, weren't you?

A. Yes.

Q. You were asked at that meeting about whether the Sparton -- the impact to groundwater associated with Sparton presented any threat to the city water supply, weren't you?

A. There was a question about that, yes.

Q. What was your answer?

A. I don't remember the specific question and I don't remember my answer.

Q. Okay. You don't recall stating, in response to that question, that, quote, "No imminent threat to any wells -- there is no imminent threat to any wells. Our customers don't need to worry"?

A. I may well have said that.

1 MR. DONNELLAN: I have one question on
2 behalf of the United States.
3 CROSS EXAMINATION
4 BY MR. DONNELLAN:
5 Q. Mr. Gaume, at the beginning of Mr. O'Dea's
6 questioning of you, he had the court reporter read
7 back a question. Do you recall that question?
8 A. Not verbatim.
9 Q. Do you --
10 MR. HARRIS: That's two questions, Michael.
11 MR. DONNELLAN: What?
12 MR. HARRIS: That's two questions.
13 MR. DONNELLAN: And your objection?
14 MR. O'DEA: Too many.
15 Q. Can you tell me why you felt the need to
16 clarify your answer to that question?
17 A. Mr. Harris' line of questioning earlier in
18 the deposition was related to my training and
19 experience to calculate in-well dilution of waters of
20 varying water quality and calculate the quality of the
21 produced water at the wellhead as a result of that.
22 I don't have training and experience that
23 qualifies me to make that -- the complex calculations
24 associated with in-well dilution of waters in an
25 aquifer that are of substantially different water

quality.

Q. Mr. Gaume, perhaps my question wasn't clear. Was there some -- did you understand the question when it was asked? Was your understanding of the question -- strike my first question. I'll ask it a different way.

Was your understanding of the question at the time you answered it the same as your understanding of the question at the time you heard it read back to you?

MR. HARRIS; Object to the leading.

Q. Go ahead and answer.

A. No, no.

MR. DONNELLAN: Nothing further.

MR. HARRIS: I don't have anything else.

(Deposition concluded at 3:14 p.m.)

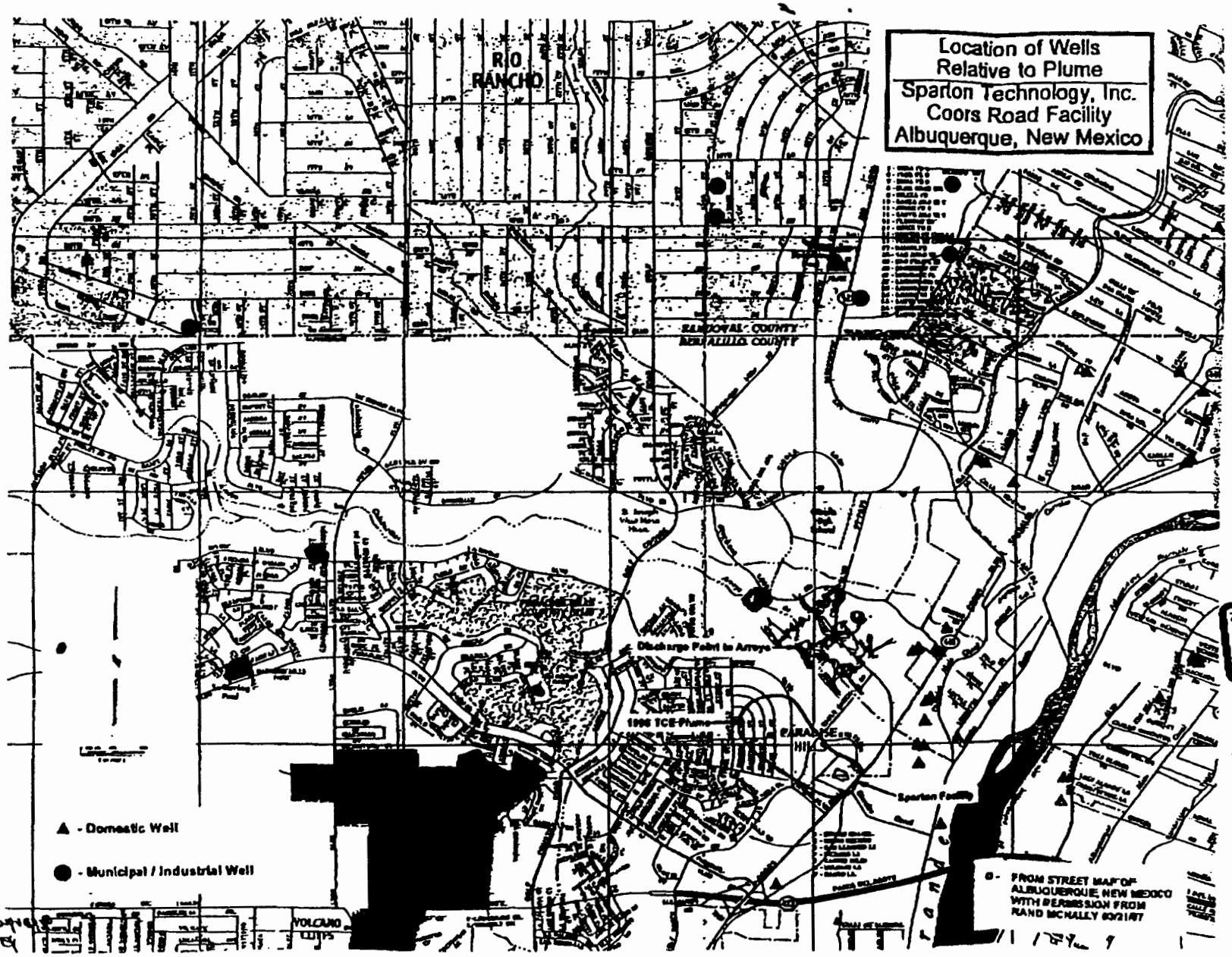

EXHIBIT 107

City of Albuquerque Service area

OGC-002453

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW MEXICO

THE CITY OF ALBUQUERQUE, and THE BERNALILLO COUNTY COMMISSIONERS, Plaintiffs, v. SPARTON TECHNOLOGY, INC. Defendant.	)	CIVIL ACTION NO. CIV 97-0206-LH
STATE OF NEW MEXICO, THE NEW MEXICO ENVIRONMENT DEPARTMENT, and THE NEW MEXICO OFFICE OF THE NATURAL RESOURCES TRUSTEE, Plaintiffs, v. SPARTON TECHNOLOGY, INC. Defendant.	)	CIVIL ACTION NO. CIV 97-0208-JC
UNITED STATES OF AMERICA Plaintiff, v. SPARTON TECHNOLOGY, INC. Defendant.	)	CIVIL ACTION NO. CIV 97-0210-M

AFFIDAVIT OF MARIA O'BRIEN

EXHIBIT
"E"

STATE OF NEW MEXICO)
) ss.
COUNTY OF BERNALILLO)

1. I, Maria O'Brien, am over the age of 18 years, am fully competent to make this affidavit, and all the facts and matters stated herein are within my personal knowledge and are true and correct.

2. I have been assisting Sparton Technology Inc. ("Sparton") as local counsel regarding issues related to groundwater contamination at its Albuquerque westside facility since February of 1996. Since that time I have undertaken numerous efforts to assist Sparton in obtaining the requisite permits and approvals necessary to proceed with installation of a containment well and additional monitoring wells in the vicinity of its facility for purposes of addressing the contamination.

3. A integral part of operation of a containment well and additional monitoring wells is a point of discharge for the treated water. In that regard I have worked with Sparton's experts, Metric Corporation, in designing a plan for discharge into the Calabacillas Arroyo. Necessary to such a plan is a permit from the Albuquerque Metropolitan Arroyo Flood Control Authority ("AMAFCA") which owns and operates the Calabacillas Arroyo. Accordingly, along with representatives of Metric Corporation and Sparton, I have met with AMAFCA staff on numerous occasions and appeared before the AMAFCA Board of Directors at two formal meetings to explain the plan and seek the requisite approval. Following my meetings with AMAFCA staff and the Board, I worked with AMAFCA staff and legal counsel to draft a permit agreement which would permit Sparton to discharge treated water into the Calabacillas Arroyo. This agreement has

undergone several revisions over the course of several months and will be presented to the AMAFCA Board this month with a formal presentation for approval in June.

4. An integral part of the proposed agreement with AMAFCA requires an alternate point of discharge in the event AMAFCA operations or maintenance preclude discharge into the Calabacillas Arroyo. The proposed alternative point of discharge is the sanitary sewer system, the relevant portions which are owned and operated in part by New Mexico Utilities ("NMU") and in part by the City of Albuquerque. In that regard I have held discussions with NMU officials who are favorably disposed to such a plan.

5. Operation of the containment well and additional monitoring well will also require use of the City of Albuquerque's storm sewer for carriage of the treated water to the ultimate point of discharge, either the Calabacillas Arroyo or the sanitary sewer. In that regard I have worked with representatives from Metric Corporation in their efforts to negotiate an agreement with the City of Albuquerque Public Works Department for use of the storm sewer. A draft agreement has been circulated for this purpose.

6. Installation of the containment well and monitoring wells requires approval from the New Mexico State Engineer. On Sparton's behalf I applied for permits to drill the containment. Sparton received emergency authorization from the State Engineer to proceed with the wells, such authorization to expire on July 23, 1997. At the time of expiration the State Engineer will examine Sparton's application to determine whether it should be granted on a long term basis. The City of Albuquerque, New Mexico Environment Department, and the New Mexico Natural Resource Trustee have all protested the granting of the application.

7. The location of the containment well is dictated by technical considerations and it must be drilled in an area within the City of Albuquerque currently zoned R-1. Containment wells with airstrippers are arguably precluded from this zone. On Sparton's behalf I have worked extensively with the relevant City officials regarding placement of the containment well in this zone and such officials have agreed to work cooperatively with Sparton on this issue.

8. In order to drill the containment well in the requisite location Sparton must acquire the underlying real property. I have assisted Sparton in working with a local real estate broker in locating and securing an option on such property.

MARIA O'BRIEN

SUBSCRIBED AND SWORN to before me this 14th day of May, 1997.

Donna J. Smith
NOTARY PUBLIC

My Commission Expires:
7/30/2000

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AFFIDAVIT

STATE OF NEW MEXICO)
)§
COUNTY OF BERNALILLO)

I, Peter H. Metzner, being first duly sworn on oath, depose, and state as follows:

1. Since the mid 1980's I have been assisting Sparton Technology, Inc. ("Sparton") as an environmental consultant regarding groundwater contamination at it's Albuquerque Coors Road Plant facility. Most recently I have provided assistance to Sparton in identifying and acquiring permits and approvals necessary for installing a containment well and associated observation wells, treating recovered contaminated groundwater, and discharging treated water in the vicinity of the Coors Road Plant.

2. A component of Sparton's plan for remediation of contaminated groundwater is disposal of the treated water. Regarding this component, I have worked in coordination with Sparton's local counsel, the Sheehan, Sheehan, and Stelzner P.A. firm, in pursuing options for discharge of treated water to the Calabacillas Arroyo. For discharge of treated water to the arroyo, a permit is required from the Albuquerque Arroyo Flood Control Authority ("AMAFCA") which operates the arroyo. Along with the local counsel I conferred with AMAFCA technical staff on several occasions, prepared exhibits, and appeared before the AMAFCA Board of Directors at two formal meetings to explain Sparton's request for discharge to the arroyo and to seek the Board's approval.

3. In connection with seeking approval of the AMAFCA Board, I worked with other underlying real property owners regarding requisite right-of-way for the discharge.

EXHIBIT
"F"

4. In connection with approvals for the discharge I also drafted Form 1 and Form 2D for an NPDES permit application for submittal to the EPA, Region VI, and drafted a Notice of Intent to Discharge for submittal to the New Mexico Environment Department. I am currently preparing a discharge plan for submittal to the state of New Mexico.

5. In order to estimate the likelihood of aquifer recharge to result from discharge to the Calabacillas Arroyo, I conducted conferrals with New Mexico Bureau of Mines, and with the Bureau of Reclamation hydrologists, regarding the Calabacillas recharge reach.

6. The option of discharge to the Calabacillas Arroyo from the contaminated groundwater treatment facility requires intermediate discharge to a local storm water facility for conveyance to the outfall at the arroyo. City of Albuquerque permission is required for connection to, and conveyance through, the storm water facility. I have conducted conferrals with Albuquerque Environment Department and Albuquerque Public Works Department technical staff regarding requirements for acquiring permission for facility use. Based on the city's form of agreement, I drafted a project specific agreement for review in acquiring this permission. In order to acquire permission for connection from the contaminated groundwater treatment facility to the storm sewer, I have been meeting with Public Works Department technical staff to determine an acceptable connection design.

7. An alternate option to discharge to the Calabacillas Arroyo is discharge of treated water to the local sanitary sewer, owned and operated by New Mexico Utilities ("NMU") and in part by the City of Albuquerque. I have held discussions with NMU technical staff regarding acceptability and conditions for utilizing the NMU sewer facility, and with the Wastewater Section of the City Public Works Department regarding pretreatment requirements for discharges to the city sewage treatment plant.

PETER H. METZNER

SUBSCRIBED AND SWORN to before me this 13th day of May, 1997.

NOTARY PUBLIC

My Commission Expires:

Sept. 9, 1998

OGC-002460

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW MEXICO

THE CITY OF ALBUQUERQUE, AND THE BERNALILLO COUNTY COMMISSIONERS, Plaintiffs, v. SPARTON TECHNOLOGY, INC., Defendant.	§ § § § § § § § § § §	CIVIL ACTION NO. CIV-97-0206-LH
STATE OF NEW MEXICO, THE NEW MEXICO ENVIRONMENT DEPARTMENT, and the NEW MEXICO OFFICE OF THE NATURAL RESOURCES TRUSTEE, Plaintiffs, v. SPARTON TECHNOLOGY, INC. Defendant.	§ § § § § § § § § § § § §	CIVIL ACTION NO CIV-97-0208-JC
UNITED STATES OF AMERICA, Plaintiff, V. SPARTON TECHNOLOGY, INC., Defendant.	§ § § § § § § § §	CIVIL ACTION NO. CIV-97-0210-M

AFFIDAVIT OF GARY L. RICHARDSON

THE STATE OF NEW MEXICO §
§
COUNTY OF BERNALILLO §

EXHIBIT
"6"

BEFORE ME, the undersigned authority personally appeared Gary Richardson, who after being sworn, deposed and stated as follows:

1. My name is Gary Richardson. I am over the age of 18 years, I have never been convicted of a crime of moral turpitude, I am fully competent to make this affidavit and all the facts and matters stated herein are within my personal knowledge and are true and correct.

2. I am half owner and Executive Vice President of METRIC Corporation located in Albuquerque, New Mexico.

3. Attached as Exhibit "A" to this Affidavit is the most current version of my curriculum vitae.

4. Since graduating from college in 1972 I have spent my entire professional career working on groundwater and surface water matters in the State of New Mexico. During that time I have personally supervised the completion of over 400 groundwater wells. I have sampled over 250 monitor wells for the purposes of determining the quality of groundwater. I have submitted over 50 bids to conduct drilling activities designed to identify the extent of impacts to groundwater from industrial and commercial activities. I have prepared over 100 reports describing the results of the groundwater investigations I have undertaken.

5. Since 1986, I have served as a consultant to Sparton Technology, Inc. with respect to impacts to groundwater associated with one of its plants located at 9621 Coors Road NW, Albuquerque, New Mexico. In connection with that relationship I have had responsibility for installing about 60 monitor and containment wells in an effort to better understand the impacts to groundwater associated with the Coors Road Plant.

6. I understand that lawsuits have been filed against Sparton Technology, Inc. in connection with the impacts to groundwater associated with its Coors Road Plant. In connection with those lawsuits I was asked to review a work plan proposed by a Robert Morrison and estimate the cost and time to complete the tasks called for.

7. Attached as Exhibits "B" and "C" are my cost estimates and schedule for completion.

8. I was also asked to review the information relied upon by Mr. Morrison in reaching his conclusions about the cost and time to complete the tasks called for in his work plan.

9. Attached as Exhibit "D" is a chart that compares the costs. For the reasons set forth more fully in that exhibit, it is my opinion that Mr. Morrison has underestimated the cost to accomplish his work plan by more than $200,000 or 62 percent.

10. It is also my opinion that he has significantly underestimated the time to complete the tasks described in his work plan. A more reasonable period of time would be 168 days, as described in Exhibit "C".

Gary Richardson

SWORN TO AND SUBSCRIBED TO BEFORE ME this 14th day of May, 1997, to certify which witness my hand and seal of office.

Notary Public, State of New Mexico

My Commission Expires:

Sept. 9, 1998

METRIC
Corporation

EXHIBIT A

QUALIFICATIONS OF GARY L. RICHARDSON, P.E.
CIVIL ENGINEER/HYDROLOGIST

New Mexico State University, M.S. in Civil Engineering, 1972

New Mexico State University, B.S. in Civil Engineering, 1970

New Mexico Registered Professional Engineer (cert. no. 6436)

Texas Registered Professional Engineer (cert. no. 73867)

Arizona Registered Professional Engineer (cert. no. 26091)

Sigma Tau Engineering Honorary Fraternity

Chi Epsilon Civil Engineering Honorary Fraternity

New Mexico Water Well Drillers License No. WD-1088

Texas Water Well Drillers License No. 2610W

Gary L. Richardson serves as Director, Executive Vice President, and Hydrologist/Civil Engineer for METRIC Corporation from 1980 to present. His technical responsibilities are in conducting ground and surface water hydrology studies, hydraulic design, erosion and sedimentation investigations, supervision, drilling, and installation of water wells, aquifer testing, and dewatering system design. Mr. Richardson serves as project manager for all hydrology projects. He has prepared diversion, flood control, and haul road designs for industrial facilities, conducted proceedings for groundwater acquisition, prepared mine discharge plans and permit applications, and prepared air quality analyses for permit applications and for PSD exemption.

Mr. Richardson has provided expert witness testimony regarding ground and surface water analyses at mine permit hearings for the Lee Ranch Mine, La Ventana Mine, Black Diamond Mine, South Hospah Mine, Gateway Mine, Bisti Mine, De-Na-Zin Mine, and La Plata Mine. He was a primary witness for Sunbelt Mining Company at the unsuitability petition hearing for the Gateway Mine. Mr. Richardson also provided expert witness testimony for Arco Pipeline Company in U.S. District Court.

Mr. Richardson served as project engineer for Earth Environmental Consultants, Inc., Albuquerque, New Mexico, from 1978 to 1980, conducting investigations in groundwater hydrology, supervision of water well installation, aquifer testing, hydraulic design, surface water hydrology, discharge analyses, erosion control and sedimentation, and water

resources management in New Mexico. In particular, he conducted ground and/or surface water analyses at the Lee Ranch Mine, Amcoal Mine, Mentmore Mine, San Juan Mine, La Ventana Mine, La Plata Mine, Black Lake Mine, Black Diamond Mine, Star Lake Mine, South Hospah Mine, Arroyo No. 1 Mine, Gateway Mine, De-Na-Zin Mine, in northwestern New Mexico. He installed wells, piezometers, stream gauges, and sediment samplers, and prepared water monitoring plans for a number of coal project areas.

From 1972 to 1978, Mr. Richardson served as hydrologic engineer with the Soil Conservation Service, Albuquerque, New Mexico. Among his project responsibilities, he was involved in locating water sources and securing water rights in Anthony, Espanola, and Santa Cruz areas for use in the construction of floodwater retarding dams. As an SCS engineer, Mr. Richardson also performed surface water hydrology and hydraulics for small watershed projects, river basin studies, and hydraulic designs, drawings, and specifications for irrigation structures, erosion and sediment control structures, floodwater retarding dams, and floodwater diversion structures.

EXHIBIT B
COST ESTIMATE FOR
ROBERT D. MORRISON SPARTON WORK PLAN

Permits			
Monitor Well Permit Application - Preparation (METRIC)			
16 hours @ $77.00/hr.			$ 1,232
Excavation Permits (3 for wells, 1 for sewer tap) (City)			
4 @ $42.00			168
	Subtotal - Permits	$1,400	
Well Drilling (Rodgers)			
Well A (T.D. 283') (4" well)			17,800
Well B (T.D. 185') (4" well)			14,958
Well B' (T.D. 245) (4" well)			16,567
Well C (T.D. 214) (4" well)			15,734
Well C' (T.D. 273) (4" well)			17,476
Pumped well (T.D. 254') (10" well)			45,677
Well OB-1 (T.D. 244') (4" well)			16,332
Well OB-2 (T.D. 239') (4" well)			16,240
Well OB-3 (T.D. 233') (4" well)			16,127
Surface Casings (12¼" hole with 8⅝" x .188" steel, grouted)			
3 @ 200' = 600' @ $71/ft.			42,642
Cuttings, Mud and Development Water Handling			
(200 drums, 4 - 8,000 gal tanks, 3 mos. rent,			
Steam cleaning)			19,014
	Subtotal - Drilling	238,567	
Well Construction Supervision (METRIC)			
320 hours @ $77.00/hr.			24,640
960 miles @ $.44/mi.			422
	Subtotal - Supervision	25,062	
Monitoring Pumps			
8 wells - 3 with packers (QED)			15,272
Freight - 8 @ $77.25.00/each			618
Labor			
32 hours @ $77.00/hr.			2,464
32 hours @ $38.00/hr.			1,216
	Subtotal - Pumps	19,570	

Well Sampling and Analysis (9 wells)			
Labor - 72 hours @ $65.00/hr.	(METRIC)		4,680
Nitrogen - 14 @ $16.50/each	(US Airweld)		231
Analyses	(AEN)		2,248
Mileage - 125 miles @ $.44/mi.			55
Subtotal - Sampling & Analysis		7,214	
Pipeline 6" x 1500' welded steel			
Install and remove	(Rodgers)		9,785
Wye into sewer at Congress St.	(Rodgers)		2,317
Reclaim Disturbance - 2 Ac. @ $1030/each	(METRIC)		2,060
Supervision - 10 hours @ $50.00/hr.			500
Subtotal - Pipeline		14,662	
Test Pumping			
Set and pull test pump - 600 gpm @ 250'	(Rodgers)		2,060
Data logger and transducers - 3 months	(Hazco)		25,570
Freight	(FEDEX)		685
Run test pump - 35 days @ $1,483.20/day	(Rodgers)		51,912
Data Collection labor - 1690 hours @ $45/hr.	(METRIC)		76,050
Field office - 10 weeks	(R.V. Stewart)		1,988
Sewer fee - ($40 + 30,240 TG x $.93/TG) X 1.03	(NM Utilities)		29,008
Mileage - 1,560 miles @ $.44/mi.	(METRIC)		686
Subtotal - Test Pumping		187,959	
Data Analysis and Report Preparation	(METRIC)		
40 hours @ $77.00/hr.			3,080
40 hours @ $53.00/hr.			2,120
24 hours @ $38.00/hr.			912
40 hours @ $32.00/hr.			1,280
Subtotal - Report		7,392	
Subtotal			501,826
New Mexico Gross Receipts Tax @ 5.5625%			27,914
TOTAL			**$529,740**

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EXHIBIT C

PROJECT SCHEDULE FOR ROBERT D. MORRISON SPARTON WORK PLAN

TASKS	WEEKS																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Monitor well permit	X	X	X	X	X																			
Schedule drill rigs (2)	X	X	X	X	X																			
Excavation permits (4)					X																			
Bluestake					X																			
Well drilling - Rig 1						X	X	X	X	X	X	X												
Well drilling - Rig 2						X	X	X	X	X	X	X												
Cuttings & mud handling								X	X	X	X	X	X	X	X	X	X	X	X					
Monitoring pump installations								X	X	X	X	X	X											
Well sampling													X											
Sample analyses														X	X	X								
Pipeline installation											X	X												
Test pump installation												X												
Run step test													X											
Allow aquifer recovery														X										
Run actual pump test															X	X	X	X						
Monitor recovery																			X	X	X	X		
Data analysis & report prep.																							X	X
Pipeline removal																			X					
Test pump removal																							X	

OGC-002469

EXHIBIT D

COMPARISON OF METRIC CORPORATION AND BEYLIK/FLUOR DANIEL GTI COSTS FOR COMPLETION OF ROBERT D. MORRISON - SPARTON WORK PLAN

		COST ESTIMATE			
	Line #	METRIC	Beylik	Fluor	Comments
Permits					
Monitor Well Permit Application - Preparation (METRIC)					
16 hours @ $77.00/hr.	1	1,232		Not incl.	
Excavation Permits (3 for wells, 1 for sewer tap) (City)					
4 @ $42.00	2	168		Not incl.	
Subtotal - Permits	3	**1,400**		Not incl.	
Well Drilling (Rodgers)					
Well A (T.D. 283') (4" well)	4	17,800	15,965		1,2
Well B (T.D. 185') (4" well)	5	14,958	10,436		2
Well B' (T.D. 245') (4" well)	6	16,567	13,822		2
Well C (T.D. 214') (4" well)	7	15,734	12,073		2
Well C' (T.D. 273') (4" well)	8	17,476	15,401		2
Pumped Well (T.D. 254') (10" well)	9	45,677	30,066		3
Well OB-1 (T.D. 244') (4" well)	10	16,332	13,766		2
Well OB-2 (T.D. 239') (4" well)	11	16,240	13,483		2
Well OB-3 (T.D. 233') (4" well)	12	16,127	13,146		2
Surface Casings (including hole, casing and grout)					
3 @ 200' = 600' @ $71/ft.	13	42,642	Not incl.		4
Cuttings, Mud and Development Water Handling					
at plant (200 drums, 4 - 8000 gal tanks,					
3 mos. rent, Steam cleaning)	14	19,014	Not incl.		5
Subtotal - Well Drilling	15	**238,567**	**138,158**		
Well Construction Supervision					
320 hours @ $77/hr. (METRIC)	16	24,640			
325 hours @ 103.77/hr. (Fluor)	17			33,725	
960 miles @ $.44/mi. (METRIC)	18	422			
2,000 miles @ $1.28/mi. (Fluor)	19			2,550	
Interface Probe & PID	20	Not needed		3,000	
Misc. Equipment & Health & Safety Plan	21	Included		1,950	
Subtotal - Construction Supervision	22	**25,062**		**41,225**	

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Monitoring Pumps					
8 wells - 3 with packers (QED)	23	15,272		Not Incl.	
Freight - 8 @ $77.25/each	24	618		Not Incl.	
Labor - 32 hours @ $77/hr. (METRIC)	25	2,464		Not Incl.	
- 32 hours @ $38/hr. (METRIC)	26	1,216		Not Incl.	
Sample Pump Rental	27	Not incl.		980	
Subtotal - Pumps	28	**19,570**		**980**	6
Well Sampling and Analysis (9 wells)					
Labor - 72 hours @ $65/hr. (METRIC)	29	4,680			
Labor - 56 hours @ $54.14/hr. (Fluor)	30			3,033	
Nitrogen - 14 @ $16.50/ea. (US Airweld)	31	231		Not needed	
Analyses (AEN)	32	2,248		3,415	7
Mileage - 125 miles @ $.44/mi.	33	55			
Evaporation Tanks	34	Not incl.		880	
Truck charges - 4 days @ $45/day	35			180	
Interface Probe & PID	36	Not incl.		3,000	
Miscellaneous Equipment	37	Included		300	
Subtotal - Sampling and Analysis	38	**7,214**		**10,808**	
Pipeline 6" x 1500' welded steel					
Install and remove (Rodgers)	39	9,785		Not incl.	
Wye into sewer at Congress St. (Rodgers)	40	2,317		Not incl.	
Reclaim disturbance - 2 ac. @ $1030/ea. (METRIC)	41	2,060		Not incl.	
Supervision - 10 hours @ $50/hr.	42	500		Not incl.	
Subtotal - Pipeline	43	**14,662**		Not incl.	8
Test Pumping					
Set and pull test pump - 600 gpm @ 250' (Rodgers)	44	2,060		4,400	
Data logger and transducers - 3 months (Hazco)	45	25,570		2,864	9
Freight (FEDEX)	46	685			
Run test pump - 35 days @ $1,483.20/day (Rodgers)	47	51,912			10
Data collection labor - 1690 hours @ $45/hr. (METRIC)	48	76,050			10
Data collection labor and run test pump -					
1018 hours @ $94.30/hr. (Fluor)	49			96,002	10
Field office - 10 weeks (R.V. Stewart)	50	1,988		Not incl.	
Sewer fee - ($40 + 30,240 TG x $.93/TG) x 1.03 (NM Util.)	51	29,008		Not incl.	11
Mileage - 1560 miles @ $.44/mi. (METRIC)	52	686			

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Mileage - 1500 miles @ $1.44/mi. (Fluor)		53			2,160	
Miscellaneous Equipment			Included		1,000	
Subtotal - Test Pumping		54	**187,959**		**106,426**	
Data Analysis and Report Preparation						
40 hours @ $77/hr. (METRIC)		55	3,080			
40 hours @ $53/hr. (METRIC)		56	2,120			
24 hours @ $38/hr. (METRIC)		57	912			
40 hours @ $32/hr. (METRIC)		58	1,280			
68 hours @ $107/hr. (Fluor)		59			7,276	
25 hours @ $131/hr. (Fluor)		60			3,275	
55 hours @ $82/hr. (Fluor)		61			4,510	
40 hours @ $53/hr. (Fluor)		62			2,120	
40 hours @ $37/hr. (Fluor)		63			1,480	
Reproductions and Shipping		64			253	
Subtotal - Report		65	**7,392**		**18,914**	
Other						
Remob at 10" well	Included in line 9					12
Sand sample analysis 10" well	Included in line 9					13
Geophysical log and standby	Included in line 9					13
Moving cuttings & fluids to plant	Included in line 4-12					15
Security guard	Included in line 4-13					14
Site work	Included in line 4-12					15
Decontamination steam cleaning	Included in line 4-13					16
Change mud before drilling prod zone	Included in line 4-12					
Subtotal			**501,826**	Not includ.	**178,353**	
New Mexico Gross Receipts Tax			**27,914**		**9,920**	
TOTAL			**$529,740**	**$138,158**	**$188,273**	17
COMPARISON			**$529,740**	**$326,431**		

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Foot Notes

1 Sparton recommends eliminating Well A and determining the vertical extent of the contamination at the 10" pumped well location by collecting water samples from the pilot hole as drilling progresses. At discrete vertical intervals pilot hole drilling would be stopped, a 4" steel well with wire wound screen would be placed in the borehole, the screen would be gravel packed, a thick bentonite slurry would be placed on top of the gravel pack, the well would be developed with a 4" submersible pump, VOC samples would be collected, the pump and well would be removed, and pilot hole drilling would continue. This procedure has been successfully used in monitor wells MW-65 and MW-67 at this site using the mud rotary drilling method. Collecting three samples from the pilot hole would cost about $7800. Eliminating Well A would save about $17,000.

2 Beylik prices for the individual 4" wells were calculated by proportioning the Beylik total price of $108,093 based on the total depth of each well.

3 The Beylik cost estimate assumes a 10" dia Sch 40 PVC well. the METRIC cost estimate assumes 10" mild steel casing and stainless steel wire would screen for the pumped well. There exists a high probability that a 10" Sch 40 PVC well at 254 ft. deep would collapse during grout placement or development. The collapse strength of 10" Sch 40 PVC casing is only 40 psi. For comparison the collapse strength of 4" Sch 40 PVC casing is 158 psi.

4 The METRIC cost estimate includes 3 - 200' surface casings. These are included because of the potential for lost circulation in the gravels at the water table. Significant lost circulation problems have been experienced at wells MW-54, 68 and 69.

5 The Beylik cost estimate assumes the cuttings, mud and development water are dumped on the ground at the well sites which are believed to be on City of Albuquerque property. The METRIC cost estimate assumes these potentially contaminated materials will be moved back to the Sparton plant property and handled in compliance with environmental regulations.

6 The METRIC cost estimate assumes dedicated bladder pumps will be placed in each of the 8 new wells to be samples, which is consistent with the other monitoring wells at the Sparton site. The Fluor estimate assumes using a rented portable pump which would be moved from well to well. This approach presents a cross contamination risk.

7 It appears the Fluor cost estimate includes TDS, alkalinity, hardness and total metals at all 9 wells whereas the Morrison work plan specifies these parameters only at the pumped well.

8 According to Bob Gay at New Mexico Utilities the nearest sanitary sewer which will accept 600 gpm is located 1500 feet south of the pumped well location. The METRIC cost estimate includes a temporary 6" welded steel pipeline to convey the potentially contaminated pump test water to the sewer.

9 The Fluor cost estimate includes $2864 for data loggers and transducer rental. The Morrison work plan specifies the data logger be in place for 77 days which equals 11 weeks. This time difference does not explain the entire difference between the two costs. METRIC obtained a quote from HAZCO for the data logger rental.

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10 There is a significant difference in the pump test labor estimated by METRIC and Fluor (i.e. 1690 hours vs. 1018 hours). The Fluor estimate may not include the pretest measurements, the step test and 30 days of recovery measurements.

11 New Mexico Utilities has told Sparton that there will be a sewer discharge fee of $28,163 to discharge 600 gpm for 35 days (assumed 5 days for step test and 30 days for constant discharge test).

12 The Morrison work plan indicates sand samples will be collected from the pilot hole to aid in sizing the filter pack and well screen. It would be necessary to move the rig off the pilot hole to allow about 3 weeks for the screen to be manufactured and delivered. This would require remobilization of the rig. The Beylik cost estimate does not appear to include the remobilization.

13 Required by Morrison work plan.

14 Vandalism has been experienced at this work site.

15 Some site work will be required.

16 Helps prevent cross contamination.

17 The cost, $529,599, represents METRIC Corporation's best estimate of the cost to complete the Morrison work plan. If METRIC were going to offer a fixed price bid on the job, we would probably add about 15% contingency.

EXHIBIT H

SPARTON'S OBJECTIONS TO PLAINTIFFS' EXHIBITS

A. Specific objections to Vincent E. Malott's declaration.[1]

1. Sparton objects to Paragraph 1 because Malott concludes that he has "personal knowledge of the following and, if called as witness, could and would testify competently thereto." Paragraphs 2 and 3 of his declaration reveal that Mr. Malott was not employed as the RCRA project manager during most of the time in question — Malott was instead variously a student, or in private industry until 1991. Hence, Malott does not have personal knowledge of relevant events before 1991, yet he repeatedly (and mistakenly) claims personal knowledge of events occurring a decade before his tenure.

2. Sparton objects to Paragraph 2 to the extent it is offered as the foundation for the opinions and conclusions Malott offers in his declaration. Malott's declaration fails to lay the proper predicate for expert testimony. The court should not rely on the title of an official, but must look to his qualifications before admitting his opinion. *Matthews v. Ashland Chem. Inc.*, 770 F.2d 1303, 1309-10 (5th Cir. 1985). Further, Malott fails to show that the information he relies upon (where any facts are given) are of the type reasonably relied upon by experts in the field. Moreover, the proponent of an expert opinion must show not only that the expert is qualified, but that his methodology (among other factors): (1) can be reliably tested, (2) has been subject to peer review, (3) has a reasonably low error rate, and (4) is generally accepted. *Daubert v. Merrell Dow Pharm.*, 113 S.Ct. 2786, 2793-2798 (1993). Opinions generated solely for litigation are suspect. *Daubert II*, 43 F.3d 1311, 1317-19 (9th Cir. 1995). Malott fails on all counts.

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[1] Plaintiffs' Exhibit 1.

3. Sparton objects to Paragraph 3 because Malott affirms that he is "familiar with the history of EPA's efforts to address contamination at the Sparton facility." Any such "knowledge" he may possess would have been gathered by the statements of other persons, not his personal knowledge. Paragraph 3 is an attempt to admit hearsay.

4. Sparton objects to Paragraph 4 because Malott states that "all exhibits attached to this Motion are true and correct copies of records maintained by EPA as part of its RCRA Enforcement and Regulatory Program." While this statement could authenticate reports authorized by law to be filed with the EPA, Malott fails to show with regard to most (if not all) of the exhibits that they are documents authorized by law to be filed with the EPA. Nor does he declare that items of this nature are kept in EPA files. Thus, Malott fails to satisfy Federal Rule of Evidence 901(7). Furthermore, many of the documents are (purportedly) not EPA documents at all, but are instead documents generated by third persons, various state or local agencies, or some other source. Thus, Malott's statement only overcomes one layer of authenticity; it does not prove that the documents that originally came to the EPA are what they purport to be.

5. Sparton objects to Paragraph 5 to the extent it improperly incorporates Exhibit A. Instead of relying on personal knowledge, Malott attempts to use Exhibit A for the truth of the matters stated therein ("According to the hazardous waste facility post-closure care plan . . . "). Malott also does not show that Exhibit A is authorized by law to be filed. Thus, Exhibit A is both hearsay and unauthenticated. Malott's restatement of what is contained in Exhibit A also violates the best evidence rule. Further, Exhibit A is missing Bates numbers 004506-07 and any pages that may exist after its internal Page 3. As a result, it violates the rule of completeness.

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6. Sparton objects to Paragraph 6 because Malott has no personal knowledge of the facts stated therein, and instead relies upon Exhibit B. Malott's statements in Paragraphs 2, 3, and 4 show that he would have no personal knowledge of whether Exhibit B is an authentic copy of a report prepared by the U.S. Geological Survey, as his relevant personal knowledge is limited to the activities of the EPA. Nor does Malott declare that Exhibit B concerns matters observed by law. Thus, Exhibit B is both unauthenticated and hearsay. Malott's restatement of Exhibit B's contents violates the best evidence rule. Further, while it is unclear whether Exhibit B has any more pages, if it does, its incompleteness violates the rule of completeness. The plaintiffs also fail to provide a foundation for the expert opinions in this exhibit. The court should not rely on the title of an agency, but must look to the preparer's qualifications before admitting his opinion. *Matthews v. Ashland Chem. Inc.*, 770 F.2d 1303, 1309-10 (5th Cir. 1985). Further, the proponent of an expert opinion must show not only that the expert is qualified, but that his methodology (among other factors): (1) can be reliably tested, (2) has been subject to peer review, (3) has a reasonably low rate of error, and (4) is generally accepted. *Daubert v. Merrell Dow Pharm.*, 113 S.Ct. 2786, 2793-2798 (1993).

7. Sparton objects to Paragraph 7 to the extent it is an insufficient predicate for Malott's opinions. *See* Objections in Paragraphs 1 and 2.

8. Sparton objects to Paragraph 8 to the extent it is an insufficient predicate for Malott's opinions. *See* Objections in Paragraphs 1 and 2.

9. Sparton objects to Paragraph 9 because it violates the best evidence rule. Malott simply is declaring the contents of 40 C.F.R. Part 261. The regulation speaks for itself and the original (or an exact duplicate) must be provided.

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10. Sparton objects to Paragraph 10 because Malott does not have personal knowledge of the facts stated therein, and is instead relying upon Exhibit C. Malott is attempting to testify to events that allegedly occurred on August 18, 1980, a period of time two (2) years before Malott was out of college, and eleven (11) years before he became the RCRA Project Manager. Exhibit C is further unauthenticated and has redactions that call its authenticity into question, and that substantially change its meaning. For example, the name of the installation's mailing address has been crossed out. Likewise, Blocks 5 and 6, under "Location of Installation," have been crossed out. To the extent Malott's testimony is a restatement of that contained in Exhibit C, it violates the best evidence rule.

11. Sparton objects to Paragraph 11 because it contains information that is not within the personal knowledge of Malott, and is instead based on the contents of Exhibit D. To the extent Paragraph 11 is a restatement of Exhibit D, it violates the best evidence rule. Further, Malott does not authenticate Exhibit D, nor is Exhibit D self-authenticating. More importantly, Exhibit D has numerous handwritten interlineations and excisions, all of which substantially change the meaning of the document. Malott does not say (nor is it likely he could say) who made these interlineations and excisions. Table B, within Paragraph 11, purports to be a summary of Exhibit D. Thus, Sparton incorporates its objections to Table B. Further, as Exhibit D is not a voluminous writing, Table B is an improper summary.

12. Sparton objects to Paragraph 12 because Malott does not have personal knowledge of the regulatory definitions in effect during 1981 and 1983 — Malott became the RCRA Project Manager in 1991. Further, Malott's testimony of the contents of 40 C.F.R. Part 261 in the form of the Table A (this is the second Table A) violates the best evidence rule.

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13. Sparton objects to Paragraph 13 because it contains allegations that are not within the personal knowledge of Malott, and is instead based upon Exhibit E. Paragraph 13 concerns events that occurred in January, 1983. Again, Mr. Malott became Director of the RCRA in 1991. Paragraph 13 also violates the best evidence rule to the extent it restates Exhibit E. Exhibit E, in turn, is not properly authenticated because there is no showing that Exhibit E is a document required by law to be provided to a government agency. Table C is allegedly a summary of information from Exhibit E. Sparton incorporates its objections to Table C. Sparton further objects to Table C as an improper summary; Exhibit E is not voluminous, nor otherwise inconvenient to present to the Court in its original form.

14. Sparton objects to Paragraph 14 because it contains information that is not within the personal knowledge of Malott, but is instead based on Exhibit F. Malott is again attempting to testify as to events that occurred before his tenure at the RCRA. To the extent Paragraph 14 is a restatement of Exhibit F, it violates the best evidence rule. Exhibit F, in turn, is not properly authenticated. Because Table D is allegedly a summary of Exhibit F, Sparton incorporates its objections to Table D. Sparton further objects to Table D as an improper summary because Exhibit E is not voluminous, nor otherwise inconvenient to present to the Court in its original form.

15. Sparton objects to Paragraph 15 because Malott is basing his statements on allegations made in Exhibit G, as opposed to having his own personal knowledge. Exhibit G is also reportedly a Dunn & Bradstreet document, and, on its face, not a government document. Exhibit G is thus hearsay, unauthenticated, and Malott's restatement violates the best evidence rule. Further, Exhibit G contains at least two (2) redactions and

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appears to be missing pages 2, 3, and 4, as well as any pages that follow page 5. Hence, Exhibit G also violates the rule of completeness.

16. Sparton objects to Paragraph 16 because it is not based on Malott's personal knowledge, but is instead based on Exhibit H. To the extent Paragraph 16 restates the contents of Exhibit H, it violates the best evidence rule. Exhibit H, in turn, is not authenticated and is hearsay. The exhibit is an accusatory instrument; as such, it embodies charges leveled by officials and does not possess the inherent indicia of reliability upon which hearsay exceptions, including those set forth in 803(6) and 803(8), are bottomed. *Lewis v. Velez*, 149 F.R.D. 474, 485 (S.D.N.Y. 1993). Business or government documents generated to support litigation are not admissible under 803(6) or 803(8). FED. R. EVID. 803 advisory committee notes; *Palmer v. Hoffman*, 318 U.S. 109, 113 (1943). Further, Exhibit H makes reference to several other documents. These documents are presumably being offered for the truth of the matter stated therein and are hearsay within hearsay. These internally referenced documents are also non-authenticated. Exhibit H is also not the best evidence of the contents of these internally referenced documents.

17. Sparton objects to Paragraph 17 because Malott does not have personal knowledge regarding the facts stated therein, but instead relies on Exhibit I. To the extent Paragraph 17 restates the contents of Exhibit I, it violates the best evidence rule. Exhibit I, in turn, is not authenticated.

18. Sparton objects to Paragraph 18 because Malott does not have personal knowledge of the facts stated therein, but instead relies upon Exhibit J. To the extent Paragraph 18 restates the contents of Exhibit J, it violates the best evidence rule. Exhibit J, in turn, is not authenticated and is hearsay. Further, the exhibit is an accusatory instrument; as such, it embodies charges leveled by officials and does not possess the inherent indicia of

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reliability upon which hearsay exceptions, including those set forth in 803(6) and 803(8), are bottomed. *Lewis v. Velez*, 149 F.R.D. 474, 485 (S.D.N.Y. 1993). Business or government documents generated to support litigation are not admissible under 803(6) or 803(8). FED. R. EVID. 803 advisory committee notes; *Palmer v. Hoffman*, 318 U.S. 109, 113 (1943). Thus, even if the plaintiffs provided the proper predicate, it would still be inadmissible. The exhibit's internal references to other communications amount to hearsay within hearsay. Moreover, there is no predicate for the expert opinions stated in Exhibit J. The court should not rely on the title of an official, but must look to his qualifications before admitting his opinion. *Matthews v. Ashland Chem. Inc.*, 770 F.2d 1303, 1309-10 (5th Cir. 1985). The proponent of an expert opinion must show not only that the expert is qualified, but that his methodology (among other factors): (1) can be reliably tested, (2) has been subject to peer review, (3) has a reasonably low rate of error, and (4) is generally accepted. *Daubert v. Merrell Dow Pharm.*, 113 S.Ct. 2786, 2793-2798 (1993). Finally, opinions (such as this opinion) generated solely for litigation are suspect. *Daubert II*, 43 F.3d 1311, 1317-19 (9th Cir. 1995).

19. Sparton objects to Paragraph 19 because Malott does not have personal knowledge regarding the facts stated therein, but instead relies upon Exhibit K. To the extent Paragraph 19 restates the contents of Exhibit K, it violates the best evidence rule. Exhibit K, in turn, is not properly authenticated and is hearsay. The proper predicate would not save this document. The exhibit is an accusatory instrument; as such, it embodies charges leveled by officials and does not possess the inherent indicia of reliability upon which hearsay exceptions, including those set forth in 803(6) and 803(8), are bottomed. *Lewis v. Velez*, 149 F.R.D. 474, 485 (S.D.N.Y. 1993). Business or government documents

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generated to support litigation are not admissible under 803(6) or 803(8). FED. R. EVID. 803 advisory committee notes; *Palmer v. Hoffman*, 318 U.S. 109, 113 (1943). Further, Exhibit K makes internal reference to other documents amounting to hearsay within hearsay. Exhibit K also makes conclusions that are unsupported by sufficient facts and the proper expert predicate, making Exhibit K further incompetent as evidence. *See* objections in Paragraph 18 regarding experts.

20. Sparton objects to Paragraph 20 because it contains statements that are not within the personal knowledge of Malott, but are instead based upon "facts" stated in Exhibits L and M. To the extent Paragraph 20 restates the contents of Exhibits L and M, it violates the best evidence rule. Further, Malott presents nothing to show that Exhibits L and M are writings authorized by law to be filed with a public office. Exhibits L and M are also being offered for the truth of the matters stated therein. Thus, Exhibits L and M are both unauthenticated and hearsay. Exhibits L and M also make internal reference to other documents. These internal references are both unauthenticated and hearsay within hearsay. Exhibits L and M also appear to be missing pages (*e.g.*, page 2 of Exhibit M is missing, there appear to be numerous exhibits from Exhibit L missing). The plaintiffs' failure to include all pages violates the rule of completeness.

21. Sparton objects to Paragraph 21 because Malott does not have personal knowledge of the facts stated therein, but instead relies upon Exhibits N and O. To the extent Paragraph 21 is a restatement of Exhibits N and O, it violates the best evidence rule. Exhibits N and O are unauthenticated. Exhibit O is also incomplete, missing Pages 2-3, 4-11, and stopping in mid-sentence on page 15; Exhibit O thus violates the rule of completeness.

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22. Sparton objects to Paragraph 22 because it contains statements not within the personal knowledge of Malott, but instead based upon Exhibit P. To the extent it restates Exhibit P, it violates the best evidence rule. Further, Exhibit P is unauthenticated, and presumably unauthenticable, by Malott; it is reputedly a document generated by an agency within the state of New Mexico, not the EPA. Malott does not show that Exhibit P is a document generated by authority of law. Exhibit P is thus also hearsay. Exhibit P contains numerous excerpts from other documents. These internal excerpts are hearsay within hearsay. The opinions stated within Exhibit P are also incompetent; no predicate for expert testimony is provided, and the facts supposedly supporting the opinions are not provided. *See* objections in Paragraph 18.

23. Sparton objects to Paragraph 23 because Malott does not have personal knowledge, but instead relies upon Exhibit Q ("Exhibit Q states that HLA, at Sparton's direction . . ."). To the extent Paragraph 23 restates the contents of Exhibit Q, it violates the best evidence rule. Malott did not, and is incompetent to, testify as to whether Exhibit Q is a document generated by authority of law; it allegedly concerns observations made by a New Mexico state agency. Malott's experience is with the EPA. Exhibit Q is thus both unauthenticated and hearsay. Exhibit Q also contains excerpts from other documents. These internal excerpts are hearsay within hearsay. The opinions stated within Exhibit Q are also incompetent; no predicate for expert testimony is provided, and the facts supposedly supporting the opinions are not provided. *See* objections in Paragraph 18. Exhibit Q violates the rule of completeness; it skips from Page 1 to Page 30 and from Page 30 to Page 46.

24. Sparton objects to Paragraph 24 because it contains assertions not within the personal knowledge of Malott, but relies on Exhibit R. To the extent Paragraph

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24 is a restatement of Exhibit R, it violates the best evidence rule. Malott does not authenticate Exhibit R.

25. Sparton objects to Paragraph 25 because it contains statements that are not within the personal knowledge of Malott; he instead relies upon Exhibit S. To the extent Paragraph 25 is a restatement of Exhibit S, it violates the best evidence rule. Malott does not state that any observations within Exhibit S were made in accordance with a duty imposed by law. Exhibit S is thus hearsay. Exhibit S also contains excerpts from other documents. These internal excerpts are hearsay within hearsay. The opinions stated within Exhibit S are also incompetent; no predicate for expert testimony is provided, and the facts supposedly supporting the opinions are not provided. *See* objections in Paragraph 18. Exhibit S also violates the rule of completeness because it skips multiple pages; Exhibit S is missing Pages 9-10, has two (2) versions of Page 14, and is missing Pages 16-36.

26. Sparton objects to Paragraph 26 because it is not based on Malott's personal knowledge, but is instead based on statements made in Exhibit T ("The report states . . ."). Malott does no authenticate Exhibit T. Further, Exhibit T apparently conflicts with the statements in Paragraph 26. Malott claims that Exhibit T is a report submitted by Sparton; the first page of Exhibit T, however, indicates that it was submitted by Black & Veatch. Exhibit T is thus hearsay (there is no showing that Black & Veatch was acting as Sparton's agent). Moreover, Exhibit T violates the rule of completeness. Exhibit T stops in mid-sentence on Bates No. 005193. It continues on Bates No. 005200. Bates No. 005200 is, in turn, only a single page of a report. Apparently, the remainder of the Black & Veatch letter is missing. The beginning of the unknown report is also missing, as well as the entire contents of the report beyond the first two paragraphs of the introduction.

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27. Sparton objects to Paragraph 27 because it is not based on personal knowledge, but on Exhibit U ("the RFI Report states the following . . ."). To the extent Paragraph 27 is a restatement of Exhibit U, it violates the best evidence rule. Malott does not authenticate Exhibit U. Further, Exhibit U is purportedly a report prepared by the Metric Corporation and HDR Engineering, Inc. The only "evidence" provided that these entities were acting as agents of Sparton comes internally from the document itself. Thus, Exhibit U is hearsay until the plaintiffs provide proof that Exhibit U is not hearsay (*i.e.* a document cannot "bootstrap" itself into evidence). Further, Exhibit U contains hearsay within hearsay; it is apparently based upon a separate report by Harding Lawson Associates. The Harding Lawson Associates report is, in turn, unauthenticated and hearsay. Exhibit U violates the rule of completeness. Apparently, pages 1-8 are missing (although more pages may be missing as the Bates labels 00002-00016 are missing). Further, pages 13-98, 100-01, 103-104, and 114-122 are missing.

28. Sparton objects to Paragraph 28 because it is not based on Malott's personal knowledge, but is instead based upon Exhibit V. To the extent Paragraph 28 is a restatement of Exhibit V, it violates the best evidence rule. Malott provides no evidence that Exhibit V is a writing authorized by law, and further fails to show it is authorized by law to be filed with a government agency. Thus, Exhibit V is unauthenticated and hearsay. Furthermore, the exhibit is an accusatory instrument; as such, it embodies charges leveled by officials and does not possess the inherent indicia of reliability upon which hearsay exceptions, including those set forth in 803(6) and 803(8) are bottomed. Therefore, even the proper predicate would not save Exhibit V. The opinions stated within Exhibit V are also incompetent; no predicate for expert testimony is provided, and the facts supposedly supporting the opinions are not provided. The court should not rely on an agency alone, but

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must look to the particular official's qualifications before admitting an opinion. *Matthews v. Ashland Chem. Inc.*, 770 F.2d 1303, 1309-10 (5th Cir. 1985); *O'Dell v. Hercules, Inc.*, 904 F.2d 1194, 1206-07 (8th Cir. 1990) (untrustworthy EPA documents not admissible). The proponent of an expert opinion must show not only that the expert is qualified, but that his methodology (among other factors): (1) can be reliably tested, (2) has been subject to peer review, (3) has a reasonably low rate of error, and (4) is generally accepted. *Daubert v. Merrell Dow Pharm.*, 113 S.Ct. 2786, 2793-2798 (1993).

29. Sparton objects to Paragraph 29 because it is not based on the personal knowledge of Malott, but is instead based on Exhibit W ("the CMS Report contained the following information . . ."). To the extent Paragraph 29 is a restatement of Exhibit W, it violates the best evidence rule. Malott does not authenticate Exhibit W. Plaintiffs also offer Exhibit W for the truth of the matter stated therein; it is thus hearsay. Malott makes no showing that Black & Veatch (the alleged authors) are the agents of Sparton other than the document itself. A document cannot "boot-strap" itself past a hearsay objection. Exhibit W also violates the rule of completeness; it is missing Bates Nos. 005492-98, 005501-02, 005504-005522, 005523-005691, and any pages that may exist after 005696.

30. Paragraph 30 is not based on Malott's personal knowledge, but is again based on Exhibit W ("in the CMS Report . . ."). Sparton reasserts its objections to Exhibit W. Sparton also objects to Paragraph 30 to the extent it attempts to restate Exhibit W as a violation of the best evidence rule.

31. Sparton objects to Paragraph 31 because it is not based on Malott's personal knowledge, but is instead based on statements made in Exhibit X. Sparton objects to Paragraph 30 to the extent it attempts to restate Exhibit X as a violation of the best evidence rule. Malott fails to properly authenticate Exhibit X; he fails to show that Exhibit

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X is a writing authorized by law to be generated and filed in a public office. Nor does Malott show that Exhibit X is the memorialization of observations made according to law. Exhibit X is thus hearsay. Further, the exhibit is an accusatory instrument; as such, it embodies charges leveled by officials and does not possess the inherent indicia of reliability upon which hearsay exceptions, including those set forth in 803(6) and 803(8), are bottomed. Additionally, the alleged author of this document is (presumably) available for trial. The Court should be reluctant to admit a document under 803(6) or (8) when a witness is available. *Sweitlowich v. Bucks*, 610 F.2d 1157, 1165 (3rd Cir. 1979). Exhibit X further contains internal references to other documents that are hearsay within hearsay. The "expert" opinions stated within Exhibit X are also incompetent; no predicate for expert testimony is provided, either concerning the qualifications of those opining, or whether the data utilized is of the type reasonably relied upon by experts in the field. In fact, the bulk of the facts supposedly supporting the opinions are not provided. The court should not rely on the title of an official or agency, but must look to the "expert's" qualifications before admitting his opinion. *Matthews v. Ashland Chem. Inc.*, 770 F.2d 1303, 1309-10 (5th Cir. 1985). The proponent of an expert opinion must show not only that the expert is qualified, but that his methodology (among other factors): (1) can be reliably tested, (2) has been subject to peer review, (3) has a reasonably low rate of error, and (4) is generally accepted. *Daubert v. Merrell Dow Pharm.*, 113 S.Ct. 2786, 2793-2798 (1993). Further, opinions generated solely for litigation are suspect. *Daubert II*, 43 F.3d 1311, 1317-19 (9th Cir. 1995). The plaintiffs fail on all counts. Exhibit X also violates the rule of completeness, or contains documents that are not part of the initial letter. The letter itself is Bates labeled 008603-008605. The two (2) documents that are purportedly attachments to this letter are Bates labeled 008248-008276 and 008367-008386. These far-removed Bates numbers

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indicate that the attachments are either not truly attachments to the letter, or that several attachments are missing.

32. Sparton objects to Paragraph 32 because it is not based on Malott's personal knowledge, but is instead based on Exhibit Y. Paragraph 32 also violates the best evidence rule. Malott fails to show that Exhibit Y is authorized by law to be recorded and fails to show that Exhibit Y concerns matters observed pursuant to a duty imposed by law. Hence, Exhibit Y is unauthenticated and hearsay. Further, the exhibit is an accusatory instrument; as such, it embodies charges leveled by officials and does not possess the inherent indicia of reliability upon which hearsay exceptions, including those set forth in 803(6) and 803(8) are bottomed. Additionally, the alleged author of this document is (presumably) available for trial. The Court should be reluctant to admit a document under 803(6) or (8) when a witness is available. *Sweitlowich v. Bucks*, 610 F.2d 1157, 1165 (3rd Cir. 1979). Thus, even with the proper predicate, the exhibit would be inadmissible. Exhibit Y also relies upon numerous other communications, for the truth of the matter asserted; these references are hearsay within hearsay. The "expert" opinions stated within Exhibit Y are also incompetent; no predicate for expert testimony is provided, either concerning the qualifications of those opining or whether the data used is of the type reasonably relied upon by experts in the field. *See* objections in Paragraph 31. Exhibit Y violates the rule of completeness because it is missing Bates Nos. 008659-790.

33. Sparton objects to Paragraph 33 because it is not based on Malott's personal knowledge, but is instead based Exhibits Z and AB. To the extent Paragraph 33 attempts to restate Exhibits Z and AB, it violates the best evidence rule. Malott fails to show that Exhibit Z and AB are authorized by law to be recorded or filed. Hence, they are unauthenticated. Malott also fails to show that Exhibit Z memorializes matters observed

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under law. Thus, it is hearsay. Further, Exhibit Z is an accusatory instrument; as such, it embodies charges leveled by officials and do not possess the inherent indicia of reliability upon which hearsay exceptions, including those set forth in 803(6) and 803(8), are bottomed. Additionally, the alleged author of this document is (presumably) available for trial. The Court should be reluctant to admit a document under 803(6) or (8) when a witness is available. *Sweitlowich v. Bucks*, 610 F.2d 1157, 1165 (3rd Cir. 1979). Thus, even the proper predicate would not render the exhibit admissible. The plaintiffs provide no predicate concerning the qualifications of those opining, nor the reliability of their methodology. *See* objections in Paragraph 31. Finally, Exhibit AB contains only the first page of the Protective Response and Request for Hearing and consequently violates the rule of completeness.

34. Sparton objects to Paragraph 34 because it is not based on Malott's personal knowledge, but is instead based on statements alleged in Exhibit AC ("according to the analytical reports . . ."). To the extent Paragraph 33 attempts to restate Exhibits AC, it violates the best evidence rule. Malott does not show that Exhibit AC concerns matters observed pursuant to a duty imposed by law and to which there was a duty to report, nor that a law authorizes its recordation. Exhibit AC is thus hearsay and unauthenticated. Furthermore, business or government documents generated to support litigation are not admissible under 803(6) or 803(8). FED. R. EVID. 803 advisory committee notes; *Palmer v. Hoffman*, 318 U.S. 109, 113 (1943). More importantly, the "expert" opinions stated within Exhibit AC are incompetent; no predicate for expert testimony is provided, either concerning the qualifications of those performing the tests (the closet is the alleged signature of "Diana Suvannunt, Ph.D." claiming that she "reviewed" something — the actual person or procedures are unknown) or whether the data is of the type reasonably relied upon by experts

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in the field. No methodology is provided. The court should not rely on the title of an official, but must look to his qualifications before admitting his opinion. *Matthews v. Ashland Chem. Inc.*, 770 F.2d 1303, 1309-10 (5th Cir. 1985). Finally, the proponent of an expert opinion must show not only that the expert is qualified, but that his methodology (among other factors): (1) can be reliably tested, (2) has been subject to peer review, (3) has a reasonably low rate of error, and (4) is generally accepted. *Daubert v. Merrell Dow Pharm.*, 113 S.Ct. 2786, 2793-2798 (1993). Opinions generated solely for litigation are suspect. *Daubert II*, 43 F.3d 1311, 1317-19 (9th Cir. 1995).

35. Sparton objects to Paragraph 35 because it violates the best evidence rule. Malott is allegedly quoting the Code of Federal Regulations. He should provide the original. Further, Malott does not include the particular section of the C.F.R., in its entirety, as an exhibit, so he violates the rule of completeness.

36. Sparton objects to Paragraph 36 because it is not based on Malott's personal knowledge, but is instead based on the contents of Exhibit AA. To the extent Paragraph 36 restates Exhibit AA, it violates the best evidence rule. Malott does not show that Exhibit AA concerns matters observed pursuant to a duty imposed by law and to which there was a duty to report, nor that a law authorizes its recordation. It is thus hearsay and unauthenticated. Exhibit AA is conclusory, and a self-serving document providing opinions made for the purposes of this litigation — generated only days before the filing of this lawsuit. The exhibit is also an accusatory instrument; does not possess the inherent indicia of reliability upon which hearsay exceptions, including those set forth in 803(6) and 803(8), are bottomed. *Lewis v. Velez*, 149 F.R.D. 474, 485 (S.D.N.Y. 1993). Business or government documents generated to support litigation are not admissible under 803(6) or

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803(8). FED. R. EVID. 803 advisory committee notes; *Palmer v. Hoffman*, 318 U.S. 109, 113 (1943). It is thus "untrustworthy" and cannot be admitted under Federal Rule of Evidence 803(8), even if the proper predicate was provided. Further, the alleged author of this document is (presumably) available for trial. The Court should be reluctant to admit a document under 803(6) or (8) when a witness is available. *Sweitlowich v. Bucks*, 610 F.2d 1157, 1165 (3rd Cir. 1979). More importantly, the opinions stated within Exhibit AA are incompetent; no predicate for expert testimony is provided, either concerning the qualifications of those allegedly performing tests, opining, or whether any data is of the type reasonably relied upon by experts in the field. No proper methodology was provided. The court should not rely on the title of an official or agency, but must look to his qualifications before admitting his opinion. *Matthews v. Ashland Chem. Inc.*, 770 F.2d 1303, 1309-10 (5th Cir. 1985). Additionally, the proponent of an expert opinion must show not only that the expert is qualified, but that his methodology (among other factors): (1) can be reliably tested, (2) has been subject to peer review, (3) has a reasonably low rate of error, and (4) is generally accepted. *Daubert v. Merrell Dow Pharm.*, 113 S.Ct. 2786, 2793-2798 (1993). Opinions, such as this, that are generated solely for litigation, are suspect. *Daubert II*, 43 F.3d 1311, 1317-19 (9th Cir. 1995). Table E purports to be a combination of Exhibit AA and various statutes and regulations. Sparton incorporates its previous objections to Table E. Next, to the extent Table E restates Exhibit AA and the statutes and regulations, it violates the best evidence rule. To the extent Table E is a summary of Exhibit AA and various statutes, it violates Federal Rule of Evidence 1006 because Exhibit AA is not voluminous and incapable of being conveniently examined (Exhibit AA's inclusion as an exhibit is proof that it is not voluminous).

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B. Sparton's specific objections to Norman Gaume's affidavit.[2]

Gaume's "affidavit" is an improper combination of an affidavit and a declaration. As a result, it bears neither a notary seal, nor does it substantially comply with 28 U.S.C. § 1746. Thus, it should not be considered by the Court.

1. Sparton objects to Paragraph 1 because it is an insufficient predicate for the opinions Gaume expresses in his affidavit. Gaume fails to show any education, training, or other evidence of special knowledge or skill. Gaume does not properly show any experience; he merely lists his current positions. Gaume does not state how long he has held these positions, how he came to hold these positions, nor does he detail what special knowledge or experience these positions give him. The court should not rely on the title of an official, but must look to his qualifications before admitting his opinion. *Matthews v. Ashland Chem. Inc.*, 770 F.2d 1303, 1309-10 (5th Cir. 1985). Thus, Gaume has failed to show that he can assist the trier of fact to understand any evidence or determine a fact at issue, and his opinion should not be considered.

2. Sparton objects to Paragraph 2 because Gaume does not have personal knowledge concerning the population of Albuquerque. To the extent Gaume is relying upon some unknown source, Paragraph 2 violates the best evidence rule and is hearsay.

3. Sparton objects to Paragraph 3 to the extent it violates the best evidence rule and is hearsay. Gaume is testifying regarding the contents of water planning documents. These documents speak for themselves and must be properly admitted.

4. Sparton objects to Paragraph 4 because Gaume's testimony is incompetent and conclusory. Gaume fails to provide a predicate for the expert testimony

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[2] **Plaintiffs' Exhibit 2.**

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provided: neither his qualifications, nor the qualifications of those allegedly performing the underlying tests, are provided. Gaume provides no data, and certainly no data of the type reasonably relied upon by experts in the field. Gaume provides no methodology for his conclusion. The proponent of an expert opinion must show not only that the expert is qualified, but that his methodology (among other factors): (1) can be reliably tested, (2) has been subject to peer review, (3) has a reasonably low rate of error, and (4) is generally accepted. *Daubert v. Merrell Dow Pharm.*, 113 S.Ct. 2786, 2793-2798 (1993). Further, opinions, such as Gaume's, that are generated solely for litigation are suspect. *Daubert II*, 43 F.3d 1311, 1317-19 (9th Cir. 1995).

5. Sparton objects to Paragraph 5 because Gaume provides no predicate to show his expertise for the opinion stated in Paragraph 5. Gaume fails to provide a predicate for the expert testimony: neither his qualifications, nor those allegedly performing underlying tests, are provided. Gaume provides no data, and certainly no data of the type reasonably relied upon by experts in the field. Gaume provides no methodology for his bare conclusion. Thus, Sparton reasserts the objections made in Paragraph 4.

6. Sparton objects to Paragraph 6 because it violates the best evidence rule, hearsay, and authentication restrictions; Gaume is testifying to the contents of some document of which no information is given. Paragraph 6 is even more conclusory and unsupported than the other paragraphs: Gaume provides no information concerning who or what prepared the Groundwater Plan on which he relies. Thus, he provides no predicate for the conclusion made in Paragraph 6: the qualifications of whomever performed any underlying tests are not provided. Gaume provides absolutely no data, and certainly no data of the type reasonably relied upon by experts in the field. Gaume provides no methodology

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for the report's (not even his) bare conclusion. Hence, Sparton reasserts the objections made in Paragraph 4.

7. Sparton objects to Paragraph 7 to the extent it is not based on Gaume's personal knowledge and instead based on an alleged "Master Plan for Water Supply for the City of Albuquerque, NM and Environs" because it violates the best evidence rule, is hearsay, and is unauthenticated.

8. Sparton objects to Paragraph 8 because Gaume fails to provide a predicate for the expert testimony provided: neither his qualifications, nor the qualifications of those allegedly performing underlying tests, are provided. Gaume provides no data, and certainly no data of the type reasonably relied upon by experts in the field to support his conclusion. Gaume provides no methodology for this bare conclusion. Sparton reasserts the objections made in Paragraph 4.

9. Sparton objects to Paragraph 9 because it is conclusory and because Gaume fails to provide a predicate for the expert testimony provided: neither his qualifications, nor the qualifications of those allegedly performing underlying tests, are provided. Gaume provides no data, and certainly no data of the type reasonably relied upon by experts in the field. Gaume provides no methodology for his bare conclusion. Hence, Sparton reasserts the objections made in Paragraph 4.

10. Sparton objects to Paragraph 10 because it is conclusory and because Gaume fails to provide a predicate for the expert testimony provided: neither his qualifications nor those allegedly performing underlying tests are provided. Gaume provides no data, and certainly no data of the type reasonably relied upon by experts in the field. Gaume provides no methodology for his bare conclusion. Thus, Sparton reasserts the objections made in Paragraph 4.

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C. Spartan's specific objections to Robert Morrison's Affidavit.[3]

Morrison's "affidavit" is an improper combination of an affidavit and a declaration. As a result, it bears neither a notary seal, nor does it substantially comply with 28 U.S.C. § 1746. Hence, it should not be considered by the Court.

1. Spartan objects to Exhibit A in Paragraph 1 as hearsay. Exhibit A is also an unsworn statement by Morrison and is further incompetent.

2. Spartan objects to Paragraph 2 because it is an insufficient predicate for an expert opinion. Morrison does not show that the reports mentioned are of the type reasonably relied upon by experts in the field. Further, the proponent of an expert opinion must show not only that the expert is qualified, but that his methodology (among other factors): (1) can be reliably tested, (2) has been subject to peer review, (3) has a reasonably low rate of error, and (4) is generally accepted. *Daubert v. Merrell Dow Pharm.*, 113 S.Ct. 2786, 2793-2798 (1993). Opinions generated solely for litigation are suspect. *Daubert II*, 43 F.3d 1311, 1317-19 (9th Cir. 1995). The plaintiffs satisfy none of these requirements. Finally, Morrison's opinions appear to be generated for this suit and are further suspect.

3. Sparton objects to Paragraph 3 because Morrison fails to provide a predicate for his opinion, and provides no supporting data. Morrison provides no methodology for his conclusions. Thus, Sparton reasserts the objections made in Paragraph 2.

4. Sparton objects to Paragraph 4 because Morrison fails to provide a predicate for his opinion, and provides no supporting data. Morrison provides no

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[3] Plaintiffs' Exhibit 3.

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methodology for his conclusions. Thus, Sparton reasserts the objections made in Paragraph 2.

5. Sparton objects to Paragraph 5 because Morrison fails to provide a predicate for his opinion, and provides no supporting data. Morrison provides no methodology for his conclusions. Thus, Sparton reasserts the objections made in Paragraph 2.

6. Sparton objects to Paragraph 6 because Morrison fails to provide a predicate for his opinion, and provides no supporting data. Morrison provides no methodology for his conclusions. Thus, Sparton reasserts the objection in Paragraph 2. Sparton objects to the Exhibit B first mentioned in Paragraph 6. Exhibit B is both unauthenticated and hearsay — in fact, it is unclear who, or what, generated Exhibit B. Its further internal references to other documents are hearsay within hearsay. If Exhibit B is a document generated for this suit, the proper predicate under 803(6) or (8) would be insufficient. Sparton also objects Exhibit B because it is conclusory and fails to supply a predicate for the expert opinions it provides: the qualifications of the unknown author are not provided. It provides no underlying data, and certainly no data of the type reasonably relied upon by experts in the field. The report provides no methodology for its conclusions. Thus, Sparton reasserts the objections made in Paragraph 2.

7. Sparton objects to Paragraph 7 because Morrison fails to provide a predicate for his opinion, and provides no supporting data. Morrison provides no methodology for his conclusions. Sparton reasserts its objections to Exhibit B and it objections in Paragraph 2.

8. Sparton objects to Paragraph 8 because Morrison fails to provide a predicate for his opinion, and provides no supporting data. Morrison provides no

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methodology for his conclusions. Further, Morrison specifically fails to show he is qualified to opine as to the costs of the proposed pump test and the drilling of five wells. Sparton reasserts its objections listed in Paragraph 2.

D. Sparton's specific objections to the purported New Mexico document.[4]

The plaintiffs provide no authentication for Exhibit 4; they just attach it to their motion. Exhibit 4 is not a self-authenticating document, nor does any individual declare what Exhibit 4 is. The plaintiffs are offering Exhibit 4 for the truth of the matters asserted therein. Further, even if Exhibit 4 is a government document, and the plaintiffs somehow satisfy the predicate for 803(6) or (8), Exhibit 4 lacks trustworthiness and could not be admitted. The apparent date of Exhibit 4, February 14, 1997, makes it clear that the document was produced for this litigation. Business or government documents generated to support litigation are not admissible under 803(6) or 803(8). FED. R. EVID. 803 advisory committee notes; *Palmer v. Hoffman*, 318 U.S. 109, 113 (1943). The exhibit is also an accusatory instrument; as such, it embodies charges leveled by officials and does not possess the inherent indicia of reliability upon which hearsay exceptions, including those set forth in 803(6) and 803(8) are bottomed. *Lewis v. Velez*, 149 F.R.D. 474, 485 (S.D.N.Y. 1993). Further, the alleged authors of this document are (presumably) available for trial. The Court should be reluctant to admit a document under 803(6) or (8) when a witness is available. *Sweitlowich v. Bucks*, 610 F.2d 1157, 1165 (3rd Cir. 1979). Thus, Sparton objects to Exhibit 4's authenticity and as hearsay. Exhibit 4 also makes internal reference to other documents. These documents are hearsay within hearsay.

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[4] Plaintiffs' Exhibit 4.

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Moreover, the plaintiffs fail to provide the requisite predicate for the expert opinions given in Exhibit 4. The qualifications of whomever (presumably the signatories) prepared Exhibit 4 are not given. The plaintiffs fail to show that the signatories, or anyone else, has any special knowledge or training. The court should not rely on the title of an official, but must look to his qualifications before admitting his opinion. *Matthews v. Ashland Chem. Inc.*, 770 F.2d 1303, 1309-10 (5th Cir. 1985). The plaintiffs also fail to show that the data utilized (where even mentioned) is of the type reasonably relied upon by experts. Moreover, the proponent of an expert opinion must show not only that the expert is qualified, but that his methodology (among other factors): (1) can be reliably tested, (2) has been subject to peer review, (3) has a reasonably low rate of error, and (4) is generally accepted. *Daubert v. Merrell Dow Pharm.*, 113 S.Ct. 2786, 2793-2798 (1993). Further, opinions generated solely for litigation are suspect. *Daubert II*, 43 F.3d 1311, 1317-19 (9th Cir. 1995). Exhibit 4 fails on all these ground; it is simply a collection of self-serving, unsupported conclusions made for this lawsuit.

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IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW MEXICO

The City of Albuquerque & The Bernalillo County Commissioners,	)	
Plaintiffs,	)	**Civil Action No.**
v.	)	**CIV-97-0206-LH**
Sparton Technology, Inc.	)	
Defendant.	)	
State of New Mexico New Mexico Environment Department, & New Mexico Office of the natural Resources Trustee,	)	**Civil Action No.**
Plaintiffs,	)	**CIV-97-02808-JC**
v.	)	
Sparton Technology, Inc.	)	
Defendant	)	
United States of America	)	
Plaintiff,	)	**Civil Action No.**
v.	)	**CIV-97-0210-M**
Sparton Technology, Inc.	)	
Defendant.	)	

AFFIDAVIT OF GLENN C. MILLNER, PH.D.

Comes the affiant, Dr. Glenn C. Millner under oath and do hereby state as follows:

1. My name is Dr. Glenn C. Millner. I am over the age of 18 years, I have never been convicted of a crime of moral turpitude, I am fully competent to make this affidavit, and the following represent my opinions and conclusions.

2. I am a Senior Toxicologist at the Center for Toxicology and Environmental Health, L.L.C. an environmental consulting firm that is part of the University of Arkansas for Medical Sciences Incubator Program. I am also an adjunct assistant professor in the College of Medicine, Division of Interdisciplinary Toxicology, University of Arkansas for Medical Sciences. As a lecturer, I speak on toxicology, government regulations, and risk assessment subjects to graduate and medical students. Attached as exhibit "A" to this affidavit is my curriculum vitae. Over the past 17 years, I have been involved in the study of hazardous waste sites and their potential impacts to human health and the environment. I have testified as an expert witness on toxicological and risk assessment subjects in trials before Federal District Courts in Denver, CO, Hot Springs, AR, New Orleans, LA, and Fort Smith, AR.

3. I am testifying as an expert in toxicology and risk assessment. As such, a definition of these disciplines is in order. Toxicology is the science of poisons. Whether a substance is a poison depends on two inseparable criteria: the intrinsic nature of the substance and the dose, or how much of a substance an individual actually takes into his or her body. In toxicology, we study the dose-response of chemicals on biological systems, with emphasis on understanding the mechanisms of harmful effects. One of the principle concerns in toxicology is the protection of public health from environmental hazards.

4. Risk assessment as we know it today was defined in 1983 by the National Academy of Science in Risk Assessment in the Federal Government: Managing the Process: *We use risk assessment to mean the characterization of the potential adverse health effects of human exposures to environmental hazards. Risk assessments include several elements: description of the potential adverse health effects based on an evaluation of results of epidemiologic, clinical, toxicologic, and environmental research; extrapolation from those results to predict the type and estimate the extent of health effects in humans under given conditions of exposure; judgments as to the number and characteristics of persons exposed at various intensities and durations; and summary judgments on the existence and overall magnitude of the public health problem. Risk assessment also includes characterization of the uncertainties inherent in the process of inferring risk (NAS, 1983).*

5. This Affidavit is prepared at the request of Sparton Technology, Inc. in connection with litigation involving the Sparton Facility ("Facility"), located at 9621 Coors Road Northwest in Albuquerque, New Mexico. This affidavit examines whether chemicals present in groundwater and soil at the Sparton Facility pose an imminent and substantial endangerment to human health.

6. In evaluating issues related to this litigation, I have reviewed the pleadings and attached exhibits, reports, and affidavits that were submitted on behalf of the plaintiffs dated on or about March 31, 1997. I have also reviewed groundwater and soil monitoring data from investigations performed by Black and Veatch on behalf of the Defendant Sparton Technology, the affidavit of Pierce L. Chandler, Mr. Gaume, and other information and materials. My evaluation is continuing and may be supplemented by additional opinions as more data become available and further analyses are performed. These sources and

11. The four basic steps of the risk assessment process follow:

HAZARD IDENTIFICATION - The hazard identification summarizes the toxicological database for the chemical of interest and identifies the potential adverse health effects observed in animal and human studies. Examples of hazard identifications are the USEPA Water Quality Criteria and Health Effects Documents.

HAZARD EVALUATION - The hazard evaluation is an analysis of the dose-response relationships, potency, and toxicological mechanisms of a chemical. Specifically, the following points are to be analyzed:

- Evaluation of the types of toxic responses and sensitive organs and tissues.
- Investigation of species variation in toxic effects.
- Examination of the mechanism(s) of toxicity.
- Determination of the validity of the tests performed in animals and their relevance for extrapolation to man.
- Comparison of animal test doses with the expected level of human exposure.
- Evaluation of available data from long-term occupational exposures and human poisonings. Such an evaluation may provide information regarding expected human effects and act as a test for extrapolations made from animal data.

EXPOSURE EVALUATION - The exposure evaluation provides estimates of likely human exposure that may result from human contact with the affected environmental media. The exposure evaluation takes into consideration site-specific characteristics that may affect the potential for human exposure to the chemical.

RISK ASSESSMENT - The risk assessment integrates the outputs of the exposure evaluation against the risk estimates for the chemical. This provides some determination as to the relative safety or hazard associated with the anticipated exposure.

12. It is important to understand that without exposure, <u>there can be no risk</u>. I have evaluated whether the risk of harm to human health is imminent by conducting an exposure assessment using EPA's own risk assessment methods (See Appendix A). In its guidance for human health risk assessment, the EPA has established guidance for conducting an exposure assessment as part of the risk assessment process. The objective of the exposure assessment is to estimate the type and magnitude of exposure to the chemicals of potential concern that are present at or migrating from a site. The results of the exposure assessment are combined with a chemical specific toxicity information to characterize

potential risks. EPA's guidance states that "An exposure pathway consists of four elements:

I. A source and mechanism of chemical release,

II. A retention or transport medium (or media in cases involving media transfer of chemicals),

III. A point of potential human contact with the contaminated medium (referred to as the exposure point), and

IV. An exposure route at the (e.g., ingestion) at the contact point."

EPA considers exposure pathways complete if all four elements are present, and incomplete if one or more of these elements are not present. Complete pathways represent the only potential routes of exposure to the chemicals of concern.

The results of my exposure assessment indicate that under current site conditions, there are no complete exposure pathways for exposure to groundwater. Thus, using the Agency's own policy guidance (EPA, 1991), the EPA cannot support its claim of imminent and substantial endangerment. It is incorrect to speculate that because chemicals are detected in groundwater that down gradient exposure to these chemicals will occur. An individual cannot be considered at risk of adverse health effects in the absence of chemical exposure. This finding is also supported by statements made by Mr. Norman Gaume in his deposition taken on April 29, 1997. Mr. Gaume is Manager of the Water Resources Division of the Public Works Department of the City of Albuquerque. In this deposition, Mr. Gaume indicated that there are no drinking water wells completed in the affected area near the Spartan facility and that the City has no plans to install a well in the near future.

13. While there can be no imminent and substantial endangerment under current site conditions, it is possible that conditions could change and that a drinking water well could be completed in the contaminated plume. It would be logical for the agency to consider the likelihood of potential future impacts from ingesting contaminated groundwater and in fact its risk assessment guidance recommends that future risks be considered when groundwater is not currently used and is of potable quality. I have reviewed EPA's and the State of New Mexico's report's concerning imminent and substantial endangerment for evidence of some estimate of the likelihood, risk, or probability of someone completing a well in the contaminated plume and drinking contaminated water. My review indicates that this type of analyses has not been performed. Thus, the agency fails to provide adequate evidence concerning the risk of harm from ingesting contaminated groundwater being "imminent". Such an analyses would include a variety of factors such as:

- Risk associated with drinking contaminated water for periods shorter than the 70 years exposure period used to estimate cancer risk,

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- Probability of a homeowner completing a well in the contaminated aquifer versus using the City's municipal water supply,
- Evaluation of dose issues,
- Cost associated with well completion, (can an average homeowner afford it?),
- Permit issues.

14. In addition to failing to provide evidence of imminent exposure, the EPA and State of New Mexico reports concerning imminent and substantial endangerment also fail to provide the necessary toxicological dose-response data to conclude groundwater conditions represent an endangerment to human health. For example, on pages 17-19 of the EPA imminent and substantial endangerment report, EPA infers that if a person were to drink groundwater from the contaminated plume, it will cause the various health effects described such as cancer, liver, central nervous system, and circulatory effects. However, the report fails to provide a single dose capable of causing any of the health effects described. Many of the described health effects occur at very high doses (considerably above drinking water standards) and from the inhalation route of exposure, not from drinking contaminated water. The report simply does not provide the necessary dose-response data showing what doses cause these potential effects (an endangerment) and more importantly will ingestion of chemical in groundwater at the detected concentration cause these effects. In toxicology, *dose* is defined as the amount of chemical absorbed into the body when one comes in contact with (is exposed to) a chemical. In this case, dose would be dependent upon how much groundwater a person drank, their body weight, the concentration of chemical in groundwater, frequency of consumption (e.g., daily, weekly, etc.), the oral bioavailability of the chemical, and the duration of exposure (how may years). Even if the above alleged exposure pathways were known to occur, it would be necessary to demonstrate that the exposure is sufficient to result in adverse health risk.

15. The maximum contaminant levels (MCLs) and the maximum contaminant levels goals (MCLGs) were put into effect under the Safe Drinking Water Act (40 CFR 141). The MCL represents a safe allowable lifetime water concentration for a specific toxic chemical, based on an average 70 kg adult male consuming 2 liters of water per day. A person's total environmental exposure to the particular chemical in question is factored into this value and includes contributions made by air, food, and water exposures. This is called relative source contribution. This is usually accomplished by limiting the acceptable water exposure (the MCL) to 20 percent of the total allowable daily intake. Safety factors are included in each of the standards, the magnitude of which provide adequate protection to potentially sensitive populations such as infants, small children, the elderly, and the infirm. Note that the relative source contribution is generally applied to non-carcinogens, but in certain cases, it is also applied to potential carcinogens. In addition to considering the potential adverse health effects posed by the contaminant in question, an MCL is legally required to reflect the technological and economic feasibility of removing that contaminant from the water supply. The limit must be feasible given the best available technology (BAT) and the effects of current water treatment techniques.

16. While there clearly is no current human exposure to groundwater, I have evaluated the potential endangerment or health risk assuming that a drinking water well is in fact completed in the contaminated groundwater plume using the main chemicals at issue in this lawsuit namely trichloroethene, 1,1-dichloroethene, 1,1,1-trichloroethane, and total chromium. Using the recent groundwater monitoring data collected in January 1996, I compared the geometric mean concentration for each detected chemical to drinking water standards and health advisories in the table below.

17. Comparison of the detected chemicals to MCLs and health advisories published by the EPA indicates that the geometric mean concentration of 1,1-dichloroethene, 1,1,1-trichloroethane, and total chromium are between 3.5 to 33,333 times below their respective MCL or health advisory. While TCE is above the MCL, the geometric mean concentration is clearly below several of EPA's health advisories including a long-term health advisory. These data clearly indicate that the average levels of chemicals in the groundwater plume do not represent a significant health risk or endangerment. These data also show that while MCLs are a health protective standard, exceeding an MCL does not necessarily mean that this exceedence represents an endangerment without a thorough understanding of the health protective basis for that particular MCL which often times includes several safety factors.

Comparison of Monitoring Well Data With MCLs (drinking water standards) and EPA Health Advisories
(concentrations in μg/L)

Chemicals of Concern	Geometric Mean	Health Advisories			MCL
	(μg/L)	One-day[1] (μg/L)	Ten-day[2] (μg/L)	Longer Term[3] (μg/L)	(μg/L)
Chlorinated Organic Hydrocarbons					
1,1 - Dichlorocthene	2	2,000	1,000	4,000	7
1,1,1 - Trichloroethane	3	100,000	40,000	100,000	200
Trichloroethene	19	—	—	300*	5
Inorganics					
Chromium (total)	19	1,000	1,000	800	100

[1] One-day health advisory - the concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects for up to 5 consecutive days of exposure, with a margin of safety.

[2] Ten-day health advisory - the concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects for up to 14 consecutive days of exposure, with a margin of safety.

[3] Long-term advisory - the concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects up to approximately 7 years (10% of an individual's lifetime) of exposure, with a margin of safety.

*Drinking water equivalent level (DWEL) - A lifetime exposure concentration protective of adverse, non-cancer health effects, that assumes all of the exposure to a contaminant is from a drinking water source.

MCL - Federal MCLs

(Source EPA, 1995 Drinking water regulations and health advisories; EPA's office of water, Washington, D.C.)

18. While my analyses used average levels for comparison with MCL and health advisories to determine potential health risks, EPA's analyses used individual monitoring well data points for comparison with MCLs to conclude endangerment. For water that is to be used for drinking, MCLs are generally applicable where the water will be provided directly to 25 or more people or will be supplied to 15 or more service connections. Moreover, MCLs apply at the tap. For these reasons, average levels of chemicals in groundwater seem more appropriate for comparison with MCLs than individual monitoring well results. In addition, the average concentrations would be more representative of the most plausible points where individuals would likely complete a well (i.e., off-site locations).

19. According to Mr. Norman Gaume, the City of Albuquerque applies drinking water standards at the tap for some chemicals and where water enters the public distribution system for others. Thus, exceeding an MCL in groundwater by definition cannot represent an imminent and substantial endangerment because it does not account for any dilution that may occur during transport to the City's distribution system or to the tap. On page 132 of the Gaume deposition, Mr. Gaume was asked: *"But you would agree with me that a portion of water produced by a well could be above MCLs and still produce water of a quality that the City would be willing to provide to consumers"?* He responded *"yes"*. In fact, Plaintiffs' fail to provide any evidence or analyses to show where any constituent of concern at the Spartan site would exceed the MCL at the tap or where groundwater would enter the public distribution system.

20. My review of EPA's imminent and substantial endangerment report and motion for a preliminary injunction reveal a number of technical inaccuracies as follows:

- On page 17 of the EPA's imminent and substantial endangerment report, EPA incorrectly suggests that the 5 μg/L MCL for trichloroethene is based on cancer risk. The 5 μg/L MCL for trichloroethene is based essentially on the practical quantitation level (PQL) which is defined as the lowest achievable level of analytical quantitation during routine laboratory operating conditions within specific limits of precision and accuracy. In other word, 5 μg/L is the level of trichloroethene that can be reliably detected in groundwater.

- The same comment applies to 1,1,1-trichloroethane and 1,2-dichloroethylene; the MCL is based essentially on the practical quantitation level. On page 17, EPA incorrectly states that trichloroethene is a B2 (probable) carcinogen. The carcinogen ranking of trichloroethene has been withdrawn by EPA and is currently undergoing review. There is considerable debate in the scientific community regarding the carcinogenicity of this chemical and how the animal data should be used to extrapolate human health risks (see comments below).

- On page 19, EPA incorrectly implies that chromium VI is a known human carcinogen in drinking water. Chromium VI is not carcinogenic in drinking water. However, in the occupational setting, chromium VI is a known human carcinogen when inhaled but not when ingested.

21. According to the affidavit of Mr. Norman Gaume, plaintiffs' contend that "The aquifer in the area of the Sparton Technology facility would provide high quality drinking water, if it were not for the contamination plume." I have reviewed the plaintiffs' and defendants' pleadings and attached reports and found that such a statement may not be true. Results of groundwater monitoring data at several locations reveal that wells located in the shallow aquifer have some total dissolved solids (TDS) measurements in excess of 500 mg/L and some sodium levels at 20 mg/L[3]. Likewise, the shallow aquifer has background occurring levels of nitrate at some locations above primary drinking water standards.

22. Potable water is defined as water that is fit for drinking (Vesilind and Pierce, 1983). The EPA sets national secondary drinking water regulations to control water, color, odor, appearance, and other characteristics affecting consumer acceptance of water. The secondary regulations are not federally enforceable but are considered guidelines for the states (Federal Register, 7/7/91). Secondary Maximum Contaminant Levels (SMCLs) and, in the case of sodium, the Drinking Water Equivalent Level (DWEL) were compared with selected individual groundwater monitoring well data in order to determine the potability of these waters. The table below illustrates the water quality parameters used in the determination of groundwater potability and their effect upon water usability.

[3] I recognize that the State of New Mexico defines all groundwater of the State to be potentially suitable for domestic or municipal water supply, except where the total dissolved solids (TDS) concentration exceeds 1,000 mg/L. However, as a practical matter, naturally occurring concentrations of total dissolved solids in the shallow ground water above federal secondary drinking water standards impart objectionable taste to the water, thereby precluding its use as a drinking water source. Similarly, background levels of nitrate above primary drinking water standards and sodium above health advisories preclude the use of shallow ground waters as a drinking water source because the levels represent potentially unacceptable human health risks.

Primary and Secondary Maximum Contaminant Levels and the Effect Upon Water Usability

Chemical	MCL, SMCL, or DWEL†	Effect upon Usability of Water
Sodium†	20 mg/L	In combination with chloride imparts a salty taste.
Nitrate	10 mg/L	Levels above 10 mg/L may cause methemoglobinemia in infants.
Total Dissolved Solids (TDS)	500 mg/L	More than 500 mg/L is undesirable for drinking.

♦ - SMCL - Secondary Maximum Contaminant Level
† - DWEL - Drinking Water Equivalent Level

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23. Total dissolved solids are a measure of the total amount of minerals dissolved in water and are, therefore, a very useful parameter in the evaluation of water quality. Water containing less than 500 mg/L is preferred for domestic use and for many industrial purposes. Less than 300 mg/L is desirable for dyeing of textiles and the manufacture of plastics, pulp paper, and rayon. Dissolved solids also cause foaming in steam boilers. Levels above 500 mg/L are undesirable for drinking. Nitrate levels in water supplies above the primary standard of 10 mg/L can induce methemoglobinemia (a potentially fatal condition) in infants.

24. Because TDS, sodium, and nitrate were not measured from all wells over a sufficient period of time, I did not have the same basis for averaging and comparing results with MCLs as I did above when I compared the average level of Spartan related chemicals to MCLs[4]. All I can say at this point is that there is some data that indicates that background water quality may not be suitable as a drinking water source, for reasons unrelated to the Spartan Facility. More data would be necessary to make a valid comparison with MCLs to determine if groundwater is of high water quality. However, if one applies EPA's method discussed above (i.e., comparing individual trichloroethene monitoring well results with MCLs) to conclude endangerment, one would also have to conclude that for reasons of taste and domestic and industrial usability, as well as protection of human health, the shallow aquifer is of sufficiently poor natural quality that it would not be desirable as a drinking water source.

25. In summary, the Plaintiffs fail to provide an adequate estimate of the likelihood, risk, or probability of someone completing a well in the contaminated plume and drinking contaminated water. Thus, the plaintiffs fail to provide evidence concerning the risk of ingesting contaminated groundwater as an "imminent" hazard. Without a plausible route for people to be exposed to contaminated groundwater, there can be no imminent and substantial endangerment. Furthermore, even if exposure is assumed to occur, the Plaintiffs provide no basis for their speculation that the degree of hypothetical exposure would be sufficient to cause human health effects. Therefore, based on the results of exposure and risk analyses of groundwater monitoring data, it is my opinion that the human health is not at risk of imminent or substantial endangerment.

FURTHER THE AFFIANT SAYETH NOT.

Glenn C. Millner, Ph.D.

[4] I also was unable to take make any dilution calculations to determine if groundwater would meet MCLs at the tap or point of distribution because such procedures were not produced by Plaintiffs'.

ACKNOWLEDGEMENT

STATE OF TEXAS)

) ss.

COUNTY OF DALLAS)

On this _____ day of May 14, 1997, before me, the undersigned, a Notary Public, duly commissioned, qualified, and acting, the within named Dr. Glenn C. Millner, to me personally well known, who states that he has so signed, executed and delivered said foregoing instrument for consideration, uses and purposes therein mentioned and set forth.

IN TESTIMONY WHEREOF, I have hereunto set my hand and official seal on this 14th day of May 1997.

ROSEMARY TOLLE
Notary Public, State of Texas
My Commission Expires 5-15-99

Notary Public

My Commission Expires:

5/15/99

1.0 EXPOSURE ASSESSMENT

The baseline risk assessment defines the types and extent of public health hazards, if any, which exist in the absence of remedial action. A baseline risk assessment typically considers the health risk posed by potential exposure to materials present in soil, sediment, groundwater, surface water, and air at a contaminated site. It analyzes facility conditions and the potential risks to human health posed by the Facility, assuming that no further remedial action are taken.

The principal guidance documents used to prepare a baseline risk assessment are the "Human Health Evaluation Manual (Volume I)" and the "Environmental Evaluation Manual (Volume II)" (USEPA, 1989a; 1989b). These documents provide methods for a baseline risk assessment according to EPA's methodology.

In its guidance for human health risk assessment, the EPA has established methods for conducting an exposure assessment as part of the risk assessment process. The objective of the exposure assessment is to estimate the type and magnitude of exposure to the chemicals of potential concern that are present at or migrating from a site. I have used this guidance below to determine whether the groundwater exposure pathway at the Sparton Facility is complete. According to EPA guidance complete pathways represent the only potential routes of exposure to chemicals of concern.

1.1 Consideration of Potentially Exposed Populations under Current Facility Conditions

This section characterizes the local populations potentially exposed to chemicals from the Sparton Facility. Currently, land use in the area immediately adjacent to the Sparton Facility consists of commercial developments and undeveloped tracts along the west side of Coors Road. There are no homes in the immediate vicinity of the Sparton Facility. The closes residences are at Paradise Hills, which are about ¼ - ¾ -miles west of the Facility. A characterization of these populations may be divided into three, not mutually exclusive, receptor populations. These receptor populations are described below.

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1.1.1 Worker Population at the Sparton Facility

As of 1994, Sparton discontinued manufacturing operations at the Facility and other than routine maintenance activities and minor machine shop operations, the Facility is currently inactive. Approximately 5 workers are employed at the machine shop facilities on a part-time basis.

1.1.2 Worker Population within 1/4 Mile of the Sparton Facility

The worker population within 1/4 mile of the Facility is comprised of workers from small businesses and industries. These include a car dealership, gas stations, restaurants, and other retail shops. There are about 10-15 businesses within 1/4 mile of the Facility (Black and Veatch, Personal Communication, April, 1997). If it is conservatively assumed that there are 5-10 workers per business, the number of workers within 1/4 mile of the Facility is between 50-150.

1.1.3 Population Living within a 1/4 Mile Radius of the Sparton Facility

There are no residential homes within ¼ mile of the Facility.

1.1.4 Population Living within a 1 Mile Radius of the Sparton Facility

There are two residential subdivisions located within ½ mile from the Facility. The Paradise Hills subdivision is an established subdivision located northwest of the Facility along Irving Boulevard. The Knols subdivision also located the northwest along Irving boulevard is a developing subdivision. According to aerial photographs, 20 homes are located within about 1/2 mile of the Facility (Black and Veatch, Personal Communication, April, 1997). Assuming 3.8 individuals per household, there are about 76 residents living within a 1/4 mile radius of the Facility.

1.1.5 Potentially Sensitive Sub-populations

Potentially sensitive sub-populations that may be present within a one-mile radius of the Facility include infants, children, and pregnant women. No data are currently available to document the number of individuals in these sub-populations. A daycare center is located along Irving Boulevard less than ¼ mile from the Facility.

1.1.6 Current Land Use

The Sparton Facility is currently zoned SU-1, which is industrial/commercial (Black and Veatch, personal communication, 1997), and is essentially an inactive circuit board manufacturing plant.

1.2 Identification of Potential Exposure Pathways for Current Populations

This section identifies potential pathways of exposure by which the above mentioned potential receptors may be exposed under current site conditions. The exposure pathway analysis describes the course a chemical may take from the Sparton Facility to the exposed individuals and evaluates four elements associated with exposure. These elements are:

1. A source and mechanism of chemical release to the environment.
2. A relevant environmental transport medium (e.g., air, groundwater, surface soil).
3. A relevant point of human exposure to the chemicals present in that medium.
4. A route of uptake at the exposure point (e.g., ingestion of water).

An exposure pathway is considered complete if all four elements are present and incomplete if one or more of these elements is not present. Implicit in a complete exposure pathway is an estimation of the expected degree of human population contact with Facility chemicals.

1.2.1 Identification of Potential Exposure Sources and Receiving Media for Current Populations

The first step in an exposure pathway analyses is to identify possible exposure sources (e.g., affected soil, groundwater) present at the Sparton Facility and the receiving media (e.g., air, groundwater, etc.) through which a person may be exposed. Exposure sources and receiving media are identified regardless of whether or not there is actual human exposure to the receiving media. For example, we identify subsurface soil as a possible exposure source and groundwater as a receiving media regardless of the fact that there is no current use of the groundwater. Since there has been remediation at the Sparton Facility, only exposure sources as they presently exist were identified (post-remediation conditions). An initial analysis of the potential chemical sources at the Sparton Facility is summarized in Table 1. In this table, environmental media that there is potential for current human exposure are characterized. These data include the source that may be releasing chemicals, the mechanism of the release, and the medium receiving the release.

Many of these potential exposure routes represent unlikely or insignificant pathways, or pathways that may exist under hypothetical alternate future land use conditions. Thus, this section evaluates which of these pathways are routes of possible human exposure to chemicals from the Sparton Facility under potential current land use conditions and hypothetical future land use conditions.

The three media of concern are air, groundwater, and soil (Table 1). Since the plaintiffs allege that groundwater represents an imminent and substantial endangerment, my analyses will focus only on groundwater exposure pathways.

1.2.2 Survey of Groundwater Usage near the Plume Area at the Sparton Facility

Black and Veatch conducted a survey of domestic and municipal/industrial water wells near the Sparton Facility. The following discussion of groundwater usage within about 2 miles of the Facility is based on this survey. The population near the Sparton Facility is served by a municipal water system from New Mexico Utilities. While there are several domestic wells and a few municipal/industrial wells located within 2 miles from the Sparton Facility, none of these wells are located within the plume area. The closest well down-gradient from the Sparton facility

is the New Mexico Utilities municipal supply well. This well is located about 2.1 miles down-gradient from the leading edge of the plume. According to estimates of groundwater flow rate provided by Chandler (1997), it takes more than 100 years for the groundwater to reach this municipal water supply. Further, even if it did reach the water supply well, the concentration of trichloroethylene (believed to be the indicator chemical for tracking the plume) in the groundwater by the time it did reach this supply would be below drinking water standards (i.e., Maximum Contaminant Levels; MCLs). Thus, any concern for people who may be using these wells is precluded by the fact that they are more than 2 miles from the Facility and the concentration of chemicals in the plume would be below drinking. For these reasons, no estimates of the potential population served by groundwater were made.

1.2.3 Identification of Potential Exposure Points and Potential Exposure Routes for Current Populations

After affected environmental media have been identified, exposure points and exposure routes are identified by determining if and where any of the potentially exposed current populations can contact these media. Consideration is given to the location of the population and activity patterns in the area of the Facility. Any point of potential contact with the chemicals in Facility media is considered to be an exposure point. The result of these analyses is summarized in Table 2.

1.2.4 Completeness of Potential Exposure Pathways for Current Populations

This section assembles the information developed in the previous two steps (i.e., Identification of Potential Exposure Sources and Receiving Media, and Identification of Exposure Points and Exposure Routes) and determines the complete exposure pathways that exist for the Facility. The criteria for a complete exposure pathway are reviewed in Section 1.2. The potentially complete exposure pathways for each receptor population are given in Table 3. The potential exposure pathways resulting from conditions at the Facility include inhalation of vapor phase and particulate phase chemicals in air, ingestion and dermal contact with affected soil, dermal contact with surface water, and dermal and ingestion exposure to sediments.

1.2.5 Potential Current Population Exposure to Groundwater

The potential exposure route at issue in this lawsuit is exposure to chemicals in groundwater. However, there are no water wells located within the plume area. For these reasons, the groundwater pathway was considered incomplete under potential current land use conditions.

1.2.6 Summary of Potentially Complete Exposure Pathways under Current Land Use Conditions

Under current land use conditions there are no complete exposure pathways for chemicals in groundwater. Complete pathways represent the only potential routes of exposure to the chemicals of concern. Thus, according to EPA risk assessment guidance, no estimate of the risks posed by potential exposures to the chemicals of concern in groundwater should be made under current site conditions.

Table 1

Preliminary Release Source Analysis for Baseline Facility Conditions

Release Source	Release Mechanism	Medium
Affected soils	Volatilization or fugitive dust emissions	Air
Affected soils and ground-water	Overflow, runoff, groundwater seepage	Surface water
Affected soil	Facility leaching ground-water flow	Groundwater
Affected soil	Desorption from soil by rainwater and ground-water	Soil/Sediment
Affected groundwater	Groundwater movement of flow	Groundwater

Table 2
Potential Exposure Routes

A. Current Land Use

Exposure Medium/ Exposure Route	Potential Current On-Facility Worker	Current Off-Facility Worker or Resident
Groundwater		
Ingestion	---	---
Dermal contact	---	---

A = exposure to adults (highest exposure is likely to occur during occupational activities)
C = exposure to children
--- = exposure to this population by this route is not likely to occur

Table 3

Summary of Complete Exposure Pathways

A. Potential Current Land Use

Potentially Exposed Population	Exposure Route, Medium and Exposure Point	Pathway Selected for Evaluation	Reason
On-Facility Worker	Ingestion exposure or dermal contact with groundwater	No	There are no completed drinking water wells in the plume area.
Off-Facility Worker	Ingestion exposure or dermal contact with groundwater	No	There are no completed drinking water wells in the plume area.
Off-Facility Resident	Ingestion exposure or dermal contact with groundwater	No	There are no completed drinking water wells in the plume area.

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CURRICULUM VITA

Glenn C. Millner, Ph.D.

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Curriculum Vita

Name

Glenn C. Miller, Ph.D.

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Employment

- Center for Toxicology and Environmental Health, L.L.C., Vice President/ Senior Toxicologist, Little Rock, AR. 72212, 1997-Present.
- Terranext (formerly Industrial Compliance), Toxicology and Health Related Sciences Division. Director of Health Sciences/Senior Toxicologist, Little Rock, AR. 72212, 1992-1997.
- University of Arkansas for Medical Sciences, College of Medicine, Division of Interdisciplinary Toxicology, Adjunct Assistant Professor, Little Rock, AR. 72212, 1989-Present.
- TERRA Inc., Toxicological Evaluations Research and Risk Assessments, Toxicologist, Little Rock, AR. 72212, 1987-1992.
- National Center For Toxicological Research, Division of Genetic Toxicology, Department of Health and Human Services, Food and Drug Administration, Jefferson, AR. Research Scientist. 1984-1988.
- Florida State University, Center for Biomedical and Toxicological Research, Adjunct Faculty, Tallahassee, Florida 1984-1988.
- Ecology and Environment, Inc. Buffalo, N.Y. Senior Level. 1981-1984.
- State University of New York College at Buffalo, Great Lakes Laboratory, Buffalo New York, Field Coordinator and Research Associate, 1977-1981.
- New York Ocean Science Laboratory, Montauk, New York, Research Intern. 1976-1977.

Education

- Ph.D. Interdisciplinary Toxicology, University of Arkansas For Medical Sciences, Little Rock, AR. 72205, 1988.
- M.A. Limnology, State University of New York College at Buffalo, Buffalo, N.Y., 1979.
- B.S. Biology, with honors, State University of New York College at Brockport, Brockport, N.Y., 1976.
- A.S. Biology/Chemistry, with honors, Nassau Community College, 1974.

Research Summary

Measured chemically induced DNA repair as unscheduled DNA synthesis (UDS) *in vitro* and *in vivo/in vitro* as an indicator of the mutagenic and carcinogenic potential of chemicals in rodent livers. This assay also allows for the measurement of hepatic S-phase synthesis, which may serve as a useful indicator of the tumor-promoting capability of nongenotoxic as well as genotoxic chemicals. Conducted over 100 DNA repair assays. Evaluated S-phase synthesis data concomitant with UDS data to evaluate whether the chemicals under consideration were initiators or act through another mechanism. The determination of a carcinogens mechanism of action is extremely important in terms of human risk assessment, as initiators purportedly have no threshold, whereas promoters do have a threshold. These studies are also important in the development of the most appropriate battery of short-term tests to determine a chemicals carcinogenic potential.

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Experience In Environmental Toxicology

Risk Assessment

Conducted and assisted in the defense of numerous Risk Assessments for industry, the EPA, the military, state and local agencies, and for various environmental consulting firms. The following is a brief overview of the major risk assessments I have performed, or assisted in performing:

State of Florida Toxicant Profiles. *Client* : State of Florida. Wrote the Toxicant Profiles used as a guideline for a water quality criteria standard for approximately 10 compounds. Determined an acceptable drinking water standard and groundwater standard for the protection of human health and the aquatic environment.

Dibenzofuran Risk Assessment. *Client* : Confidential. Evaluated the potential human health effects of dibenzofurans and determined an acceptable level of dibenzofurans in air, on building surfaces, and in water.

Polycylic Aromatic Hydrocarbon (PAHs) Risk Assessment. *Client* : Confidential. Evaluated the potential human health effects of some of the lower molecular weight PAHs and determined an acceptable soil level.

Caribou Reservoir Risk Assessment. *Client* : Pacific Gas and Electric. Assessed the risk of residual PCB's to fish and wildlife from a transformer spill.

Swanson River Oil Field Risk Assessment. *Client* : Chevron USA Inc. Evaluated the potential risk to terrestrial and aquatic biological resources resulting from the accidental contamination with PCB's of approximately 14 acres of road surface in the Kenai National Wildlife Refuge, Alaska.

Risk Assessment for the Proposed W.R. Grace Cambridge Massachusetts Site. *Client* : W.R. Grace. Evaluated the potential human health effects of contaminants at the site.

Witco Chemical Risk Assessment. *Client* : Confidential. Assessed whether PCB contamination of the Witco facility was the cause of cancers in various workers.

Risk Assessment for the Kerr-McGee Jacksonville Site. *Client* : Kerr-McGee. Assessed the risks associated with the chemical contamination of soils on the Kerr-McGee Jacksonville, Site. Determined whether or not soil pesticide residue levels are a significant human health hazard.

Risk Assessment of General Tire and Rubber Co. Lawrence, Massachusetts Facility. *Client* : General Tire and Rubber. Determined an acceptable PCB level at which remedial action can be stopped. Provided a toxicological assessment of the proposed remedial actions in terms of cost-effectiveness so that rationale choices amongst different clean-up methods could be made.

Fort Howard Paper Co. An Evaluation of the Chronic Toxicity of Effluents. *Client* : Fort Howard Paper Co. Evaluated the chronic toxicity of five outfalls to aquatic resources in the Saginaw River.

Tetrahydrofuran Risk Assessment. *Client*: Foth and Van Dyke. Determined an acceptable level of tetrahydrofuran in groundwater.

Hazard Assessment of the Soil Contamination at the Badger Army Ammunition Plant. *Client*: Foth and Van Dyke. Conducted a hazard analysis of the contaminants found in soil samples taken at the Badger Army Ammunition Plant.

Phosphoric Acid Exposure Assessment. *Client*: Soils and Materials Engineers. Evaluated the potential exposure pathways and toxicities of phosphoric acid to area residents from a phosphoric acid spill.

Toxicant Profiles of 8 Chemicals. *Client*: Aware Inc. Assisted the client in evaluating the toxicities associated with 8 chemicals selected as indicator compounds as part of an Endangerment Assessment.

Toluene Diisocyanate (TDI) Risk Assessment. *Client*: Confidential. Evaluated the human health effects of TDI, and determined whether a particular exposure scenario was responsible for the workers alleged health complaints.

Dichloroacetylene Risk Assessment. *Client*: Confidential. Evaluated the human health effects of dichloroacetylene and determined an acceptable air level.

Endangerment Assessment, Sand Springs Superfund Site, Sand Springs, OK. Evaluated the potential toxicity of metals, chlorinated solvents, and polynuclear aromatic hydrocarbons to human health.

Endangerment Assessment, Compass Superfund Site, OK. Evaluated the potential toxicity of metals, chlorinated solvents, and polynuclear aromatic hydrocarbons to human health.

Public Health Assessment, SCP Superfund Site, Carlstadt, New Jersey. *Client*: Principal and Responsible Parties, Project manager, Identified and quantified human health risks from potential exposure to site contaminants.

Risk Assessment for Southern Pacific Transportation Co.. Evaluated the potential toxicity and carcinogenic risk to humans from exposure to chrysene, phenanthrene, acenaphthene, and fluorene. Assessed human exposure and developed soil clean-up guidelines for these chemicals.

Evaluated the safety of spices, flavorings, and additives to be added to consumer products for a corporate client.

Risk Assessment of Carbon Tetrachloride. Project Manager. Reviewed the mutagenicity, carcinogenicity and epidemiologic data for CCl_4, selected appropriate cancer data for use in cancer risk assessment, and determined acceptable cancer risks from inhalation exposure to CCl_4.

Public Health Assessment of the Woodland Townships Route 532 and 72 Superfund Sites, New Jersey, (addendum). Project Manager. Assessed the potential human health risks to cranberry-bog workers from exposure to chemicals present in a commercial cranberry bog. Determined the potential environmental impacts to the marsh environment. Also evaluated human health risks under a future site-use scenario.

Scientific support for litigation involving environmental exposure to chlorinated hydrocarbons.

Lecturer on Cancer Risk Assessment, Conference on Remediation at Hazardous Waste Sites, Center for Professional Advancement, East Brunswick, New Jersey.
Provided technical and scientific support to several law firms concerning product liability cases, workmen's compensation, chemical exposure law suits, and in depositions.

Research

Began a systematic study to evaluate the potential differences in the ability of several rodent species to metabolically activate a variety of weak and strong chemical carcinogens using the hepatocyte DNA repair assay. These studies are an important contribution to risk assessment for the selection of the most appropriate animal model, and for extrapolating across species by an appropriate chosen dosage scale.

Examined the mutagenicity of the two most toxic isomers of PCBs, the 3,3',4,4'-tetrachlorobiphenyl isomer, and the 2,2',5,5'-tetrachlorobiphenyl isomer, using the chinese hamster ovary (CHO) hypoxanthine-guanine phosphoribosyl transferase locus mutation assay (HGPRT).

Applied and refined an assay that measures the inhibition of intercellular communication in rat and mouse hepatocytes. The assay is used as an indicator of the tumor promoting potential of a chemical.

Designed and conducted a study of the effects of several industrially important chemicals on the male reproductive tract. Examined the effect of depletion of epididymal, testicular, caput and cauda glutathione, on exacerbating the dominant lethal effects of an agent such as ethyl methane sulfonate (EMS).

Developed a rapid automated procedure for the determination of low-levels of reduced and oxidized glutathione, using the Multistat III.

Developed extraction techniques and HPLC methods for the separation and quantification of the fungal metabolites of 6-Nitrobenzo[a]pyrene.

Conducted a study designed to evaluate whether the highly mutagenic/carcinogenic compound 6-Nitrobenzo[a]pyrene was metabolized in the environment, and if so, are the metabolites activated or detoxified products. Examined the mutagenicity of all the metabolites using the *Salmonella typhimurium* reversion assay, both with and without S9 fraction.

Hazardous Waste

Primary responsibilities include serve as an authorized representative/technical consultant for the EPA at sites/facilities where hazardous wastes are generated, stored, treated, transported by or disposed of; to insure compliance with applicable federal laws. Prepare and perform preliminary assessments, risk analysis and full field investigations of Superfund hazardous waste sites to EPA.

Provide enforcement support to EPA, particularly cost recovery. Serve as document control officer to insure compliance with National Enforcement Investigation Center protocol. At various sites throughout the country; sampled groundwater, surface water, soil, sludge and leachate. Have assisted in feasibility assessments of remedial action alternatives for various hazardous waste sites. Experienced with asbestos removal and worker personal protection, including ambient air monitoring and personal pumps.

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Safety

Prepare written site safety plans for company employees to follow while conducting hazardous waste site work. Plans require a thorough knowledge of chemical exposure pathways, OSHA and NIOSH regulations, and available methods to protect the worker. Safety plans include a characterization of waste type, quantity, apparent level of hazard, personal protection requirements, surveillance equipment, site entry procedures, work limitations, decontamination procedures, and emergency contingency plans.

Serve as site safety officer while on hazardous waste sites. Responsibilities included overall charge of all employee safety and conduct ambient air monitoring. Experienced with air monitoring equipment such as portable Organic Vapor Analyzers and Photoionization detectors (HNU). Have conducted training courses for the worker on personal protection; proper use, limitations, types, and principle of operation of respirators, types and useful life of cartridges, buddy system and chain of command.

Aquatic Toxicology and Limnology

Developed a former employers capabilities in the field of aquatic toxicity testing/bioassays. Have conducted numerous bioassays using species such as *Daphnia magna* as well as fish and benthic organisms for industrial clients and for several wastewater treatment plants. Perform static acute and chronic toxicity tests. Have conducted renewal and recycling bioassays to evaluate the toxicity of chemical compounds, effluent, sediment, and solid waste. Have used the Microtox bioassay to screen industrial sample toxicity. Was project manager for a large toxicity testing job where a client was registering nine new chemical products.

Conducted ecological evaluations of aquatic communities in lakes and riverine habitats. The studies have included the determination of the composition, structure, and temporal and spatial distribution of aquatic communities; delineation of ambient water quality conditions; and assessment of the potential impact of activities such as hazardous waste disposal, dredging, wastewater discharges and in-stream construction activities on aquatic resources.

Co-designed a dioxin monitoring program for the Spring River Basin near Verona, Missouri, to evaluate the physical transport, biodynamics, and toxicological and public health concerns associated with dibenzo-*p*-dioxins, for the EPA. After a consent decree was signed with the generator, reviewed the agreement for the EPA to insure the protection of public health and the environment.

Project manager for an ecosystem assessment of fish, benthic macroinvertebrates, phytoplankton, and periphyton conducted on the Niagara River to evaluate the effects of a treated wastewater discharge from a major waste-disposal company. Also managed the dilution dye study component designed to track the dilution and dispersion of the discharge in the river. Results were used by the NY State DEC for the clients discharge permit. Familiar with a wide range of limnological sampling methods and analytical techniques. Previously managed the field section of the Great Lakes Laboratory of the State University College at Buffalo.

Wastewater

Was project manager for toxicity testing of five outfalls from a major pesticide manufacturing firm. Experienced with wastewater sampling, and assisted clients in determining compliance with National Pollution Discharge Elimination System (NPDES) permit guidelines. Have also conducted a study for a client, on evaluating wastewater treatment effectiveness along different phases of the process train. Aided in determining specific causative pollutants responsible for the toxic effluent.

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Great Lakes

Directed the efforts of 10 people for the United State Army Corps of Engineers Lake Ontario shoreline erosion control program. For the US Army Corps of Engineers, managed sampling efforts for several Lake Ontario and Erie sites for dredge permit work. Assisted in establishing the acceptability for open-lake disposal of dredge material by performing-bulk sediment chemistry and the Standard Elutriate test.

Planned and conducted efforts for the identification of biological and chemical composition of former dredge sites in all of the Great Lakes for the US Army Corps of Engineers.

Helped organize, conduct, and prepare the proceedings for a major international conference concerning "Changes in the Biota of Lake Erie and Ontario". Aided in the editing of the conference papers and the documentation of panel discussions for publication in the proceedings.

International

Conducted marine ecological studies at Bahia de Portete, Colombia, as part of the Cerrejon Coal Project. Developed a monitoring program to ascertain the possible environmental effects of large-scale dredging operations on marine life in the bay. Also conducted surveys of the relative health of the coral reefs and sea grass beds located along the coastline. Collected sea grass samples for total biomass analysis.

Participated in E&E's marine studies in the Red Sea at Yanbu, Saudi Arabia. As a member of the survey team, assessed the general condition of coral reefs, conducted studies to determine the health and functioning of reference coral reefs in order to monitor the effects of dredging and wastewater discharges on the marine community as a whole to the port complex. Also conducted a cursory evaluation of mangrove areas to determine their relative abundance and density and to evaluate the effect of construction activities. Worked in the on-site water quality laboratory.

Professional Affiliations

Society of Environmental Toxicology and Chemistry (SETAC)

American Chemical Society

Society for Risk Analysis

South Central Chapter of the Society of Toxicology

Association for the Environmental Health of Soils

Scientific Reviewer of Manuscripts

Reviewer for Risk Analysis: An International Journal

Reviewer for Journal of Soil Contamination

Published Abstracts and Presentations at Scientific Meetings

1. Millner, G.C., May 6, 1978, Factors Influencing Vertical and Temporal Lake Erie Phytoplankton Distribution Near Dunkirk, New York, paper presented to the 21st Conference on Great Lakes Research, Windsor, Ontario, Canada.

2. Millner, G.C. May 1, 1979, Qualitative and Quantitative Comparison of Phytoplankton of Erie Harbor, Pennsylvania, and Surrounding Water, paper presented to the 22nd Conference on Great Lakes Research, Rochester, New York.

3. Millner, G.C., and R.A. Sweeney, May 22, 1980, Biomass Density and Distribution of *Cladophora glomerata* and their Relationship to Some Physical Chemical Variables, paper presented to the 23rd Conference on Great Lakes Research, Kingston, Ontario, Canada.

4. Millner, G.C., and R.A. Sweeney, October 15-16, 1980, Biomass Density and Distribution of *Cladophora glomerata* and their Relationship to Some Physical-Chemical Variables: A Summary of 1979 and 1980. Invited paper presented at the Symposium on Ecological Studies of the Major Filamentous Algae of the Great Lakes, Kellogg Biological Station, Kalamazoo, Michigan.

5. Sweeney, R.A., and G.C. Millner, October 15-16, 1980, A Summary of the Lake Erie Monitoring Effort, Invited paper presented at the Symposium on Ecological Studies of the Major Filamentous Algae of the Great Lakes, Kellogg Biological Station, Kalamazoo, Michigan.

6. Millner, G.C. April 28-30, 1981, A Comparison of *Cladophora glomerata* Biomass and Nutrient Relationships Over a 2 Year Period, paper presented at 24th Conference on Great Lakes Research, Columbus, Ohio.

7. Frederick, V. Ray, and G.C. Millner, April 28-30, 1981 Phytoplankton of Erie Harbor, Pennsylvania, and Surrounding Waters During the Lake Erie Intensive Study, 1978-1979, paper presented at 24th Conference on Great Lakes Research, Columbus, Ohio.

8. Millner, G.C. 1981, A 96-Hour Re-Cycling Bioassay Method to Determine the Toxicity of Solid Waste at Hazardous Waste Sites, paper presented at 2nd Annual Meeting, Society of Environmental Toxicology and Chemistry, Arlington, Virginia.

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Awards and Achievements

Who's Who Among Students In American Universities and Colleges 1978-1979.

SCUBA Certified by both National Association of Underwater Instructors (NAUI) and Young Mens Christian Association (YMCA)

Cardio-Pulmonary Resuscitation (CPR) Instructor American Red Cross

Head Coach State University College at Buffalo Ice Hockey Team 1979-1983.

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U.S. vs. SPARTON TECHNOLOGY INC., No. CIV97 0210M;

N.M. vs. SPARTON TECHNOLOGY INC., No. CIV97 0208JC;

ALBUQUERQUE vs. SPARTON TECHNOLOGY INC., No. CIV97 0206LH;

AFFIDAVIT

STATE OF NEW MEXICO)
) ss:
COUNTY OF BERNALILLO)

I, NORMAN GAUME, upon personal knowledge, state under oath as follows:

This affidavit is submitted in support of the above referenced actions.

1. I am the Manager of the Water Resources Division of the City of Albuquerque, Public Works Department. In my capacity as Manager of the Water Resources Division, I am responsible for developing plans for Albuquerque's long-term sustainable water supply. I am also the City Chief Administrative Officer's designee and co-chair of the implementation committee for the *Albuquerque/Bernalillo County Groundwater Protection Policy and Action Plan*, which is a comprehensive source water and wellhead protection program adopted by the City in August, 1994.

2. Groundwater is presently the sole source of drinking water for the citizens of Albuquerque. More than 500,000 people in the Albuquerque metropolitan area rely solely on local groundwater for municipal, industrial, and private domestic water supply.

3. All planning scenarios for a sustainable water supply rely on the availability of continued, substantial groundwater production.

4. The groundwater contamination from the Sparton Technology site is located within the Santa Fe Group aquifer system that provides the sole source of drinking water for the citizens of the Albuquerque metropolitan area.

5. The aquifer in the area of the Sparton Technology facility would provide high quality drinking water, if it were not for the contamination plume.

PLAINTIFF'S EXHIBIT 2

6. The *Albuquerque/Bernalillo County Groundwater Protection Policy and Action Plan* identifies the area of the Sparton contamination as a crucial area for groundwater protection.

7. The water resources contaminated by Sparton have been planned for public water supply use. The City has planned to install groundwater production wells in the area of the Sparton contamination. The City's 1982 *Master Plan of Water Supply for City of Albuquerque, N. M. and Environs* specifically identifies the area of the Sparton contamination as the site of a future City well field. Additionally, New Mexico Utilities Inc., the privately owned water utility now providing water service to the area including the Sparton site, has a permit issued by the New Mexico State Engineer to install a drinking water supply well in the immediate vicinity of the Sparton site.

8. The Sparton contamination is located in an area where substantially increasing demands for water supply must be met due to dramatic development and population growth, both current and projected. Present and pending City water resource strategies identify the Sparton area as an area for potential groundwater development and aquifer recharge.

9. But for the contamination plume from Sparton Technology, the area of contamination would be an especially attractive site for groundwater production, and for potential aquifer recharge, as part of the City's water resource program to provide a safe and sustainable water supply.

10. The Sparton contamination has, and will, substantially interfere with the City's ability to manage water resources to ensure a sustainable, locally available, water supply.

FURTHER AFFIANT SAYETH NAUGHT.

Norman Gaume, Affiant

I declare under penalty of perjury that the foregoing is true and correct, executed on this 31st of March, 1997.

Preliminary Volatiles Results for Sparton					Sorted by Well Number		
NM Scientific Laboratory Division							
30-Jan-96							
			Results (ug/L)				Sampling
SLD #	RID #	Location	TCE	1,1-DCE	1,1,1,-TC	PCE	Date
96-							
228	154930	MW-07	100	22	32		1/16/96
234	154934	MW-09	600	29	52		1/16/96
264	154864	MW-12	570	41	59		1/17/96
232	154932	MW-13	240	16	33		1/16/96
227	154852	MW-14	300	1			1/12/96
235	154954	MW-16	6600				1/16/96
267	154870	MW-17	2000	120 J	620		1/17/96
268	154860	MW-19	20	1.2	0.6 J		1/17/96
269	154862	MW-20	1.8				1/17/96
223	154854	MW-21	230	17	98		1/12/96
233	154952	MW-22	57	14	35		1/16/96
229	154956	MW-29	0.9				1/16/96
264	154866	MW-30	23	1.6	0.8 J		1/17/96
226	154844	MW-31	3				1/12/96
169	154922	MW-32	1300 E	140	42	6.8 J	1/11/96
230	154936	MW-33	2000				1/16/96
145	154940	MW-34					1/10/96
167	154927	MW-35					1/11/96
141	154942	MW-36	2.5				1/10/96
144	154907	MW-37	710	21			1/10/96
231	154958	MW-38					1/16/96
266	154868	MW-39	87	6.2	29	1.4	1/17/96
225	154850	MW-40					1/12/96
166	154925	MW-41	130	27	32		1/11/96
146	154948	MW-42	430	53	49		1/10/96
142	154950	MW-43	160 E	34	32		1/10/96
143	154904	MW-44					1/10/96
91	154900	MW-45	61	2			1/9/96
92	154902	MW-46	3700	290	92		1/8/96
89	154898	MW-47	45	1.5			1/9/96
93	154880	MW-48	260	7.7			1/8/96
221	154846	MW-49					1/12/96
168	154928	MW-51					1/11/96
84	154892	MW-52					1/9/96
83	154893	MW-53	51	1.6			1/9/96
82	154881	MW-55	920				1/8/96
88	154882	MW-56	420	12			1/8/96
147	154944	MW-57					1/10/96
87	154883	MW-58	140	3.4			1/8/96
222	154842	MW-59					1/12/96
86	154884	MW-60	140	6.8	1		1/8/96
85	154885	MW-61	1600	45			1/8/96
90	154896	MW-62	2.1	7.6	7.4		1/9/96
224	154840	MW-63					1/12/96
148	154946	MW-64	30				1/10/96
170	154921	MW-PZ1					1/11/96

materials are the type of information normally found reliable and are customarily relied upon by toxicologists in the practice of their profession.

7. It is my understanding that the plaintiffs allege that chemicals in the groundwater and environment surrounding the Sparton Facility are causing an imminent and substantial endangerment to human health. The basis for this contention can be found in the EPA and the State of New Mexico reports entitled "Determination of Imminent and Substantial Endangerment Pursuant to Section 7002 of RCRA and Section 1431 of the SDWA" and "Finding of Imminent and Substantial Endangerment", respectively. I have synthesized these reports and determined that basically the plaintiffs' position is that when chemicals in groundwater (e.g., trichloroethylene or TCE) exceed the drinking water standard (i.e., exceed maximum contaminant levels, MCLs), this finding or fact represents an imminent and substantial endangerment to human health.

8. I have been asked to determine whether potential exposure to chemicals in groundwater from the Sparton Facility represent an imminent and substantial endangerment to human health.[1] To accomplish this charge, I have evaluated actual soil and groundwater monitoring data[2] collected by the plaintiffs' and defendants' consultants using acceptable exposure and risk practices established by the United Stated Environmental Protection Agency (EPA). I also evaluated the toxicological literature regarding the chemicals at issue in this lawsuit. Based on these studies and my experience as a toxicologist in assessing public health risks resulting from potential exposure to chemicals in air, surface water, groundwater, soil, and sediment, I conclude that there is no imminent or substantial endangerment to human health as a result of conditions existing on or near the Sparton Facility. This conclusion is based on health-protective methods used by the EPA and other regulatory agencies. The basis for my conclusion that there is no imminent or substantial endangerment is summarized below.

9. All chemicals have the potential to cause toxicity and harm under the appropriate set of circumstances. Toxicants are defined as chemical agents that, under certain conditions, may produce adverse effects on biological systems, ranging from minor alterations of normal function to death. The main goal of any risk assessment is to determine those conditions likely to produce harm.

10. In general terms, risk (R) represents a relationship between the toxicity (T) of the compound and factors related to the exposure (E) to the compound ($R = T \times E$). Regardless of how risks are expressed, they remain dependent on the toxicity of a compound and the exposure circumstances.

---

[1] Note that some of the plaintiffs' pleadings, reports and analyses also make references to imminent and substantial endangerment to human health and the environment. However, plaintiffs fail to provide any analyses concerning effects or impacts of groundwater contamination on any ecological receptors, habitats or ecosystems. Thus, to be consistent with the government, I also focused my analyses on human health, and not the environment.

[2] Note that I was unable to determine if plaintiffs' have properly validated their data using accepted analytical data validation techniques.

Cover Letter & Revised Final
Corrective Measure Study Report

OGC-002534 - OGC-002677

BLACK & VEATCH

5728 LBJ Freeway, Suite 300, Dallas, Texas 75240, (972) 770-1500, Fax: (972) 770-1549

Sparton Technology, Inc.

B&V Project 26602.100
March 14, 1997

Mr. Ronald Crossland, Chief
Technical Section (6H-CX)
RCRA Enforcement Branch
U.S. EPA Region 6
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-27733

MAR 1997
RECEIVED

Subject: Revised Final Corrective Measures Study Report
Sparton Technology, Inc.
Coors Road Facility
Albuquerque, New Mexico

Dear Mr. Crossland:

Transmitted herewith is Sparton's revision to the May 13, 1996 Draft Final Corrective Measures Study Report approved by U.S. EPA on June 24, 1996. This revision consists of revised pages and a new Appendix 5. These pages revise and supersede information given in the May 13, 1996 Report. Please insert these pages as replacements to those in the previous Report.

This revision is based on additional investigations conducted since May 1996 and meetings and discussions with U.S. EPA, State of New Mexico, City of Albuquerque, and New Mexico Utilities. This revision is being submitted on behalf of Mr. Richard D. Mico, Vice-President and General Manager of Sparton Technologies, Inc. Additional copies are being transmitted to parties indicated on the Distribution List contained in the Report.

Sincerely,

BLACK & VEATCH

Pierce L. Chandler, Jr.
Senior Project Manager

cs
Enclosure

A Report Prepared for:

Sparton Technology, Inc.
4901 Rockaway Boulevard, SE
Rio Rancho, New Mexico

REVISED FINAL CORRECTIVE MEASURE STUDY
Sparton Technology, Inc.
Coors Road Facility
Albuquerque, New Mexico

Prepared by HDR Engineering, Inc.
12700 Hillcrest Avenue, Suite 125
Dallas, Texas 75230-2096

Revised by Black & Veatch
5728 LBJ Freeway, Suite 300
Dallas, Texas 75240

March 14, 1997

Pierce L. Chandler, Jr.
Senior Project Manager
Black & Veatch

OGC-002535

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pathways with respect to the contamination characterization for the Sparton Facility. As noted in Section III, some 43 groundwater wells have extensive time-histories. Of the 32 wells that have detection histories, 24 wells (75%) exhibit decreasing concentration with time and 7 wells (22%) show increasing concentration. These trends are consistent in the UFZ, ULFZ, and LLFZ with decreasing/increasing percentages of 82/18, 64/27 and 75/25 respectively. The plume has continued to expand at the extreme western (down-gradient) end; however, as of July 1996, there are nine non-detect downgradient monitoring wells around the leading edge of the plume -- UFZ wells MW-50, MW-52, MW-57, MW-62, and MW-68; LLFZ wells MW-65, MW-66, and MW-69; and TFZ well MW-67.

Under the NFA alternative, quarterly monitoring of selected wells would continue. Confirming vertical plume limits in the vicinity of well cluster No. 4 (MW-15, MW-41, MW-32) could be accomplished by installing a fourth well in the Third Flow Zone (TFZ). It should be noted that well cluster No. 4 is the only onsite cluster showing an increase in TCE concentration with depth. This new well would also be monitored on a quarterly basis.

The results of the continued groundwater monitoring and changes in land use/development would be monitored by requesting notices of proposed subdivision

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groundwater gradient by injection in the vicinity of the downgradient edge may cause the plume to disperse over a larger area and spread the contamination.

- Infiltration galleries and injection wells are used primarily for small groundwater plumes. The areal extent of the plume makes the use of these alternatives infeasible. Furthermore, these alternatives require a steady flow of water to be effective. Under typical groundwater extraction plans, wells are pumped in a pulse format, i.e., a several week pumping period followed by a similar recovery period. This type of pumping scheme will not supply either sufficient quantities, or a continuous supply, of water to the injection wells or infiltration galleries for them to be effective.

3. Extraction Wells for Containment

EPA has directed that groundwater extraction wells be evaluated for containment of the contaminant plume (US EPA, 1996). Based on understanding of the current plume, containment could be provided by a single extraction well located in the western end (leading edge) of the plume. The partially penetrating well would be screened through the entire vertical of the plume as defined during installation activities. Using aquifer properties given in the RFI Report and confirmed by the USGS, a pumping rate of 50 to 100 gpm would give a capture zone width (at the well) of approximately 1,500 to 2,000 feet which would adequately cover the width of the

OGC-002545

plume. Calculations for these capture zones and other confirming calculations are given in Appendix 5. Alternatively, capture zone width could be based on the 600-foot-plus radius of influence demonstrated in pumping tests reported in the RFI. The pumping rate would give a drawdown in the range of six to ten feet. The pumping rate should be adjusted to provide sufficient drawdown for containment but not so much drawdown to pull shallow contamination deeper into the aquifer.

Extracted water would either be treated near the wellhead or conveyed through a buried pipeline installed in the public right-of-way to the Sparton facility for treatment. It should be noted that bringing contaminated water to the surface in off-site areas poses some risk to the general public, off-site landowners and the environment.

Costs for a single well extraction system are given in Figure 24.

C. Restoration of the Dissolved Groundwater Phase (Saturated Zone)

Groundwater remediation alternatives for this project would include no further action, groundwater extraction and treatment system, vapor extraction system, in situ air stripping, and in situ bioremediation. Treatment of the water effluent pumped from the ground may utilize air stripping, granular activated carbon (GAC), advanced oxidation, aerobic bioreactors, or a combination of all the above to treat volatile organics. The treatment train may include ion exchange and chemical precipitation for metal treatment. Vapor obtained from vapor extraction and/or in situ air stripping may be treated with granular activated carbon (GAC) or thermally destructed. Bioremediation provides total treatment in place.

OGC-002546

Figure 23 Screening of Corrective Measure Technologies, this technology, if previously considered, would have been eliminated for several reasons. First, lining of the canal would be relatively ineffective since the majority of the recharge is coming from the irrigated fields supplied by the canal. The canal represents only a small fraction of the recharge area and lining would have little impact. Secondly, seasonal fluctuation of the groundwater levels in the UFZ onsite probably enhances both the performance of the IM and in situ bioremediation by alternatively saturating and then exposing and aerating a portion of the UFZ.

3. Expansion of Interim Measure

This alternative is similar to the previous discussion in Item 2 with the exception of adding two or more groundwater recovery wells to the existing IM system. On-site lower lower flow zone well 32 and upper lower flow zone well 42 would be added to the IM to address the high concentrations of VOC in these wells. Additional wells would be included in the expanded IM as necessary to achieve a total combined extraction rate of 20 gpm. Any additional wells would be selected based on their potential yield and the presence of elevated VOC concentration. Based on historical data, wells to be considered for expanded IM purposes would include MW-43 and MW-19. Capital costs would be approximately $10,000. Operation and maintenance costs would be unchanged from Item 2.

4. Large-Scale Groundwater Extraction and Treatment System

Extracting groundwater with pumped wells on a large scale and treating it at the surface has been retained as a corrective measure alternative at the Sparton site for

OGC-002547

groundwater remediation. Use for containment was previously discussed in VII.B.3. This technology is more suitable in high permeability materials such as the subsurface gravelly sands and less effective in the clays and silts at the Sparton site. It should be noted that groundwater extraction and treatment is limited in its ability to reduce groundwater

Section VII.C.4.a.(1). Costs for pumping to the golf course from extraction wells on the Sparton facility (source control) would be approximately doubled due to the increased distance and increased elevation difference.

Other options are currently being explored with both the City of Albuquerque and New Mexico Utilities. Beneficial reuse requires some suitable site that can accept and use the water year round. In the absence of a potential user year round, the extraction system would either require seasonal suspension or alternative disposal.

(6) Calabacillas Arroyo Recharge

EPA also directed that surficial recharge in the Calabacillas Arroyo be considered (U.S. EPA, 1996). A "Calabacillas Recharge Window" was described by Mr. Steve Hansen of the USDOI Bureau of Reclamation (BuRec) during the public meeting on February 1, 1996, and in a subsequent memorandum furnished to EPA. The memorandum provided little meaningful or area-specific information on hydrogeological features to allow evaluation of this alternative. The memorandum further referenced several reports published through 1996 (by author and date); however, review of these referenced reports did not provide any specific information. However, in November 1996, Metric Corporation conducted a 24-hour, 200-gpm infiltration test in the Calabacillas Arroyo, approximately 3,300 feet upstream from Coors Road. Water was discharged from a New Mexico Utilities fire hydrant into a City of Albuquerque storm sewer that feeds into the Calabacillas Arroyo. The test demonstrated that 97 to 99 percent of the discharge

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infiltrated into the arroyo bottom. Based on this test, discharge to the Calabacillas Arroyo is technically feasible.

(7) Summary

Legal issues related to injection wells and beneficial reuse include: potential liability for the creation of toxic conditions not present not from use of the

For highly porous subsurface conditions with high VOC concentrations observed in the uppermost portion of an aquifer, operation of vapor recovery systems installed immediately above the water table can significantly impact the groundwater dissolved-phase VOC concentrations. Removal of soil gas from above the water table reduces the vapor phase VOC concentrations resulting in off-gassing (dissolution) from the groundwater in accordance with Henry's Law. To be most effective, vapor recovery systems should be operated in a pulsed mode similar to groundwater extraction systems. Vapor extraction is also useful in removing adsorbed phase VOC from soil materials dewatered during groundwater extraction.

Soil gas surveys and groundwater sample analyses indicate highest soil gas (and groundwater) VOC concentrations occur under the facility. In April 1996, soil gas immediately above the saturated zone was sampled from on-site and off-site UFZ wells. Results are discussed in the Section III.B.1.c. Deep Soil Gas and included in Appendix 2. This deep soil gas information indicates that : elevated soil gas concentrations are found only in the immediate, original source area; significant off-gassing from the groundwater is not occurring since soil gas concentrations are generally below equilibrium conditions; and subsurface gas transmissivity is not has high as expected. In fact, significant negative pressures were required to produce gas flow rates in the order of one standard cubic foot per minute (scfm).

In June 1996, a six-probe cluster VP-1 was installed near the old closed sump. Soil-gas TCE concentrations ranged from 24000 mg/m^3 (5376 ppmv) at 30 feet bgs to 8200

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mg/m^3 (1837 ppmv) near the aquifer (50 feet bgs). In February 1997, five soil gas monitoring/recovery wells VR-1 through VR-5 were installed in and around the original source area in accordance with the proposals included in Appendix 5. TCE concentrations ranged from 7400 mg/m^3 (1658 ppmv) in the closed sump area to 870 mg/m^3 (195 ppmv) approximately 100 feet to the north. This latest data suggests that soil gas concentrations above 10 ppmv extend out less than 200 feet from the closed sump area.

Based on the characterization discussed in the RFI, an average radius of influence of approximately 150 feet was anticipated for SVE recovery wells. SVE pilot testing conducted by AcuVac Remediation, Inc., in February 1997 at well VR-1 indicates an actual radius of influence of approximately 200 feet.

OGC-002552

Depending on the overlap between vapor extraction wells, and well-specific radius of influence, between ten and twenty wells will be required to cover the area showing elevated soil gas concentration in the most recent (1991) soil-gas survey. Recent deep soil gas investigation indicates that the area and number of wells will be much less. The 1997 SVE pilot testing and sampling indicate that recovery well VR-1 is probably sufficient to cover the area of elevated soil-gas VOC. Combined extraction rate would thus range from 50 standard cubic feet per minute (scfm) to 200 scfm (or 5 to 10 scfm per well). Extracted vapor would be routed to a central vacuum unit. The effluent from the vacuum unit would then be treated using GAC air polishing or thermal destruction as required by applicable regulations to remove VOC. Estimated costs for VES installation and operation are given in Figure 40.

The benefits of using vacuum extraction include:

- Implementation can be conducted in situ and requires relatively little disturbance to existing facilities or operations.
- The process reduces contaminant concentration and mobility at the treated area.
- Implementation can be flexible, allowing for adaptation to changing site conditions or as additional analytical and subsurface data is developed.
- In situ installation and operation requires little handling of contaminated materials, limiting the risk of exposure to workers and the public.
- Vacuum extraction has few secondary impacts.

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Based on the subsurface characterization detailed in the RFI Report, the observed decrease in surface soil gas concentration, the April 1996 deep soil gas sampling, the June 1996 cluster probe sampling and the February 1997 recovery well sampling, and pilot testing, the following observations are pertinent:

- The subsurface is a layered, heterogeneous and anisotropic sequence of gravelly sands, silts, and clays.
- Highest VOC concentrations are associated with clay layers.
- The subsurface directly above the aquifer is not as gas transmissive as previously thought.
- Soil gas concentrations are highest in the closed sump area and decrease exponentially with distance.
- Significant off-gassing from the groundwater is apparently not occurring.
- Effective radius of influence is approximately 200 feet.

As discussed in Section VII.C.2., lining of the Corrales Main Canal has no technical basis and, in fact, would defeat the synergy of a VES with a fluctuating water level as described above.

6. <u>In Situ Air Stripping (Air Sparging)</u>

An innovative technology for treatment of volatile organic compounds in groundwater is in situ air stripping or sparging. This technology is an enhanced version of vapor recovery and utilizes air injection wells installed in the aquifer in addition to the

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vapor extraction system (VES). Dissolved-phase VOC are stripped from the groundwater by the mechanics of the rising air bubbles around the air injection wells. The vapor-phase VOC are then removed by the VES. Typical operation utilizes standard VES operation until a tailing phenomenon is observed in soil-gas VOC concentrations. Air injection is then

VIII JUSTIFICATION AND RECOMMENDATION OF THE CORRECTIVE MEASURE

A. General

The recommended corrective action alternative consists of three elements: plume leading edge containment through groundwater extraction; a phased approach to soil vapor extraction; and expansion of the current onsite Interim Measure (IM) groundwater recovery and treatment system. Included in the three elements is additional characterization of soil, soil-gas, and groundwater contamination and further evaluation of subsurface characteristics through aquifer testing and vapor extraction system pilot testing. The recommended corrective action alternative utilities efficient and environmentally friendly discharge of produced water to the Calabacillas Arroyo. This recommendation has evolved from further study/characterization and various meetings/correspondence with local, state, and federal agencies. This recommendation was based on the following:

- Lack of risk from current conditions considering both current and potential receptors and exposure pathways identified at the site.
- Lack of impact on use of the affected groundwater considering potential use of that resource.
- Inability of available technologies to restore groundwater quality to Maximum Contaminant Levels (MCLs) within any reasonable time period or at a reasonable cost.
- Constituent concentrations in much of the plume area have already dropped

OGC-002557

below technology application levels.

- Effectiveness of previous corrective actions (i.e., closure and capping of the ponds/sump).
- Effectiveness of the currently operating IM system to prevent migration off-site.
- Cost effectiveness of the IM system relative to other alternatives retained from the Initial Screening.
- Discharge to the Calabacillas Arroyo will result in beneficial recharge to the shallow portions of the aquifer.

Detailed background information for the recommended alternative can be found in Sparton's proposals dated September 18, 1996, Sparton's revised proposals dated December 7, 1996, and Sparton's revised proposals dated January 17, 1997. Copies of these proposals are included in Appendix 5. It should be noted that an application for an NPDES permit was filed on January 31, 1997, and other permits, including water rights, are being obtained. Further, proposed field work for soil gas characterization and the VES pilot test was completed in February 1997.

B. Description of the Recommended Alternative

Based on the characterization in the RFI, and subsequent confirming investigations and analyses completed to date, corrective action consisting of plume leading edge containment, a phased approach to soil vapor extraction, and expansion of the existing IM is recommended. The recommended corrective action would be supported by additional

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investigation/characterization consisting of additional monitor wells/piezometers, aquifer testing, and soil-gas investigation.

Plume leading edge containment would be provided by one or more extraction wells located near the leading edge of the plume. Recovered water will be air-stripped to remove VOC and discharged to the Calabacillas Arroyo. Any extraction well would be screened through the entire vertical interval of the plume as detailed in the December 6, 1996, proposal in Appendix 5, and further discussed in §VII.B.3. on page VII-10. Capture zone calculations were furnished in the September 18, 1996, proposal in Appendix 5. Containment (capture) will be demonstrated by a series of pumping tests in the installed well.

Based on current information, soil vapor extraction will be conducted, as a minimum, from installed vapor recovery well VR-1 in the closed sump area. Continuing analyses and further investigation, as necessary, will be used in a phased approach to evaluate the need for further soil vapor extraction. Details of the VES are detailed in the proposals in Appendix 5 and discussed in §VII.C.5.. Through the current date, additional vapor recovery wells have been installed, additional soil gas sampling, and VES pilot testing have been conducted as detailed in the proposals. Additional phases of investigation, and additional VES, will be utilized as necessary to reduce soil vapor concentrations to less than 10 ppm_v.

The existing IM would be expanded to include pumping from existing wells MW-32 and MW-42 and potentially wells MW-43 and MW-19 to achieve a production rate of

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approximately 20 gpm as detailed in the proposals in Appendix 5 and §VII.c.3.. Water will be treated in the existing onsite air stripping system. Treated water will be discharged to the Calabacillas Arroyo.

Additional monitoring/characterization of groundwater contamination would be provided by two additional non-detect monitoring wells and the containment well as detailed in the December 6, 1996, proposal in Appendix 5.

As part of this recommendation, groundwater monitoring wells at selected locations would be sampled and analyzed on a semi-annual to annual (40CFR265.92) basis to confirm plume characteristics. The results of groundwater monitoring and evaluations of any changes in land use/development would be monitored by requesting notices of proposed subdivision approvals and zoning changes within two miles of the Sparton facility be provided to Sparton. An annual evaluation would be conducted to determine the need, if any, for further corrective measure studies, based on changes in land use.

Applications for permits to drill and complete private or public drinking water wells in groundwater impacted by Sparton's operations will be monitored on at least an annual basis. Notice will be given to the State Engineer's Office of the area impacted by Sparton's operations and that Sparton should be notified in the event that any applications are received for the drilling and completion of wells within that area. Sparton will, on an annual basis, update its description of the impacted area to take into consideration any expansion or contraction of the impacted groundwater as shown by the quarterly monitoring and other data. Sparton will participate in any permit proceedings, and to the extent a permit is

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granted that will allow a well to be drilled in the impacted area, Sparton will undertake an additional corrective measure study to determine what response is appropriate in order to address any threat that may be presented.

The IM consists of groundwater extraction wells and treatment in a packed tower aeration unit. The current IM groundwater recovery network is comprised of eight wells (PW-1, MW-18, MW-23, MW-24, MW-25, MW-26, MW-27, and MW-28) installed in the upper flow zone at the on-site locations shown on Figure 47 (Figure 5, Effectiveness Report). The wells are set in the upper flow zone (UFZ) with screened interval depths ranging from 60 to 78 feet below the existing ground surface. Figure 48 (Table 1, Effectiveness Report) lists the pertinent construction details for each of the eight wells.

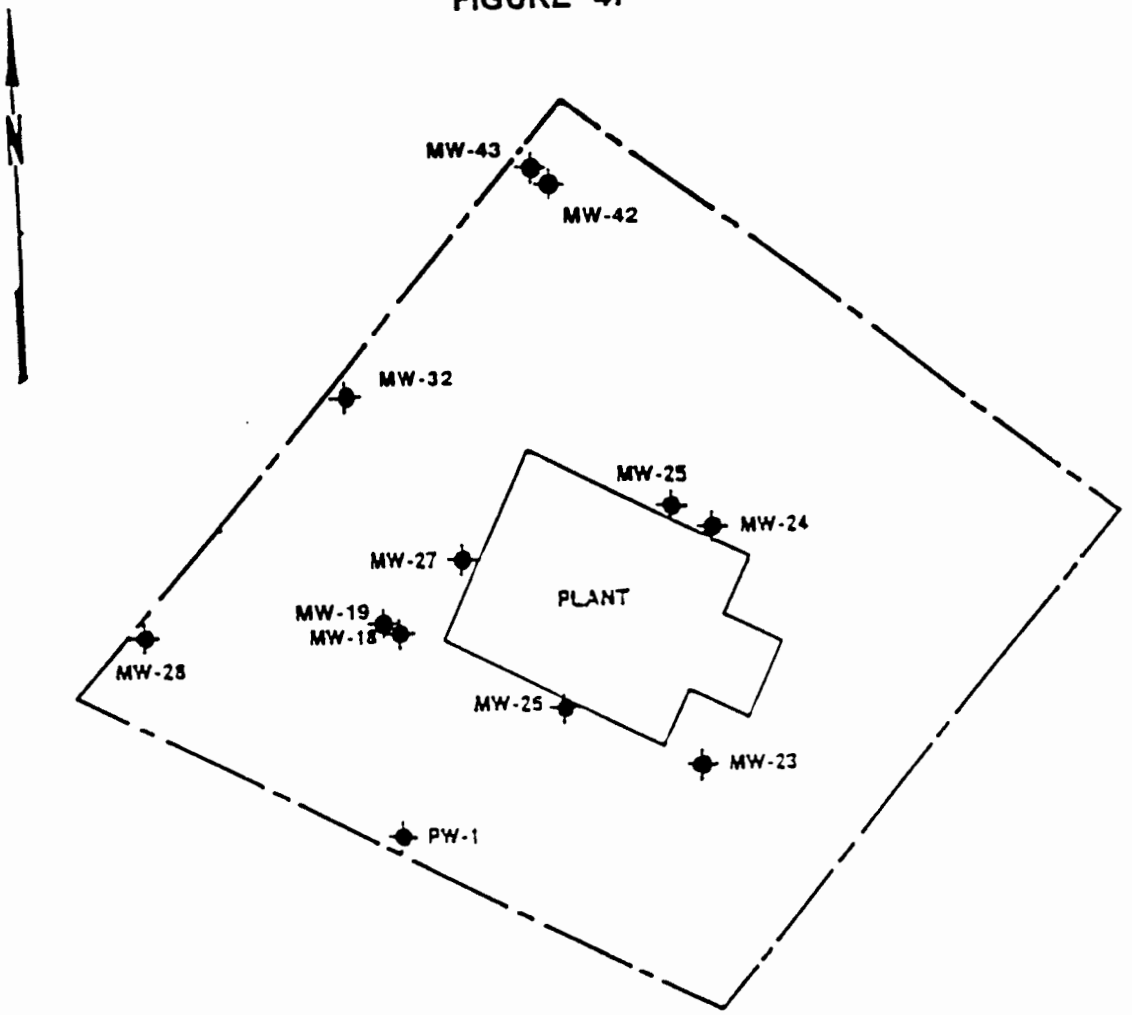
Compressed-air-operated, positive-displacement pumps were installed at or near the bottom of each well. The compressed air is supplied by an air compressor located in the central control building. Air is pumped through piping to the well pumps and pump controllers. Four controllers are provided to control pump operations. Two pumps are controlled by each controller. Each well pump is equipped with a remote well operator to allow independent adjustment of pumping rates for each well. Each well pump discharges through flexible tubing into a common gravity drain or header. Each discharge line is equipped with a two-way sampling valve for sample collection and flow measurement.

The enhanced IM system would include pumping from onsite lower lower flow zone (LLFZ) monitoring well MW-32 and upper lower flow zone (ULFZ) monitoring well MW-42. Drilling records indicate reasonable water production can be obtained from these wells.

Well MW-32 has historically exhibited erratic and anomalously high concentrations of VOC relative to surrounding adjacent wells. Well MW-42 has also exhibited elevated concentrations of VOC. If additional extraction is needed to fully utilize the 20 gpm treatment capacity of the existing IM system, consideration will be given to including LLFZ well MW-43 and ULFZ well 19 into the enhanced IM. These wells have a history of VOC detection and should produce some quantity of water. All of these wells are located onsite and relatively close to the IM treatment unit. Well locations are shown on Figure 47 and construction details are given on Figure 48.

OGC-002562

FIGURE 47



LEGEND

MW-23
RECOVERY WELL LOCATION AND NUMBER

0 200 400
SCALE FEET

HDR
HDR ENGINEERING, INC.
DALLAS, TEXAS

Recovery Well Location Plan
Sparton Technology, Inc.
Coors Road Facility
Albuquerque, New Mexico

Date 8/92

Revised 3/97

FIGURE 48

IM GROUNDWATER RECOVERY NETWORK WELL CONSTRUCTION DETAILS						
Well No.	Well Diameter (inches)	Well Screen Material	Riser Material	Depth of Screened Interval (feet)	Elevation at top of Screen (ft., MSL)	Construction Date
PW-1	10	PVC (1)	PVC	60-70	4984.54	9/84
MW-18	4	PVC	PVC	68-78	4977.58	5/86
MW-19	4	SS	PVC	97-107	4949.25	5/86
MW-23	2	SS(2)	PVC	72-77	4976.51	8/86
MW-24	2	SS	PVC	68.4-73.4	4980.30	12/86
MW-25	2	SS	PVC	67.7-72.7	4981.30	12/86
MW-26	2	SS	PVC	73-78	4972.71	5/88
MW-27	2	SS	PVC	67-72	4978.50	5/88
MW-28	2	SS	PVC	65-70	4977.69	5/88
MW-32	4	SS	PVC	108-118	4940.05	6/88
MW-42	4	SS	PVC	105-115	4952.33	10/89
MW-43	4	SS	PVC	127-137	4930.74	11/89

(1) Polyvinyl chloride
(2) Stainless Steel

OGC-002564

Groundwater extracted simultaneously at each well location is piped to an air stripper system for treatment and ultimate beneficial use in the Sparton Facility. The collection piping system consists of discharge lines encased in secondary piping to provide leak detection and containment. Figure 49 (Table 2, Effectiveness Report) describes the pumping flow rate for each recovery well as of late February 1992.

The produced groundwater is collected in a 550-gallon fiberglass-coated steel tank. The double wall tank has a leak detection system with a visual and audible alarm in the control building. A centrifugal transfer pump, which is controlled by the water level in the collection tank, transports water from the collection tank to the top of the packed tower (air stripper).

The twenty-gallon-per-minute packed tower aeration unit receives untreated water from the transfer pump and discharges to the storage tank. A 400-cfm blower provides a counter-current flow of air through the packed tower to remove volatile organic constituents (VOC) from the water. A recirculation line is provided on the packed tower discharge to allow a portion of the flow to be recirculated to the collection tank. The recirculation shortens the time between pumping cycles of the transfer pump. This procedure maintains the tower packing in a wet condition, thus improving treatment efficiency. The rate of recirculation may be adjusted by setting the butterfly valve on the recirculation line.

Effluent from the packed tower is discharged to a 15,000-gallon fiberglass-coated steel tank for storage. The double-walled tank has a leak detection system with a visual and audible alarm in the control building. Water from the storage tank is used in the main plant building as cooling and flushing water and eventually discharged into the sewer system.

OGC-002565

FIGURE 49

CURRENT RECOVERY WELL NETWORK FLOW RATES	
Well No.	Flow Rate (gal/hr)
PW-1	3.7
MW-18	10.0
MW-23	21.3
MW-24	1.0
MW-25	1.8
MW-26	2.0
MW-27	13.4
MW-28	2.9
TOTAL	56.1

To date, approximately 3.82 million gallons of water have been treated in the packed tower. The air stripping system has demonstrated an average VOC removal efficiency of 99 percent for the measured indicators, which include 1,1-dichloroethylene (DCE), methylene chloride (MeCl), 1,1,1-trichloroethane (TCA), and trichloroethylene (TCE). Total influent concentrations have exceeded 1000 micrograms per liter (µg/l). Air stripper treatment is producing effluent concentrations in the range of one µg/l for each constituent being monitored. Demonstrated reliability and performance to date indicate a remaining useful life of at least ten years.

C. Justification of Recommended Corrective Measure

1. Human Health/Environmental

The recommended corrective actions are consistent with the requirements of 40 CFR 264.100. The RFI, and subsequently obtained data, indicates that the groundwater plume is expanding slowly to the west-northwest; however, in the majority of monitoring wells, constituent concentrations are decreasing. Highest concentrations of TCE and TCA are present in the immediate vicinity of the source at the Sparton Facility.

As previously discussed, the plume does not present a risk of injury to potential receptors and will not cause the loss of any reasonably foreseeable use of the aquifer. Therefore, neither containment of the plume nor restoration of the aquifer are necessary to achieve the corrective action objectives of implementing those measures necessary to protect public health or the environment.

OGC-002567

Even if restoration was necessary to protect public health or the environment, which it is not, that goal cannot be achieved. Given the conditions of this site, the most reasonable technical conclusion about the effectiveness of a pump and treat remedy is that it might achieve health-based standards within hundreds of years. NMED has concurred with this conclusion. The remedy proposed in this study should achieve the same result within approximately the same time period.

2. Performance

Groundwater extraction, combined with PTA treatment, is considered a best demonstrated available technology (BDAT) for volatile organic constituents (VOC) such as TCE and TCA. Further, over 7-1/2 years successful experience with the current IM consisting of groundwater extraction and PTA treatment confirms the applicability of this technology to the Sparton site. Any containment well near the plume leading edge will be screened through the entire vertical interval of the plume to provide effective vertical capture. In addition, previous RFI pump testing and a number of recent studies/ investigations show that a single well will have horizontal capture capabilities exceeding the current width of the plume (see calculations in September 18, 1996, proposal in Appendix 5). However, horizontal and vertical capture of the containment well will be verified by extended demonstration as discussed in the proposals in Appendix 5. Long-term performance of the containment well can be monitored through the existing groundwater monitoring network.

OGC-002568

The ability of the IM system to achieve significant reduction in contaminant concentration coupled with the location in the area of maximum constituent concentration should provide an effective source removal/groundwater remediation tool. As previously demonstrated, the IM system performance can also be easily monitored through the numerous available sampling points existing at the Sparton site.

Soil vapor extraction (SVE), using a vapor extraction system (VES), is a well-established methodology for remediating both soil-sorbed (residual NAPL) phase and groundwater-dissolved phase VOC contamination. For the subsurface conditions existing at the Sparton site, SVE would be considered a BDAT for unsaturated zone VOC remediation. SVE performance has been confirmed through recent implementation in the Albuquerque area in similar hydrogeologic conditions and by recently completed onsite pilot testing.

3. Reliability

The recommended corrective actions consists of proven, state-of-the-art technologies that have been designated BDATS. It should be noted that the IM has been operated for over 8 years without any significant difficulty or breakdown. There has been no evidence of any decrease in system performance.

SVE has been widely implemented and proven to be reliable. Components of a VES are generally "off-the-shelf" and commonly available as modular units. Operation can be easily monitored. Recently completed pilot testing confirms the applicability of the technology to this site.

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4. Implementability

As detailed in the proposals in Appendix 5, groundwater extraction from a containment wells near the plume leading edge and from an expanded IM can be efficiently implemented. Air stripping to remove VOC has been demonstrated by over 8 years' experience with the IM. Discharge of the treated water to the Calabacillas Arroyo is feasible and provides for beneficial use of the water with minimal losses as compared to other disposal alternatives.

Any containment well will be installed on a developed lot to provide security for the wellhead and site screening. Treatment can be provided either at the wellhead or at the Sparton facility. Storm sewers accessing the Calabacillas Arroyo are available at both locations.

Since the IM system is already in operation, there are no implementability concerns or restrictions for the enhanced IM. Based on recent study, it is anticipated that any implementation of VES would be on-site in localized areas near the original source. The combination of on-site location and wide documented usage confirms implementability of VES. BDAT designation for technologies incorporated in the recommended alternative further confirms the implementability.

5. Summary

The recommended corrective measure alternative is a synergistic combination of proven technologies capable of containing plume movement and achieving reductions in contaminant levels in the source area and limiting, if not preventing, further migration from

OGC-002570

on-site areas in an efficient, cost-effective manner. Continued operation of the enhanced IM and implementation of SVE will meet the requirements for source control and removal and reduction of VOC in the most heavily impacted areas on-site. However, SVE implementation and continued operation of the enhanced IM will not achieve MAC/MCL within any reasonable time period. The plume containment well will also remove VOC from ground water; however, based on current rate of movement within the plume, containment will not achieve MAC/MCL within any reasonable time period. Continued monitoring over the operation period of this alternative will provide ample opportunity to assess the need, if any, for additional measures beyond the recommended system. Any new development in off-site areas will also be periodically evaluated during the operational period relative to potential receptor/exposure pathways. Any significant increase in risk or threat resultant from unexpected off-site development may require additional corrective measure studies.

APPENDIX 5

CORRECTIVE ACTION PROPOSALS

a) September 18, 1996
b) December 7, 1996
c) January 17, 1997

BLACK & VEATCH

~~5728 LBJ Freeway, Suite 300, Dallas, Texas 75240, (214) 770-1500, Fax: (214) 770-1549~~

5728 LBJ Freeway, Suite 300, Dallas, Texas 75240, (972) 770-1500, Fax: (972) 770-1549

Sparton Technology
Coors Road Facility

B&V Project 26602.0100
B&V File B
September 18, 1996

Ms. Ana Marie Ortiz
Assistant General Counsel
State of New Mexico Environment Department
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502

Re: Corrective Action Proposals
Sparton Technology, Inc.
Coors Road Facility

Dear Ms. Ortiz:

On behalf of Sparton Technology, we are submitting the enclosed proposals for three corrective actions. These proposals cover:

1. Plume leading edge containment;

2. Vapor extraction system pilot testing; and

3. Expansion of Interim Measures.

We are also attaching copies of pertinent backup information for the submitted proposals. This backup information includes:

1. Updated corrective action recommendations (Black & Veatch letter of July 10, 1996);

2. Vapor extraction system pilot testing outline (Black & Veatch letter of August 12, 1996);

3. Calculations of hydraulic influence for groundwater containment wells (Black & Veatch letter of August 22, 1996);

Sparton Technology
Ms. Ana Marie Ortiz

B&V Project 26602.0100
September 18, 1996

These proposals are being submitted in response to your letter of September 12, 1996, and our continuing discussion and correspondence with NMED staff. Copies of these proposals are being sent by facsimile to expedite your review. Actual proposal documents and backup information are being transmitted by overnight mail.

If you have any questions or need further information, please call. Further note that as of September 14, 1996, our area code changed from 214 to 972.

Sincerely,

BLACK & VEATCH

Pierce L. Chandler, Jr.
Project Manager

bk
enclosures

cc: Mr. R. Jan Appel, Sparton Technology, Inc.
Mr. Jim Harris, Thompson and Knight
Mr. Gary Richardson, Metric Corporation

PROPOSAL

Plume Leading Edge Containment Well
Coors Road Facility
Sparton Technology, Inc.
Albuquerque, New Mexico

Prepared for:

Sparton Technology, Inc.
Rio Rancho, New Mexico

Prepared by:

Black & Veatch
Dallas, Texas

in Association With

Metric Corporation
Albuquerque, New Mexico

September 17, 1996

OGC-002576

Objectives

The objectives for installation and operation of the plume leading edge containment well are:

1. To intercept or capture the leading edge of the contaminant plume to prevent further down-gradient migration.

2. To recover contaminated groundwater, treat and dispose to reduce the quantity of contamination.

3. To demonstrate/document the performance of the containment well in achieving the first two objectives.

4. To provide (through pump testing) confirmation of aquifer characteristics.

Definition of Plume Leading Edge

In the RCRA Facility Investigation (RFI) Report submitted to USEPA on May 21, 1992, and subsequently approved on July 1, 1992, the horizontal and vertical limits of the plume were defined by sampling and analysis through June 1991 using both on- and off-site groundwater monitoring wells. In particular, the leading edge of the plume was defined by a number of non-detect groundwater monitoring wells outside the perimeter of the plume.

Subsequent to the RFI completion, plume movement continued beyond the existing groundwater monitoring system. However, based on historic movement, groundwater gradient, and relatively constant geologic conditions, the limits of the leading edge of the plume were estimated in the May 1996 Corrective Measure Study (CMS) Report approved by USEPA on June 24, 1996. To further define the limits of the plume, five additional groundwater monitoring wells (MW-65 through MW-69) were installed around and outside the predicted limits of the plume. Well locations were chosen to provide additional definition of the horizontal and vertical extent of the leading (down-gradient) edge of the plume through non-detection. These and other non-detect wells around the leading edge provide good definition of the plume. The new well installations and subsequent sampling and analysis of these and other existing monitoring wells confirm

OGC-002577

that the plume limits shown in the CMS Report are reasonable and that the CMS conclusions about direction and rate of movement are also reasonable.

Based on the currently defined plume limits and characteristics, a single well located along Buckeye, some 500 feet north of Arrowhead (see Figure 1) is proposed for plume leading edge containment. (This is the same location shown in the July 10 B&V proposal.) Calculations of predicted well containment performance based on various methodologies and examples of field demonstrations of radius of influence were previously furnished to NMED in the B&V letter of August 22, 1996. These calculations show that a single well is capable of containing the leading edge of the plume.

Available Groundwater Monitoring Network

The attached Table 1 is a summary of monitoring points available to verify the performance (containment function) of a groundwater recovery well installed to contain the leading edge of the plume.

With respect to the attached summary (see Table 1), there are 21 groundwater monitoring wells (including 7 clusters) within 1,500 feet of the proposed recovery well (see Figure 1). These wells include 12 in the upper flow zone (UFZ), three in the upper lower flow zone (ULFZ), five in the lower lower flow zone (LLFZ), and one in the third flow zone (TFZ). There are four down-gradient, three cross-gradient, and 14 up-gradient wells.

The available monitoring network includes all wells that currently define the limits of the leading edge of the plume. The network includes all non-detect monitoring wells outside the plume and detection wells inside the plume. This combination of wells was used to define the plume and is, therefore, capable of showing successful containment performance by demonstrating inward flow (toward the recovery well) across the entire leading edge of the plume. Conversely, the existing groundwater monitoring network is also capable of detecting any deficiency of the proposed recovery well relative to containing the entire leading edge of the plume. Containment performance can be monitored thorough continuing water level observations and water quality sampling and analyses in the groundwater monitoring well network.

OGC-002578

Groundwater Containment/Recovery Well Design

Our recommendations on groundwater recovery are similar to those in the CMS Report. The recovery well should be screened at least into the upper 30 to 35 feet of the saturated zone. Screen depth should be adjusted downward, as necessary, based on pilot hole logging to ensure screen placement into a transmissive zone. Due to the geologic anisotropy, the plume depth is very shallow (<100 ft) whereas the width (≈1,500 ft), and length (≈3,000 ft) are large. Thus, a well screened to approximately 50 percent of the plume thickness should be effective. Further, the bulk of the contamination occurs in the top of the aquifer. As a consequence, very deep well penetrations (greater screen length) are undesirable due to the potential for contaminant migration from the upper flow zone (UFZ) to the lower lower flow zone (LLFZ). For similar reasons, a pumping rate of 50 to 100 gpm (drawdown in the range of 6 to 10 feet) is also desirable. All available information indicates that this pumping rate should be more than adequate to achieve containment of the plume. The design intent is to provide sufficient drawdown to achieve containment yet avoid pulling shallow contamination deeper into the aquifer. A second design intent is to minimize the amount of "clean" water recovered by the well.

Produced water from the recovery well would be treated to meet discharge permit requirements for both air and water effluents. Treatment is proposed at the well head. This proposal assumes that treated water can be economically disposed by either discharge to the Rio Grande River by NPDES permit or through some other economic alternative such as discharge to a sanitary sewer.

Containment Demonstration

Demonstration of containment will be established by conducting a series of pumping tests during the initial startup of the groundwater recovery well. The first pump test would be a two to three day test (with a temporary pump) used to determine the required size (pumping rate) for the production pump. Time-drawdown data would be obtained from a constant-rate test at approximately 100 gpm to evaluate produced drawdown and impact to the closer monitoring wells. The resulting time-drawdown and distance-drawdown data would be analyzed to verify the design pumping rate needed to produce approximately 10 feet of drawdown in the recovery well. The data would also be used to project the edge or limit of the recovery well influence relative to plume capture/containment. The temporary pump test would also be used to establish produced water quality by sampling

OGC-002579

and laboratory analysis on a daily frequency. Flow rate, total quantity, and monitor well levels will be recorded during the pumping test.

After the production pump is installed, a long-term (approximately one month) pumping test would be conducted using the production well and the monitoring network described in Table 1. Closer monitoring wells (<750 feet horizontal distance) would be read two to four times daily for the first several days, and once daily for the rest of the first week. More distant wells would be read daily for the first week. Thereafter, all well levels would be recorded once per week for the duration of the test. This second pump test would be used to demonstrate both the performance of the recovery well/treatment system and the plume area impacted by the pumping.

Contingency

There are at least two possible scenarios that could be identified during the pumping test. The first of these is that the chosen well location may have atypical or non-representative geology such as an absence of coarser, transmissive material in the uppermost saturated zone. Such a condition has been encountered in several monitoring wells.

Pilot hole procedures and installation of a temporary pump are two ways to minimize the effect of an unexpected geologic condition. As previously noted, screen length would be extended as a first solution. In the highly unlikely event the geologic condition was vertically extensive (tens of feet), consideration would have to be given to an alternate location.

The second scenario is that the long-term pumping test of the recovery well indicates that portions of the leading edge of the plume are not being effectively intercepted. (Effective interception would be defined as demonstration of flow toward the recovery well using water level data from various monitoring wells to show an inward gradient to the recovery well, i.e., to show a cone of depression over the horizontal and vertical extent of the plume.) This scenario is also unlikely and the solution, in all probability, would be to increase the pumping rate (increase stress in the aquifer).

There is a third scenario that could appear months or years into recovery well operation. This scenario would be the appearance of contamination in a currently non-detect monitor

OGC-002580

well outside the influence area of the recovery well. The solution could involve the installation of additional monitoring wells and subsequent characterization/evaluation.

Schedule

The schedule for implementing the plume leading edge containment is a dual concurrent track. The first track is the process of obtaining the necessary permits for installing and operating the containment well system. The permits include air quality, well installation, groundwater rights, variance from zoning, public right-of-way use, and discharge (including NPDES). This first track would begin immediately upon authorization to proceed and is considered the critical path. Schedule estimates for this track are at least six months.

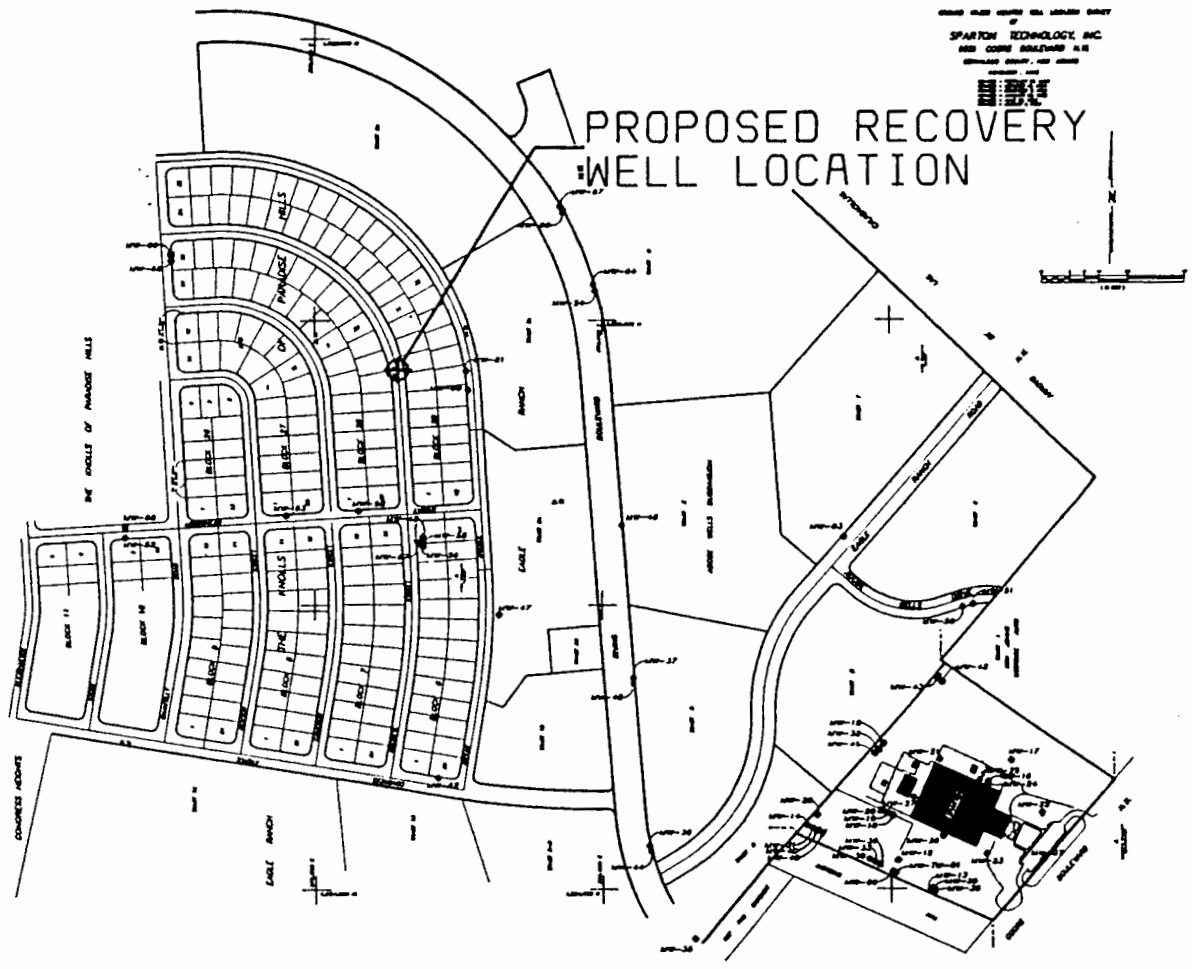
The second track is the actual installation and testing of the containment well system. The second track also presumes that track one will be successfully completed. Elements (and schedule estimates) for this second track are as follows:

1. Select and purchase property for the wellhead (four to six weeks).
2. Review permits status.
3. Drill and install recovery well (two months).
4. Review permits status.
5. Construct building/shelter for treatment unit (four months).
6. Acquire and install treatment equipment and discharge pipeline (one month).
7. Verify completion of permits.
8. Conduct temporary pump test and install production pump (one month).
9. Conduct production pump test (one month).
10. Evaluate and report installation and test data (two months).

Based on the above estimates, it will take at least eight months to actually begin pumping water with the permit process being the critical impact on the schedule.

OGC-002581

OGC-002582



LEGEND

- UPPER FLOW ZONE WELL
- UPPER LOWER FLOW ZONE WELL
- LOWER LOWER FLOW ZONE WELL
- THIRD FLOW ZONE WELL

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

DESIGNED
DETAILED
CHECKED
APPROVED
DATE

Black & Veatch

PROJECT NO. 26602

FIGURE 1

RECOVERY WELL AND MONITORING NETWORK

SHEET OF

Table 1 Summary of Groundwater Monitoring Wells Within 1500 Feet of Proposed Containment Well Location						
Monitor Well	Flow Zone	Approx. Radial Distance ft	Gradient Position	Inside Plume*	Recent Contamination History**	Cluster Well
MW 37	UFZ	1,350	Up	Yes	High, Decr	Yes
MW 45	ULFZ	1,350	Up	Yes	Low, Decr	Yes
MW 46	ULFZ	950	Up	Yes	V. High	No
MW 47	UFZ	925	Up	Yes	Low, Decr	No
MW 48	UFZ	600	Up	Yes	High, Decr	Yes
MW 52	UFZ	1,100	Down	No	ND	Yes
MW 53	UFZ	650	Cross	Yes	Low	No
MW 54	UFZ	750	Up	NA	NA	Yes
MW 55	LLFZ	600	Up	Yes	High	Yes
MW 56	ULFZ	600	Up	Yes	High	Yes
MW 57	UFZ	825	Cross	No	ND	Yes
MW 58	UFZ	500	Up	Yes	High	No
MW 60	ULFZ	250	Up	Yes	High	Yes
MW 61	UFZ	250	Up	Yes	V. High, Decr	Yes
MW 62	UFZ	1,425	Up	No	<5 µg/l	No
MW 64	ULFZ	750	Up	Yes	Low, Incr	Yes
MW 65	LLFZ	1,100	Down	No	<5 µg/l	Yes
MW 66	LLFZ	825	Cross	No	ND	Yes
MW 67	TFZ	600	Up	No	ND	Yes
MW 68	UFZ	875	Down	No	ND	Yes
MW 69	LLFZ	875	Down	No	ND	Yes

* Inside 5 µg/l contour

** Very high=>1,000 µg/l, high=>100 µg/l, low=<100 µg/l
ND=no detect, Incr=increasing trend, Decr=decreasing trend

OGC-002583

PROPOSAL

Vapor Extraction System Pilot Testing
Coors Road Facility
Sparton Technology, Inc.
Albuquerque, New Mexico

Prepared for:

Sparton Technology, Inc.
Rio Rancho, New Mexico

Prepared by:

Black & Veatch
Dallas, Texas

in Association With

Metric Corporation
Albuquerque, New Mexico

September 17, 1996

Objective

The following proposal is a discussion of specific details and operating procedures to conduct and analyze a VES pilot test and to define the limits of elevated soil-gas volatile organic constituent (VOC) concentrations (i.e., the "soil vapor cloud") in the unsaturated subsurface at the Sparton facility. This discussion of technical details and definition of level of effort is a logical extension from the existing data base and should provide sufficient information to determine what, if any, additional work will be needed.

Soil-Gas Monitoring System

A number of monitoring points for both subsurface soil-gas characterization and for vapor extraction pilot test/production purposes have been previously proposed (B&V letter of August 12, 1996). The monitoring system included both existing groundwater monitor wells (with exposed screen) and the existing vapor cluster probe (VP-1) as well as new vapor recovery wells installed in and around the source area. Previous studies had identified highest VOC concentrations in the soil gas in the closed sump area. Concentrations dropped off by orders of magnitude with increasing horizontal distance from the sump/pond (source area).

The proposed monitoring system additions are designed to characterize the soil gas VOC concentration with respect to distance/location relative to the closed sump area. In addition, the monitoring points would be useful in evaluating the effective influence of a vapor recovery well centrally located in the closed sump (source) area. The monitoring system is shown on the attached Figure 1 and includes four existing groundwater monitoring wells (MW-17, MW-21, MW-24, MW-25, and, perhaps, MW-16 depending on seasonal water level (fluctuation), existing six-well vapor probe cluster (VP-1) and five new vapor recovery wells (VR-1 through VR-5).

The new vapor recovery wells are designed to function as both monitoring points and as potential vapor extraction/air injection wells. The new central vapor recovery well (VR-1) would be a four-inch well; the remaining new vapor recovery wells (VR-2 through VR-5) would be two-inch wells. Wells would consist of 60 feet of 0.040-inch machine slotted PVC screen surrounded by a #6 to #9 coarse sand filter. The uppermost 10 feet of each well would be a grouted surface seal to minimize air intrusion or bypassing. New wells would be installed using hollow-stem auger drilling procedures. As part of the characterization work, drilling would be monitored using field screening instruments to

OGC-002585

provide a relative comparison of soil gas VOC as a function of location, depth, and soil type. Completed wells would also be sampled and analyzed using EPA method 8010/8020 for specific VOC presence/concentration.

The proposed monitoring system is expected to confirm the significant dropoff in soil gas VOC concentration with increasing distance from the closed sump area. In addition, it should also define the area where vapor extraction and treatment would be appropriate.

The need for any additional monitoring/characterization data outside the proposed network would be based on a combination of perimeter soil-gas VOC concentrations above 10 ppm and projected edge (shape and distribution) of the "vapor cloud" extending out beyond the definition interval of the proposed network. The proposed network has maximum interwell horizontal spacings of ±100 feet in the outer perimeter. Projected vapor cloud edges extending outward less than this interwell spacing should be adequately defined.

Updated Soil-Gas Characterization

Soil-gas data from the additional new wells would be combined with the existing data base to provide a three-dimensional picture of the soil-gas "vapor cloud". This analysis and related data would be presented in the form of an update to the soil contamination characterization presented in the May 6, 1996 Corrective Measure Study (CMS) Report approved by U.S.EPA on June 24, 1996. The updated soil-gas characterization would also be used to confirm the application area for vapor extraction and the selection of the pilot test location.

Pilot Test Design

All data obtained to date and the history of the facility indicate that the closed solvent sump is the probable source of VOC observed in the soil gas. Highest soil-gas VOC concentrations occur in the immediate area of the sump with significant VOC concentration decrease observed with increasing horizontal distance from the source area. As a minimum, vapor extraction will be implemented in the sump area. Thus, the sump area is the most logical location for pilot testing.

The pilot test is proposed to define the relationship between VOC concentrations and extraction vacuum and extraction flow rates from a recovery well located directly under

the sump area (see Figure 1). Monitoring points (proposed and existing) are located at varying horizontal distances and depths to allow evaluation of effective influence of the centrally located recovery well.

The pilot test is also designed as a prototype demonstration of the planned VES system to show capability for extraction and ability to meet City/County air quality requirements. Further, the pilot test will show probable production rates and estimates of required operation time.

Pilot Test Equipment

For the pilot test, we are proposing AcuVac as the subcontractor to provide necessary equipment. AcuVac is experienced in soil vapor recovery pilot testing in the Albuquerque area and they have demonstrated the ability to successfully conduct meaningful pilot tests and to meet stringent City/County emission requirements. Further, the AcuVac procedure utilizes an environmentally friendly destructive technology to efficiently remove VOC from the extracted soil gas.

The proposed extraction/destruction unit is based around a 300 cubic inch in-line six cylinder internal combustion (I.C.) engine fueled by the extracted soil-gas VOC and supplemental fuel as required. Emissions are controlled by the I.C. process and redundant catalytic converters.

A vacuum blower propelled by the I.C. engine is capable of producing well flow rates of up to 120 cfm and negative pressures of up to 15 inches of mercury. AcuVac-furnished pilot test equipment also includes: a data recording system; magnehelic pressure gauges capable of reading to 0.01 inches of water; soil gas flow measuring devices; real-time field screening/analytical equipment; temperature and barometric measurement; and sampling ports for recovery of influent samples.

Pilot Test Procedure

The pilot test is proposed to be conducted using the central four-inch recovery well (VR-1). The remaining recovery wells (VR-2 through VR-5), UFZ groundwater monitoring wells (MW-17, MW-21, MW-24, and MW-25), and vapor probe cluster (VP-1) would be used as observation points for the pilot testing (see Figure 1). The pilot testing will be conducted at several different rates of vacuum and flow (up to the

OGC-002587

maximum capability of the extraction unit) to determine the performance characteristics of the vapor recovery well/adjacent subsurface.

Prior to each individual test, depth to water, temperature and barometric pressure, and magnehelic pressure gauge readings at each monitoring point would be recorded. After the pilot test is started, extraction well vacuum and flow and extraction system operating data (including supplemental fuel flow) will be recorded. Pressure instrumentation at each of the observation wells will be monitored and recorded to determine vacuum communication with the recovery well (demonstration of radius of influence).

The produced vapor stream (influent) will be analyzed (on a real-time basis) using field screening instruments to determine variation in influent VOC concentration. At selected intervals, influent samples will also be obtained for confirmatory laboratory analyses (EPA Method 8010 and 8020). At least one confirmatory sample will be obtained for each extraction rate test. The purpose of the screening/testing will be to determine VOC concentration variation as a function of both pumping rate/vacuum and elapsed pumping duration.

Based on previous experience, the pilot test should require no more than two days of actual vapor extraction. It is anticipated that two to four extraction rates will be tested. Each extraction rate test will nominally take three to four hours. Upon completion of testing, a detailed pilot test report, including all operating and analytical data and recommendations for operating parameters and effective vacuum radius of influence, will be compiled and provided to NMED.

Pilot Test Schedule

Upon authorization to proceed, it will take from two weeks to over a month to schedule a drilling contractor to install the five vapor recovery wells. Approximately one week will be required to install the wells. Sampling and analytical testing will require several more weeks. Pilot testing can then be arranged in accordance with the subcontractor's schedule. Currently, several weeks are required to mobilize the pilot test equipment; however, once equipment is on site, the actual pilot testing can be conducted in several days. Interference with the schedule could be caused by the holiday season and possibly weather.

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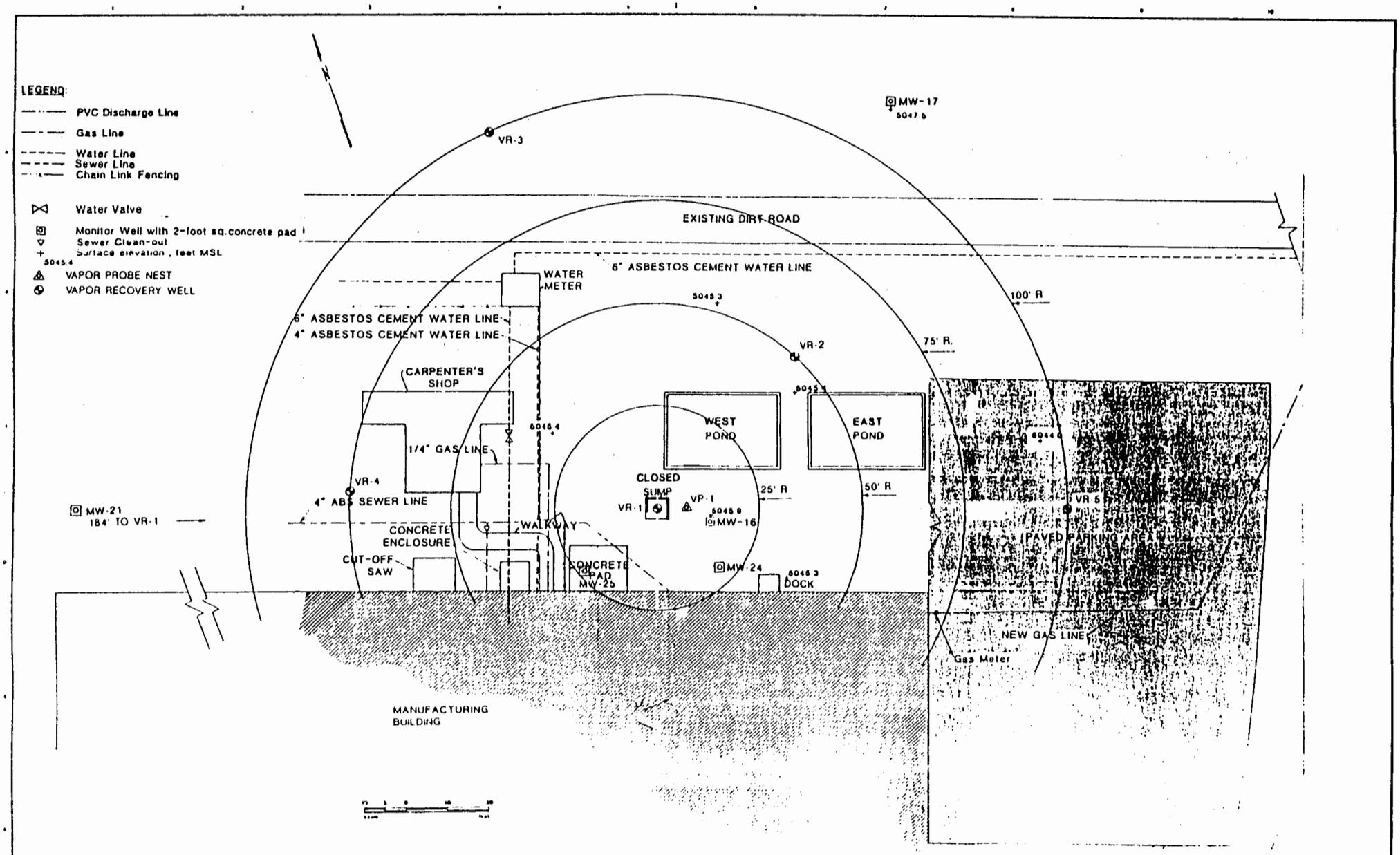


MAP SOURCE: RCRA POST-CLOSURE PERMIT APPLICATION
HARDING LAWSON ASSOCIATES, MARCH 1986

Black & Veatch
Engineers Architects
Dallas, Texas

PROJECT NO

SPARTON TECHNOLOGY, INC.
COORS ROAD FACILITY
VES - PILOT TEST

FIG 1

CONTRACT NO

SHEET NO

PROPOSAL

Expansion of Interim Measures (IM)
Coors Road Facility
Sparton Technology, Inc.
Albuquerque, New Mexico

Prepared for:

Sparton Technology, Inc.
Rio Rancho, New Mexico

Prepared by:

Black & Veatch
Dallas, Texas

in Association With

Metric Corporation
Albuquerque, New Mexico

September 17, 1996

OGC-002590

Objectives

The objectives of this proposal are two-fold:

1. To address high volatile organic constituent (VOC) concentrations in groundwater at the location of MW-32.

2. To evaluate the cause of erratic VOC detections historically observed during periodic sampling of groundwater monitoring well MW-32.

Lower lower flow zone (LLFZ) groundwater monitoring well MW-32 has historically exhibited erratic detections of volatile organic constituents (VOC). Periodically, it exhibits anomalously high concentrations relative to surrounding adjacent wells and also periodically exhibits anomalous constituents. Further, out of 13 cluster well locations, well MW-32 is the bottom well in the only cluster showing an increase in VOC concentration with depth.

The source of the erratic detections is a matter of speculation, but would include completion problems such as a defective grout seal or a cracked well casing allowing intrusion of shallow contamination. Sampling procedures have been ruled out as a cause through detailed resampling and multiple split procedures.

One procedure to determine the cause of the erratic behavior would be to pump the well for an extended period and observe the effect on sampled water quality. If well MW-32 does represent a zone or area of higher VOC concentration, the extended pumping from this well would also be a form of source control and containment. It should be noted that MW-32 is also immediately downgradient of the source area.

Proposed IM Expansion

The current IM system recovers a total of approximately 2 gpm from the upper portion of the aquifer. The treatment capacity of the IM system is 20 gpm. Well installation data for MW-32 indicate that pumping rates of 10 to 15 gpm could possibly be achieved. Actual production rate would be determined by installing a temporary pump and conducting a limited pumping test to determine production pumping rate and drawdown. A production pump would then be sized and installed. Discharge would be routed to the

OGC-002591

existing onsite treatment unit. It should be noted that MW-32 is located almost adjacent to the treatment unit -- allowing economical, secure connection.

Production and impact on water quality would be evaluated on a periodic basis and furnished as a part of the site operation reporting.

Schedule

The current IM system is permitted for a production of 20 gpm. Adding well MW-32 to the IM system is simply a matter of conducting a limited pumping test for sizing purposes, and then installing the pump, controls, and connecting piping. It is estimated that well MW-32 could be recovering water within two months of authorization to proceed.

OGC-002592

BLACK & VEATCH

5728 LBJ Freeway, Suite 300, Dallas, Texas 75240, (214) 770-1500, Fax: (214) 770-1549

Sparton Technology
Coors Road Facility

B&V Project 26602.0100
B&V File B
July 10, 1996

Mr. R. Jan Appel
Vice President and General Counsel
Sparton Corporation
2400 East Ganson Street
Jackson, Michigan 49202

Re: Updated Corrective Action Recommendations

Dear Mr. Appel:

As part of the continuing, phased investigation at the Coors Road facility, we have obtained additional preliminary data on the extent of soil gas and groundwater VOC concentration. In response to your request, the purpose of this letter is to briefly outline three corrective actions set forth as follows:

1. Install and operate a vapor extraction system (VES) in the immediate source area to reduce VOC concentration in the unsaturated zone.

2. Install and operate a groundwater extraction well to contain the leading edge of the defined plume.

3. Expand the existing onsite Interim Measure (IM) pump and treat system to include LLFZ well MW-32.

These recommended actions are described more fully in following sections of this letter. All of these actions are consistent with information given in the Corrective Measure Study (CMS) Report.

Vapor Extraction Systems (VES)

Preliminary analytical results from the recently installed vapor probe in the center of the source area (adjacent to the solvent sump) and the April 1996 deep soil gas investigation confirmed the findings of the RFI and CMS Reports. Specifically, elevated soil gas concentrations (above 10 ppmv) of TCE and 1,1,1-TCA are found in the immediate source area and negligible soil gas VOC concentrations are found

offsite. The elevated soil gas VOC concentrations are believed to be the result of adsorption to fine-grained silts and clays in the upper 40 feet or so of the unsaturated zone.

The elevated soil gas VOC concentrations indicate that VES should be considered in the source area. As many as seven soil gas extraction wells (as shown in the attached figure) may be necessary to cover the source area with elevated soil-gas VOC concentration. The areal coverage provided by these wells indicates that further vapor probe installation in the interior source area is not warranted. Any additional soil gas monitoring, if necessary, could be provided by the individual extraction wells.

Detailed information of VES is given in the CMS Report. Extraction rates are expected to be in the range of 5 to 10 scfm per well. It is anticipated that the VES would be operated on a pulsed basis for up to three years to obtain maximum practical reduction in VOC concentration in the unsaturated zone.

Plume Containment

Based on preliminary sampling and analyses at the three new groundwater monitoring well locations that have been drilled so far -- specifically, UFZ wells MW-66 and MW-68 and TFZ well MW-67 (Sparton correspondence 5/14/96) -- the 1996 TCE plume contours given in the CMS Report seem reasonable. Based on the plume configuration, a single groundwater extraction well located along Buckeye (as shown in the attached figure) should be capable of containing the defined plume. For security, it would be advantageous to install the well on a vacant residential lot.

The partially penetrating well should be screened at least into the upper thirty to thirty-five of the saturated zone. (Upper and Lower Flow Zones). Screen depth should be adjusted, based on pilot hole logging, to assume placement in a transmissive zone. Very deep penetrations are undesirable due to the potential for contaminant migration to the Lower Lower Flow Zone (LLFZ).

Using aquifer properties given in the RFI Report and confirmed by the USGS, a pumping rate of 50 to 100 gpm would give a capture zone width (at the well) of approximately 1,500 to 2,000 feet which would adequately cover the width of the plume. Alternatively, capture zone width could be based on the 600-foot-plus radius of influence demonstrated in pumping tests reported in the RFI. The pumping rate would give a drawdown in the range of six to ten feet. The pumping rate should be

adjusted to provide sufficient drawdown for containment but not so much drawdown to pull shallow contamination deeper into the aquifer.

Extracted water would be treated at the well head on the residential lot to avoid any problem with transmission of untreated water along public right-of-way. It is anticipated that the only required treatment would be air stripping to remove VOC. Air polishing of air effluent should not be required since the total VOC emissions will be less than 5 pounds per day.

Treated water could be routed from the well head treatment site to the Rio Grande in a pipeline buried in the public right-of-way. An NPDES permit would be necessary for such a discharge, as discussed in the CMS Report.

Enhanced IM Recovery

We continue to recommend that LLFZ groundwater monitoring well MW-32 be added to the existing onsite IM pump and treat system as detailed in the CMS Report § VIII.B.

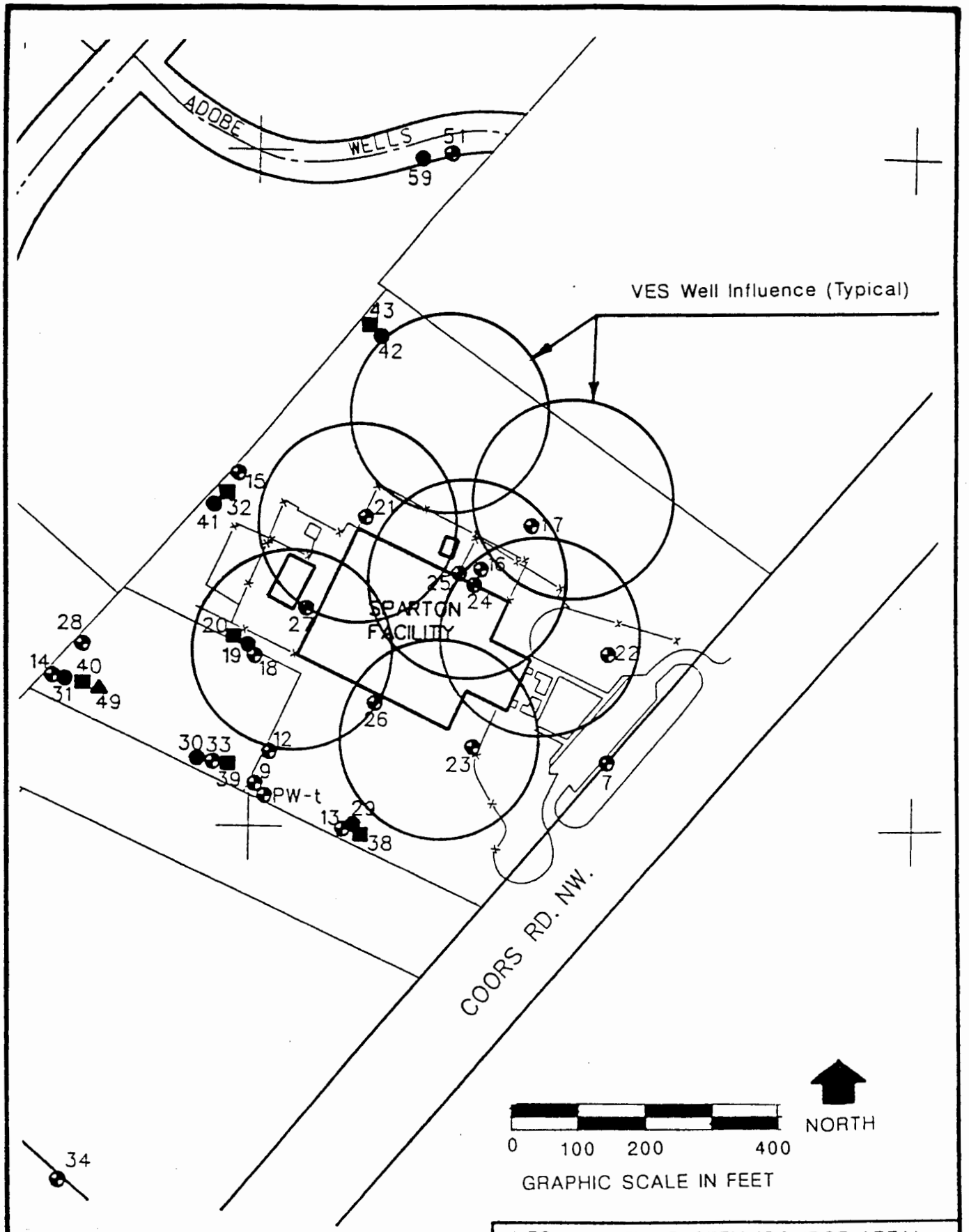
We appreciate the opportunity to provide this information. If you have any questions, please call.

Sincerely,

BLACK & VEATCH

Pierce L. Chandler, Jr.
Project Manager

bk
enclosures



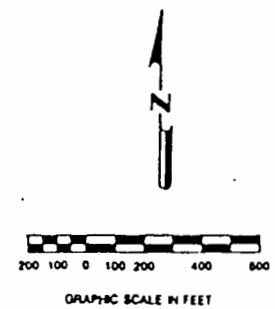
OGC-002596

BASE MAP FROM RFI - FIGURE 11

VES - 7 WELL SYSTEM (SOURCE AREA)	
SPARTON TECHNOLOGY, INC.	
BY	Black & Veatch Engineers-Architects Dallas, Texas
DATE	

300062

OGC-002597



LEGEND

- UPPER FLOW ZONE WELL
- UPPER LOWER FLOW ZONE WELL
- LOWER LOWER FLOW ZONE WELL
- THIRD FLOW ZONE WELL

1996 ADDITIONAL WELL INSTALLATIONS

- O - UPPER FLOW ZONE WELL
- □ - LOWER LOWER FLOW ZONE WELL
- △ - THIRD FLOW ZONE WELL

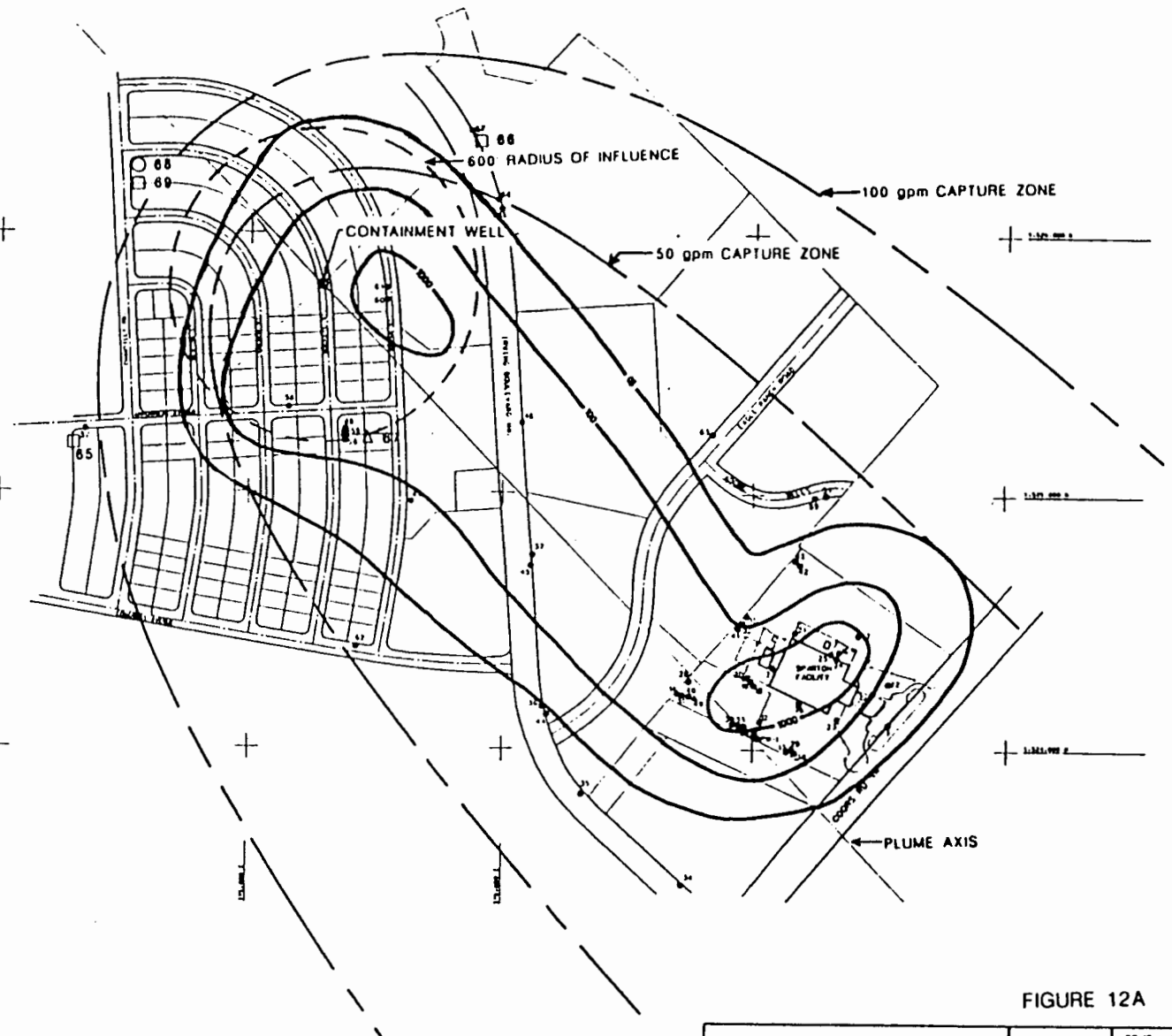


FIGURE 12A

Black & Veatch
Engineers · Architects
Dallas, Texas

PROJECT NO 026602

UPPER FLOW ZONE
TCE CONTOURS - 1996 DATA

CONT IN

SHEET NO.

BLACK & VEATCH

5728 LBJ Freeway, Suite 300, Dallas, Texas 75240, (214) 770-1500, Fax: (214) 770-1549

Sparton Technology
Coors Road Facility

B&V Project 26602.0100
B&V File B
August 12, 1996

Ms. Anna Marie Ortiz
Assistant General Counsel
State of New Mexico Environment Department
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 887502

Re: Vapor Extraction System Pilot Testing
Coors Road Facility

Dear Ms. Ortiz:

In our teleconference on August 5, 1996, we had discussions with you, Dennis McQuillan, and Rob Pine concerning pilot testing for the proposed VES. Based on those discussions, we are submitting this additional information on VES pilot testing as indicated in Jim Harris' letter of August 6, 1996. Specifically, this information covers the installation of additional vapor observation/recovery wells and pilot testing of a centrally located vapor recovery well in the sump area.

The centrally located vapor recovery well would be a 4-inch well installed in the sump area as described in our July 22, 1996, revised proposal. Additional 2-inch vapor wells (as previously described) would be installed at varying radial distances of 50 to 100 feet from the central well. A minimum of four wells would be installed at the approximate locations shown on the attached base map. These wells would be utilized as observation wells (together with the existing soil gas vapor probe VP-1 and existing groundwater monitoring wells with screen exposure above the water table) in a pilot test to evaluate production rates, radius of influence, and VOC concentration in the produced vapor stream. The additional vapor wells would also be used to further define the extent of VOC concentration in the soil gas. These wells could also be potentially used in the VES for vapor recovery and/or air introduction.

We anticipate that the pilot test would use a locally experienced subcontractor such as AcuVac to recover soil vapor from the central vapor recovery well and monitor the

surrounding observation network. It is our opinion that several days of pilot testing would be required to determine recovery rates and VOC concentrations for permit purposes. Once we have reached agreement on the location and number of pilot test wells and observation points, we will submit a more detailed description of the actual pilot test procedure. At the conclusion of the pilot testing, analyses would be provided relative to the extended VES implementation.

As shown in the following table, there are potentially four groundwater monitoring wells that could be utilized in the pilot test for vapor observation wells.

GROUNDWATER MONITOR WELLS IN VAPOR RECOVERY AREA (PILOT TEST)			
	Elevation Top of Screen (ft)	July 1996 Water Level Elevation (ft)	Screen Exposure (ft)
MW-16	4979.50	4979.45	.05
MW-17*	4982.28	4979.44	2.84
MW-21*	4983.86	4979.18	4.68
MC-22	4976.06	4979.06	(3)
MW-24**	4980.30	4975.72	4.58
MW-25**	4981.31	4977.64	3.67

* Vapor sampled successfully April 1996.
** IM groundwater recovery wells.

The four wells with good screen exposure (MW-17, MW-21, MW-24, and MW-25) were tested in April 1996 for the presence of VOC above the water table; however, VOC concentration in two of the wells, MW-24 and MW-25, could not be confirmed by laboratory analyses due to the water level being drawn above the top of the screen. It should be noted that photoionization detector readings during purging were significantly lower than comparable readings in MW-17. The locations of these four groundwater monitoring wells relative to the central vapor recovery well are shown on the attached base map. Note that two of the wells are within a 25-foot radial distance.

Sparton Technology
Ms. Anna Marie Ortiz

B&V Project 26602.0100
August 12, 1996

Two-inch vapor wells as previously described in the July 22, 1996 proposal would be installed at four locations around the central vapor well. Radial distance ranges from 50 to 100 feet as shown on the base map. The locations and radial distances conform to our previous discussion of pilot testing as described in the August 6, 1996 letter.

We trust this pilot testing information is sufficient for your needs.

Sincerely,

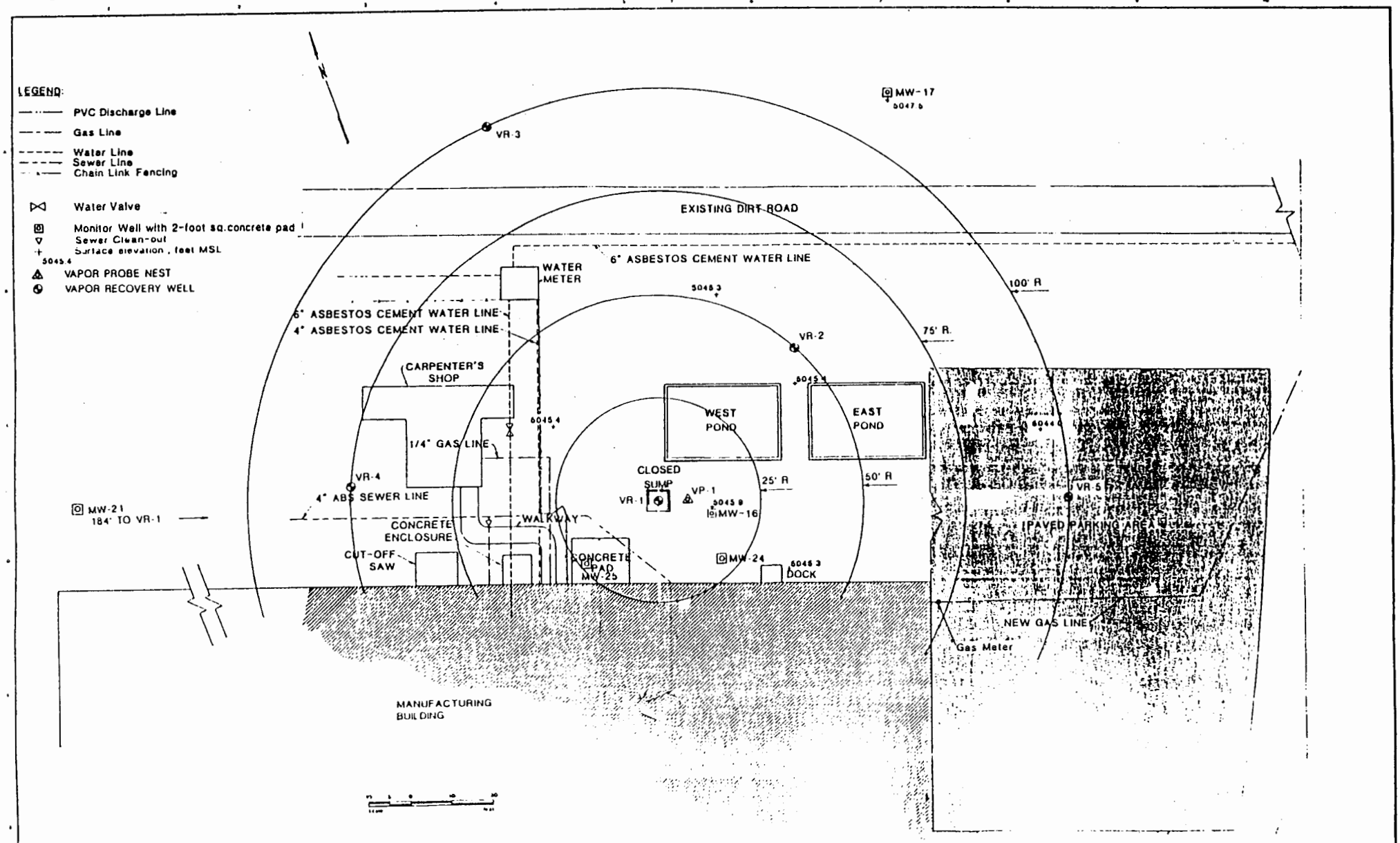
BLACK & VEATCH

Pierce L. Chandler, Jr.
Project Manager

bk
enclosures

cc: Mr. James B. Harris
Mr. R. Jan Appel

OGC-002601



MAP SOURCE: RCRA POST-CLOSURE PERMIT APPLICATION
HARDING LAWSON ASSOCIATES, MARCH 1986

Black & Veatch
Engineers Architects
Dallas, Texas

PROJECT NO

SPARTON TECHNOLOGY, INC.

COORS ROAD FACILITY
VES - PILOT TEST

FIG 1

CONTRACT NO

SHEET NO

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5728 LBJ Freeway, Suite 300, Dallas, Texas 75240, (214) 770-1500, Fax: (214) 770-1549

Sparton Technology
Coors Road Facility

B&V Project 26602.0100
B&V File B
August 22, 1996

Ms. Anna Marie Ortiz
Assistant General Counsel
State of New Mexico Environment Department
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 887502

Re: Calculations of Hydraulic Influence
Groundwater Containment Wells
Coors Road Facility

Dear Ms. Ortiz:

In recent discussions with you, Dennis McQuillan, and Rob Pine, copies of our calculations of predicted groundwater containment well performance were requested. Attached to this letter are copies of the requested calculations. The calculations include:

1. Site-specific calculations of radius of influence using pump test data from the U.S. EPA-approved RFI Report (RFI Attachment 10).

2. Illustration of containment well radius of influence based on RFI pump test data and pumping duration of one day superposed on the January 1996 plume configuration from the CMS Report.

3. Confirmatory calculations of radius of influence using data from the 1995 U.S.G.S. Albuquerque Basin Model.

4. Field demonstrations of radius of influence from Intel Production wells approximately 2.5 miles north of the Sparton Facility.

Sparton Technology
Ms. Anna Marie Ortiz

B&V Project 26602.0100
August 22, 1996

5. Calculations of capture zone using conventional methodology (Fetter 1994, Grubb 1993, and others) using a range of site-specific parameters and containment pumping rates. Note that transmissivity values are from the RFI/CMS Reports and hydraulic gradient is from third quarter 1996 water level data including the recently installed monitoring wells outside the leading edge of the plume.

6. Copy of site-specific 50- and 100-gpm capture zones (T=18,000 gpd/ft) for a potential containment well superposed over the January 1996 plume configuration from CMS report.

7. Calculations of capture zone using USGS-based parameters.

8. Copy of USGS-based capture zones superposed on the January 1996 Plume footprint from the CMS Report.

We trust that the attached information will be helpful in your review.

Sincerely,

BLACK & VEATCH

Pierce L. Chandler, Jr.
Project Manager

bk
enclosures

cc: Mr. James B. Harris
Mr. R. Jan Appel

BLACK & VEATCH

Owner SPARTON TECHNOLOGY Computed By PLC (1)
Plant COORS ROAD Unit _____ Date 8/6 19 96
Project No. 026602.0100 File No. _____ Verified By _____
Title RADIUS OF INFLUENCE Date _____ 19 ____
USING RFI PUMP TEST VALUES Page 1 of 3

1) PUMP TEST WAS CONDUCTED IN EARLY OCTOBER 1984.

2) PUMP TEST WAS CONDUCTED NEAR END OF IRRIGATION SEASON WHICH RUNS FROM MID-APRIL TO MID-NOVEMBER

3) IRRIGATION IS PROVIDED BY CORRALES MAIN CANAL AND RESULTS IN A TWO TO THREE FOOT INCREASE IN POTENTIOMETRIC ELEVATION

4) THE UNLINED CORRALES MAIN CANAL IS LESS THAN 700 FEET SOUTHEAST OF THE PUMPED WELL PW-1 USED IN THE PUMP TEST.

5) PUMP TEST WAS A 180-GPM CONSTANT RATE TEST WITH A 25-HOUR DURATION PRODUCING DRAWDOWN OF 24 FEET IN THE PUMPED WELL

6) NOT SURPRISINGLY, PUMP TEST DATA EXHIBITED AN "EQUILIBRIUM" SIGNATURE (CONDITION OF RECHARGE EQUAL TO PUMPING RATE) AFTER SOME 200 MINUTES OF CONSTANT RATE PUMPING

7) PUMP TEST WAS MONITORED BY THREE OBSERVATION WELLS LOCATED AT RADIAL DISTANCES OF 45, 150, AND 350 FEET FROM THE PUMPED WELL.

8) DISTANCE-DRAWDOWN DATA FROM THE OBSERVATION WELLS DEMONSTRATED A RADIUS OF INFLUENCE OF APPROXIMATELY 600 FEE

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REVISED, SUPERSEDED, AND VOID CALCULATIONS MUST BE CLEARLY IDENTIFIED.

9) PREDICTABLY, THE RADIUS OF INFLUENCE OF 600 FEET IS ALSO THE APPROXIMATE DISTANCE TO THE CORRALES MAIN CANAL AND IRRIGATED FARM LAND (DEMONSTRATED SOURCE OF RECHARGE)

10) IN THE ABSENCE OF THIS CLOSE SOURCE OF RECHARGE, THE CONE OF DEPRESSION WOULD HAVE CONTINUED TO DEEPEN AND EXPAND DURING THE PUMP TEST

11) ANALYSIS OF THE PUMP TEST DATA RESULTED IN THE FOLLOWING RECOMMENDED DESIGN PARAMETERS:

TRANSMISSIVITY, T = 18,000 gpd/ft *

STORAGE COEFFICIENT, S = 0.0025 *

12) THE RFI AND SUBSEQUENT STUDIES HAVE CONFIRMED THAT HYDROGEOLOGIC CONDITIONS DEFINED BY THE PUMP TEST ARE RELATIVELY CONSTANT OVER THE PLUME AREA.

13) THE LEADING EDGE OF THE PLUME IS SEVERAL THOUSAND FEET FROM THE RECHARGE AREA, SO RADIUS OF INFLUENCE CAN BE CALCULATED FROM THE DESIGN PARAMETERS USING NON-EQUILIBRIUM METHODS

* SEE ATTACHED CONCLUSIONS & CALCULATIONS FROM RFI ATTACHMENT 10

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Plant Unit Date 8/6 19 96
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Page 3 of 3

14) USING THE COOPER-JACOB APPROXIMATIONS OF THE THEIS NON-EQUILIBRIUM EQUATION, THE RADIUS OF INFLUENCE CAN BE CALCULATED FROM THE FOLLOWING:

$$R_o = \sqrt{\frac{0.3\,T t}{S}}$$

WHERE R_o = RADIUS OF INFLUENCE (ft)
T = TRANSMISSIVITY (gpd/ft)
t = PUMPING DURATION (days)
S = STORAGE COEFFICIENT

15) SUBSTITUTING THE PUMP TEST VALUES INTO THE ABOVE EQUATION YIELDS

$$R_o = \sqrt{\frac{0.3\,(18{,}000\ \text{gpd/ft})(t)}{0.0025}}$$

$$R_o = 1469.7\sqrt{t}$$

WHEN t = 1 day	R_o = 1470 ft
= 2 days	= 2078 ft
= 7 days	= 3,888 ft
= 30 days	= 8,050 ft
= 365 days	= 28,078 ft

16) IN CONCLUSION, RADIUS OF INFLUENCE IS AT LEAST 600 FEET ON SITE (DUE TO CORRALES MAIN CANAL). OFF-SITE, RADIUS OF INFLUENCE WILL BE LARGER.

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steady solution. However equilibrium or steady-state conditions provide a higher level of confidence in analytical results.

10. As noted in the analysis section, there is considerable ambiguity as to whether the aquifer is unconfined, partially confined or confined. However, considering the saturated thickness of the aquifer (approximately 75 feet), relatively small drawdowns at the observation wells (1.5 feet to 6 feet), and the apparent equilibrium or steady-state conditions that developed during the pumping tests, there is no significant analytical difference between confined or unconfined conditions. Indeed analysis showed differences in the order of 5% in the calculation of transmissivity. However, the calculated storage coefficient values in the range of 0.002 to 0.003 indicate essentially confined conditions. In any case, the more critical parameter, radius of influence, is well documented and not dependent on aquifer confinement evaluation.

CONCLUSIONS AND RECOMMENDATIONS

Aquifer parameters for the lower flow zones obtained from current analysis of the 1984 pumping test data are adequate for the evaluation of various remedial alternatives to be included in the Corrective Measure Study (CMS). Although these aquifer parameters were developed from on-site pumping tests, geologic correlation off-site indicates general application to the entire plume area.

A radius of influence, R_o, of approximately 600 feet has been demonstrated by both

analytical methods (see Figure 23) and remote observation points during actual pumping. This value should be used in future calculations of capture area, etc. The 600-ft radius of influence reflects steady-state or equilibrium conditions; i.e., it is not a time-dependent value. It should also be noted that this radius of influence will not be affected by pumping rate.

A transmissivity, T, of 18,000 gpd/ft has generally been calculated for the data base as a whole, with lesser values in the order of 12,000 to 14,000 gpd/ft considering only PW-1 data. For conservative design, a transmissivity of 18,000 gpd/ft is recommended.

Both the HLA Report and current analysis indicate a storage coefficient, S, value in the range of 0.002 to 0.003. Some individual analyses indicate a storage coefficient an order of magnitude less. However, considering that radius of influence is well defined, a storage coefficient of 0.0025 is recommended as a conservative measure.

Finally, it should be recognized in any pumping system design that the aquifer is significantly stratified with significant anisotropy. As a result, fully penetrating pumped wells with significant drawdowns could cause downward vertical movement of contaminants from near-water-surface (UFZ) high-constituent-concentration areas.

Analysis by Pierce L. Chandler, Jr., P.E.

HDR Engineering, Inc.

May 1, 1992

SAMPLE CALCULATIONS

I. LOWER FLOW ZONES

A. Steady radial flow without vertical movement

1. Using distance-drawdown data given on Figure 23, the Transmissivity, T, may be calculated from:

$$T = \frac{2.30\ Q}{2\pi\ \Delta s/\Delta \log_{10} r}$$

(Lohman, Eq 34, units of $L^2\ T^{-1}$)

with appropriate conversions for T expressed in gallons per day per foot, the equation becomes

$$T = \frac{528\ Q}{\Delta s/\Delta \log_{10} r}$$

where Q = 180 gallons per minute and

$\Delta s/\Delta \log_{10} r$ = 5.2 feet/cycle

T = 18277 gallons per day per foot

The Storage Coefficient, S, may be determined from the calculated T; the radial distance to zero drawdown, r_o = 600 feet extrapolated from the data in Figure 23; and, the nominal time to equilibrium, t_o, of 200 minutes (0.139 days) using:

$$S = 2.25\ T \left(\frac{t}{r^2}\right)_0 \qquad \text{(Lohman, Eq 59, Dimensionless)}$$

with appropriate conversion factors for T in gallons per day per foot

$$S = \frac{0.3\ T\ t_o}{r_0^{\ 2}} = \frac{0.3\ (18277\ \text{gal/day/ft})\ (0.139\ \text{days})}{(600\ \text{ft})^2}$$

S = 0.0021

note that if $t_e \approx 300$ minutes

$$S \cong 0.003$$

2. Using data from MW-12 and MW-13, and assuming <u>confined</u> conditions, Transmissivity was checked using:

$$T = \frac{2.30\ Q \log_{10}(r_2/r_1)}{2\pi\ (s_1 - s_2)} \quad \text{(Lohman, Eq 32, } L^2T^{-1} \text{ units)}$$

in typical units,

$$T = \frac{528\ Q \log_{10}(r_{MW\text{-}13}/r_{MW\text{-}12})}{s_{MW\text{-}12} - s_{MW\text{-}13}}$$

For $Q = 180$ gpm
$r_{MW\text{-}12} = 45$ feet
$r_{MW\text{-}13} = 150$ feet
$s_{MW\text{-}12} = 5.9$ feet
and $s_{MW\text{-}13} = 3.1$ feet,
the calculation of T is:

$$T = \frac{528\ (180\ \text{gpm})\ \log_{10}(150\ \text{ft}/45\ \text{ft})}{5.9\ \text{ft} - 3.1\ \text{ft}}$$

$$T = 17{,}748\ \text{gal/day/ft}$$

3. Using the MW-12 and MW-13 data, but assuming <u>unconfined</u> conditions; a saturated thickness, b, equal to 75 feet; and the base of the aquifer at an elevation of 4900 feet, T may be calculated using:

$$K = \frac{2.30\ Q \log_{10}(r_2/r_1)}{\pi\ (h^2_2 - h^2_1)} \quad \text{(Lohman, Eq 31, } LT^{-1} \text{ units)}$$

and $T = Kb$

with appropriate conversion factors, the combined equation becomes:

$$T = \frac{1055\ b\ Q\ \log_{10}(r_{MW\text{-}13}/r_{MW\text{-}12})}{(h_{MW\text{-}13})^2 - (h_{MW\text{-}12})^2}$$

For $Q = 180$ gpm
$b = 75$ ft
$r_{MW\text{-}12} = 45$ ft
$r_{MW\text{-}13} = 150$ ft
$h_{MW\text{-}12} = 69.1$ ft (75 ft - 5.9 ft)
$h_{MW\text{-}13} = 71.9$ ft (75 ft - 3.1 ft)

$$T = \frac{1055\ (75\ \text{ft})\ (180\ \text{gpm})\ \log_{10}(150\ \text{ft}/45\ \text{ft})}{(71.9\ \text{ft})^2 - (69.1\ \text{ft})^2}$$

$T =$ **18863 gal/day/ft**

OGC-002611

K+E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
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OGC-002612

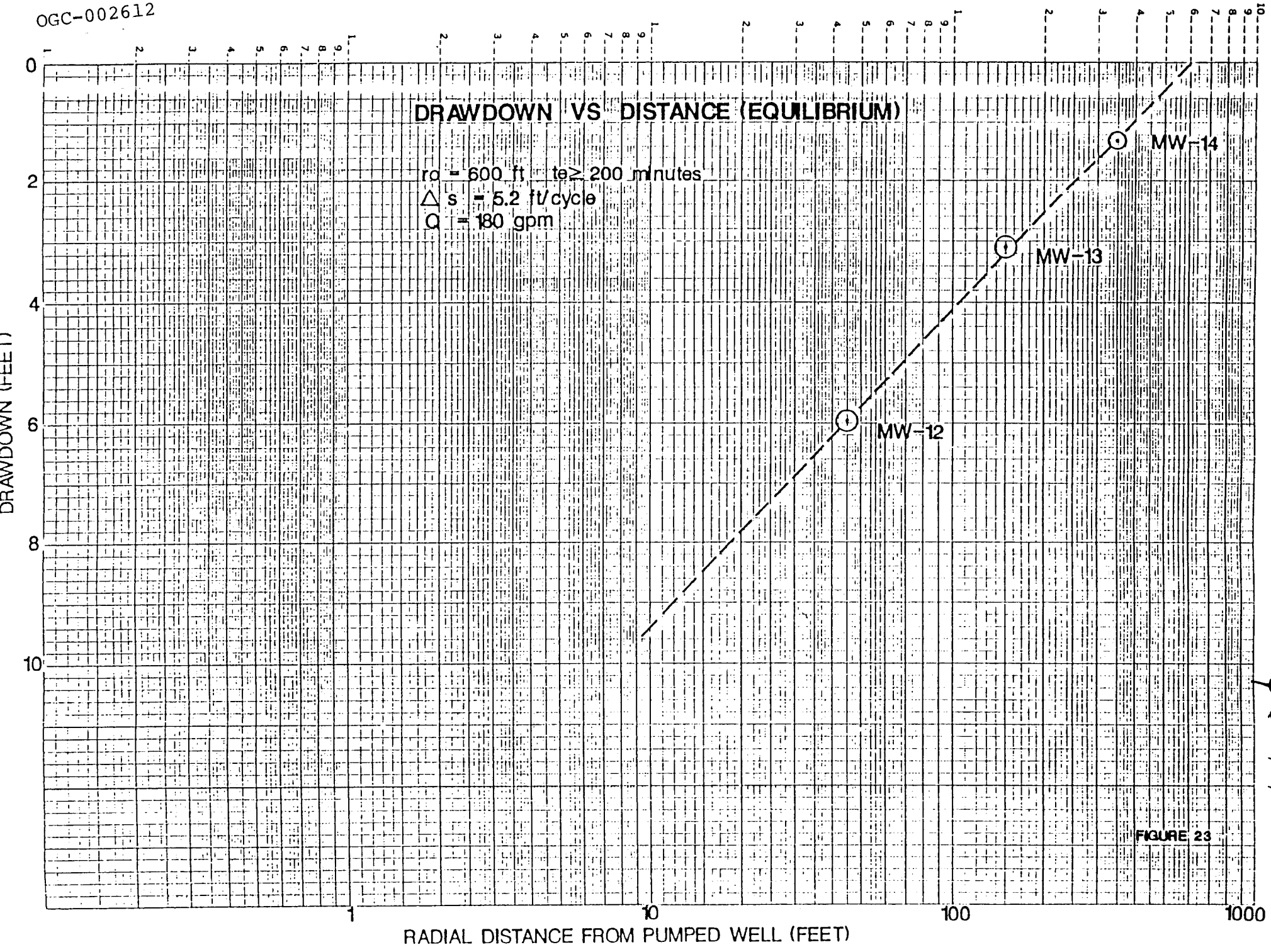

FIGURE 23

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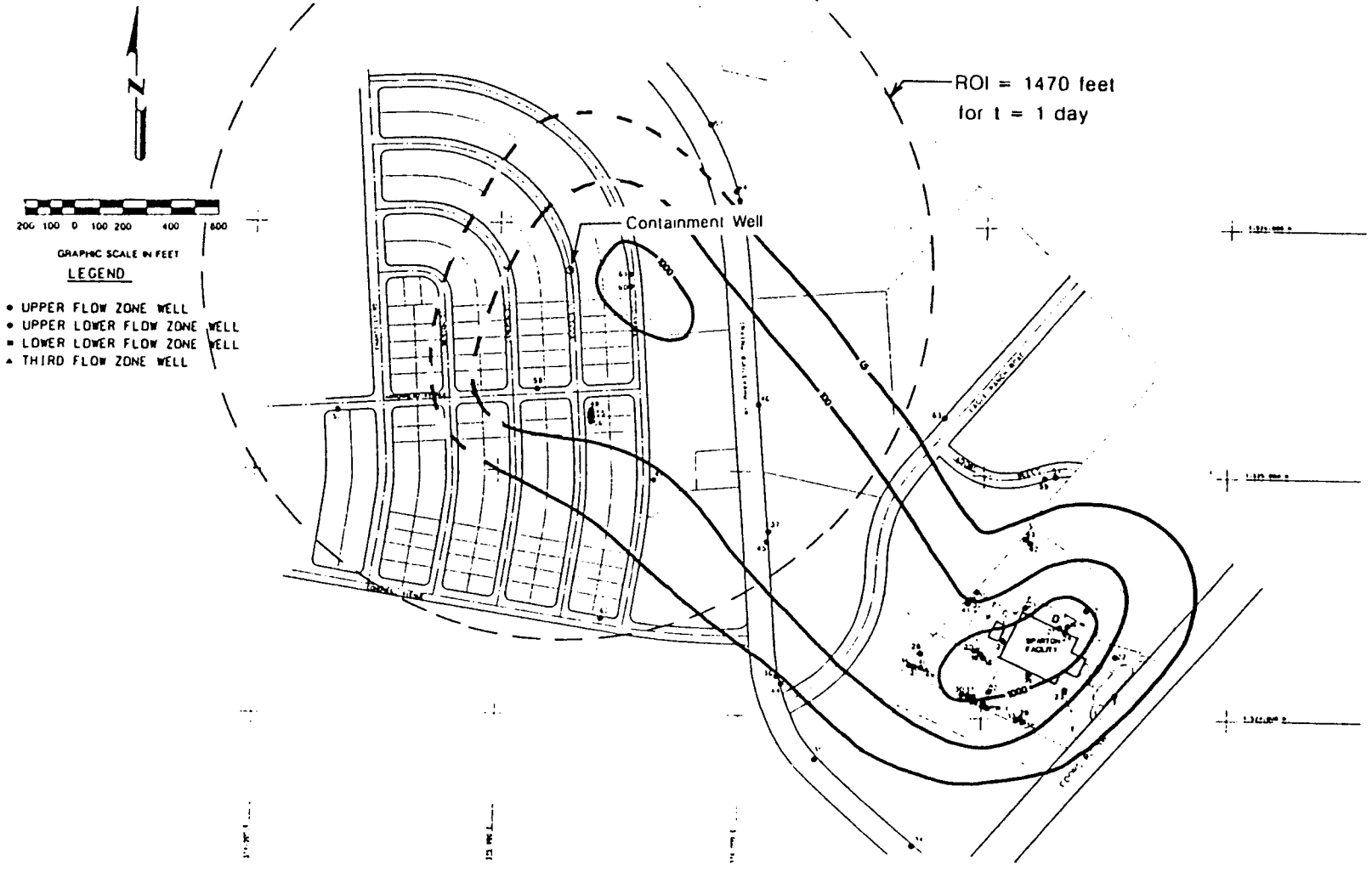

RADIUS OF INFLUENCE
Site Specific Parameters

FIGURE 12A

			Black & Veatch Engineers Architects Dallas Texas	PROJECT NO 026602	UPPER FLOW ZONE TCE CONTOURS - 1996 DATA		CONTRACT NO / SHEET NO

2

BLACK & VEATCH

Owner SPARTON TECHNOLOGY Computed By PLC (3)

Plant COORS ROAD Unit _____ Date 8/6 19 96

Project No. 026602.0100 File No. _____ Verified By _____

Title RADIUS OF INFLUENCE USING 1995 USGS MODEL VALUES Date _____ 19 ____

Page 1 of 1

1) THE 1995 U.S.G.S. ALBUQUERQUE BASIN MODEL COVERS THE UPPER 1730 FEET OF THE SANTA FE GROUP AQUIFER SYSTEM USING ELEVEN LAYERS.

2) IN THE SPARTON AREA, HORIZONTAL HYDRAULIC CONDUCTIVITY, K, OF 15 FEET/DAY IS USED IN THE FIRST EIGHT MODEL LAYERS (580 TOTAL FEET) WITH ISOLATED POCKETS OF UP TO 25 FEET/DAY (SEE PAGES 26-33, USGS 1995)

3) STORAGE COEFFICIENTS IN THE MODEL WERE ESTIMATED USING A SPECIFIC STORAGE OF 2×10^{-6} PER FOOT BASED ON LOHMAN (USGS 1979)

4) RADIUS OF INFLUENCE CAN BE CALCULATED FROM THE ABOVE VALUES USING THE RELATIONSHIP:

$$R_o = \sqrt{\frac{2.25\,Tt}{S}}$$

AND REMEMBERING $T = Kb$ AND $S = S_s b$

5) SUBSTITUTING THE USGS MODEL VALUES

$$R_o = \sqrt{\frac{2.25\,(15\ \text{Feet/Day})(\cancel{b})(t)}{(2\times10^{-6}/\text{Foot})(\cancel{b})}}$$

$$R_o = 4108\sqrt{t}$$

WHEN	$t = 1$ day	$R_o = 4108$ feet
	$t = 2$ days	$R_o = 5810$ feet
	$t = 7$ days	$R_o = 10{,}869$ feet
	$t = 30$ days	$R_o = 22{,}500$ feet
	$t = 365$ days	$R_o = 78{,}483$ feet

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Owner SPARTON TECHNOLOGY Computed By DLC
Plant COORS ROAD Unit Date 8/6 19 96
Project No. 026602.0100 File No. Verified By
Title RADIUS OF INFLUENCE Date 19
INTEL WELL DEMONSTRATION Page 1 of 6

1) THE IMPACT OF THE INTEL PRODUCTION WELLS ON THE AQUIFER IS MONITORED BY A NETWORK OF 3 CLUSTER WELLS (15 TOTAL WELLS) AND 15 DOMESTIC WELLS. SEE FIGURE 1 FOR LOCATION (JOHN SHOMAKER & ASSOC, MARCH 1996)

2) INTEL HAS BEEN PUMPING FROM THE THREE PRODUCTION WELLS ON A SUSTAINED BASIS SINCE EARLY SEPTEMBER 1995. COMBINED PUMPING RATE IS APPROXIMATELY 3 MGD (2080 GPM) – PRIMARILY FROM WELLS 2 AND 3. SEE FIGURE 40 (SHOMAKER, 1996)

3) PRODUCTION WELLS ARE SCREENED FROM 730 TO 2000 FEET BGS (CORRESPONDS TO USGS 1995 BASIN MODEL LAYERS 8 to 11)

4) ALL THREE CLUSTER WELL LOCATIONS SHOW INFLUENCE OF PUMPING. SEE FIGURES 22–24 (SHOMAKER, 1996). NOTE THAT CLUSTER B IS OVER 4000 FOOT DISTANT AND CLUSTER C IS OVER 8000-FOOT DISTANT.

5) INTEL HYDROGEOLOGIC CONDITIONS ARE MODELLED SIMILARLY TO SPARTON (USGS 1995)

6) RADIUS OF INFLUENCE IS MUCH LARGER THAN 8,000 FEET

ENCLOSURES

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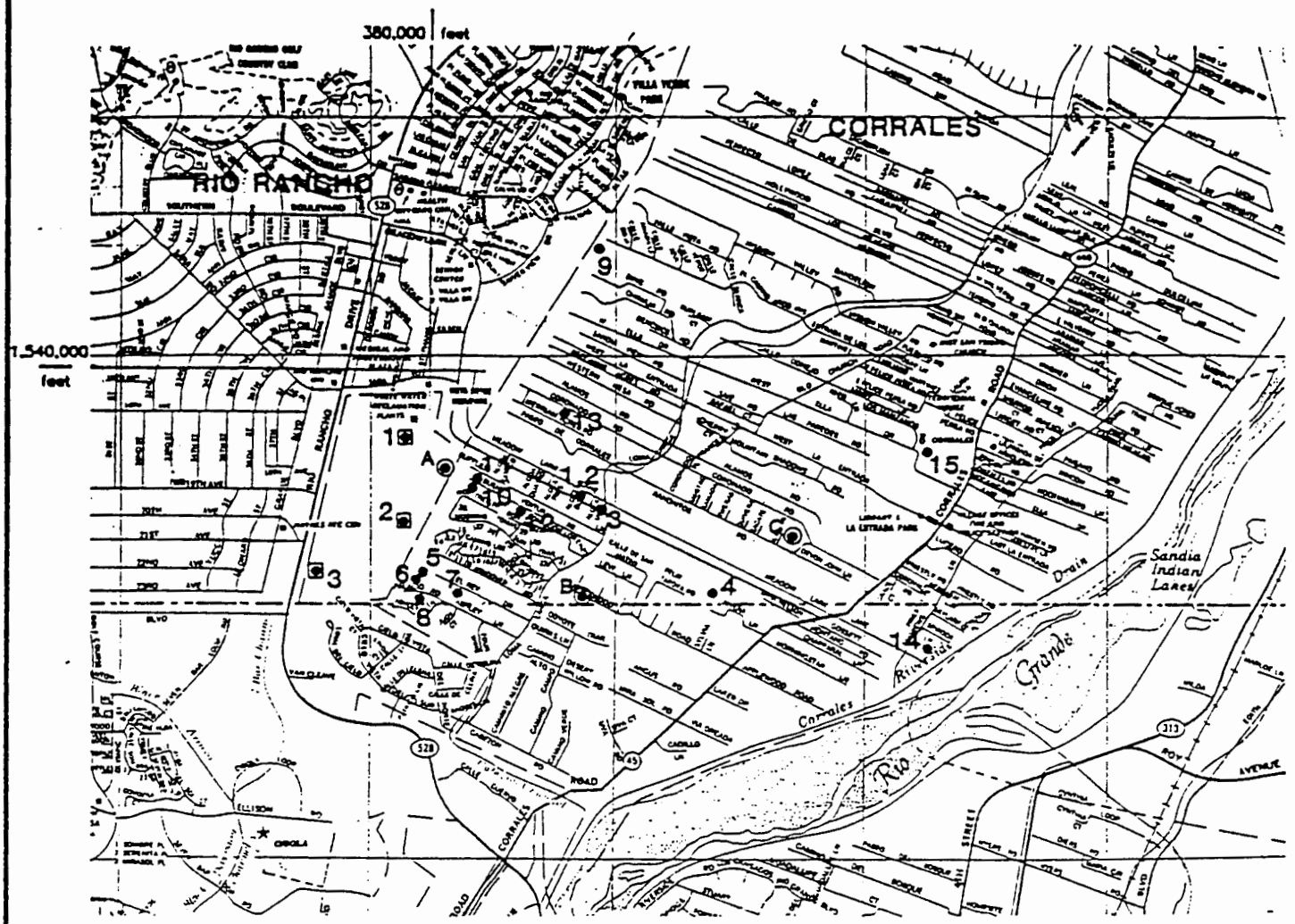

Explanation

- Intel production well location
  1. Intel Production Well No. 1
  2. Intel Production Well No. 2
  3. Intel Production Well No. 3
- domestic monitor well
  1. Betsill
  2. Betsill
  3. Hutchinson
  4. Campbell
  5. Tice
  6. Sheppard
  7. King
  8. Passage
  9. Goering
  10. Walker
  11. Corrales
  12. Rockwell
  13. Swanson
  14. Joseph
  15. Allen
- Intel monitor wells site
  A. Intel monitor wells A1, A2, A3, A4, A5, A6
  B. Intel monitor wells B1, B2, B3
  C. Intel monitor wells C1, C2, C3, C4, C5, C6

N

0 .5 1 mile

Figure 1. Map showing locations of Intel production wells, Intel monitor wells, and domestic monitor wells.

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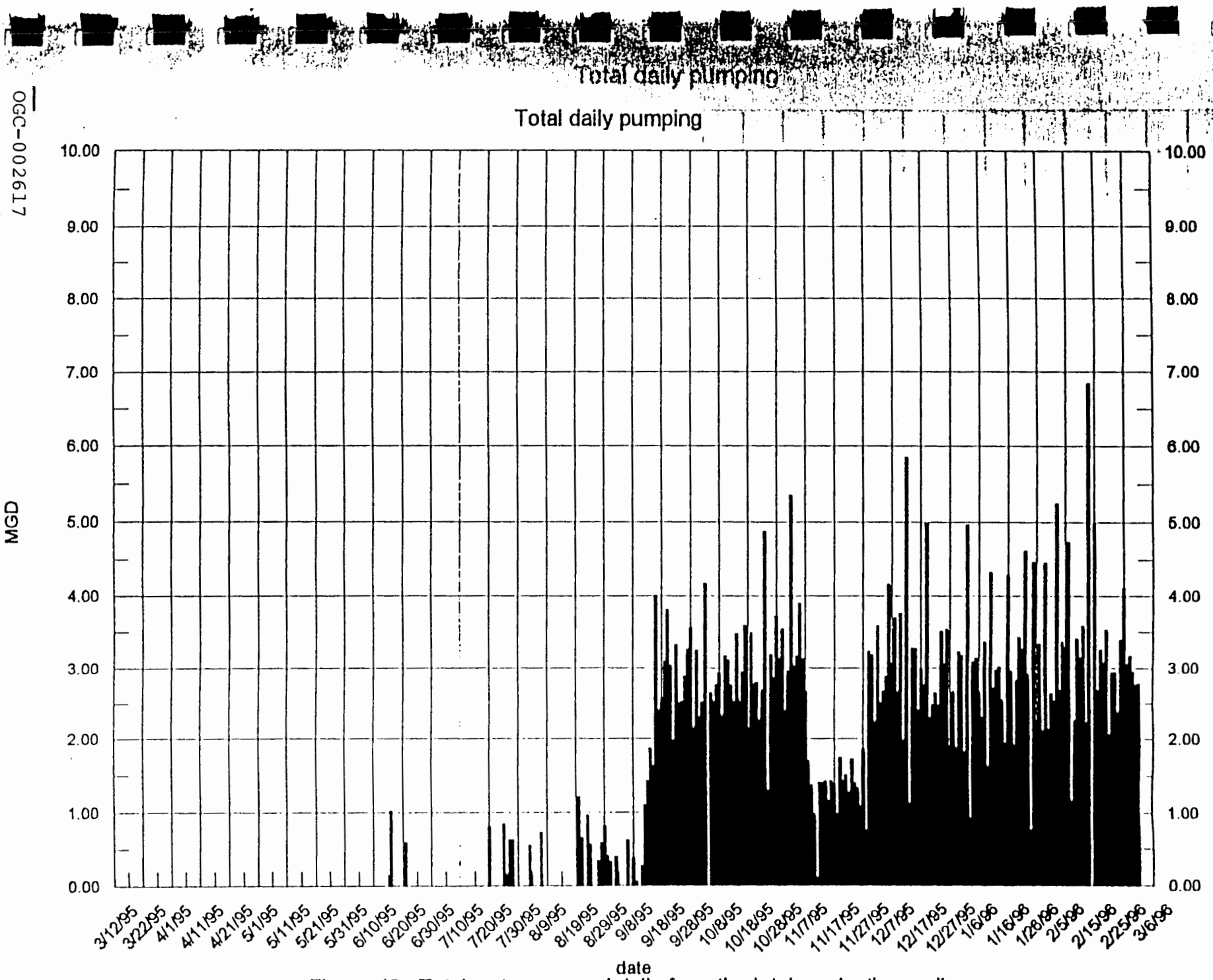

Figure 40. Total water pumped daily from the Intel production wells.

Page 4

OGC-002618

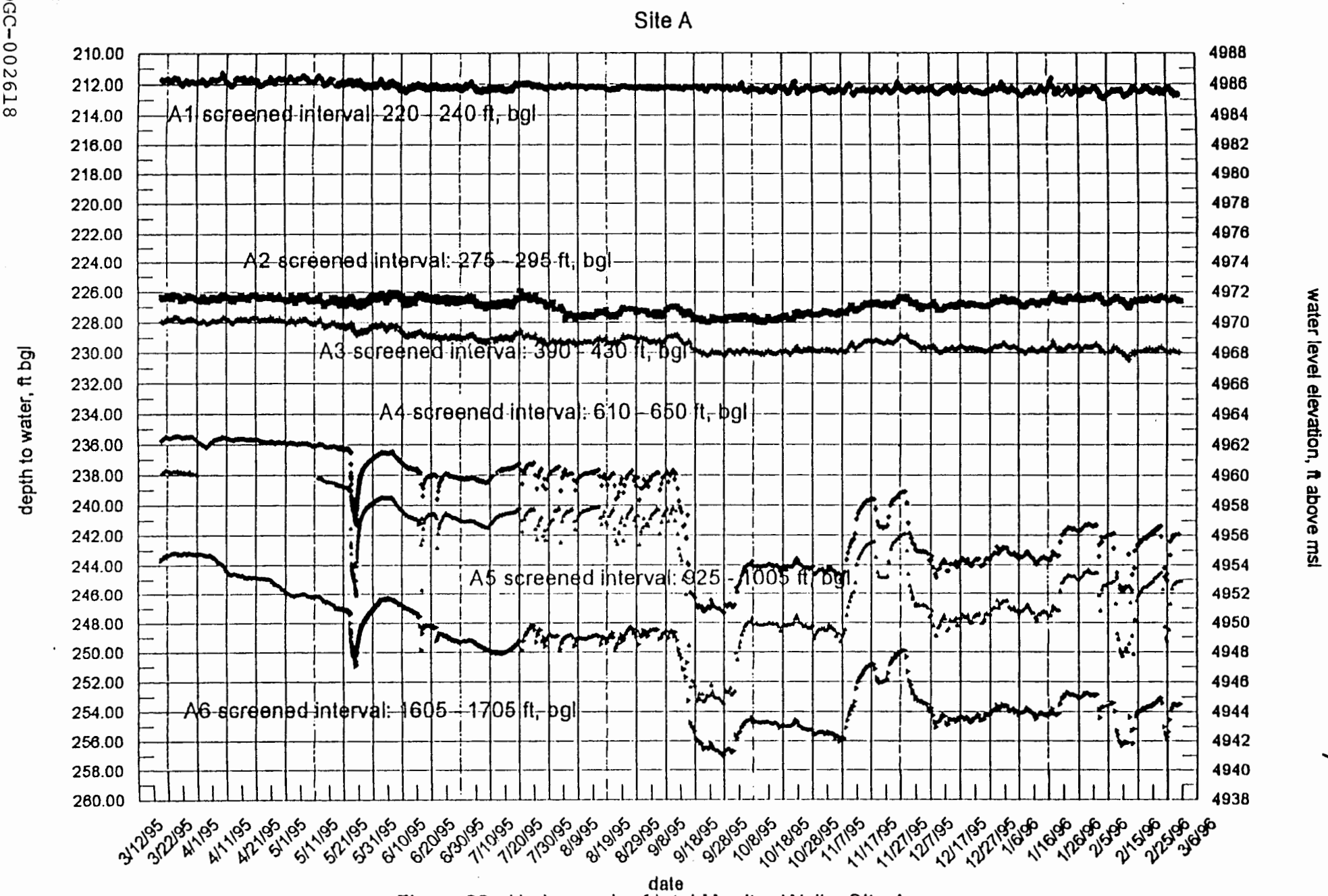

Figure 22. Hydrograph of Intel Monitor Wells, Site A.

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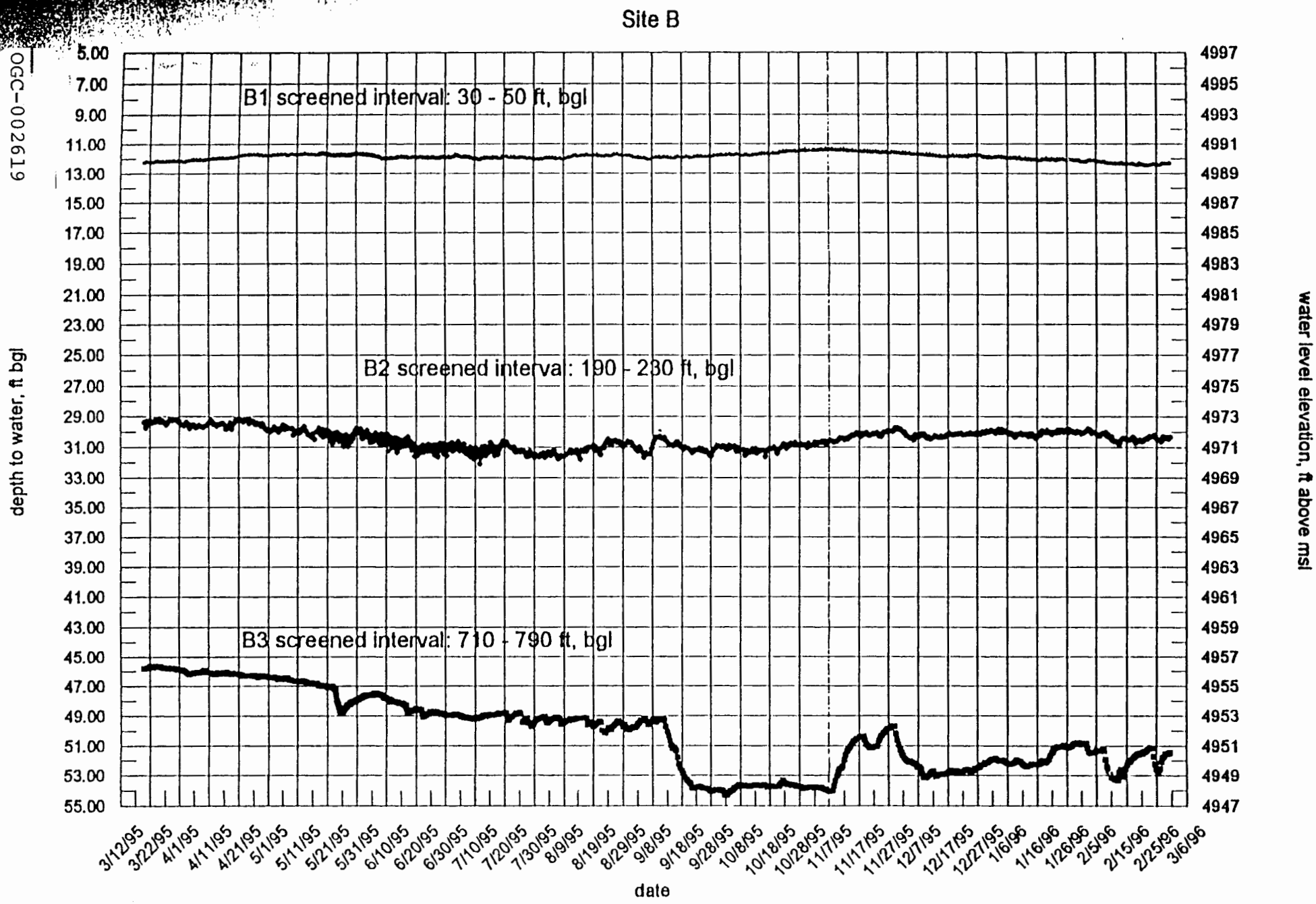


Figure 23. Hydrograph of Intel Monitor Wells, Site B.

OGC-002620

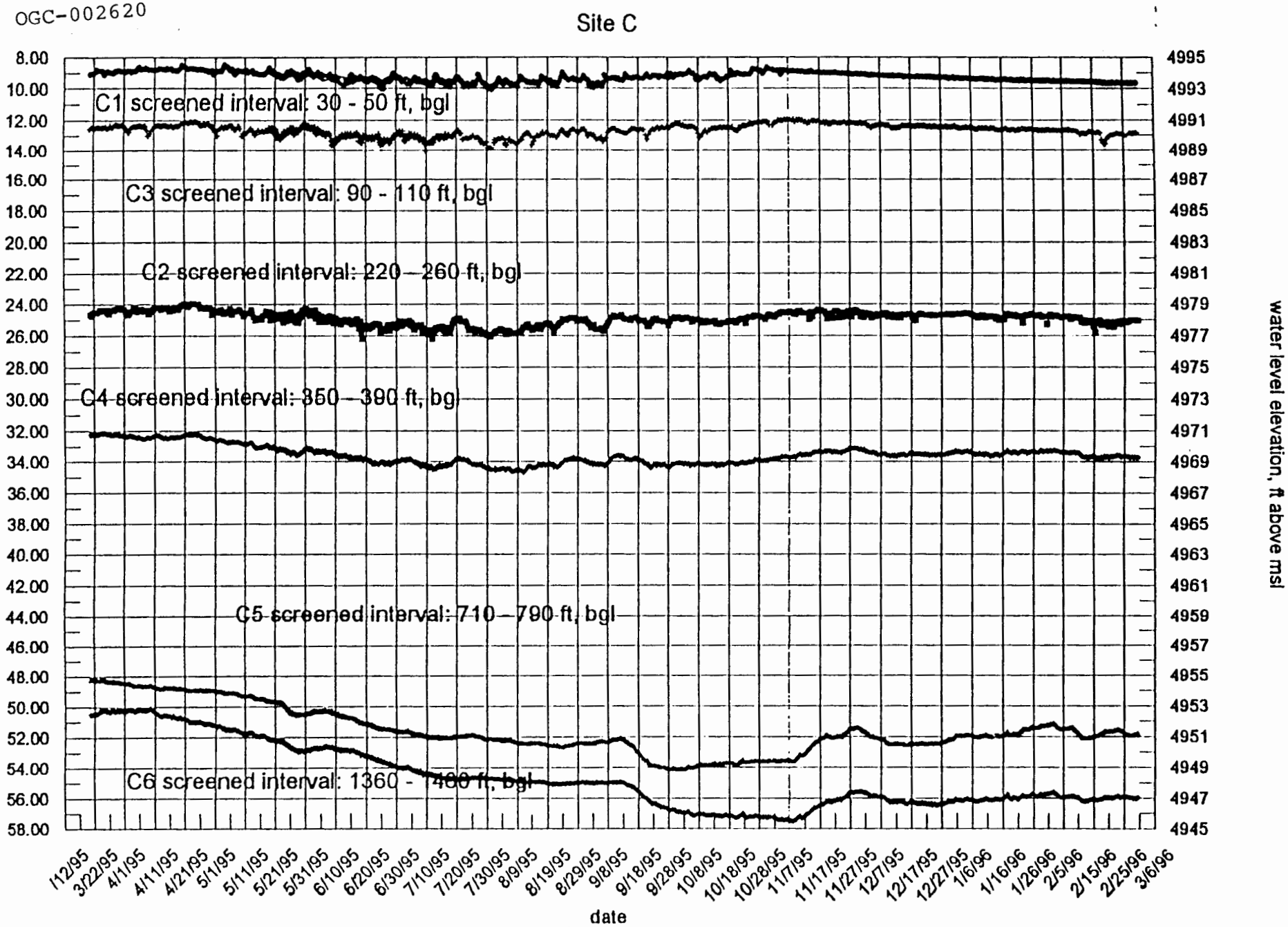


Figure 24. Hydrograph of Intel Monitor Wells, Site C.

Page 36

SPARTON TECHNOLOGY, INC.

Coors Road Facility

Capture Zone Definition

Definition for the Edge of Capture Zone	Stagnation Point	Maximum width of capture Zone
x=(-y)/[tan(2*PI*K*b*i*y/Q)] - in radians	x(0) = -Q/(2*PI*K*b*i)	y(max) = (+/-)Q/(2*K*b*i)

*

x = distance from pumping well (feet) - parallel to flow
y = distance from pumping well (feet) - perpendicular to flow
PI = 3.141593
K = hydraulic conductivity (feet / minute)
b = initial saturated thickness of aquifer (feet)
i = hydraulic gradient of flow field in absence of pumping (feet / feet)
Q = pumping rate (cubic feet / minute)
T = K*b = Transmissivity (square feet / minute)

Solve for Q = 10,20,50,100,200 gallons per minute
K*b = 12,000 - 18,000 gallons per day per foot (From RFI/CMS Reports)
i = 0.002 feet / feet (third Quarter 1996 water level data)

		K*b (gpd/ft) =		12,000	K*b (gpd/ft) =		15,000	K*b (gpd/ft) =		18,000
		K*b (SF/min) =		1.114	K*b (SF/min) =		1.392	K*b (SF/min) =		1.671
Q		x(0)	y(max)	y@x=0	x(0)	y(max)	y@x=0	x(0)	y(max)	y@x=0
GPM	CF/min		+/-							
10	1.34	(95.49)	300	150	(76.39)	240	120	(63.66)	200	100
20	2.67	(190.99)	600	300	(152.79)	480	240	(127.32)	400	200
50	6.68	(477.46)	1,500	750	(381.97)	1,200	600	(318.31)	1,000	500
100	13.37	(954.93)	3,000	1,500	(763.94)	2,400	1,200	(636.62)	2,000	1,000
200	26.73	(1,909.86)	6,000	3,000	(1,527.89)	4,800	2,400	(1,273.24)	4,000	2,000

Calculate edge of Capture Zone

K*b =	12,000	gpd/ft =	1.114	SF/min						
	GPM	CF/min	GPM	CF/min	GPM	CF/min	GPM	CF/min	GPM	CF/min
Q =	10	1.34	20	2.67	50	6.68	100	13.37	200	26.73
	Y	X	Y	X	Y	X	Y	X	Y	X
	1	(95.49)	1	(190.98)	1	(477.46)	1	(954.93)	1	(1,909.86)
	10	(95.14)	50	(186.60)	200	(449.21)	250	(933.01)	1,000	(1,732.05)
	100	(57.74)	100	(173.21)	400	(360.16)	500	(866.03)	2,000	(1,154.70)
	150	0.00	200	(115.47)	600	(194.95)	1,000	(577.35)	2,500	(669.87)
	200	115.47	300	0.00	750	0.00	1,500	0.00	3,000	0.00
	300	3E+06	400	230.94	800	84.08	2,000	1,154.70	4,000	2,309.40
			500	866.03	1,000	577.35	2,500	4,330.13	5,000	8,660.25
			600	1E+07	1,500	7E+07	3,000	3E+08	6,000	1E+09

K*b =	15,000	gpd/ft =	1.392	SF/min						
	GPM	CF/min	GPM	CF/min	GPM	CF/min	GPM	CF/min	GPM	CF/min
Q =	10	1.34	20	2.67	50	6.68	100	13.37	200	26.73
	Y	X	Y	X	Y	X	Y	X	Y	X
	1	(76.39)	1	(152.79)	1	(381.97)	1	(763.94)	1	(1,527.89)
	10	(75.96)	50	(147.30)	200	(346.41)	250	(736.48)	1,000	(1,303.23)
	100	(26.79)	100	(130.32)	400	(230.94)	500	(651.61)	2,000	(535.90)
	120	0.00	200	(53.59)	600	0.00	1,000	(267.95)	2,400	0.00
	200	346.41	240	0.00	750	310.66	1,200	0.00	3,000	1,242.64
	240	2E+06	400	692.82	800	461.88	1,600	923.76	3,500	3,069.42
			450	2,262.30	1,000	1,732.05	2,000	3,464.10	4,000	6,928.20
			480	7E+06	1,200	5E+08	2,400	2E+08	4,800	7E+08

K*b =	18,000	gpd/ft =	1.671	SF/min						
	GPM	CF/min	GPM	CF/min	GPM	CF/min	GPM	CF/min	GPM	CF/min
Q =	10	1.34	20	2.67	50	6.68	100	13.37	200	26.73
	Y	X	Y	X	Y	X	Y	X	Y	X
	1	(63.66)	1	(127.32)	1	(318.31)	1	(636.62)	1	(1,273.24)
	10	(63.14)	50	(120.71)	200	(275.28)	250	(603.55)	500	(1,207.11)
	50	(50.00)	100	(100.00)	400	(129.97)	500	(500.00)	1,000	(1,000.00)
	100	0.00	200	0.00	500	0.00	1,000	0.00	2,000	0.00
	150	150.00	300	300.00	600	194.95	1,250	517.77	2,500	1,035.53
	200	9E+20	400	2E+21	800	1,101.11	1,500	1,500.00	3,000	3,000.00
					900	3E+03	1,600	2E+03	3,500	8,449.75
					1,000	5E+21	2000	9E+21	4,000	2E+22

* C.W. Fetter, Applied Hydrogeology, pp 501 – 504, 1994.

Attachment 1 To Capture Zone Definition
p 1 of 3

SPARTON TECHNOLOGY, INC.
Offsite Monitoring Well Water Level Elevations
08/02/96

MPE = Measuring Point Elevation in feet above sea level.

SR = Sounder Reading in feet.

WLE = Water Level Elevation in feet above sea level. MPE-SR=WLE.

Well No.	MPE(ft)	SR(ft)	WLE(ft.)	Date	
PZ-1	5142.22	183.75	4958.47	07/23/96	
MW-34	5034.49	58.85	4975.64	07/23/96	
MW-35	5042.50	69.70	4972.80	07/23/96	*3
MW-36					*1
MW-37					*1
MW-44	5058.75	87.43	4971.32	07/23/96	
MW-45	5089.65	120.00	4969.65	07/23/96	
MW-46	5118.98	150.46	4968.52	07/16/96	
MW-47	5155.83	187.59	4968.24	07/15/96	
MW-48	5168.31	200.79	4967.52	07/15/96	
MW-50	5211.21	249.81	4961.40	07/23/96	
MW-52	5156.79	191.70	4965.09	07/15/96	*2
MW-53	5164.24	197.48	4966.76	07/15/96	
MW-54	5097.64	130.47	4967.17	07/23/96	
MW-55	5168.61	201.79	4966.82	07/15/96	
MW-56	5168.61	201.13	4967.48	07/15/96	
MW-57	5103.54	136.78	4966.76	07/16/96	
MW-58	5168.89	201.71	4967.18	07/15/96	
MW-59	5059.18	88.55	4970.63	07/23/96	
MW-60	5134.87	167.71	4967.16	07/15/96	*2
MW-61	5135.23	168.05	4967.18	07/15/96	*2
MW-62					*1
MW-63	5065.74	90.05	4975.69	07/24/96	*3
MW-64	5097.84	130.56	4967.28	07/15/96	
MW-65	5156.45	191.60	4964.85	07/18/96	
MW-66	5103.03	137.21	4965.82	07/18/96	
MW-67	5169.21	209.11	4960.10	07/18/96	
MW-68	5165.53	201.11	4964.42	07/26/96	
MW-69	5165.46	201.15	4964.31	07/26/96	
MW-65	5156.45	191.48	4964.97	08/02/96	
MW-66	5103.03	137.28	4965.75	08/02/96	
MW-67	5169.21	209.08	4960.13	08/02/96	
MW-68	5165.53	201.11	4964.42	08/02/96	
MW-69	5165.46	201.12	4964.34	08/02/96	

*1 Airlines were installed in MW-36, 37 and 62 on 9-15-95 see AR report for WLE.

*2 New surveyed MPE for MW-52 5156.79 survey date = 6-10-96.

*3 WLE below top of pump, pull pump, SR taken next day.

Attachment 1
p 2 of 3

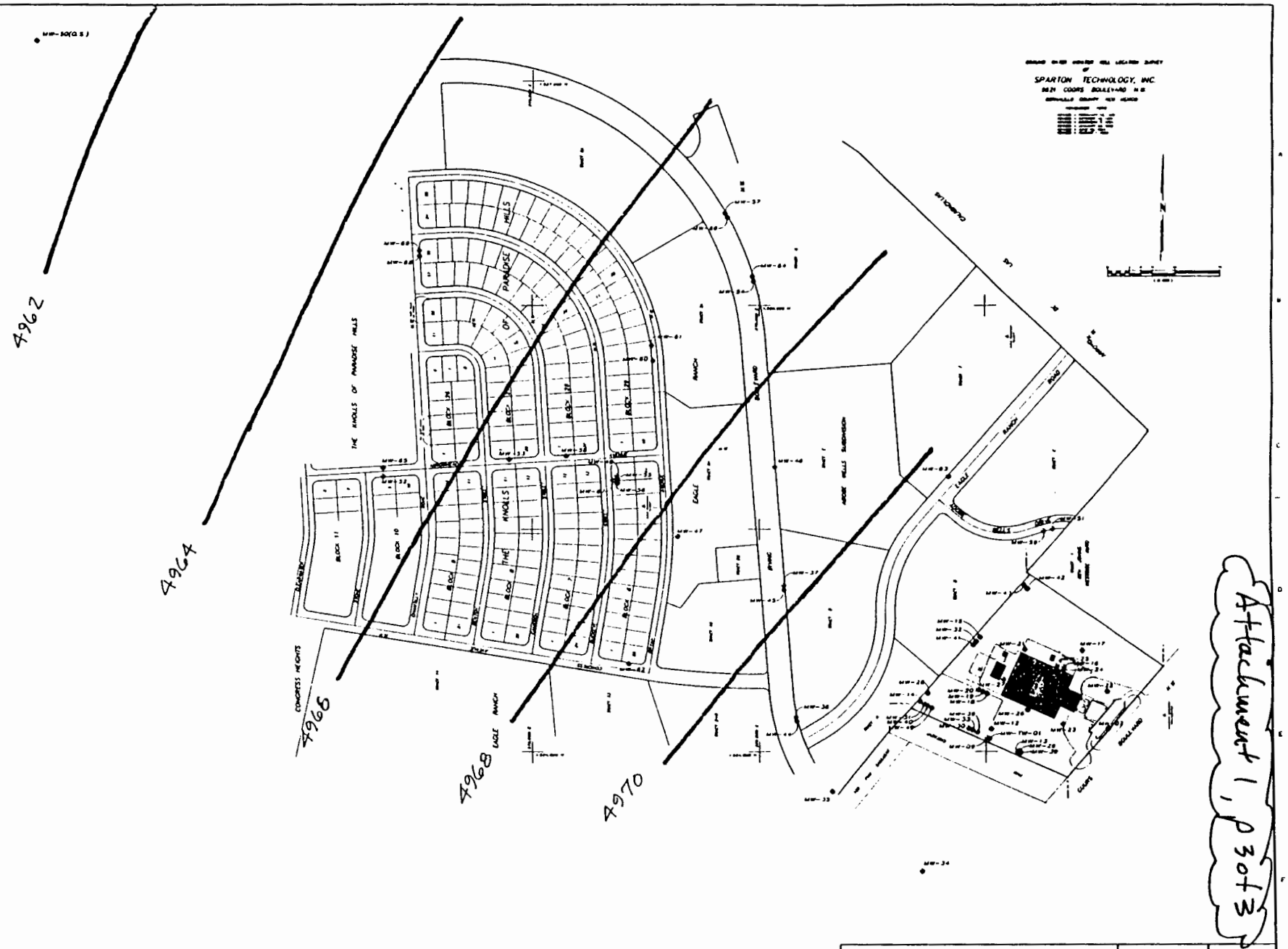
SPARTON TECHNOLOGY, INC.
Onsite Monitoring Well Water Level Elevations
08/01/96

AE = Airline Elevation in feet above sea level.
AR = Airline Reading in inches of water
WLE = Water Level Elevation in feet above sea level. AE+AR/12=WLE.

Well No.	AE (ft)	AR (in)	WLE (ft.)	Date
MW-7	4973.07	67	4978.65	07/23/96
MW-9	4969.41	60	4974.41	07/17/96
MW-12	4968.17	71	4974.09	07/23/96
MW-13	4972.09	46	4975.92	07/23/96
MW-14	4970.39	27	4972.64	07/17/96
MW-15	4974.27	dry	dry	07/17/96
MW-16	4977.28	26	4979.45	07/17/96
MW-17	4978.36	13	4979.44	07/23/96
MW-19	4968.66	54	4973.16	07/17/96
MW-20	4968.07	56	4972.74	07/17/96
MW-21	4978.01	14	4979.18	07/17/96
MW-22	4975.64	41	4979.06	07/17/96
MW-29	4970.24	56	4974.91	07/23/96
MW-30	4968.89	56	4973.56	07/23/96
MW-31	4967.81	57	4972.56	07/23/96
MW-32	4968.54	46	4972.37	07/16/96
MW-33	4972.36	17	4973.78	07/23/96
MW-38	4969.14	68	4974.81	07/23/96
MW-39	4968.97	57	4973.72	07/23/96
MW-40	4968.43	51	4972.68	07/23/96
MW-41	4968.46	47	4972.38	07/23/96
MW-42	4970.34	19	4971.92	07/16/96
MW-43	4970.48	17	4971.90	07/16/96
MW-49	4967.66	55	4972.24	07/16/96
MW-36 OS	4969.19	27	4971.44	07/16/96
MW-37 OS	4967.57	27	4969.82	07/16/96
MW-51 OS	4977.04	44	4980.71	07/16/96
MW-62 OS	4966.94	27	4969.19	07/16/96
Recovery Wells *1				
PW-1	4964.71	7	4965.29	07/23/96
MW-18	4968.07	15	4969.32	07/23/96
MW-23	4973.42	30	4975.92	07/23/96
MW-24	4974.89	10	4975.72	07/23/96
MW-25	4976.06	19	4977.64	07/23/96
MW-26	4965.88	13	4966.96	07/23/96
MW-27	4972.23	13	4973.31	07/23/96
MW-28	4971.62	12	4972.62	07/23/96

*1. AE on Recovery Wells needs recalibration
OS = Offsite

OGC-002624



Attachment 1, p 3 of 3

DESIGNED DETAILED CHECKED APPROVED DATE	Black & Veatch	PROJECT NO.	POTENTIOMETRIC LEVELS JULY 1996 DATA SPARTON TECHNOLOGY COORS ROAD FACILITY		SHEET OF

OGC-002625

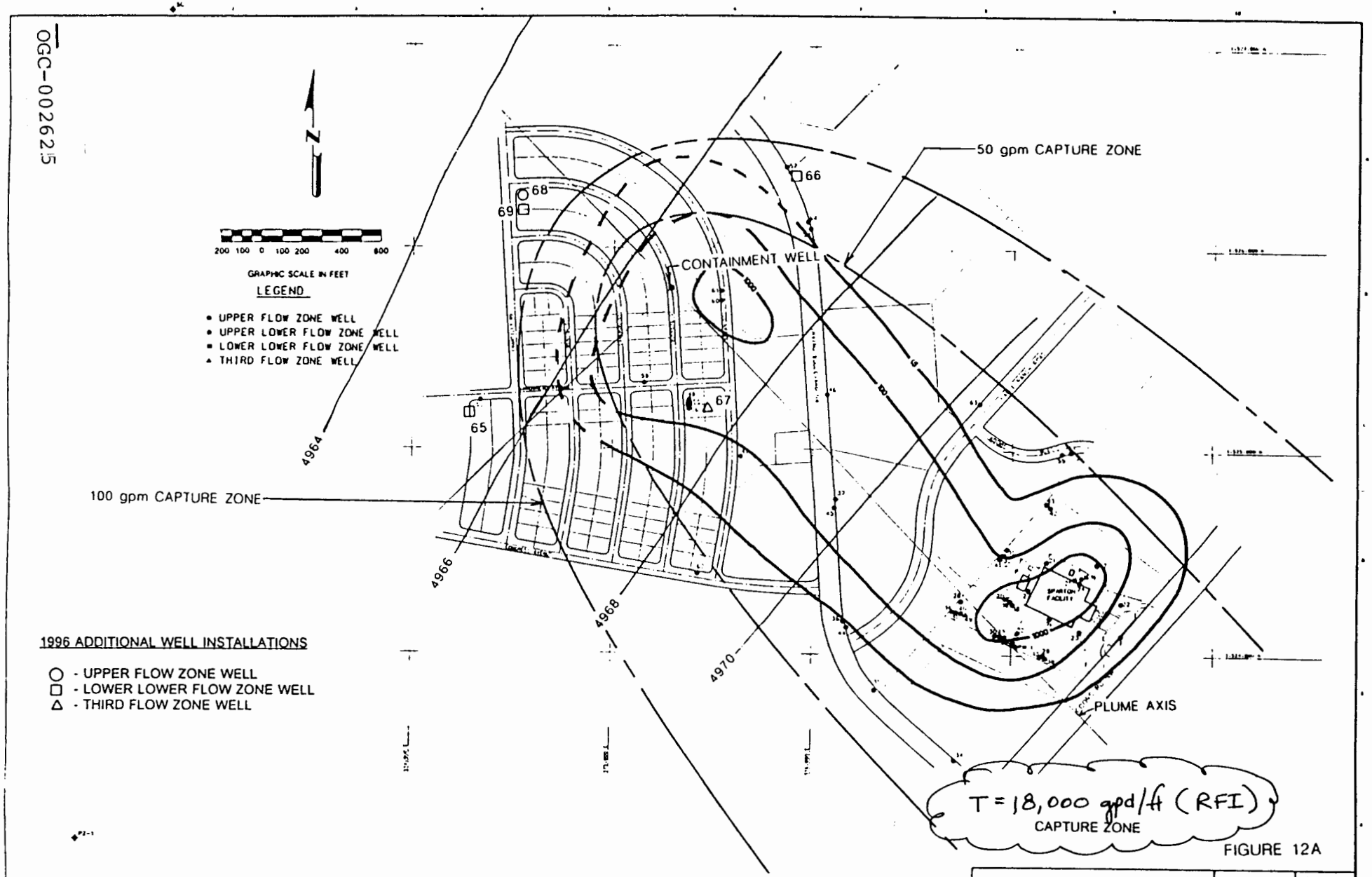


FIGURE 12A

Black & Veatch Engineers Architects Dallas, Texas	PROJECT NO 026602	UPPER FLOW ZONE TCE CONTOURS - 1996 DATA	CONTRACT NO SHEET NO

6

SPARTON TECHNOLOGY, INC.

Coors Road Facility

Capture Zone Definition - USGS Conditions

Definition for the Edge of Capture Zone	Stagnation Point	Maximum width of capture Zone
x=(-y)/[tan(2*PI*K*b*i*y/Q)] - in radians	x(0) = -Q/(2*PI*K*b*i)	y(max) = (+/-)Q/(2*K*b*i)

x = distance from pumping well (feet) - parallel to flow
y = distance from pumping well (feet) - perpendicular to flow
PI = 3.141593
K = hydraulic conductivity (feet / minute)
b = initial saturated thickness of aquifer (feet)
i = hydraulic gradient of flow field in absence of pumping (feet / feet)
Q = pumping rate (cubic feet / minute)
T = K*b = Transmissivity (square feet / minute)

K =	15	feet per day - per USGS
b =	75	feet - per approved RFI
T = K*b =	8,416	gallons per day per foot

Solve for Q = 10,20,50,100,200 gallons per minute

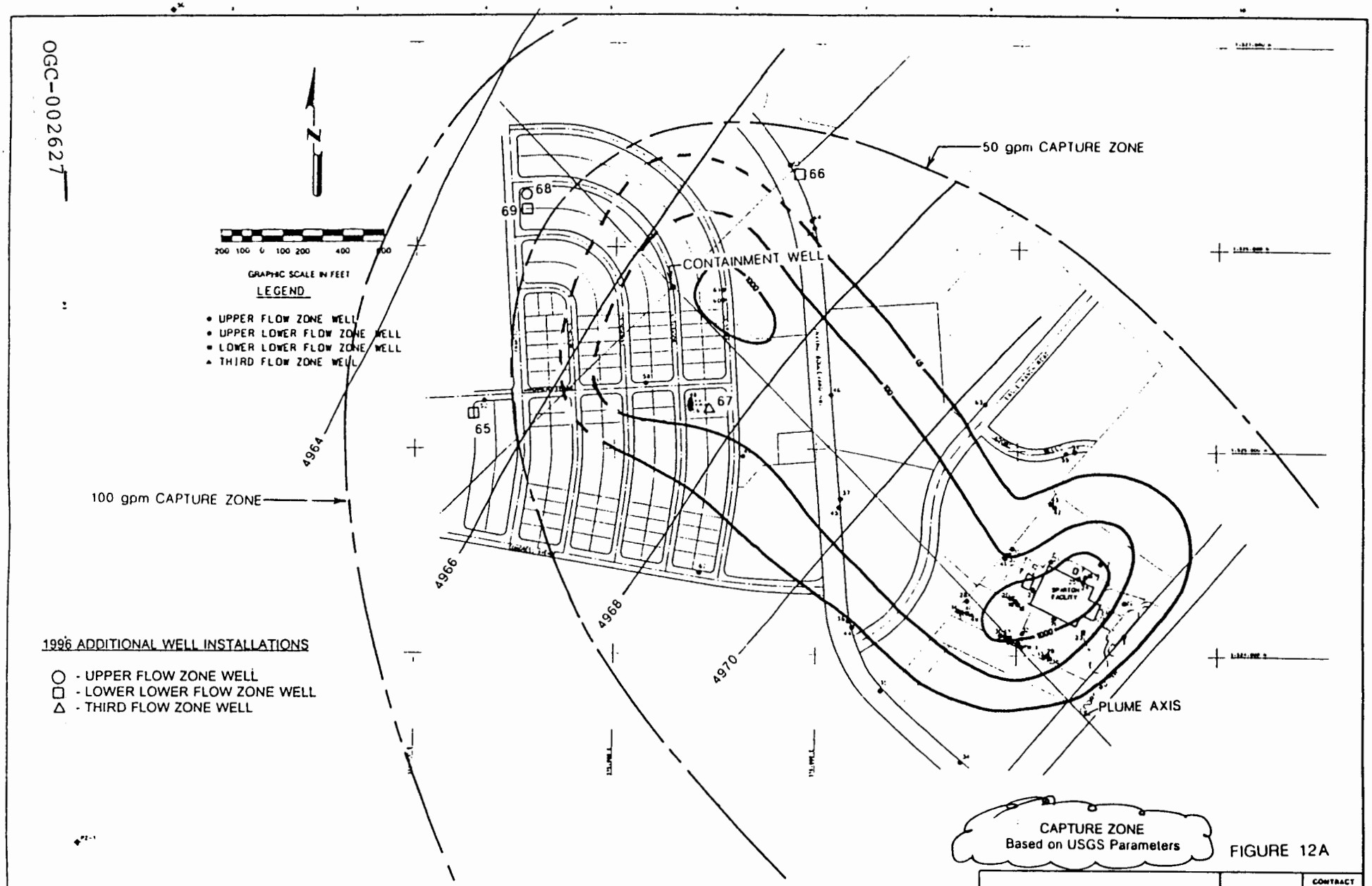
i = 0.002 feet / feet (third Quarter 1996 water level data)

		K*b (gpd/ft) =		8,416
		K*b (SF/min) =		0.781
Q		x(0)	y(max)	y@x=0
GPM	CF/min		+/-	
10	1.34	(136.16)	428	214
20	2.67	(272.31)	856	428
50	6.68	(680.79)	2,139	1,070
100	13.37	(1,361.57)	4,278	2,139
200	26.73	(2,723.14)	8,555	4,2[illegible]3

Calculate edge of Capture Zone

K*b =	8,416	gpd/ft =	0.781	SF/min						
	GPM	CF/min	GPM	CF/min	GPM	CF/min	GPM	CF/min	GPM	CF/min
Q =	10	1.34	20	2.67	50	6.68	100	13.37	200	26.73
	Y	X	Y	X	Y	X	Y	X	Y	X
	1	(136.15)	1	(272.31)	1	(680.79)	1	(1,361.57)	1	(2,723.14)
	100	(110.75)	100	(259.96)	400	(600.58)	600	(1,272.28)	1,000	(2,599.62)
	150	(76.03)	200	(221.49)	800	(334.17)	1,200	(989.32)	2,500	(1,911.34)
	200	(20.45)	300	(152.06)	1,000	(102.26)	2,000	(204.52)	3,500	(1,027.38)
	214	0.20	400	(40.90)	1,070	0.20	2,139	0.39	4,000	(409.04)
	250	7E+01	428	(0.39)	1,250	339.65	2,500	679.31	4,278	(0.00)
	300	2E+02	500	135.86	1,500	1,099.52	3,000	2,199.04	4,500	368.50
	350	5E+02	600	4E+02	2,100	4E+04	4,000	2E+04	6,000	4E+03

OGC-002627



CAPTURE ZONE
Based on USGS Parameters

FIGURE 12A

Black & Veatch
Engineers Architects
Dallas, Texas

PROJECT NO 026602

UPPER FLOW ZONE
TCE CONTOURS - 1996 DATA

CONTRACT NO

SHEET NO

08

THOMPSON & KNIGHT
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AUSTIN
FORT WORTH
HOUSTON
MONTERREY, MEXICO

December 7, 1996

Ana Marie Ortiz
Assistant General Counsel
State of New Mexico
Environment Department
Harold Runnels Building
1190 St. Francis Drive
P. O. Box 26110
Santa Fe, New Mexico 87502

Re: Proposals for: (1) Aquifer Test/Extraction Demonstration/Additions to Monitoring Network; (2) Vapor Extraction System Pilot Testing; and (3) Expansion of Interim Measures

Dear Ana:

I am pleased to enclose with this letter the above-referenced proposals, subject to the following conditions.

With respect to the proposal to conduct an aquifer test/extraction demonstration/additions to monitoring network, Sparton must have authorization from NMED, EPA, or both to allow long term discharge of recovered and treated groundwater to the Calabacillas Arroyo or feel comfortable before implementing that proposal that it will receive such authorization.

When Jan and I met with you in Santa Fe in October to discuss obtaining discharge plan approval, we left that meeting with the understanding that the state would be unwilling to approve a discharge plan until a final remediation plan had been agreed to by all interested parties. Based on subsequent telephone conversations and letters, including your most recent letter of December 2, 1996, we now understand that NMED is willing to consider approving a discharge plan, in the absence of a completed and approved remediation plan for our facility at Coors Road.

If you will confirm to me in writing that our understanding is correct, Sparton is willing to proceed to develop and submit, hopefully in the next 30 days, a discharge plan. If we are comfortable such an application will be: (1) processed as promptly as possible; (2) considered without reference to whether final agreement has been reached on remediation, by all interested parties; and (3) will result in an authorization that will allow

us to operate a containment system without final resolution of all remediation issues, we would be prepared to implement our proposal.

Additionally, we are planning to meet with EPA on Monday to discuss whether an NPDES permit is necessary. Any action by us to move forward in seeking an NPDES permit, would be with the understanding that approval of such an application will be expedited. If EPA issues Sparton an NPDES permit to discharge to the arroyo, will we need to obtain approval of a discharge plan, or is the process for obtaining approval of a discharge plan merely simplified?

With respect to the proposal to expand the interim measure, we cannot take any action until we have some place to discharge the greater volume of water generated through that activity. The city of Albuquerque has unequivocally said we cannot put the new volume into the sanitary sewer system. The only economical way for us to handle that water is through a discharge to the Calabacillas Arroyo. To do so we must have either an approved discharge plan, an NPDES permit or both. Without one or both of these we are not in a position to recover any more water. We are willing to put together the necessary applications, if we are comfortable that NMED or EPA or both intend to expeditiously process such applications, will not condition the issuance of any such authorizations on agreement about final remedy selection associated with our Coors Road facility, and support our proposal to discharge to the arroyo.

I also want to make it clear that as requested in your letter of October 17, 1996, all three proposals are subject to the following conditions:

(1) NMED reserves the right to disapprove the adequacy or accuracy of the results of any tests we conduct.

(2) It is NMED's position that the horizontal and vertical extent of the plume has yet to be adequately defined.

(3) That NMED's approval of our proposal shall in no way constitute an approval, expressed or implied, of any remediation or containment system design.

(4) That NMED does not currently consider the on-site interim pump-and-treat system, even as expanded in our proposal, to necessarily provide on-site groundwater containment.

(5) That discretionary field decisions shall be agreed to by NMED and Sparton at the time a decision is needed.

We understand that within seven (7) days after receiving these proposals, we will hear from Rob Pine as to whether they have been approved or disapproved. If disapproved, we will be provided NMED's specific concerns.

Within 90 days from the date Sparton receives NMED's approval of the soil vapor pilot test proposal, we will submit a report.

Setting a more definitive schedule for the other two proposals is a bit problematic, given that they are dependent upon either receiving authorizations to discharge recovered and treated water to the arroyo, or Sparton obtaining sufficient comfort to believe that such authorizations will be received. We intend to use our best efforts to obtain all federal, state and local approvals necessary to implement these proposals, including but not limited to discharge plans, permits and necessary zoning changes, but those approvals are largely out of our control.

Upon approval of our proposals for the aquifer test/extraction demonstration/additions to monitoring network, and expansion of interim measures, we will provide you a flowchart identifying the authorizations we need, whether they have been sought or the time in which they will be sought, and an estimate of when they might be received. As set forth in our proposals for activities other than soil vapor extraction, we believe the field work required by those proposals can be completed within five (5) months of the date we either have necessary authorizations to discharge recovered and treated water to the arroyo or comfort that they will be issued. A report on the pump test activities could be submitted one month later.

I add that in conjunction with any field work, we will provide NMED with one week prior notice. We will allow you to take split samples. We will provide you a copy of all final analytical data and final deliverable reports.

I have taken the liberty to send, by federal express, a copy of this letter and our proposal to Rob and to Dave Fishel at DOJ. I suggest that we schedule a conference call when Rob is prepared to discuss any comments he may have on the proposals, and at that time we also see if we can reach closure on the discharge issue.

Yours very truly,

James B. Harris

JBH/eshd

cc: Mark Weidler, NMED Secretary
Rob Pine, NMED
David Fishel, DOJ
R. Jan Appel, Sparton
Pierce Chandler, Black & Veatch

40310 00001 LERA 53980

PROPOSAL

Aquifer Testing/Extraction Demonstration/ Additions to Monitoring Network
Coors Road Facility
Sparton Technology, Inc.
Albuquerque, New Mexico

Prepared for:

Sparton Technology, Inc.
Rio Rancho, New Mexico

Prepared by:

Black & Veatch
Dallas, Texas

in Association With

Metric Corporation
Albuquerque, New Mexico

Revised, December 6, 1996

OGC-002633

Objectives

The objectives are:

1. To verify aquifer characteristics (through multiple well pump testing) in the vicinity of the leading edge of the plume.

2. To demonstrate/document the ability of a single well to intercept or capture the leading edge of the contaminant plume to prevent further down-gradient migration above MCL.

3. To install additional groundwater monitoring wells and a piezometer to further define plume limits and provide additional pump test data.

Definition of Plume Leading Edge

In the RCRA Facility Investigation (RFI) Report submitted to USEPA on May 21, 1992, and subsequently approved on July 1, 1992, the horizontal and vertical limits of the plume were defined by sampling and analysis through June 1991 using both on- and off-site groundwater monitoring wells. In particular, the leading edge of the plume was defined by a number of non-detect groundwater monitoring wells outside the perimeter of the plume.

Subsequent to the RFI completion, plume movement continued beyond the existing groundwater monitoring system. However, based on historic movement, groundwater gradient, and relatively constant geologic conditions (which are themselves heterogeneous and anisotropic), the limits of the leading edge of the plume were estimated in the May 1996 Corrective Measure Study (CMS) Report. This further definition was continued by five additional groundwater monitoring wells (MW-65 through MW-69) installed around and outside the predicted limits of the plume. Well locations were chosen to provide additional definition of the horizontal and vertical extent of the leading (down-gradient) edge of the plume through non-detection. These and other non-detect wells around the leading edge provide good definition of the plume.

Pump Test Location

Based on the currently defined plume limits and characteristics, a single well located along Bryan Avenue, some 250 feet north of Arrowhead Avenue (see Figure 1) is

proposed for the test well location. This location was developed during the meetings on September 26 and 27, 1996, and represents a developed building lot (Lot 46, Block 29) available for purchase by Sparton. The Paradise Hills area above the leading edge of the plume is currently undergoing significant development including major grade changes, paving, and utility installation. Location of the pump test well on an already developed lot assures that pump testing can continue without interruption. Secondly, placement of the pump test well on a private lot (as compared to the public right-of-way) increases security of the installation and allows above-ground well head completion details. Thirdly, if any pretreatment of produced water is needed, there is ample room for equipment at the well head. Finally, use of a developed lot provides access to both sanitary and storm sewers.

Available Groundwater Monitoring Network

The attached Table 1 is a summary of monitoring points available to verify the performance of a groundwater pump test well installed near the leading edge of the plume.

With respect to the attached summary (see Table 1), there are 22 existing groundwater monitoring wells (including 7 clusters) within 1,500 feet of the proposed recovery well (see Figure 1). These wells include 12 in the upper flow zone (UFZ), five in the upper lower flow zone (ULFZ), four in the lower lower flow zone (LLFZ), and one in the third flow zone (TFZ). There are five down-gradient, five cross-gradient, and 12 up-gradient wells.

The available monitoring network includes all wells that currently define the limits of the leading edge of the plume. The network includes all non-detect monitoring wells outside the plume and detection wells inside the plume. This combination of wells was used to define the plume and is, therefore, capable of showing single-well containment feasibility by demonstrating inward flow (toward the pump test well) across the entire leading edge of the plume. Conversely, the existing groundwater monitoring network is also capable of detecting any deficiency of the proposed pump test well relative to influence over the entire leading edge of the plume. Pump test well performance can be monitored thorough continuing water level observations and water quality sampling and analyses in the groundwater monitoring well network.

OGC-002635

Pump Test Well Design

The pump test well will be screened through the entire vertical interval of the plume as defined by installation activities. Temporary casing and sampling will be used to determine the vertical limits of the plume during drilling. Screen depth may be further adjusted downward, as necessary, based on pilot hole logging to ensure screen placement into a transmissive zone.

The pump test casing/screen will be sized to accommodate a pumping rate of up to 200 gpm. Previous calculations have shown that pumping rates of half as much (100 gpm) should provide influence over the entire leading edge of the plume. Actual pumping rate will be a function of the aquifer transmissivity at the pump test location and available drawdown based on the completion depth of the well.

Water from the pump test will be routed to the sanitary sewer adjacent to Lot 46. The existing New Mexico Utilities sanitary sewer can accept up to 200 gpm discharge without difficulty. Due to the prevailing wastewater pretreatment requirements and anticipated quality of the produced groundwater, treatment will not be required for discharge to the sewer. However, if needed, produced water will be treated prior to discharge into the sewer.

Additions to Existing Groundwater-Monitoring Network

An additional groundwater monitoring well, MW-70, clustered with separate piezometer, PZ-2, will be installed in the public right-of-way along Buckeye Street northwest of the pump test well location and existing cluster 10 (MW-60/MW-61). This new piezometer/ well cluster would be located as shown on Figure 1.

The new well, MW-70, will be installed as a non-detect well to define the vertical limit of the plume. Temporary casing will be installed during drilling to allow sampling/ analysis verification of plume limits prior to well installation. The vertical plume limits at MW-70 will be compared to the vertical plume limits at the previously installed pump test well. Anticipating MW-70 will be completed to a higher excavation than the bottom of the pump test well, the piezometer will be installed deeper to the same approximate bottom elevation as the pump test well. However, if MW-70 extends to approximately the same bottom elevation as the pump test well, then the piezometer would be installed in the uppermost portion of the aquifer. The purpose for the well/piezometer cluster is

OGC-002636

to provide (a) vertical definition of the plume, and (b) vertical coverage of that portion of the aquifer penetrated by the pump test well.

A second non-detect monitoring well, MW-71, will be installed at the location of existing well cluster 4 (MW-15/MW-32/MW-41). This monitoring well will utilize temporary casing and sampling to verify non-detect screen placement below the existing cluster screen intervals. This well is intended for confirmation of vertical plume limits in a well-documented transverse flow cross-section up gradient of the proposed test well location. The new wells will be 4 inch schedule 40 PVC with 10-foot screens similar to those previously installed. The new piezometer will be 3/4 inch PVC with a five-foot screen.

Pump Test Procedures

A series of pumping tests will be conducted using the pump test well. The first pump test would be a two to three day test (with a temporary pump) used to determine the required size (pumping rate) for a longer-term containment demonstration test. In the initial test, time-drawdown data would be obtained from a constant-rate test at approximately 100 gpm to evaluate produced drawdown and impact to the closer monitoring wells. The resulting time-drawdown and distance-drawdown data would be analyzed to verify aquifer characteristics near the plume leading edge. The data would also be used to project the edge or limit of the pump test well influence relative to plume capture/containment. The initial pump test would also be used to establish produced water quality by sampling and laboratory analysis on a daily frequency. Flow rate, total pumped quantity, and monitor well levels will be recorded during the pumping test.

There are 22 existing wells and the proposed well piezometer cluster within 1,500 feet of the proposed pump test location. (See Table 1) Sixteen of the wells are within 1,000 feet and nine wells (and the single piezometer) are within 500 feet of the pump test well. Water level readings would be taken in the closest wells (<500 feet as detailed in Table 1) at a frequency of not less than once per hour for the first 24 hours, and three to four times daily for the remainder of the test. These wells include existing MW-48, MW-55, MW-56, MW-58, MW-60, MW-61, MW-67, and new MW-70 and PZ-2. Water levels would be obtained using calibrated electronic water level indicators with manual recording of level and date/time. Wells close to the pump test well (MW-60, MW-61, and the new MW-70 and PZ-2) will have dedicated water level indicators to allow increased reading frequency during the first few hours of the pump test. The more distant wells (>500 feet)

OGC-002637

would be read at a reduced frequency, but at least three to four times daily. After pump shutdown, recovery data will be obtained at a similar frequency.

After the initial pump test has been conducted and verification of aquifer parameters obtained, a long-term (approximately one month) pumping test would be conducted using the pump test well and the monitoring network described in Table 1. The well would be pumped at a constant rate anticipated to be in the range of 100 to 200 gpm depending on the results of the initial pump test. Closer monitoring wells (<750 feet horizontal distance) would be read two to four times daily for the first several days, and once daily for the rest of the first week. More distant wells would be read daily for the first week. Thereafter, all well levels would be recorded once per week for the duration of the test. This second pump test would be used to demonstrate the plume area impacted by the pumping and the feasibility of single-well containment near the leading edge of the plume. Produced water would be sampled at approximately weekly intervals during the long-term pump test to provide information on water quality relative to pumping duration.

Contingency

There is at least one possible problem scenario that could be identified during the pump test. The location chosen for the pump test may have atypical or non-representative geology such as an absence of coarser, transmissive material in the saturated zone. Such a condition has been encountered in several monitoring wells.

Pilot hole logging procedures and installation of a temporary pump are two ways to minimize the effect of an unexpected geologic condition. As previously noted, screen length could be extended as a first solution. In the highly unlikely event the geologic condition was vertically extensive (tens of feet), consideration would have to be given to an alternate location.

Schedule

The schedule for implementing the plume leading edge containment is a dual concurrent track. The first track is the process of obtaining the necessary permits for installing and operating the containment well system. The permits could include air quality, well installation, groundwater rights, variance from zoning, public right-of-way use, and discharge to the sanitary sewer and/or storm sewer to the Calabacillas Arroyo.

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Applications for permits or authorization are either being prepared or have been submitted.

The second track is the actual installation of the pump test well and additional monitoring wells/piezometers and conducting the pump test. The second track also presumes that track one has been successfully completed. Elements (and schedule estimates) for this second track are as follows:

1. Purchase property for the pump test wellhead (four to six weeks). Note that variance from zoning is required for purchase.

2. Review permits status.

3. Drill and install pump test well (two months).

4. Drill and install additional monitor wells and piezometers (one month).

5. Review permits status.

6. Construct secure area for well head/pump protection.

7. Install discharge pipeline to sanitary sewer.

8. Verify completion of permits.

9. Conduct initial three-day pump test, verify aquifer parameters, and install long-term pumping equipment (one month).

10. Conduct long-term pump test (one month).

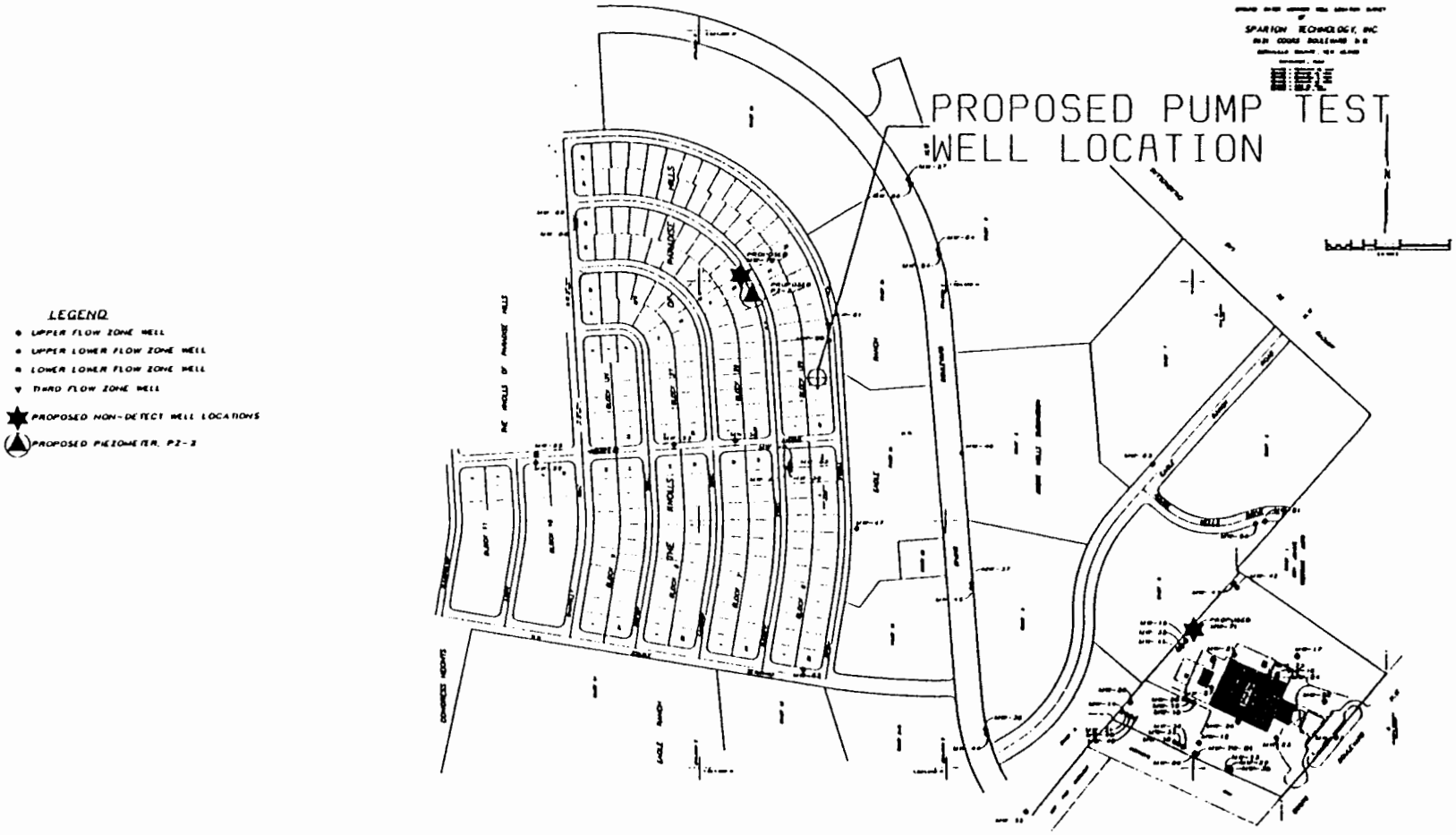
11. Evaluate and report installation and test data (one month).

12. Review and approval of pump test report by NMED.

Based on the above estimates, the second track will take at least four months to actually begin test pumping.

OGC-002639

OGC-002640



Black & Veatch

PROJECT NO. 26602

FIGURE 1

RECOVERY WELL AND MONITORING NETWORK

Table 1
Summary of Groundwater Monitoring Wells Within
1500 Feet of Proposed Pump Test Well Location

Monitor Well	Flow Zone	Approx. Radial Distance ft	Gradient Position	Inside Plume*	Recent Contamination History**	Cluster Well
MW 37	UFZ	1,075	Up	Yes	High, Decr	Yes
MW 45	ULFZ	1,075	Up	Yes	Low, Decr	Yes
MW 46	ULFZ	675	Up	Yes	V. High	No
MW 47	UFZ	650	Up	Yes	Low, Decr	No
MW 48	UFZ	375	Up	Yes	High, Decr	Yes
MW 52	UFZ	1,200	Down	No	ND	Yes
MW 53	UFZ	700	Cross	Yes	Low	No
MW 54	UFZ	700	Up	NA	NA	Yes
MW 55	LLFZ	400	Up	Yes	High	Yes
MW 56	ULFZ	400	Up	Yes	High	Yes
MW 57	UFZ	900	Cross	No	ND	Yes
MW 58	UFZ	425	Up	Yes	High	No
MW 60	ULFZ	175	Up	Yes	High	Yes
MW 61	UFZ	225	Up	Yes	V. High, Decr	Yes
MW 62	UFZ	1,200	Up	No	<5 µg/l	No
MW-63	UFZ	1400	Up	No	No	No
MW 64	ULFZ	725	Up	Yes	Low, Incr	Yes
MW 65	LLFZ	1,175	Down	No	<10 µg/l	Yes
MW 66	LLFZ	875	Cross	No	ND	Yes
MW 67	TFZ	400	Up	No	ND	Yes
MW 68	UFZ	1,150	Down	No	ND	Yes
MW 69	LLFZ	1,175	Down	No	ND	Yes
MW-70	UFZ?	350±	Down	No	Proposed Well	Yes
PZ-2	LLFZ?	350±	Down	No?	Proposed Piezometer	Yes

* Inside 5 µg/l contour
** Very high=>1,000 µg/l, high=>100 µg/l, low=<100 µg/l
ND=no detect, Incr=increasing trend, Decr=decreasing trend

QGC-002641

PROPOSAL

Vapor Extraction System Pilot Testing
Coors Road Facility
Sparton Technology, Inc.
Albuquerque, New Mexico

Prepared for:

Sparton Technology, Inc.
Rio Rancho, New Mexico

Prepared by:

Black & Veatch
Dallas, Texas

in Association With

Metric Corporation
Albuquerque, New Mexico

Revised, December 6, 1996

OGC-002642

Objective

The following proposal is a discussion of specific details and operating procedures to conduct and analyze a VES pilot test and to define the limits of elevated soil-gas volatile organic constituent (VOC) concentrations (i.e., the "soil vapor cloud") in the unsaturated subsurface at the Sparton facility. This discussion of technical details and definition of level of effort is a logical extension from the existing data base and should provide sufficient information to determine what, if any, additional work will be needed.

Soil-Gas Monitoring System

A number of monitoring points for both subsurface soil-gas characterization and for vapor extraction pilot test/production purposes have been previously proposed (B&V letter of August 12, 1996). The monitoring system included both existing groundwater monitor wells (with exposed screen) and the existing vapor cluster probe (VP-1) as well as new vapor recovery wells installed in and around the source area. Previous studies had identified highest VOC concentrations in the soil gas in the closed sump area. Concentrations dropped off by orders of magnitude with increasing horizontal distance from the sump/pond (source area).

The proposed monitoring system additions are designed to characterize the soil gas VOC concentration with respect to distance/location relative to the closed sump area. In addition, the monitoring points would be useful in evaluating the effective influence of a vapor recovery well centrally located in the closed sump (source) area. The monitoring system is shown on the attached Figure 1 and includes four existing groundwater monitoring wells (MW-17, MW-21, MW-24, MW-25, and, perhaps, MW-16 depending on seasonal water level (fluctuation), existing six-well vapor probe cluster (VP-1) and five new vapor recovery wells (VR-1 through VR-5).

The new vapor recovery wells are designed to function as both monitoring points and as potential vapor extraction/air injection wells. The new central vapor recovery well (VR-1) would be a four-inch well; the remaining new vapor recovery wells (VR-2 through VR-5) would be two-inch wells. Wells would consist of 60 feet of 0.040-inch machine slotted PVC screen surrounded by a #6 to #9 coarse sand filter. The uppermost 10 feet of each well would be a grouted surface seal to minimize air intrusion or bypassing. Vapor recovery wells would be screened to just above the highest seasonal water level observed in nearby groundwater wells. New wells would be installed using hollow-stem auger

OGC-002643

drilling procedures. As part of the characterization work, drilling would be monitored using field screening instruments to provide a relative comparison of soil gas VOC as a function of location, depth, and soil type. Completed wells would also be sampled and analyzed using EPA method 8010/8020 for specific VOC presence/concentration.

The proposed monitoring system is expected to confirm the significant dropoff in soil gas VOC concentration with increasing distance from the closed sump area. In addition, it should also define the area where vapor extraction and treatment would be appropriate.

The need for any additional monitoring/characterization data outside the proposed network would be based on a combination of perimeter soil-gas VOC concentrations above 10 ppm and projected edge (shape and distribution) of the "vapor cloud" extending out beyond the definition interval of the proposed network. The proposed network has maximum interwell horizontal spacings of ±100 feet in the outer perimeter. Projected vapor cloud edges extending outward less than this interwell spacing should be adequately defined.

Updated Soil-Gas Characterization

Soil-gas data from the additional new wells would be combined with the existing data base to provide a three-dimensional picture of the soil-gas "vapor cloud". This analysis and related data would be presented in the form of an update to the current soil contamination characterization (as presented in the May 6, 1996 Corrective Measure Study (CMS) Report.) Subject to review and approval by NMED, the updated soil-gas characterization would also be used to confirm the application area for vapor extraction and the selection of the pilot test location.

Pilot Test Design

All data obtained to date and the history of the facility indicate that the closed solvent sump is the probable source of VOC observed in the soil gas. Highest soil-gas VOC concentrations occur in the immediate area of the sump with significant VOC concentration decrease observed with increasing horizontal distance from the source area. As a minimum, vapor extraction will be implemented in the sump area. Thus, the sump area is the most logical location for pilot testing.

The pilot test is proposed to define the relationship between VOC concentrations and extraction vacuum and extraction flow rates from a recovery well located directly under the sump area (see Figure 1). Monitoring points (proposed and existing) are located at varying horizontal distances and depths to allow evaluation of effective influence of the centrally located recovery well.

The pilot test is also designed as a prototype demonstration of the planned VES system to show capability for extraction and ability to meet City/County air quality requirements. Further, the pilot test will show probable production rates and estimates of required operation time.

Pilot Test Equipment

For the pilot test, we are proposing AcuVac as the subcontractor to provide necessary equipment. AcuVac is experienced in soil vapor recovery pilot testing in the Albuquerque area and they have demonstrated the ability to successfully conduct meaningful pilot tests and to meet stringent City/County emission requirements. Further, the AcuVac procedure utilizes an environmentally friendly destructive technology to efficiently remove VOC from the extracted soil gas.

The proposed extraction/destruction unit is based around a 300 cubic inch in-line six cylinder internal combustion (I.C.) engine fueled by the extracted soil-gas VOC and supplemental fuel as required. Emissions are controlled by the I.C. process and redundant catalytic converters.

A vacuum blower propelled by the I.C. engine is capable of producing well flow rates of up to 120 cfm and negative pressures of up to 15 inches of mercury. AcuVac-furnished pilot test equipment also includes: a data recording system; magnehelic pressure gauges capable of reading to 0.01 inches of water; soil gas flow measuring devices; real-time field screening/analytical equipment; temperature and barometric measurement; and sampling ports for recovery of influent samples.

Pilot Test Procedure

The pilot test is proposed to be conducted using the central four-inch recovery well (VR-1). The remaining recovery wells (VR-2 through VR-5), UFZ groundwater monitoring wells (MW-17, MW-21, MW-24, and MW-25), and vapor probe cluster

(VP-1) would be used as observation points for the pilot testing (see Figure 1). The pilot testing will be conducted at several different rates of vacuum and flow (up to the maximum capability of the extraction unit) to determine the performance characteristics of the vapor recovery well/adjacent subsurface.

Prior to each individual test, depth to water, temperature and barometric pressure, and magnehelic pressure gauge readings at each monitoring point would be recorded. After the pilot test is started, extraction well vacuum and flow and extraction system operating data (including supplemental fuel flow) will be recorded. Pressure instrumentation at each of the observation wells will be monitored and recorded to determine vacuum communication with the recovery well (demonstration of radius of influence).

The produced vapor stream (influent) will be analyzed (on a real-time basis) using field screening instruments to determine variation in influent VOC concentration. At selected intervals, influent samples will also be obtained for confirmatory laboratory analyses (EPA Method 8010 and 8020). At least one confirmatory sample will be obtained for each extraction rate test. The purpose of the screening/testing will be to determine VOC concentration variation as a function of both pumping rate/vacuum and elapsed pumping duration.

Based on previous experience, the pilot test should require no more than two days of actual vapor extraction. It is anticipated that two to four extraction rates will be tested. Each extraction rate test will nominally take three to four hours. Upon completion of testing, a detailed pilot test report, including all operating and analytical data and recommendations for operating parameters and effective vacuum radius of influence, will be compiled and provided to NMED for their review and approval.

Pilot Test Schedule

Upon authorization to proceed, it will take from two weeks to over a month to schedule a drilling contractor to install the five vapor recovery wells. Approximately one week will be required to install the wells. Sampling and analytical testing will require several more weeks. Pilot testing can then be arranged in accordance with the subcontractor's schedule. Currently, several weeks are required to mobilize the pilot test equipment; however, once equipment is on site, the actual pilot testing can be conducted in several

days. Interference with the schedule could be caused by the holiday season and possibly weather.

OGC-002647

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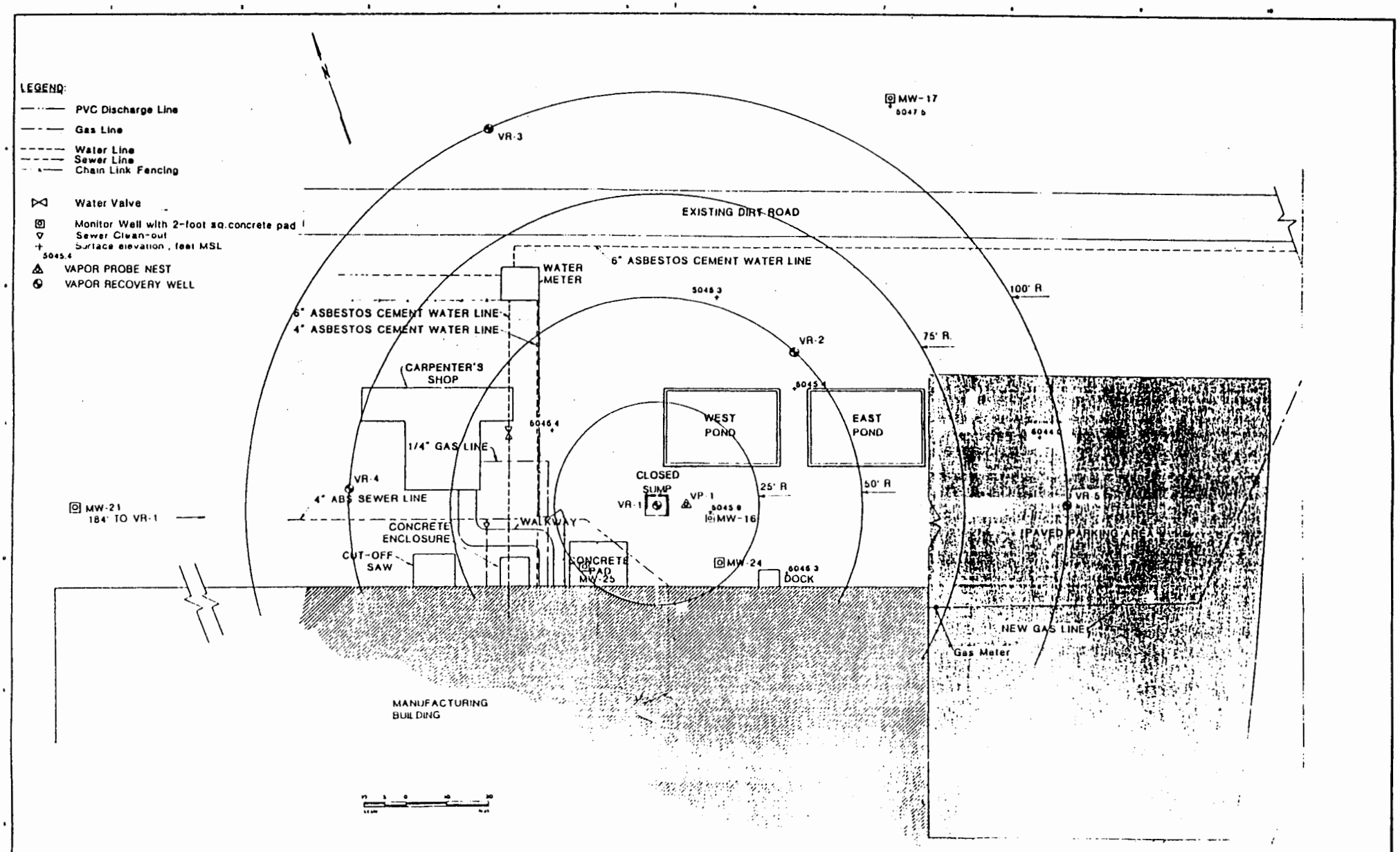

MAP SOURCE: RCRA POST-CLOSURE PERMIT APPLICATION
HARDING LAWSON ASSOCIATES, MARCH 1986

Black & Veatch
Engineers Architects
Dallas, Texas

PROJECT NO

SPARTON TECHNOLOGY, INC.

COORS ROAD FACILITY
VES - PILOT TEST

FIG 1

CONTRACT NO

SHEET NO

PROPOSAL

Expansion of Interim Measures (IM)
Coors Road Facility
Sparton Technology, Inc.
Albuquerque, New Mexico

Prepared for:

Sparton Technology, Inc.
Rio Rancho, New Mexico

Prepared by:

Black & Veatch
Dallas, Texas

in Association With

Metric Corporation
Albuquerque, New Mexico

Revised, December 6, 1996

Objectives

The objectives of this proposal are three-fold:

1. To address high volatile organic constituent (VOC) concentrations in groundwater at the location of groundwater monitoring wells MW-32 and MW-42.

2. To evaluate the cause of erratic VOC detections historically observed during periodic sampling of groundwater monitoring well MW-32.

3. To enhance interim onsite mass removal.

Lower lower flow zone (LLFZ) groundwater monitoring well MW-32 has historically exhibited erratic detections of volatile organic constituents (VOC). Periodically, it exhibits anomalously high concentrations relative to surrounding adjacent wells and also periodically exhibits anomalous constituents. Further, out of 13 cluster well locations, well MW-32 is the bottom well in the only cluster showing an increase in VOC concentration with depth.

The source of the erratic detections is a matter of speculation, but would include completion problems such as a defective grout seal or a cracked well casing allowing impacts of shallow contamination. Sampling procedures have been ruled out as a cause through detailed resampling and multiple split procedures.

One procedure to determine the cause of the erratic behavior would be to pump the well for an extended period and observe the effect on sampled water quality. If well MW-32 does represent a zone or area of higher VOC concentration, the extended pumping from this well would also be a form of source control and containment. It should be noted that MW-32 is also immediately downgradient of the source area. As detailed in the pump test proposal revised December 6, 1996, an additional non-detect monitor well is proposed below MW-32 to define the lower vertical limits of the VOC plume.

Upper lower flow zone (ULFZ) groundwater monitoring well MW-42 has historically exhibited high VOC concentrations and is outside the recovery area of the existing IM system. In addition, well MW-42 is also down gradient of the source area.

OGC-002650

Proposed IM Expansion

The current IM system recovers a total of approximately 2 gpm from the upper portion of the aquifer. The treatment capacity of the IM system is 20 gpm. Well installation data for MW-32 and MW-42 indicate that combined systems pumping rates of 15 to 20 gpm could possibly be achieved. Actual production rate would be determined by installing a temporary pump in each well and conducting a limited pumping test to determine production pumping rate and drawdown. A production pump would then be sized and installed. Discharge would be routed to the existing onsite treatment unit. It should be noted that wells MW-32 and MW-42 are located close to the treatment unit -- allowing economical, secure connection. Increasing the recovery rate to 20 gpm is conditioned to the ability to obtain permits to either discharge to the sanitary sewer or, preferably, to discharge to the Calabacillas Arroyo through the existing storm sewer system.

Installation data would be included in a report updating the current onsite groundwater recovery well system. The report would be submitted to NMED for review and approval. Production and impact on water quality would be evaluated on a periodic basis and furnished as a part of the site operation reporting.

Schedule

The current IM system is permitted for a production of 20 gpm. Adding wells MW-32 and MW-42 to the IM system is simply a matter of conducting a limited pumping test for sizing purposes, and then installing the pump, controls, and connecting piping. It is estimated that wells MW-32 and MW-42 could be recovering water within two months of authorization to discharge treated water to the storm sewer entering the Calabacillas Arroyo.

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January 17, 1997

VIA FACSIMILE

Ana Marie Ortiz
Assistant General Counsel
State of New Mexico
Environment Department
Harold Runnels Building
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Santa Fe, New Mexico 87502

Re: Response to NMED Comments of January 3, 1997 to December 9, 1996 Sparton Proposal

Dear Ana:

The following is Sparton Technology, Inc.'s ("Sparton") response to NMED's comments of January 3, 1997. We have followed the format and numbering of your comments in making our response. We have only responded to those items where we think there may be a difference of opinion or where you asked us to do something and we have agreed.

Aquifer Testing/Extraction Demonstration/Additions to Monitoring Network

1. Sparton intends to use a 6-inch diameter well for pump test purposes. This 6-inch well can accommodate a pumping rate of up to 250 gpm. We intended to use a pump no larger than 5 inch, which would be sufficient to achieve the 250 gpm pumping rate. We do not know whether New Mexico Utilities will be willing to accept a discharge into their service system at the 250 gpm rate.

   We agree with NMED that there may be some uncertainty about the pumping rate that will adequately contain the plume. To deal with this concern we are proposing to do a three day pump test at 100 gpm, then to analyze the results and agree for the longer term test on a rate, which could be anywhere from 50 gpm to 250 gpm. That range is our best estimate of the pumping rates that might be needed to achieve containment. Technically, changing rates during a pumping test complicates analyses and makes conclusions uncertain; that is why we would run two tests.

2. In the September 26-27, 1996, meetings, NMED initially had requested a minimum of four additional monitoring wells located along what Dennis McQuillan described as a "keel." The requested wells were located as follows:

   a. A non-detect well below existing cluster MW-15, MW-32, and MW-41;

   b. A non-detect well below existing well MW-46; and

   c. A new two-well cluster on Buckeye Street northwest of existing cluster MW-60 and MW-61.

   Sparton considered the NMED request and offered to install the following:

   a. A new no-detect well to the existing cluster MW-15, MW-32, and MW-41, (MW-71).

   b. A new piezometer/well cluster on Buckeye Street northwest of the proposed pump test location and approximately on the "keel." The new well would be installed as a non-detect well. Based on the completion depth of the well, a piezometer would be installed either above or below the well screened interval to provide water level data in the entire zone (depth) impacted by the pump test well (MW-70).

   c. A pump test well would also serve as another non-detect well, that initially would be installed across the entire plume vertical interval to provide additional definition of the bottom of the plume along the "keel," in lieu of the new deep monitoring well at the existing well MW-46 location (Pump Test Well).

   Our notes and recollections are that NMED agreed to the Sparton offer. Additionally, your October 17, 1996, letter made reference to a "nested monitor well and piezometer" that we understood to describe exactly what was proposed and what was agreed to at the September 26-27, 1996, meeting.

   Your letter suggests something other than what we agreed to. In particular, we understand you are now asking for either multiple wells or a multiple completion well in the vicinity of the location of our proposed MW-70, and a separate piezometer distant from whatever monitor well is installed. We continue to believe what we proposed and you accepted is sufficient for purposes of defining the "keel," and analyzing the effectiveness of the pump test well.

3. Sparton will resubmit a contingency plan by January 31, 1997, that will specify that in the event the initial and long-term pump tests do not produce an acceptable demonstration

of capture the long term test will be rerun at a higher pumping rate subject to the limits of the 6-inch well or any limitations imposed by New Mexico Utilities. We disagree that there is a sparsity of monitor wells.

4. As Sparton has previously communicated, the 180 days should begin when we have permits to dispose of the recovered water in the arroyo.

5. For the long term (approximately one month) pumping test, closer monitoring wells (currently assumed to be <750 feet horizontal distance pending results from the initial pump test) would be read two to four times daily for the first several days and then (with NMED concurrence) at a decreasing frequency as time-histories become defined at each well. The intent is to define the shape of the time-drawdown response at each individual monitoring well. Composite distance-drawdown analyses would be conducted on a continuing basis. When the distance-drawdown analyses show the test pumping influence is covering the closer wells, the remaining, more distant wells would be read on a daily frequency until a distinct time-drawdown response can be verified; thereafter, distant wells would be read at a reduced frequency (with NMED concurrence) as needed to define the shape of the time-drawdown response.

   Pressure transducers connected to a continuous recording data logger will be installed in wells MW-60, MW-61, and the pump test well.

6. As previously communicated, initiation of the off-site pump test should not begin until permits are issued to allow discharge of recovered water to the arroyo. We have considered reinjection wells. We identified in the CMS (pp. VII-25 - VII - 30) a host of reasons why we believed reinjection wells would not work at this site. Gary Richardson has advised us of three situations in the Albuquerque area where reinjection wells have had to be replaced, in two cases on a monthly basis. In all situations these wells have required incredibly high maintenance, and in all cases they have had frequent breakdowns. We have estimated that reinjection at a 200 gpm rate, when compared with discharge to the arroyo, would require at least an additional $500,000 in capital costs, and at least an additional $175,000 in annual O&M costs.

Vapor Extraction System Plot Testing

A drilling contractor has been scheduled to begin installation of soil vapor recovery wells VR-1 through VR-5 the first week of February 1997.

Expansion of Interim Measures (IM)

1. Sparton will monitor water levels in existing monitor wells MW-41, MW-43, MW-19, MW-20, and MW-21 in the vicinity of MW-32 and MW-42 before and after groundwater extraction beings to allow evaluation of aquifer response to expansion of the IM. Sparton will monitor discharge rates from these two wells and will sample/analyze water from these wells for VOC on a quarterly basis. Sparton will revise by January 31, 1997, the December 6, 1996, proposal to include this additional work.

2. Sparton will add one or more wells to the expanded IM as necessary to achieve a total pumping rate of 20 gpm. It is anticipated that the additional wells would be added based on yield and presence of elevated VOC concentration. Based on historical data, wells to be considered for expanded IM usage would include MW-43 and MW-19.

3. Sparton does not agree that reinjection is a reasonable alternative for disposal -- see Aquifer Testing Response 6.

4. NMED's concern with the identified statement apparently is based on the agency defining the phrase "changes in concentration with depth" differently than Sparton. As used in the December 6, 1996, proposal, Sparton intended an "increase in VOC concentration with depth" to mean that VOC concentration increases with depth in all wells in the cluster. At Cluster No. 4 (MW-15/MW-41/MW-32), the bottom well MW-32 has the highest VOC concentration. However, at Cluster No. 9 (MW-48/MW-56/MW-55/MW-67), MW-67, the deepest well, is non-detect for VOCs; thus that cluster does not exhibit an increase in all deeper wells.

Yours very truly,

James B. Harris

JBH:eshd
cc: R. Jan Appel
Pierce Chandler
Gary O'Dea

40310 00001 LERA 55222

PROPOSAL

Aquifer Testing/Extraction Demonstration/ Additions to Monitoring Network
Coors Road Facility
Sparton Technology, Inc.
Albuquerque, New Mexico

Prepared for:

Sparton Technology, Inc.
Rio Rancho, New Mexico

Prepared by:

Black & Veatch
Dallas, Texas

in Association With

Metric Corporation
Albuquerque, New Mexico

Revised, December 6, 1996
Revised, January 17, 1997

Objectives

The objectives are:

1. To verify aquifer characteristics (through multiple well pump testing) in the vicinity of the leading edge of the plume.

2. To demonstrate/document the ability of a single well to intercept or capture the leading edge of the contaminant plume to prevent further down-gradient migration above MCL.
3. To install additional groundwater monitoring wells and a piezometer to further define plume limits and provide additional pump test data.

Definition of Plume Leading Edge

In the RCRA Facility Investigation (RFI) Report submitted to USEPA on May 21, 1992, and subsequently approved on July 1, 1992, the horizontal and vertical limits of the plume were defined by sampling and analysis through June 1991 using both on- and off-site groundwater monitoring wells. In particular, the leading edge of the plume was defined by a number of non-detect groundwater monitoring wells outside the perimeter of the plume.

Subsequent to the RFI completion, plume movement continued beyond the existing groundwater monitoring system. However, based on historic movement, groundwater gradient, and relatively constant geologic conditions (which are themselves heterogeneous and anisotropic), the limits of the leading edge of the plume were estimated in the May 1996 Corrective Measure Study (CMS) Report. This further definition was continued by five additional groundwater monitoring wells (MW-65 through MW-69) installed around and outside the predicted limits of the plume. Well locations were chosen to provide additional definition of the horizontal and vertical extent of the leading (down-gradient) edge of the plume through non-detection. These and other non-detect wells around the leading edge provide good definition of the plume.

Pump Test Location

Based on the currently defined plume limits and characteristics, a single well located along Bryan Avenue, some 250 feet north of Arrowhead Avenue (see Figure 1) is proposed for the test well location. This location was developed during the meetings on

OGC-002658

September 26 and 27, 1996, and represents a developed building lot (Lot 46, Block 29) available for purchase by Sparton. The Paradise Hills area above the leading edge of the plume is currently undergoing significant development including major grade changes, paving, and utility installation. Location of the pump test well on an already developed lot assures that pump testing can continue without interruption. Secondly, placement of the pump test well on a private lot (as compared to the public right-of-way) increases security of the installation and allows above-ground well head completion details. Thirdly, if any pretreatment of produced water is needed, there is ample room for equipment at the well head. Finally, use of a developed lot provides access to both sanitary and storm sewers.

Available Groundwater Monitoring Network

The attached Table 1 is a summary of monitoring points available to verify the performance of a groundwater pump test well installed near the leading edge of the plume.

With respect to the attached summary (see Table 1), there are 22 existing groundwater monitoring wells (including 7 clusters) within 1,500 feet of the proposed recovery well (see Figure 1). These wells include 12 in the upper flow zone (UFZ), five in the upper lower flow zone (ULFZ), four in the lower lower flow zone (LLFZ), and one in the third flow zone (TFZ). There are five down-gradient, five cross-gradient, and 12 up-gradient wells.

The available monitoring network includes all wells that currently define the limits of the leading edge of the plume. The network includes all non-detect monitoring wells outside the plume and detection wells inside the plume. This combination of wells was used to define the plume and is, therefore, capable of showing single-well containment feasibility by demonstrating inward flow (toward the pump test well) across the entire leading edge of the plume. Conversely, the existing groundwater monitoring network is also capable of detecting any deficiency of the proposed pump test well relative to influence over the entire leading edge of the plume. Pump test well performance can be monitored thorough continuing water level observations and water quality sampling and analyses in the groundwater monitoring well network.

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Pump Test Well Design

The pump test well will be screened through the entire vertical interval of the plume as defined by installation activities. Temporary casing and sampling will be used to determine the vertical limits of the plume during drilling. Screen depth may be further adjusted downward, as necessary, based on pilot hole logging to ensure screen placement into a transmissive zone.

The pump test casing/screen will be sized to accommodate a pumping rate of up to 200 gpm. Previous calculations have shown that pumping rates of half as much (100 gpm) should provide influence over the entire leading edge of the plume. Actual pumping rate will be a function of the aquifer transmissivity at the pump test location and available drawdown based on the completion depth of the well.

Water from the pump test will be routed to the sanitary sewer adjacent to Lot 46. The existing New Mexico Utilities sanitary sewer can accept up to 200 gpm discharge without difficulty. Due to the prevailing wastewater pretreatment requirements and anticipated quality of the produced groundwater, treatment will not be required for discharge to the sewer. However, if needed, produced water will be treated prior to discharge into the sewer.

Additions to Existing Groundwater-Monitoring Network

An additional groundwater monitoring well, MW-70, clustered with separate piezometer, PZ-2, will be installed in the public right-of-way along Buckeye Street northwest of the pump test well location and existing cluster 10 (MW-60/MW-61). This new piezometer/ well cluster would be located as shown on Figure 1.

The new well, MW-70, will be installed as a non-detect well to define the vertical limit of the plume. Temporary casing will be installed during drilling to allow sampling/ analysis verification of plume limits prior to well installation. The vertical plume limits at MW-70 will be compared to the vertical plume limits at the previously installed pump test well. Anticipating MW-70 will be completed to a higher excavation than the bottom of the pump test well, the piezometer will be installed deeper to the same approximate bottom elevation as the pump test well. However, if MW-70 extends to approximately the same bottom elevation as the pump test well, then the piezometer would be installed in the uppermost portion of the aquifer. The purpose for the well/piezometer cluster is

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to provide (a) vertical definition of the plume, and (b) vertical coverage of that portion of the aquifer penetrated by the pump test well.

A second non-detect monitoring well, MW-71, will be installed at the location of existing well cluster 4 (MW-15/MW-32/MW-41). This monitoring well will utilize temporary casing and sampling to verify non-detect screen placement below the existing cluster screen intervals. This well is intended for confirmation of vertical plume limits in a well-documented transverse flow cross-section up gradient of the proposed test well location. The new wells will be 4 inch schedule 40 PVC with 10-foot screens similar to those previously installed. The new piezometer will be 3/4 inch PVC with a five-foot screen.

Pump Test Procedures

A series of pumping tests will be conducted using the pump test well. The first pump test would be a two to three day test (with a temporary pump) used to determine the required size (pumping rate) for a longer-term containment demonstration test. In the initial test, time-drawdown data would be obtained from a constant-rate test at approximately 100 gpm to evaluate produced drawdown and impact to the closer monitoring wells. The resulting time-drawdown and distance-drawdown data would be analyzed to verify aquifer characteristics near the plume leading edge. The data would also be used to project the edge or limit of the pump test well influence relative to plume capture/containment. The initial pump test would also be used to establish produced water quality by sampling and laboratory analysis on a daily frequency. Flow rate, total pumped quantity, and monitor well levels will be recorded during the pumping test.

There are 22 existing wells and the proposed well piezometer cluster within 1,500 feet of the proposed pump test location. (See Table 1) Sixteen of the wells are within 1,000 feet and nine wells (and the single piezometer) are within 500 feet of the pump test well. Water level readings would be taken in the closest wells (<500 feet as detailed in Table 1) at a frequency of not less than once per hour for the first 24 hours, and three to four times daily for the remainder of the test. These wells include existing MW-48, MW-55, MW-56, MW-58, MW-60, MW-61, MW-67, and new MW-70 and PZ-2. Water levels would be obtained using calibrated electronic water level indicators with manual recording of level and date/time. Wells close to the pump test well (MW-60, MW-61, and the new MW-70 and PZ-2) will have dedicated water level indicators to allow increased reading frequency during the first few hours of the pump test. The more distant wells (>500 feet)

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would be read at a reduced frequency, but at least three to four times daily. After pump shutdown, recovery data will be obtained at a similar frequency.

After the initial pump test has been conducted and verification of aquifer parameters obtained, a long-term (approximately one month) pumping test would be conducted using the pump test well and the monitoring network described in Table 1. The well would be pumped at a constant rate anticipated to be in the range of 100 to 200 gpm depending on the results of the initial pump test. Closer monitoring wells (<750 feet horizontal distance) would be read two to four times daily for the first several days, and once daily for the rest of the first week. More distant wells would be read daily for the first week. Thereafter, all well levels would be recorded once per week for the duration of the test. This second pump test would be used to demonstrate the plume area impacted by the pumping and the feasibility of single-well containment near the leading edge of the plume. Produced water would be sampled at approximately weekly intervals during the long-term pump test to provide information on water quality relative to pumping duration.

Contingency

There is at least one possible problem scenario that could be identified during the pump test. The location chosen for the pump test may have atypical or non-representative geology such as an absence of coarser, transmissive material in the saturated zone. Such a condition has been encountered in several monitoring wells.

Pilot hole logging procedures and installation of a temporary pump are two ways to minimize the effect of an unexpected geologic condition. As previously noted, screen length could be extended as a first solution. In the highly unlikely event the geologic condition was vertically extensive (tens of feet), consideration would have to be given to an alternate location.

In the event that the initial and long-term pump tests do not produce an acceptable demonstration of capture, the long-term pump test will be rerun at a higher pumping rate subject to the limits of the 6-inch well and/or any discharge limitations imposed by New Mexico Utilities.

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Schedule

The schedule for implementing the plume leading edge containment is a dual concurrent track. The first track is the process of obtaining the necessary permits for installing and operating the containment well system. The permits could include air quality, well installation, groundwater rights, variance from zoning, public right-of-way use, and discharge to the sanitary sewer and/or storm sewer to the Calabacillas Arroyo. Applications for permits or authorization are either being prepared or have been submitted.

The second track is the actual installation of the pump test well and additional monitoring wells/piezometers and conducting the pump test. The second track also presumes that track one has been successfully completed. Elements (and schedule estimates) for this second track are as follows:

1. Purchase property for the pump test wellhead (four to six weeks). Note that variance from zoning is required for purchase.

2. Review permits status.

3. Drill and install pump test well (two months).

4. Drill and install additional monitor wells and piezometers (one month).

5. Review permits status.

6. Construct secure area for well head/pump protection.

7. Install discharge pipeline to sanitary sewer.

8. Verify completion of permits.

9. Conduct initial three-day pump test, verify aquifer parameters, and install long-term pumping equipment (one month).

10. Conduct long-term pump test (one month).

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11. Evaluate and report installation and test data (one month).

12. Review and approval of pump test report by NMED.

Based on the above estimates, the second track will take at least four months to actually begin test pumping.

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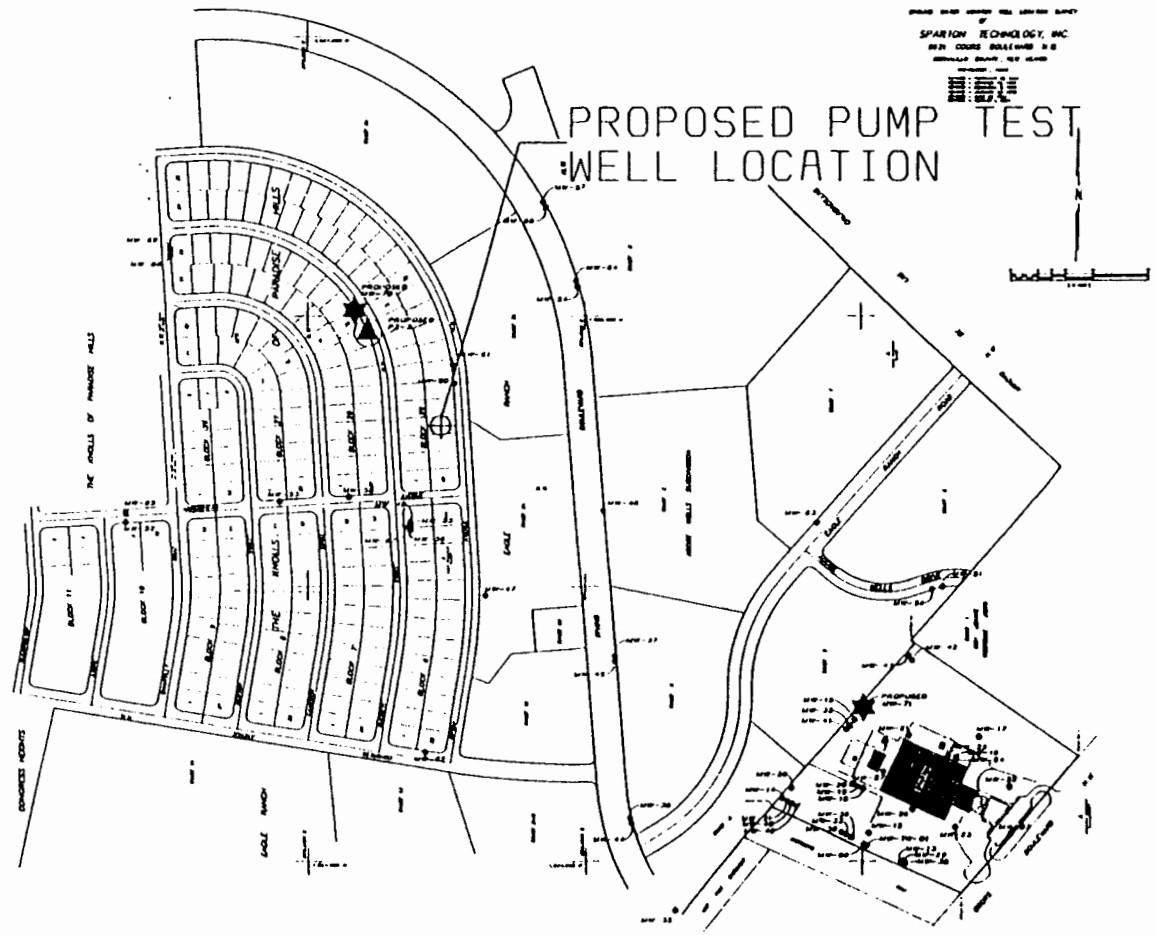
OGC-002665



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PROJECT NO. 26602

FIGURE 1

RECOVERY WELL AND MONITORING NETWORK

SHEET OF

Table 1
Summary of Groundwater Monitoring Wells Within
1500 Feet of Proposed Pump Test Well Location

Monitor Well	Flow Zone	Approx. Radial Distance ft	Gradient Position	Inside Plume*	Recent Contamination History**	Cluster Well
MW 37	UFZ	1,075	Up	Yes	High, Decr	Yes
MW 45	ULFZ	1,075	Up	Yes	Low, Decr	Yes
MW 46	ULFZ	675	Up	Yes	V. High	No
MW 47	UFZ	650	Up	Yes	Low, Decr	No
MW 48	UFZ	375	Up	Yes	High, Decr	Yes
MW 52	UFZ	1,200	Down	No	ND	Yes
MW 53	UFZ	700	Cross	Yes	Low	No
MW 54	UFZ	700	Up	NA	NA	Yes
MW 55	LLFZ	400	Up	Yes	High	Yes
MW 56	ULFZ	400	Up	Yes	High	Yes
MW 57	UFZ	900	Cross	No	ND	Yes
MW 58	UFZ	425	Up	Yes	High	No
MW 60	ULFZ	175	Up	Yes	High	Yes
MW 61	UFZ	225	Up	Yes	V. High, Decr	Yes
MW 62	UFZ	1,200	Up	No	<5 µg/l	No
MW-63	UFZ	1400	Up	No	No	No
MW 64	ULFZ	725	Up	Yes	Low, Incr	Yes
MW 65	LLFZ	1,175	Down	No	<10 µg/l	Yes
MW 66	LLFZ	875	Cross	No	ND	Yes
MW 67	TFZ	400	Up	No	ND	Yes
MW 68	UFZ	1,150	Down	No	ND	Yes
MW 69	LLFZ	1,175	Down	No	ND	Yes
MW-70	UFZ?	350±	Down	No	Proposed Well	Yes
PZ-2	LLFZ?	350±	Down	No?	Proposed Piezometer	Yes

* Inside 5 µg/l contour
** Very high=>1,000 µg/l, high=>100 µg/l, low=<100 µg/l
ND=no detect, Incr=increasing trend, Decr=decreasing trend

OGC-002666

PROPOSAL

Vapor Extraction System Pilot Testing
Coors Road Facility
Sparton Technology, Inc.
Albuquerque, New Mexico

Prepared for:

Sparton Technology, Inc.
Rio Rancho, New Mexico

Prepared by:

Black & Veatch
Dallas, Texas

in Association With

Metric Corporation
Albuquerque, New Mexico

Revised, December 2, 1996

Objective

The following proposal is a discussion of specific details and operating procedures to conduct and analyze a VES pilot test and to define the limits of elevated soil-gas volatile organic constituent (VOC) concentrations (i.e., the "soil vapor cloud") in the unsaturated subsurface at the Sparton facility. This discussion of technical details and definition of level of effort is a logical extension from the existing data base and should provide sufficient information to determine what, if any, additional work will be needed.

Soil-Gas Monitoring System

A number of monitoring points for both subsurface soil-gas characterization and for vapor extraction pilot test/production purposes have been previously proposed (B&V letter of August 12, 1996). The monitoring system included both existing groundwater monitor wells (with exposed screen) and the existing vapor cluster probe (VP-1) as well as new vapor recovery wells installed in and around the source area. Previous studies had identified highest VOC concentrations in the soil gas in the closed sump area. Concentrations dropped off by orders of magnitude with increasing horizontal distance from the sump/pond (source area).

The proposed monitoring system additions are designed to characterize the soil gas VOC concentration with respect to distance/location relative to the closed sump area. In addition, the monitoring points would be useful in evaluating the effective influence of a vapor recovery well centrally located in the closed sump (source) area. The monitoring system is shown on the attached Figure 1 and includes four existing groundwater monitoring wells (MW-17, MW-21, MW-24, MW-25, and, perhaps, MW-16 depending on seasonal water level (fluctuation), existing six-well vapor probe cluster (VP-1) and five new vapor recovery wells (VR-1 through VR-5).

The new vapor recovery wells are designed to function as both monitoring points and as potential vapor extraction/air injection wells. The new central vapor recovery well (VR-1) would be a four-inch well; the remaining new vapor recovery wells (VR-2 through VR-5) would be two-inch wells. Wells would consist of 60 feet of 0.040-inch machine slotted PVC screen surrounded by a #6 to #9 coarse sand filter. The uppermost 10 feet of each well would be a grouted surface seal to minimize air intrusion or bypassing. Vapor recovery wells would be screened to just above the highest seasonal water level observed in nearby groundwater wells. New wells would be installed using hollow-stem auger

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drilling procedures. As part of the characterization work, drilling would be monitored using field screening instruments to provide a relative comparison of soil gas VOC as a function of location, depth, and soil type. Completed wells would also be sampled and analyzed using EPA method 8010/8020 for specific VOC presence/concentration.

The proposed monitoring system is expected to confirm the significant dropoff in soil gas VOC concentration with increasing distance from the closed sump area. In addition, it should also define the area where vapor extraction and treatment would be appropriate.

The need for any additional monitoring/characterization data outside the proposed network would be based on a combination of perimeter soil-gas VOC concentrations above 10 ppm and projected edge (shape and distribution) of the "vapor cloud" extending out beyond the definition interval of the proposed network. The proposed network has maximum interwell horizontal spacings of ±100 feet in the outer perimeter. Projected vapor cloud edges extending outward less than this interwell spacing should be adequately defined.

Updated Soil-Gas Characterization

Soil-gas data from the additional new wells would be combined with the existing data base to provide a three-dimensional picture of the soil-gas "vapor cloud". This analysis and related data would be presented in the form of an update to the current soil contamination characterization (as presented in the May 6, 1996 Corrective Measure Study (CMS) Report.) Subject to review and approval by NMED, the updated soil-gas characterization would also be used to confirm the application area for vapor extraction and the selection of the pilot test location.

Pilot Test Design

All data obtained to date and the history of the facility indicate that the closed solvent sump is the probable source of VOC observed in the soil gas. Highest soil-gas VOC concentrations occur in the immediate area of the sump with significant VOC concentration decrease observed with increasing horizontal distance from the source area. As a minimum, vapor extraction will be implemented in the sump area. Thus, the sump area is the most logical location for pilot testing.

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The pilot test is proposed to define the relationship between VOC concentrations and extraction vacuum and extraction flow rates from a recovery well located directly under the sump area (see Figure 1). Monitoring points (proposed and existing) are located at varying horizontal distances and depths to allow evaluation of effective influence of the centrally located recovery well.

The pilot test is also designed as a prototype demonstration of the planned VES system to show capability for extraction and ability to meet City/County air quality requirements. Further, the pilot test will show probable production rates and estimates of required operation time.

Pilot Test Equipment

For the pilot test, we are proposing AcuVac as the subcontractor to provide necessary equipment. AcuVac is experienced in soil vapor recovery pilot testing in the Albuquerque area and they have demonstrated the ability to successfully conduct meaningful pilot tests and to meet stringent City/County emission requirements. Further, the AcuVac procedure utilizes an environmentally friendly destructive technology to efficiently remove VOC from the extracted soil gas.

The proposed extraction/destruction unit is based around a 300 cubic inch in-line six cylinder internal combustion (I.C.) engine fueled by the extracted soil-gas VOC and supplemental fuel as required. Emissions are controlled by the I.C. process and redundant catalytic converters.

A vacuum blower propelled by the I.C. engine is capable of producing well flow rates of up to 120 cfm and negative pressures of up to 15 inches of mercury. AcuVac-furnished pilot test equipment also includes: a data recording system; magnehelic pressure gauges capable of reading to 0.01 inches of water; soil gas flow measuring devices; real-time field screening/analytical equipment; temperature and barometric measurement; and sampling ports for recovery of influent samples.

Pilot Test Procedure

The pilot test is proposed to be conducted using the central four-inch recovery well (VR-1). The remaining recovery wells (VR-2 through VR-5), UFZ groundwater monitoring wells (MW-17, MW-21, MW-24, and MW-25), and vapor probe cluster

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(VP-1) would be used as observation points for the pilot testing (see Figure 1). The pilot testing will be conducted at several different rates of vacuum and flow (up to the maximum capability of the extraction unit) to determine the performance characteristics of the vapor recovery well/adjacent subsurface.

Prior to each individual test, depth to water, temperature and barometric pressure, and magnehelic pressure gauge readings at each monitoring point would be recorded. After the pilot test is started, extraction well vacuum and flow and extraction system operating data (including supplemental fuel flow) will be recorded. Pressure instrumentation at each of the observation wells will be monitored and recorded to determine vacuum communication with the recovery well (demonstration of radius of influence).

The produced vapor stream (influent) will be analyzed (on a real-time basis) using field screening instruments to determine variation in influent VOC concentration. At selected intervals, influent samples will also be obtained for confirmatory laboratory analyses (EPA Method 8010 and 8020). At least one confirmatory sample will be obtained for each extraction rate test. The purpose of the screening/testing will be to determine VOC concentration variation as a function of both pumping rate/vacuum and elapsed pumping duration.

Based on previous experience, the pilot test should require no more than two days of actual vapor extraction. It is anticipated that two to four extraction rates will be tested. Each extraction rate test will nominally take three to four hours. Upon completion of testing, a detailed pilot test report, including all operating and analytical data and recommendations for operating parameters and effective vacuum radius of influence, will be compiled and provided to NMED for their review and approval.

Pilot Test Schedule

Upon authorization to proceed, it will take from two weeks to over a month to schedule a drilling contractor to install the five vapor recovery wells. Approximately one week will be required to install the wells. Sampling and analytical testing will require several more weeks. Pilot testing can then be arranged in accordance with the subcontractor's schedule. Currently, several weeks are required to mobilize the pilot test equipment; however, once equipment is on site, the actual pilot testing can be conducted in several

days. Interference with the schedule could be caused by the holiday season and possibly weather.

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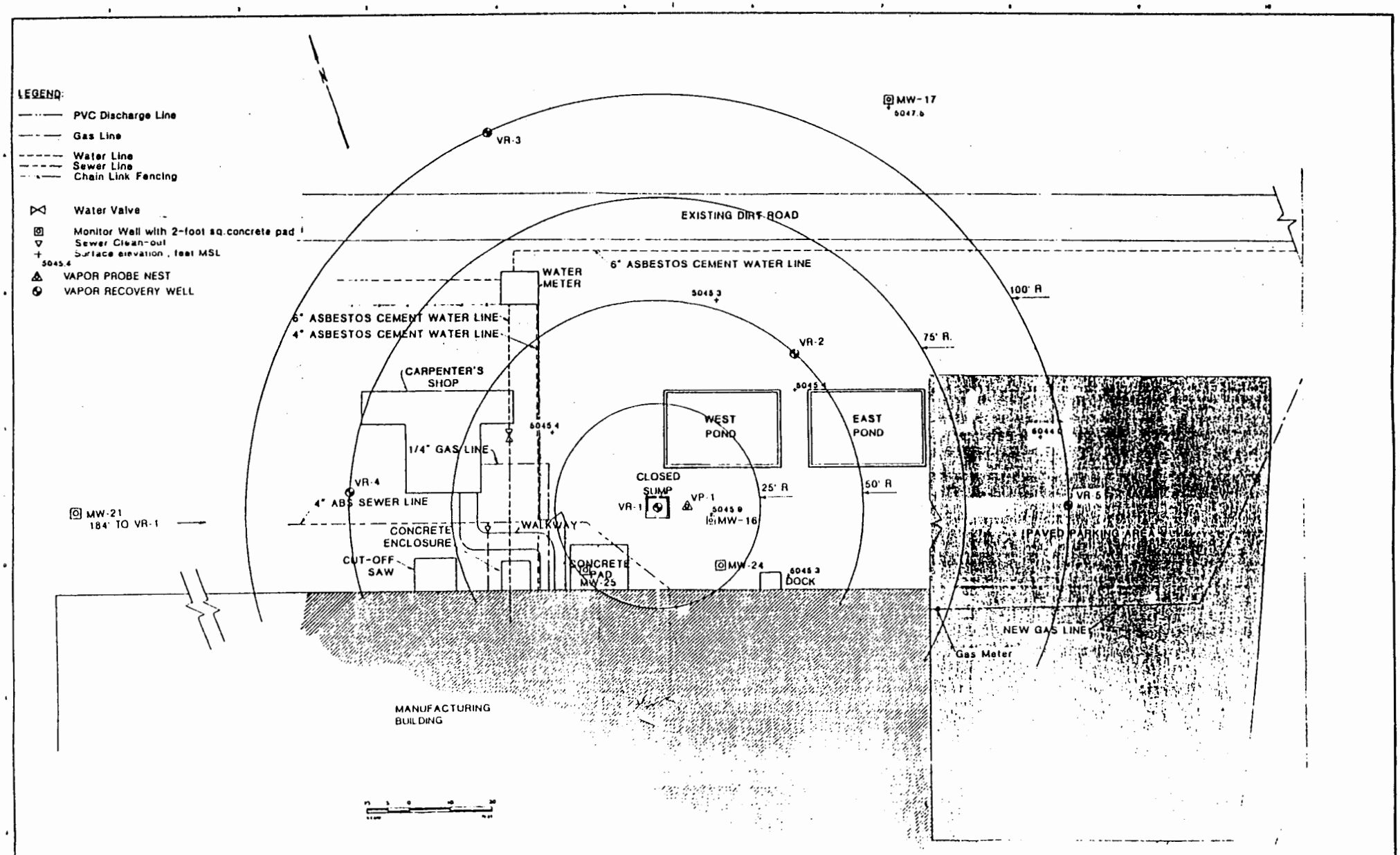

MAP SOURCE: RCRA POST-CLOSURE PERMIT APPLICATION
HARDING LAWSON ASSOCIATES, MARCH 1986

Black & Veatch
Engineers · Architects
Dallas, Texas

PROJECT NO	SPARTON TECHNOLOGY, INC. COORS ROAD FACILITY VES - PILOT TEST	FIG 1	CONTRACT NO SHEET NO

PROPOSAL

Expansion of Interim Measures (IM)
Coors Road Facility
Sparton Technology, Inc.
Albuquerque, New Mexico

Prepared for:

Sparton Technology, Inc.
Rio Rancho, New Mexico

Prepared by:

Black & Veatch
Dallas, Texas

in Association With

Metric Corporation
Albuquerque, New Mexico

Revised, December 6, 1996
Revised, January 17, 19967

Objectives

The objectives of this proposal are three-fold:

1. To address high volatile organic constituent (VOC) concentrations in groundwater at the location of groundwater monitoring wells MW-32 and MW-42.

2. To evaluate the cause of erratic VOC detections historically observed during periodic sampling of groundwater monitoring well MW-32.

3. To enhance interim onsite mass removal.

Lower lower flow zone (LLFZ) groundwater monitoring well MW-32 has historically exhibited erratic detections of volatile organic constituents (VOC). Periodically, it exhibits anomalously high concentrations relative to surrounding adjacent wells and also periodically exhibits anomalous constituents. Further, out of 13 cluster well locations, well MW-32 is the bottom well in the only cluster showing an increase in VOC concentration with depth.

The source of the erratic detections is a matter of speculation, but would include completion problems such as a defective grout seal or a cracked well casing allowing impacts of shallow contamination. Sampling procedures have been ruled out as a cause through detailed resampling and multiple split procedures.

One procedure to determine the cause of the erratic behavior would be to pump the well for an extended period and observe the effect on sampled water quality. If well MW-32 does represent a zone or area of higher VOC concentration, the extended pumping from this well would also be a form of source control and containment. It should be noted that MW-32 is also immediately downgradient of the source area. As detailed in the pump test proposal revised December 6, 1996, an additional non-detect monitor well is proposed below MW-32 to define the lower vertical limits of the VOC plume.

Upper lower flow zone (ULFZ) groundwater monitoring well MW-42 has historically exhibited high VOC concentrations and is outside the recovery area of the existing IM system. In addition, well MW-42 is also down gradient of the source area.

Proposed IM Expansion

The current IM system recovers a total of approximately 2 gpm from the upper portion of the aquifer. The treatment capacity of the IM system is 20 gpm. Well installation data for MW-32 and MW-42 indicate that combined systems pumping rates of 15 to 20 gpm could possibly be achieved. Actual production rate would be determined by installing a temporary pump in each well and conducting a limited pumping test to determine production pumping rate and drawdown. A production pump would then be sized and installed. Discharge would be routed to the existing onsite treatment unit. It should be noted that wells MW-32 and MW-42 are located close to the treatment unit -- allowing economical, secure connection. Increasing the recovery rate to 20 gpm is conditioned to the ability to obtain permits to either discharge to the sanitary sewer or, preferably, to discharge to the Calabacillas Arroyo through the existing storm sewer system.

Water levels will be measured in existing monitor wells MW-41, MW-43, MW-19, MW-20, and MW-21 (in the vicinity of MW-32 and MW-42) before and after expanded groundwater extraction begins to allow evaluation of aquifer response to pumping from MW-32 and MW-42. Discharge rates from these two wells will be monitored and produced water will be sampled and analyzed on a quarterly basis.

Installation data would be included in a report updating the current onsite groundwater recovery well system. The report would be submitted to NMED for review and approval. Production and impact on water quality would be evaluated on a periodic basis and furnished as a part of the site operation reporting.

Contingency

Additional wells will be included in the expanded IM as necessary to achieve a total combined extraction rate of 20 gpm. Any additional wells would be selected based on their potential yield and the presence of elevated VOC concentration. Based on historical data, wells to be considered for expanded IM purposes would include MW-43 and MW-19.

Schedule

The current IM system is permitted for a production of 20 gpm. Adding wells MW-32 and MW-42 to the IM system is simply a matter of conducting a limited pumping test for sizing purposes, and then installing the pump, controls, and connecting piping. It is estimated that wells MW-32 and MW-42 could be recovering water within two months

estimated that wells MW-32 and MW-42 could be recovering water within two months of authorization to discharge treated water to the storm sewer entering the Calabacillas Arroyo.

OGC-002677

Attachment 10 Pumping Test Analysis

OGC-002678 - OGC-002912

ATTACHMENT 10

Pumping Test Analysis

ATTACHMENT 10

PUMPING TEST ANALYSIS

BACKGROUND

Aquifer characteristics of the lower flow zones were determined from analysis of data obtained from two constant rate pumping tests conducted in October 1984. The two pumping tests were conducted along the southwest boundary of the Sparton property. The pump test data and details of the well installations and other information are contained in the Harding Lawson Associates (HLA) Report, Hydrogeologic Characterization and Remedial Investigation, Sparton Technology, Inc., 9621 Coors Road N.W., Albuquerque, New Mexico, dated March 13, 1985. A copy of this report is included in the Appendix to this Attachment.

The pumping tests were conducted in well PW-1, and wells MW-12, MW-13, and MW-14 were used as observation wells. A diagram or plan view of the pumping test installation is given on the attached Figure 1. The geologic cross-section corresponding to the pumping test installation is included as Figure 2 (reproduced from Figure 11 of the HLA Report). Specifically, PW-1 included a 10-inch screen and well casing installed in a 16-inch borehole. The screened interval extended from 60 feet below ground to a total depth of 138 feet. MW-12 was a 4-inch well screened from a depth of 64 feet to 133 feet. MW-13 was a 2-inch well installed in an 8-inch borehole with screen from 60 feet to 139.5 feet. MW-14 was a 2-inch well screened from 61 feet to 127 feet. The screen lengths were sufficient to completely penetrate the upper lower (ULFZ) and lower lower flow

OGC-002679

zones (LLFZ) as well as the upper flow zone (UFZ). Installation logs for each well are given in the HLA Report. Water levels were measured in each well using a computer-controlled pressure transducer system. In addition to the wells with transducer installations, hand-measured observations were also obtained during the pumping tests from monitor wells MW-4 (UFZ well), MW-10 (LLFZ well), MW-11 (LLFZ well), and MW-15 (all flow zones). Horizontal distances to the observation wells with respect to the pumping well PW-1 are as follows: MW-4 -- 300 feet northeast; MW-10 -- 310 feet northeast; MW-11 -- 480 feet northeast; MW-12 -- 45 feet north; MW-13 -- 153 feet east; MW-14 -- 345 feet northwest; and MW-15 -- 450 feet north. (See Figure 1 for location.) After the pumping tests, the wells were modified/plugged as follows:

Well No.	Status*
PW-1	Plugged back to UFZ
MW-4	Plugged
MW-10	Plugged
MW-11	Plugged
MW-12	Plugged back to UFZ
MW-13	Plugged back to UFZ
MW-14	Plugged back to UFZ
MW-15	Plugged back to UFZ
* See Figure 53, Final RFI Report.	

The pumping tests were conducted using a 25-horsepower submersible pump installed 126 feet below the top of casing in well PW-1. The discharge from the pump was directed through a 4-inch discharge pipe into the municipal sewer located just off the

southeast corner of the Sparton property. Sparton had previously obtained permission from New Mexico Utilities for the discharge during the pumping tests.

The first pumping test was scheduled as a 48-hour constant-rate test. The pumping rate was designed to be 200 gallons per minute; however, there were flow regulation problems during the first hour or so of the test. For the remainder of the test, a constant rate of 180 gallons per minute was maintained. Equilibrium or steady-state conditions developed in the pumped well and monitor wells after approximately 200 minutes of pumping and corresponded to a drawdown of approximately 25 feet in well PW-1. Pumping was continued for approximately 1300 minutes thereafter for a total pumping time of 1500 minutes (25 hours). Upon completion of the pumping interval, recovery data was obtained for three and one-half hours. However, recovery to pre-pumping water levels occurred in approximately 100 to 200 minutes.

Due to the problems with flow control management in the first hour or so of the first pumping test, a second pumping test was run at a constant rate of 189 gallons per minute to obtain information on the early portion of the pumping test. The second pumping test was run for 120 minutes. The data set looks almost identical to the first test results. Upon completion of the two-hour pumping, recovery data was obtained for approximately 30 minutes upon which the drawdown had essentially reached pre-pumping levels. It should be noted that the drawdowns observed in the second test were comparable to the first test when ratioed according to the respective pumping rates.

Transducer strip chart plots and digitized data for wells PW-1, MW-12, MW-13, and MW-14 are included in the HLA Report with the exception of the digitized time-drawdown

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data for MW-13 for the first pumping test. However, this information was synthesized from the strip chart plot of the transducer's output. (A tabulation of all pump test data is included as Tables 1 through 4.)

The original HLA Report did not contain any data plots other than the strip chart plots of the actual transducer data. For current analyses the drawdown and recovery data has been plotted in a variety of ways to allow understanding and analysis of this information. These various plots are attached as figures to this attachment. The data plots include:

1. Cartesian coordinate plots of drawdown/recovery data for the original pumping test for wells PW-1, MW-12, MW-13, and MW-14 (Figures 3-6).
2. Semi-logarithmic plots of time-drawdown information for both the original pumping test and the two-hour pumping test for wells PW-1, MW-12, MW-13, and MW-14 (Figures 7-14).
3. Semi-logarithmic plots of residual drawdown versus time (t/t') for the original pumping test for wells PW-1, MW-12, MW-13, and MW-14 (Figures 15-18).
4. Full logarithmic data plots in non-dimensional form of drawdown versus time (t/r^2) for both the original pumping tests and the two-hour pumping tests for all four wells (Figures 19-22). Note that the chosen scale is compatible with common graphical matching type curves such as those found in Lohman, etc.
5. A distance drawdown plot of the equilibrium drawdowns measured in each

of the wells to demonstrate the radius of influence existing for the pumping test of PW-1 (Figure 23).

ANALYSIS

Original Analysis

The original HLA Report contains a summary (page 43) of aquifer characteristics based on analysis of the data from each individual observation well. According to the report, these parameters were calculated using Theis and Hantush methods and also Jacob straight-line approximations to semi-logarithmic time-drawdown data. With respect to the aquifer parameters reported by HLA, significant variation was observed well to well. No attempt was made to analyze the data on a multi-well basis or consider the effects of aquifer stratification, semi-confined conditions, and/or the development of an equilibrium or steady-state drawdown condition during pumping.

Current Analysis

Continued investigation and analysis of subsurface conditions indicated a significant degree of aquifer stratification or anisotropy. Further, the intermittent presence of finer grained layers indicated that semi-confined conditions could exist. Finally, the presence of a potential recharge source (irrigation canal and irrigated fields) to the immediate east of the Sparton property suggested that equilibrium or steady-state conditions could develop during a pumping test. Recognizing the potential for these various conditions, the aquifer data was reanalyzed using a variety of methods with primary emphasis on multi-well distance drawdown analyses using the equilibrium or

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steady-state portion of the time-drawdown data for each well. Analysis was based on procedures for steady radial flow without vertical movement given in Ground Water Hydraulics by Lohman (USGS Professional Paper 708). Note that Equation 34 used in this analysis is identical to Jacob's approximation to the non-steady Theis equation (Equation 57). Using data plotted in Figure 23, a transmissivity, T, of 18,277 gallons per day per foot can be calculated. Using the extrapolated value for radius of influence(or radial distance to zero drawdown), R_o, and the previously calculated transmissivity, Lohman's Equation 59 can be utilized to obtain a storage coefficient, S, value of 0.0021. Note that this storage coefficient corresponds to an equilibrium time of 200 minutes. If an equilibrium time of 300 minutes had been used in the calculations, the storage coefficient would increase to approximately 0.003. It should be noted that the extrapolated radius of influence obtained from MW-12, MW-13, and MW-14 data agrees well with reported observations of drawdown in more remote wells up to 450 to 480 feet away (MW-11 and MW-15) as noted in the HLA Report on page 41. As a further check of equilibrium methods, data from MW-12 and MW-13 was analyzed for both confined and unconfined conditions using Lohman's Equations 31(unconfined) and 32 (confined).

For calculation purposes, an aquifer saturated thickness of 75 feet was assumed. In addition, the base of the aquifer was assumed to be at elevation 4900 which agrees reasonably well with geologic profiles of the area. Utilizing the referenced equations, a transmissivity of 17,748 gallons per day per foot was calculated for confined conditions, and a transmissivity of 18,863 gallons per day per foot was calculated for unconfined conditions. This good agreement is reasonable since the equilibrium equations recognize

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that thick unconfined aquifers with small drawdowns are similar to confined aquifers. It should be noted that these calculations agreed very well with the previous multi-well steady-state analysis.

Other types of analysis were considered as well. Using the full logarithmic plots of the time drawdown data given on Figures 19-22, a variety of possible non-steady and steady conditions were investigated. The analytical conditions considered were:

1. Non-steady radial flow without vertical movement (Theis method).
2. Leaky confined aquifers with vertical movement (Cooper method and the Hantush modified method to evaluate semi-pervious confining beds).
3. Unconfined aquifers with vertical movement (Boulton's general method and also Boulton's delayed yield procedure).
4. Aquifer boundaries and theory of images (Stallman's method).

One of the problems in applying these analytical methods to the pumping test data in Figures 19-22 is that the four wells do not provide a consistent "family" or grouping. Each of the wells appears to have its own separate family identity, although there are similarities in shape common to all four non-dimensional plots.

The data do not match Theis type curves at all. In addition, Jacob's approximation cannot be validly used on the semi-logarithmic data plots since sloping of the drawdown curve occurs only during the very early portion of the data. The individual plots have similarity to the Cooper type curves for leaky confined aquifers with vertical movement. However, it should be noted that an equilibrium condition in the time-drawdown data would also match up reasonably well to a Cooper type curve. The Hantush type curves

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for leaky confined aquifers with vertical movement through semi-pervious confining beds do not match the data at all. The test data also does not match the Boulton type curves, either for unconfined conditions with vertical movement and/or vertical movement due to delayed yield. However, individual well plots match up well with Stallman's image procedure, which it should be noted is an equilibrium type solution. However, as with the other analyses, the multi-well data plot indicates some other phenomenon is present. Obviously, there are some other flaws with using the Stallman approach, since the observation wells are located in three general compass directions away from the pumped well, and the assumed source of recharge would be only on the east side. The large curve displacement observed in the recovery data indicates that some form of recharge is obviously taking place.

The general appearance of the pump test data indicates that equilibrium and/or steady-state conditions developed at an early stage during the pumping test. Continued pumping did not result in an increase in either drawdown or area of influence. The recognition that the radius of influence is relatively constant and fairly extensive is very important with respect to the evaluation of various remedial alternatives included as part of the Corrective Measure Study (CMS). The values for transmissivity and storage obtained from the current analysis of the pump test data also seem reasonable and compare favorably to rule-of-thumb specific capacity numbers used by water well contractors in the immediate area.

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POSSIBLE PUMPING TEST ANALYSIS DEFICIENCIES

1. Significant time has elapsed since data was obtained, and field notes are unavailable from HLA. Current analysis is based on published information and data.

2. The test installation included only on-site wells. However, subsequent geologic correlation of off-site conditions to those investigated in the pumping tests indicate general applicability to the entire site.

3. Digital data for the pumping portion of the first test is unavailable for MW-13; however, this deficiency is offset by a copy of the strip chart recording of the missing data and the availability of data from the second pumping test.

4. There were pumping rate control problems in the first test and some transducer noise/interference problems noted in both tests. However, the confirmation provided by the second test satisfactorily covers the former deficiency and the overall data base is relatively unaffected by the "noise".

5. Drawdown in the pumped well PW-1 seems 20 to 30% high with respect to both cumulative log-log plotting and distance-drawdown data. Conversely the specific capacity of PW-1, reported at 7.5 gpm/ft, seems low compared to the typical 9 gpm/ft for this area (personal communication with Rogers & Co). However, it should be noted that drawdown observations in pumped wells are often suspect and the remaining observation well data is very consistent.

6. For a stratified and potentially unconfined aquifer, the pumping test typically

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should have been designed to run for 72 hours to evaluate delayed yield, etc. In fact, the pumping test was designed for 48 hours of constant rate pumping. However, since the equilibrium or steady-state conditions prevailed for approximately 22 hours of the 25-hour first test and since the second pumping test confirmed the equilibrium or steady-state condition, the lack of 72 hours of pumping data is not a serious deficiency.

7. Analysis of time-drawdown data from individual wells yields a wide range of transmissivity and some variation in storage coefficient values as previously reported by HLA report and as calculated in the current analysis. This possible deficiency is offset by the excellent agreement in the distance-drawdown data using the equilibrium portion of each data set. Further, the individual non-steady well analyses are generally based on the early portion of the time-drawdown data where either the curve shape can be matched or the curve slope can be quantified.

8. When all the pump test data is plotted together on a cumulative non-dimensional plot it is obvious that a "textbook" aquifer condition does not exist and a simple Theis solution is not available. The lack of any "family" grouping is probably more of a "real world" situation due to the aquifer complexity than a deficiency.

9. Probably the biggest deficiency was the failure to anticipate that an equilibrium or steady-state condition would develop at all, much less at a very early pumping stage. Indeed, previous analysis tried to force a non-

steady solution. However equilibrium or steady-state conditions provide a higher level of confidence in analytical results.

10. As noted in the analysis section, there is considerable ambiguity as to whether the aquifer is unconfined, partially confined or confined. However, considering the saturated thickness of the aquifer (approximately 75 feet), relatively small drawdowns at the observation wells (1.5 feet to 6 feet), and the apparent equilibrium or steady-state conditions that developed during the pumping tests, there is no significant analytical difference between confined or unconfined conditions. Indeed analysis showed differences in the order of 5% in the calculation of transmissivity. However, the calculated storage coefficient values in the range of 0.002 to 0.003 indicate essentially confined conditions. In any case, the more critical parameter, radius of influence, is well documented and not dependent on aquifer confinement evaluation.

CONCLUSIONS AND RECOMMENDATIONS

Aquifer parameters for the lower flow zones obtained from current analysis of the 1984 pumping test data are adequate for the evaluation of various remedial alternatives to be included in the Corrective Measure Study (CMS). Although these aquifer parameters were developed from on-site pumping tests, geologic correlation off-site indicates general application to the entire plume area.

A radius of influence, R_o, of approximately 600 feet has been demonstrated by both

analytical methods (see Figure 23) and remote observation points during actual pumping. This value should be used in future calculations of capture area, etc. The 600-ft radius of influence reflects steady-state or equilibrium conditions; i.e., it is not a time-dependent value. It should also be noted that this radius of influence will not be affected by pumping rate.

A transmissivity, T, of 18,000 gpd/ft has generally been calculated for the data base as a whole, with lesser values in the order of 12,000 to 14,000 gpd/ft considering only PW-1 data. For conservative design, a transmissivity of 18,000 gpd/ft is recommended.

Both the HLA Report and current analysis indicate a storage coefficient, S, value in the range of 0.002 to 0.003. Some individual analyses indicate a storage coefficient an order of magnitude less. However, considering that radius of influence is well defined, a storage coefficient of 0.0025 is recommended as a conservative measure.

Finally, it should be recognized in any pumping system design that the aquifer is significantly stratified with significant anisotropy. As a result, fully penetrating pumped wells with significant drawdowns could cause downward vertical movement of contaminants from near-water-surface (UFZ) high-constituent-concentration areas.

Analysis by Pierce L. Chandler, Jr., P.E.

HDR Engineering, Inc.

May 1, 1992

OGC-002690

SAMPLE CALCULATIONS

I. LOWER FLOW ZONES

A. Steady radial flow without vertical movement

1. Using distance-drawdown data given on Figure 23, the Transmissivity, T, may be calculated from:

$$T = \frac{2.30\ Q}{2\pi\ \Delta s/\Delta \log_{10} r}$$

(Lohman, Eq 34, units of $L^2\ T^{-1}$)

with appropriate conversions for T expressed in gallons per day per foot, the equation becomes

$$T = \frac{528\ Q}{\Delta s/\Delta \log_{10} r}$$

where Q = 180 gallons per minute and

$\Delta s/\Delta \log_{10} r$ = 5.2 feet/cycle

T = 18277 gallons per day per foot

The Storage Coefficient, S, may be determined from the calculated T; the radial distance to zero drawdown, r_o = 600 feet extrapolated from the data in Figure 23; and, the nominal time to equilibrium, t_e, of 200 minutes (0.139 days) using:

$$S = 2.25\ T \left(\frac{t}{r^2}\right)_0 \qquad \text{(Lohman, Eq 59, Dimensionless)}$$

with appropriate conversion factors for T in gallons per day per foot

$$S = \frac{0.3\ T\ t_e}{r_0^{\ 2}} = \frac{0.3\ (18277\ \text{gal/day/ft})\ (0.139\ \text{days})}{(600\ \text{ft})^2}$$

S = 0.0021

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note that if $t_e \approx 300$ minutes

$$\mathbf{S \cong 0.003}$$

2. Using data from MW-12 and MW-13, and assuming <u>confined</u> conditions, Transmissivity was checked using:

$$T = \frac{2.30\ Q \log_{10}(r_2/r_1)}{2\pi\ (s_1 - s_2)} \quad \text{(Lohman, Eq 32, } L^2T^{-1} \text{ units)}$$

in typical units,

$$T = \frac{528\ Q \log_{10}(r_{MW\text{-}13}/r_{MW\text{-}12})}{s_{MW\text{-}12} - s_{MW\text{-}13}}$$

For $Q = 180$ gpm
$r_{MW\text{-}12} = 45$ feet
$r_{MW\text{-}13} = 150$ feet
$s_{MW\text{-}12} = 5.9$ feet
and $s_{MW\text{-}13} = 3.1$ feet,
the calculation of T is:

$$T = \frac{528\ (180\ \text{gpm})\ \log_{10}(150\ \text{ft}/45\ \text{ft})}{5.9\ \text{ft} - 3.1\ \text{ft}}$$

$$\mathbf{T = 17{,}748\ gal/day/ft}$$

3. Using the MW-12 and MW-13 data, but assuming <u>unconfined</u> conditions; a saturated thickness, b, equal to 75 feet; and the base of the aquifer at an elevation of 4900 feet, T may be calculated using:

$$K = \frac{2.30\ Q \log_{10}(r_2/r_1)}{\pi\ (h^2_2 - h^2_1)} \quad \text{(Lohman, Eq 31, } LT^{-1} \text{ units)}$$

and $T = Kb$

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with appropriate conversion factors, the combined equation becomes:

$$T = \frac{1055\ b\ Q \log_{10}(r_{MW\text{-}13}/r_{MW\text{-}12})}{(h_{MW\text{-}13})^2 - (h_{MW\text{-}12})^2}$$

For $Q = 180$ gpm
$b = 75$ ft
$r_{MW\text{-}12} = 45$ ft
$r_{MW\text{-}13} = 150$ ft
$h_{MW\text{-}12} = 69.1$ ft (75 ft - 5.9 ft)
$h_{MW\text{-}13} = 71.9$ ft (75 ft - 3.1 ft)

$$T = \frac{1055\ (75\ \text{ft})\ (180\ \text{gpm})\ \log_{10}(150\ \text{ft}/45\ \text{ft})}{(71.9\ \text{ft})^2 - (69.1\ \text{ft})^2}$$

T = 18863 gal/day/ft

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II. UPPER FLOW ZONE (from Draft Effectiveness Report)

A. Calculation of In Situ Field Permeability, K

1. Using the pump test drawdown values measured after the pump was shut off, the permeability may be calculated with:

$$K = \frac{d^2 \ln(2\, m\, L/D)}{8\, L\, (t_2 - t_1)} \quad \ln (H_1/H_2)$$

(Hvorslev, 1951)*

* Case G, well point-filter in uniform sand, for variable head tests with the condition $m\, L/D > 4$ (see Figure 1).

Where:

K_h = Horizontal Coefficient of Permeability
K_v = Vertical Coefficient of Permeability
m = Transformation Ratio = $\sqrt{K_h/K_v}$
d = Diameter, standpipe
D = Diameter, intake pipe
L = Length of intake
t = time
H_1 = Drawdown at time t_1
H_2 = Drawdown at time t_2

2. An example of the calculations for Recovery Well PW-1 follows: Using these parameters for Recovery Well PW-1,

m = 3 (approximated)
d = 25.4 cm
D = 25.4 cm
L = 304.8 cm
m L/D = 36 > 4

Hvorslev's equation reduces to

$$K_h = \frac{1.13}{t_2 - t_1} \ln (H_1/H_2)$$

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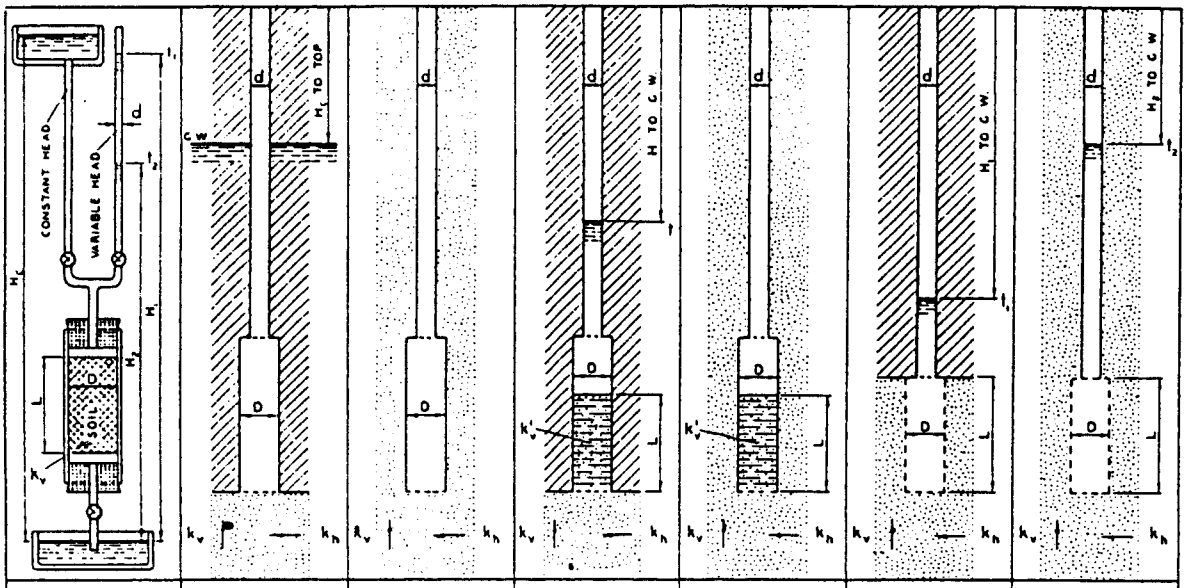


LABORATORY PERMEAMETER (CONSOLIDOMETER) A	FLUSH BOTTOM AT IMPERVIOUS BOUNDARY B	FLUSH BOTTOM IN UNIFORM SOIL C	SOIL IN CASING AT IMPERVIOUS BOUNDARY D	SOIL IN CASING IN UNIFORM SOIL E	WELL POINT-FILTER AT IMPERVIOUS BOUNDARY F	WELL POINT-FILTER IN UNIFORM SOIL G

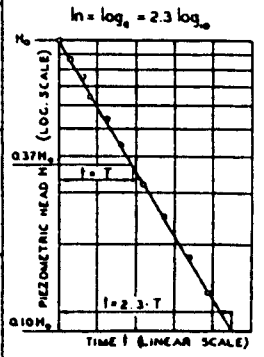
CASE	CONSTANT HEAD	VARIABLE HEAD	BASIC TIME LAG
A	$k_v = \frac{4 \cdot q \cdot L}{\pi \cdot D^2 \cdot H_c}$	$k_v = \frac{d^2 \cdot L}{D^2 \cdot (t_2 - t_1)} \ln \frac{H_1}{H_2}$ $k_v = \frac{L}{t_2 - t_1} \ln \frac{H_1}{H_2}$ FOR $d = D$	$k_v = \frac{d^2 \cdot L}{D^2 \cdot T}$ $k_v = \frac{L}{T}$ FOR $d = D$
B	$k_m = \frac{q}{2 \cdot D \cdot H_c}$	$k_m = \frac{\pi \cdot d^2}{8 \cdot D \cdot (t_2 - t_1)} \ln \frac{H_1}{H_2}$ $k_m = \frac{\pi \cdot D}{8 \cdot (t_2 - t_1)} \ln \frac{H_1}{H_2}$ FOR $d = D$	$k_m = \frac{\pi \cdot d^2}{8 \cdot D \cdot T}$ $k_m = \frac{\pi \cdot D}{8 \cdot T}$ FOR $d = D$
C	$k_m = \frac{q}{2.75 \cdot D \cdot H_c}$	$k_m = \frac{\pi \cdot d^2}{11 \cdot D \cdot (t_2 - t_1)} \ln \frac{H_1}{H_2}$ $k_m = \frac{\pi \cdot D}{11 \cdot (t_2 - t_1)} \ln \frac{H_1}{H_2}$ FOR $d = D$	$k_m = \frac{\pi \cdot d^2}{11 \cdot D \cdot T}$ $k_m = \frac{\pi \cdot D}{11 \cdot T}$ FOR $d = D$
D	$k'_v = \frac{4 \cdot q \cdot \left[\frac{\pi}{8} \cdot \frac{k'_v}{k_v} \cdot \frac{D}{m} + L\right]}{\pi \cdot D^2 \cdot H_c}$	$k'_v = \frac{d^2 \cdot \left[\frac{\pi}{8} \cdot \frac{k'_v}{k_v} \cdot \frac{D}{m} + L\right]}{D^2 \cdot (t_2 - t_1)} \ln \frac{H_1}{H_2}$ $k_v = \frac{\frac{\pi}{8} \cdot \frac{D}{m} + L}{t_2 - t_1} \ln \frac{H_1}{H_2}$ FOR $k'_v = k_v$, $d = D$	$k'_v = \frac{d^2 \cdot \left[\frac{\pi}{8} \cdot \frac{k'_v}{k_v} \cdot \frac{D}{m}\right] + L}{D^2 \cdot T}$ $k_v = \frac{\frac{\pi}{8} \cdot \frac{D}{m} + L}{T}$ FOR $k'_v = k_v$, $d = D$
E	$k'_v = \frac{4 \cdot q \cdot \left[\frac{\pi}{11} \cdot \frac{k'_v}{k_v} \cdot \frac{D}{m} + L\right]}{\pi \cdot D^2 \cdot H_c}$	$k'_v = \frac{d^2 \cdot \left[\frac{\pi}{11} \cdot \frac{k'_v}{k_v} \cdot \frac{D}{m} + L\right]}{D^2 \cdot (t_2 - t_1)} \ln \frac{H_1}{H_2}$ $k_v = \frac{\frac{\pi}{11} \cdot \frac{D}{m} + L}{t_2 - t_1} \ln \frac{H_1}{H_2}$ FOR $k'_v = k_v$, $d = D$	$k'_v = \frac{d^2 \cdot \left[\frac{\pi}{11} \cdot \frac{k'_v}{k_v} \cdot \frac{D}{m} + L\right]}{D^2 \cdot T}$ $k'_v = \frac{\frac{\pi}{11} \cdot \frac{D}{m} + L}{T}$ FOR $k'_v = k_v$, $d = D$
F	$k_h = \frac{q \cdot \ln \left[\frac{2mL}{D} + \sqrt{1 + \left(\frac{2mL}{D}\right)^2}\right]}{2 \cdot \pi \cdot L \cdot H_c}$	$k_h = \frac{d^2 \ln \left[\frac{2mL}{D} + \sqrt{1 + \left(\frac{2mL}{D}\right)^2}\right]}{8 \cdot L \cdot (t_2 - t_1)} \ln \frac{H_1}{H_2}$ $k_h = \frac{d^2 \cdot \ln \left(\frac{4mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \ln \frac{H_1}{H_2}$ FOR $\frac{2mL}{D} > 4$	$k_h = \frac{d^2 \cdot \ln \left[\frac{2mL}{D} + \sqrt{1 + \left(\frac{2mL}{D}\right)^2}\right]}{8 \cdot L \cdot T}$ $k_h = \frac{d^2 \cdot \ln \left(\frac{4mL}{D}\right)}{8 \cdot L \cdot T}$ FOR $\frac{2mL}{D} > 4$
G	$k_h = \frac{q \ln \left[\frac{mL}{D} + \sqrt{1 + \left(\frac{mL}{D}\right)^2}\right]}{2 \pi L \cdot H_c}$	$k_h = \frac{d^2 \cdot \ln \left[\frac{mL}{D} + \sqrt{1 + \left(\frac{mL}{D}\right)^2}\right]}{8 \cdot L \cdot (t_2 - t_1)} \ln \frac{H_1}{H_2}$ $k_h = \frac{d^2 \cdot \ln \left(\frac{2mL}{D}\right)}{8 \cdot L \cdot (t_2 - t_1)} \ln \frac{H_1}{H_2}$ FOR $\frac{mL}{D} > 4$	$k_h = \frac{d^2 \cdot \ln \left[\frac{mL}{D} + \sqrt{1 + \left(\frac{mL}{D}\right)^2}\right]}{8 \cdot L \cdot T}$ $k_h = \frac{d^2 \cdot \ln \left(\frac{2mL}{D}\right)}{8 \cdot L \cdot T}$ FOR $\frac{mL}{D} > 4$

NOTATION

D = DIAM. INTAKE, SAMPLE, CM
d = DIAMETER, STANDPIPE, CM
L = LENGTH, INTAKE, SAMPLE, CM
H_c = CONSTANT PIEZ. HEAD, CM
H_1 = PIEZ. HEAD FOR $t = t_1$, CM
H_2 = PIEZ. HEAD FOR $t = t_2$, CM
q = FLOW OF WATER, CM^3/SEC.
t = TIME, SEC.
T = BASIC TIME LAG, SEC.
k'_v = VERT. PERM. CASING, CM/SEC.
k_v = VERT. PERM. GROUND, CM/SEC.
k_h = HORZ. PERM. GROUND, CM/SEC.
k_m = MEAN COEFF. PERM., CM/SEC.
m = TRANSFORMATION RATIO

$k_m = \sqrt{k_h \cdot k_v}$ $\quad m = \sqrt{k_h / k_v}$

$\ln = \log_e = 2.3 \log_{10}$



DETERMINATION BASIC TIME LAG T

ASSUMPTIONS

SOIL AT INTAKE, INFINITE DEPTH AND DIRECTIONAL ISOTROPY (k_v AND k_h CONSTANT) - NO DISTURBANCE, SEGREGATION, SWELLING OR CONSOLIDATION OF SOIL - NO SEDIMENTATION OR LEAKAGE - NO AIR OR GAS IN SOIL, WELL POINT, OR PIPE - HYDRAULIC LOSSES IN PIPES, WELL POINT OR FILTER NEGLIGIBLE

Formulas for determination of permeability

Figure 1.

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The permeability for various values of H_1, H_2, t_1, t_2 was calculated, then averaged for a reported value as shown in Table 1 below.

Table 1

H_1 (ft)	t_1 (sec)	H_2 (ft)	t_2 (sec)	$\ln(H_1/H_2)$	t_2-t_1(sec)	K_h(cm/sec)
1.98	0	1.90	120	0.041	120	3.86×10^{-4}
1.94	45	1.86	210	0.042	165	2.88×10^{-4}
1.88	150	1.73	360	0.083	210	4.47×10^{-4}
1.80	300	1.66	600	0.081	300	3.05×10^{-4}
1.63	720	1.50	1080	0.083	360	2.61×10^{-4}
1.50	1080	0.93	3000	0.478	1920	2.81×10^{-4}
0.93	3000	0.42	6000	0.795	3000	2.99×10^{-4}

average K_h: 3.24×10^{-4} cm/sec

Table 2 provides a summary of field permeabilities for all eight Recovery Wells and MW-16.

Table 2

Well No.	In situ field permeabilities (cm/sec)
PW-1	3.24×10^{-4}
MW-16	2.39×10^{-4}
MW-18	3.46×10^{-4}
MW-23	2.53×10^{-3}
MW-24	4.36×10^{-4}
MW-25	4.50×10^{-4}
MW-26	3.56×10^{-4}
MW-27	2.90×10^{-3}
MW-28	2.91×10^{-5}

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B. Calculation of Radius of Influence, r_o

1. Using the permeabilities calculated with Hvorslev's equation and a well drawdown equal to the upper flow zone saturated thickness, the Radius of Influence (r_o) at each well location may be calculated with the following equation:

$$r_o = C (H - h_w) \sqrt{K}$$ (Sichardt's method, U.S. Department of the Army, 1971)

Where:

r_o = Radius of Influence, ft
C = Empirical Relation of K vs. r
H = Height of water table (saturated thickness), ft
h_w = Head of water in well, ft
K = Coefficient of Permeability, microns/sec

2. An example of the calculations for Recovery Well PW-1 follows:

C = 3 (for a single well)
K_h = 3.24×10^{-4} cm/sec = 3.24 microns/sec
$H-h_w$ = 10 ft
r_o = 3 (10ft) ($\sqrt{3.24}$)
r_o = 54 ft

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Table 3 provides a summary of calculated Radii of Influence for all eight Recovery Wells and MW-16.

Table 3

Well No.	Calculated Radius of Influence (ft)
PW-1	54
MW-16	46
MW-18	56
MW-23	136
MW-24	63
MW-25	93
MW-26	57
MW-27	162
MW-28	35

C. Calculation of Transmissivity, T

1. Using the permeability values calculated with Hvorslev's equation and an upper flow zone saturated thickness of 10 feet, the Transmissivity, T, for each well location may be calculated with the following equation:

$$T = k\,b$$

Where:

T = Transmissivity
k = Permeability
b = saturated thickness

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2. An example of the calculations for Recovery Well PW-1 follows:

$k = 3.24 \times 10^{-4}$ cm/sec = 0.28 m/day
b = 10 ft = 3.05 m

T = (0.28 m/day) (3.05 m) (80.5 gal/day/ft per m^2/day)
= **68.7 gal/day/ft**

Table 4 provides a summary of Transmissivity values for all eight Recovery Wells and MW-16.

Table 4

Well No.	Transmissivity, T (gal/day/ft)
PW-1	68.7
MW-16	50.7
MW-18	73.7
MW-23	536.4
MW-24	92.5
MW-25	95.5
MW-26	75.5
MW-27	615.0
MW-28	6.2

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D. Calculation of Storage Coefficient, S

1. Using the Transmissivity, T, and Radius of Influence, r_o, values previously calculated, as well as the elapsed time from pump test start to finish, the Storage Coefficient, S, for each well location may be calculated with:

$$S = 2.25\, T \left(\frac{t}{r^2} \right)_0 \qquad \text{(Lohman, Eq 59, Dimensionless)}$$

Where:

S = Storage Coefficient
T = Transmissivity
t = time
r_o = Radius of Influence

2. An example of the calculation for Recovery Well PW-1 follows:

T = 68.7 gal/day/ft = 0.84 m^2/day
t = 4332 min = 3.0 days
r_o = 54 ft = 16.5 m

$$S = \frac{2.25\ (0.84\ m^2/day)\ (3.0\ days)}{(16.5\ m)^2}$$

S = 0.0205

OGC-002700

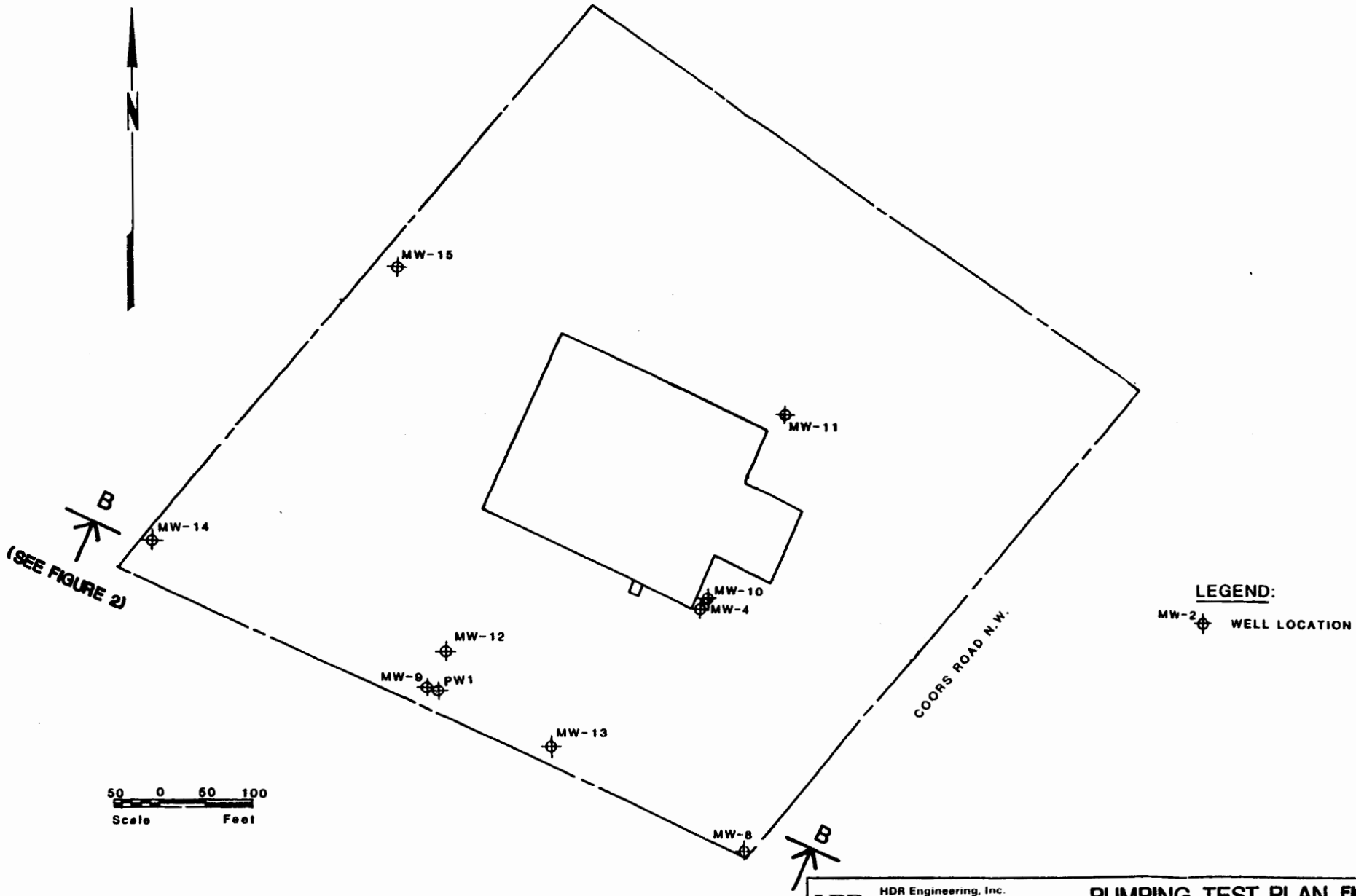
Table 5 provides a summary of Storage Coefficient values for all eight Recovery Wells and MW-16.

Table 5

Well No.	Storage Coefficient, S
PW-1	0.0205
MW-16	0.0217
MW-18	0.0144
MW-23	0.0261
MW-24	0.0214
MW-25	0.0095
MW-26	0.0207
MW-27	0.0206
MW-28	0.0045

OGC-002701

OGC-002702



REFERENCE: SPARTON TECH. INC. SURVEY BY DENNEY-GROSS & ASSOC., INC., DATED 10/5/84

HDR

HDR Engineering, Inc.
Suite 125
12700 Hillcrest Road
Dallas, Texas
75230-2096

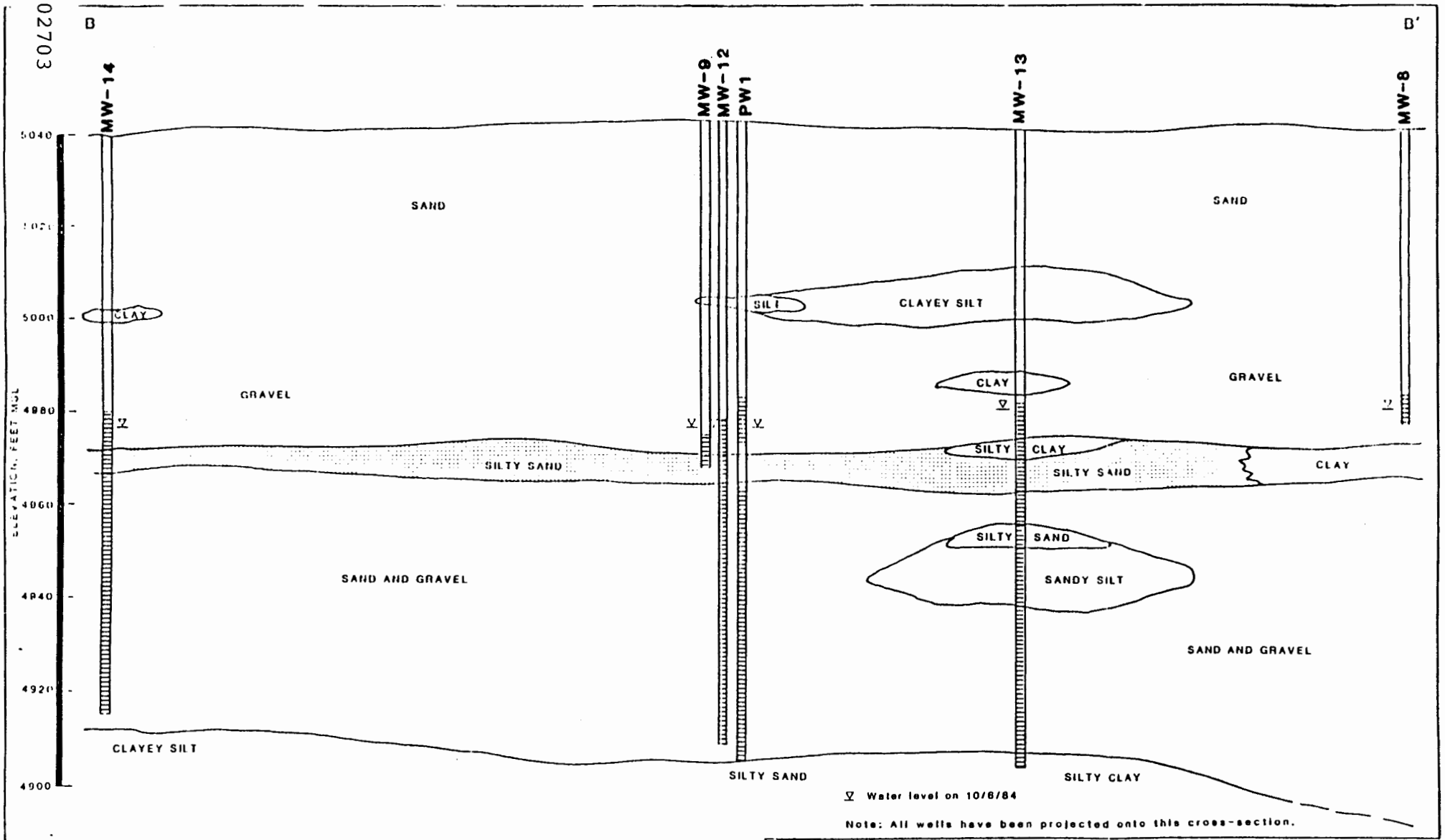
PUMPING TEST PLAN

Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 1

DRAWN | JOB NUMBER | APPROVED | DATE

OGC-002703



50 0 50 100
scale HORIZONTAL feet

HDR Engineering, Inc.
Suite 125
12700 Hillcrest Road
Dallas, Texas
75230-2096

GEOLOGIC CROSS-SECTION B-B'
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 2

DRAWN | JOB NUMBER | APPROVED | DATE | REVISED | DATE

OGC-002704

25 HOUR PUMPING TEST WELL PW-1

DRAWDOWN RECOVERY

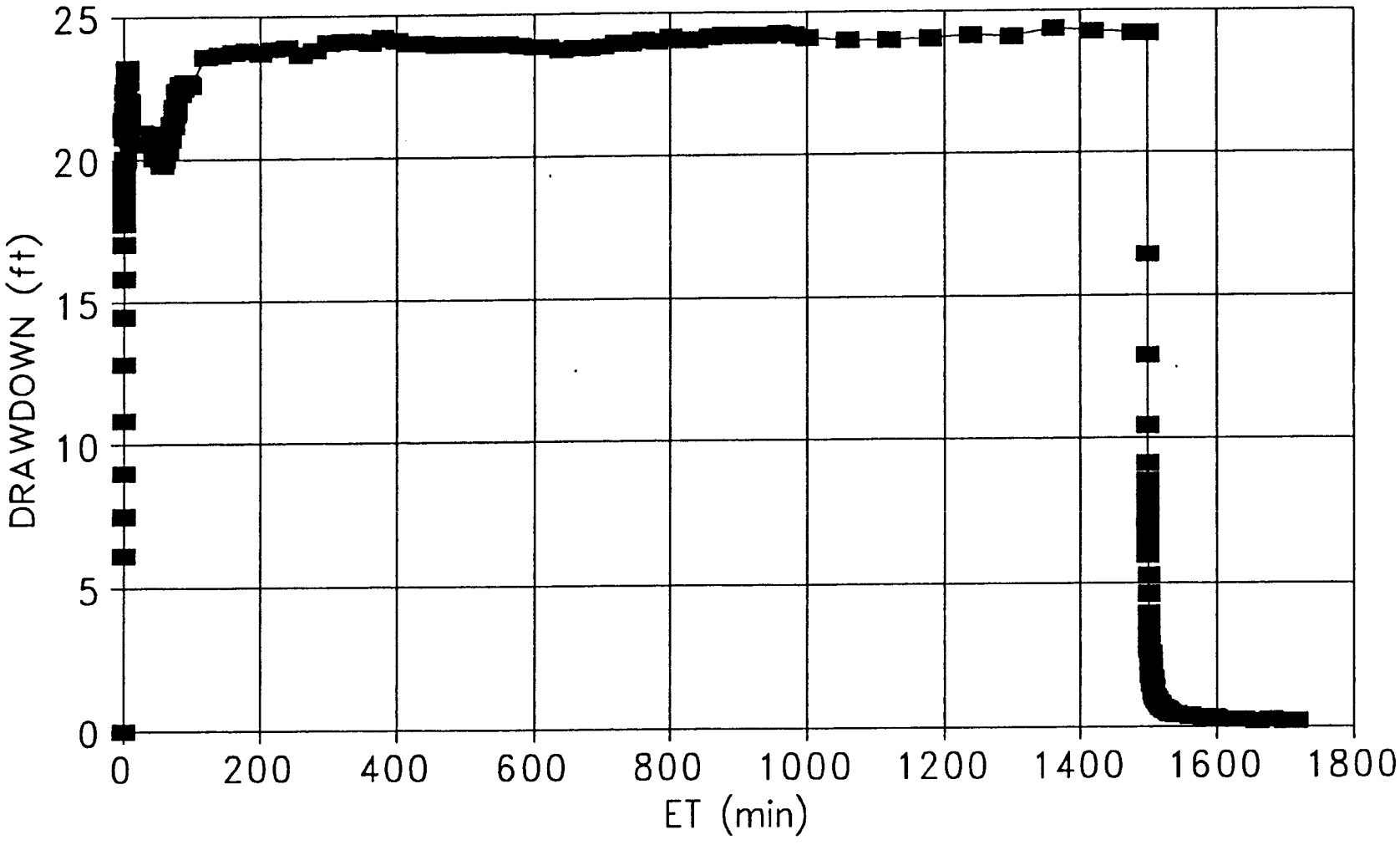


FIGURE 3

OGC-002705

25 HOUR PUMPING TEST WELL MW-12

DRAWDOWN RECOVERY

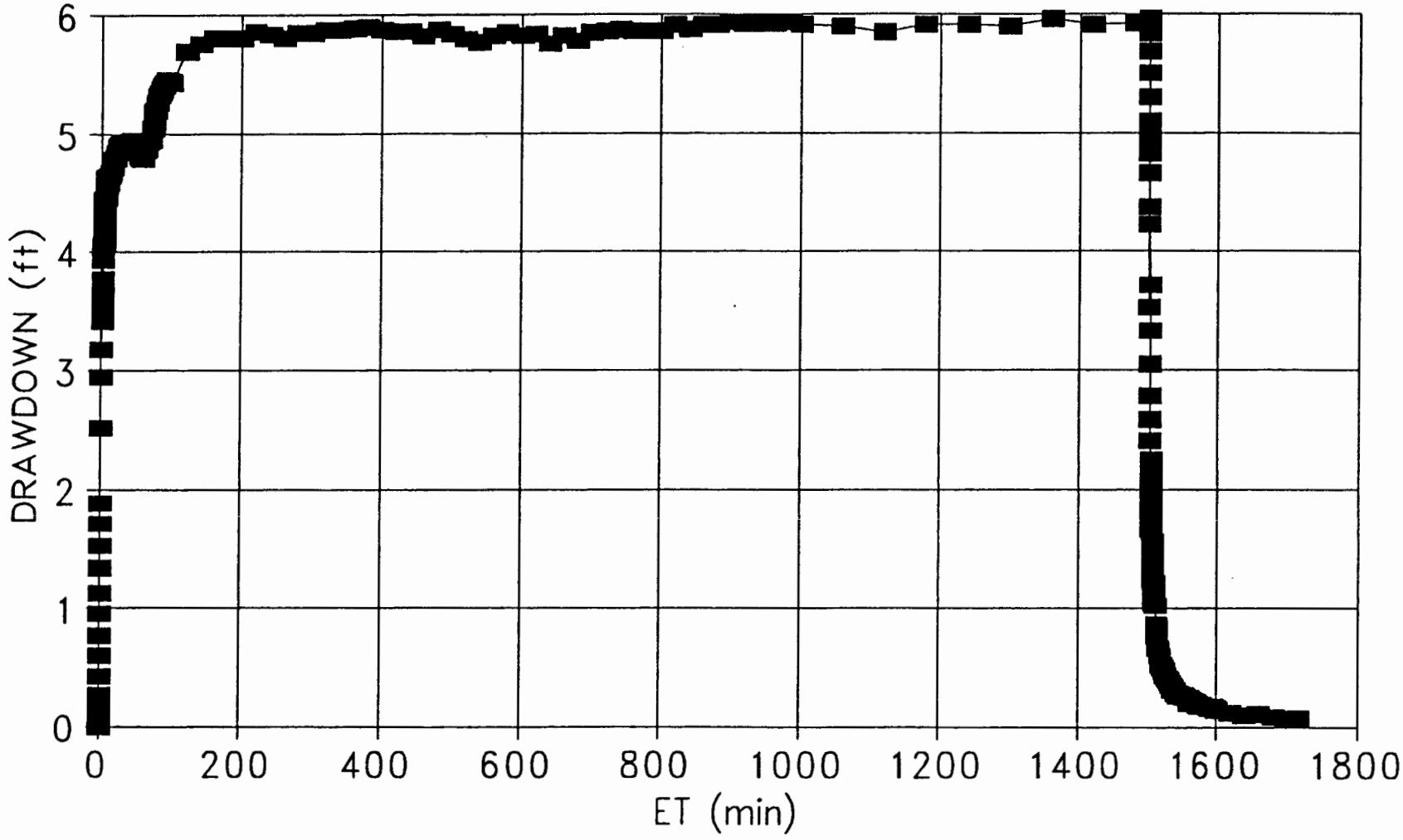


FIGURE 4

OGC-002706

25 HOUR PUMPING TEST WELL MW-13

DRAWDOWN RECOVERY

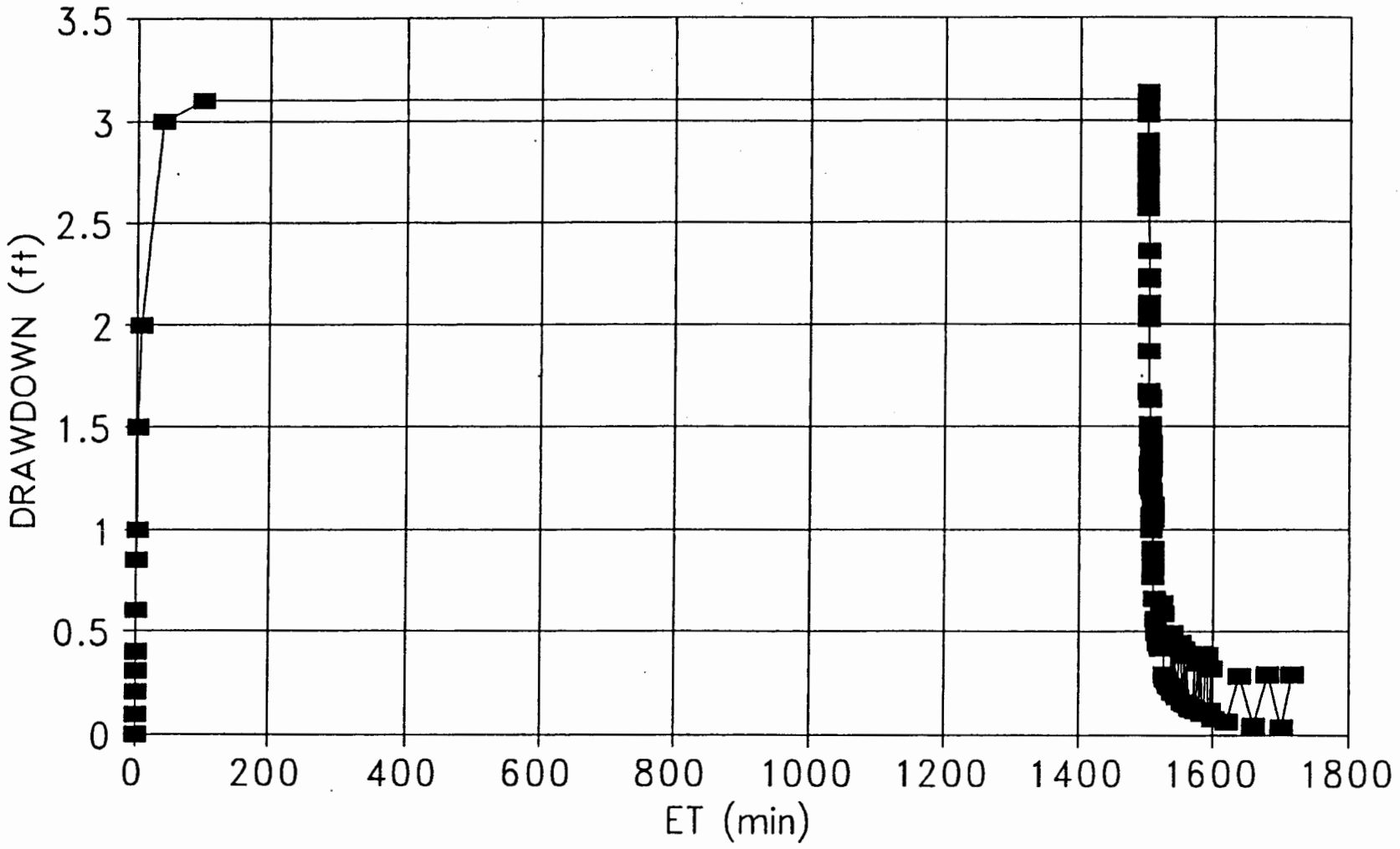


FIGURE 5

OGC-002707

25 HOUR PUMPING TEST WELL MW-14

DRAWDOWN RECOVERY

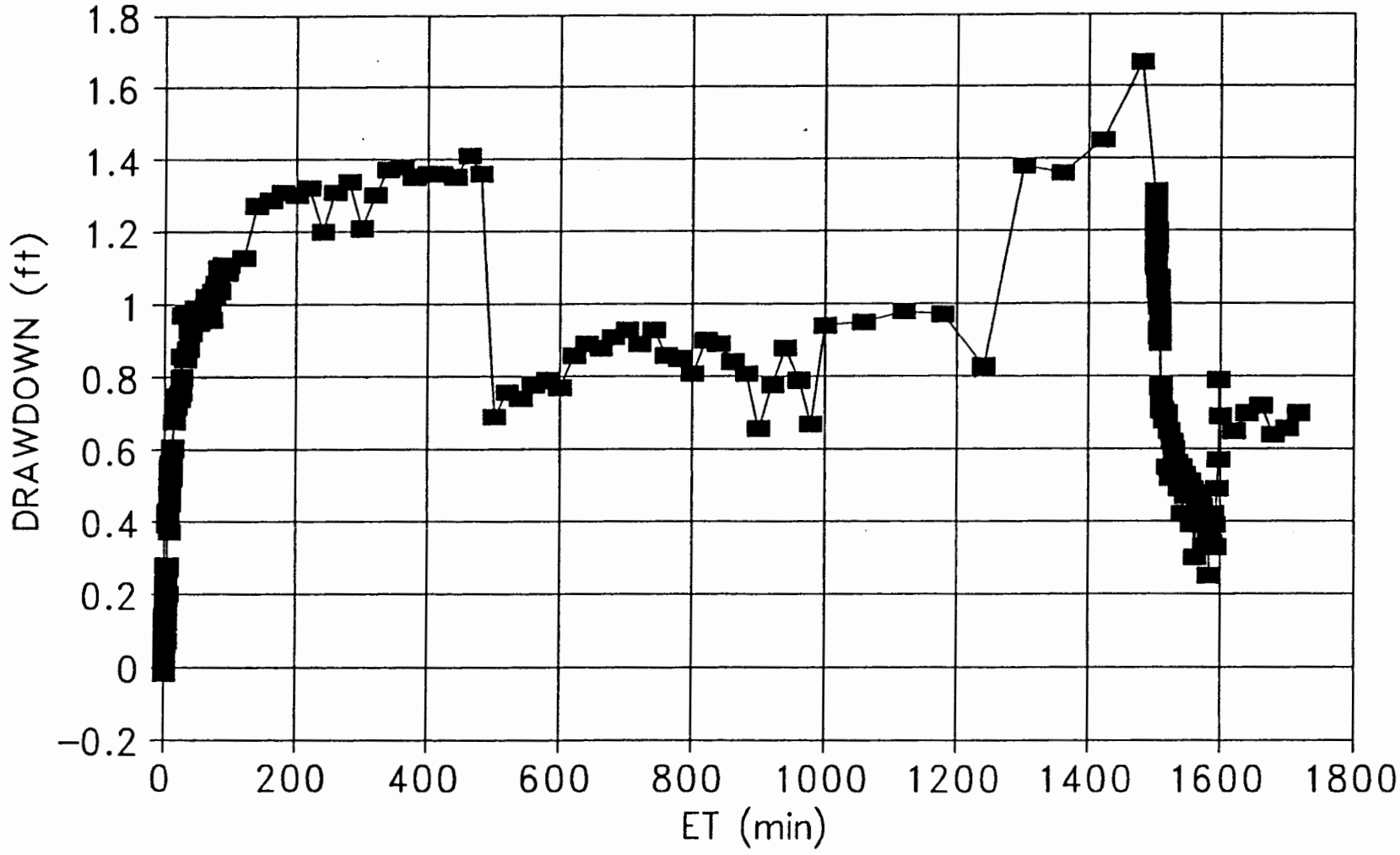


FIGURE 6

OGC-002708

25 HOUR PUMPING TEST WELL PW-1

DRAWDOWN RECOVERY

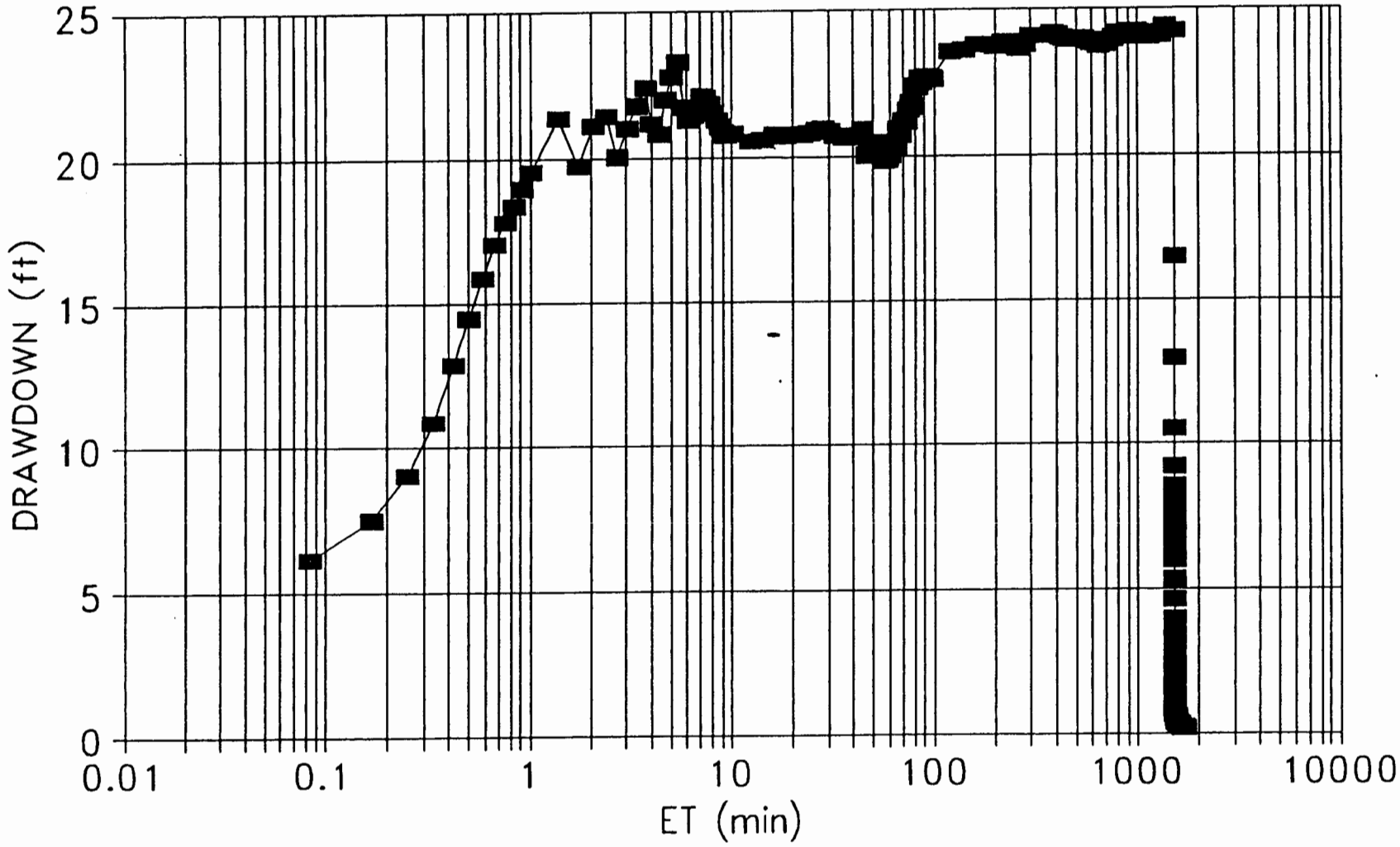


FIGURE 7

OGC-002709

25 HOUR PUMPING TEST WELL MW-12

DRAWDOWN RECOVERY

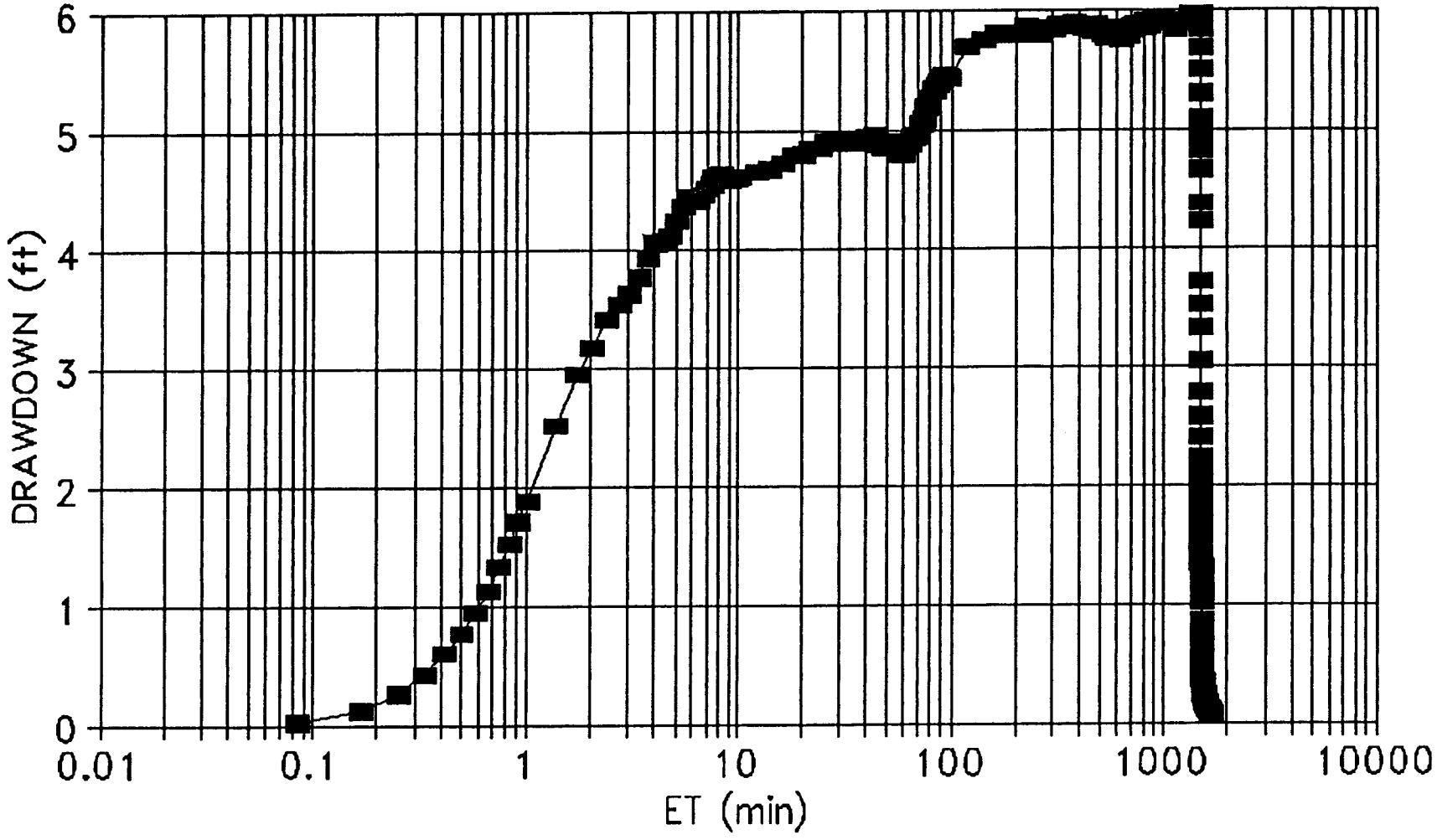


FIGURE 8

OGC-002710

25 HOUR PUMPING TEST WELL MW-13

DRAWDOWN RECOVERY

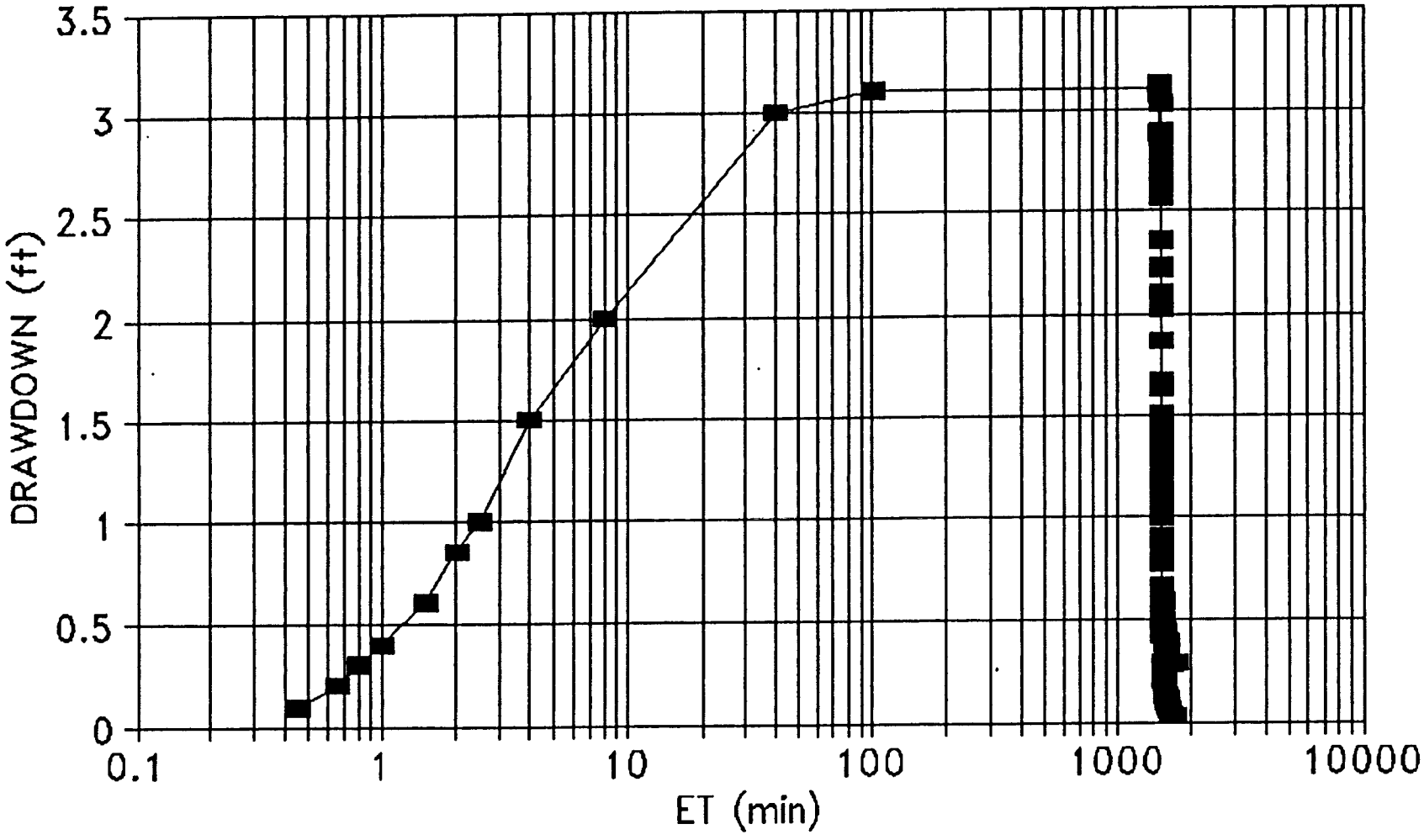


FIGURE 9

OGC-002711

25 HOUR PUMPING TEST WELL MW-14

DRAWDOWN RECOVERY

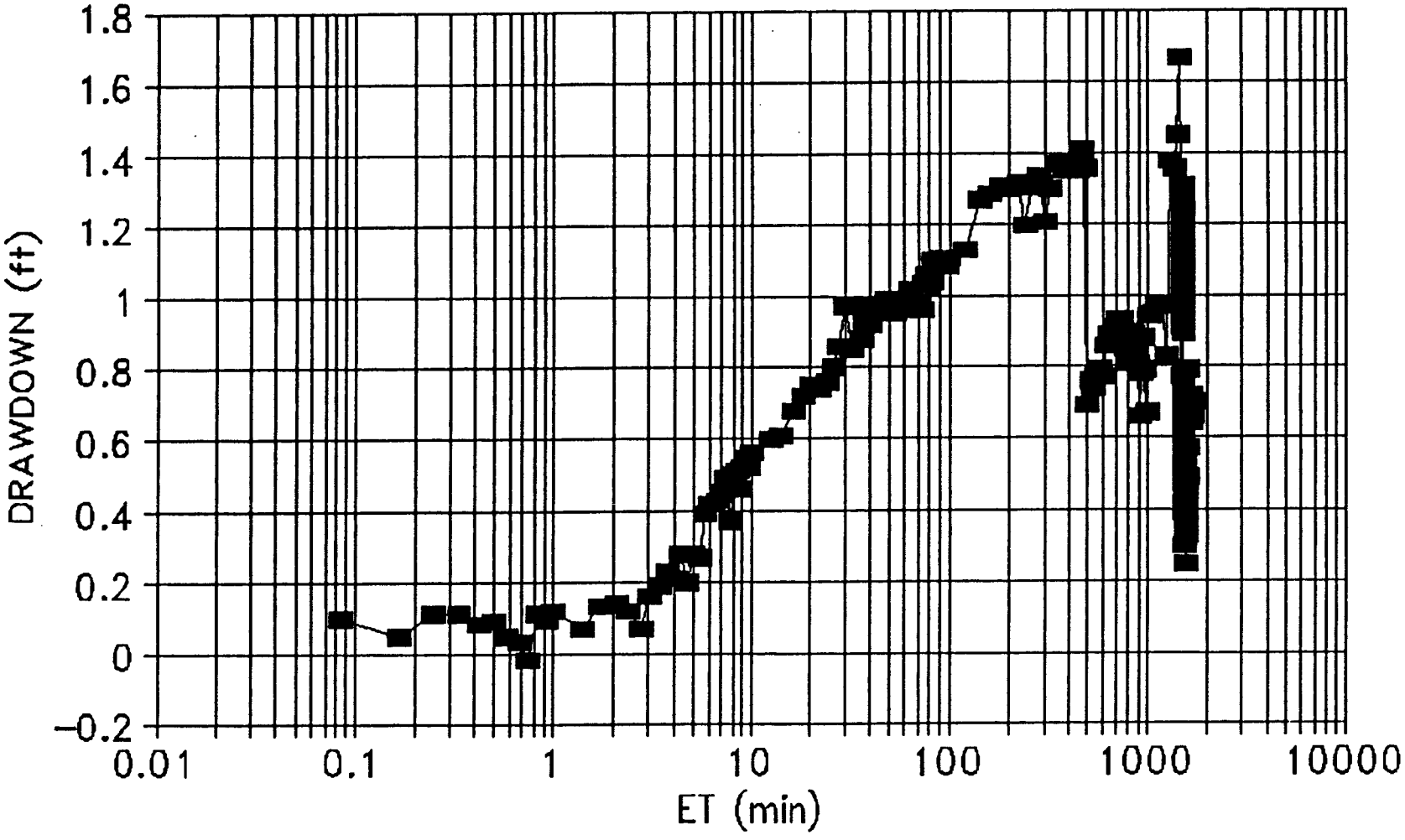


FIGURE 10

OGC-002712

2 HOUR PUMPING TEST WELL PW-1

DRAWDOWN

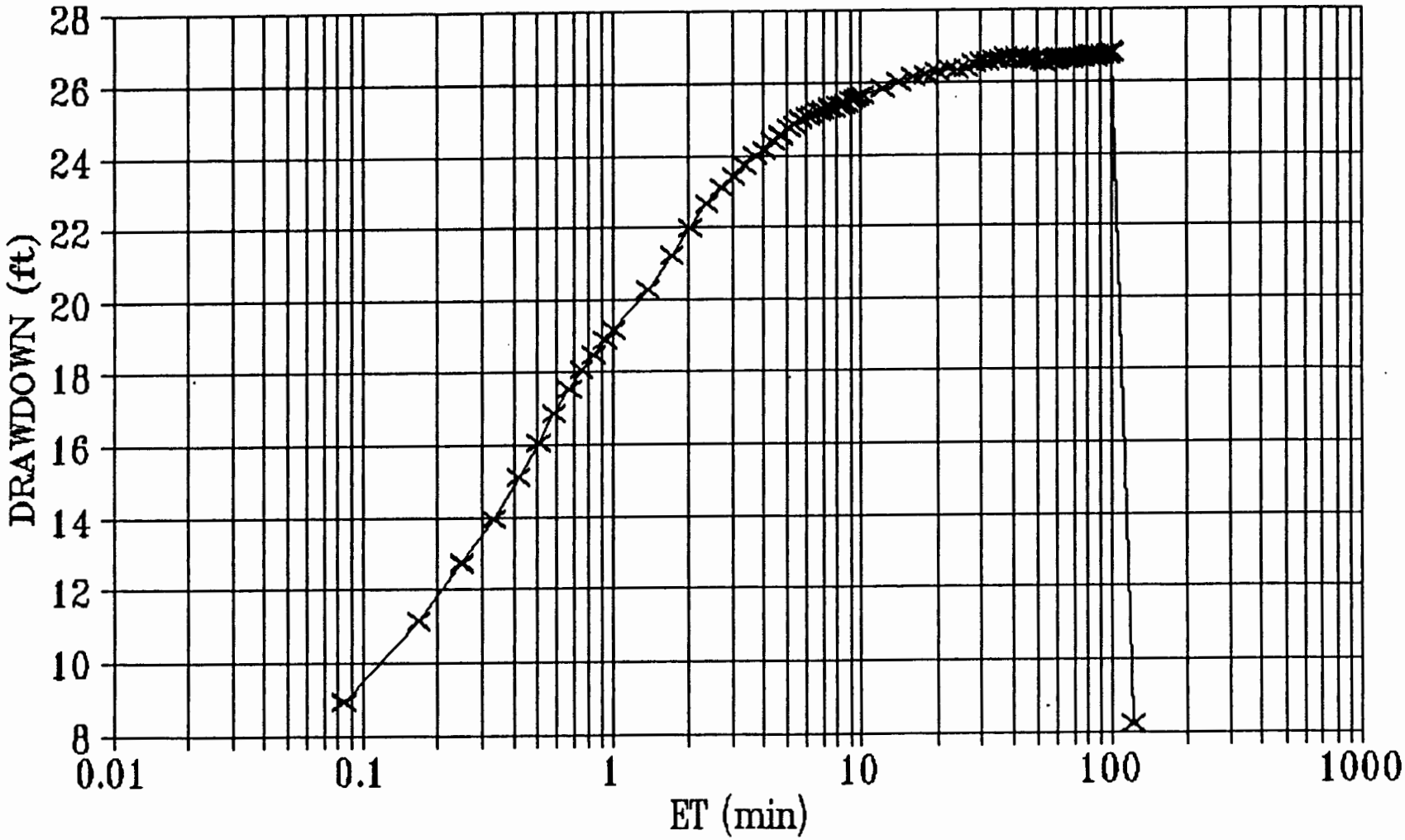


FIGURE 11

OGC-002713

2 HOUR PUMPING TEST WELL MW-12

DRAWDOWN

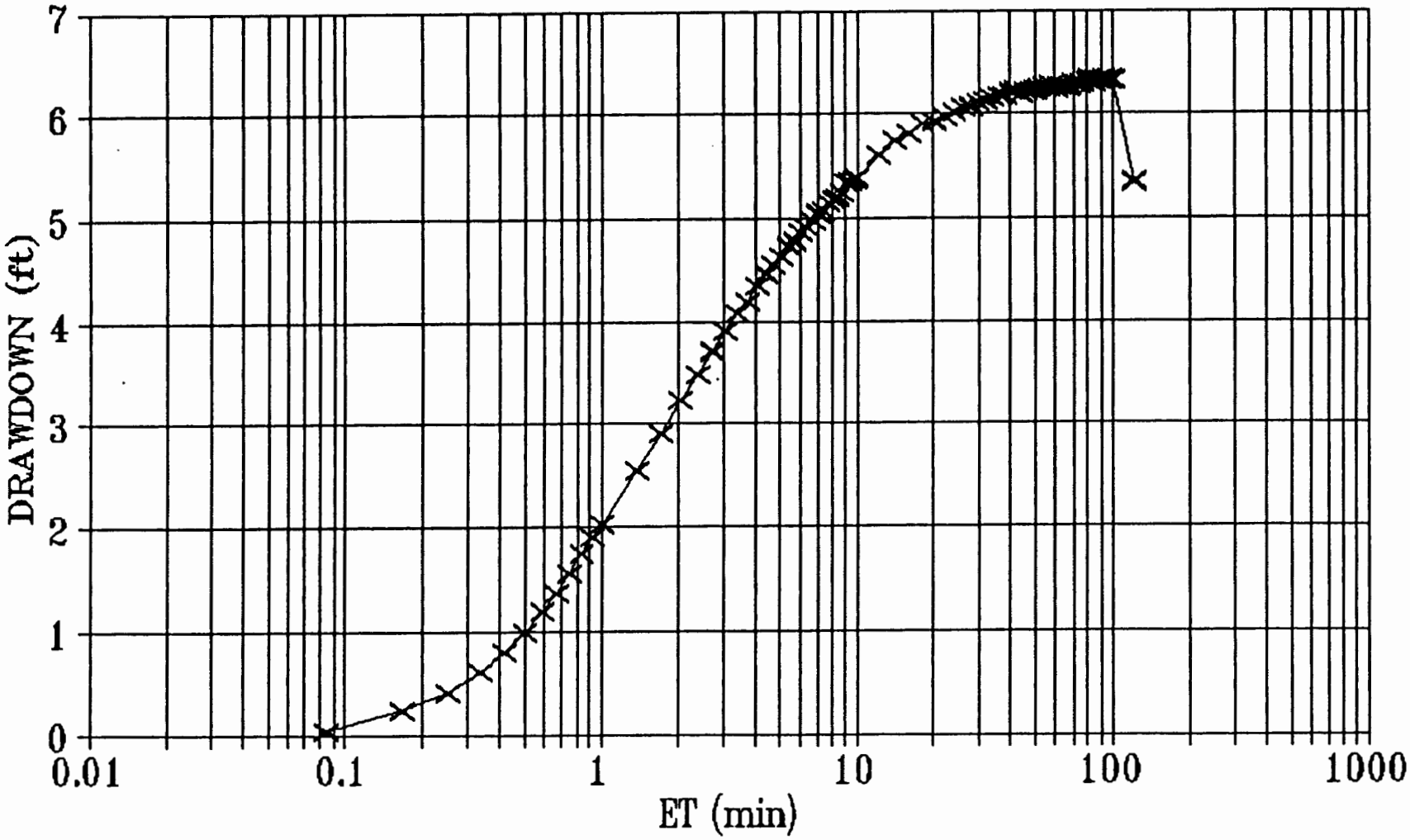


FIGURE 12

OGC-002714

2 HOUR PUMPING TEST WELL MW-13

DRAWDOWN

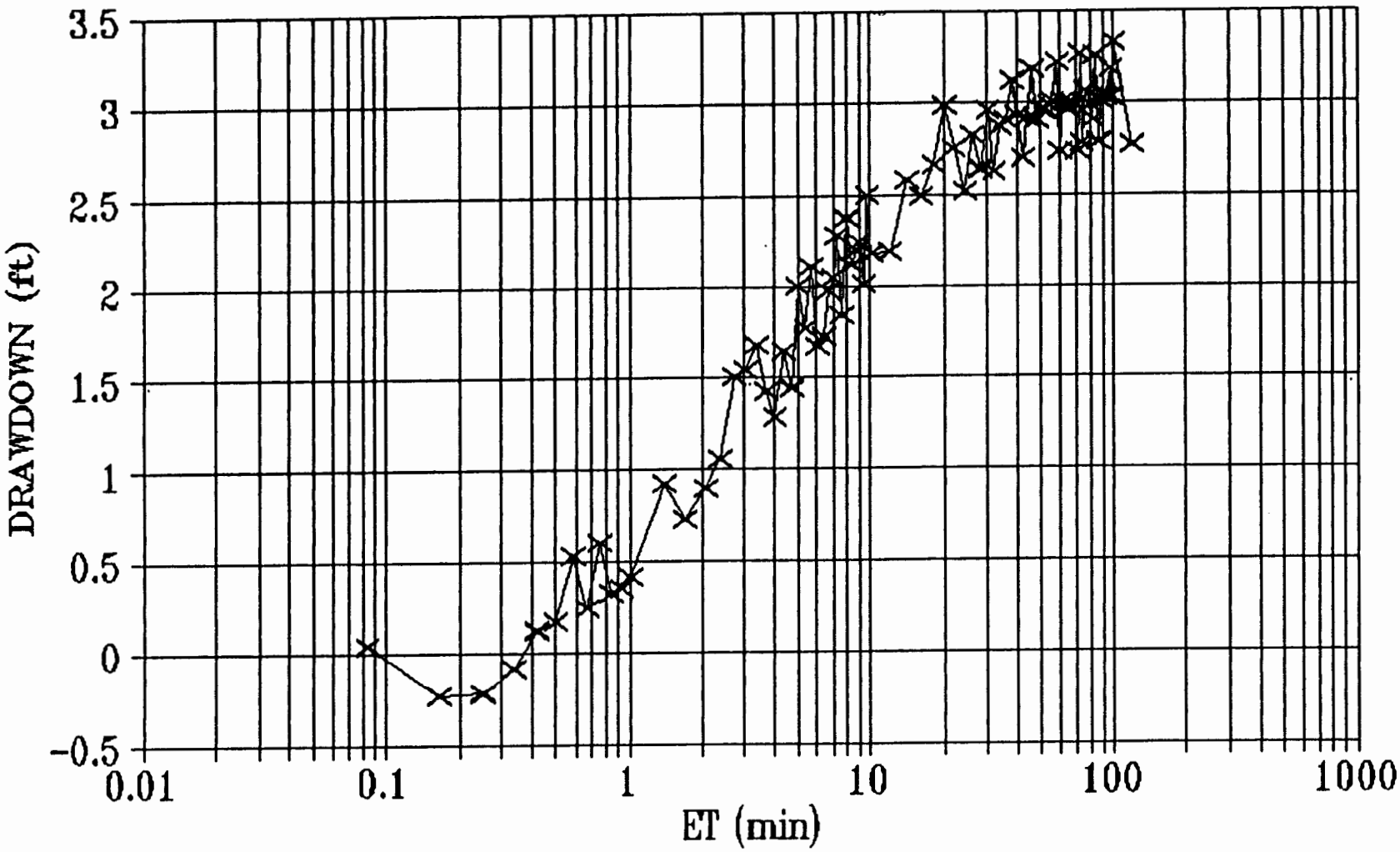


FIGURE 13

OGC-002715

2 HOUR PUMPING TEST WELL MW-14

DRAWDOWN

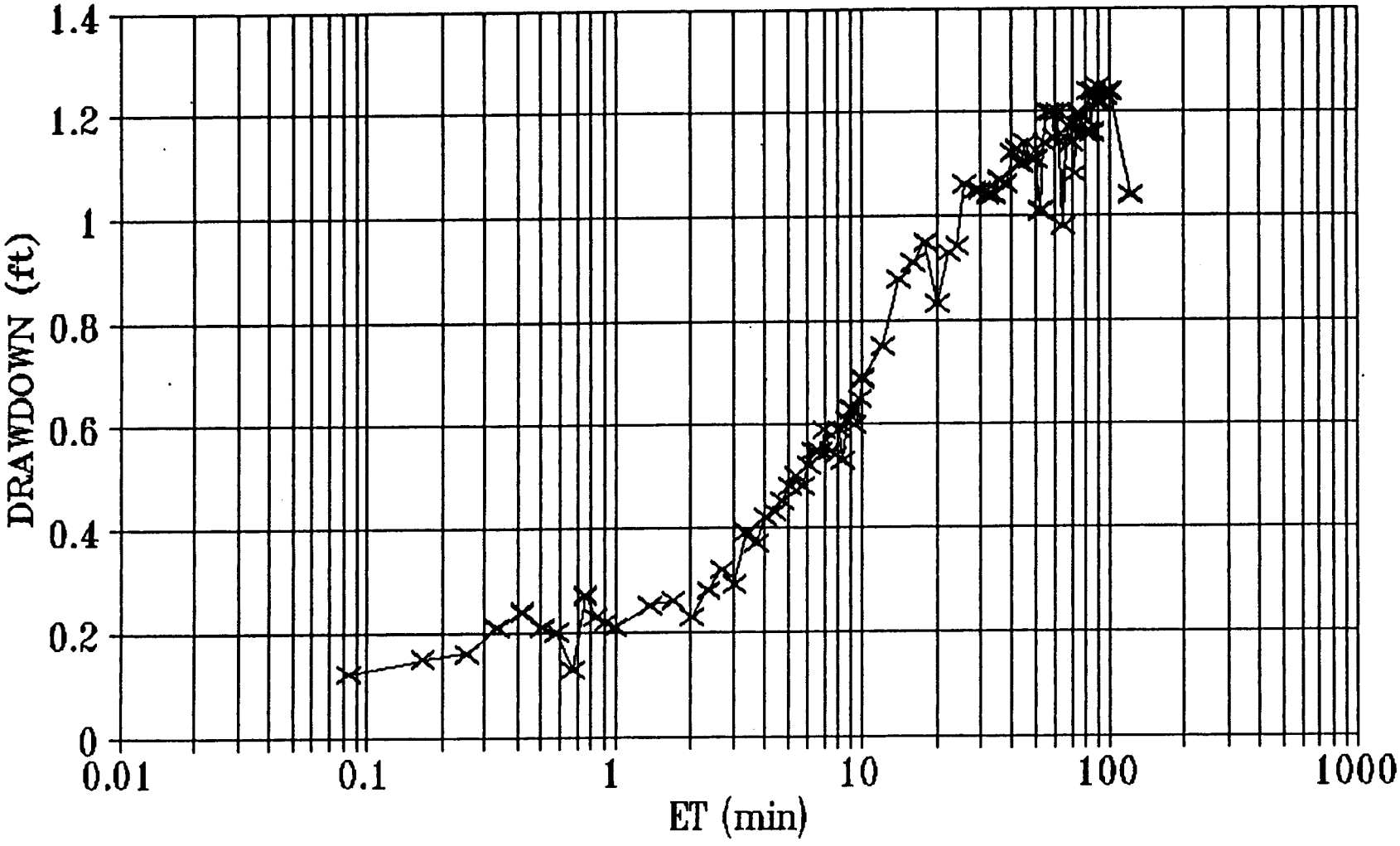


FIGURE 14

OGC-002716

25 HOUR PUMPING TEST WELL PW-1

RESIDUAL DRAWDOWN

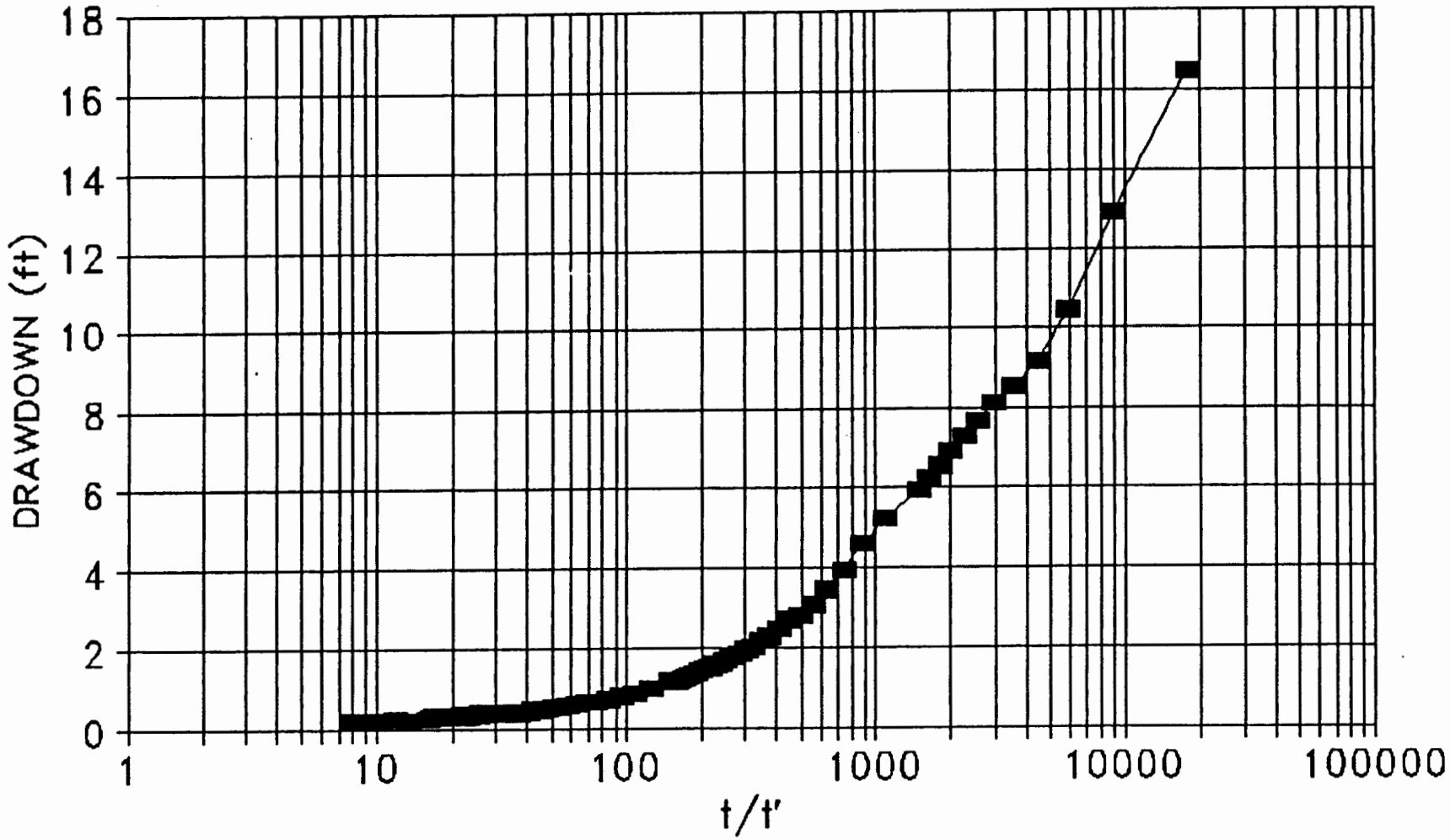


FIGURE 15

OGC-002717

24 HOUR PUNPING TEST WELL MW-12

RESIDUAL DRAWDOWN

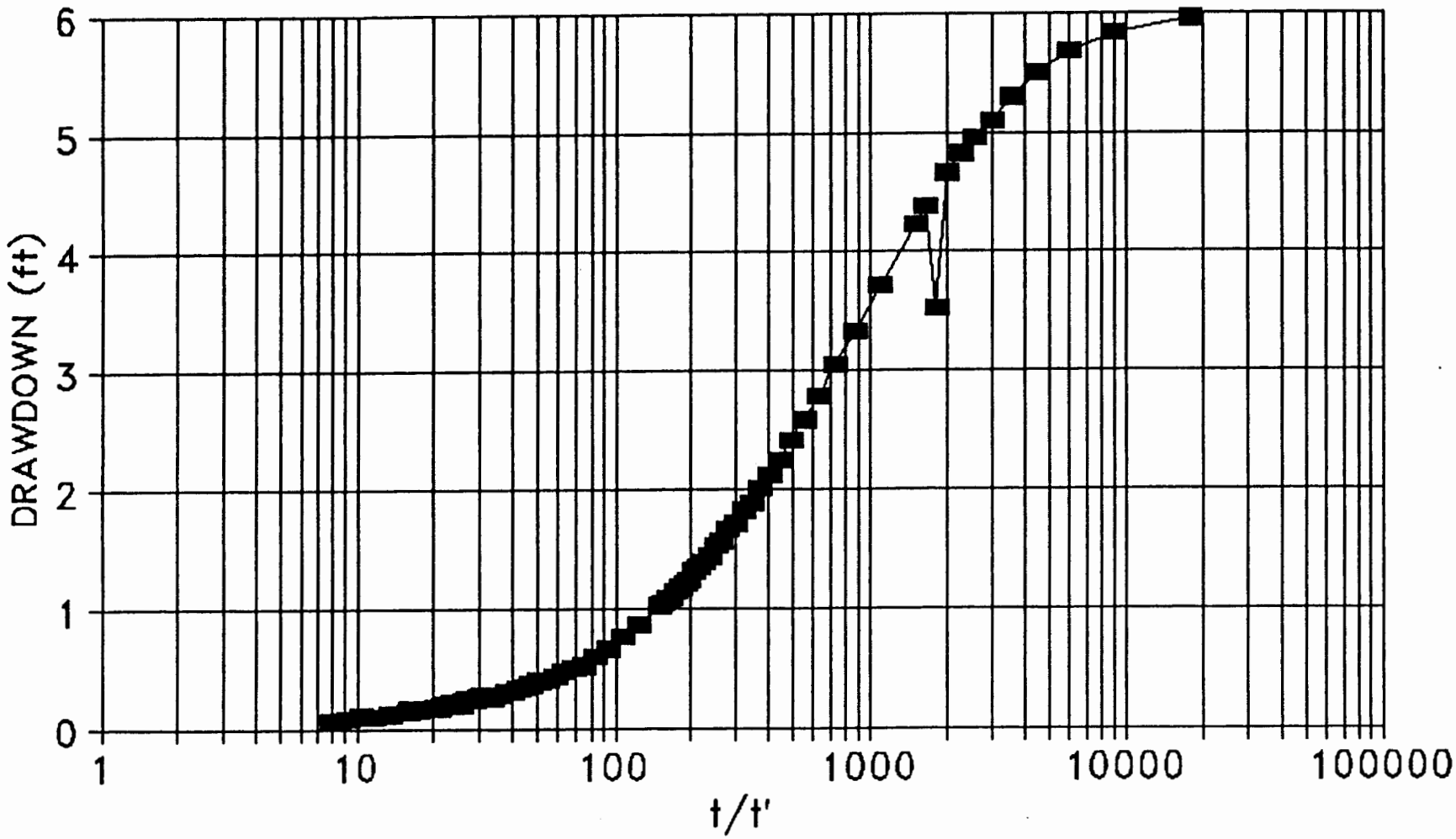


FIGURE 16

OGC-002718

25 HOUR PUMPING TEST WELL MW-13

RESIDUAL DRAWDOWN

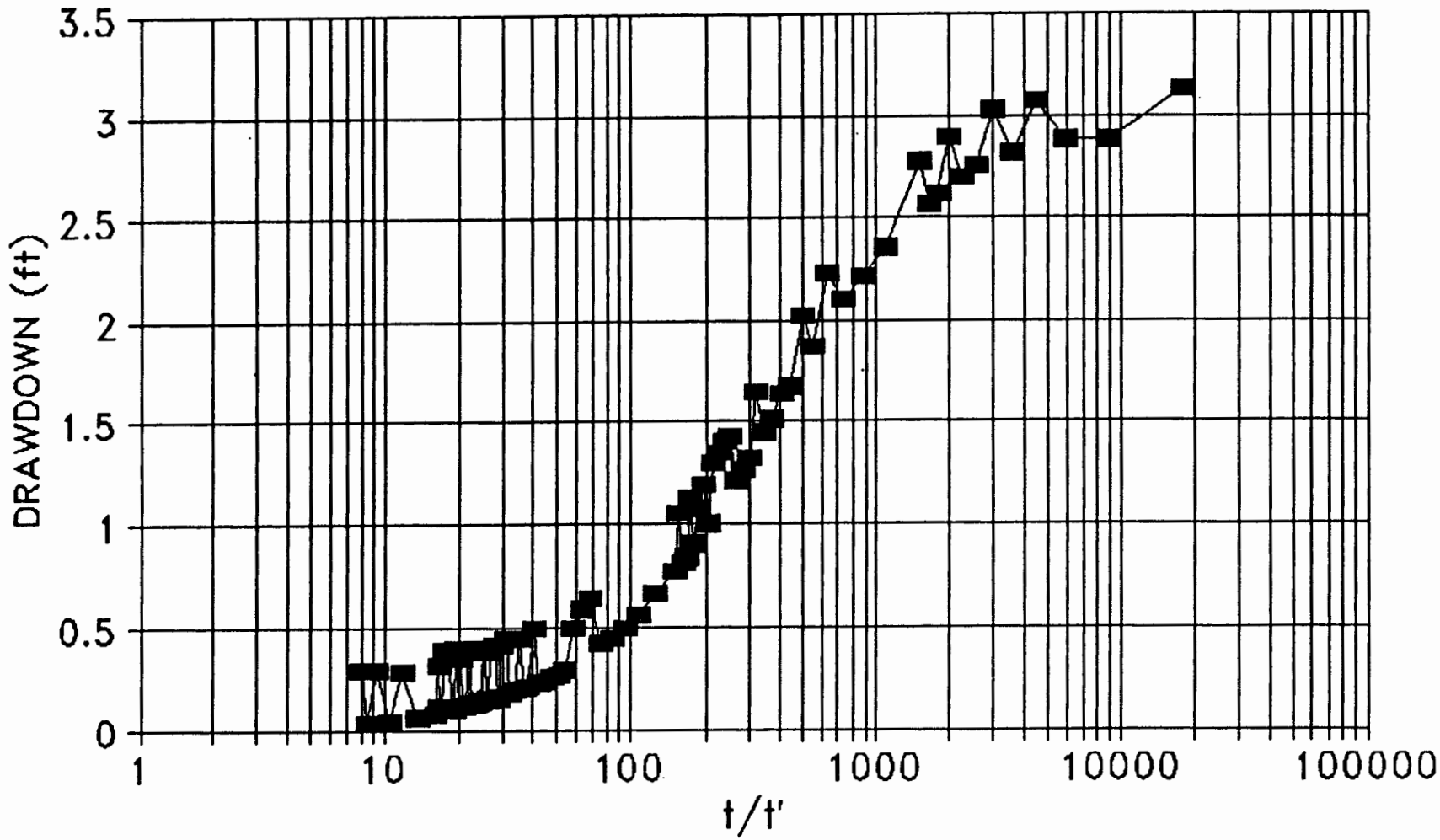


FIGURE 17

OGC-002719

25 HOUR PUMPING TEST WELL MW-14

RESIDUAL DRAWDOWN

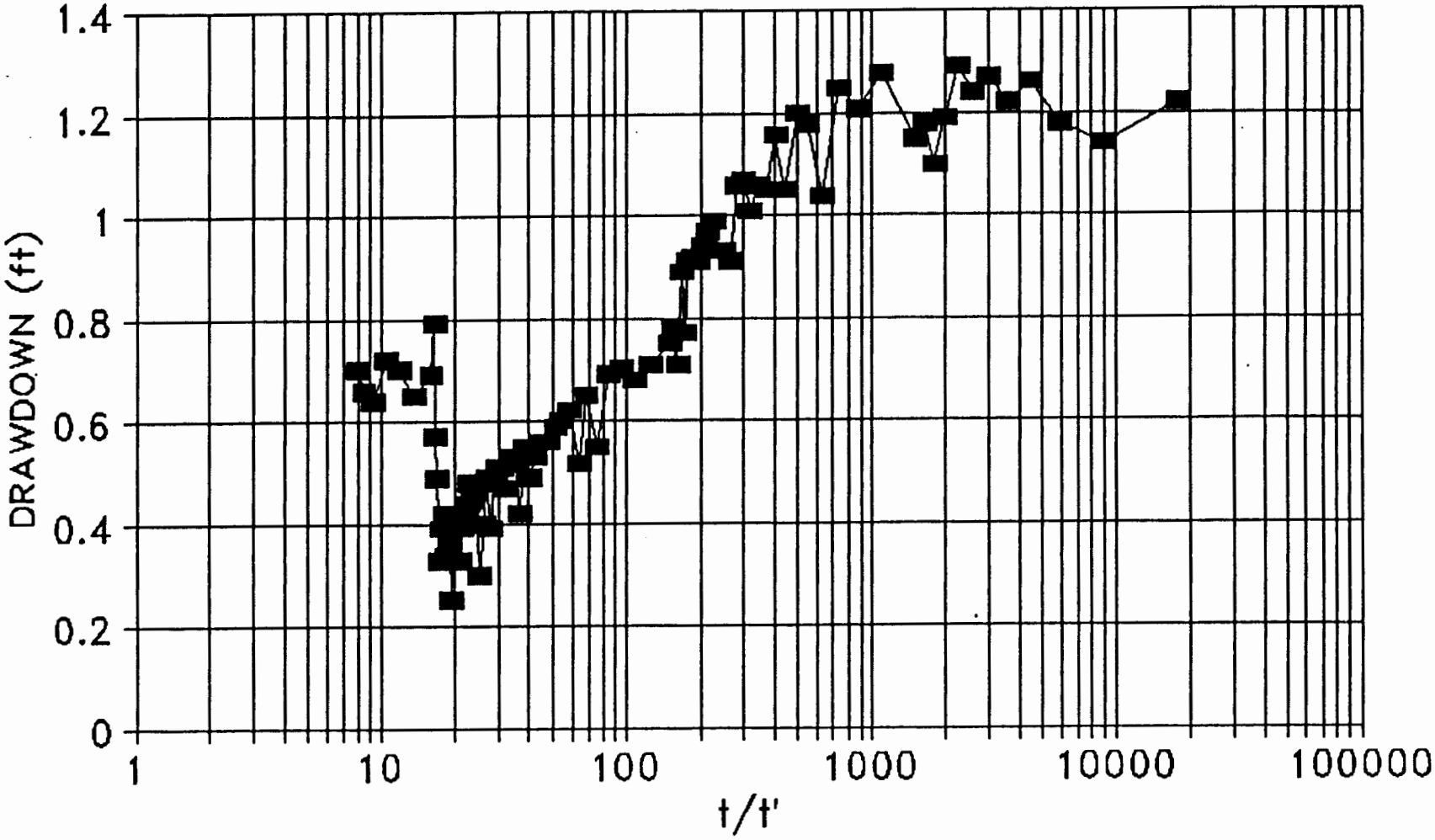


FIGURE 18

OGC-002720

TIME-DRAWDOWN DATA WELL PW-1

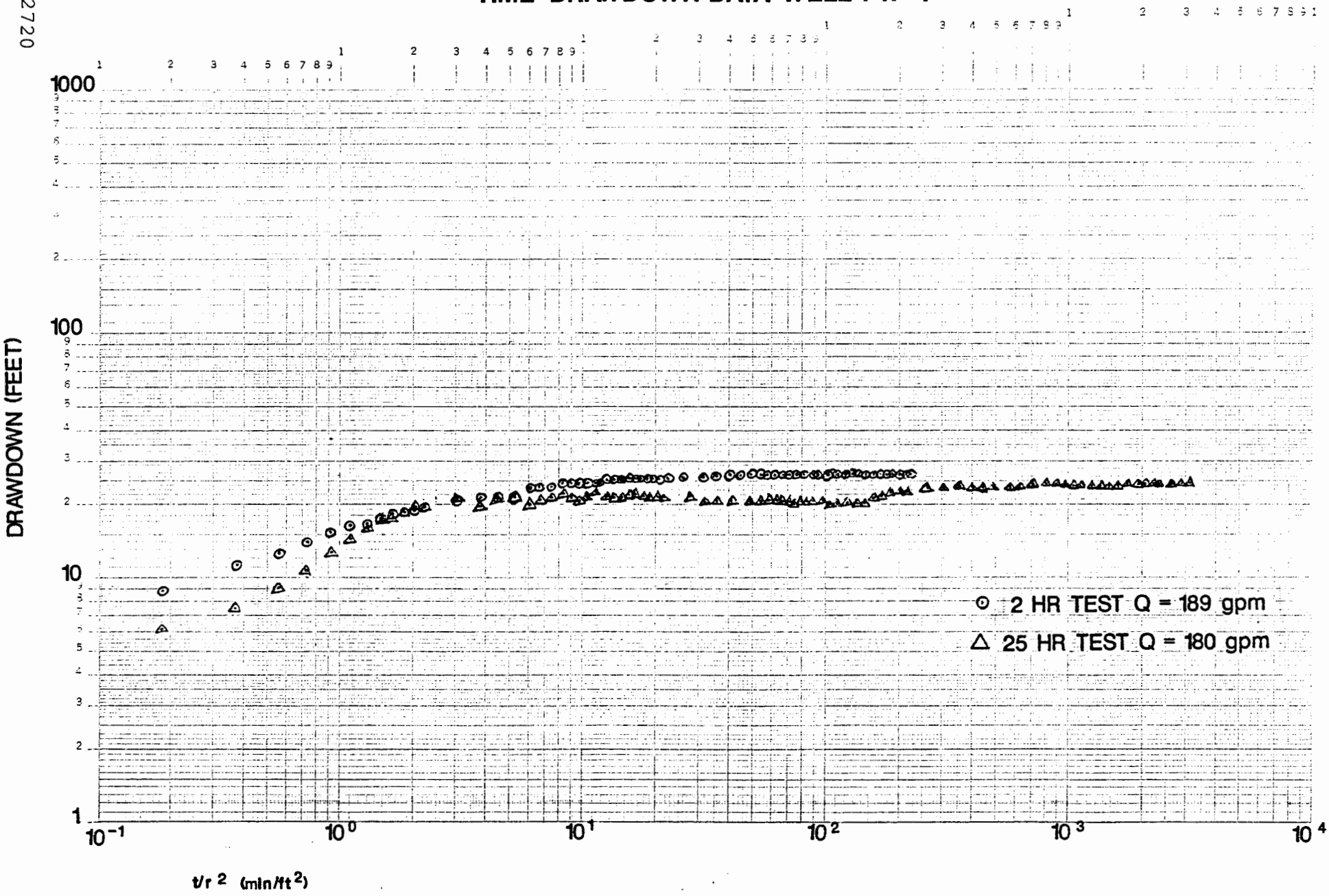


FIGURE 19

OGC-002721

K+E LOGARITHMIC 3 X 5 CYCLES KEUFFEL & ESSER CO. MADE IN U.S.A. 46 7522

TIME-DRAWDOWN DATA, WELL MW-12

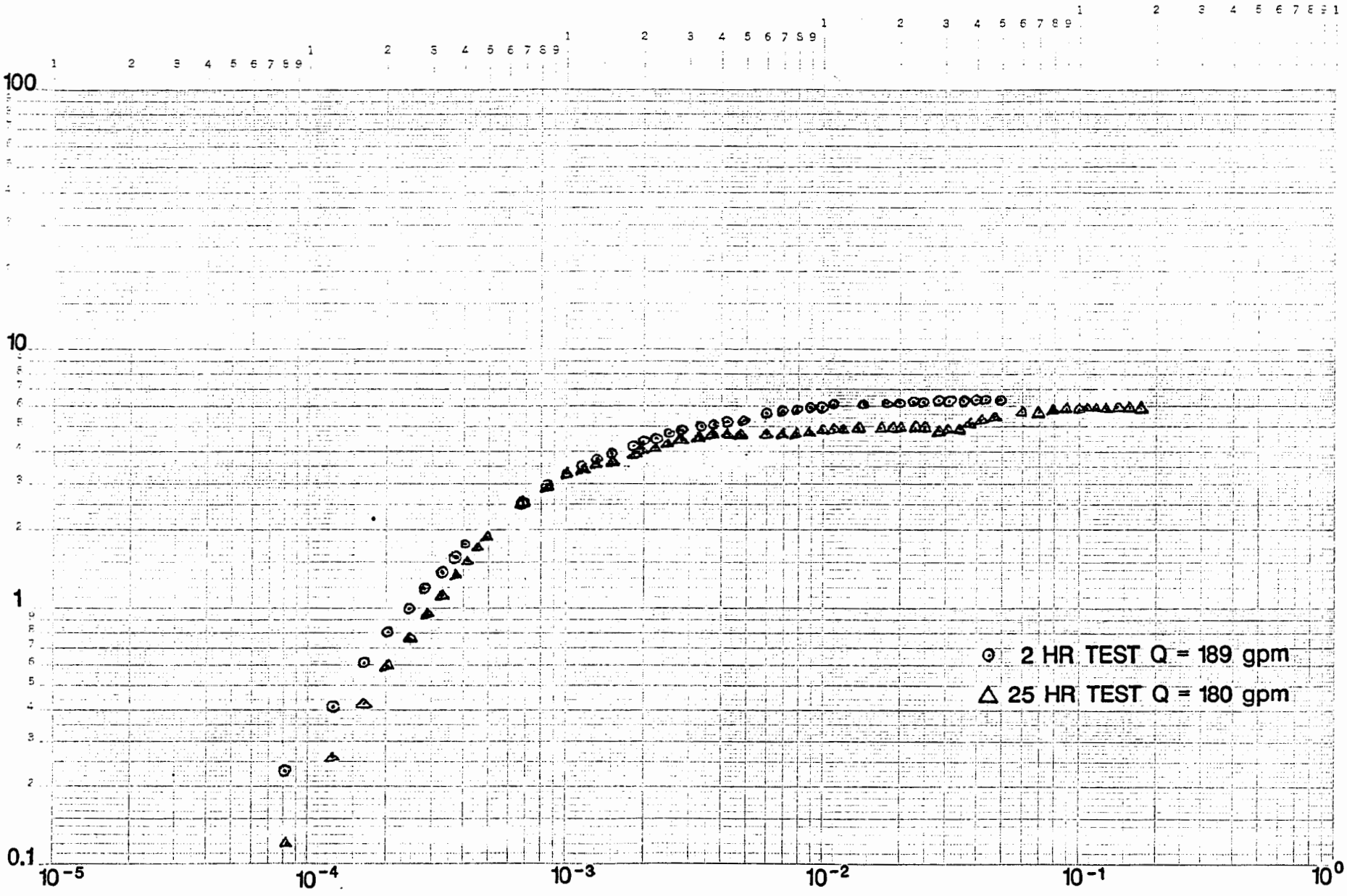


FIGURE 20

OGC-002722

K+E LOGARITHMIC 3 x 5 CYCLES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 7522

TIME-DRAWDOWN DATA, WELL MW-13

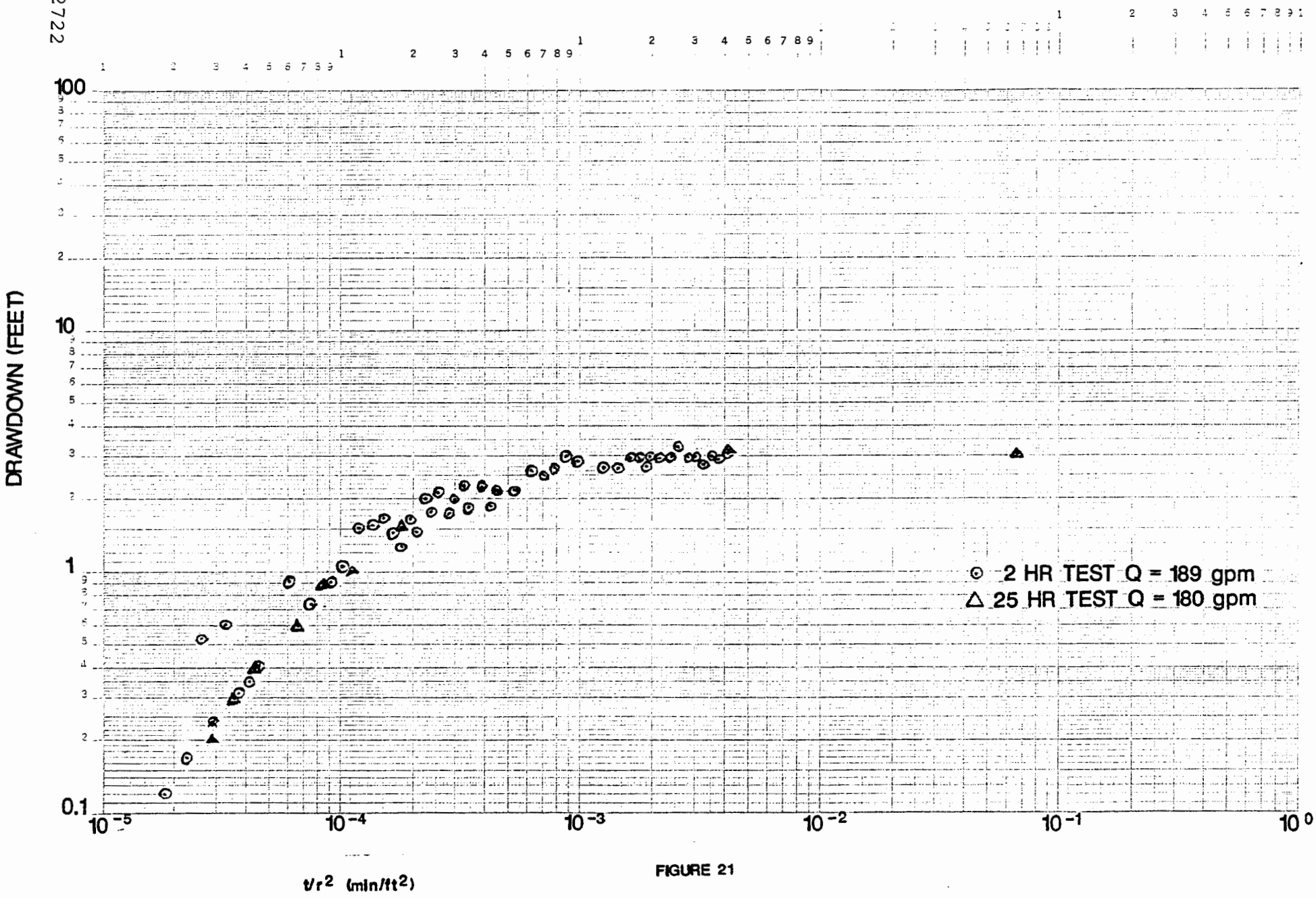


FIGURE 21

OGC-002723

K+E LOGARITHMIC 3 X 5 CYCLES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 7522

TIME-DRAWDOWN DATA, WELL MW-14

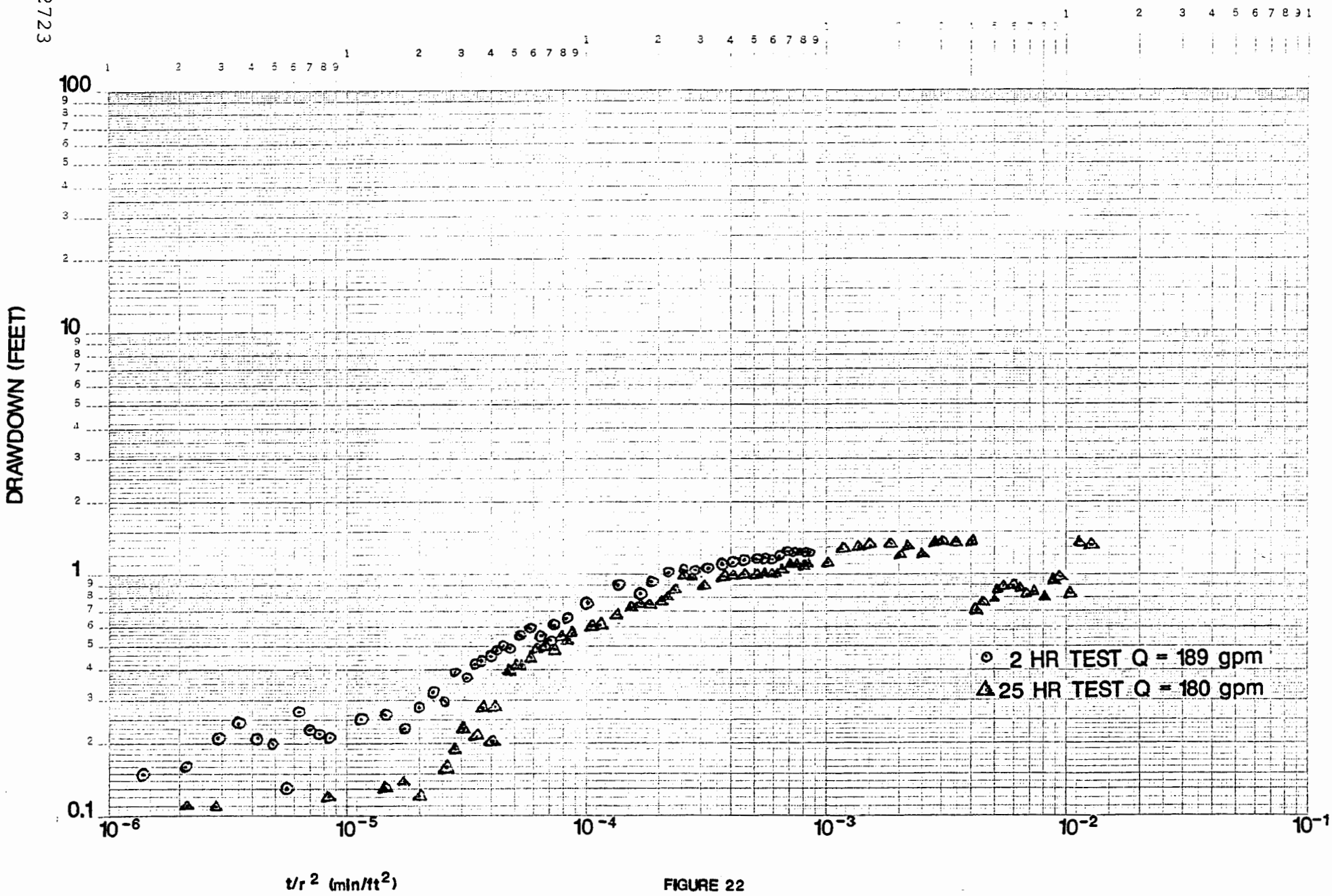


FIGURE 22

K+E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6010

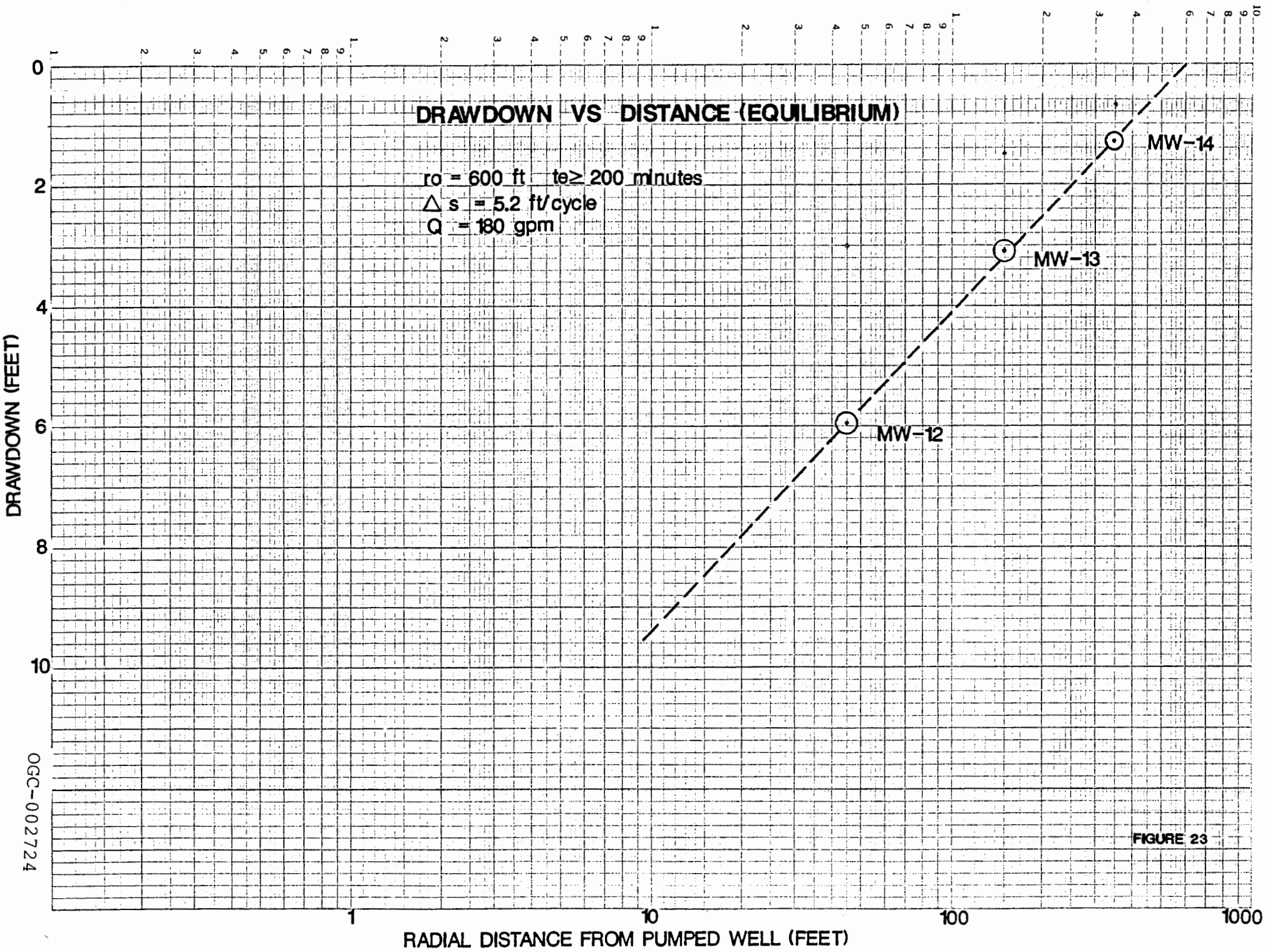


FIGURE 23

OGC-002724

PW-1

TABLE 1

DRAWDOWN REPORT (ORIG)

INPUT 1 ET (min)	LEVEL(ft)	DRAWDOWN	T/R^2
0	67.47	0	0
0.084	73.58	6.11	0.187124
0.167	74.95	7.48	0.37202
0.251	76.47	9	0.559145
0.334	78.32	10.85	0.744041
0.417	80.28	12.81	0.928937
0.501	81.95	14.48	1.116061
0.584	83.33	15.86	1.300958
0.667	84.51	17.04	1.485854
0.751	85.24	17.77	1.672978
0.834	85.79	18.32	1.857875
0.917	86.41	18.94	2.042771
1.001	86.97	19.5	2.229895
1.377	88.84	21.37	3.067498
1.71	87.2	19.73	3.809312
2.043	88.57	21.1	4.551125
2.377	88.86	21.39	5.295166
2.71	87.48	20.01	6.036979
3.043	88.44	20.97	6.778793
3.377	89.22	21.75	7.522834
3.71	89.84	22.37	8.264647
4.043	88.64	21.17	9.00646
4.377	88.25	20.78	9.750501
4.71	89.41	21.94	10.49231
5.043	90.21	22.74	11.23413
5.377	90.69	23.22	11.97817
5.71	89.16	21.69	12.71998
6.043	88.74	21.27	13.4618
6.377	88.87	21.4	14.20584
6.71	89.19	21.72	14.94765
7.043	89.52	22.05	15.68946
7.377	89.51	22.04	16.4335
7.71	89.26	21.79	17.17532
8.043	88.97	21.5	17.91713
8.377	88.71	21.24	18.66117
8.71	88.51	21.04	19.40299
9.043	88.33	20.86	20.1448
9.377	88.21	20.74	20.88884
9.71	88.28	20.81	21.63065
10.043	88.24	20.77	22.37247
12.312	88.02	20.55	27.42704
14.078	88.07	20.6	31.3611
16.142	88.2	20.73	35.95901
18.142	88.17	20.7	40.41435
20.142	88.21	20.74	44.86968
22.142	88.23	20.76	49.32502

2 HR TEST

INPUT 1 ET (min)	LEVEL(ft)	DRAWDOW	T/R^2
0	65.57		0
0.084	74.5	8.93	0.187124
0.167	76.73	11.16	0.37202
0.251	78.29	12.72	0.559145
0.334	79.53	13.96	0.744041
0.417	80.68	15.11	0.928937
0.501	81.64	16.07	1.116061
0.584	82.42	16.85	1.300958
0.667	83.11	17.54	1.485854
0.751	83.65	18.08	1.672978
0.834	84.05	18.48	1.857875
0.917	84.45	18.88	2.042771
1.001	84.75	19.18	2.229895
1.377	85.86	20.29	3.067498
1.71	86.83	21.26	3.809312
2.043	87.59	22.02	4.551125
2.377	88.24	22.67	5.295166
2.71	88.67	23.1	6.036979
3.043	89	23.43	6.778793
3.377	89.33	23.76	7.522834
3.71	89.59	24.02	8.264647
4.043	89.74	24.17	9.00646
4.377	89.97	24.4	9.750501
4.71	90.16	24.59	10.49231
5.043	90.33	24.76	11.23413
5.377	90.44	24.87	11.97817
5.71	90.57	25	12.71998
6.043	90.66	25.09	13.4618
6.377	90.69	25.12	14.20584
6.71	90.78	25.21	14.94765
7.043	90.82	25.25	15.68946
7.377	90.9	25.33	16.4335
7.71	90.89	25.32	17.17532
8.043	90.98	25.41	17.91713
8.377	91	25.43	18.66117
8.71	91.05	25.48	19.40299
9.043	91.11	25.54	20.1448
9.377	91.15	25.58	20.88884
9.71	91.18	25.61	21.63065
10.043	91.22	25.65	22.37247
12.127	91.44	25.87	27.01493
14.127	91.62	26.05	31.47026
16.075	91.74	26.17	35.80976
18.075	91.81	26.24	40.26509
20.075	91.87	26.3	44.72043
22.075	91.96	26.39	49.17576

OGC-002725

24.142	88.28	20.81	53.78035	24.1	91.91	26.34	53.68679
26.068	88.38	20.91	58.07084	26.133	91.98	26.41	58.21564
28.068	88.41	20.94	62.52618	28.133	92.09	26.52	62.67097
30.068	88.3	20.83	66.98151	30.133	92.11	26.54	67.12631
32.068	88.18	20.71	71.43685	32.133	92.14	26.57	71.58164
34.068	88.14	20.67	75.89218	34.133	92.17	26.6	76.03698
36.068	88.1	20.63	80.34752	36.133	92.19	26.62	80.49231
38.068	88.12	20.65	84.80285	38.133	92.29	26.72	84.94765
40.068	88.18	20.71	89.25819	40.133	92.27	26.7	89.40299
42.068	88.17	20.7	93.71352	42.133	92.29	26.72	93.85832
44.068	88.38	20.91	98.16886	44.27	92.22	26.65	98.61885
46.068	87.52	20.05	102.6242	46.213	92.22	26.65	102.9472
48.193	87.79	20.32	107.358	48.213	92.19	26.62	107.4025
50.193	87.76	20.29	111.8133	50.213	92.22	26.65	111.8579
52.193	87.94	20.47	116.2687	52.213	92.11	26.54	116.3132
54.193	87.61	20.14	120.724	54.213	92.1	26.53	120.7685
56.193	87.29	19.82	125.1793	56.213	92.19	26.62	125.2239
58.193	87.32	19.85	129.6347	58.213	92.13	26.56	129.6792
60.193	87.51	20.04	134.09	60.213	92.14	26.57	134.1346
62.193	87.76	20.29	138.5453	62.213	92.26	26.69	138.5899
64.193	87.74	20.27	143.0007	64.213	92.27	26.7	143.0452
66.193	88.34	20.87	147.456	66.213	92.2	26.63	147.5006
68.193	88.17	20.7	151.9113	68.213	92.23	26.66	151.9559
70.193	88.67	21.2	156.3667	70.213	92.24	26.67	156.4112
72.193	88.64	21.17	160.822	72.213	92.27	26.7	160.8666
74.193	89.05	21.58	165.2773	74.213	92.24	26.67	165.3219
76.193	89.29	21.82	169.7327	76.213	92.26	26.69	169.7772
78.193	89.15	21.68	174.188	80.138	92.3	26.73	178.5208
80.193	89.85	22.38	178.6434	82.138	92.32	26.75	182.9762
82.193	89.77	22.3	183.0987	84.138	92.33	26.76	187.4315
84.193	90.08	22.61	187.554	86.138	92.27	26.7	191.8868
86.193	89.95	22.48	192.0094	88.053	92.32	26.75	196.1528
88.193	90.11	22.64	196.4647	90.072	92.29	26.72	200.6505
90.193	90.17	22.7	200.92	92.072	92.32	26.75	205.1058
92.193	90.16	22.69	205.3754	97.072	92.32	26.75	216.2442
94.193	90.1	22.63	209.8307	96.073	92.32	26.75	214.0187
96.193	90.08	22.61	214.286	98.072	92.42	26.85	218.4718
98.193	90.05	22.58	218.7414	100.07	92.37	26.8	222.9227
120.15	91.02	23.55	267.6543	120.02	73.81	8.24	267.3647
140.16	91.08	23.61	312.2299				
160.16	91.21	23.74	356.7832				
180.17	91.22	23.75	401.3589				
200.15	91.15	23.68	445.8677				
220.15	91.32	23.85	490.421				
240.15	91.34	23.87	534.9744				
260.07	91.11	23.64	579.3495				
280.07	91.22	23.75	623.9029				
300.07	91.51	24.04	668.4562				
320.07	91.54	24.07	713.0096				
340.07	91.55	24.08	757.5629				

360.07	91.52	24.05		802.1163
380.07	91.64	24.17		846.6696
400.07	91.58	24.11		891.223
420.07	91.47	24		935.7763
440.07	91.44	23.97		980.3297
460.03	91.38	23.91		1024.794
480.03	91.42	23.95		1069.347
500.03	91.42	23.95		1113.901
520.03	91.41	23.94		1158.454
540.03	91.41	23.94		1203.007
560.03	91.39	23.92		1247.561
580.03	91.34	23.87		1292.114
600.03	91.29	23.82		1336.667
620.03	91.31	23.84		1381.221
640.03	91.19	23.72		1425.774
660.03	91.26	23.79		1470.327
680.03	91.22	23.75		1514.881
700.1	91.31	23.84		1559.59
720.1	91.38	23.91		1604.143
740.1	91.39	23.92		1648.697
760.1	91.48	24.01		1693.25
780.1	91.47	24		1737.804
800.1	91.62	24.15		1782.357
820.13	91.48	24.01		1826.977
840.13	91.51	24.04		1871.53
860.13	91.62	24.15		1916.084
880.13	91.65	24.18		1960.637
900.13	91.68	24.21		2005.19
920.13	91.68	24.21		2049.744
940.13	91.64	24.17		2094.297
960.13	91.7	24.23		2138.851
980.13	91.68	24.21		2183.404
1000.1	91.58	24.11		2227.89
1060.3	91.45	23.98		2361.996
1120.3	91.45	23.98		2495.656
1180.3	91.51	24.04		2629.316
1240.3	91.62	24.15		2762.976
1300.3	91.54	24.07		2896.636
1360.3	91.81	24.34		3030.296
1420.2	91.7	24.23		3163.734
1480.2	91.68	24.21		3297.394
1499.9	91.68	24.21	t/t'	3341.279
1499.984	83.93	16.46	17856.95	
1500.067	80.4	12.93	8982.437	
1500.151	77.94	10.47	5976.697	
1500.234	76.62	9.15	4491.719	
1500.317	75.98	8.51	3597.882	
1500.401	75.55	8.08	2994.812	
1500.484	75.12	7.65	2569.322	
1500.567	74.73	7.26	2249.726	

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1500.651	74.37	6.9	1998.204
1500.734	74.02	6.55	1799.441
1500.817	73.71	6.24	1636.66
1500.901	73.42	5.95	1499.402
1501.277	72.73	5.26	1090.252
1501.61	72.08	4.61	878.1345
1501.943	71.42	3.95	735.1654
1502.277	70.94	3.47	632.0055
1502.61	70.57	3.1	554.4686
1502.943	70.29	2.82	493.9017
1503.277	70.18	2.71	445.1516
1503.61	69.98	2.51	405.2857
1503.943	69.79	2.32	371.9869
1504.277	69.65	2.18	343.6776
1504.61	69.53	2.06	319.4501
1504.943	69.43	1.96	298.4222
1505.277	69.33	1.86	279.9474
1505.61	69.26	1.79	263.6795
1505.943	69.19	1.72	249.2045
1506.277	69.11	1.64	236.2046
1506.61	69.07	1.6	224.532
1506.943	69	1.53	213.9632
1507.277	68.95	1.48	204.3211
1507.61	68.91	1.44	195.5396
1507.943	68.85	1.38	187.4851
1508.277	68.81	1.34	180.0498
1508.61	68.77	1.3	173.2044
1508.943	68.74	1.27	166.8631
1509.277	68.7	1.23	160.9552
1509.61	68.67	1.2	155.4696
1509.943	68.64	1.17	150.3478
1512.041	68.48	1.01	124.5401
1514.041	68.36	0.89	107.0675
1516.041	68.29	0.82	93.92485
1518.042	68.22	0.75	83.67556
1520.042	68.13	0.66	75.46629
1522.042	68.12	0.65	68.74004
1524.042	68.09	0.62	63.12824
1526.042	68.05	0.58	58.37511
1528.042	68.03	0.56	54.29756
1530.042	68	0.53	50.76113
1532.042	67.98	0.51	47.6648
1534.042	67.93	0.46	44.93123
1536.042	67.93	0.46	42.50019
1538.042	67.92	0.45	40.3241
1540.042	67.89	0.42	38.36485
1542.042	67.87	0.4	36.59157
1544.042	67.87	0.4	34.97898
1546.042	67.86	0.39	33.50618
1548.042	67.86	0.39	32.15575

1550.042	67.87	0.4	30.91305
1552.042	67.87	0.4	29.76568
1554.042	67.86	0.39	28.70308
1556.042	67.85	0.38	27.71618
1558.042	67.85	0.38	26.79719
1560.042	67.85	0.38	25.93931
1562.042	67.83	0.36	25.13665
1564.042	67.82	0.35	24.38405
1566.042	67.82	0.35	23.67697
1568.042	67.8	0.33	23.01139
1570.042	67.8	0.33	22.38376
1572.042	67.82	0.35	21.79094
1574.042	67.8	0.33	21.2301
1575.997	67.8	0.33	20.71037
1578.042	67.79	0.32	20.19454
1580.042	67.79	0.32	19.71553
1582.042	67.77	0.3	19.25984
1584.042	67.76	0.29	18.82582
1586.042	67.76	0.29	18.41195
1588.042	67.77	0.3	18.01686
1590.042	67.8	0.33	17.6393
1592.042	67.8	0.33	17.27814
1594.042	67.8	0.33	16.93232
1596.042	67.77	0.3	16.60088
1598.042	67.76	0.29	16.28296
1600.04	67.73	0.26	15.97803
1620.21	67.69	0.22	13.46696
1640.21	67.7	0.23	11.6899
1660.21	67.67	0.2	10.35625
1680.22	67.69	0.22	9.31799
1700.22	67.67	0.2	8.48752
1715.97	67.67	0.2	7.941732

MW-12 TABLE 2

INPUT 2 ET (min)	LEVEL(ft)	DRAWDOWN	T/R^2	2 HR TEST INPUT 2 ET (min)	LEVEL(ft)	DRAWDOWN	T/R^2
0	64.52	0	0	0	64.68		0
0.084	64.54	0.02	4.15E-05	0.084	64.72	0.04	4.15E-05
0.167	64.64	0.12	8.25E-05	0.167	64.91	0.23	8.25E-05
0.251	64.78	0.26	0.000124	0.251	65.09	0.41	0.000124
0.334	64.94	0.42	0.000165	0.334	65.29	0.61	0.000165
0.417	65.11	0.59	0.000206	0.417	65.48	0.8	0.000206
0.501	65.28	0.76	0.000247	0.501	65.67	0.99	0.000247
0.584	65.47	0.95	0.000288	0.584	65.87	1.19	0.000288
0.667	65.64	1.12	0.000329	0.667	66.05	1.37	0.000329
0.751	65.85	1.33	0.000371	0.751	66.24	1.56	0.000371
0.834	66.04	1.52	0.000412	0.834	66.42	1.74	0.000412
0.917	66.23	1.71	0.000453	0.917	66.57	1.89	0.000453
1.001	66.41	1.89	0.000494	1.001	66.7	2.02	0.000494
1.377	67.05	2.53	0.00068	1.377	67.23	2.55	0.00068
1.71	67.47	2.95	0.000844	1.71	67.59	2.91	0.000844
2.043	67.69	3.17	0.001009	2.043	67.91	3.23	0.001009
2.377	67.93	3.41	0.001174	2.377	68.17	3.49	0.001174
2.71	68.06	3.54	0.001338	2.71	68.39	3.71	0.001338
3.043	68.15	3.63	0.001503	3.043	68.59	3.91	0.001503
3.377	68.28	3.76	0.001668	3.377	68.76	4.08	0.001668
3.71	68.45	3.93	0.001832	3.71	68.88	4.2	0.001832
4.043	68.57	4.05	0.001997	4.043	69.03	4.35	0.001997
4.377	68.6	4.08	0.002161	4.377	69.14	4.46	0.002161
4.71	68.64	4.12	0.002326	4.71	69.23	4.55	0.002326
5.043	68.76	4.24	0.00249	5.043	69.31	4.63	0.00249
5.377	68.88	4.36	0.002655	5.377	69.42	4.74	0.002655
5.71	68.97	4.45	0.00282	5.71	69.46	4.78	0.00282
6.043	68.96	4.44	0.002984	6.043	69.54	4.86	0.002984
6.377	68.94	4.42	0.003149	6.377	69.6	4.92	0.003149
6.71	68.98	4.46	0.003314	6.71	69.66	4.98	0.003314
7.043	69.03	4.51	0.003478	7.043	69.73	5.05	0.003478
7.377	69.07	4.55	0.003643	7.377	69.75	5.07	0.003643
7.71	69.13	4.61	0.003807	7.71	69.82	5.14	0.003807
8.043	69.15	4.63	0.003972	8.043	69.85	5.17	0.003972
8.377	69.16	4.64	0.004137	8.377	69.88	5.2	0.004137
8.71	69.14	4.62	0.004301	8.71	69.93	5.25	0.004301
9.043	69.11	4.59	0.004466	9.043	70.01	5.33	0.004466
9.377	69.13	4.61	0.004631	9.377	70.04	5.36	0.004631
9.71	69.12	4.6	0.004795	9.71	70.06	5.38	0.004795
10.043	69.13	4.61	0.00496	10.043	70.07	5.39	0.00496
12.312	69.17	4.65	0.00608	12.127	70.28	5.6	0.005989
14.078	69.2	4.68	0.006952	14.127	70.42	5.74	0.006976
16.142	69.25	4.73	0.007971	16.075	70.5	5.82	0.007938
18.142	69.31	4.79	0.008959	18.075	70.58	5.9	0.008926
20.142	69.33	4.81	0.009947	20.075	70.61	5.93	0.009914
22.142	69.37	4.85	0.010934	22.075	70.65	5.97	0.010901

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24.142	69.38	4.86	0.011922
26.068	69.42	4.9	0.012873
28.068	69.44	4.92	0.013861
30.068	69.45	4.93	0.014848
32.068	69.44	4.92	0.015836
34.068	69.43	4.91	0.016824
36.068	69.44	4.92	0.017811
38.068	69.43	4.91	0.018799
40.068	69.46	4.94	0.019787
42.068	69.45	4.93	0.020774
44.068	69.47	4.95	0.021762
46.068	69.4	4.88	0.02275
48.193	69.37	4.85	0.023799
50.193	69.4	4.88	0.024787
52.193	69.43	4.91	0.025774
54.193	69.38	4.86	0.026762
56.193	69.34	4.82	0.02775
58.193	69.33	4.81	0.028737
60.193	69.31	4.79	0.029725
62.193	69.39	4.87	0.030713
64.193	69.4	4.88	0.0317
66.193	69.46	4.94	0.032688
68.193	69.48	4.96	0.033676
70.193	69.48	4.96	0.034663
72.193	69.58	5.06	0.035651
74.193	69.61	5.09	0.036639
76.193	69.71	5.19	0.037626
78.193	69.73	5.21	0.038614
80.193	69.79	5.27	0.039601
82.193	69.85	5.33	0.040589
84.193	69.87	5.35	0.041577
86.193	69.9	5.38	0.042564
88.193	69.92	5.4	0.043552
90.193	69.95	5.43	0.04454
92.193	69.97	5.45	0.045527
94.193	69.96	5.44	0.046515
96.193	69.96	5.44	0.047503
98.193	69.95	5.43	0.04849
120.15	70.21	5.69	0.059333
140.16	70.28	5.76	0.069215
160.16	70.32	5.8	0.079091
180.17	70.33	5.81	0.088973
200.15	70.33	5.81	0.09884
220.15	70.38	5.86	0.108716
240.15	70.35	5.83	0.118593
260.07	70.33	5.81	0.12843
280.07	70.36	5.84	0.138306
300.07	70.36	5.84	0.148183
320.07	70.39	5.87	0.158059
340.07	70.39	5.87	0.167936

24.1	70.7	6.02	0.011901
26.133	70.74	6.06	0.012905
28.133	70.75	6.07	0.013893
30.133	70.79	6.11	0.01488
32.133	70.8	6.12	0.015868
34.133	70.83	6.15	0.016856
36.133	70.85	6.17	0.017843
38.133	70.85	6.17	0.018831
40.133	70.89	6.21	0.019819
42.133	70.91	6.23	0.020806
44.27	70.87	6.19	0.021862
46.213	70.89	6.21	0.022821
48.213	70.89	6.21	0.023809
50.213	70.9	6.22	0.024797
52.213	70.93	6.25	0.025784
54.213	70.95	6.27	0.026772
56.213	70.93	6.25	0.02776
58.213	70.96	6.28	0.028747
60.213	70.92	6.24	0.029735
62.213	70.95	6.27	0.030722
64.213	70.95	6.27	0.03171
66.213	70.94	6.26	0.032698
68.213	70.95	6.27	0.033685
70.213	70.98	6.3	0.034673
72.213	70.96	6.28	0.035661
74.213	70.97	6.29	0.036648
76.213	70.98	6.3	0.037636
80.138	70.99	6.31	0.039574
82.138	71.02	6.34	0.040562
84.138	70.98	6.3	0.04155
86.138	71	6.32	0.042537
88.053	71.01	6.33	0.043483
90.072	71.01	6.33	0.04448
92.072	71.02	6.34	0.045468
97.072	71	6.32	0.047937
96.073	71.01	6.33	0.047443
98.072	71.02	6.34	0.048431
100.07	71	6.32	0.049417
120.02	70.03	5.35	0.059269

360.07	70.4	5.88	0.177812
380.07	70.41	5.89	0.187689
400.07	70.39	5.87	0.197565
420.07	70.38	5.86	0.207442
440.07	70.37	5.85	0.217319
460.03	70.34	5.82	0.227175
480.03	70.39	5.87	0.237052
500.03	70.35	5.83	0.246928
520.03	70.31	5.79	0.256805
540.03	70.29	5.77	0.266681
560.03	70.34	5.82	0.276558
580.03	70.36	5.84	0.286435
600.03	70.34	5.82	0.296311
620.03	70.35	5.83	0.306188
640.03	70.28	5.76	0.316064
660.03	70.34	5.82	0.325941
680.03	70.3	5.78	0.335817
700.1	70.36	5.84	0.345728
720.1	70.37	5.85	0.355605
740.1	70.39	5.87	0.365481
760.1	70.38	5.86	0.375358
780.1	70.37	5.85	0.385235
800.1	70.38	5.86	0.395111
820.13	70.42	5.9	0.405002
840.13	70.39	5.87	0.414879
860.13	70.42	5.9	0.424756
880.13	70.43	5.91	0.434632
900.13	70.45	5.93	0.444509
920.13	70.44	5.92	0.454385
940.13	70.44	5.92	0.464262
960.13	70.44	5.92	0.474138
980.13	70.45	5.93	0.484015
1000.1	70.43	5.91	0.493877
1060.3	70.41	5.89	0.523605
1120.3	70.36	5.84	0.553235
1180.3	70.42	5.9	0.582864
1240.3	70.42	5.9	0.612494
1300.3	70.41	5.89	0.642123
1360.3	70.47	5.95	0.671753
1420.2	70.42	5.9	0.701333
1480.2	70.44	5.92	0.730963
1499.9	70.47	5.95	0.740691
1499.984	70.48	5.96	
1500.067	70.35	5.83	
1500.151	70.2	5.68	
1500.234	70.02	5.5	
1500.317	69.82	5.3	
1500.401	69.63	5.11	
1500.484	69.49	4.97	
1500.567	69.35	4.83	

1500.651	69.19	4.67
1500.734	68.04	3.52
1500.817	68.9	4.38
1500.901	68.75	4.23
1501.277	68.23	3.71
1501.61	67.85	3.33
1501.943	67.57	3.05
1502.277	67.31	2.79
1502.61	67.11	2.59
1502.943	66.93	2.41
1503.277	66.77	2.25
1503.61	66.64	2.12
1503.943	66.53	2.01
1504.277	66.41	1.89
1504.61	66.34	1.82
1504.943	66.23	1.71
1505.277	66.18	1.66
1505.61	66.08	1.56
1505.943	66.04	1.52
1506.277	65.96	1.44
1506.61	65.91	1.39
1506.943	65.87	1.35
1507.277	65.83	1.31
1507.61	65.75	1.23
1507.943	65.73	1.21
1508.277	65.69	1.17
1508.61	65.65	1.13
1508.943	65.6	1.08
1509.277	65.59	1.07
1509.61	65.56	1.04
1509.943	65.54	1.02
1512.041	65.38	0.86
1514.041	65.28	0.76
1516.041	65.18	0.66
1518.042	65.11	0.59
1520.042	65.04	0.52
1522.042	65.02	0.5
1524.042	64.99	0.47
1526.042	64.95	0.43
1528.042	64.93	0.41
1530.042	64.91	0.39
1532.042	64.89	0.37
1534.042	64.86	0.34
1536.042	64.85	0.33
1538.042	64.83	0.31
1540.042	64.83	0.31
1542.042	64.8	0.28
1544.042	64.8	0.28
1546.042	64.78	0.26
1548.042	64.78	0.26

1550.042	64.79	0.27
1552.042	64.78	0.26
1554.042	64.76	0.24
1556.042	64.77	0.25
1558.042	64.76	0.24
1560.042	64.75	0.23
1562.042	64.71	0.19
1564.042	64.74	0.22
1566.042	64.74	0.22
1568.042	64.72	0.2
1570.042	64.73	0.21
1572.042	64.71	0.19
1574.042	64.7	0.18
1575.997	64.69	0.17
1578.042	64.7	0.18
1580.042	64.69	0.17
1582.042	64.69	0.17
1584.042	64.69	0.17
1586.042	64.69	0.17
1588.042	64.69	0.17
1590.042	64.69	0.17
1592.042	64.68	0.16
1594.042	64.69	0.17
1596.042	64.68	0.16
1598.042	64.68	0.16
1600.04	64.66	0.14
1620.21	64.64	0.12
1640.21	64.62	0.1
1660.21	64.63	0.11
1680.22	64.6	0.08
1700.22	64.59	0.07
1715.97	64.59	0.07

MW-13 TABLE 3

INPUT 3 ET (min)	LEVEL (ft)	DRAWDOW	T/R^2
0	65.18	0	0
0.45	65.27	0.09	2E-05
0.65	65.38	0.2	2.89E-05
0.8	65.48	0.3	3.56E-05
1	65.58	0.4	4.44E-05
1.5	65.78	0.6	6.67E-05
2	66.03	0.85	8.89E-05
2.5	66.18	1	0.000111
4	66.68	1.5	0.000178
8	67.18	2	0.000356
40	68.18	3	0.001778
100	68.28	3.1	0.004444
1499.9	68.28	3.1	0.066662
1499.984	68.31	3.13	
1500.067	68.06	2.88	
1500.151	68.06	2.88	
1500.234	68.25	3.07	
1500.317	68	2.82	
1500.401	68.21	3.03	
1500.484	67.94	2.76	
1500.567	67.88	2.7	
1500.651	68.08	2.9	
1500.734	67.8	2.62	
1500.817	67.75	2.57	
1500.901	67.96	2.78	
1501.277	67.54	2.36	
1501.61	67.4	2.22	
1501.943	67.28	2.1	
1502.277	67.41	2.23	
1502.61	67.05	1.87	
1502.943	67.2	2.02	
1503.277	66.85	1.67	
1503.61	66.81	1.63	
1503.943	66.69	1.51	
1504.277	66.62	1.44	
1504.61	66.82	1.64	
1504.943	66.5	1.32	
1505.277	66.44	1.26	
1505.61	66.39	1.21	
1505.943	66.6	1.42	
1506.277	66.58	1.4	
1506.61	66.52	1.34	
1506.943	66.48	1.3	
1507.277	66.18	1	
1507.61	66.37	1.19	
1507.943	66.25	1.07	

2 HR TEST

INPUT 3 ET (min)	LEVEL (ft)	DRAWDOW	T/R^2
0	64.69	0	0
0.084	64.73	0.04	3.73E-06
0.167	64.45	0.01	7.42E-06
0.251	64.47	0.01	1.12E-05
0.334	64.6	0.01	1.48E-05
0.417	64.81	0.12	1.85E-05
0.501	64.86	0.17	2.23E-05
0.584	65.22	0.53	2.6E-05
0.667	64.93	0.24	2.96E-05
0.751	65.29	0.6	3.34E-05
0.834	65.01	0.32	3.71E-05
0.917	65.04	0.35	4.08E-05
1.001	65.1	0.41	4.45E-05
1.377	65.61	0.92	6.12E-05
1.71	65.42	0.73	7.6E-05
2.043	65.59	0.9	9.08E-05
2.377	65.75	1.06	0.000106
2.71	66.2	1.51	0.00012
3.043	66.24	1.55	0.000135
3.377	66.37	1.68	0.00015
3.71	66.12	1.43	0.000165
4.043	65.97	1.28	0.00018
4.377	66.34	1.65	0.000195
4.71	66.13	1.44	0.000209
5.043	66.69	2	0.000224
5.377	66.46	1.77	0.000239
5.71	66.8	2.11	0.000254
6.043	66.36	1.67	0.000269
6.377	66.42	1.73	0.000283
6.71	66.67	1.98	0.000298
7.043	66.73	2.04	0.000313
7.377	66.97	2.28	0.000328
7.71	66.53	1.84	0.000343
8.043	67.07	2.38	0.000357
8.377	66.81	2.12	0.000372
8.71	66.89	2.2	0.000387
9.043	66.94	2.25	0.000402
9.377	66.7	2.01	0.000417
9.71	67.2	2.51	0.000432
10.043	66.87	2.18	0.000446
12.127	66.88	2.19	0.000539
14.127	67.28	2.59	0.000628
16.075	67.19	2.5	0.000714
18.075	67.36	2.67	0.000803
20.075	67.68	2.99	0.000892
22.075	67.45	2.76	0.000981

1508.277	66.08	0.9
1508.61	66.3	1.12
1508.943	66.02	0.84
1509.277	65.99	0.81
1509.61	66.23	1.05
1509.943	65.95	0.77
1512.041	65.84	0.66
1514.041	65.74	0.56
1516.041	65.67	0.49
1518.042	65.62	0.44
1520.042	65.6	0.42
1522.042	65.82	0.64
1524.042	65.77	0.59
1526.042	65.67	0.49
1528.042	65.47	0.29
1530.042	65.45	0.27
1532.042	65.44	0.26
1534.042	65.42	0.24
1536.042	65.41	0.23
1538.042	65.67	0.49
1540.042	65.39	0.21
1542.042	65.38	0.2
1544.042	65.62	0.44
1546.042	65.37	0.19
1548.042	65.36	0.18
1550.042	65.62	0.44
1552.042	65.59	0.41
1554.042	65.34	0.16
1556.042	65.59	0.41
1558.042	65.56	0.38
1560.042	65.33	0.15
1562.042	65.56	0.38
1564.042	65.32	0.14
1566.042	65.31	0.13
1568.042	65.3	0.12
1570.042	65.31	0.13
1572.042	65.57	0.39
1574.042	65.3	0.12
1575.997	65.29	0.11
1578.042	65.53	0.35
1580.042	65.29	0.11
1582.042	65.57	0.39
1584.042	65.28	0.1
1586.042	65.28	0.1
1588.042	65.55	0.37
1590.042	65.56	0.38
1592.042	65.56	0.38
1594.042	65.28	0.1
1596.042	65.29	0.11
1598.042	65.5	0.32

24.1	67.21	2.52	0.001071
26.133	67.52	2.83	0.001161
28.133	67.33	2.64	0.00125
30.133	67.65	2.96	0.001339
32.133	67.32	2.63	0.001428
34.133	67.56	2.87	0.001517
36.133	67.6	2.91	0.001606
38.133	67.81	3.12	0.001695
40.133	67.63	2.94	0.001784
42.133	67.39	2.7	0.001873
44.27	67.61	2.92	0.001968
46.213	67.88	3.19	0.002054
48.213	67.6	2.91	0.002143
50.213	67.65	2.96	0.002232
52.213	67.66	2.97	0.002321
54.213	67.68	2.99	0.002409
56.213	67.7	3.01	0.002498
58.213	67.91	3.22	0.002587
60.213	67.43	2.74	0.002676
62.213	67.7	3.01	0.002765
64.213	67.66	2.97	0.002854
66.213	67.7	3.01	0.002943
68.213	67.68	2.99	0.003032
70.213	67.43	2.74	0.003121
72.213	67.96	3.27	0.003209
74.213	67.47	2.78	0.003298
76.213	67.76	3.07	0.003387
80.138	67.68	2.99	0.003562
82.138	67.6	2.91	0.003651
84.138	67.95	3.26	0.003739
86.138	67.48	2.79	0.003828
88.053	67.71	3.02	0.003913
90.072	67.74	3.05	0.004003
92.072	67.72	3.03	0.004092
97.072	67.88	3.19	0.004314
96.073	67.72	3.03	0.00427
98.072	67.72	3.03	0.004359
100.07	68.02	3.33	0.004448
120.02	67.46	2.77	0.005334

1600.04	65.26	0.08
1620.21	65.24	0.06
1640.21	65.46	0.28
1660.21	65.22	0.04
1680.22	65.47	0.29
1700.22	65.21	0.03
1715.97	65.47	0.29

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TABLE 4

INPUT 4 ET (min)	LEVEL (ft)	DRAWDOW	T/R^2
0	65.47	0	0
0.084	65.57	0.1	7.06E-07
0.167	65.52	0.05	1.4E-06
0.251	65.58	0.11	2.11E-06
0.334	65.58	0.11	2.81E-06
0.417	65.55	0.08	3.5E-06
0.501	65.56	0.09	4.21E-06
0.584	65.52	0.05	4.91E-06
0.667	65.5	0.03	5.6E-06
0.751	65.45	0.01	6.31E-06
0.834	65.58	0.11	7.01E-06
0.917	65.56	0.09	7.7E-06
1.001	65.59	0.12	8.41E-06
1.377	65.54	0.07	1.16E-05
1.71	65.6	0.13	1.44E-05
2.043	65.61	0.14	1.72E-05
2.377	65.59	0.12	2E-05
2.71	65.54	0.07	2.28E-05
3.043	65.63	0.16	2.56E-05
3.377	65.66	0.19	2.84E-05
3.71	65.7	0.23	3.12E-05
4.043	65.68	0.21	3.4E-05
4.377	65.75	0.28	3.68E-05
4.71	65.67	0.2	3.96E-05
5.043	65.75	0.28	4.24E-05
5.377	65.74	0.27	4.52E-05
5.71	65.86	0.39	4.8E-05
6.043	65.89	0.42	5.08E-05
6.377	65.89	0.42	5.36E-05
6.71	65.9	0.43	5.64E-05
7.043	65.92	0.45	5.92E-05
7.377	65.96	0.49	6.2E-05
7.71	65.84	0.37	6.48E-05
8.043	65.97	0.5	6.76E-05
8.377	65.98	0.51	7.04E-05
8.71	65.93	0.46	7.32E-05
9.043	65.99	0.52	7.6E-05
9.377	66.02	0.55	7.88E-05
9.71	65.99	0.52	8.16E-05
10.043	66.03	0.56	8.44E-05
12.312	66.07	0.6	0.000103
14.078	66.08	0.61	0.000118
16.142	66.15	0.68	0.000136
18.142	66.19	0.72	0.000152
20.142	66.22	0.75	0.000169
22.142	66.21	0.74	0.000186

2 HR TEST

INPUT 4 ET (min)	LEVEL (ft)	DRAWDOW	T/R^2
0	65.65	0.18	0
0.084	65.77	0.12	7.06E-07
0.167	65.8	0.15	1.4E-06
0.251	65.81	0.16	2.11E-06
0.334	65.86	0.21	2.81E-06
0.417	65.89	0.24	3.5E-06
0.501	65.86	0.21	4.21E-06
0.584	65.85	0.2	4.91E-06
0.667	65.78	0.13	5.6E-06
0.751	65.92	0.27	6.31E-06
0.834	65.88	0.23	7.01E-06
0.917	65.87	0.22	7.7E-06
1.001	65.86	0.21	8.41E-06
1.377	65.9	0.25	1.16E-05
1.71	65.91	0.26	1.44E-05
2.043	65.88	0.23	1.72E-05
2.377	65.93	0.28	2E-05
2.71	65.97	0.32	2.28E-05
3.043	65.94	0.29	2.56E-05
3.377	66.04	0.39	2.84E-05
3.71	66.02	0.37	3.12E-05
4.043	66.07	0.42	3.4E-05
4.377	66.08	0.43	3.68E-05
4.71	66.1	0.45	3.96E-05
5.043	66.13	0.48	4.24E-05
5.377	66.15	0.5	4.52E-05
5.71	66.13	0.48	4.8E-05
6.043	66.17	0.52	5.08E-05
6.377	66.2	0.55	5.36E-05
6.71	66.2	0.55	5.64E-05
7.043	66.24	0.59	5.92E-05
7.377	66.2	0.55	6.2E-05
7.71	66.19	0.54	6.48E-05
8.043	66.24	0.59	6.76E-05
8.377	66.18	0.53	7.04E-05
8.71	66.26	0.61	7.32E-05
9.043	66.28	0.63	7.6E-05
9.377	66.25	0.6	7.88E-05
9.71	66.3	0.65	8.16E-05
10.043	66.34	0.69	8.44E-05
12.127	66.4	0.75	0.000102
14.127	66.53	0.88	0.000119
16.075	66.56	0.91	0.000135
18.075	66.6	0.95	0.000152
20.075	66.48	0.83	0.000169
22.075	66.58	0.93	0.000185

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24.142	66.23	0.76	0.000203
26.068	66.27	0.8	0.000219
28.068	66.33	0.86	0.000236
30.068	66.44	0.97	0.000253
32.068	66.32	0.85	0.000269
34.068	66.45	0.98	0.000286
36.068	66.35	0.88	0.000303
38.068	66.4	0.93	0.00032
40.068	66.39	0.92	0.000337
42.068	66.45	0.98	0.000353
44.068	66.44	0.97	0.00037
46.068	66.43	0.96	0.000387
48.193	66.46	0.99	0.000405
50.193	66.42	0.95	0.000422
52.193	66.42	0.95	0.000439
54.193	66.46	0.99	0.000455
56.193	66.43	0.96	0.000472
58.193	66.46	0.99	0.000489
60.193	66.44	0.97	0.000506
62.193	66.46	0.99	0.000523
64.193	66.49	1.02	0.000539
66.193	66.49	1.02	0.000556
68.193	66.48	1.01	0.000573
70.193	66.46	0.99	0.00059
72.193	66.43	0.96	0.000607
74.193	66.51	1.04	0.000623
76.193	66.49	1.02	0.00064
78.193	66.53	1.06	0.000657
80.193	66.53	1.06	0.000674
82.193	66.51	1.04	0.000691
84.193	66.57	1.1	0.000707
86.193	66.57	1.1	0.000724
88.193	66.57	1.1	0.000741
90.193	66.58	1.11	0.000758
92.193	66.57	1.1	0.000775
94.193	66.58	1.11	0.000791
96.193	66.56	1.09	0.000808
98.193	66.58	1.11	0.000825
120.15	66.6	1.13	0.001009
140.16	66.74	1.27	0.001178
160.16	66.76	1.29	0.001346
180.17	66.78	1.31	0.001514
200.15	66.77	1.3	0.001682
220.15	66.79	1.32	0.00185
240.15	66.67	1.2	0.002018
260.07	66.78	1.31	0.002185
280.07	66.81	1.34	0.002353
300.07	66.68	1.21	0.002521
320.07	66.77	1.3	0.002689
340.07	66.84	1.37	0.002857

24.1	66.59	0.94	0.000202
26.133	66.71	1.06	0.00022
28.133	66.7	1.05	0.000236
30.133	66.7	1.05	0.000253
32.133	66.69	1.04	0.00027
34.133	66.69	1.04	0.000287
36.133	66.72	1.07	0.000304
38.133	66.71	1.06	0.00032
40.133	66.77	1.12	0.000337
42.133	66.78	1.13	0.000354
44.27	66.75	1.1	0.000372
46.213	66.79	1.14	0.000388
48.213	66.76	1.11	0.000405
50.213	66.76	1.11	0.000422
52.213	66.66	1.01	0.000439
54.213	66.79	1.14	0.000455
56.213	66.85	1.2	0.000472
58.213	66.85	1.2	0.000489
60.213	66.8	1.15	0.000506
62.213	66.85	1.2	0.000523
64.213	66.63	0.98	0.000539
66.213	66.8	1.15	0.000556
68.213	66.82	1.17	0.000573
70.213	66.79	1.14	0.00059
72.213	66.73	1.08	0.000607
74.213	66.85	1.2	0.000624
76.213	66.84	1.19	0.00064
80.138	66.81	1.16	0.000673
82.138	66.89	1.24	0.00069
84.138	66.81	1.16	0.000707
86.138	66.89	1.24	0.000724
88.053	66.87	1.22	0.00074
90.072	66.9	1.25	0.000757
92.072	66.87	1.22	0.000774
97.072	66.89	1.24	0.000816
96.073	66.88	1.23	0.000807
98.072	66.89	1.24	0.000824
100.07	66.89	1.24	0.000841
120.02	66.69	1.04	0.001008

360.07	66.85	1.38	0.003025
380.07	66.82	1.35	0.003193
400.07	66.83	1.36	0.003361
420.07	66.83	1.36	0.003529
440.07	66.82	1.35	0.003697
460.03	66.88	1.41	0.003865
480.03	66.83	1.36	0.004033
500.03	66.16	0.69	0.004201
520.03	66.23	0.76	0.004369
540.03	66.21	0.74	0.004537
560.03	66.25	0.78	0.004705
580.03	66.26	0.79	0.004873
600.03	66.24	0.77	0.005041
620.03	66.33	0.86	0.005209
640.03	66.36	0.89	0.005377
660.03	66.35	0.88	0.005545
680.03	66.38	0.91	0.005713
700.1	66.4	0.93	0.005882
720.1	66.36	0.89	0.00605
740.1	66.4	0.93	0.006218
760.1	66.33	0.86	0.006386
780.1	66.32	0.85	0.006554
800.1	66.28	0.81	0.006722
820.13	66.37	0.9	0.00689
840.13	66.36	0.89	0.007058
860.13	66.31	0.84	0.007226
880.13	66.28	0.81	0.007394
900.13	66.13	0.66	0.007563
920.13	66.25	0.78	0.007731
940.13	66.35	0.88	0.007899
960.13	66.26	0.79	0.008067
980.13	66.14	0.67	0.008235
1000.1	66.41	0.94	0.008402
1060.3	66.42	0.95	0.008908
1120.3	66.45	0.98	0.009412
1180.3	66.44	0.97	0.009916
1240.3	66.3	0.83	0.01042
1300.3	66.85	1.38	0.010925
1360.3	66.83	1.36	0.011429
1420.2	66.92	1.45	0.011932
1480.2	67.14	1.67	0.012436
1499.9	66.78	1.31	0.012602
1499.984	66.69	1.22	
1500.067	66.61	1.14	
1500.151	66.65	1.18	
1500.234	66.73	1.26	
1500.317	66.69	1.22	
1500.401	66.74	1.27	
1500.484	66.71	1.24	
1500.567	66.76	1.29	

1500.651	66.66	1.19
1500.734	66.57	1.1
1500.817	66.65	1.18
1500.901	66.62	1.15
1501.277	66.75	1.28
1501.61	66.68	1.21
1501.943	66.72	1.25
1502.277	66.51	1.04
1502.61	66.65	1.18
1502.943	66.67	1.2
1503.277	66.52	1.05
1503.61	66.63	1.16
1503.943	66.52	1.05
1504.277	66.53	1.06
1504.61	66.48	1.01
1504.943	66.54	1.07
1505.277	66.53	1.06
1505.61	66.38	0.91
1505.943	66.4	0.93
1506.277	66.4	0.93
1506.61	66.46	0.99
1506.943	66.44	0.97
1507.277	66.41	0.94
1507.61	66.38	0.91
1507.943	66.39	0.92
1508.277	66.38	0.91
1508.61	66.24	0.77
1508.943	66.36	0.89
1509.277	66.18	0.71
1509.61	66.25	0.78
1509.943	66.22	0.75
1512.041	66.18	0.71
1514.041	66.15	0.68
1516.041	66.17	0.7
1518.042	66.16	0.69
1520.042	66.02	0.55
1522.042	66.12	0.65
1524.042	65.99	0.52
1526.042	66.09	0.62
1528.042	66.07	0.6
1530.042	66.06	0.59
1532.042	66.03	0.56
1534.042	66.03	0.56
1536.042	66	0.53
1538.042	65.96	0.49
1540.042	66.02	0.55
1542.042	65.89	0.42
1544.042	65.99	0.52
1546.042	66	0.53
1548.042	65.94	0.47

1550.042	65.98	0.51
1552.042	65.98	0.51
1554.042	65.95	0.48
1556.042	65.86	0.39
1558.042	65.96	0.49
1560.042	65.87	0.4
1562.042	65.77	0.3
1564.042	65.95	0.48
1566.042	65.92	0.45
1568.042	65.95	0.48
1570.042	65.91	0.44
1572.042	65.88	0.41
1574.042	65.86	0.39
1575.997	65.8	0.33
1578.042	65.86	0.39
1580.042	65.88	0.41
1582.042	65.72	0.25
1584.042	65.83	0.36
1586.042	65.81	0.34
1588.042	65.89	0.42
1590.042	65.86	0.39
1592.042	65.8	0.33
1594.042	65.96	0.49
1596.042	66.04	0.57
1598.042	66.26	0.79
1600.04	66.16	0.69
1620.21	66.12	0.65
1640.21	66.17	0.7
1660.21	66.19	0.72
1680.22	66.11	0.64
1700.22	66.13	0.66
1715.97	66.17	0.7

APPENDIX

HYDROGEOLOGIC CHARACTERIZATION AND REMEDIAL INVESTIGATION

SPARTON TECHNOLOGY, INC.

HYDROGEOLOGIC CHARACTERIZATION AND REMEDIAL INVESTIGATION SPARTON TECHNOLOGY, INC. ALBUQUERQUE, NEW MEXICO

March 13, 1985

A Report Prepared for:

Sparton Corporation
2400 East Ganson Street
Jackson, Michigan 49202

HYDROGEOLOGIC CHARACTERIZATION AND REMEDIAL INVESTIGATION SPARTON TECHNOLOGY, INC. 9261 COORS ROAD, NORTHWEST ALBUQUERQUE, NEW MEXICO

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I INTRODUCTION

This report presents the work performed by Harding Lawson Associates (HLA) for the SPARTON Technology, Inc. manufacturing facility located at Coors Boulevard, Albuquerque, New Mexico. In this report, we have incorporated data from previous work phases conducted by HLA at the site.

The purpose of this report is to provide SPARTON with additional understanding of the hydrogeologic conditions at the plant site, to categorize the extent and rate of migration of dissolved volatile organics and metals in the ground water, and to determine the concentration of organics and metals in soil near a suspected contamination source.

HLA performed a review of existing data, reports, and files relevant to the above purpose. Field work for this phase of the project included drilling and installation of six monitoring wells and one production well, collecting soil and water samples for organic and metal analyses, water level monitoring, and conducting both a pump test and an infiltration test to evaluate the hydrogeologic framework.

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This report includes appendices which describe in detail the operating procedures and methods used during the field work and for data analyses. The main text therefore contains only data and interpretation obtained during this work phase. The reader is referred to these appendices to obtain specific methodology.

II FIELD WORK

A. Drilling, Well Construction and Development

Six monitor wells (MW-12 through MW-17) and one production well (PW-1) were installed during this phase of work. Wells were installed using both rotary wash (mud-rotary) and hollow-stem auger drilling methods. Appendices A and B detail the methodologies used for the drilling program. The locations of all existing and new wells are shown on Figure 1.

B. Well MW-12

Well MW-12 was drilled approximately 50 feet northeast of MW-9. The well site was selected to collect formation samples for the design of the production well, to obtain a water sample representative of the ground water in the vicinity of the planned production well, and to monitor water level response during the pumping test.

A hollow-stem auger drilling rig was used to drill to a depth of 70 feet below grade. Continuous sampling with the 5-foot core barrel was conducted from 50 to 70 feet. Flowing sand conditions and large gravels in the borehole slowed the drilling rate and the remainder of the boring was completed with a mud-rotary drilling rig. Soils were classified from split-spoon samples taken at selected depths in conjunction with a description of the drill cuttings. Figures 2A and 2B are a log of the materials penetrated and the well construction details for MW-12.

The boring encountered fine to medium grain sand from 0 to 39 feet. A dense fine layer was present from 39 to 40 feet which overlaid a 5-foot section of coarse gravel and cobbles. The coarse material appeared to be a terrace-type deposit consisting of sub-rounded, flat granite cobbles 2 inches in diameter.

Drive samples from 50 to 70 feet indicated a well graded sand with small percentages of gravel and silt. The soils increased in moisture content at 60 feet and the auger rig encountered flowing (saturated) sand conditions below 65 feet.

Split-spoon samples obtained by the mud-rotary rig showed that a 4-foot thick layer of dense brown, fine silty sand is present from 74 to 78 feet. A sample obtained from the 75- to 77-foot depth was submitted to HLA's soil laboratory for sieve analysis. Figure 3 is a grain size distribution graph showing the material as a very fine sand with about 25 percent fines.

The materials from 80 to 135 feet are a well-graded sand with little or no fines. Figure 3 also includes the grain size analyses conducted by Rodgers & Company of samples taken from 60 to 70 and from 80 to 135 feet for the design of the well screen. The sand has a median grain size of greater than 0.6 millimeters, which is about

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three times larger than the median grain size of the silty sand layer of 74 to 78 feet. The silty sand layer had over 25 percent silt and clay size particles while the sand had no appreciable quantity of fine materials.

A layer of fine-grained material was encountered at a depth of 138 feet. A split-spoon sample collected from 139 to 140 foot interval contained 4 inches of silty clay above a dense brown silt having a small percentage of clay.

A 4-inch-diameter PVC threaded and flush-jointed well was constructed in the borehole with 69 feet of well screen. The screen with a slot size of 0.020 inches was installed at a depth of 64 to 133 feet. Centralizers were placed around the screen to keep the well in the center of the boring. Solid 4-inch-diameter casing extended from the top of the screen to ground surface. Specially-graded sand (Grade No. 10 x 20; see Appendix A) was placed in the annular space to 60 feet. A 2-foot bentonite pellet layer was placed above the sand and the remainder of the annular space was pressure grouted with a neat grout and bentonite mixture. The well was finished below grade with a drive over box and locking cap. The elevation of the top of casing was surveyed into mean sea level datum. The information is listed at the end of this chapter in Section J.

The well was developed for two hours with an air compressor. The flow rate at the end of development was estimated at 30 to 40 gallons per minute (gpm). Following development, a 1/2 horsepower submersible pump was lowered 100 feet below top of casing and the well was pumped for 60 minutes at 5 gpm. The flow rate was then reduced to 1 gpm and samples were obtained for organic and metal analyses using the sampling protocol in Appendix C. All water from development and sampling was discharged to the municipal sanitary sewer. The volatile organic samples were placed in 40 milliliter teflon-sealed vials with no head space and a two liter sample was taken for metal analyses. All samples were immediately iced and delivered to Rocky Mountain Analytical Laboratory (RMA), Arvada, Colorado by overnight delivery. Section III C. discusses the results of the analytical work.

C. Well MW-13

This monitoring well is located next to the south property line, about 200 feet west of MW-8 (Figure 1). The purpose of this boring was to determine the stratigraphy of the subsurface between wells MW-8 and MW-9 and for use as an observation well and a sampling location during later portions of this field work. An 8-inch diameter boring was drilled using mud-rotary techniques. The geologic log and well construction details are shown in Figures 4A and 4B.

The upper 66 feet of the boring consisted of sands and gravels, with two layers of fine-grained material from 30 to 44 feet and from 54 to 56 feet. A dense, silty clay layer with a small quantity of fine sand was noted from 66 to 71. A split-spoon sample was pushed into this material, but no recovery of the soil was obtained. Beneath this layer, a fine sandy silt layer was present from 70 to 80 feet.

Sand was noted from 80 to 86 feet, which changed to silty sand from 86 to 90 feet. A sandy silt was penetrated from 90 to 105 feet and a coarse gravelly sand was present from 105 to 135 feet. This gravelly sand material had similar drilling and textural properties as was noted during the drilling from 80 to 138 feet in MW-12.

A fine-grained layer was present in the bottom of MW-13, and a split-spoon sample of the material was taken at 140 feet. The soil was a fine sandy silt with a trace of clay. The sample was very dense.

A 2-inch diameter threaded and flush-jointed PVC well was constructed in the boring with 79.5 feet of 0.020-inch slot screen placed from 60 to 139.5 feet. The annular space around the well screen was packed with 10 x 20 sand up to 58 feet. Two feet of bentonite pellets were placed above the sand pack and the remainder of the annular space was filled with a neat grout and bentonite slurry. The well construction was completed by cementing a 6-inch diameter steel protector pipe with a locking cap around the PVC well.

The well was developed with air for two hours. The average withdrawal rate of water was 6 gpm. All water was discharged to the municipal sanitary sewer.

D. Well MW-14

This well, located in the southwestern corner of the SPARTON property (Figure 1), was used as an observation point for water level measurements, water sample collection, and to obtain subsurface information from that portion of the site. An 8-inch boring was drilled using rotary wash techniques. Figures 5A and 5B shows the log of subsurface material and well construction.

A coarse sand and gravel layer was present from 40 to 127 feet separated by a 2-foot layer of fine silty sand from 69 to 71 feet. A dense, silty clay layer was encountered at 127 to 130 feet. Split-spoon samples show that the material from both layers was very dense and nonplastic.

A 2-inch-diameter threaded and flush-jointed PVC monitoring well was constructed with 66 feet of 0.020 slot well screen from 61 to 127 feet. Graded 10 x 20 sand was placed in the annular space from 58 to 130 feet. The remainder at the annular space was sealed with a 2-foot layer of bentonite pellets, followed by neat grout with bentonite. The well was finished by cementing a 6-inch diameter steel protector pipe with a locking cap.

The well was developed with air for a period of two hours with a yield of 5 gpm. All water was discharged to the municipal sanitary sewer.

E. MW-15

An 8-inch boring was drilled by rotary wash technique at the western border of the plant property (Figure 1). Data obtained from this boring, along with the information derived from MW-14, were used to develop a better understanding of the hydrogeology on the western site of the property. Figures 6A and 6B are a log of the sub-surface materials and well construction details.

The top 39 feet of the boring consisted of a fine silty sand with a small percentage of clay. Beneath this material was a coarse gravel layer to 70 feet. A fine-grained layer was encountered from 70 to 77 feet. A soil sample from 70 to 71.5 feet showed a fine silty sand with a small percentage of clay. A 3-foot gravel layer was present from 77 to 80 feet. Beneath the gravel layer the formation alternated from coarse sand and gravel to fine-grained soils in approximately 10-foot layers. A dense clay was encountered at 125 feet. Drilling was continued to 130 feet where a split-spoon sample was to have been taken. However, the formation changed to sand and gravel, and the sample was not obtained. Drilling continued to a total depth of 140 feet.

The clay layer breached from 125 to 130 feet may separate a lower aquifer. To assure that ground-water flow would not occur through the boring, the bottom was filled with sand to 130 feet, and a 2-foot layer of bentonite pellets were placed in the boring opposite the clay layer prior to well construction.

MW-15 was constructed using 2-inch-threaded and flush-jointed PVC with 64.5 feet of 0.020-slot well screen from 60 to 124.5 feet. The sand pack extended from 55 to 128 feet and consisted of 10 x 20 sand. The remainder of the annular space was sealed with a 2-foot layer of bentonite followed by a neat grout with bentonite. A 6-inch steel protector pipe with locking cap was cemented into place.

The well was developed with air for two hours. The average yield of the well was 6 gpm. All water from the development was discharged to the municipal sanitary sewer.

F. MW-16

This boring is located in the fenced area adjacent to the two lined lagoons and is about 5 feet east from MW-1 (Figure 1). The boring was drilled using hollow-stem auger methods. Sampling with a 5-foot internal core barrel was used to a total depth of 73 feet.

The purpose of this boring was to obtain a series of soil samples for analytical analyses of total metals. Soil samples were also screened for organic vapor concentration using a photo-ionization detector (PID) meter manufactured by HNU Corporation (Model 101 with 11.7 eV lamp). The PID was calibrated to benzene vapors and was also used to continuously monitor the ambient atmosphere in the work area for health and safety purposes. Figure 7 is a log of the subsurface material encountered and the well construction details.

The boring penetrated brown, well-graded sand to 30 feet, where a 5-foot dense layer of clay was encountered. Beneath the clay layer coarse sand was present to 70 feet with a stiff clay layer located at 53 to 55 feet. Flowing sand conditions were encountered below 70 feet, causing sand to enter the augers after the core barrel was removed. Data regarding organic vapor concentration and metal concentration are included in Section III D.

A monitoring well was installed in the boring using 2-inch-diameter threaded and flush-jointed PVC casing and screen. Five feet of 0.020-inch slot well screen was installed from 68 to 73 feet. The annular space surrounding the well screen was allowed to collapse from 58 to 73 feet. Thick bentonite slurry was placed from 14 to 58 feet, and a neat cement grout was set from 0 to 14 feet. The well was finished with a 6-inch steel protector pipe with a locking cap.

The well was developed by bailing sand and water from the well for approximately two hours. The well yield was less than 0.5 gpm. All water was placed into the lined lagoons.

G. MW-17

Boring MW-17 is located approximately 55 feet north of the eastern lined lagoon (Figure 1). This boring was originally located adjacent to MW-3, but was moved when New Mexico Environmental Improvement Division (NMEID) personnel expressed reservations about conducting an infiltration test adjacent to the lined lagoons. The purpose of this well was to monitor water level fluctuation during the infiltration test. The boring was drilled similarly to MW-16, using a hollow-stem auger with a 5-foot internal core barrel. Figure 8 shows the well construction and subsurface materials encountered during drilling.

The top 40 feet of the boring encountered well-graded sand with a few thin fine-grained layers. Fine-grained clayey sand was noted from 40 to 45 feet, with clayey sandy silt from 45 to 50 feet, and coarse sand was penetrated from 50 to 55 feet. A dense clay layer was present from 55 to 60 feet. Coarse sand and gravelly sand was found to 72 feet where flowing sand conditions were encountered.

A 2-inch-diameter threaded and flush-jointed monitoring well was installed with a 5-foot well screen (0.020-slot) from 67 to 72 feet. The borehole was allowed to collapse from 63 to 72 feet. The annular space was filled with a thick bentonite slurry from 20 to 63 feet, with neat grout from 0 to 20 feet. A steel protector pipe was then cemented over the PVC well casing.

The well was developed by bailing for approximately two hours. The yield during development was less then 0.5 gpm. Water was discharged to the lined ponds.

H. PW-1

A production well was drilled approximately 8 feet east of MW-9 (Figure 1). The immediate purpose of this well was to conduct a pump test to evaluate the hydrogeologic properties of the aquifer beneath the site. The well was drilled with a 16-inch drill bit and with 47 feet of stabilizers, using rotary wash techniques. The well depth and screen design were based upon the samples obtained from MW-12. Figures 9A and 9B shows the materials encountered during drilling and the well construction.

The materials encountered during the drilling were similar in texture and stratigraphy as was noted in MW-12. A fine-grained layer was present in the boring from about 70 to 80 feet which corresponds to the upper silty sand layer present from 74 to 78 feet in MW-12. A

second fine-grained layer was encountered at about 135 feet. The drill cuttings continued to increase in silt and clay content to the bottom of the boring at 145 feet. Original plans were to drill to 140 feet, but the boring was extended an additional 5 feet to allow an ample sump for any cuttings which may not have been removed from the boring. This allowed the driller to use a much thinner drilling fluid which aided in well development.

A 10-inch diameter threaded and flush-jointed PVC well casing and screen was installed in the boring to a total depth of 138 feet. Two intervals are screened: from 60 to 70 feet to collect ground water from above the upper silty sand layer; and from 80 to 138 feet to allow the well to be open opposite the coarse sand and gravel below the upper fine-grained layer. The well screen has slot openings of 0.045 inches, based on the grain size analyses from MW-12.

Three sets of centralizers were used to allow the uniform placement of 66 - 100 pounds bags of 8 x 16 gravel around the well screen from the bottom of the boring to 55 feet. Bentonite pellets were placed from 53 to 55 feet and a neat grout with bentonite was pumped into the annular space from 53 feet to grade. The well was completed by cementing a 14-inch steel protector pipe with locking cap over the PVC well casing.

Well development was conducted with the drill rig's air compressor. The initial withdrawal rate was 60 gpm, but after about 90 minutes, the rate was 100 gpm. Development continued for a total of 4 hours 15 minutes until the well produced water with little to no sediment or turbidity. All water was discharged to the municipal sanitary sewer.

I. Infiltration Gallery

An 8-foot-long by 0.88 foot by 4-foot-deep infiltration gallery was installed with a backhoe 4 feet south of MW-17 (Figure 1). The open area of the bottom of the gallery was 7 feet^2. The gallery consisted of a wooden box with an open bottom filled with 3 feet of 1.5-inch gravel to ensure integrity and stop erosion during the test. As mentioned earlier, the intended location of the gallery was originally adjacent to MW-16, but was relocated because of concerns expressed by NMEID.

The purpose of the gallery was to conduct a pilot scale infiltration test to determine the capability of the subsurface to receive infiltration. A test of this scale (as opposed to a small test with an infiltrometer) was used to give a much more accurate depiction of the infiltration characteristics of the subsurface.

J. Well Data Summary

Table 1 lists the top of casing elevation and screened interval below grade for the seven wells. The elevation data were obtained from Denny-Gross & Associates, Inc., registered surveyors from Alburquerque, New Mexico. The top of casing data listed are actually the elevation of the top of a flat 3/8-inch-thick bar laid across the top of the steel protector pipe. All water level measurements were obtained using the top of the bar as the reference point.

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TABLE 1

WELL COMPLETION SUMMARY

SPARTON TECHNOLOGY, INC.

ALBUQUERQUE, NEW MEXICO

Well	Top of Casing Feet MSL	Screened Interval Feet Below Grade
MW-12	5041.81	64-133
MW-13	5043.35	60-139.5
MW-14	5041.94	61-127
MW-15	5047.51	60-124.5
MW-16	5047.53	68-73
MW-17	5049.30	67-72
PW-1	5043.89	60-70; 80-138

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III HYDROGEOLOGIC FRAMEWORK

A. Geologic Conditions

Based upon the results of previous field investigation and the data obtained from these borings, a conceptual three-dimensional hydrogeologic framework has been developed for the SPARTON site. In general, the plant is located on unconsolidated sand and gravel deposits with occasional fine-grained layers of silt and clay located at specific depths. The stratigraphy of these deposits is characteristic of valley-fill alluvium and colluvium of the unconsolidated aquifer in the Rio Grande Valley. The flat, subrounded gravels are indicative of a meandering stream, which deposited sand and gravel in the main channel, and fine-grained sediments on a relatively broad flood plain. Some of these fine-grained layers appear to be found almost continuously beneath the site; the impact of these layers are discussed in this section.

The subsurface conditions can be most easily understood by constructing cross-sections using the geologic information gathered during this and the previous phases of site work. These crosssections are necessarily interpretive, and are therefore subject to change based upon future data acquisition and analysis.

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Figure 10 is cross-section A-A' (shown in Figure 1) which shows the interpreted geologic conditions beneath the center of the plant site in a northeast-southwest direction. The boring information from MW-1, 2, 3, 4, 9, 10, 11, 12, 16, 17 and PW-1 is projected onto this cross-section.

The unsaturated zone consists mainly of sand, silty sand, and sandy gravel, with an occasional silt and clay lenses. No data are available to suggest that any of these fine-grained layers are continuous in the unsaturated zone.

Two fine-grained layers are suspected to be present almost continuously beneath the site in this cross-section. A layer, alternately described as silty sand or clayey silt, is present between elevation 4965 to 4975 feet in boring MW-9, 10, 11, 12 and PW-1. MW-16 and 17 were not drilled to this depth. MW-2, 3, and 4 were not logged as having encountered this material, however split-spoon samples were not obtained during drilling of these wells.

The second fine-grained layer is present at about elevation 4900 feet and consists of dense fine sands, silts and clays. The thickness and areal extent of this layer is presently unknown, but the log of MW-10 showed a 1-foot thick clay layer at that depth. Wells MW-9, 16,

and 17 are screened above the upper fine-grained layer, while MW-1, 2, 3, 4, 12 and PW-1 are screened above and below that layer. MW-10 and 11 are screened at or below the lower fine-grained layer.

Figure 11 shows the interpretive cross-section B-B' along the southern property boundary of the plant (Figure 1) and contains data projected from MW-8, 9, 12, 13, 14 and PW-1. This view shows that both of the fine-grained units are probably continuous at this location and gives added indications that these units may be continuous beneath the plant site. Wells MW-8 and 9 are screened above the upper fine-grained layer, while the remainder of the wells are screened above and below.

Boring MW-13 encountered additional fine-grained layers both above and below the water table. The 20-foot thickness of this material below the water table could reduce the transmissivity of the aquifer between the two fine-grained layers which appear to be continuous beneath the site.

Figure 12 shows geologic cross-section C-C' which includes data projected from MW-5, 14, 15, and P-1 (Figure 1). The upper fine-grained layer is present in all boring logs except for P-1 from which split-spoon samples were not collected. Boring MW-15 apparently drilled through the lower fine-grained layer from 4915 to 4920 feet.

That layer consisted of a dense clay which abruptly changed to gravelly sand at 4915 feet. The boring was sealed with a bentonite plug in this interval to assure that no possible migration pathway remained into the sediments beneath the lower fine-grain layer.

The log of MW-15 is similar to MW-13 in that the aquifer between the fine-grained layers contains units of clays and silty sands which may reduce the transmissivity in this area.

In summary, the subsurface at the SPARTON site can be divided into a series of sand and gravel units separated by fine-grained layers. The upper unit extends from the land surface to approximately 70 feet below grade where the upper fine-grained layer was found to be present in all of the borings during this phase of drilling and was noticed in most of the logs from previous field investigations which did not have as vigorous a sampling plan. Ground water is present above this upper fine-grained layer, causing a 5- to 10- foot thickness of saturated sands and gravels above that layer.

A second sand and gravel unit is generally found at elevation 4910 to 4970 feet. This layer generally consists of coarse sand and gravel beneath the water table, although MW-13 and 15 intersected a series of silts and clays between the two fine-grained layers. A

second fine-grained layer appears to be present beneath the site at elevation 4910 to 4900 feet, which may act to separate the lower aquifer from deeper sand and gravel units.

B. Ground-Water Conditions

Ground water was encountered in all of the borings at about 60 to 70 feet below grade. Wells were screened at different intervals throughout the phases of field work at this site, so all water level data must be carefully interpreted in order to develop the most representative concept of the ground-water flow regime of the site.

The upper fine-grained layer appears to divide the sediments into two aquifers: a relatively thin unconfined aquifer at about elevation 4970 to 4980 feet; and a lower aquifer that is present from 4910 to 4970 feet. The integrity of the upper fine-grained layer is not totally known, but based upon this last phase of field work, it appears to be sufficiently continous beneath the site to cause a head difference between the aquifers. Also, chemistry data and results of the aquifer test suggest that the upper unit acts as a semi-confining unit, restricting vertical ground-water flow. These last two topics are discussed in more detail in subsequent sections.

Figure 13 is a cross-section of the ground-water conditions at the SPARTON site. The section was taken through A-A' which is shown on Figure 1. The contour map was constructed using the head data in all wells. The mid-point of the screen was used as the reference elevation corresponding to head measurements for the wells in which large thicknesses of the aquifer were monitored. The contours on the crosssection show an apparent downward vertical gradient with up to 4.0 feet of head difference present between adjacent wells MW-16 and MW-11. The downward vertical gradient present on-site complicates the determination of the horizontal flow gradients since the monitoring wells were completed at different elevations and in both aquifers. We interpolated and extrapolated water-level measurements taken for this study, adjusting the levels to what the piezometric elevation is anticipated to be in the upper and lower aquifers, allowing for the vertical gradient.

Figure 14 is a contour map of the water-table elevations of the upper aquifer. The direction of flow is towards the southwest. An anomoly on this map is the apparent low gradient from MW-6 to MW-8. The gradient beneath the plant site of 0.006 is roughly four times as steep as the gradient along the eastern property boundary. The reason for this difference is presently unknown.

Figure 15 shows the piezometric head data for the lower aquifer on the SPARTON site. As mentioned earlier, construction of this map required the interpretation of the water levels taken throughout the plant site. The horizontal gradient in the lower aquifer is about 0.005 toward the west. The gradient of the lower aquifer's piezometric head is less than the gradient of the overlying water table aquifer. The difference in gradients may be due to leakage or changes in the thickness of the upper aquifer.

C. Ground Water Chemistry

This section includes the analyses of water samples taken during this phase of field work. Water samples have been taken from all monitoring wells and PW-1. All analytical work for this phase has been conducted by Rocky Mountain Analytical Laboratory (RMA), Arvada, Colorado. Water samples collected during this phase of work were obtained according to the Ground-Water Sampling and Analytical Protocol attached as Appendix C. All water obtained during well purging was discharged to the sanitary sewer, which was arranged and authorized through SPARTON personnel.

Water samples were taken in MW-12 in order to obtain preliminary chemical data of the anticipated water quality for discharge into the sanitary sewer. PW-1 was sampled four times during the pumping test to determine if any chemical trends could be identified. Water

samples were taken before and after the infiltration test from MW-16 and MW-17 to determine the effects of the vadose zone flushing on ground water chemical constituents. The remainder of the new monitoring wells were sampled to augment and update our information about the areal chemical character of the ground water.

Previous ground-water sampling at the SPARTON site has shown the presence of high concentrations of volatile organic chemicals (VOC) in wells MW-1, 3, and 9 with some VOC constituents found in all of the monitoring well samples. The concentrations of VOCs are greatest from the samples from the wells that are screened above the upper fine-grained layer, as evidenced by the chemical results from MW-9, which is about 500 feet from the suspected contamination source. Wells MW-10 and 11, which are screened at or below the lower fine-grained layer, have shown much lower concentrations. These two wells were not sealed below the water table to prevent downward leakage from the water table to the screened area, so the results from these two wells may not be indicative of ground-water quality at that depth.

Previous sampling of MW-1 through 11 showed high concentrations of boron, chromium, manganese, and nickel. Wells with the highest concentrations were in MW-1, 3, and 9, although manganese was the only one of these metals analyzed in MW-9.

Table 2 lists all of the chemical analyses compiled from the new wells installed during this phase of work. Results of the subs quent sampling in November 1984 are in Appendix C. The concentrations of metals and VOCs were greatest in MW-16, which obtained ground water from above the upper fine-grained layer in the area immediately adjacent to the suspected contamination source. High concentrations of VOCs and metals were also found in MW-14, and 15, on the west side of the plant site. The lowest levels of contaminants were found in the samples from MW-12 and PW-1. Samples for metals analysis were not filtered in the field rior to acidification during this phase of work. Therefore the chemical results ra resent total metals instead of dissolved metals.

A comparison of the trichloroethylene, Total Organic Carbon, and Specific Conductance re ults from this work phase and subsequent sampling during November 1984 is shown in Table 3. Trichloroethylene was selected because it is a volatile organic constituent which as been detected in all wells. The highest concentration of trichloroethylene is found in MW-3, with 59,000 ug/l of the organic constituent. The lowest trichloroethylene concentrations are found in MW-5, 6, 8, 10, 12, and PW-1. Trichloroethylene was not detected in MW-11. TOC concentration is highest in MW-3. The highest specific conductance value was found in MW-16, with MW-1, 3, and 9 also exhibiting elevated results. The lowest values were found in MW-2, 5, 7, 8, 10, 11, and 17. A comparison of results in MW-9, 12,

TABLE __

SPARTON TECHNOLOGY, INC.

Analytical Results of Water Samples MW-12 through MW-17 and PW-1

TABLE 3

TRICHLOROETHYLENE, TOC,

AND SPECIFIC CONDUCTANCE VALUES

SPARTON TECHNOLOGY, INC.

ALBUQUERQUE, NEW MEXICO

Well	Sample Date	Sample Method*	Aquifer Sampled**	Trichloroethylene (ug/l)	TOC (mg/l)	Specific Conductance (uho/cm)
MW-1	11/29/84	G	U	23,000	48	3,420
MW-2	11/29/84	G	U	2,100	1.0	713
MW-3	11/29/84	G	U	59,000	86	4,250
MW-4	11/29/84	G	U	7,400	1.8	983
MW-5	11/28/84	G	U	140	3.8	721
MW-6	11/28/84	G	U	310	6.1	866
MW-7	11/27/84	G	U	530	3.6	[illegible]
MW-8	11/27/84	G	U	250	5.5	[illegible]
MW-9	11/29/84	G	U	9,600	14	2,350
MW-10	11/20/84	G	L	120	3.0	702
MW-11	11/20/84	G	L	ND*	2.2	699
MW-12	08/29/84	P	L	61	1.7	769
MW-13	10/04/84	B	U	6,900	5.2	1,090
MW-14	10/04/84	B	U	12,000	5.9	1,290
MW-15	10/04/84	B	U	4,400	2.7	885
MW-16	10/05/84	B	U	37,000	54	5,300
MW-17	10/05/84	B	U	4,300	5.1	695
PW-1	10/07/84	P	L	200	3.8	801

* G-Gas Squeeze B adder Pump
P-Submersible Centrifugal Pump
B-Teflon Bailer
ND-Not Detected

** U-Upper Aquifer
L-Lower Aquifer

and PW-1, which were obtained by different methods, suggests that the ground water above the upper fine-grained layer is much more contaminated than the ground water beneath the layer. This is explained below.

The samples in MW-13, 14, 15, 16, and 17 were obtained with a Teflon bailer. Sampling methodology for all wells during this phase of work is included in Appendix C. Samples taken with the bailer from MW-13, 14, and 15 should have been representative of conditions in the upper aquifer. Based on this premise, the data indicate that the ground water above the upper fine-grained layer is contaminated at these locations. Samples from MW-12 and PW-1, taken with a submersible pump set near the bottom of the screen, probably were a mixture of water from the two aquifers. However, because of the coarseness of the lower aquifer, most of the water in these samples was from the lower aquifer.

Figure 16 is a contour map of the specific conductance data obtained from all wells except MW-10, 11, 12 and PW-1. The contoured data, which were taken over a period of time listed on Table 3, are more representative of the ground-water chemistry of the upper aquifer. The high conductivity plume extends from the suspected contamination source as measured by MW-1, 3, and 16 towards the southwest. Background conductance values range from about 690 to 760 umhos/cm.

A similar contour pattern is shown in Figure 17, which is a contour map of trichloroethylene data listed in Table 3. Results of MW-10, 11, 12, and PW-1 are not included on this map.

Both contour maps show that the upper aquifer contains relatively high concentrations of the contaminants present at the suspected contamination source. The direction of contaminant migration is towards the southwest. Additional sampling from the upper and lower aquifer in the existing wells MW-12, 13, 14, and 15 would aid in defining the degree of contamination above and below the fine-grained layer.

Four water samples were obtained from the submersible pump line discharge during the pumping test on PW-1 (Table 2). Concentrations of TOX decreased somewhat as pumping continued; the initial TOX concentration was 380 ugCl^-/l and after 12 hours of pumping the concentration was down to 240 ugCl^-/l. The third sample, at the end of the 1500-minute pumping test, had a TOX concentration of 210 ugCl^-/l. A fourth sample taken at the end of the 120-minute pumping test also had a TOX concentration of 210 ugCl^-/l. Based upon the results of these tests, the long-term TOX concentration of pumped water from PW-1 should be about 200 ugCl^-/l; the major organic constituents should be methylene chloride and trichlorethylene.

Samples were taken from MW-16 and 17 before and after the infiltration test. Chemical results show that volatile organic constituents increased in both wells (Table 2), with sharp increases in acetone, 1,1 dichloroethane, methylene chloride, 1,1,1 trichloroethane, and trichloroethylene in MW-16. Metal concentrations increased in MW-16 but decreased in MW-17.

In summary, the ground-water sampling and analytical results show that VOCs and some metals are elevated across the entire plant site in the upper aquifer. The highest concentrations were found in MW-16, which is adjacent to the suspected contamination source. Differences in results between wells screened in the upper and lower aquifer indicate the upper aquifer is more contaminated than the ground water in the lower aquifer. Ground water pumped from MW-12 and PW-1 is more representative of the chemical condition in the lower aquifer, while bailed samples from MW-13, 14, and 15 are more indicative of the chemical condition in the upper aquifer.

Samples taken in MW-16 and 17 before and after the infiltration test suggest that some flushing of organic constituents from the vadose zone were taking place due to the infiltration gallery test. Data are less conclusive about metal flushing; MW-16 showed an increase, while MW-17 metal concentrations decreased in the sample

taken after the test. Increases would be expected to be greatest in the ground water adjacent to the suspected contamination source, as was the case.

D. Unsaturated Zone Studies

Continuous soil samples were obtained in boring MW-16 for metals and organics analyses and to determine the geologic conditions adjacent the suspected contamination source. Samples were obtained with a 5 foot long internal core barrel in the hollow-stem auger as described in Appendix B. Samples from each interval were collected from the barrel, scanned by the PID (see Section II F.) for organic vapor emissions and split into representative samples for laboratory analysis of total metals, extraction procedure (EP) soluble metals and selected TOX analyses. Approximately 20 ml of soil was placed into a 40 ml vial, tightly-capped and placed in the sun for two hours to determine the organic vapor emissions with the PID after the soil was allowed to heat up in a sealed vial.

Table 4 shows the initial and capped PID readings which had been calibrated to benzene vapors. Also shown are RMA lab analyses for TOX on the soil.

The greatest decrease in vapor concentration from the initial sampling was seen at 45 feet which is the top of a 5 foot layer of dense clay. The vapor concentration decreased with depth; at 70 feet the initial vapor levels were less than 10 ppm. The difference in vapor concentration between the initial and capped samples showed the following phenomena: the upper 25 feet of soil had roughly the same concentration with the two methods; from 25 to 45 feet the capped samples had a lower concentration; samples below 45 feet had a higher capped concentration. The mechanism that causes these relationships is unknown.

As mentioned above, soil samples from MW-16 were collected and sent to RMA for analysis. These samples and EP-extracts were analyzed for total concentrations of cadmium, chromium, lead, nickel, and silver. The EP-extracts were also tested for hexavalent chromium. The soil samples were also analyzed for cyanide.

Table 5 lists the total metal and cyanide concentrations for the soil samples. Nickel concentrations are highest in samples from 30 to 45 feet, corresponding to the depth above where organic vapor concentration decreased at 45-50 feet. These metal concentrations are much higher than would be expected in the subsurface away from the suspected contamination source. A subsequent work phase to attempt to determine the "background" metal concentration is discussed in the Recommendation Section of this report.

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TABLE 4

MW - 16

ORGANIC VAPOR EMISSIONS

FROM SOIL

Concentration in PPM BENZENE

SPARTON TECHNOLOGY, INC.

ALBUQUERQUE, NEW MEXICO

DEPTH INTERVAL	INITIAL SAMPLE	WARMED & CAPPED SAMPLE	Lab TOX Concentration *
0-5	-	-	
5-10	100	150	
10-15	200	200	
15-20	200	240	ND
20-25	200	150	
25-30	200	80	
30-35	175	50	ND
35-40	175	50	
40-45	150	40	
45-50	40	70	
50-55	30	70	
55-60	20	50	ND
60-65	15	20	
65-70	5	70	
70-73	5	20	

* TOX mg Cl^-/Kg (ppm). Detection limit = 100 ppm
ND = Not Detected

Table 6 lists the metal concentrations found in EP-extracts of the soil samples. The results of these tests follow a similar pattern as the total metal analyses; chromium and nickel concentrations are greatest in the 30 to 45 foot interval. Most of the extracted chromium measured is in the hexavalent form as would be expected.

HLA conducted these tests to show the marked differences between the total and the water-extracted metal concentrations. While the concentrations listed in Tables 5 and 6 are not directly comparable, the data can be used to generally show the expected concentrations of water infiltrating through these soils.

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TABLE 5

TOTAL METALS AND CYANIDE CONCENTRATIONS

IN SOIL MW-16

SPARTON TECHNOLOGY, INC.

ALBUQUERQUE, NEW MEXICO

Concentrations in mg/Kg (ppm)

Depth Feet	Cadmium [0.1]*	Chromium [0.3]	Lead [1.3]	Nickel [0.5]	Silver [0.2]	Cyanide [0.25]
5-10	0.8	3.2	3.4	3.3	ND	ND
10-15	0.7	7.7	3.4	4.3	ND	ND
15-20	0.8	6.7	3.6	4.4	ND	ND
20-25	0.9	8.4	3.2	4.0	ND	ND
25-30	0.9	8.6	3.0	4.6	ND	ND
30-35	1.0	350	ND	30	ND	ND
35-40	1.1	500	2.1	41	ND	ND
40-45	2.6	480	2.7	38	ND	ND
45-50	1.1	80	4.2	14	ND	ND
50-55	0.5	130	2.7	13	ND	ND
55-60	0.6	9.8	3.6	5.6	ND	ND
60-65	0.4	24	2.3	4.8	ND	ND
65-70	1.0	52	3.6	9.8	ND	ND
70-73	1.2	69	3.5	7.5	ND	ND

* = Detection Limit

ND = Not Detected

TABLE 6
EP METAL CONCENTRATIONS
IN SOIL EXTRACTS FROM MW-16
SPARTON TECHNOLOGY, INC.
ALBUQUERQUE, NEW MEXICO

All Concentrations in mg/l (ppm) of Extract

Depth Feet	Cadmium [0.002]*	Chromium [0.005]	Hex Chromium [0.01]	Lead [0.025]	Nickel [0.01]	Silver [0.003]
5-10	ND	ND	ND	ND	0.01	ND
10-15	ND	0.027	ND	ND	0.02	ND
15-20	0.003	0.060	0.02	ND	0.027	ND
20-25	ND	0.048	0.02	ND	0.01	ND
25-30	ND	0.083	ND	ND	0.027	ND
30-35	0.003	4.1	3.6	ND	0.13	ND
35-40	0.006	8.6	8.0	ND	0.19	ND
40-45	0.028	2.1	1.6	ND	0.12	ND
45-50	0.013	0.70	0.5	ND	0.11	ND
50-55	0.005	1.1	0.81	ND	0.11	ND
55-60	ND	ND	ND	ND	0.045	ND
60-65	ND	ND	ND	ND	0.026	ND
65-70	ND	0.011	ND	ND	0.050	ND
70-75	ND	0.007	ND	ND	0.045	ND

* = Detection Limit ND = Not Detected

IV AQUIFER TESTS

Tests were conducted on PW-1 and the infiltration gallery in order to determine the hydrogeologic characteristics of the aquifers and the unsaturated zone beneath the plant site. Water samples were collected from the pumping well in order to determine the degree of contamination for design purposes of an on-site treatment facility. The methodologies for these tests are described in Appendix D.

A 6-hour step-drawdown test, and 25-hour and 2-hour constant rate pumping test were conducted on PW-1 during the period of October 5 through 8, 1984. An infiltration test was conducted on the infiltration gallery adjacent to MW-17 on October 9 through 10, 1984. The results of the tests are discussed in the next section.

A. Step-Drawdown Test

The step-drawdown test was conducted on PW-1 on October 5, 1984. The pumping schedule was set to nominally withdraw water at 50 gpm increments at 60-minute intervals. The actual rates are as follows:

Elapsed Time Minute	Withdrawal GPM
0 - 60	50
60 - 130	100
130 - 180	150
180 - 360	200

At the 200 gpm step, the hydraulics of the well changed drastically in conjunction with an influx of fine sands and silts into the well. The change is due to the increased development of the formation surrounding the well. The development process increases the available yield of the well by increasing the hydraulic capabilities of the formation adjacent to the well screen. This increase is most easily seen by comparing specific capacities of the well at each pumping rate. Specific capacity is defined as the pumping rate divided by the amount of drawdown; the units used here are gallons per minute per foot of drawdown (gpm/ft):

	Pumping Rate GPM	Drawdown Feet	Specific Capacity GPM/Ft
	50	13.0	3.85
	100	23.8	4.20
	150	36.3	4.13
initial	200	51.3	3.86
ending	200	36.1	5.54

The increase in specific capacity during the 200 gpm rate showed that the well had not been sufficiently developed during construction with the drilling rig's air compressor. While this was anticipated, the degree of fine sand inflow necessitated additional development prior to running the constant-rate test.

The additional development was conducted on October 6, 1984, by pumping and surging the well at rates up to 300 gpm. The development was continued for a total of 5-hours, at the end of which the well was producing relatively clear water with a low sand content. Following the development, the specific capacity of the well was increased to 7.5 gpm/ft at 200 gpm, which is an approximately 100 percent increase over the initial specific capacity at that pumping rate.

Based on the results of the step-drawdown test and the development program, a rate of 200 gpm was chosen for the constant-rate portion of the aquifer test.

B. Constant-Rate Test

A 48-hour constant-rate test of PW-1 at 200 gpm was proposed to start on October 7, 1984. The test was started at 1015 hours and the rate was set to approximately 200 gpm. Unfortunately, sand apparently blocked the flow meter a few minutes into the test and the pumping rate fluctuated for the first 60 minutes. Data from the early portion of the test is important in aquifer analysis, and it was decided to repeat the early portion after this test was ended.

The test was continued at a constant-rate of 180 gpm for a total of 1500 minutes. Water levels were measured with the transducer system in MW-12, 13, 14 and PW-1 as described in Appendices D and E.

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Periodic hand-level measurements as discussed in Appendix D were taken in all other wells to determine the extent of pumping influence. Measurable drawdown was observed in all wells equipped with transducers as well as in MW-4, 9, 10, 11, and 15.

Following pump shut-down, water level recovery was monitored in all wells which had shown discernable drawdown. These results are also discussed in the next section.

Following recovery of water levels, a 120-minute constant-rate test was conducted at 189 gpm. Drawdown was measured by transducer in MW-12, 13, 14, and PW-1. This test allowed for much better data to be collected for methods used to analyze early test data.

Water levels were obtained from all monitoring wells at the end of the first constant-rate test. These data were contoured to estimate the ground-water flow directions which were developed due to pumping. Figure 18 is a contour map of cross-section A-A', showing the differences in piezometric head with depth.

Figure 19 is a contour map of the water table in the upper aquifer at the end of the first test. Ground-water flow is still towards the south and the relative thinness of the upper aquifer limits the extent of drawdown away from the well.

Figure 20 shows the piezometric head of the lower aquifer at the end of the test. The ground-water flow direction has been altered, and the direction of flow is towards the south.

C. Aquifer Test Analysis

Appendix E contains the printout and graphical data from the well-tests on PW-1 and the infiltration test. The quantity of data recovered from these tests precludes the individual discussion of drawdown analysis by each method for each portion of the test; rather, this section will summarize the hydrogeologic parameters.

Table 7 lists the mean transmissivity (T), hydraulic conductivity (K), storage coefficient, and leakage coefficients (K'/b') found in the observation wells during the PW-1 tests. The table is divided into groups which are indicative of the upper and lower aquifer.

Well MW-9 was the only point which had measurable drawdown in the upper aquifer; the other wells were screened either in both aquifers or only in the lower aquifer. Transmissivity and Storage Coefficient information on the upper aquifer was obtained during the 50 gpm pumping period of the step drawdown test. The T and K values listed for the upper aquifer take into account the fact that pumping caused withdrawals from both aquifers and the analytical method assumed that all water was removed from a single aquifer. Based on our experience and judgement the actual K of the aquifer should be about 1000 gpd/ft.

TABLE 7

PW-1 Pump Test Summary

SPARTON TECHNOLOGY, INC.

ALBUQUERQUE, NEW MEXICO

Upper Aquifer

$\frac{1,000\ gal}{day\ ft} \times \frac{ft^3}{7.48\ gal} \times \frac{12\ in}{ft} \times \frac{2.54\ cm}{in}$

$\frac{1\ day}{24\ hr} \times \frac{1\ hr}{60\ min} \times \frac{1\ min}{60\ sec}$

Well	T gpd/ft	K gpd/ft^2	S
MW-9	5,000 - 1,000	1,000 4.7×10^{-2}	0.10

Lower/Both Aquifers

Well	T gpd/ft	K gpd/ft^2	S	K'/b' 1/day
PW-1	25,000	420	-	-
MW-12	13,200	190	0.00047	0.030
MW-13	25,700	360	0.00020	0.018
MW-14	66,200	880	0.00024	0.0018
MW-15	69,000	920	0.00015	-
MW-4	193,400	2,580	0.00028	-
MW-10	63,000	840	0.00024	-
MW-11	67,000	890	0.00026	-

The storage coefficient of 0.10 in MW-9 indicates that the upper aquifer is unconfined. This correlates with the boring log data which does not show any confining layers at the water table elevation.

5×10^{-2} cm/hr

$\frac{1000\ gal}{day \cdot ft^2} \times \frac{ft^3}{7.48\ gal} \times \frac{12''}{ft} \times \frac{2.54\ cm}{1''}$

$\times \frac{1\ day}{24\ hr} \times \frac{1\ hr}{60\ min} \times \frac{1\ min}{60\ sec}$

Examination of the data from wells set in the lower aquifer shows that some of the data are anomolous and probably not representative. For example, the T value from MW-4 appears to be too great, considering the placement of the well screen through what is believed to be the lower-permeable layer which separates the upper and lower aquifer. The screen extends below this layer, and it is possible that a thin sand or gravel layer exists which gives the high transmissivity indication. In fine-grained sediments adjacent to a more transmissive aquifer, pump test data can often produce misleadingly high T values due to the limited drawdown and by delayed leakage from the fine sediments.

MW-12, 13, and PW-1 produced results of a lower T than the other wells which were monitored in the lower aquifer. Boring MW-13 showed silt and clay lenses present in the middle of the lower aquifer, which may reduce transmissivity. However, similar layers were present in boring MW-15 and the transmissivity of the aquifer in that location is similar to the values obtained from MW-10, 11, and 14, which suggests that MW-10 and 11 are in direct hydrologic contact with the lower aquifer. Based upon the results from these tests, the transmissivity of the lower aquifer is between 60,000 to 70,000 gpd/ft. The hydraulic conductivity of the lower aquifer is estimated at 1,000 gpd/ft^2, using an average thickness of the lower aquifer of about 65 feet.

The storage coefficient of the wells in the lower aquifer is approximately 0.0002, which is indicative of a confined or semiconfined aquifer. This information, along with the boring logs from this phase of work, strongly supports the differentiation of the subsurface into the two different aquifers.

Leakage rates of the semi-confining layer were obtained from the time-drawdown graphs of MW-12, 13, and 14. The data, also listed in Table 7, show that the leakage coefficient ranges between 0.002 to 0.03/day. The further the observation point is from the pumping well, the lower the apparent leakage coefficient. Data from the closer wells are more representative since the drawdowns were slightly greater and the leakage across the layer would have been established for a longer time period during the test. Using an average leakage coefficient of 0.02/day and assuming a thickness of 5 feet, the hydraulic conductivity of the semi-confining unit is 0.75 gpd/ft^2 (3.5×10^{-5} cm/sec) which is approximately 3 orders of magnitude less than the hydraulic conductivity of either the upper or lower aquifer. This lower leakage coefficient restricts the flow of ground water between the two aquifers, causing the observed head differences and the chemical concentration patterns present beneath the SPARTON site.

In summary, the results of the pumping test indicate the presence of two aquifers beneath the SPARTON site, separated by a less-permeable layer that appears to be sufficiently continuous to cause the semi-confined aquifer responses of the lower aquifer. The hydraulic conductivity of both aquifers is approximately 1000 gpd/ft^2; the transmissivity of each aquifer is dependent upon the saturated thickness throughout the site. In general, the upper aquifer, being 5- to 10-feet-thick, has a T ranging from 5000 to 10,000 gpd/ft. The lower aquifer, which is about 60- to 70-feet-thick, has a T of 60,000 to 70,000 gpd/ft. MW-10 and 11 exhibited water-level responses during the pumping test which suggests that these two wells are in direct hydrologic contact with the lower aquifer.

The storage coefficient of the upper aquifer is 0.10, indicative of an unconfined aquifer. The S of the lower aquifer is approximately 0.0002, indicative of a semi-confined aquifer.

The semi-confining layer between the two aquifers has an estimated hydraulic conductivity of 0.75 gpd/ft^2, which is about three orders of magnitude less than the K found in both the upper and lower aquifers.

D. Infiltration Test

An infiltration test was conducted on the infiltration gallery from October 8-9, 1984. It was hoped to conduct this test at a sufficient rate to impact the water table, causing a mound beneath the gallery. However, the gallery would accept only 6,100 gallons of water over the 1240 minute test (4.9 gpm) which was insufficient to cause a pronounced mound. Slight water table increases were noticed in MW-16 and 17 but the change could be due to natural fluctuations.

The results of the test show that the gallery could infiltrate water at 4.9 gpm. Using the open area at the bottom of the gallery of 7.0 ft^2, a vertical unsaturated hydraulic conductivity of about 1000 gpd/ft^2 is estimated. This value is the same as the saturated hydraulic conductivity of the two aquifers.

V CONCLUSIONS

Based upon the results of field work and interpretations of pumping, water level, and chemical data, the following conclusions have been made about the SPARTON site:

The SPARTON site is underlain by at least two distinctly different aquifers. The upper aquifer is a relatively thin unconfined system which is present above a fine-grained unit occurring at elevation 4960 to 4970 feet msl. Another aquifer is present beneath this unit which exhibits semi-confined characteristics. The estimated hydrogeologic properties of both aquifers are:

Upper Aquifer	Lower Aquifer
T = 5,000 - 10,000 gpd/ft	60,000 - 70,000 gpd/ft
K = 1,000 gpd/ft	K = 1,000 gpd/ft
S = 0.10	S = 0.0002

An initial estimate of the Leakage Coefficient of the semi-confining layer between the two aquifers is 0.02/day, and the hydraulic conductivity is estimated to be approximately 0.75 gpd/ft^2.

A second fine-grained unit is found at about elevation 4900 feet. The hydrogeologic importance and areal extent of this layer are not fully known at this time.

The ground-water flow direction in the upper aquifer is towards the south-southwest, generally in a direction from MW-16 towards MW-9. The direction of flow in the lower aquifer is apparently towards the west south-west. Extrapolating the piezometric gradient towards the east suggests that the lower aquifer may be in hydrologic contact with the shallow water table upgradient in the area surrounding the Rio Grande.

A significant vertical hydraulic gradient is present beneath the SPARTON site, resulting in the upper aquifer having a hydraulic head more than 4.0 feet above the piezometer level of the lower aquifer in an adjacent monitoring well.

Chemical analyses of ground-water samples show that volatile organic constituents are present in the upper aquifer across the site. Concentrations of metals in ground water also appear to be elevated; however, all samples in this study have been acidified prior to filtering, which takes metals adsorbed onto the sediment into solution. The actual dissolved metal concentration of the ground water has not been determined, but is probably lower.

Infiltration of water through the vadose zone appears to be feasible. Based upon the pilot-scale test, the infiltration rate of the unsaturated zone is 0.70 gpm/ft^2, which is approximately 1,000 gpd/ft^2. Infiltration flushed some of the contaminants from the soil, based upon water samples taken in MW-16 after the test which showed an increase in VOC and metal concentrations.

The unsaturated zone sampled by boring MW-16 showed high concentrations of metals. VOC were not determined from the samples, however, VOCs concentrations were reflected by the PID readings of the vapor emissions. Both metals and VOCs appear to the concentrated in the upper 55 feet near the suspected contamination source.

VI RECOMMENDATIONS

Additional work is required to define the extent of metal and VOC concentrations in the vadose zone and to determine the chemical and hydrostatic head differences in the two aquifers at the southern and western portion of the plant site.

Vadose Zone Contamination

Seven soil borings are recommended to be located around the suspected spill location (concrete sump) as shown in Figure 21. These borings will be drilled using the Hollow Stem Auger and sampling tecnniques described in Appendix B. The borings will extend to approximately 75 feet below grade.

Soil samples will be taken from each 5-foot soil interval and will be analyzed for total cadmium, chromium, lead, and nickel. VOCs will be determined by solvent extraction followed by purge and trap gas chromatography and mass spectroscopy following U.S. EPA procedure 624. Metal concentrations may be determined from EP-extracts of some of the samples.

An eighth boring will be drilled in order to obtain 'background' metal concentrations of the soil. The location of this boring is shown in Figure 21. Monitoring wells, similar in construction as MW-17, may be installed in some of the borings.

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Comparisons of the metallic and organic concentrations between the borings will be used to estimate the extent of vadose zone contamination.

Ground Water Investigation

A series of tests should be conducted on selected wells in order to determine the chemical and hydrostatic profile at the site. These tests will be conducted by inserting inflatable packers in the monitoring well with a pump. A low volume pump, such as a gas squeeze pump, will be used to collect ground-water samples between the two packers. A sufficient quantity of water will be removed prior to sampling to assure that the water samples are representative at each profile. Samples will be analyzed for selected VOC constituents and dissolved metals found during previous sampling. Static water levels will be measured with transducers and a recorder prior to pumping with the packers in place. Vertical communication along the well annulus may affect the water level measurements, but the results should show a vertical profile.

The results of this ground-water investigation will allow us to further evaluate the vertical extent of contamination and the direction of ground-water flow in both aquifers. This information, in conjunction with the results of previous studies, will allow us to design a remedial plan for ground-water contamination abatement. For

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example, if the ground-water sampling profile shows no significant contamination in the lower aquifer the remedial design will include only pumpage and treatment of ground-water flow from the water table aquifer. If significant concentrations of contaminants are found in the lower aquifer, a withdrawal system will be designed for both aquifers. Disposal of treated water will probably include infiltration through the vadose zone at the areas found to contain increased concentration of VOCs and metals at the suspected contamination source.

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QUALITY CONTROL REVIEW:

FOR

Eric G. Lappala
Principal Hydrogeologist

APPENDIX A
to
ATTACHMENT 4

Rotary Drilling and
Well Construction Procedures

APPENDIX A

Rotary Drilling and Well Construction Procedures

Borings MW-13, 14, 15, and PW-1 were drilled using rotary wash (mud rotary) techniques. MW-12, drilled from 0 to 70 feet using a hollow-stem auger, was completed using a rotary rig. The following general drilling and construction procedures were used on all rotary drilling wells.

Equipment Set-up

Prior to the set-up of the drilling rig on the prospective well site, all underground utilities were located to help assure that the borings will not encounter any buried power, gas, or telephone lines. Overhead electrical power lines were shrouded with rubber by the electrical utility to protect the workers from electrical hazards. Additionally, all drilling equipment were cleaned with a high pressure steam cleaning machine in order to remove any material which could possibly cause any cross-contamination between boreholes.

Drilling Procedure

The rotary wash well-drilling process involves the use of drilling fluid, normally a bentonite and water mixture, to suspend drill cuttings obtained by the advancement of a tri-cone drill bit into unconsolidated formations. The drilling fluid is pumped down through

the inside of the drill pipe, through the end of the drill bit, and then returns to the surface through the annulus between the drill pipe and the bore hole wall. The fluid cools the drill bit, carries the cuttings to the surface, stops excessive loss of fluid into the formation, and prevents the borehole from collapsing. Upon circulating to the ground surface, the fluid is directed in to mud pits or a portable mud tank in which the cuttings drop out of suspension and are removed.

Soil Sampling

Samples of the formation encountered during drilling were obtained by two different methods: cuttings suspended in the drilling mud and 2-inch split-spoon pushed ahead of the drill bit. Additional data was obtained by noting the rate and ease of drilling penetration.

Formation cuttings were collected at the top of the boring in a strainer. The samples were classified according to the Unified Soil Classification System (USCS) into gravel, sand, silt, and clay mixtures to allow for an understanding of the geologic characteristics of the subsurface. Figure A-1 shows the classification system. This method of sampling has a tendency to miss portions of both the coarse and fine-grain materials, but are satisfactory to delineate the textural changes which occur in the borehole and to determine the depth for split-spoon samples.

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS (MORE THAN HALF IS LARGER THAN #200 SIEVE)	GRAVELS (MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL - SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL - SAND - SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL - SAND - CLAY MIXTURES
	SANDS (MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POORLY GRADED SAND - SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND - CLAY MIXTURES
FINE GRAINED SOILS (MORE THAN HALF IS SMALLER THAN #200 SIEVE)	SILTS AND CLAYS (LIQUID LIMIT LESS THAN 50)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (LIQUID LIMIT GREATER THAN 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

UNIFIED SOIL CLASSIFICATION SYSTEM

Consol — Consolidation
LL — Liquid Limit (in %)
PL — Plastic Limit (in %)
G_s — Specific Gravity
SA — Sieve Analysis
"Undisturbed" Sample
Bulk Sample

	Shear Strength, psf	Confining Pressure, psf	
*Tx	320	(2600)	Unconsolidated Undrained Triaxial
TxCU	320	(2600)	Consolidated Undrained Triaxial
DS	2750	(2000)	Consolidated Drained Direct Shear
FVS	470		Field Vane Shear
*UC	2000		Unconfined Compression
LVS	700		Laboratory Vane Shear

Notes: (1) All strength tests on 2.8" or 2.4" diameter samples unless otherwise indicated.

(2) * indicates 1.4" diameter sample.

KEY TO TEST DATA

OGC-002804

Harding Lawson Associates
Engineers, Geologists & Geophysicists

SOIL CLASSIFICATION CHART AND KEY TO TEST DATA
Sparton Technology, Inc.
Albuquerque, New Mexico

PLATE A1

DRAWN | JOB NUMBER 6310,013.12 | APPROVED | DATE | REVISED | DATE

Split-spoon samples were obtained with the following methodology. Upon reaching a desired sampling interval (as noted by the drill cuttings), the drill pipe and bit were raised one foot off the bottom of the borehole and the remaining cuttings in the boring were cleaned by increasing the velocity of the drilling fluid. On occasion, this process would not remove coarse gravel from the borehole and the drilling fluid would have to be thickened in order to help float this coarse material out of the borehole. Upon cleaning out the hole, the drill bit was removed and a 2-foot long, 2-inch outside diameter split-spoon sampler was screwed onto the drill pipe. The sampler was seated into the bottom of the borehole and was pushed into the formation using the hydraulic system of the drill rig. The sampler was pushed a maximum of 24-inches, or until refusal, which was defined as the point where the rig was about to be lifted off its jacks by the pressure on the drill pipe.

The sample was then retrieved and classified according to the USCS standards. Select samples were bagged and kept for future reference. The sampler was then thoroughly cleaned with the high pressure steam cleaning machine.

Well Construction

Upon drilling the boring to its total depth, the hole was cleaned out by a process similar to the one used during the split-spoon sampling process. After the boring is clean, a 1-inch diameter tremie pipe is

lowered to near the bottom of the hole. The well screen and casing are then lowered into the boring. All screen and casing used in this project were threaded and flush-jointed PVC manufactured by Timco, Inc. Couplings between portions of solid casing were made leak-proof by wrapping the threads with Teflon tape. The diameter and lengths of casing and slot size of screen varied in the wells installed; refer to the main text for a discussion of the design of each individual well.

After the well had been placed at its correct position in the boring, lower weight drilling fluid (i.e. less mud content) was added at the bottom of the boring through the tremie pipe. This process helped remove some of the mud which is attached to the side of the boring and reduced the weight of the mud, allowing the pack material to fall through the fluid.

Specially-graded sand was used to pack the annular space from the bottom of the boring to above the top of the well screen. The sand was graded and sold by Fountain Sand and Gravel, Denver, Colorado. Grade numbers listed in the main text refer to the 10 and 99 percentage retained on standard U.S. Sieves. Sand was poured into the annular space around the well, and the tremie pipe was used to sense the level of sand in the well and to assure that this material did not bridge on upper portions of the boring. The level of sand was brought up at least 2-feet above the top of the screen.

Following the placement of the sand pack, the tremie pipe was raised about 4 feet off the top of the sand and sufficient bentonite pellets were placed uniformally into the annular space to give a 2-foot thickness in the boring. The bentonite acts as an excellent seal, retarding vertical flow of ground water in the annular space and acting to stop the grout, which is added next, from invading the sand pack.

A neat grout mixture of approximately one 94 pound sack of cement, 15 pounds of bentonite powder and 7 gallons of water were mixed together and pumped through the tremie pipe down to the top of the bentonite seal. The grout displaced the remaining drilling fluid in the annular space, assuring a competent seal to stop infiltration of any surface water down the bore hole.

Each well was finished by installing either a steel protector pipe or drive-over box depending upon whether the well was finished above or below grade. Each well is secured by a locking cap and the elevation of the top of the protector pipe were surveyed into mean sea level datum by a registered surveyor.

Well Development

Each well was developed shortly after construction by lowering a 1-inch diameter pipe down to near the bottom of the well and forcing

air into the well, which blows water, fine sand, and drilling fluid out of the well. The development process was continued until the water is relatively free of mud and sand. The rate at which water was removed from each wall is listed in the main report. All fluids obtained during development were discharged into the sewer line, under an agreement which was arranged between SPARTON personnel and New Mexico Utilities, Inc.

APPENDIX B
to
ATTACHMENT 4

Hollow Stem Auger Drilling
and Well Construction Procedures

APPENDIX B

Auger Drilling and Well Construction Procedures

Borings MW-16 and 17 were drilled using a hollow-stem auger. MW-12 was drilled from 0 to 70 feet with a hollow stem auger and completed using a rotary rig. The following general drilling and construction procedures were used on all augered wells.

Equipment Set-up

Prior to the set-up of the auger rig on the prospective well site, all underground utilities are located to help assure that the boring will not hit the utilities. All equipment and materials are cleaned with a portable high-pressure steam cleaning machine to remove any material which could possibly cause any cross-contamination between bore holes.

Drilling Procedure

The hollow stem auger drilling procedure involves rotating a hollow auger into the soil. As the auger is rotated into the soil, cuttings are brought to the surface on the continuous flights surrounding the hollow stem. Samples of the formation were obtained by a 5-foot long core barrel in the hollow stem extended out past the bottom of the drill bit. No drilling fluid is used in this method which enables a more representative sample to be obtained.

OGC-002810

Each soil sample was removed from the core barrel and classified according to the Unified Soil Classification System (USCS) into gravel, sand, silt, and clay mixtures to allow for an understanding of the three-dimensions geologic characteristic of the subsurface. The sampler was thoroughly cleaned with the steam cleaner between samples.

Well Construction

Upon augering the boring to its total depth, the coring mechanism is removed from the hollow stem augers and a 2-inch-diameter PVC well screen and casing was lowered through the hollow stem. The screen was manufactured by Timco, Inc. and consisted of 10- and 20-foot lengths of threaded and flush-jointed sections; the threads of the joints connecting the solid casing were wrapped with Teflon tape to make them leak-proof. The lengths and depths of casing and screen varied between each well; refer to main text for a discussion of the design of each individual well.

After the well had been placed at its correct position in the hollow stem, the augers were pulled up in the borehole to allow the natural formation to surround the screen. A thick bentonite slurry (approximately 3 pounds of bentonite per gallon of water) was pumped down the annular space to fill up the space above the natural sand pack. The auger was then removed in phases, filling the annulus space with mud as the flights were removed.

OGC-00811

A neat grout with about 15 percent bentonite was added the next day to the top of the bentonite after slurry has settled.

Each well was finished by cementing a steel protector pipe with a locking cap over the PVC well. The elevation of both the top of the protector pipe and PVC well were surveyed into mean sea level datum by a registered surveyor.

Well Development

Each well was developed shortly after construction by bailing water, fine sand, and mud from the well. The development process was continued until the water was relatively free of mud and sand. All fluids obtained during bailing were discharged into a lined lagoon.

APPENDIX C
to
ATTACHMENT 4

Ground-Water Sampling
and Analytical Protocol

OGC-002814

TABLE 4. ANALYTICAL RESULTS FOR [illegible]TILE PRIORITY POLLUTANT ORGANICS

Parameter		Detection Limit	Concentration, mg/l										
Sparton #			MW-10	MW-11	MW-5	MW-6	MW-7	MW-8	MW-9	MW-1	MW-2[2]	MW-3[2]	MW-4[3]
RMA #			4466-01	4466-02	4466-03	4466-04	4466-05	4466-06	4466-07	4466-08	4466-09	4466-10	4466-1
1V	Acrolein	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2V	Acrylonitrile	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3V	Benzene	0.005	ND	ND	ND	ND	ND	ND	0.016	0.050	ND	0.083	ND
4V	Bis(chloromethyl)ether	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5V	Bromoform	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6V	Carbon tetrachloride	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7V	Chlorobenzene	0.005	ND	ND	ND	ND	ND	ND	ND	0.006	ND	0.060	ND
8V	Chlorodibromomethane	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
9V	Chloroethane	0.010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
10V	2-Chloroethylvinyl ether	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11V	Chloroform	0.005	ND	ND	ND	ND	ND	ND	0.057	0.16	ND	0.15	ND
12V	Dichlorobromomethane	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
13V	Dichlorodifluoromethane	0.010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
14V	1,1-Dichloroethane	0.005	ND	ND	ND	ND	ND	ND	0.12	0.015	ND	0.061	ND
15V	1,2-Dichloroethane	0.005	ND	ND	ND	ND	ND	ND	ND	0.020	ND	0.050	ND
16V	1,1-Dichloroethylene	0.005	ND	ND	0.007	0.028	0.11	22	1.2	1.4	0.16	4.8	1.0
17V	1,2-Dichloropropane	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
18V	1,3-Dichloropropylene	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
19V	Ethylbenzene	0.005	ND	ND	ND	ND	ND	ND	0.013	0.086	ND	ND	ND
20V	Methylbromide	0.010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
21V	Methylchloride	0.010	16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
22V	Methylene chloride	0.010	ND	ND	ND	ND	ND	ND	5.2	17	0.035	57	2.3
23V	1,1,2,2-Tetrachloroethane	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.086	ND
24V	Tetrachloroethylene	0.005	ND	ND	ND	ND	ND	ND	0.060	0.12	ND	0.50	ND
25V	Toluene	0.005	ND	ND	ND	ND	ND	ND	0.29	1.4	0.042	3.2	ND
26V	1,2-trans-Dichloroethylene	0.005	ND	ND	ND	ND	ND	ND	0.011	ND	ND	ND	ND
27V	1,1,1-Trichloroethane	0.005	0.005	ND	0.070	0.081	0.18	0.082	6.9	2.8	0.86	27	4.4
28V	1,1,2-Trichloroethane	0.005	ND	ND	ND	ND	ND	ND	0.11	0.16	ND	0.42	ND
29V	Trichloroethylene	0.005	0.012	ND	0.14	0.31	0.53	0.25	9.6	23	2.1	59	7.4
30V	Trichlorofluoromethane	0.010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
31V	Vinyl chloride	0.010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes

1. ND = Not detected.
2. Detection limit 10x those listed.
3. Detection limit 100x those listed.

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TABLE 5. ANALYTICAL RESULTS FOR NON-PRIORITY POLLUTANT VOLATILE ORGANICS

		Concentration, mg/l										
Sparton #		MW-10	MW-11	MW-5	MW-6	MW-7	MW-8	MW-9	MW-1	MW-2[2]	MW-3[1]	MW-4
RMA #		4466-01	4466-02	4466-03	4466-04	4466-05	4466-06	4466-07	4466-08	4466-09	4466-10	4466-1
Parameter	Detection Limit											
Acetone	0.010	ND[3]	ND	ND	ND	ND	ND	0.033	6.0	0.069	56	ND
Ethanol	0.50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Hexanone	0.010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichorotrifluoroethane	0.005	ND	ND	ND	0.061	0.073	ND	0.20	0.16	0.11	0.47	0.17
m-Xylene	0.005	ND	ND	ND	ND	ND	ND	0.007	0.033	ND	0.020	ND
o,p-Xylene[4]	0.005	ND	ND	ND	ND	ND	ND	0.015	0.036	ND	0.042	ND

Notes

1. Detection limit 10 x those listed.
2. Detection limit 100 x those listed.
3. ND = Not detected.
4. o-Xylene & p=Xylene reported together.

ROCKY MOUNTAIN ANALYTICAL LABORATORY

Organic Analytical Methodology

OGC-002816

Parameter	Units	Nominal Detection Limit[a]	Methodology	Reference[1]	Preservation Bottle No.	Maximum Holding Time[b]
Purgeables	ug/l	1	Purge & Trap GC/MS	624	11	14 days
Base/Neutrals	ug/l	10	Extraction/GC/MS	625	12	7 days/40 days
Acids	ug/l	10	Extraction/GC/MS	625	12	7 days/40 days
Organochlorine Pesticides/PCB's	ug/l	0.01	Extraction/GC/ECD	608	13	7 days/40 days
		10	Extraction/GC/MS	625	12	7 days/40 days
Phenoxy Herbicides	ug/l	0.01	Extraction/GC/ECD	(2)	14	7 days/40 days
Total Organic Halogen (TOX)	ug/l	5	Adsorbtion/Coulometric	450.1(3)	15	-
Trihalomethanes (THM)	ug/l	1	Extraction/GC/ECD	(4)	11	14 days
		1	Purge & Trap GC/MS	(4)	11	14 days
Dioxin	ug/l	0.005	Extraction/GC/MS/ECD	613	16	7 days/40 days
Purgeable Halocarbons	ug/l	0.01	Purge & Trap/GC/Hall	601	11	14 days
Purgeable Aromatics	ug/l	1	Purge & Trap/GC/FID	602	17	14 days
Acrolein & Acrylonitrile	ug/l	100	Purge & Trap/GC/FID	603	18	14 days
Phenols by GC	ug/l	10	Extraction/GC/FID	604	16	7 days/40 days
Benzidines	ug/l	0.1	Extraction/HPLC	605	19	7 days/40 days
Phthalate Esters	ug/l	10	Extraction/GC/FID	606	12	7 days/40 days
Nitrosamines	ug/l	1	Extraction/GC/NPD	607	20	7 days/40 days
Nitroaromatics/isophorone	ug/l	1	Extraction/GC/FID & GC/ECD	609	12	7 days/40 days
Polynuclear Aromatics	ug/l	0.5	Extraction/HPLC	610	20	7 days/40 days
Haloethers	ug/l	1	Extraction/GC/Hall	611	17	7 days/40 days
Chlorinated Hydrocarbons	ug/l	0.02	Extraction/GC/ECD	612	12	7 days/40 days
Organophosphorus Pesticides	ug/l	0.1	Extraction/GC/NPD	622(5)	12	7 days/40 days
Triazine Pesticides	ug/l	0.1	Extraction/GC/NPD	(6)	12	7 days/40 days

References

(1) Federal Register, Vol. 44, No. 233, Monday, December 3, 1979.
(2) "Method for Chlorinated Phenoxy Acid Herbicides in Industrial Effluents," Federal Register, Vol. 38, No. 75, Part II.
(3) "Total Organic Halide," US EPA-EMSL, Cincinnati, November, 1980.
(4) Federal Register, Vol. 44, No. 231, Thursday, November 29, 1979, Appendix, Part I.
(5) "Method 622- Organophosphorus Pesticides," Proposed EPA Method, 304 (h) Committee.
(6) Federal Register, Vol. 38, No. 75, 1973.

Notes

[a] Nominal values are the best achievable with the listed analytical method for a typical component. Interferrences in specific samples may resu in a higher detection limit.

[b] Applicable to NPDES Wastes as updated by Robert C. Booth, Director, EMSL-Cincinnati, September 22, 1981. Where two times are given, the first refers to the time to extraction, the second to the time of instrumental analysis.

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ROCKY MOUNTAIN ANALYTICAL LABORATORY

Organic Analytical Methodology (continued)

Preservation Bottle No.	Parameter Group	Bottle	Preservation
11	Purgeables	40 ml glass with teflon lined silicone septum cap	4°C (thiosulfate if Cl_2 present)
17	Purgeables	40 ml glass with teflon lined silicone septum cap	4°C, HCl to pH less than 2 (thiosulfate if Cl_2 present)
18	Purgeables	40 ml glass with teflon lined silicone septum cap	4°C, adjust pH to 4 - 5 (thiosulfate if Cl_2 present)
16	Extractables	1 liter glass with teflon lined cap	4°C (thiosulfate if Cl_2 present)
19	Extractables	1 liter glass with teflon lined cap	4°C, adjust pH to 2 - 7 (thiosulfate if Cl_2 present)
12, 13, 14	Extractables	1 liter glass with teflon lined cap	4°C
20	Extractables	1 liter glass with teflon lined cap	4°C, store in dark (thiosulfate is Cl_2 present)
15	TOX	250 ml glass with teflon lined cap, single 1 liter glass with teflon lined cap, quad.	4°C, store in dark (thiosulfate if Cl_2 present)

ROCKY MOUNTAIN A LYTICAL LABORATORY

Inorganic Analytical Methodology

Parameter	Units	Nominal Detection Limit[a]	Methodology	Reference	Preservation Bottle No.	Maximum Holding Time
MAJOR IONS						
Sodium	mg/l	0.5	ICP Emission Spectroscopy	3	4	6 months
Potassium	mg/l	0.3	ICP Emission Spectroscopy	3	4	6 months
Calcium	mg/l	0.1	ICP Emission Spectroscopy	3	4	6 months
Magnesium	mg/l	0.1	ICP Emission Spectroscopy	3	4	6 months
Chloride	mg/l	3	Manual Titrimetric, $Hg(NO_3)_2$	1-325.3/2-407B	1	28 days
			Automated Colorimetric Ferricyanide	1-325.2	1	28 days
Fluoride	mg/l	0.1	Electrode	1-340.2/2-413B	1	28 days
Sulfate	mg/l	5	Manual Turbidimetric	1-375.4/2-426C	1	28 days
			Automated Colorimetric MTB	1-375.2	1	28 days
Total Alkalinity as $CaCO_3$ at pH 4.5	mg/l	5	Titrimetric	1-310.1/2-403	1	14 days
Carbonate Alkalinity as $CaCO_3$ at pH 8.3	mg/l	5	Titrimetric	1-310.1/2-403	1	14 days
Bicarbonate Alkalinity as $CaCO_3$ at pH 4.5	mg/l	5	Titrimetric	1-310.1/2-403	1	14 days
Hydroxide Alkalinity as $CaCO_3$	mg/l	5	Calculation	2-403	-	-
Nitrate+Nitrite as N	mg/l	0.1	Manual Cd Reduction - Colorimetric	1-353.3/2-418C	2	28 days
		0.1	Automated Cd Reduction - Colorimetric	1-353.2	2	28 days
Total Cations	meq/l	0.1	Calculation	2-104C	-	-
Total Anions	meq/l	0.1	Calculation	2-104C	-	-
Difference	%	0.1	Calculation	2-104C	-	-
RADIOCHEMISTRY						
Gross Alpha	pCi/l	0.1	Proportional Counter	2-703	5	6 months
Gross Beta	pCi/l	0.1	Proportional Counter	2-703	5	6 months
Radium 226	pCi/l	0.1	Separation - Counter	2-705	5	6 months
Radium 228	pCi/l	0.1	Separation - Counter	2-707	5	6 months
Uranium	mg/l	0.005	Fluorimetric	4-D2907-75	5	6 months

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ROCKY MOUNTAIN ANALYTICAL LABORATORY

Inorganic Analytical Methodology (Continued)

Parameter	Units	Nominal Detection Limit[a]	Methodology	Reference	Preservation Bottle No.	Maximum Holding Time
TRACE METALS[c]						
Aluminum	mg/l	0.05	ICP Emission Spectroscopy	3	4	6 months
Antimony	mg/l	0.002	Furnace Atomic Absorption	1-204.2	4	6 months
Arsenic	mg/l	0.002	Furnace Atomic Absorption	1-206.2	4	6 months
Barium	mg/l	0.005	ICP Emission Spectroscopy	3	4	6 months
Beryllium	mg/l	0.001	ICP Emission Spectroscopy	3	4	6 months
Boron	mg/l	0.004	ICP Emission Spectroscopy	3	4	6 months
Cadmium	mg/l	0.002	ICP Emission Spectroscopy	3	4	6 months
Chromium	mg/l	0.005	ICP Emission Spectroscopy	3	4	6 months
Cobalt	mg/l	0.003	ICP Emission Spectroscopy	3	4	6 months
Copper	mg/l	0.002	ICP Emission Spectroscopy	3	4	6 months
Iron	mg/l	0.05	ICP Emission Spectroscopy	3	4	6 months
Lead	mg/l	0.025	ICP Emission Spectroscopy	3	4	6 months
		0.001	Furnace Atomic Absorption	1-239.2	4	6 months
Manganese	mg/l	0.005	ICP Emission Spectroscopy	3	4	6 months
Mercury	mg/l	0.0002	Cold Vapor Atomic Absorption	1-245.1	4	6 months
Molybdenum	mg/l	0.005	ICP Emission Spectroscopy	3	4	6 months
Nickel	mg/l	0.01	ICP Emission Spectroscopy	3	4	6 months
Selenium	mg/l	0.002	Furnace Atomic Absorption	1-270.2	4	6 months
Silver	mg/l	0.003	ICP Emission Spectroscopy	3	4	6 months
Strontium	mg/l	0.005	ICP Emission Spectroscopy	3	4	6 months
Thallium	mg/l	0.002	Furnace Atomic Absorption	1-279.2	4	6 months
Tin	mg/l	0.03	ICP Emission Spectroscopy	3	4	6 months
Titanium	mg/l	0.002	ICP Emission Spectroscopy	3	4	6 months
Vanadium	mg/l	0.002	ICP Emission Spectroscopy	3	4	6 months
Zinc	mg/l	0.004	ICP Emission Spectroscopy	3	4	6 months
INORGANIC PARAMETERS						
pH	units	0.01	Meter	1-150.1; 2-423	1	ASAP
Specific Conductance at 25°C	umhos/cm	1	Bridge	1-120.1; 2-205	1	28 days
Total Dissolved Solids	mg/l	10	Gravimetric, 180°C	1-160.1; 2-209B	1	7 days
Total Suspended Solids	mg/l	2	Gravimetric, 105°C	1-160.2	1	7 days
Total Solids	mg/l	10	Gravimetric, 105°C	1-160.3	1	7 days
Total Volatile Solids	mg/l	10	Gravimetric, 550°C	1-160.4	1	7 days
Orthophosphate as P	mg/l	0.01	Single Reagent Colorimetric	1-365.2; 2-424F	1	48 hours

ROCKY MOUNTAIN ANALYTICAL LABORATORY

Inorganic Analytical Methodology (Continued)

Parameter	Units	Nominal Detection Limit[a]	Methodology	Reference	Preservation Bottle No.	Maximum HoldingTime[b]
INORGANIC PARAMETERS (Continued)						
Total Phosphorus as P	mg/l	0.06	Digestion; ICP Emission Spectroscopy	1-4.1.4; 3	4	28 days
		0.01	Digestion - Colorimetric	1-365.2; 1-424C,F	2	28 days
Silica as SiO_2	mg/l	0.1	ICP Emission Spectroscopy	3	4	28 days
	mg/l	1	Colorimetric	1-370.1; 2-425C	1	28 days
Biological Oxygen Demand	mg/l	2	Dilution Bottle - D.O. Probe	1-405.1; 2-507	1	48 hours
Chemical Oxygen Demand	mg/l	5	Micro Colorimetric	1-410.4; 2-508A	2	28 days
Total Organic Carbon	mg/l	0.1	Oxidation-Infrared Absorption	1-415.1; 2-505	2	28 days
Ammonia as N	mg/l	0.1	Electrode	1-350.3; 2-417E	2	28 days
		0.1	Automated Colorimetric	1-350.1	2	28 days
Total Kjeldahl Nitrogen as N	mg/l	0.1	Digestion - Electrode	1-351.4; 2-420B	2	28 days
		0.1	Digestion - Colorimetric	1-351.2	2	28 days
Total Organic Nitrogen as N	mg/l	0.1	Calculation (TKN - NH_3)	-	-	-
Oil and Grease	mg/l	1	Freon Extraction-Gravimetric	1-413.1; 2-503A	3	28 days
Free Cyanide	mg/l	0.01	Chlorination-Distillation-Colorimetric	1-335.1; 2-412F,D	6	14 days
Total Cyanide	mg/l	0.01	Distillation - Colorimetric	1-335.2; 2-412B,D	6	14 days
Phenolics	mg/l	0.01	Distillation - Colorimetric	1-420.1; 2-510A,B	2	28 days
Fecal Coliform	Colonies/100 ml	1	Membrane Filter	2-909C	8	ASAP
Total Coliform	Colonies/100 ml	1	Membrane Filter	2-909A	8	ASAP
Bromide	mg/l	0.1	Colorimetric	2-405	1	28 days
Residual Chlorine	mg/l	0.05	Amperometric	1-330.2; 2-408C	1	ASAP
Hexavalent Chromium	mg/l	0.01	Colorimetric	1-218.4; 2-312B	1	24 hours
Color	units	5	Pt-Co Colorimetric	1-110.2; 2-204A	1	48 hours
Hardness as $CaCO_3$	mg/l	5	Calculation	2-314A	4	6 months
Nitrite as N	mg/l	0.01	Colorimetric	1-354.1; 2-419	1	48 hours
Sulfide	mg/l	0.05	Titrimetric - Electrode	1-376.1; 2-427B,D	7	7 days
Sulfite	mg/l	2	Titrimetric	1-377.1; 2-428	1	ASAP
MBAS (Surfactants)	mg/l	0.1	Colorimetric	1-425.1; 2-512A	1	48 hours
Turbidity	NTU	0.1	Turbidimeter	1-180.1; 2-214A	1	48 hours

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ROCKY MOUNTAIN ANALYTICAL LABORATORY

Inorganic Analytical Methodology (Continued)

References

(1) "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, EMSL, Cincinnati, 1979.

(2) "Standard Methods for the Examination of Water and Wastewater", 15th Edition, APHA, 1980.

(3) Federal Register, 40 CFR 136, December 3, 1979; USEPA EMSL-Cincinnati, OH 45268.

(4) "Annual Book of ASTM Standards", Part 31, Water, 1980.

Notes

[a] Nominal values are the best achievable with the listed analytical method. Interferences in specific samples may result in a higher detection limit.

[b] Applicable to NPDES wastes as updated by Robert C. Booth, Director, EMSL-Cincinnati, September 22, 1981.

[c] Digestion procedure 1-4.1.4 used for elements determined by ICP Emission Spectroscopy when determining total metals. Digestion procedures for graphite furnace elements included with reference listed.

11/10/82

GUIDELINES FOR SAMPLE BOTTLES AND PRESERVATIVES[a]

Bottle No.	Parameters	Container	Preservative	Notes
1	Cl^-, F^-, $SO_4^=$, Tot. Alk., $CO_3^=$ Alk., HCO_3^- Alk., OH^- Alk., pH, spec. cond., TDS, TSS, TS, TVS, o-PO_4 SiO_2, BOD, Br^-, res. Cl_2, Cr^{+6}, color, NO_2^-, $SO_3^=$, MBAS, Turbidity.	1 liter poly	4° C	Provide unfiltered sample for solids and turbidity.
2	Tot. P, COD, TOC, NH_3, TKN, TON, Phenolics NO_3 + NO_2.	500 ml poly	2 ml 50% H_2SO_4, 4°C	
3	O & G	1 liter glass	4 ml 50% H_2SO_4, 4°C	Do not filter, collect directly in bottle.
4	Na, K, Ca, Mg, Al, Sb, As, Ba, Be, B, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Mo, Ni, Se, Ag, Sr, Tl, Sn, Ti, V, Zn, ICP, Hardness.	500 ml poly	5 ml 50% HNO_3	Provide separate samples for total and dissolved sample (filter before adding to bottle.)
5	Alpha, Beta, Ra^{226}, Ra^{228}, U	1 liter poly (no Ra^{228}) ½ gallon poly (with Ra^{228})	10 ml 50% HNO_3 20 ml 50% HNO_3	
6	Free CN, Tot. CN	500 ml poly	2 ml 50% NaOH, 4°C	
7	Sulfide	250 ml poly	1 ml 1 N Zn acetate, 1 ml 50% NaOH, 4°C	
8	Fecal coli., total coli.	8 oz. sterile	4° C	Collect directly in sterile bottle
11	VOA, purgeable organics, THM	2 - 40 ml glass vial	4° C	Completely fill bottle, leave no air bubbles.
12	B/NA	1 liter glass	4° C	
13	Pest./PCB	1 liter glass	4° C	
14	Herbicides	1 liter glass	4° C	
15	TOX	1 liter glass	4° C	

[a]Federal Register, 40 CFR 136, December 3, 1979, as updated by EPA, EMSL-Cincinnati, September 22, 1981.

11/5/82

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APPENDIX C

Ground-Water Sampling and Analytical Protocol

Introduction

This sampling and analysis protocol has been compiled for use at locations which require ground-water monitoring and sampling for volatile organic constituents (VOCs). The methods described are equivalent to other HLA sampling plans, such as the document used for sampling MW-1 through 4. This protocol includes procedures and techniques for:

1. Sample collection
2. Sample preservation and shipment
3. Chain of custody control
4. Analytical procedures

Before sample collection can begin, the water sampled from the well casing must be fresh aquifer water. Well purging replaces stagnant well water with representative aquifer water each time a set of samples is taken from the well.

There are no mandated procedures for sample collection, and shipment, only guidelines as contained in two Environmental Protection Agency

OGC-002821

(EPA) recommended publications. The sample collection and preservation protocol maintains sample integrity while reducing collection time. It is adaptable to most ground-water monitoring wells and meets both state and federally-recommended guidelines.

Shipping and handling of samples will route the samples to Rocky Mountain Analytical, Arvada, Colorado for the analyses. The chain of custody control program lists all sample handlers, and provides for maximum protection against sample contamination. The recommended procedures for chain of custody control and holding time are followed in this protocol.

Sampling Equipment Water Depth

A battery-operated water-level indicator, such as Model DR-760A as manufactured by Soiltest, Inc., is used to measure water level within the well. This information, along with well construction data, will be used to calculate the volume of water standing in the well casing.

Field Measurements

Portable instruments are used if field measurements are to be obtained. Temperature and conductivity are measured using equipment such as a Yellow Springs Model 33 SCT Meter and an Orion Research Model 399 A/F meter to measure pH.

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Well Evacuation

All 2-inch diameter monitoring wells will be purged with a gas squeeze pump or a PVC or Teflon bailer. Wells 4 inches in diameter and larger will be purged by bailing or with an electrical submersible pump. The well will be considered properly purged after four standing water volumes have been removed. In low-yielding wells, the standing water will be removed until the well is essentially dry. The water level in the well will be allowed to recover until a sufficient volume of water is present to obtain the samples.

Sample Collection

All samples for VOCs will be placed in 30 ml septum-seal vials with no headspace. Duplicate VOC samples will be obtained from all wells. Following collection and labeling, all samples will be stored in an ice-filled cooler.

After the well has been properly purged, a water sample will be obtained with a Teflon bailer or a gas squeeze pump.

Equipment Cleaning Procedures

Cleaning and sterilization of the bailer is accomplished by using either a 5 percent household bleach and water or with a dilute methanol solution. Following the cleaning, the bailer is thoroughly

OGC-002823

rinsed with deionized water. The submersible pump and tubing, if transferred between wells, are rinsed with deionized water. Dedicated gas-squeeze pumps do not need to be cleaned.

Rocky Mountain Analytical laboratories provided all sample bottles which have been cleaned following EPA-recommended procedures.

Sample Shipment

All samples will be transported to the lab directly from the field. If necessary, insulated cartons and cold packs are available to maintain the temperature ($4^{o}C$) required for the preservation of samples. At the lab, the samples are routed for analysis with priorties based on sample holding times.

Chain of Custody Control

Sample identification numbers and sample name are recorded on a label affixed to each sample. Sample transfer is accomplished in groups with a chain of custody record. When a portion of the samples identified on the record form is to be transferred, the individual samples are noted in the column with the signature of the person relinquishing them. The sample collector is responsible for packaging and dispatching the samples, properly filling out, dating, and signing the chain of custody record form.

VOC Analytical Methodology

The method employed for the analysis of the volatile organic compounds was EPA Method 624 (Federal Register, December 3, 1979, page 69532). The method can be summarized as follows: helium is bubbled through a 5 ml. water sample contained in a specially designed purging chamber at ambient temperature. The purgeable volatile organic compounds are efficiently transferred from an aqueous phase to the vapor phase.

Vapor is swept through a sorbent column where the purgeables are trapped. After purging is completed, the sorbent column is heated and back flushed with helium to desorb the purgeables onto a gas chromtographic column. The gas chromatograph is temperature programmed to separate the purgeables which are then detected with a mass spectrometer.

Other Parameters

Information about analytical methods and sample containers is contained in documents prepared by Rocky Mountain Analytical Laboratory, and incorporated with this Appendix.

Quality Assurance Protocol

The quality assurance protocol followed in all sample analyses is based on the "Handbook for Analytical Control in Water and Wastewater Laboratories," EPA 600/4-79-019, March 1979; National Enforcement Investigation Center Policies and Procedures manual; EPA-330/9/79/001-R, October 1979; and the recommended guidelines to EPA Method 624 and 625.

OGC-002826

SAMPLE DESCRIPTION INFORMATION

for

Sparton Technology, Inc.

RMA Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
4333-01	MW-13	Water	10/4/84	10/6/84
4333-02	MW-14	Water	10/4/84	10/6/84
4333-03	MW-15	Water	10/4/84	10/6/84
4333-04	MW-16	Water	10/5/84	10/6/84
4333-05	MW-17	Water	10/5/84	10/6/84
4333-06	PW-1-1	Water	10/7/84	10/11/84
4333-07	PW-1-4	Water	10/8/84	10/11/84
4333-08	MW-16	Water	10/10/84	10/11/84
4333-09	MW-17	Water	10/10/84	10/11/84

October 31, 1984

ANALYTICAL RESULTS

for

Sparton Technology, Inc.

INORGANIC PARAMETERS

Parameter	Units	Detection Limit	4333-01	4333-02	4333-03	4333-04	4333-05	4333-06	4333-07	4333-08	4333-09
pH	units	0.01	7.43	7.61	7.68	7.17	7.90	8.03	7.82	7.30	7.94
Specific Conductance at 25°C	umhos/cm	1	1090	1290	885	5300	695	801	798	5960	748
Fluoride	mg/l	0.1	1.1	0.8	0.8	7.9	1.5	0.8	0.7	6.9	1.4
Nitrate as N	mg/l	0.1	0.6	1.0	4.4	ND	ND	0.7	0.8	ND	0.2
Sulfate	mg/l	5	148	192	146	2180	98	130	130	2320	102
Total Organic Carbon	mg/l	0.1	5.2	5.9	2.7	54	5.1	3.8	6.0	71	4.8
Total Organic Halogen	ugCl^-/l	5	3600	3700	1100	15000	3100	380	210	25000	2500
Total Kjeldahl Nitrogen as N	mg/l	0.1	3.1	1.0	0.5	310	1.5	0.6	0.3	380	1.0
Hexavalent Chromium	mg/l	0.01	ND	0.60	ND	ND	ND	ND	0.01	0.01	ND
Phenolics	mg/l	0.01	0.01	ND	ND	0.04	ND	ND	ND	0.04	ND

TOTAL TRACE METALS

Parameter	Units	Detection Limit	4333-01	4333-02	4333-03	4333-04	4333-05	4333-06	4333-07	4333-08	4333-09
Boron	mg/l	0.004	2.6	2.0	0.16	14	0.19	0.18	0.16	20	0.18
Cadmium	mg/l	0.002	0.003	ND	ND	0.003	0.013	ND	ND	0.012	0.006
Chromium	mg/l	0.005	0.038	0.58	ND	0.75	0.27	ND	ND	2.3	0.092
Manganese	mg/l	0.005	2.0	0.76	0.060	17	4.1	1.1	1.1	25	2.7
Nickel	mg/l	0.01	0.04	0.04	ND	0.40	0.11	ND	ND	0.68	0.05
Sodium	mg/l	0.5	79	77	54	200	69	56	54	266	56

ND = Not detected. NR = Not requested.

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ANALYTICAL RESULTS

for

Sparton Technology, Inc.

VOLATILE ORGANICS - PRIORITY POLLUTANTS

Parameter		Units	Detection Limit	4333-01	4333-02	4333-03	4333-04	4333-05	4333-06	4333-07	4333-08	4333-09
1V	Acrolein	ug/l	100	ND	ND	ND	ND	ND	ND	ND	ND	ND
2V	Acrylonitrile	ug/l	100	ND	ND	ND	ND	ND	ND	ND	ND	ND
3V	Benzene	ug/l	5	ND	9	ND	58	ND	ND	ND	56	6
4V	Bis(chloromethyl)ether	ug/l	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
5V	Bromoform	ug/l	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
6V	Carbon tetrachloride	ug/l	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
7V	Chlorobenzene	ug/l	5	ND	ND	ND	16	ND	ND	ND	17	ND
8V	Chlorodibromomethane	ug/l	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
9V	Chloroethane	ug/l	10	ND	ND	ND	45	ND	ND	ND	27	ND
10V	2-Chloroethylvinyl ether	ug/l	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
11V	Chloroform	ug/l	5	15	34	ND	25	ND	ND	ND	33	ND
12V	Dichlorobromomethane	ug/l	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
13V	Dichlorodifluoromethane	ug/l	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
14V	1,1-Dichloroethane	ug/l	5	13	17	ND	3200	1900	ND	ND	2700	2100
15V	1,2-Dichloroethane	ug/l	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
16V	1,1-Dichloroethylene	ug/l	5	820	1000	85	3100	260	13	9	3700	460
17V	1,2-Dichloropropane	ug/l	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
18V	1,3-Dichloropropylene	ug/l	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
19V	Ethylbenzene	ug/l	5	ND	ND	ND	63	ND	ND	ND	53	ND
20V	Methylbromide	ug/l	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
21V	Methylchloride	ug/l	10	ND	ND	ND	70	ND	ND	ND	23	ND
22V	Methylene chloride	ug/l	10	1700	3600	11	49000	17	330	170	51000	66
23V	1,1,2,2-Tetrachloroethane	ug/l	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
24V	Tetrachloroethylene	ug/l	5	17	25	34	140	53	ND	ND	140	77
25V	Toluene	ug/l	5	45	6	ND	1600	50	ND	ND	1400	32
26V	1,2-trans-Dichloroethylene	ug/l	5	ND	ND	ND	200	19	ND	ND	140	21
27V	1,1,1-Trichloroethane	ug/l	5	4600	4100	2200	5500	2300	31	21	6700	2900
28V	1,1,2-Trichloroethane	ug/l	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
29V	Trichloroethylene	ug/l	5	6900	12000	4400	37000	4300	200	130	38000	6200
30V	Trichlorofluoromethane	ug/l	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
31V	Vinyl chloride	ug/l	10	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = Not detected. NR = Not requested.

ANALYTICAL RESULTS

for

Sparton Technology, Inc.

VOLATILE ORGANICS - ADDITIONAL COMPONENTS

Parameter	Units	Detection Limit	4333-01	4333-02	4333-03	4333-04	4333-05	4333-06	4333-07	4333-08	4333-09
Acetone	ug/l	10	ND	ND	ND	17000	28	ND	ND	22000	53
Ethanol	ug/l	400	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Hexanone	ug/l	10	ND	ND	ND	ND	ND	ND	ND	ND	ND
Meta-xylene*	ug/l	5	ND	ND	ND	42	ND	ND	ND	32	ND
Ortho, Para-xylene*	ug/l	5	ND	ND	ND	84	ND	ND	ND	67	ND
Trichlorotrifluoroethane	ug/l	5	24	9	48	73	35	ND	ND	90	67

ND = Not detected. NR = Not requested.

*Please note that xylene = dimethylbenzene. The ortho and para isomers are not resolved chromatographically and are therefore reporte together. Adding the ortho,para and meta results together gives the total xylene (dimethylbenzene) results.

SAMPLE DESCRIPTION INFORMATION

for

Sparton Technology, Inc.. Inc.

RMA Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
4346-01	PW-1-2	Water	10/8/84	10/11/84
4346-02	PW-1-3	Water	10/8/84	10/11/84

October 31, 1984

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ANALYTICAL RESULTS

for

Sparton Technology, Inc.

INORGANIC PARAMETERS

Parameter	Units	Detection Limit	4346-01	4346-02
pH	units	0.01	7.86	7.85
Specific Conductance at 25°C	umhos/cm	1	791	789
Total Organic Carbon	mg/l	0.1	5.8	3.5
Total Organic Halogen	ugCl^-/l	5	240	210

VOLATILE ORGANICS

Parameter	Units	Detection Limit	4346-01	4346-02
16V 1,1-Dichloroethylene	ug/l	5	16	12
29V Trichloroethylene	ug/l	5	150	110

ND = Not detected. NR = Not requested.

SAMPLE DESCRIPTION INFORMATION

for

Sparton Technology, Inc.

RMA Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
4216-01	MW-12	Water	8/29/84	8/30/84

September 28, 1984

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OGC-002832

ANALYTICAL RESULTS

for

Sparton Technology

ORGANIC PARAMETERS

ameter	Units	Detection Limit	4216-01
	units	0.01	7.65
cific Conductance at 25°C	umhos/cm	1	769
oride	mg/l	0.1	0.3
oride	mg/l	3	23
rite as N	mg/l	0.01	0.02
rate as N	mg/l	0.01	1.3
ho-Phosphate as P	mg/l	0.01	ND
fate	mg/l	5	136
al Organic Carbon	mg/l	0.1	1.7
al Organic Halogen	mg/l	5	74
monia as N	mg/l	0.1	ND
nolics	mg/l	0.01	ND
omium +3	mg/l	0.005	ND
valent Chromium	mg/l	0.005	ND

= Not detected. NR = Not requested.

OGC-002833

ANALYTICAL RESULTS

for

Sparton Technology

RACE METALS

arameter	Units	Detection Limit	4216-01
rsenic	mg/l	0.002	0.006
arium	mg/l	0.005	0.21
oron	mg/l	0.004	0.12
admium	mg/l	0.002	0.005
hromium	mg/l	0.005	ND
opper	mg/l	0.002	0.005
on	mg/l	0.05	0.09
ead	mg/l	0.025	ND
anganese	mg/l	0.005	0.98
ercury	mg/l	0.0002	ND
olybdenum	mg/l	0.005	0.012
ickel	mg/l	0.01	ND
elenium	mg/l	0.002	ND
ilver	mg/l	0.003	ND
odium	mg/l	0.5	54
in	mg/l	0.03	ND
inc	mg/l	0.004	0.055

D = Not detected. NR = Not requested.

OGC-002834

ANALYTICAL RESULTS

for

Sparton Technology

LATILE ORGANICS

rameter	Units	Detection Limit	4216-01
Acrolein	ug/l	100	ND
Acrylonitrile	ug/l	100	ND
Benzene	ug/l	5	ND
Bis(chloromethyl)ether	ug/l	5	ND
Bromoform	ug/l	5	ND
Carbon tetrachloride	ug/l	5	ND
Chlorobenzene	ug/l	5	ND
Chlorodibromomethane	ug/l	5	ND
Chloroethane	ug/l	10	ND
V 2-Chloroethylvinyl ether	ug/l	5	ND
V Chloroform	ug/l	5	ND
V Dichlorobromomethane	ug/l	5	ND
V Dichlorodifluoromethane	ug/l	10	ND
V 1,1-Dichloroethane	ug/l	5	ND
V 1,2-Dichloroethane	ug/l	5	ND
V 1,1-Dichloroethylene	ug/l	5	ND
V 1,2-Dichloropropane	ug/l	5	ND
V 1,3-Dichloropropylene	ug/l	5	ND
V Ethylbenzene	ug/l	5	ND
V Methylbromide	ug/l	10	ND
V Methylchloride	ug/l	10	20
V Methylene chloride	ug/l	10	ND
/ 1,1,2,2-Tetrachloroethane	ug/l	5	ND
/ Tetrachloroethylene	ug/l	5	ND
/ Toluene	ug/l	5	ND
/ 1,2-trans-Dichloroethylene	ug/l	5	ND
/ 1,1,1-Trichloroethane	ug/l	5	ND
/ 1,1,2-Trochloroethane	ug/l	5	ND
/ Trichloroethylene	ug/l	5	61
/ Trichlorofluoromethane	ug/l	10	ND
/ Vinyl chloride	ug/l	10	ND

= Not detected. NR = Not requested.

OGC-002835

ANALYTICAL RESULTS

for

Sparton Technology

OLATILE ORGANICS

arameter	Units	Detection Limit	4216-01
Acetone	ug/l	10	ND
Ethanol	ug/l	10	ND
Freon	ug/l	5	ND
2-Hexanone	ug/l	10	ND
Xylene (Dimethyl benzene)	ug/l	5	ND
O-Xylene (Dimethyl benzene)	ug/l	5	ND

D = Not detected. NR = Not requested.

SAMPLE DESCRIPTION INFORMATION

for

Sparton Technology

RMA Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
4208-01	Boring MW-16 5-10'	Soil	8/16/84	8/25/84
4208-02	Boring MW-16 10-15'	Soil	8/16/84	8/25/84
4208-03	Boring MW-16 15-20'	Soil	8/16/84	8/25/84
4208-04	Boring MW-16 20-25'	Soil	8/16/84	8/25/84
4208-05	Boring MW-16 25-30'	Soil	8/16/84	8/25/84
4208-06	Boring MW-16 30-35'	Soil	8/16/84	8/25/84
4208-07	Boring MW-16 35-40'	Soil	8/16/84	8/25/84
4208-08	Boring MW-16 40-45'	Soil	8/16/84	8/25/84
4208-09	Boring MW-16 45-50'	Soil	8/16/84	8/25/84
4208-10	Boring MW-16 50-55'	Soil	8/20/84	8/25/84
4208-11	Boring MW-16 55-60'	Soil	8/20/84	8/25/84
4208-12	Boring MW-16 60-65'	Soil	8/20/84	8/25/84
4208-13	Boring MW-16 65-70'	Soil	8/20/84	8/25/84
4208-14	Boring MW-16 70-73'	Soil	8/20/84	8/25/84

October 3, 1984

OGC-002837

ANALYTIC... RESULTS

for

Sparton Technology

INORGANIC PARAMETERS

Parameter	Units	Detection Limit	4208-01	4208-02	4208-03	4208-04	4208-05	4208-06	4208-07	4208-08	4208-09	4208-10
pH	units	0.01	7.76	8.25	8.55	8.22	8.27	7.60	8.00	7.52	7.79	7.71
Total Organic Halogen	$mgCl^-/kg$	100	NR	NR	ND	NR	NR	NR	ND	NR	NR	NR
Total Cyanide	mg/kg	0.25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexavalent Chromium, EP TOX	mg/l	0.01	ND	ND	0.02	0.02	ND	3.6	6.0	1.6	0.5	0.81
% Solids	%	0.1	94.0	97.0	97.5	95.6	92.6	95.4	94.2	91.3	94.0	93.5

Parameter	Units	Detection Limit	4208-11	4208-12	4208-13	4208-14
pH	units	0.01	8.27	8.20	8.17	8.08
Total Organic Halogen	$mgCl^-/kg$	100	ND	NR	NR	NR
Total Cyanide	mg/kg	0.25	ND	ND	ND	ND
Hexavalent Chromium, EP TOX	mg/l	0.01	ND	ND	ND	ND
% Solids	%	0.1	87.2	87.2	91.9	86.6

ND = Not detected. NR = Not requested.

OGC-002838

ANALYTICAL RESULTS

for

Sparton Technology

TOXICITY METALS

·ameter	Units	Detection Limit	4208-01	4208-02	4208-03	4208-04	4208-05	4208-06	4208-07	4208-08	4208-09	4208-10
dmium	mg/l	0.002	ND	ND	0.003	ND	ND	0.003	0.006	0.028	0.013	0.005
·omium	mg/l	0.005	ND	0.027	0.060	0.048	0.083	4.1	8.6	2.1	0.70	1.1
ıd	mg/l	0.025	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
kel	mg/l	0.01	0.01	0.02	0.027	0.01	0.027	0.13	0.19	0.12	0.11	0.11
·er	mg/l	0.003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ameter	Units	Detection Limit	4208-11	4208-12	4208-13	4208-14
lmium	mg/l	0.002	ND	ND	ND	ND
omium	mg/l	0.005	ND	ND	0.011	0.007
d	mg/l	0.025	ND	ND	ND	ND
kel	mg/l	0.01	0.045	0.026	0.050	0.045
er	mg/l	0.003	ND	ND	ND	ND

= Not detected. NR = Not requested.

OGC-002839

ANALYTICAL RESULTS

for

Sparton Technology

OTAL TRACE METALS

arameter	Units	Detection Limit	4208-01	4208-02	4208-03	4208-04	4208-05	4208-06	4208-07	4208-08	4208-09	4208-10
admium	mg/kg	0.1	0.8	0.7	0.8	0.9	0.9	1.0	1.1	2.6	1.1	0.5
hromium	mg/kg	0.3	3.2	7.7	6.7	8.4	8.6	350	500	480	80	130
ead	mg/kg	1.3	3.4	3.4	3.6	3.2	3.0	ND	2.1	2.7	4.2	2.7
ickel	mg/kg	0.5	3.3	4.3	4.4	4.0	4.6	30	41	38	14	13
lver	mg/kg	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ppm

arameter	Units	Detection Limit	4208-11	4208-12	4208-13	4208-14
admium	mg/kg	0.1	0.6	0.4	1.0	1.2
hromium	mg/kg	0.3	9.8	24	52	69
ead	mg/kg	1.3	3.6	2.3	3.6	3.5
ickel	mg/kg	0.5	5.6	4.8	9.8	7.5
lver	mg/kg	0.2	ND	ND	ND	ND

D = Not detected. NR = Not requested.

Results given on a dry weight basis.

SUMMARY OF ANALYTICAL RESULTS AND METHODOLOGY

for

Sparton Technology, Inc. - November 1984 Sampling

As shown on the Sample Description Information sheet, RMAL received eleven samples in late November, 1984.

Results

Analytical results are presented in the enclosed tables. In general, all results are reported in mg/l (ppm). This represents a change over previous reports. This change was made to better permit cross comparison of the GC/MS results to results from other determinations.

These data are consistent with previous reports with one exception, volatile organic compound concentration, for sample MW-11. Previously (RMA #3339), volatile organics were detected in this sample in concentrations varying from .09 to .8 mg/l. The data reported for this sample in this report shows the compounds to be not detected. A review of both reports has not revaled any obvious errors. The current values appear to be correct based on the TOX value of only 0.006 ug/l. In general, the sum of the volatile organics and the TOX values correlate very well for this set of data.

Note that the results for MW-1 are consistent with the previous data in that the 1,1-dichloroethane is substantially less than the 1,1-dichloroethylene. The previous results for MW-16 still cannot be explained.

Analytical Methods

In general, all analyses were in accordance with standard EPA methodology as promulgated in 40 CFR 136. The enclosed table of Inorganic Analytical Methodology summarizes the methods for all parameters except organics.

The volatile organic species were determined by a combination of both GC and GC/MS. All of the priority pollutant organics listed in Table 4 were determined by GC/MS using EPA Method 624. Furthermore, with the exception of ethanol, all of the additional organics listed in Table 5 were also determined by GC/MS. These six organics (including ethanol) were also determined by direct aqueous injection GC/FID using a variation of EPA Method 603. This technique was also used to quantify high concentrations of volatile priority pollutants.

OGC-002840

SAMPLE DESCRIPTION INFORMATION

[illegible] RESULTS AND METHODOLOGY
for

Sparton Technology, Inc.

RMA Sample No.	Sample Description	Sample Type	Date Sampled	Date Received
4466-01	MW-10	Water	11/20/84	11/21/84
4466-02	MW-11	Water	11/20/84	11/21/84
4466-03	MW-5	Water	11/28/84	11/29/84
4466-04	MW-6	Water	11/28/84	11/29/84
4466-05	MW-7	Water	11/27/84	11/29/84
4466-06	MW-8	Water	11/27/84	11/29/84
4466-07	MW-9	Water	11/27/84	11/29/84
4466-08	MW-1	Water	11/29/84	11/30/84
4466-09	MW-2	Water	11/29/84	11/30/84
4466-10	MW-3	Water	11/29/84	11/30/84
4466-11	MW-4	Water	11/29/84	11/30/84

December 31, 1984

OGC-002841

TABLE 1. ANALYTICAL RESULTS FOR INORGANIC PARAMETERS, WELLS 5-11

	Sparton #		MW-10	MW-11	MW-5	MW-6	MW-7	MW-8	MW-9
	RMA #		4466-01	4466-02	4466-03	4466-04	4466-05	4466-06	4466-07
ırameter	Units	Detection Limit							
I	units	0.01	7.74	7.76	7.64	7.50	7.43	7.50	6.70
›ecific Conductance at 25°C	umhos/cm	1	702	699	721	866	692	763	2350
.uoride	mg/l	0.1	0.2	0.2	0.4	0.3	0.3	0.3	0.3
itrate as N	mg/l	0.01	0.2	0.5	1.8	16	3.3	7.4	ND
ılfate	mg/l	5	119	118	112	120	85	80	372
›tal Organic Carbon	mg/l	0.1	3.0	2.2	3.8	6.1	3.6	5.5	14
›tal Organic Halogen	mgCl^-/l	5	0.040	0.006	0.22	0.45	0.85	0.18	21
›tal Kjeldahl Nitrogen as N	mg/l	0.1	0.4	0.6	0.6	0.1	0.2	0.4	1.7
ıenolics	mg/l	0.01	ND	ND	ND	ND	ND	ND	0.02
ɜxavalent Chromium	mg/l	0.01	ND	ND	ND	ND	0.02	ND	ND
·ivalent Chromium	mg/l	0.01	ND	ND	ND	ND	ND	ND	ND

D = Not detected.

OGC-002842

TABLE 2. ANALYTICAL RESULTS F[illegible] ORGANIC PARAMETERS, WELLS 1-4

Parameter	Units	Detection Limit	MW-1	MW-2	MW-3	MW-4
Sparton #			MW-1	MW-2	MW-3	MW-4
RMA #			4466-08	4466-09	4466-10	4466-11
H Value 1	units	0.01	7.73	7.50	7.48	8.17
H Value 2	units	0.01	7.75	7.60	7.48	8.18
H Value 3	units	0.01	7.72	7.57	7.47	8.17
H Value 4	units	0.01	7.71	7.59	4.48	8.17
pecific Conductance at 25°C	umhos/cm	1	3450	714	4250	996
pecific Conductance at 25°C	umhos/cm	1	3420	711	4250	981
pecific Conductance at 25°C	umhos/cm	1	3410	716	4260	979
pecific Conductance at 25°C	umhos/cm	1	3410	710	4250	978
luoride	mg/l	0.1	0.4	0.3	0.8	0.4
itrate as N	mg/l	0.01	0.9	3.7	1.5	2.3
ulfate	mg/l	5	285	112	810	150
otal Organic Carbon Value 1	mg/l	0.1	47	1.1	86	1.8
otal Organic Carbon Value 2	mg/l	0.1	49	1.0	86	1.8
otal Organic Carbon Value 3	mg/l	0.1	48	1.0	85	1.8
otal Organic Carbon Value 4	mg/l	0.1	47	1.0	85	1.8
otal Organic Halogen Value 1	mg/Cl^-/l	0.005	45	2.8	86	14
otal Organic Halogen Value 2	mg/Cl^-/l	0.005	45	2.3	68	14
otal Organic Halogen Value 3	mg/Cl^-/l	0.005	42	2.7	74	14
otal Organic Halogen Value 4	mg/Cl^-/l	0.005	39	2.5	80	12
otal Kjeldahl Nitrogen as N	mg/l	0.1	17	0.5	34	0.7
henolics	mg/l	0.01	ND	0.01	0.03	ND
lexavalent Chromium	mg/l	0.01	24	ND	1.0	ND
rivalent Chromium	mg/l	0.01	ND	ND	ND	ND

ID = Not detected.

OGC-002843

TABLE 3. ANALYTICAL RESULTS FOR TRACE METALS

Parameter	Units	Detection Limit	MW-10	MW-11	MW-5	MW-6	MW-7	MW-8	MW-9	MW-1	MW-2	MW-3	MW-4
Sparton #			4466-01	4466-02	4466-03	4466-04	4466-05	4466-06	4466-07	4466-08	4466-09	4466-10	4466-11
RMA #													
Boron	mg/l	0.05	ND	ND	0.12	0.25	0.11	0.37	13	4.4	0.06	32	1.6
Cadmium	mg/l	0.009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	mg/l	0.01	0.01	0.01	ND	ND	0.021	ND	ND	22	0.022	0.64	ND
Manganese	mg/l	0.006	0.93	0.78	0.68	0.34	0.03	ND	1.9	1.4	0.009	4.2	0.14
Nickel	mg/l	0.006	0.02	0.006	ND	0.005	ND	ND	0.19	0.042	ND	0.73	0.034
Sodium	mg/l	0.5	39	38	71	71	45	75	149	120	49	210	55

ND = Not detected.

APPENDIX D
to
ATTACHMENT 4

Aquifer Test Procedures

APPENDIX D

Aquifer Test Procedures

The purpose of an aquifer test is to estimate the hydrogeologic properties of the subsurface. These properties are determined by stressing the aquifer by either the addition or removal of water and monitoring the hydrostatic and chemical changes which occur at monitoring points throughout the system. Prediction of aquifer response can be made under different conditions, if the hydrogeologic framework is correctly understood. These test are also used to determine the hydraulics of wells in order to design pumping systems.

The tests conducted at the SPARTON site included a series of pumping tests on PW-1 and an infiltration test of the infiltration gallery adjacent to MW-17. The methodology employed in each test is discussed in the next section.

PW-1 Aquifer Test

A 25-horsepower submersible pump was installed 126 feet below TOC in PW-1 by Rodgers & Company on October 4, 1984. Discharge from the pump was directed through 4-inch irrigation pipe to the municipal sewer located just off the southeast corner of SPARTON property. SPARTON personnel obtained permission from the Albuquerque Sewer Authority for the discharge.

OGC-002845

The pump was powered with a diesel electric generator and flow was controlled with a valve and direct-reading totalizing flow meter.

Water level measurements were taken in all wells with an accurately calibrated water level indicator such as a chalked steel tape or electric conductivity probe. All levels were referenced into the TOC elevation, which was determined by a registered surveyor.

Constant water level measurements were automatically recorded with the use of a computer-operated pressure transducer system manufactured by INSITU-Inc., Laramie, Wyoming. The SE-2000 system collected data from four transducers throughout the tests, reduced and tabulated the data, and printed graphs of water level changes in MW-12, 13, 14, and PW-1. These data were complemented by periodic hand water level measurements in the surrounding wells using a chalked steel tape or a battery-operated water level indicator.

All data from the tests were reduced into a format of elapsed time and drawdown and analyzed by standard hydrogeologic methods such as those discussed in Lohman, 1979. The Theis, Jacob, and Hantush methods of analyses were used to develop aquifer parameters.

The results of these analyses were then used to estimate the flow and storage properties of the subsurface, and to determine the hydraulic characteristics of the upper finer-grain layer.

OGC-002846

Infiltration Test

A pilot-scale infiltration test was conducted using the infiltration gallery constructed 5 feet south of MW-17. The gallery consisted of a nominal 8-foot long, 1-foot wide, wooden box 4-feet deep filled with coarse gravel. The actual open area of the bottom of the gallery was 7 feet^2.

Water was added to the gallery from the fire hydrant at the northwest corner of the SPARTON property, keeping the gallery filled to a prescribed elevation. The infiltration rate was monitored with an in-line flow meter and controlled with a valve.

The pressure transducer system was used to monitor water-level changes in MW-11, 16, and 17. The fourth transducer was placed in the gallery.

This pilot-scale test was conducted in order to develop actual infiltration rates rather than a small double-ring infiltrometer which would yield data on the vertical hydraulic conductivity coefficient. The pilot-scale study removed much of the calculation and extrapolation which would be necessary to design a full-scale infiltration gallery.

Aquifer Parameters

The parameters of greatest interest are the aquifer's Transmissivity, Hydraulic Conductivity, Storage and Leakage coefficients. The following is a brief discussion of each parameter.

Transmissivity (T) describes the ability of water to flow through the aquifer. Specifically defined, it is the quantity of ground water which will travel through a vertical unit width of aquifer under a hydraulic gradient of one. It is dependent upon both the aquifer material and thickness. Typical units are gallons per day per foot (gpd/ft) or feet ^{2}/day (ft^2/day).

Hydraulic conductivity (K) of an aquifer is defined as the quantity of ground water that will flow through a unit area of aquifer under a unit gradient. The horizontal K of an aquifer is equal to the Transmissivity divided by the aquifer thickness (b): $K = T/b$. Typical units are gallons per day per square foot (gpd/ft^2) or feet/day (ft/day). Soil hydraulic conductivity is often listed in cm/sec, but these units are generally not applicable to ground water situations.

Storage coefficient (S) describes the quantity of ground water removed from the aquifer per unit decline of either the water table or the potentiometric surface. For water table aquifers, S typically ranges

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from 0.01 to 0.20 and in confined or semi-confined aquifers, S can range from 0.000001 to 0.001. The parameter is unitless, being the ratio of water yielded to volume of aquifer.

Leakage coefficient (K'/b') is the ratio of the hydraulic conductivity of the semi-confining layer to its thickness. Typical units are in 1/day or gallons per day per cubic feet (gpd/ft^3). The leakier the confining layer, the greater the K'/b'.

REFERENCES

1. Lohman, S.W. 1979. Ground-Water Hydraulics: United States Geological Survey Professional Paper 708.

APPENDIX E
to
ATTACHMENT 4

Aquifer Test Data

RTON CONSTANT-RATE TEST PW-1
Run 3
10/07/84

SE200B DATA
constant rate test

SPARTON TECHNOLOGY INC
ALBUQUERQUE NEW MEXICO
Constant rate test of PW-1
HARDING LAWSON ASSOCIATES INC
HOUSTON TEXAS
JOB # 6310 013.12
OPERATORS: DAVID BRATBERG &
FRANK DELUCA
Anticipated Q= 150 gpm
Total test time: 48 hrs

TRANSDUCER TABLE

Input 1: PW-1
Transducer s/n: 135
Scale factor: 49.95
Initial level: 67.47 feet

Input 2: MW-12
Transducer s/n: 871/846
Scale factor: 10.02
Initial level: 64.52 feet

Input 3: MW-13
Transducer s/n: 477/830
Scale factor: 10.12
Initial level: 65.18 feet

Input 4: MW-14
Transducer s/n: 034
Scale factor: 10.1
Initial level: 65.47 feet

PUMP SCHEDULE

Drawdown for 2880 min
Pump at 200 GPM
Pump set at 131 feet

Recovery for 1440 min

SAMPLING SCHEDULE

[illegible]	min	@	5	sec
0	min	@	20	sec
0-100	min	@	2	min
100-1000	min	@	20	min
1000-10000	min	@	60	min
10000-9999[illegible]	[illegible]	@	300	min

DRAWDOWN REPORT

Started at 1015
Lasted 1499.9 min

Input 1 (feet):

Time	ET (min)	level	Δlevel
1015	0.000	67.47	0.00
1015	0.084	73.58	-6.11
1015	0.167	74.95	-7.47
1015	0.251	76.47	-9.00
1015	0.334	78.32	-10.85
1015	0.417	80.28	-12.80
1015	0.501	81.95	-14.48
1015	0.584	83.33	-15.86
1015	0.667	84.51	-17.04
1015	0.751	85.24	-17.77
1015	0.834	85.79	-18.32
1015	0.917	86.41	-18.94
1016	1.001	86.97	-19.50
1016	1.377	88.84	-21.37
1016	1.710	87.20	-19.73
1017	2.043	88.57	-21.10
1017	2.377	88.86	-21.39
1017	2.710	87.48	-20.01
1018	3.043	88.44	-20.97
1018	3.377	89.22	-21.75
1018	3.710	89.84	-22.37
1019	4.043	88.64	-21.17
1019	4.377	88.25	-20.78
1019	4.710	89.41	-21.94
1020	5.043	90.21	-22.74
1020	5.377	90.69	-23.22
1020	5.710	89.16	-21.69
1021	6.043	88.74	-21.27
1021	6.377	88.87	-21.40
1021	6.710	89.19	-21.72
1022	7.043	89.52	-22.05
1022	7.377	89.51	-22.04
1022	7.710	89.26	-21.79
1023	8.043	88.9[illegible]	-21.50
1023	8.377	88.7[illegible]	-21.23
1023	8.710	88.5[illegible]	-21.04
1024	9.043	88.33	-20.86
1024	9.377	88.21	-20.74
1024	9.710	88.28	-20.81
1025	10.043	88.24	-20.77
1027	12.312	88.02	-20.55
1029	14.078	88.07	-20.60
1031	16.142	88.20	-20.73
1033	18.142	88.17	-20.70
1035	20	[illegible]	-20.74
1037	22	3	-20.75
1039	24	8	-20.81

1041	26	[illegible]	-20.91
1043	28	[illegible]	-20.94
1045	30	[illegible]	-20.83
1047	32.068	88.18	-20.71
1049	34.068	88.14	-20.67
1051	36.068	88.10	-20.62
1053	38.068	88.12	-20.65
1055	40.068	88.18	-20.71
1057	42.068	88.17	-20.70
1059	44.068	88.38	-20.91
1101	46.068	87.52	-20.05
1103	48.193	87.79	-20.32
1105	50.193	87.76	-20.29
1107	52.193	87.94	-20.47
1109	54.193	87.61	-20.14
1111	56.193	87.29	-19.82
1113	58.193	87.32	-19.85
1115	60.193	87.51	-20.03
1117	62.193	87.76	-20.29
1119	64.193	87.74	-20.26
1121	66.193	88.34	-20.87
1123	68.193	88.17	-20.70
1125	70.193	88.67	-21.20
1127	72.193	88.64	-21.17
1129	74.193	89.05	-21.58
1131	76.193	89.29	-21.82
1133	78.193	89.15	-21.68
1135	80.193	89.85	-22.38
1137	82.193	89.77	-22.30
1139	84.193	90.08	-22.61
1141	86.193	89.95	-22.48
1143	88.193	90.11	-22.64
1145	90.193	90.17	-22.70
1147	92.193	90.16	-22.68
1149	94.193	90.10	-22.63
1151	96.193	90.08	-22.61
1153	98.193	90.05	-22.58
1215	120.150	91.02	-23.55
1235	140.160	91.08	-23.61
1255	160.160	91.21	-23.74
1315	180.170	91.22	-23.75
1335	200.150	91.15	-23.68
1355	220.150	91.32	-23.85
1415	240.150	91.34	-23.87
1435	260.070	91.11	-23.63
1455	280.070	91.22	-23.75
1515	300.070	91.51	-24.04
1535	320.070	91.54	-24.07
1555	340.070	91.55	-24.08
1615	360.070	91.52	-24.05
1635	380.070	91.64	-24.17
1655	400.070	91.58	-24.11
1715	420.070	91.47	-23.99
1735	440.070	91.44	-23.97
1755	460.030	91.38	-23.91
1815	480.030	91.42	-23.95
1835	500.030	91.42	-23.95
1855	520.030	91.41	-23.94
1915	540.030	91.41	-23.94
1935	560.030	91.39	-23.92
1955	580.030	91.34	-23.87
2015	600.030	91.29	-23.82
2035	620.030	91.31	-23.84
2055	640.		-23.72
2115	660		-23.79
2135	680.		-23.75

2155	70[illegible]	[illegible]71	-23.84
2215	72[illegible]	[illegible]8	-23.91
2235	740.100	91.39	-23.92
2255	760.100	91.48	-24.2[illegible]
2315	780.100	91.47	-23.[illegible]
2335	800.100	91.62	-24.15
2355	820.130	91.48	-24.01
0015	840.130	91.51	-24.04
0035	860.130	91.62	-24.15
0055	880.130	91.65	-24.18
0115	900.130	91.68	-24.21
0135	920.130	91.68	-24.21
0155	940.130	91.64	-24.17
0215	960.130	91.70	-24.23
0235	980.130	91.68	-24.21
0255	1000.100	91.58	-24.11
0355	1060.300	91.45	-23.98
0455	1120.300	91.45	-23.98
0555	1180.300	91.51	-24.04
0655	1240.300	91.62	-24.15
0755	1300.300	91.54	-24.07
0855	1360.300	91.81	-24.34
0955	1420.200	91.70	-24.23
1055	1480.200	91.68	-24.21
1114	1499.900	91.68	-24.21

Average [illegible].29

1.150

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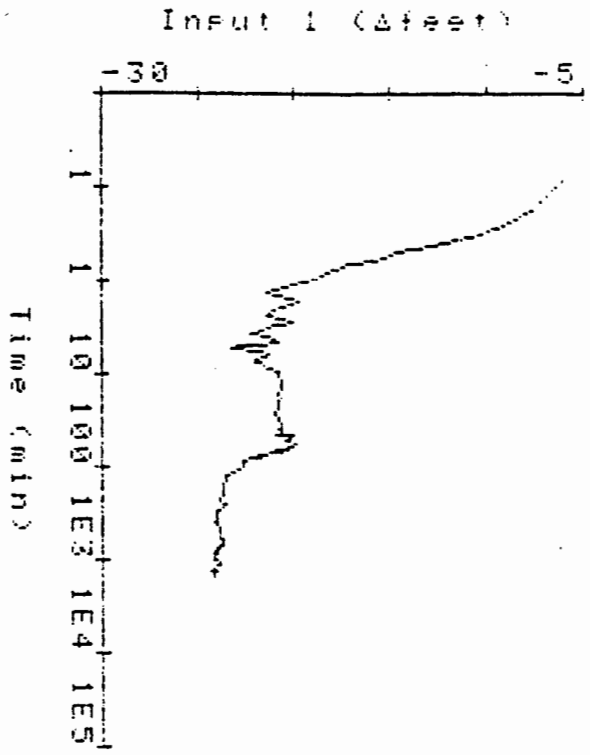

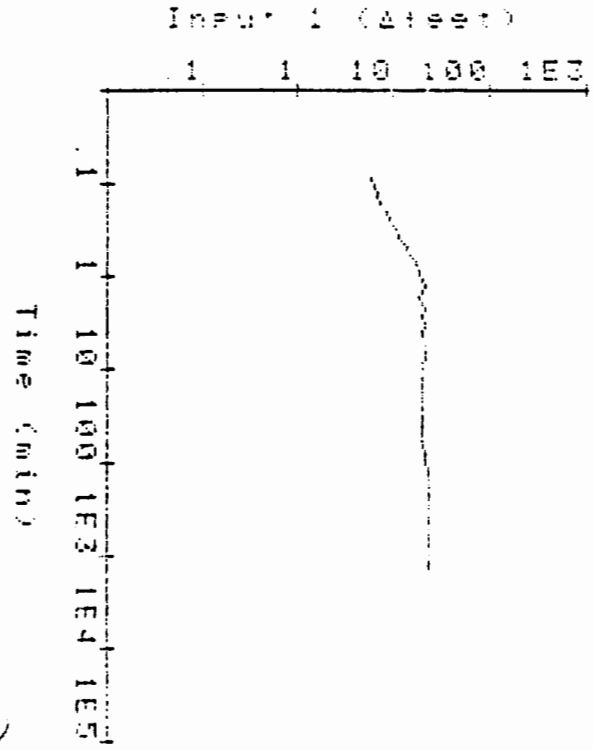

Input 2 (

Time	ET (		Δlevel
1015	0.000	64.52	0.00
1015	0.084	64.54	-0.02
1015	0.167	64.64	-0.12
1015	0.251	64.78	-0.26
1015	0.334	64.94	-0.42
1015	0.417	65.11	-0.59
1015	0.501	65.28	-0.76
1015	0.584	65.47	-0.95
1015	0.667	65.64	-1.12
1015	0.751	65.85	-1.33
1015	0.834	66.04	-1.51
1015	[illegible].917	66.23	-1.70
1016	[illegible].001	66.41	-1.89
1016	1.377	67.05	-2.53
1016	1.710	67.47	-2.95
1017	2.043	67.69	-3.17
1017	2.377	67.93	-3.41
1017	2.710	68.06	-3.54
1018	3.043	68.15	-3.63
1018	3.377	68.28	-3.76
1018	3.710	68.45	-3.93
1019	4.043	68.57	-4.05
1019	4.377	68.60	-4.08
1019	4.710	68.64	-4.11
1020	5.043	68.76	-4.24
1020	5.377	68.88	-4.36
1020	5.710	68.97	-4.45
1021	6.043	68.96	-4.44
1021	6.377	68.94	-4.42
1021	6.710	68.98	-4.46
1022	7.043	69.03	-4.51
1022	7.377	69.07	-4.55
1022	7.710	69.13	-4.61
1023	8.043	69.15	-4.63
1023	8.377	69.16	-4.64
1023	8.710	69.14	-4.62
1024	9.043	69.11	-4.59
1024	9.377	69.13	-4.61
1024	9.710	69.12	-4.60
1025	10.043	69.13	-4.61
1027	12.312	69.17	-4.65
1029	14.078	69.20	-4.67
1031	16.142	69.25	-4.73
1033	18.142	69.31	-4.79
1035	20.472	69.33	-4.81
1037	22.068	69.37	-4.85
1039	24.068	69.38	-4.86
1041	26.068	69.42	-4.89
1043	28.068	69.44	-4.92
1045	30.068	69.45	-4.93
1047	32.068	69.44	-4.92
1049	34.068	69.43	-4.91
1051	36.068	69.44	-4.92
1053	38.068	69.43	-4.91
1055	40.068	69.46	-4.93
1057	42.068	69.45	-4.93
1059	44.068	69.47	-4.95
1101	46.068	69.40	-4.88
1103	48.193	69.37	-4.85
1105	50.193	69.40	-4.88
1107	52.193	69.43	-4.91
1109	54.193	69.38	-4.86
1111	56.193	69.34	-4.82
1113	58	33	-4.81
1115	60	31	-4.79
[illegible]	[illegible]	[illegible]	[illegible]

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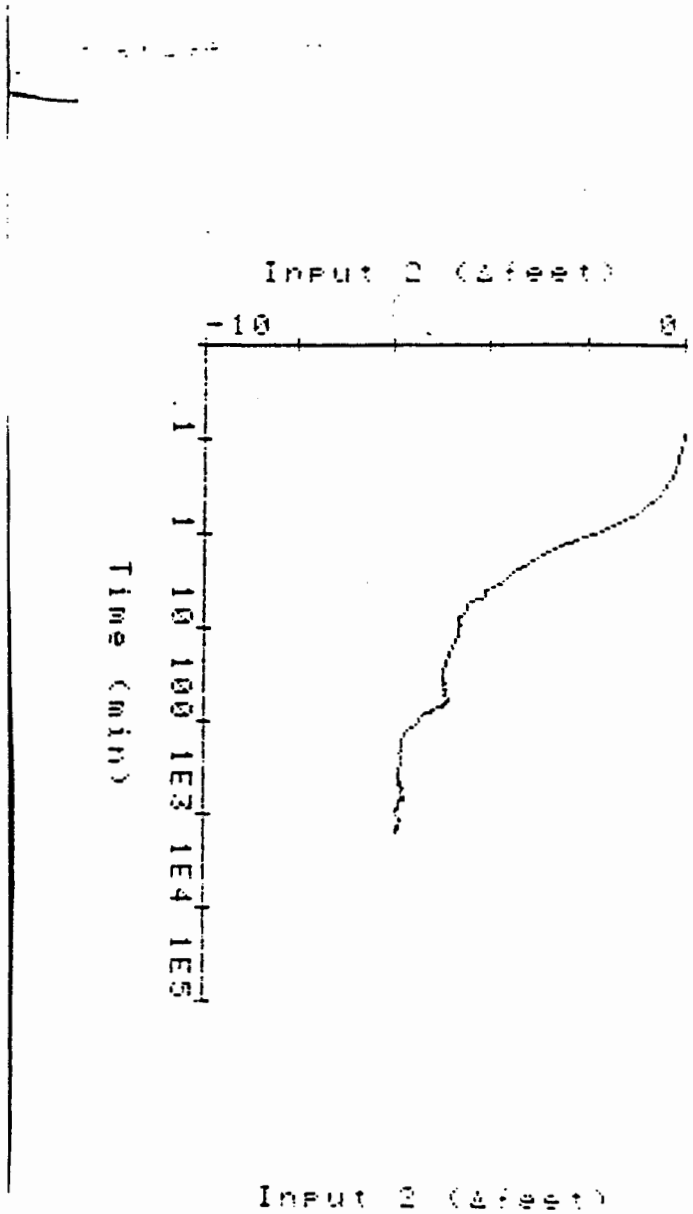
1119	[illegible]	69.40	-4.88
1121	[illegible]	69.46	-4.94
1123	[illegible]	69.48	-4.96
1125	[illegible]	69.56	-5.04
1127	72.193	69.58	-5.06
1129	74.193	69.61	-5.09
1131	76.193	69.71	-5.19
1133	78.193	69.73	-5.21
1135	80.193	69.79	-5.27
1137	82.193	69.85	-5.33
1139	84.193	69.87	-5.35
1141	86.193	69.90	-5.38
1143	88.193	69.92	-5.40
1145	90.193	69.95	-5.43
1147	92.193	69.97	-5.45
1149	94.193	69.96	-5.43
1151	96.193	69.96	-5.44
1153	98.193	69.95	-5.43
1215	120.150	70.21	-5.69
1235	140.160	70.28	-5.76
1255	160.160	70.32	-5.80
1315	180.170	70.33	-5.81
1335	200.150	70.33	-5.81
1355	220.150	70.38	-5.86
1415	240.150	70.35	-5.82
1435	260.070	70.33	-5.81
1455	280.070	70.36	-5.84
1515	300.070	70.36	-5.84
1535	320.070	70.39	-5.87
1555	340.070	70.39	-5.87
1615	360.070	70.40	-5.88
1635	380.070	70.41	-5.89
1655	400.070	70.39	-5.87
1715	420.070	70.38	-5.86
1735	440.070	70.37	-5.85
1755	460.030	70.34	-5.82
1815	480.030	70.39	-5.87
1835	500.030	70.35	-5.82
1855	520.030	70.31	-5.79
1915	540.030	70.29	-5.77
1935	560.030	70.34	-5.82
1955	580.030	70.36	-5.84
2015	600.030	70.34	-5.82
2035	620.030	70.35	-5.83
2055	640.170	70.28	-5.76
2115	660.050	70.34	-5.82
2135	680.050	70.30	-5.78
2155	700.050	70.36	-5.84
2215	720.050	70.37	-5.85
2235	740.100	70.39	-5.87
2255	760.100	70.38	-5.86
2315	780.100	70.37	-5.85
2335	800.100	70.38	-5.86
2355	820.130	70.42	-5.90
0015	840.130	70.39	-5.87
0035	860.130	70.42	-5.89
0055	880.130	70.43	-5.91
0115	900.130	70.45	-5.93
0135	920.130	70.44	-5.92
0155	940.130	70.44	-5.92
0215	960.130	70.44	-5.92
0235	980.130	70.45	-5.93
0255	1000.100	70.43	-5.91
0355	1060.300	70.41	-5.89
0455	1120.300	70.36	-5.84
0555	1180.300	70.42	-5.89
0655	1240.300	70.42	-5.90
0755	1300.300	70.41	-5.89
0855	1360.300	70.47	-5.95
0955	1420	42	-5.90
1055	1480	44	-5.92



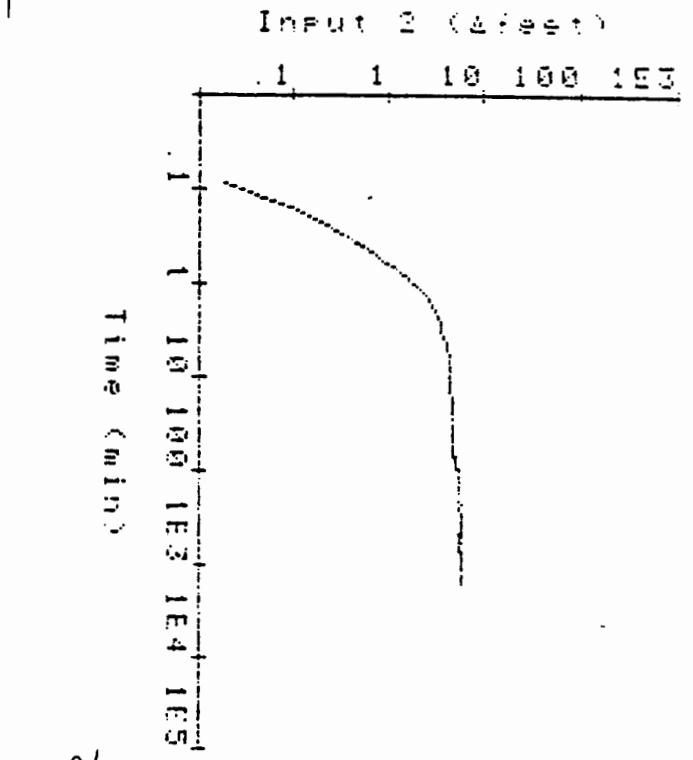


Fig-12

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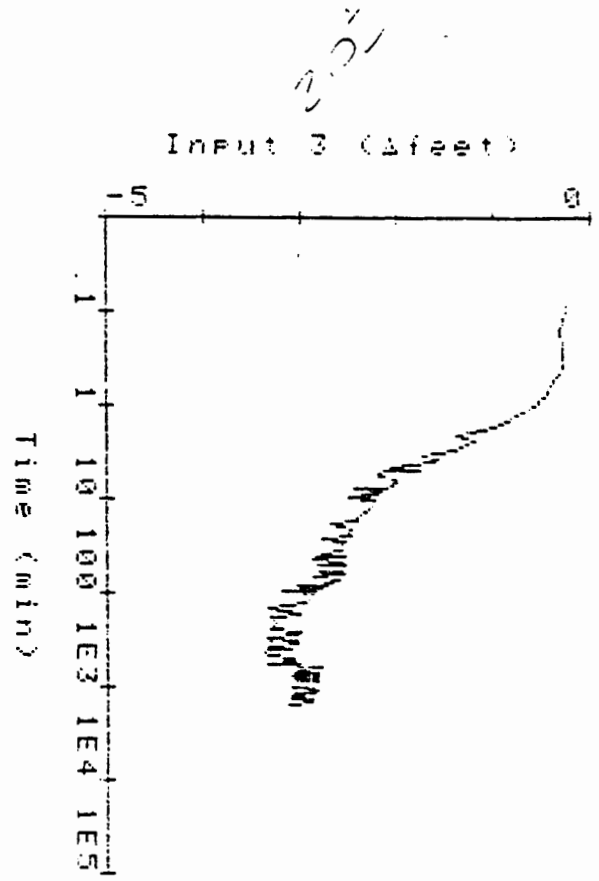

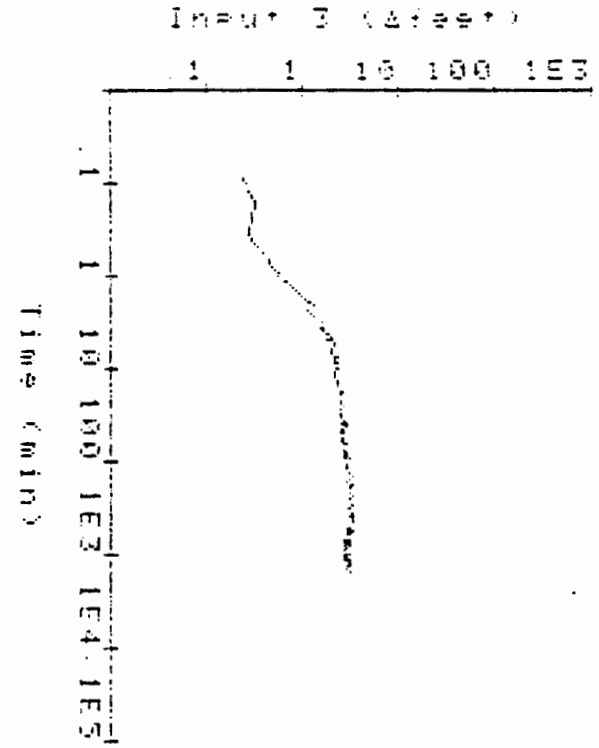

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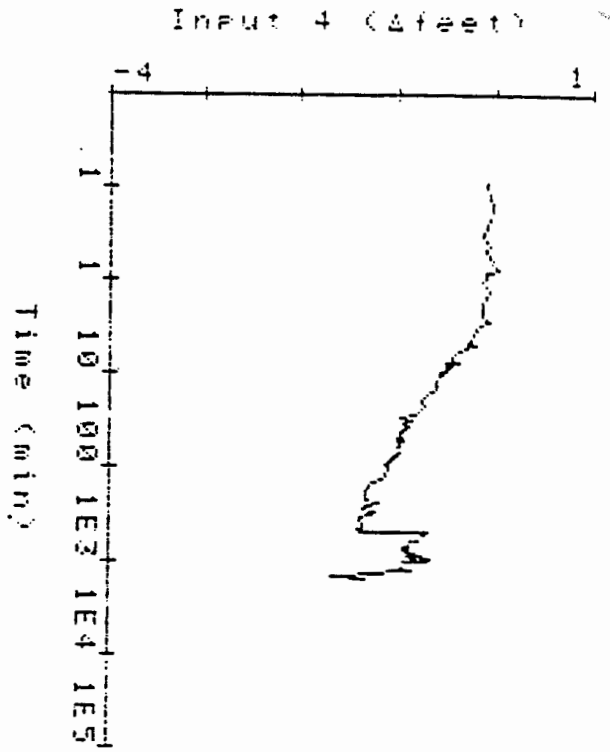
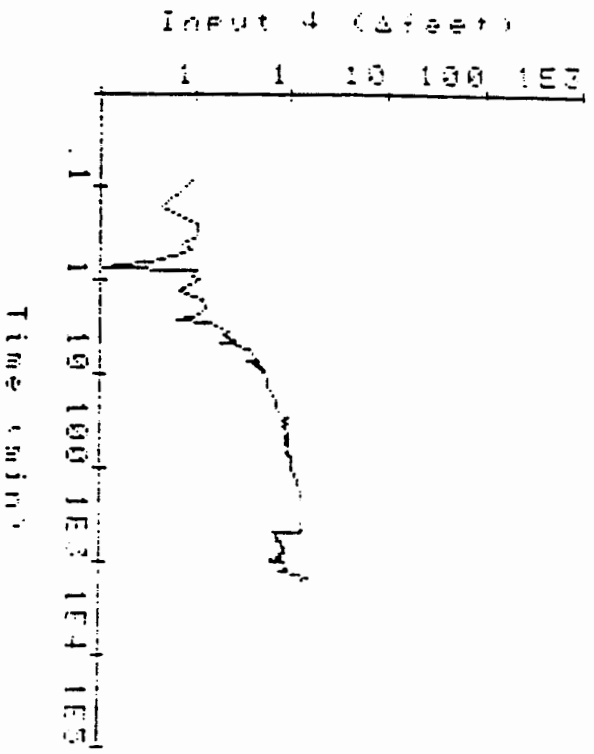
INPUT 4 :

Time	ET		Δlevel
1015	0.000	65.47	0.00
1015	0.084	65.57	-0.10
1015	0.167	65.52	-0.05
1015	0.251	65.58	-0.11
1015	0.334	65.58	-0.11
1015	0.417	65.55	-0.08
1015	0.501	65.56	-0.09
1015	0.584	65.52	-0.05
1015	0.667	65.50	-0.03
1015	0.751	65.45	0.02
1015	0.834	65.58	-0.10
1015	0.917	65.56	-0.09
1016	1.001	65.59	-0.12
1016	1.377	65.54	-0.07
1016	1.710	65.60	-0.13
1017	2.043	65.61	-0.14
1017	2.377	65.59	-0.12
1017	2.710	65.54	-0.07
1018	3.043	65.63	-0.15
1018	3.377	65.66	-0.19
1018	3.710	65.70	-0.23
1019	4.043	65.68	-0.21
1019	4.377	65.75	-0.28
1019	4.710	65.67	-0.20
1020	5.043	65.75	-0.28
1020	5.377	65.74	-0.27
1020	5.710	65.86	-0.39
1021	6.043	65.89	-0.41
1021	6.377	65.89	-0.42
1021	6.710	65.90	-0.43
1022	7.043	65.92	-0.45
1022	7.377	65.96	-0.49
1022	7.710	65.84	-0.36
1023	8.043	65.97	-0.50
1023	8.377	65.98	-0.51
1023	8.710	65.93	-0.45
1024	9.043	65.99	-0.52
1024	9.377	66.02	-0.55
1024	9.710	65.99	-0.52
1025	10.043	66.03	-0.56
1027	12.312	66.07	-0.59
1029	14.078	66.08	-0.61
1031	16.142	66.15	-0.68
1033	18.142	66.19	-0.71
1035	20.472	66.22	-0.75
1037	22.068	66.21	-0.73
1039	24.068	66.23	-0.76
1041	26.068	66.27	-0.80
1043	28.068	66.33	-0.86
1045	30.068	66.44	-0.97
1047	32.068	66.32	-0.85
1049	34.068	66.45	-0.98
1051	36.068	66.35	-0.88
1053	38.068	66.40	-0.93
1055	40.068	66.39	-0.92
1057	42.068	66.45	-0.98
1059	44.068	66.44	-0.97
1101	46.068	66.43	-0.96
1103	48.193	66.46	-0.99
1105	50.193	66.42	-0.95
1107	52.193	66.42	-0.94
1109	54.193	66.46	-0.99
1111	56.193	66.43	-0.96
1113	58.193	66.46	-0.99
1115	60.193	66.44	-0.97
1117	62.197	66.46	-0.99
1119	64.1	67.49	-1.02

1123			-1.01
1125			-0.99
1127	72.193	[illegible]	-0.96
1129	74.193	66.51	-1.04
1131	76.193	66.49	-1.02
1133	78.193	66.53	-1.06
1135	80.193	66.53	-1.06
1137	82.193	66.51	-1.04
1139	84.193	66.57	-1.10
1141	86.193	66.57	-1.10
1143	88.193	66.57	-1.10
1145	90.193	66.58	-1.10
1147	92.193	66.57	-1.10
1149	94.193	66.58	-1.11
1151	96.193	66.56	-1.09
1153	98.193	66.58	-1.10
1215	120.150	66.60	-1.13
1235	140.160	66.74	-1.26
1255	160.160	66.76	-1.28
1315	180.170	66.78	-1.31
1335	200.150	66.77	-1.30
1355	220.150	66.79	-1.32
1415	240.150	66.67	-1.20
1435	260.070	66.78	-1.30
1455	280.070	66.81	-1.33
1515	300.070	66.68	-1.21
1535	320.070	66.77	-1.30
1555	340.070	66.84	-1.37
1615	360.070	66.85	-1.38
1635	380.070	66.82	-1.35
1655	400.070	66.83	-1.35
1715	420.070	66.83	-1.36
1735	440.070	66.82	-1.35
1755	460.030	66.88	-1.41
1815	480.030	66.83	-1.36
1835	500.030	66.16	-0.68
1855	520.030	66.23	-0.76
1915	540.030	66.21	-0.74
1935	560.030	66.25	-0.77
1955	580.030	66.26	-0.79
2015	600.030	66.24	-0.77
2035	620.030	66.33	-0.86
2055	640.170	66.36	-0.89
2115	660.050	66.35	-0.88
2135	680.050	66.38	-0.91
2155	700.050	66.40	-0.93
2215	720.050	66.36	-0.89
2235	740.100	66.40	-0.93
2255	760.100	66.33	-0.86
2315	780.100	66.32	-0.85
2335	800.100	66.28	-0.81
2355	820.130	66.37	-0.90
0015	840.130	66.36	-0.89
0035	860.130	66.31	-0.84
0055	880.130	66.28	-0.81
0115	900.130	66.13	-0.66
0135	920.130	66.25	-0.78
0155	940.130	66.35	-0.88
0215	960.130	66.26	-0.79
0235	980.130	66.14	-0.67
0255	1000.100	66.41	-0.94
0355	1060.300	66.42	-0.94
0455	1120.300	66.45	-0.98
0555	1180.300	66.44	-0.97
0655	1240.300	66.30	-0.83
0755	1300.300	66.85	-1.37
0855	1360.300	66.83	-1.36
0955	1420.200	66.92	-1.45
1055	1480.200	67.14	-1.67
1114	1499.900	66.78	-1.31

Average level 35





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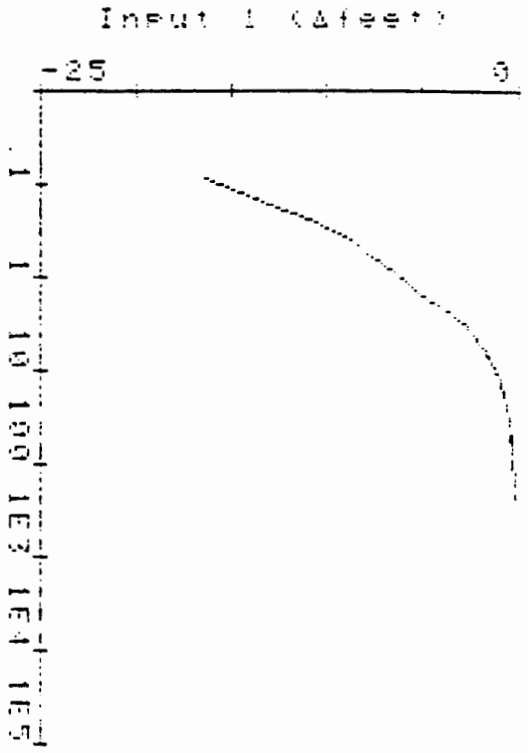
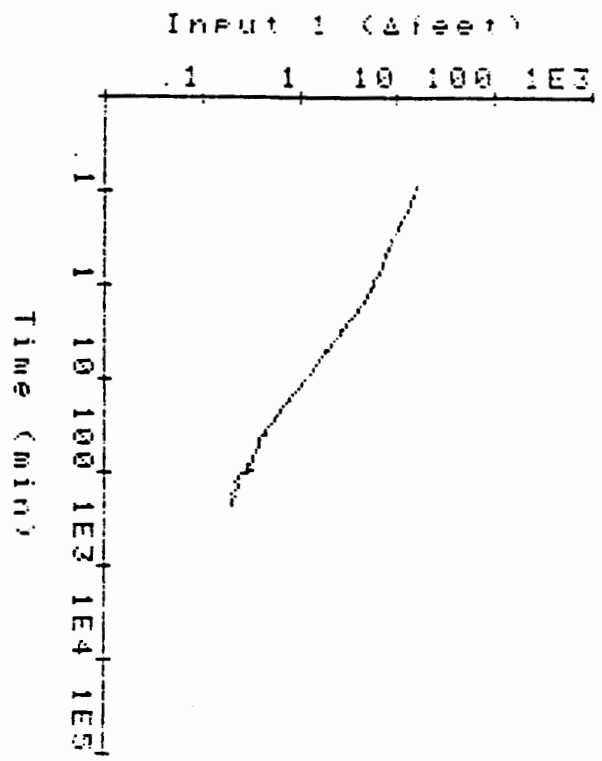
--------RECOVERY REPORT---------

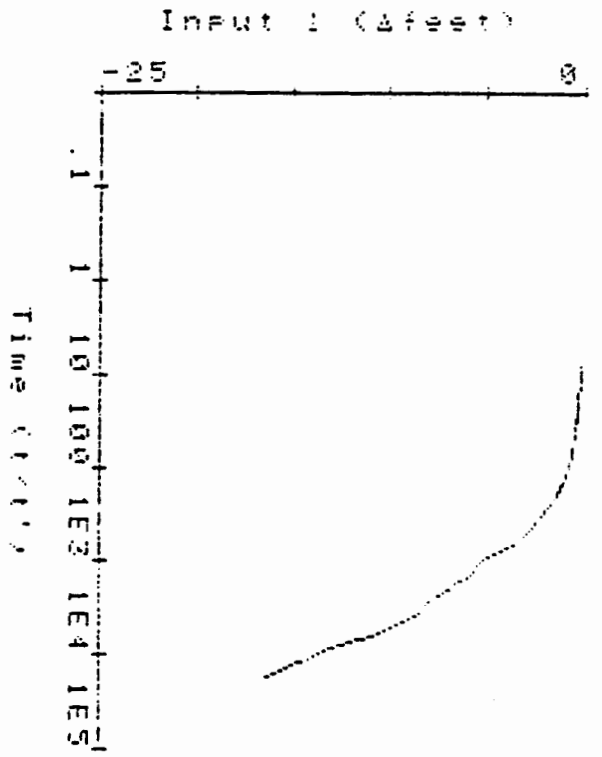
Started at 1114
Lasted 216 07 min

Input 1 (feet)

Time	ET (min)	level	Δlevel
1115	0.084	83.93	-16.46
1115	0.167	80.40	-13.93
1115	0.251	77.94	-10.47
1115	0.334	76.62	-9.15
1115	0.417	75.98	-8.51
1115	0.501	75.55	-8.08
1115	0.584	75.12	-7.65
1115	0.667	74.73	-7.26
1115	0.751	74.37	-6.90
1115	0.834	74.02	-6.55
1115	0.917	73.71	-6.24
1115	1.001	73.42	-5.95
1116	1.376	72.73	-5.26
1116	1.710	72.08	-4.61
1116	2.043	71.42	-3.95
1117	2.376	70.94	-3.47
1117	2.710	70.57	-3.10
1117	3.043	70.29	-2.82
[illegible]	3.376	70.18	-2.71
[illegible]	3.710	69.98	-2.51
[illegible]	4.043	69.79	-2.32
1119	4.376	69.65	-2.17
1119	4.710	69.53	-2.06
1119	5.043	69.43	-1.96
1120	5.377	69.33	-1.86
1120	5.710	69.26	-1.79
1120	6.043	69.19	-1.71
1121	6.377	69.11	-1.64
1121	6.710	69.07	-1.60
1121	7.043	69.00	-1.53
1122	7.377	68.95	-1.48
1122	7.710	68.91	-1.44
1122	8.043	68.85	-1.38
1123	8.377	68.81	-1.34
1123	8.710	68.77	-1.30
1123	9.043	68.74	-1.27
1124	9.376	68.70	-1.22
1124	9.710	68.67	-1.20
1124	10.043	68.64	-1.17
1127	12.141	68.48	-1.01
1129	14.141	68.36	-0.89
1131	16.141	68.29	-0.82
1133	18.142	68.22	-0.75
1135	20.142	68.13	-0.66
1137	22.142	68.12	-0.65
1139	24.142	68.09	-0.62
[illegible]	26.142	68.05	-0.58
[illegible]	28.142	68.03	-0.56
[illegible]	30.142	68.00	-0.53
1147	32.142	67.98	-0.50
1149	34.142	67.93	-0.46
1151	[illegible]		-0.46
1153	[illegible]		-0.45
1155	[illegible]		-0.43
1157	[illegible]		-0.43
1159	44	87	-0.40
1201	46	86	-0.39
1203	48	86	-0.39
1205	50.142	67.87	-0.40
1207	52.142	67.87	-0.40
1209	54.142	67.86	-0.39
1211	56.142	67.85	-0.37
1213	58.142	67.85	-0.37
1215	60.142	67.85	-0.37
1217	62.142	67.83	-0.36
1219	64.142	67.82	-0.35
1221	66.142	67.82	-0.35
1223	68.142	67.80	-0.33
1225	70.142	67.80	-0.33
1227	72.142	67.82	-0.35
1229	74.142	67.80	-0.33
1231	76.097	67.80	-0.33
1233	78.142	67.79	-0.32
1235	80.142	67.79	-0.32
1237	82.142	67.77	-0.30
1239	84.142	67.76	-0.29
1241	86.142	67.76	-0.29
1243	88.142	67.77	-0.30
1245	90.142	67.80	-0.33
1247	92.142	67.80	-0.33
1249	94.142	67.80	-0.33
1251	96.142	67.77	-0.30
1253	98.142	67.76	-0.29
1255	100.140	67.73	-0.26
1315	120.310	67.69	-0.22
1335	140.310	67.70	-0.23
1355	160.310	67.67	-0.20
1415	180.320	67.69	-0.22
1435	200.320	67.67	-0.20
1451	216.070	67.67	-0.20







Input 2 (feet):

Time	ET (min)	level	Δlev
1115	0.084	70.48	-5.96
1115	0.167	70.35	-5.82
1115	0.251	70.20	-5.68
1115	0.334	70.02	-5.50
1115	0.417	69.82	-5.30
1115	0.501	69.63	-5.11
1115	0.584	69.49	-4.97
1115	0.667	69.35	-4.83
1115	0.751	69.19	-4.67
1115	0.834	69.04	-4.52
1115	0.917	68.90	-4.38
1115	1.001	68.75	-4.22
1116	1.376	68.23	-3.70
1116	1.710	67.85	-3.33
1116	2.043	67.57	-3.05
1117	2.376	67.31	-2.79
1117	2.710	67.11	-2.59
1117	3.043	66.93	-2.41
1118	3.376	66.77	-2.25
1118	3.710	66.64	-2.11
1118	4.043	66.53	-2.01
1119	4.376	66.41	-1.89
1119	4.710	66.34	-1.81
1119	5.043	66.23	-1.71
1120	5.377	66.18	-1.66
1120	5.710	66.08	-1.[illegible]
1120	6.043	66.04	-1.[illegible]
1121	6.377	65.96	-1.[illegible]
1121	6.710	65.91	-1.38
1121	7.043	65.87	-1.35
1122	7.377	65.83	-1.31
1122	7.710	65.75	-1.27
1122	8.043	65.73	-1.29
1123	8.377	65.69	-1.17
1123	8.710	65.65	-1.13
1123	9.043	65.60	-1.07
1124	9.376	65.59	-1.07
1124	9.710	65.56	-1.03
1124	10.043	65.54	-1.01
1127	12.141	65.38	-0.86
1129	14.141	65.28	-0.76
1131	16.141	65.18	-0.66
1133	18.142	65.11	-0.59
1135	20.142	65.04	-0.51
1137	22.142	65.02	-0.50
1139	24.142	64.99	-0.47
1141	26.142	64.95	-0.43
1143	28.142	64.93	-0.41
1145	30.142	64.91	-0.39
1147	32.142	64.89	-0.37
1149	34.142	64.86	-0.34
1151	36.142	64.85	-0.33
1153	38.142	64.83	-0.31
1155	40.142	64.83	-0.[illegible]
1157	42.142	64.80	-0.[illegible]
1159	44.142	64.80	-0.[illegible]
1201	46.142	64.78	-0.2[illegible]
1203	48.142	64.78	-0.26
1205	50.142	64.79	-0.27
1207	[illegible]	[illegible].78	-0.26
1209	[illegible]	76	-0.24
1211	5[illegible]	77	-0.[illegible]

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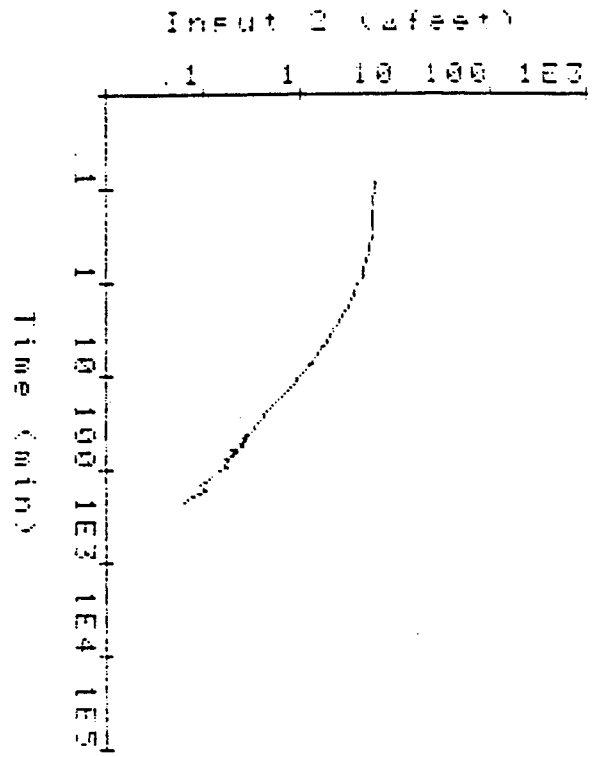
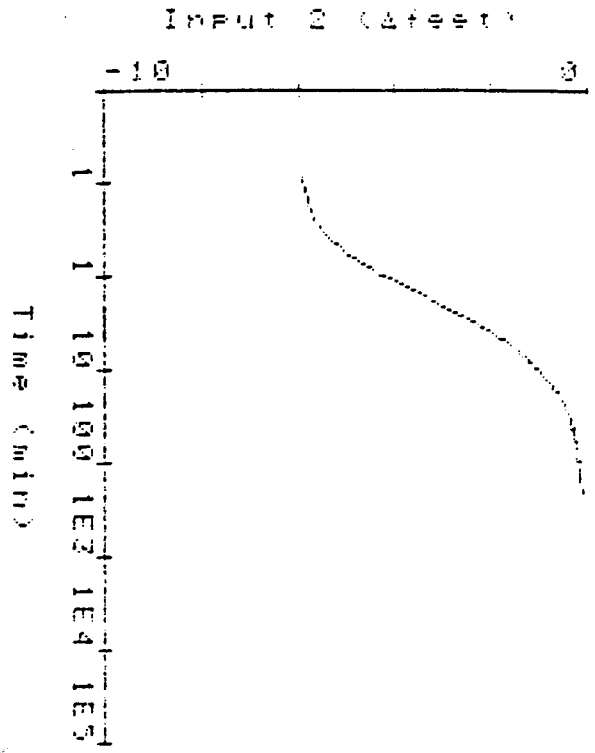
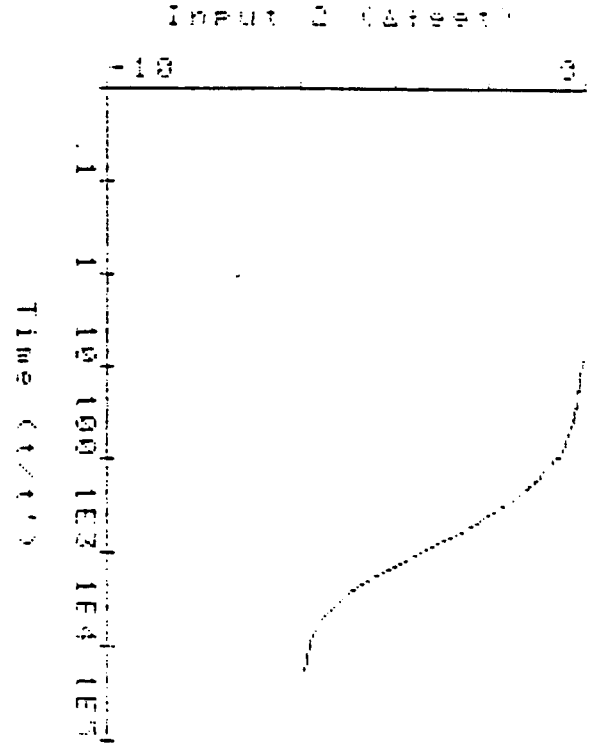
1215	[illegible]	[illegible] 75	-0.23
[illegible]7	[illegible]	[illegible] 71	-0.19
9	64.142	[illegible].4	-0.22
21	66.142	64.74	-0.21
1223	68.142	64.72	-0.20
1225	70.142	64.73	-0.21
1227	72.142	64.71	-0.18
1229	74.142	64.70	-0.18
1231	76.097	64.69	-0.17
1233	78.142	64.70	-0.18
1235	80.142	64.69	-0.17
1237	82.142	64.69	-0.17
1239	84.142	64.69	-0.16
1241	86.142	64.69	-0.17
1243	88.142	64.69	-0.16
1245	90.142	64.69	-0.17
1247	92.142	64.68	-0.16
1249	94.142	64.69	-0.17
1251	96.142	64.68	-0.16
1253	98.142	64.68	-0.16
1255	100.140	64.66	-0.14
1315	120.310	64.64	-0.12
1335	140.310	64.62	-0.10
1355	160.310	64.63	-0.10
1415	180.320	64.60	-0.08
1435	200.320	64.59	-0.07
1451	216.070	64.59	-0.07

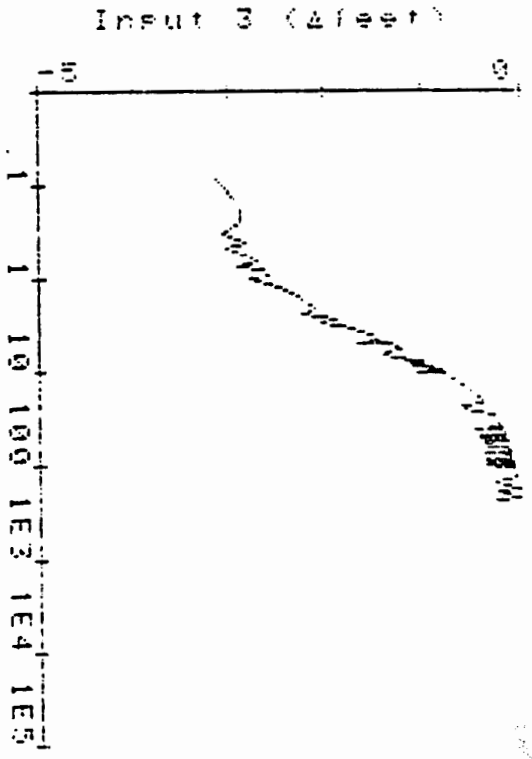






Input 3 (feet):

Time	ET (min)	level	Δlevel
1115	0.084	68.31	-3.13
1115	0.167	68.06	-2.88
1115	0.251	68.06	-2.88
1115	0.334	68.25	-3.07
1115	0.417	68.00	-2.82
1115	0.501	68.21	-3.03
1115	0.584	67.94	-2.76
1115	0.667	67.88	-2.70
1115	0.751	68.08	-2.90
1115	0.834	67.80	-2.61
1115	0.917	67.75	-2.57
1115	1.001	67.96	-2.78
1116	1.376	67.54	-2.36
1116	1.710	67.40	-2.21
1116	2.043	67.28	-2.10
1117	2.376	67.41	-2.23
1117	2.710	67.05	-1.86
1117	3.043	67.20	-2.02
1118	3.376	66.85	-1.67
1118	3.710	66.81	-1.63
1118	4.043	66.69	-1.51
1119	4.376	66.62	-1.44
1119	4.710	66.82	-1.64
1119	5.043	66.50	-1.32
1120	5.377	66.44	-1.26
1120	5.710	66.39	-1.21
1120	6.043	66.60	-1.42
1121	6.377	66.58	-1.40
1121	6.710	66.52	-1.34
1121	7.043	66.48	-1.30
1122	7.377	66.18	-1.00
1122	7.710	66.37	-1.19
1122	8.043	66.25	-1.07
1123	8.377	66.08	-0.90
1123	8.710	66.30	-1.12
1123	9.043	66.02	-0.83
1124	9.376	65.99	-0.81
1124	9.710	66.23	-1.05
1124	10.043	65.95	-0.77
1127	12.141	65.84	-0.66
1129	14.141	65.74	-0.56
1131	16.141	65.67	-0.49
1133	18.142	65.62	-0.43
1135	20.142	65.60	-0.42
1137	22.142	65.82	-0.64
1139	24.142	65.77	-0.59
1141	26.142	65.67	-0.49
1143	28.142	65.47	-0.29
1145	30.142	65.45	-0.27
1147	32.142	65.44	-0.26
1149	34.142	65.42	-0.24
1151	36.142	65.41	-0.23
1153	38.142	65.67	-0.49
1155	40.142	65.39	-0.21
1157	42.142	65.38	-0.20
1159	44.142	65.62	-0.44
1201	46.142	65.37	-0.19
1203	48.142	65.36	-0.18
1205	50.[illegible]	[illegible].62	-0.44
1207	52.[illegible]	[illegible].59	-0.41
1209	54.[illegible]	[illegible].34	-0.16
1211	56.[illegible]	[illegible].79	-0.41
1213	58.[illegible]	[illegible].76	-0.38
1215	60.142	[illegible].73	-0.1[illegible]
1217	62.142	65.56	-0.[illegible]
1219	64.142	65.32	-0.[illegible]
1221	66.142	65.31	-0.[illegible]
1223	68.142	65.30	-0.12
1225	70.142	65.31	-0.13
1227	72.142	65.57	-0.39
1229	74.142	65.30	-0.12
1231	76.097	65.29	-0.11
1233	78.142	65.53	-0.34
1235	80.142	65.29	-0.11
1237	82.142	65.57	-0.39
1239	84.142	65.28	-0.10
1241	86.142	65.28	-0.10
1243	88.142	65.55	-0.37
1245	90.142	65.56	-0.38
1247	92.142	65.56	-0.38
1249	94.142	65.28	-0.10
1251	96.142	65.29	-0.11
1253	98.142	65.50	-0.32
1255	100.140	65.26	-0.08
1315	120.310	65.24	-0.06
1335	140.310	65.46	-0.28
1355	160.310	65.22	-0.04
1415	180.320	65.47	-0.29
1435	200.320	65.21	-0.03
1451	216.070	65.47	-0.29



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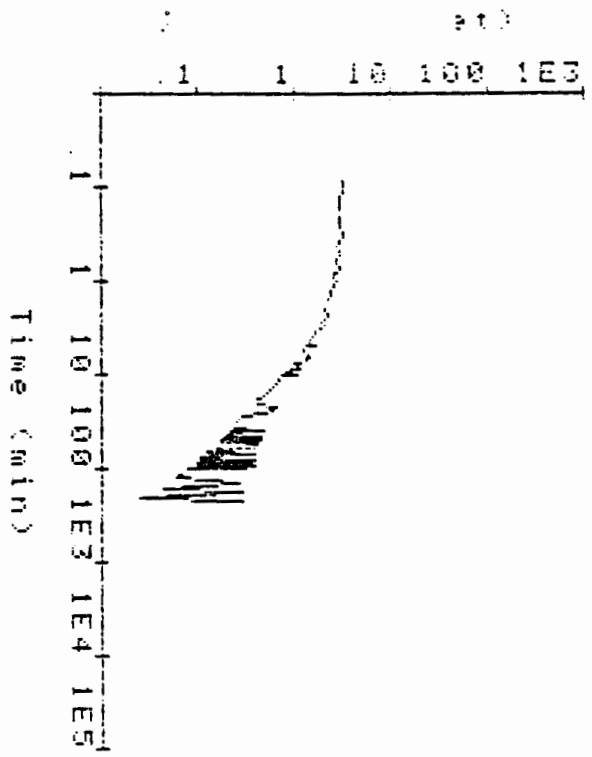
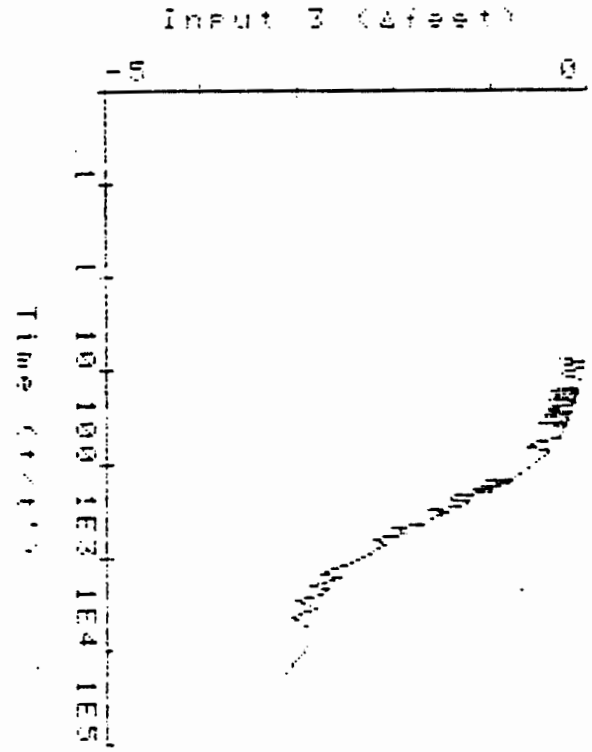
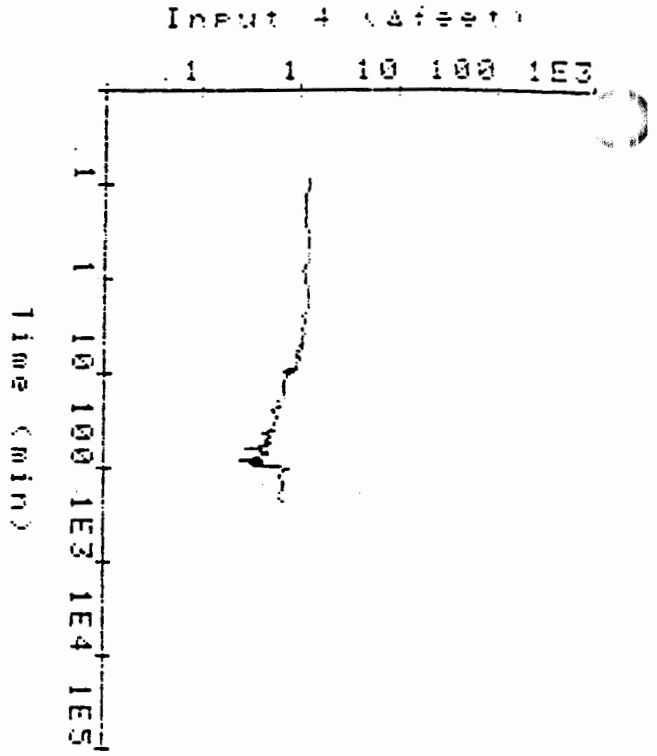


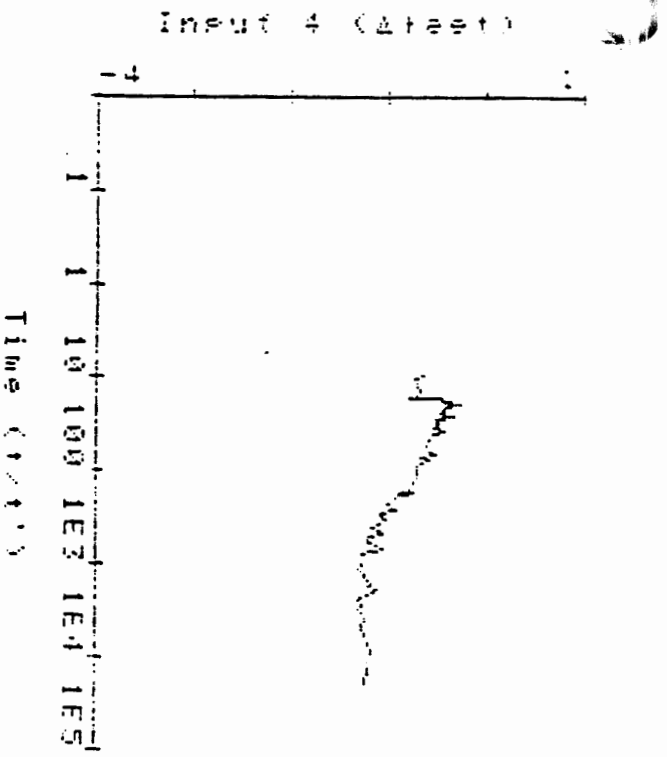


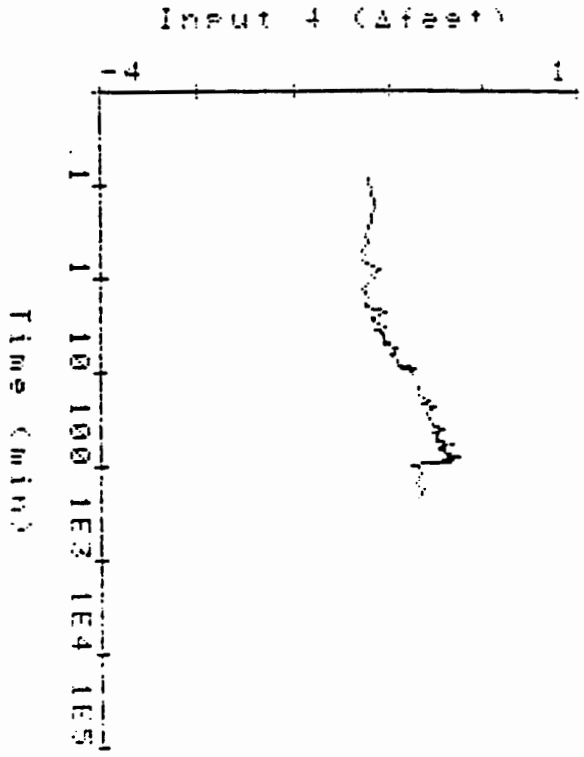
Input 4 (feet):

Time	ET (min)	level	Δlevel
1115	0.084	66.69	-1.22
1115	0.167	66.51	-1.14
1115	0.251	66.65	-1.18
1115	0.334	66.73	-1.26
1115	0.417	66.69	-1.22
1115	0.501	66.74	-1.27
1115	0.584	66.71	-1.23
1115	0.667	66.76	-1.28
1115	0.751	66.66	-1.19
1115	0.834	66.57	-1.10
1115	0.917	66.65	-1.18
1115	1.001	66.62	-1.15
1116	1.376	66.75	-1.28
1116	1.710	66.68	-1.21
1116	2.043	66.72	-1.25
1117	2.376	66.51	-1.04
1117	2.710	66.65	-1.18
1117	3.043	66.67	-1.20
1118	3.376	66.52	-1.05
1118	3.710	66.63	-1.16
1118	4.043	66.52	-1.05
1119	4.376	66.53	-1.06
1119	4.710	66.48	-1.01
1119	5.043	66.54	-1.07
1120	5.377	66.53	-1.06
1120	5.710	66.38	-0.91
1120	6.043	66.40	-0.93
1121	6.377	66.40	-0.93
1121	6.710	66.46	-0.98
1121	7.043	66.44	-0.97
1122	7.377	66.41	-0.94
1122	7.710	66.38	-0.91
1122	8.043	66.39	-0.91
1123	8.377	66.38	-0.91
1123	8.710	66.24	-0.77
1123	9.043	66.36	-0.89
1124	9.376	66.18	-0.71
1124	9.710	66.25	-0.78
1124	10.043	66.22	-0.75
1127	12.141	66.18	-0.71
1129	14.141	66.15	-0.68
1131	16.141	66.17	-0.70
1133	18.142	66.16	-0.69
1135	20.142	66.02	-0.55
1137	22.142	66.12	-0.65
1139	24.142	65.99	-0.52
1141	26.142	66.04	-0.56
1143	28.142	66.07	-0.60
1145	30.142	66.06	-0.59
1147	32.142	66.03	-0.56
1149	34.142	66.03	-0.56
1151	36.142	66.00	-0.53
1153	38.142	65.96	-0.48
1155	40.142	66.02	-0.54
1157	42.142	65.89	-0.41
1159	44.142	65.99	-0.52
1201	46.142	66.00	-0.52
1203	48.142	65.94	-0.47
1205	50.142	65.99	-0.50
1207	52.142	65.98	-0.51
1209	54.142	65.95	-0.48
1211	56.1[illegible]	5.86	-0.39
1213	58.1[illegible]	5.96	-0.49
1215	60.1[illegible]	5.97	-0.49

1217	62.[illegible]	[illegible]7	-0.30
1219	64.[illegible]	[illegible]5	-0.48
1221	66.142	[illegible]2	-0.45
1223	68.142	65.95	-0.48
1225	70.142	65.91	-0.44
1227	72.142	65.88	-0.40
1229	74.142	65.86	-0.39
1231	76.097	65.80	-0.33
1233	78.142	65.86	-0.39
1235	80.142	65.88	-0.41
1237	82.142	65.72	-0.25
1239	84.142	65.83	-0.36
1241	86.142	65.81	-0.34
1243	88.142	65.89	-0.42
1245	90.142	65.86	-0.39
1247	92.142	65.80	-0.33
1249	94.142	65.96	-0.49
1251	96.142	66.04	-0.57
1253	98.142	66.26	-0.79
1255	100.140	66.16	-0.69
1315	120.310	66.12	-0.65
1335	140.310	66.17	-0.70
1355	160.310	66.19	-0.72
1415	180.320	66.11	-0.63
1435	200.320	66.13	-0.66
1451	216.070	66.17	-0.70







SE200B manufactured by
In-Situ, Inc.
Laram[illegible] [illegible]

OGC-002862

SPARTON SOUTHWEST PUMPTEST
Run 4
10/08/84

SE200B DATA
constant rate test

---[illegible] LAWSON ASSOCIATES
[illegible]TON TEXAS
[illegible]E # 6310 013.12
[illegible] ANT-RATE PUMPING TEST OF
PL[illegible] AT SPARTON TECH[illegible]
A[illegible]UERQUE NEW MEXICO
TES[illegible] WILL RUN 120 MINUTES [illegible]
ORDER TO ACQUIRE EARLY TIME-
DRAWDOWN DATA IN THE SURROUNDING
WELLS.

TRANSDUCER TABLE

Input 1: PW-1
Transducer s/n: 135
Scale factor: 49.95
Initial level: 65.57 feet

Input 2: MW-12
Transducer s/n: 871/846
Scale factor: 10.02
Initial level: 64.68 feet

Input 3: MW-13
Transducer s/n: 477/830
Scale factor: 10.12
Initial level: 64.69 feet

Input 4: MW-14
Transducer s/n: 034
Scale factor: 10.1
Initial level: 65.65 feet

PUMP SCHEDULE

Drawdown for 180 min
Pump at 180 GPM
Pump set at 126 feet

Recovery for 180 min

SAMPLING SCHEDULE

0-1	min	@	5	sec
1-[illegible]9	min	@	20	sec
[illegible]-100	min	@	2	min
[illegible]-1000	min	@	20	min
1000-10000	min	@	60	min
10000-99999	min	@	200	min

_____DRAWDOWN REPORT _____

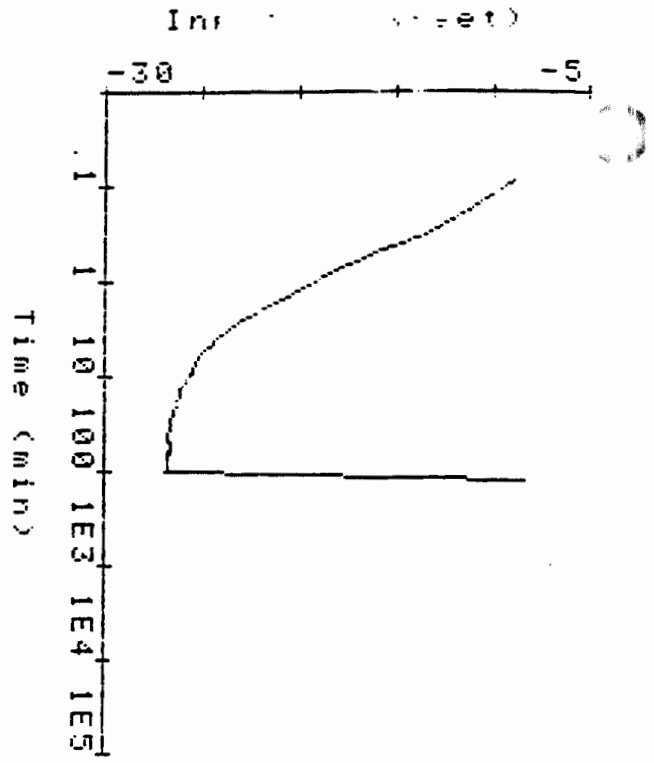
Started at 1515
Lasted 120.02 min

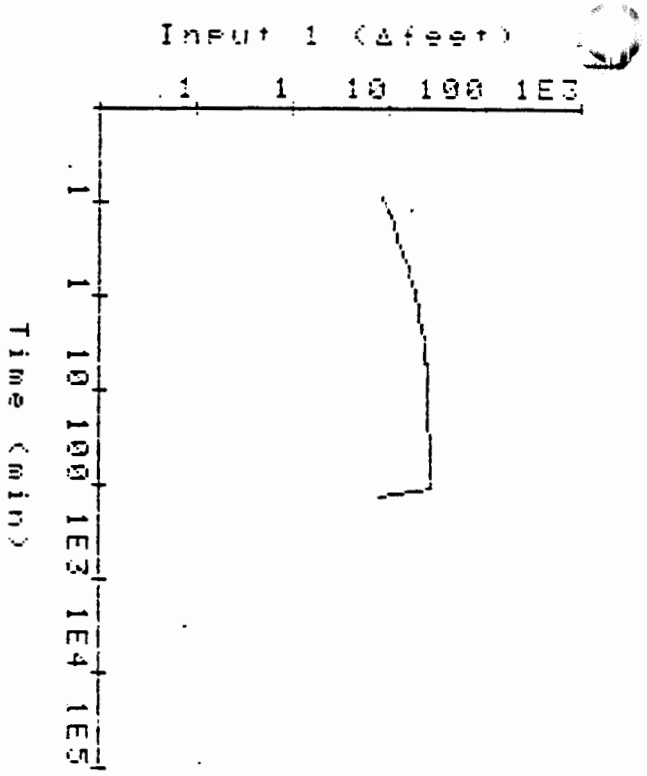
Input 1 (feet):

Time	ET (min)	level	Δlevel
1515	0.000	65.57	0.00
1515	0.084	74.50	-8.93
1515	0.167	76.73	-11.16
1515	0.251	78.29	-12.72
1515	0.334	79.53	-13.96
1515	0.417	80.68	-15.11
1515	0.501	81.64	-16.07
1515	0.584	82.42	-16.85
1515	0.667	83.11	-17.54
1515	0.751	83.65	-18.08
1515	0.834	84.05	-18.48
1515	0.917	84.45	-18.88
1516	1.001	84.75	-19.18
1516	1.377	85.86	-20.29
1516	1.710	86.83	-21.26
1517	2.043	87.59	-22.02
1517	2.377	88.24	-22.67
1517	2.710	88.67	-23.10
1518	3.043	89.00	-23.43
1518	3.377	89.33	-23.76
1518	3.710	89.59	-24.02
1519	4.043	89.74	-24.17
1519	4.377	89.97	-24.40
1519	4.710	90.16	-24.59
1520	5.043	90.33	-24.76
1520	5.377	90.44	-24.87
1520	5.710	90.57	-25.00
1521	6.043	90.66	-25.09
1521	6.377	90.69	-25.12
1521	6.710	90.78	-25.21
1522	7.043	90.82	-25.25
1522	7.377	90.90	-25.33
1522	7.710	90.89	-25.32
1523	8.043	90.98	-25.41
1523	8.377	91.00	-25.43
1523	8.710	91.05	-25.48
1524	9.043	91.11	-25.54
1524	9.377	91.15	-25.58
1524	9.710	91.18	-25.61
1525	10.043	91.22	-25.65
1527	12.127	91.44	-25.87
1529	14.127	91.62	-26.05
1531	16.075	91.74	-26.17
1533	18.075	91.81	-26.24
1535	[illegible]	91.87	-26.30
1537		96	-26.39
1539		91	-26.34

1541	2[illegible]	[illegible] 98	-26.41
1543	2[illegible]	[illegible] 09	-26.52
1545	30.133	92.11	-26.54
1547	32.133	92.14	-26.57
1549	34.133	92.17	-26.60
1551	36.133	92.19	-26.62
1553	38.133	92.29	-26.72
1555	40.133	92.27	-26.70
1557	42.133	92.29	-26.72
1559	44.270	92.22	-26.65
1601	46.213	92.22	-26.65
1603	48.213	92.19	-26.62
1605	50.213	92.22	-26.65
1607	52.213	92.11	-26.54
1609	54.213	92.10	-26.53
1611	56.213	92.19	-26.62
1613	58.213	92.13	-26.56
1615	60.213	92.14	-26.57
1617	62.213	92.26	-26.69
1619	64.213	92.27	-26.70
1621	66.213	92.20	-26.63
1623	68.213	92.23	-26.66
1625	70.213	92.24	-26.67
1627	72.213	92.27	-26.70
1629	74.213	92.24	-26.67
1631	76.213	92.26	-26.69
1635	80.138	92.30	-26.73
1637	82.138	92.32	-26.75
1639	84.138	92.33	-26.76
1641	86.138	92.27	-26.70
1643	88.053	92.32	-26.75
1645	90.072	92.29	-26.72
1647	92.072	92.32	-26.75
1649	94.072	92.32	-26.75
1651	96.073	92.32	-26.75
1653	98.072	92.42	-26.85
1655	100.070	92.37	-26.80
1715	120.020	73.81	-8.24

Average level: 88.85

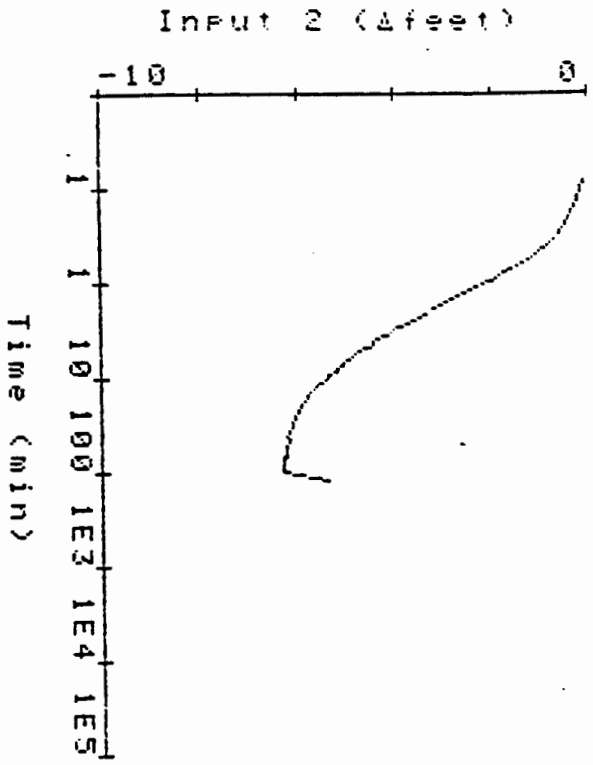


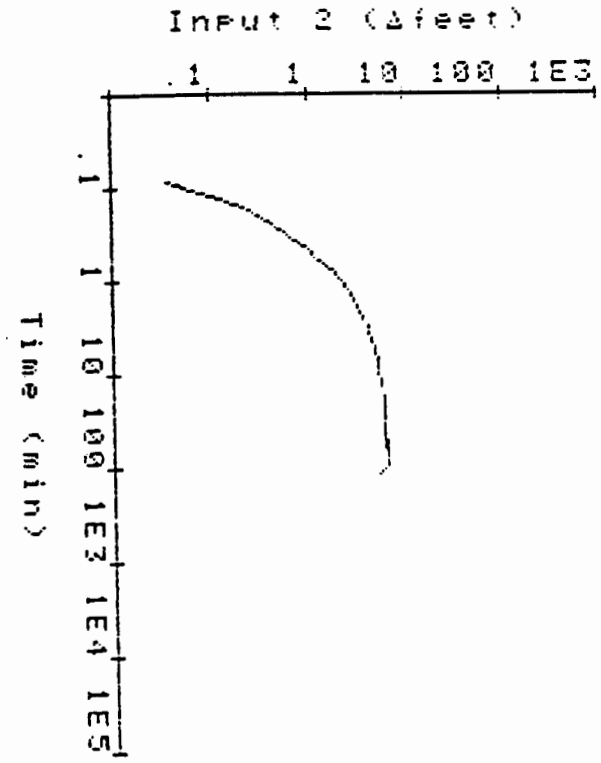


Input 2 (feet):

Time	ET (min)	level	Δlevel
1515	0.000	64.68	0.00
1515	0.084	64.72	-0.04
1515	0.167	64.91	-0.23
1515	0.251	65.09	-0.41
1515	0.334	65.29	-0.61
1515	0.417	65.48	-0.80
1515	0.501	65.67	-0.99
1515	0.584	65.87	-1.19
1515	0.667	66.05	-1.37
1515	0.751	66.24	-1.56
1515	0.834	66.42	-1.74
1515	0.917	66.57	-1.89
1516	1.001	66.70	-2.02
1516	1.377	67.23	-2.55
1516	1.710	67.59	-2.91
1517	2.043	67.91	-3.23
1517	2.377	68.17	-3.49
1517	2.710	68.39	-3.71
1518	3.043	68.59	-3.91
1518	3.377	68.76	-4.08
1518	3.710	68.88	-4.20
1519	4.043	69.03	-4.35
[illegible]9	4.377	69.14	-4.46
[illegible]19	4.710	69.23	-4.55
1520	5.043	69.31	-4.63
1520	5.377	69.42	-4.74
1520	5.710	69.46	-4.78
1521	6.043	69.54	-4.86
1521	6.377	69.60	-4.92
1521	6.710	69.66	-4.98
1522	7.043	69.73	-5.05
1522	7.377	69.75	-5.07
1522	7.710	69.82	-5.14
1523	8.043	69.85	-5.17
1523	8.377	69.88	-5.20
1523	8.710	69.93	-5.25
1524	9.043	70.01	-5.32
1524	9.377	70.04	-5.36
1524	9.710	70.06	-5.38
1525	10.043	70.07	-5.39
1527	12.127	70.28	-5.60
1529	14.127	70.42	-5.74
1531	16.075	70.50	-5.82
1533	18.075	70.58	-5.90
1535	20.075	70.61	-5.93
1537	22.075	70.65	-5.97
1539	24.[illegible]	70.70	-6.02
1541	26.[illegible]	[illegible]74	-6.06
1543	28.[illegible]	[illegible]75	-6.07
1545	[illegible]	[illegible]79	-6.11
1547	[illegible]	[illegible]80	-6.12
1549	34.133	[illegible]83	-6.15
1551	36.133	70.85	-6.17
1553	38.133	70.85	-6.17
1555	40.133	70.89	-6.21
1557	42.133	70.91	-6.23
1559	44.270	70.87	-6.19
1601	46.213	70.89	-6.21
1603	48.213	70.89	-6.21
1605	50.213	70.90	-6.22
1607	52.213	70.93	-6.25
1609	54.213	70.95	-6.27
1611	56.213	70.93	-6.25
1613	58.213	70.96	-6.28
1615	60.213	70.92	-6.23
1617	62.213	70.95	-6.27
1619	64.213	70.95	-6.27
1621	66.213	70.94	-6.26
1623	68.213	70.95	-6.27
1625	70.213	70.98	-6.30
1627	72.213	70.96	-6.28
1629	74.213	70.97	-6.29
1631	76.213	70.98	-6.30
1635	80.138	70.99	-6.31
1637	82.138	71.02	-6.34
1639	84.138	70.98	-6.30
1641	86.138	71.00	-6.32
1643	88.053	71.01	-6.33
1645	90.072	71.01	-6.33
1647	92.072	71.02	-6.34
1649	94.072	71.00	-6.32
1651	96.073	71.01	-6.33
1653	98.072	71.02	-6.34
1655	100.070	71.00	-6.32
1715	120.020	70.03	-5.35

Average level: 70.56



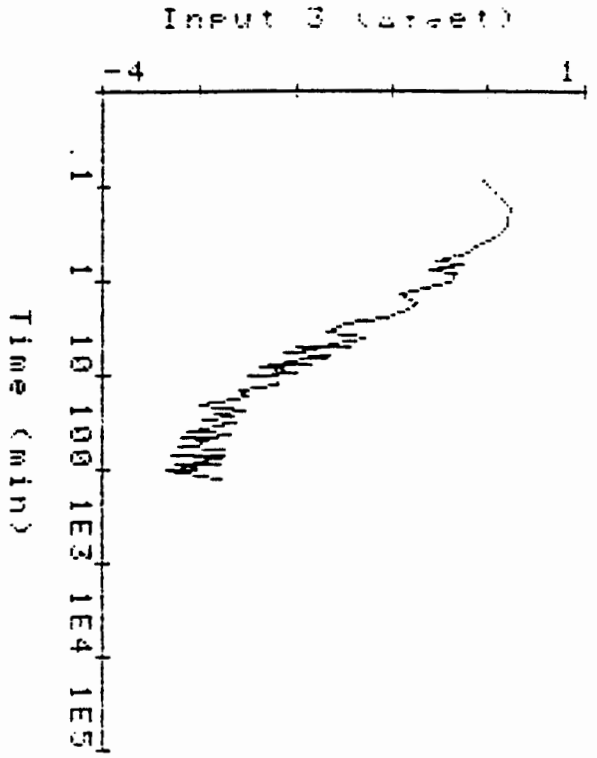


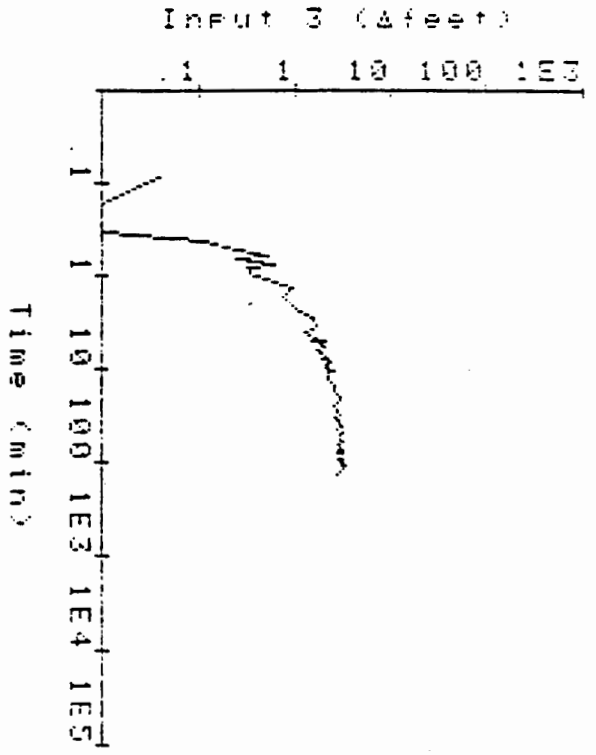
Input 3 (feet):

Time	ET (min)	level	Δlevel
1515	0.000	64.69	0.[illegible]
1515	0.084	64.73	-0.04
1515	0.167	64.45	0.24
1515	0.251	64.47	0.22
1515	0.334	64.60	0.09
1515	0.417	64.81	-0.12
1515	0.501	64.86	-0.18
1515	0.584	65.22	-0.53
1515	0.667	64.93	-0.25
1515	0.751	65.29	-0.60
1515	0.834	65.01	-0.32
1515	0.917	65.04	-0.35
1516	1.001	65.10	-0.41
1516	1.377	65.61	-0.92
1516	1.710	65.42	-0.73
1517	2.043	65.59	-0.90
1517	2.377	65.75	-1.06
1517	2.710	66.20	-1.51
1518	3.043	66.24	-1.56
1518	3.377	66.37	-1.68
1518	3.710	66.12	-1.43
1519	4.043	65.97	-1.28
1519	4.377	66.34	-1.65
1519	4.710	66.13	-1.44
1520	5.043	66.69	-2.00
1520	5.377	66.46	-1.77
1520	5.710	66.80	-2.[illegible]
1521	6.043	66.36	-1.[illegible]
1521	6.377	66.42	-1.7[illegible]
1521	6.710	66.67	-1.98
1522	7.043	66.73	-2.04
1522	7.377	66.97	-2.28
1522	7.710	66.53	-1.84
1523	8.043	67.07	-2.38
1523	8.377	66.81	-2.12
1523	8.710	66.89	-2.20
1524	9.043	66.94	-2.25
1524	9.377	66.70	-2.01
1524	9.710	67.20	-2.52
1525	10.043	66.87	-2.18
1527	12.127	66.88	-2.19
1529	14.127	67.28	-2.59
1531	16.075	67.19	-2.50
1533	18.075	67.36	-2.67
1535	20.075	67.68	-2.99
1537	22.075	67.45	-2.76
1539	24.447	67.21	-2.5[illegible]
1541	26.133	67.52	-2.83
1543	28.133	67.33	-2.64
1545	30.133	67.65	-2.96
1547	32.133	67.32	-2.63
1549	34.133	67.56	-2.87
1551	36.133	67.60	-2.91
1553	38.133	67.81	-3.1[illegible]
1555	40.133	67.63	-2.[illegible]
1557	42.133	67.39	-2.[illegible]
1559	44.270	67.61	-2.9[illegible]
1601	46.213	67.88	-3.19
1603	48.213	67.60	-2.91
1605	5[illegible]	[illegible].65	-2.96
1607	5.[illegible]	[illegible]	-2.97
1609	5.[illegible]		-2.99

1611	56.[illegible]	[illegible]70	-3.01
1613	58.[illegible]	[illegible]1	-3.22
1615	60.213	67.43	-2.74
1617	62.213	67.70	-3.01
1619	64.213	67.66	-2.97
1621	66.213	67.70	-3.01
1623	68.213	67.68	-2.99
1625	70.213	67.43	-2.74
1627	72.213	67.96	-3.27
1629	74.213	[illegible]	-2.78
1631	76.21[illegible]	[illegible]	-3.07
1635	80.[illegible]	[illegible]	-2.99
1637	82.13[illegible]	[illegible]	-2.91
1639	84.13[illegible]	[illegible]	-3.26
1641	86.138	67.46	-2.79
1643	88.053	67.71	-3.02
1645	90.072	67.74	-3.06
1647	92.072	67.72	-3.03
1649	94.072	67.88	-3.20
1651	96.073	67.72	-3.03
1653	98.072	67.72	-3.03
1655	100.070	68.02	-3.33
1715	120.020	67.46	-2.77

Average level: 67.47

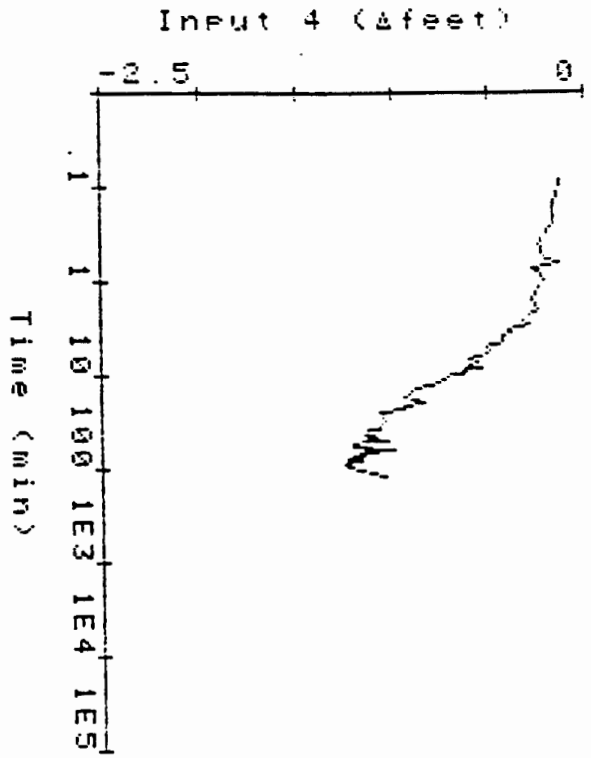


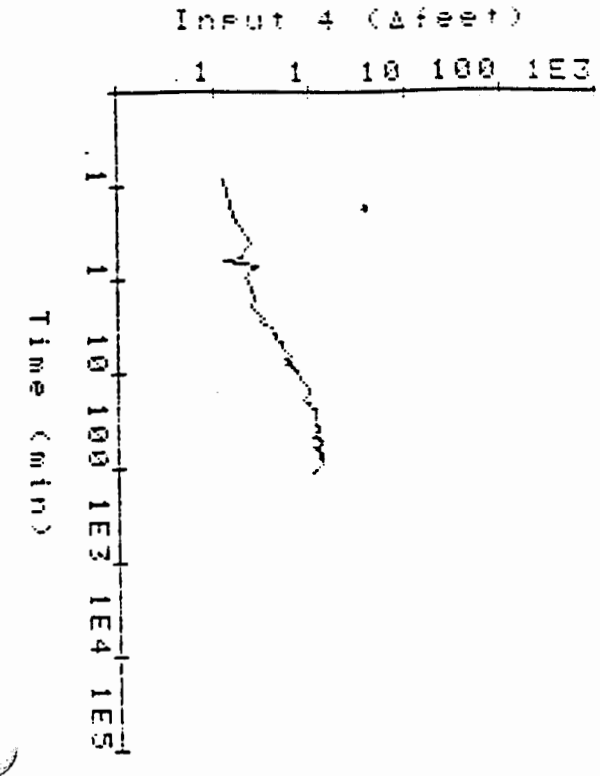


Input 4 (feet):

Time	ET (min)	level	Δlevel
1515	0.000	65.65	0.00
1515	0.084	65.77	-0.12
1515	0.167	65.80	-0.15
1515	0.251	65.81	-0.16
1515	0.334	65.86	-0.21
1515	0.417	65.89	-0.24
1515	0.501	65.86	-0.21
1515	0.584	65.85	-0.20
1515	0.667	65.78	-0.13
1515	0.751	65.92	-0.27
1515	0.834	65.88	-0.23
1515	0.917	65.87	-0.22
1516	1.001	65.86	-0.21
1516	1.377	65.90	-0.24
1516	1.710	65.91	-0.26
1517	2.043	65.88	-0.23
1517	2.377	65.93	-0.27
1517	2.710	65.97	-0.32
1518	3.043	65.94	-0.29
1518	3.377	66.04	-0.39
1518	3.710	66.02	-0.37
1519	4.043	66.07	-0.42
1519	4.377	66.08	-0.43
1519	4.710	66.10	-0.45
1520	5.043	66.13	-0.48
1520	5.377	66.15	-0.50
1520	5.710	66.13	-0.48
1521	6.043	66.17	-0.52
1521	6.377	66.20	-0.55
1521	6.710	66.20	-0.55
1522	7.043	66.24	-0.59
1522	7.377	66.20	-0.55
1522	7.710	66.19	-0.54
1523	8.043	66.24	-0.59
1523	8.377	66.18	-0.53
1523	8.710	66.26	-0.61
1524	9.043	66.28	-0.63
1524	9.377	66.25	-0.60
1524	9.710	66.30	-0.65
1525	10.043	66.34	-0.68
1527	12.127	66.40	-0.75
1529	14.127	66.53	-0.88
1531	16.075	66.56	-0.91
1533	18.[illegible]	66.60	-0.94
1535	20.[illegible]	[illegible] 48	-0.83
1537	22[illegible]	[illegible] 9	-0.93
1539	24[illegible]	[illegible]	-0.94
1541	26.[illegible]	[illegible]	-1.06
1543	28.133	[illegible]	-1.05
1545	30.133	66.70	-1.05
1547	32.133	66.69	-1.04
1549	34.133	66.69	-1.04
1551	36.133	66.72	-1.07
1553	38.133	66.71	-1.06
1555	40.133	66.77	-1.12
1557	42.133	66.78	-1.12
1559	44.270	66.75	-1.10
1601	46.213	66.79	-1.14
1603	48.213	66.76	-1.11
1605	50.213	66.76	-1.11
1607	52.213	66.66	-1.01
1609	54.213	66.79	-1.14
1611	56.213	66.85	-1.20
1613	58.213	66.85	-1.20
1615	60.213	66.80	-1.15
1617	62.213	66.85	-1.20
1619	64.213	66.63	-0.98
1621	66.213	66.80	-1.[illegible]
1623	68.213	66.82	-1[illegible]
1625	70.213	66.79	-1.[illegible]
1627	72.213	66.73	-1.0[illegible]
1629	74.213	66.85	-1.20
1631	76.213	66.84	-1.19
1635	80.138	66.81	-1.16
1637	82.138	66.89	-1.24
1639	84.138	66.81	-1.16
1641	86.138	66.89	-1.23
1643	88.053	66.87	-1.22
1645	90.072	66.90	-1.25
1647	92.072	66.87	-1.22
1649	94.072	66.89	-1.24
1651	96.073	66.88	-1.23
1653	98.072	66.89	-1.24
1655	100.070	66.89	-1.24
1715	120.020	66.69	-1.03

Average level: 66.69



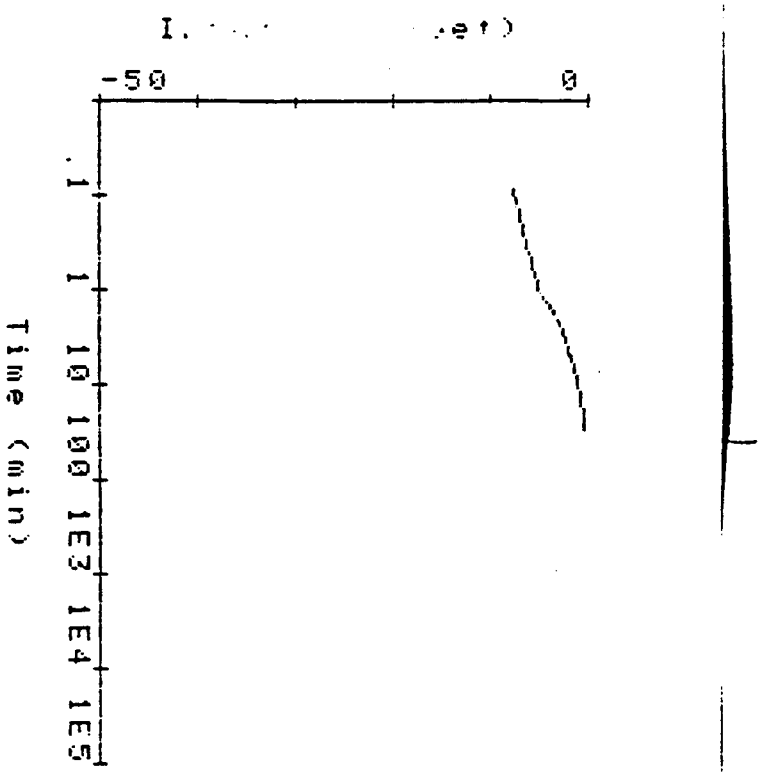


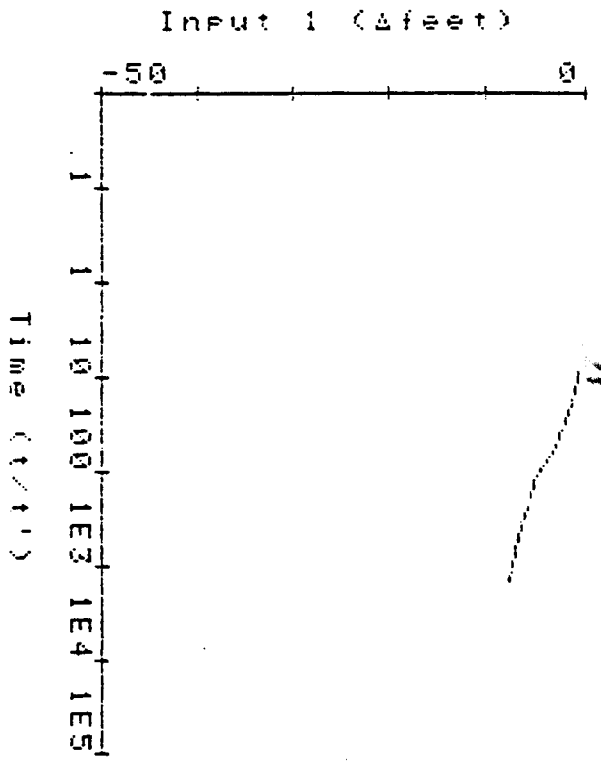
--- IRT---

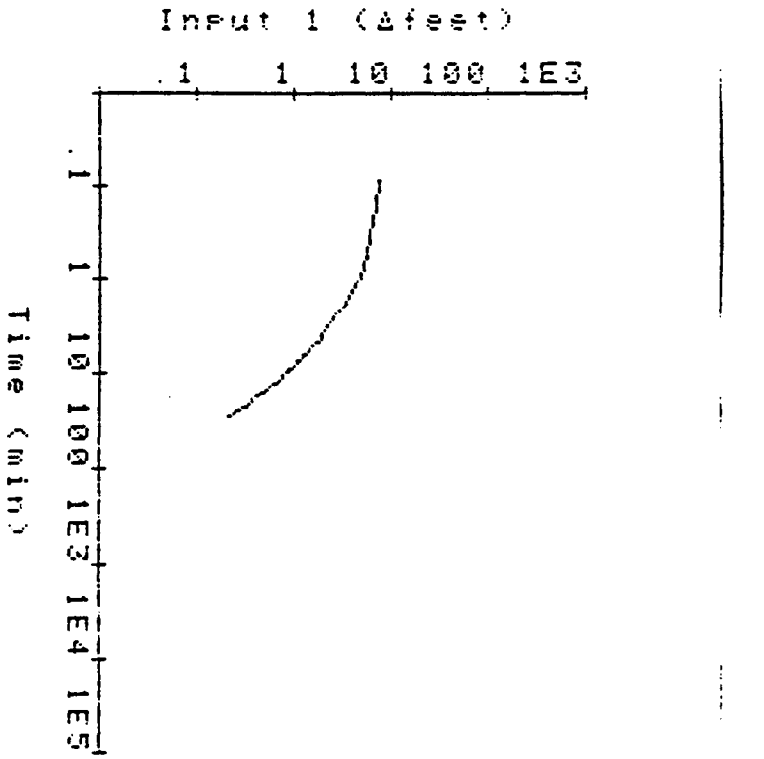
Started at 1715
Lasted 30.123 min

Input 1 (feet):

Time	ET (min)	level	Δlevel
1715	0.084	72.92	-7.35
1715	0.167	72.53	-6.96
1715	0.251	72.15	-6.58
1715	0.334	71.84	-6.27
1715	0.417	71.56	-5.99
1715	0.501	71.29	-5.72
1715	0.584	71.04	-5.47
1715	0.667	70.83	-5.26
1715	0.751	70.74	-5.17
1715	0.834	70.70	-5.13
1716	0.917	70.60	-5.03
1716	1.001	70.47	-4.90
1716	1.376	69.63	-4.06
1716	1.710	69.10	-3.53
1717	2.043	68.70	-3.13
1717	2.376	68.41	-2.84
1717	2.710	68.18	-2.61
1718	3.043	67.98	-2.41
1718	3.376	67.82	-2.25
1718	3.710	67.67	-2.10
1719	4.043	67.54	-1.97
1719	4.376	67.43	-1.86
1719	4.710	67.33	-1.76
1720	5.043	67.21	-1.64
1720	5.377	67.13	-1.56
1720	5.710	67.04	-1.47
1721	6.043	66.97	-1.40
1721	6.377	66.90	-1.33
1721	6.710	66.84	-1.27
1722	7.043	66.78	-1.21
1722	7.377	66.71	-1.14
1722	7.710	66.67	-1.09
1723	8.043	66.62	-1.05
1723	8.377	66.58	-1.01
1723	8.710	66.54	-0.96
1724	9.043	66.49	-0.92
1724	9.376	66.46	-0.89
1724	9.710	66.43	-0.86
1725	10.043	66.41	-0.84
1727	12.134	66.25	-0.68
1729	14.134	66.12	-0.55
1731	16.155	66.05	-0.48
1733	18.137	65.97	-0.40
1735	20.198	65.93	-0.36
1737	22.187	65.90	-0.33
1739	24.187	65.86	-0.29
1741	26.187	65.83	-0.26
1743	28.187	65.80	-0.23
1745	30.123	65.77	-0.20

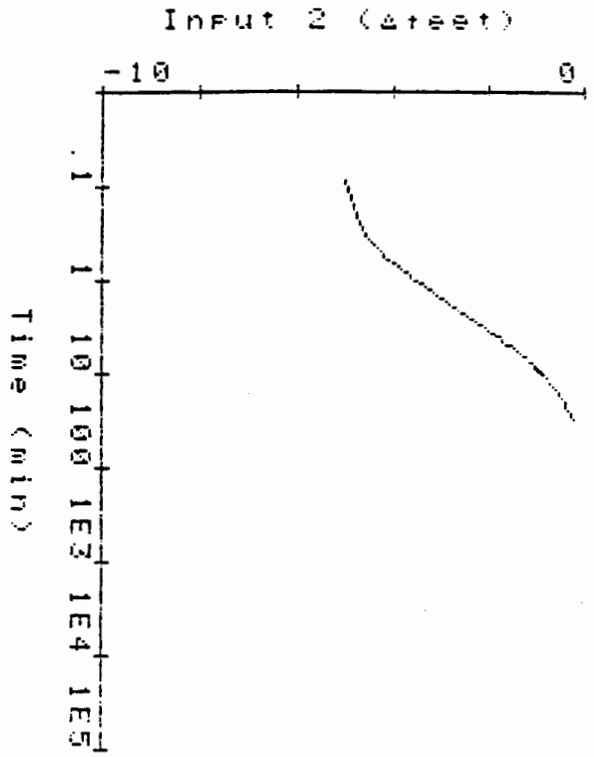

-50
0
.1
1
10
100
1E3
1E4
1E5
Time (min)

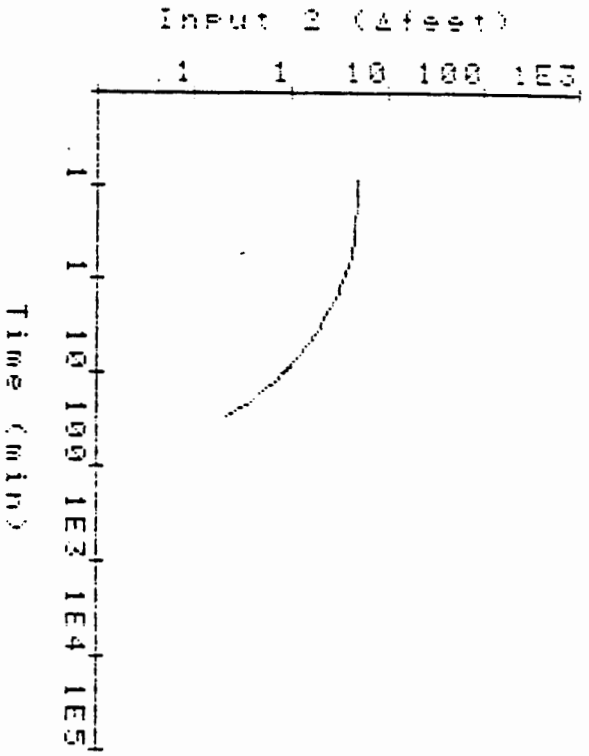

Input 1 (Δfeet)
-50
0
.1
1
10
100
1E3
1E4
1E5
Time (t/t')

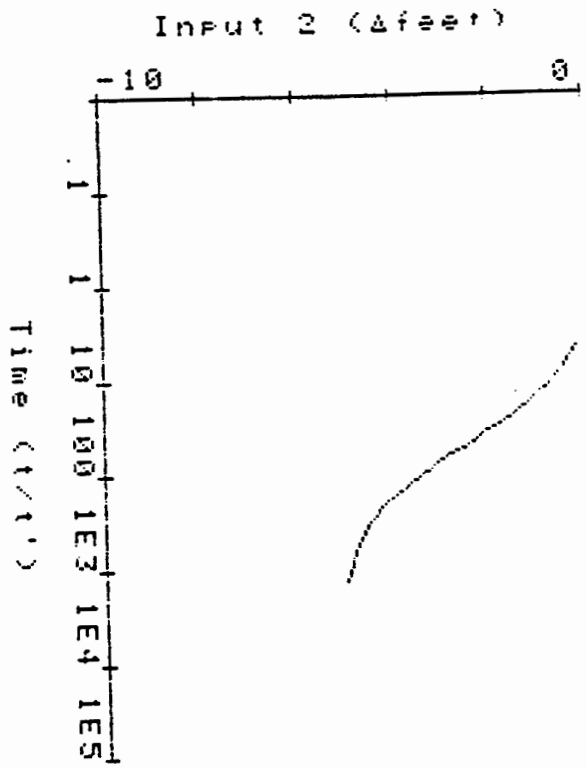

Input 1 (Δfeet)
.1
1
10
100
1E3
1E4
1E5
Time (min)

put 2 (feet):

Time	ET (min)	level	Δlevel
1715	0.084	69.69	-5.01
1715	0.167	69.52	-4.84
1715	0.251	69.37	-4.69
1715	0.334	69.22	-4.54
1715	0.417	69.07	-4.39
1715	0.501	68.92	-4.24
1715	0.584	68.77	-4.09
1715	0.667	68.65	-3.97
1715	0.751	68.50	-3.82
1715	0.834	68.40	-3.72
1716	0.917	68.28	-3.60
1716	1.001	68.20	-3.52
1716	1.376	67.82	-3.13
1716	1.710	67.54	-2.86
1717	2.043	67.31	-2.63
1717	2.376	67.10	-2.42
1717	2.710	66.95	-2.27
1718	3.043	66.79	-2.11
1718	3.376	66.67	-1.99
1718	3.710	66.55	-1.87
1719	4.043	66.45	-1.77
1719	4.376	66.36	-1.68
1719	4.710	66.27	-1.59
1720	5.043	66.21	-1.53
1720	5.377	66.12	-1.44
1720	5.710	66.06	-1.38
1721	6.043	65.99	-1.31
1721	6.377	65.93	-1.25
1721	6.710	65.89	-1.20
1722	7.043	65.84	-1.16
1722	7.377	65.79	-1.11
1722	7.710	65.76	-1.08
1723	8.043	65.71	-1.03
1723	8.377	65.66	-0.98
1723	8.710	65.64	-0.96
1724	9.043	65.61	-0.93
1724	9.376	65.56	-0.88
1724	9.710	65.54	-0.86
1725	10.043	65.51	-0.83
1727	12.134	65.36	-0.68
1729	14.134	65.24	-0.56
1731	16.155	65.17	-0.49
1733	18.137	65.12	-0.44
1735	20.198	65.06	-0.38
1737	22.187	65.03	-0.35
1739	24.187	64.98	-0.30
1741	26.187	64.95	-0.27
1743	28.187	64.91	-0.23
1745	30.123	64.90	-0.22

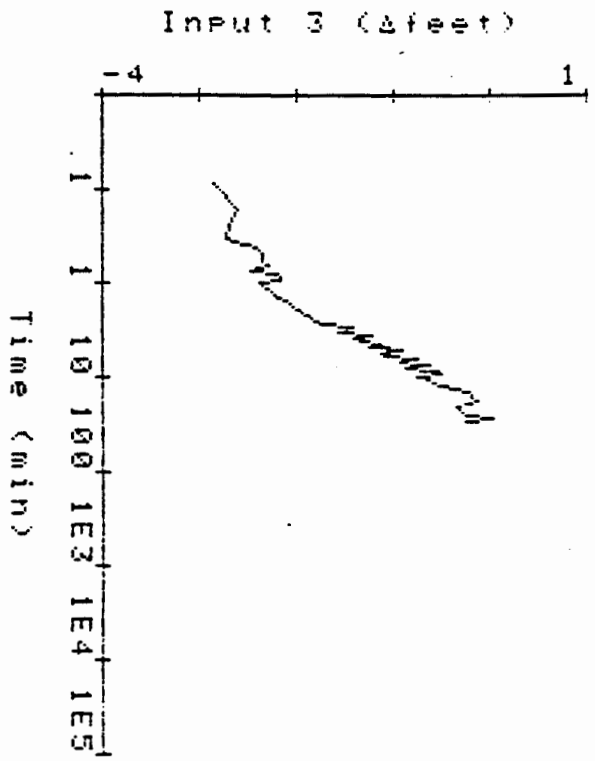


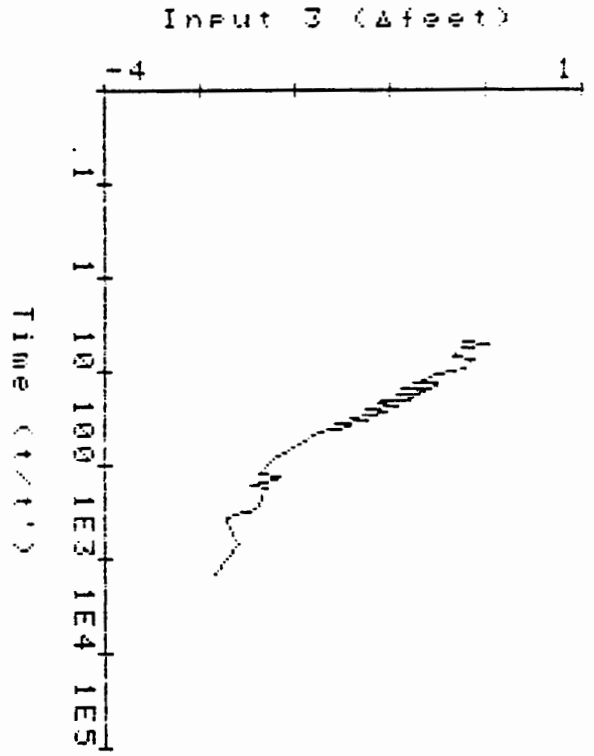


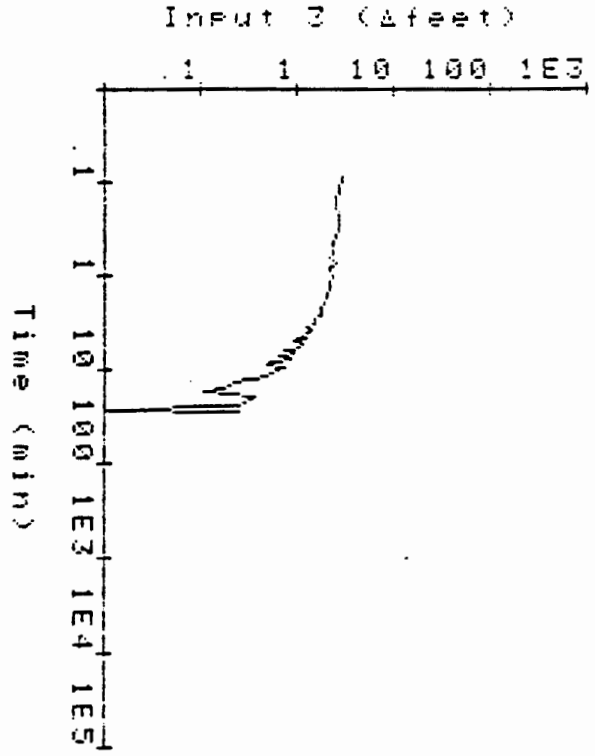


Input 3 (feet):

Time	ET (min)	level	Δlevel
1715	0.084	67.54	-2.85
1715	0.167	67.27	-2.58
1715	0.251	67.37	-2.68
1715	0.334	67.41	-2.72
1715	0.417	67.10	-2.41
1715	0.501	67.05	-2.36
1715	0.584	67.02	-2.33
1715	0.667	66.96	-2.27
1715	0.751	67.17	-2.48
1715	0.834	66.87	-2.18
1716	0.917	66.83	-2.14
1716	1.001	67.07	-2.38
1716	1.376	66.90	-2.21
1716	1.710	66.74	-2.05
1717	2.043	66.62	-1.93
1717	2.376	66.53	-1.84
1717	2.710	66.43	-1.74
1718	3.043	66.10	-1.41
1718	3.376	66.24	-1.55
1718	3.710	65.92	-1.23
1719	4.043	66.10	-1.4[illegible]
1719	4.376	65.85	-1.1[illegible]
1719	4.710	65.72	-1.03
1720	5.043	65.94	-1.25
1720	5.377	65.61	-0.92
1720	5.710	65.80	-1.11
1721	6.043	65.77	-1.08
1721	6.377	65.47	-0.78
1721	6.710	65.42	-0.74
1722	7.043	65.64	-0.95
1722	7.377	65.41	-0.72
1722	7.710	65.32	-0.63
1723	8.043	65.58	-0.89
1723	8.377	65.27	-0.58
1723	8.710	65.23	-0.54
1724	9.043	65.20	-0.51
1724	9.376	65.17	-0.48
1724	9.710	65.44	-0.75
1725	10.043	65.40	-0.71
1727	12.134	65.19	-0.50
1729	14.134	64.91	-0.22
1731	16.155	64.87	-0.18
1733	18.137	64.80	-0.11
1735	20.198	65.04	-0.35
1737	22.187	65.00	-0.32
1739	24.187	64.97	-0.28
1741	26.187	64.94	-0.25
1743	28.187	64.66	0.03
1745	30.133	64.94	-0.2[illegible]

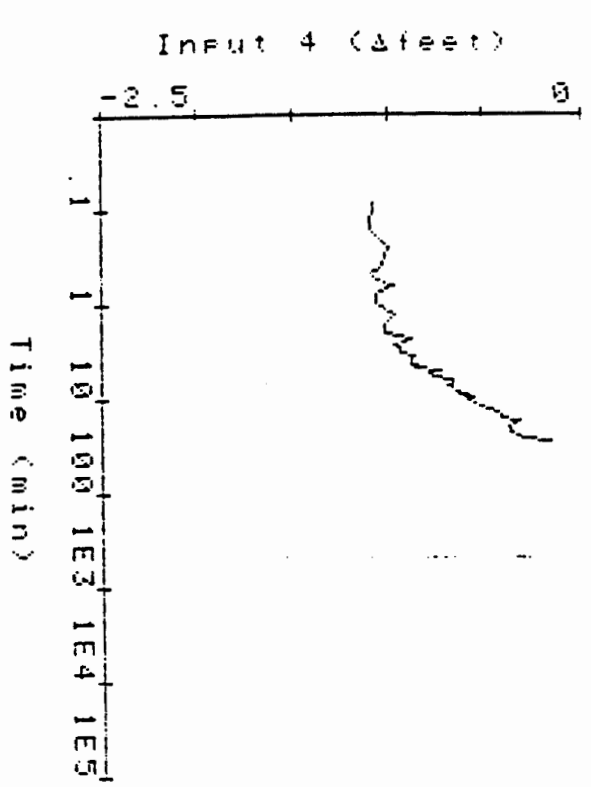

Input 3 (Δfeet)
-4
1
.1
1
10
100
1E3
1E4
1E5
Time (min)

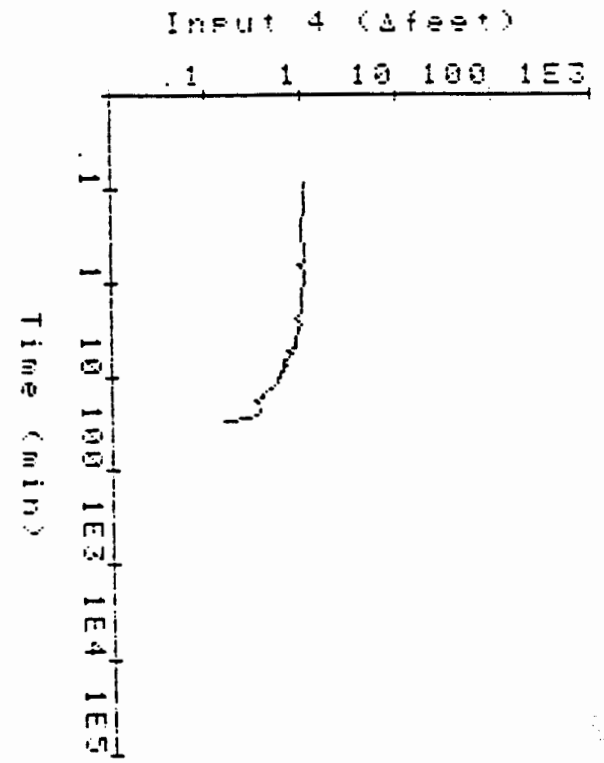

Input 3 (Δfeet)
-4
1
.1
1
10
100
1E3
1E4
1E5
Time (t/t')

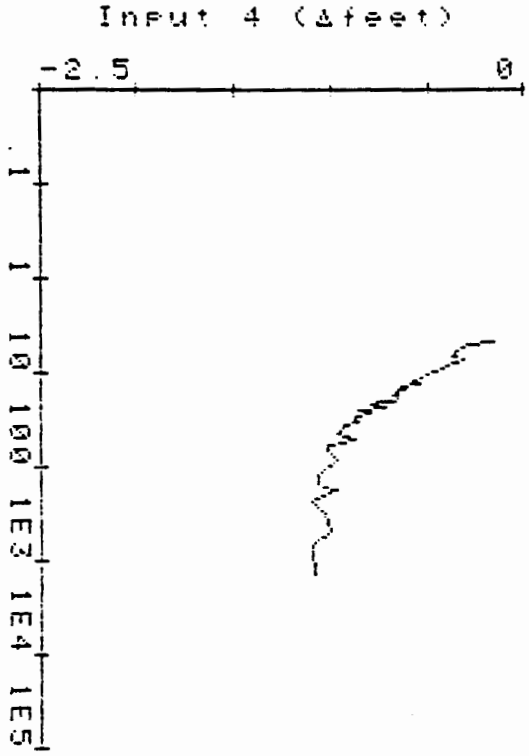

Input 3 (Δfeet)
.1
1
10
100
1E3
.1
1
10
100
1E3
1E4
1E5
Time (min)

Input 4 (feet):

Time	ET (min)	level	Δlevel
1715	0.084	66.73	-1.08
1715	0.167	66.75	-1.10
1715	0.251	66.66	-1.00
1715	0.334	66.66	-1.01
1715	0.417	66.70	-1.05
1715	0.501	66.74	-1.09
1715	0.584	66.69	-1.04
1715	0.667	66.62	-0.96
1715	0.751	66.69	-1.04
1715	0.834	66.71	-1.06
1716	0.917	66.72	-1.07
1716	1.001	66.72	-1.07
1716	1.376	66.62	-0.97
1716	1.710	66.67	-1.02
1717	2.043	66.66	-1.01
1717	2.376	66.52	-0.87
1717	2.710	66.62	-0.97
1718	3.043	66.59	-0.94
1718	3.376	66.59	-0.94
1718	3.710	66.50	-0.85
1719	4.043	66.52	-0.87
1719	4.376	66.52	-0.87
1719	4.710	66.46	-0.80
1720	5.043	66.50	-0.85
1720	5.377	66.37	-0.72
1720	5.710	66.45	-0.80
1721	6.043	66.41	-0.76
1721	6.377	66.32	-0.67
1721	6.710	66.31	-0.66
1722	7.043	66.31	-0.66
1722	7.377	66.34	-0.69
1722	7.710	66.32	-0.66
1723	8.043	66.30	-0.65
1723	8.377	66.27	-0.62
1723	8.710	66.29	-0.64
1724	9.043	66.27	-0.61
1724	9.376	66.25	-0.60
1724	9.710	66.20	-0 54
1725	10.043	66.25	-0.59
1727	12.134	66.17	-0.52
1729	14.134	66.07	-0.42
1731	16.155	66.05	-0.40
1733	18.137	65.97	-0.31
1735	20.198	66.03	-0.38
1737	22.187	66.01	-0.36
1739	24.187	66.00	-0.35
1741	26.187	65.97	-0.32
1743	28.187	65.95	-0.30
1745	30.123	65.81	-0.15







SE200B manufactured by
In-situ, Inc.
Lar[illegible]

OGC-002875

APPENDIX F
to
ATTACHMENT 4

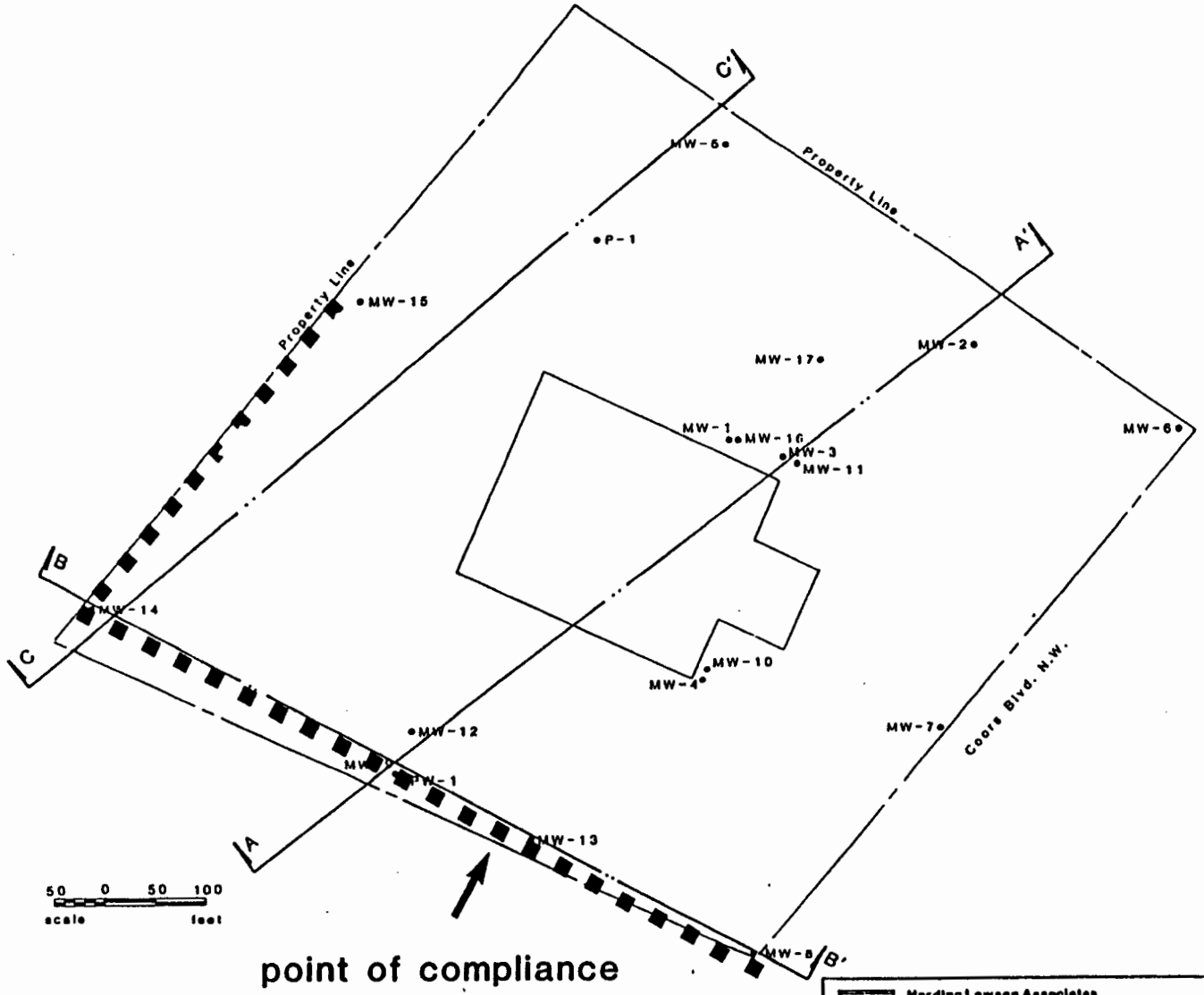
Figures 1 through 21

Appendix F

Figures 1 through 21

Figure 1	Site Location Map
Figure 2A	Log of Well MW-12
Figure 2B	Log of Well MW-12 (cont'd)
Figure 3	Particle Size Analysis
Figure 4A	Log of Well MW-13
Figure 4B	Log of Well MW-13 (cont'd)
Figure 5A	Log of Well MW-14
Figure 5B	Log of Well MW-14 (cont'd)
Figure 6A	Log of Well MW-15
Figure 6B	Log of Well MW-15 (cont'd)
Figure 7	Log of Well MW-16
Figure 8	Log of Well MW-17
Figure 9A	Log of Well PW-1
Figure 9B	Log of Well PW-1 (cont'd)
Figure 10	Geologic Cross-Section A-A'
Figure 11	Geologic Cross-Section B-B'
Figure 12	Geologic Cross-Section C-C'
Figure 13	Static Piezometric Head
Figure 14	Static Water Table in Upper Aquifer
Figure 15	Static Piezometric Head in Lower Aquifer
Figure 16	Specific Conductance Values in Upper Aquifer
Figure 17	Trichloroethylene Concentrations in Upper Aquifer
Figure 18	Piezometric Head at End of Pumping Test
Figure 19	Water Table in Upper Aquifer End of Test
Figure 20	Piezometric Head in Lower Aquifer at End of Test
Figure 21	Proposed Soil Boring Locations

OGC-002878



point of compliance

KEY:

MW-1 Monitoring Well Location

A A' Cross-Section Location

Reference: Sparton Tech. Inc. Survey by Denney-Gross & Assoc., Inc., Dated 10/5/84.

Harding Lawson Associates
Engineers, Geologists & Geophysicists

SITE LOCATION MAP
Sparton Technology, Inc.
Albuquerque, New Mexico

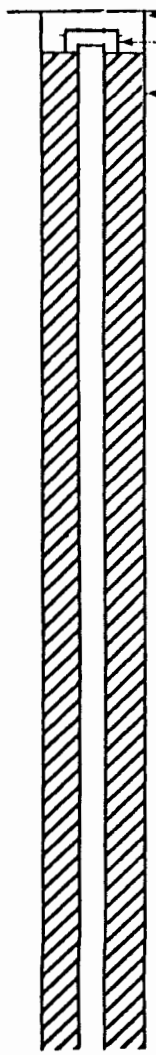
FIGURE 1

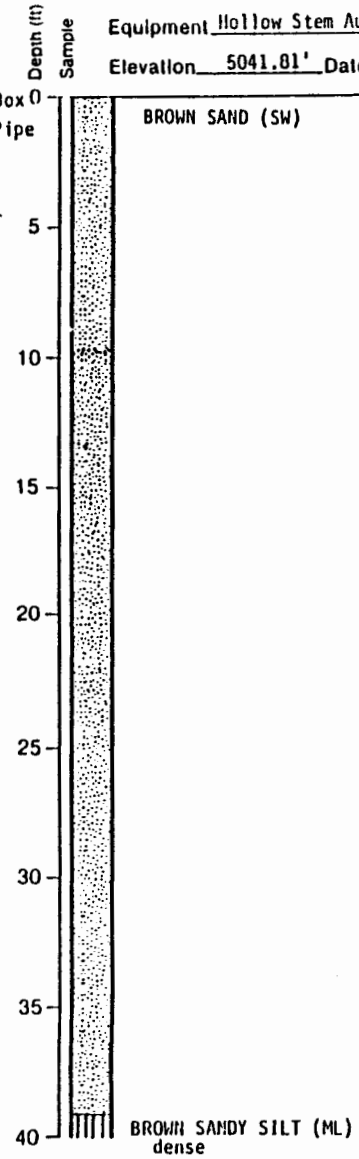
DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
HM	6310,013.12				

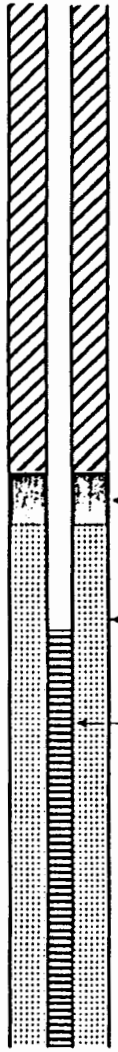
WELL CON TION

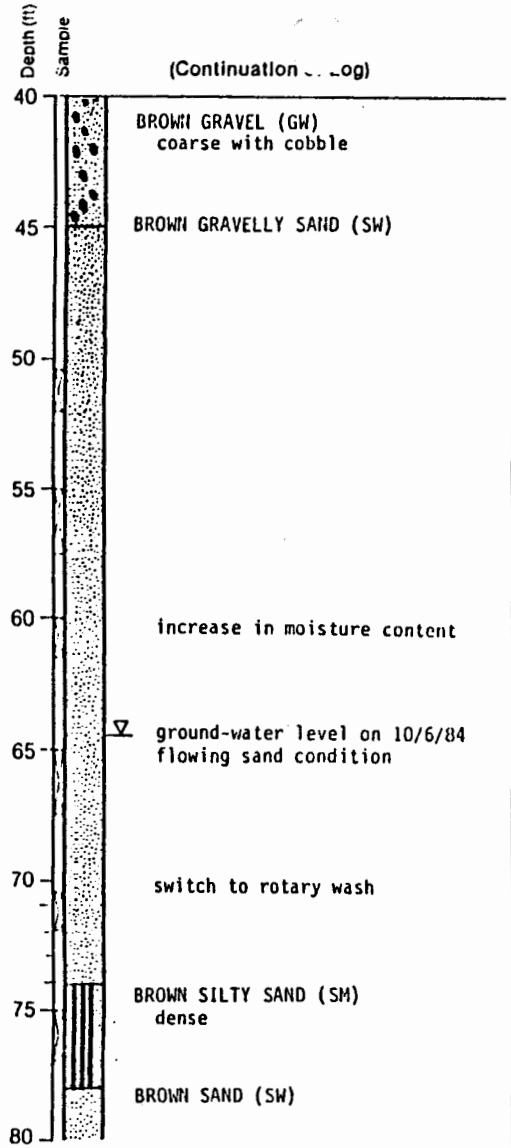
Equipment Hollow Stem Auger/Rotary Was

Elevation 5041.81' Date 8/22/84









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LOG OF WELL MW-12

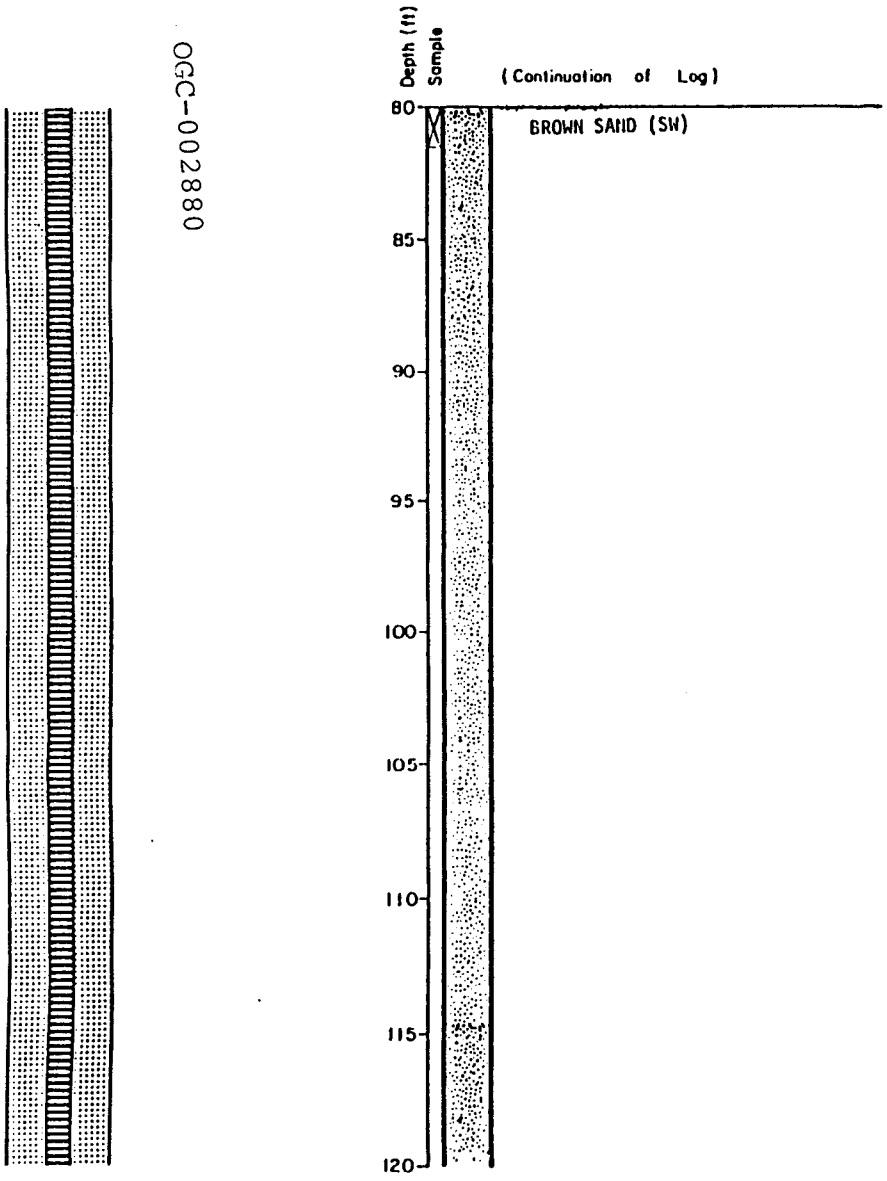
Sparton Technology, Inc.
Albuquerque, New Mexico

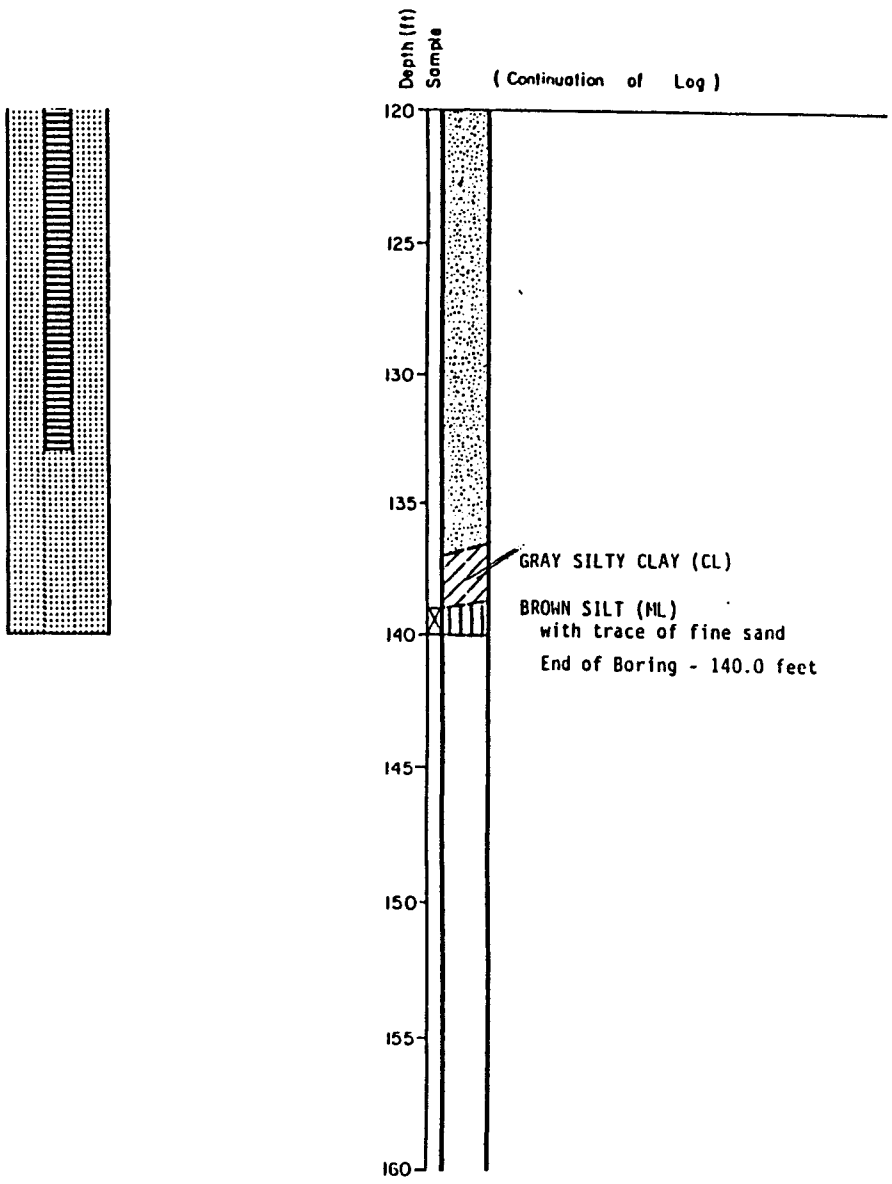
FIGURE 2A

6310,013.12

OGC-002879

OGC-002880





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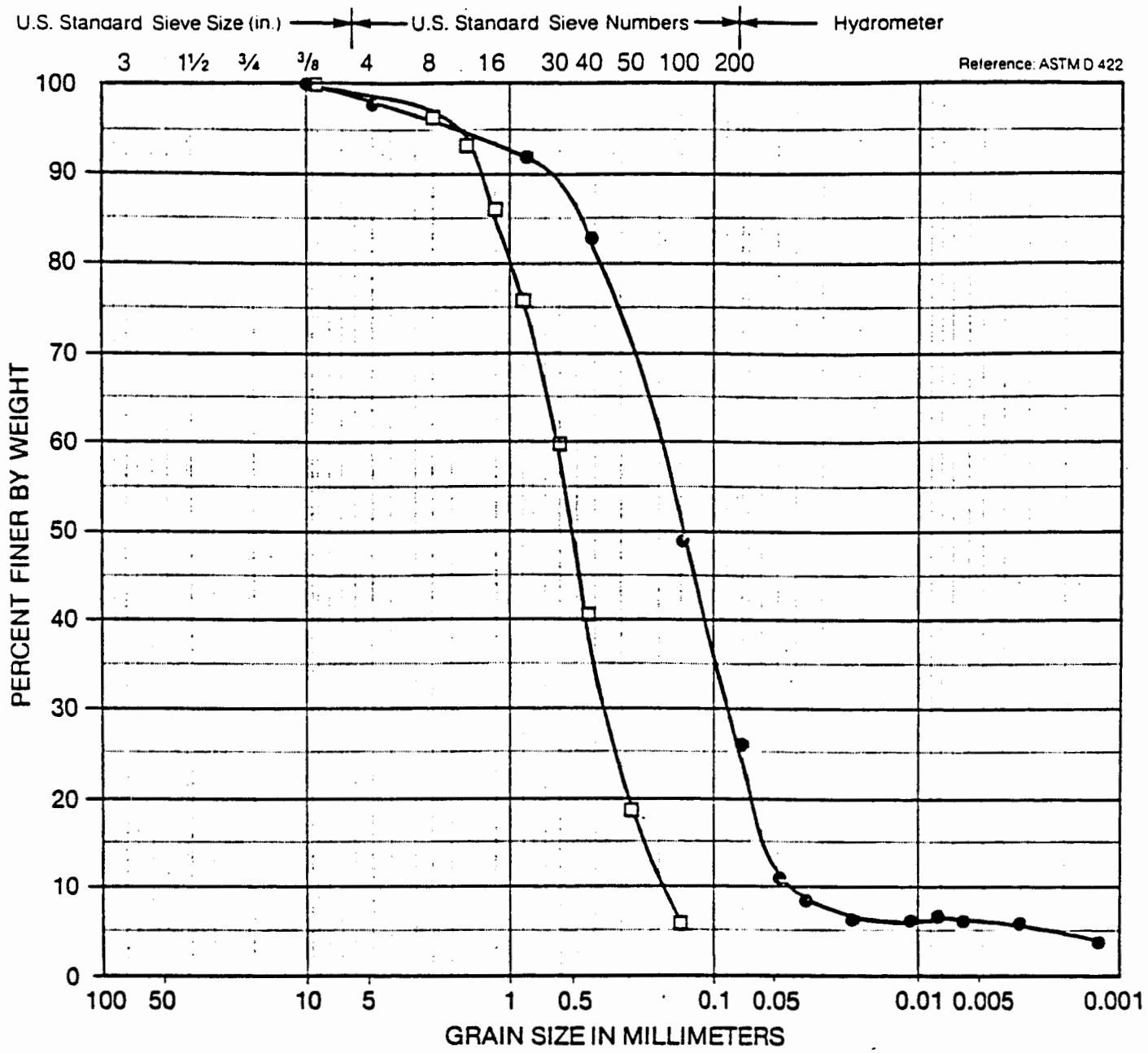
LOG OF WELL MW-12 (Cont'd)
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 2B

6310,013.12



COBBLES	GRAVEL: COARSE	GRAVEL: FINE	SAND: COARSE	SAND: MEDIUM	SAND: FINE	SILT OR CLAY

Symbol	Sample Source	Classification
●	MW-12 at 75-77'	Silty Sand (SM) (spooned sample) Analyzed by HLA
□	MW-12 at 60-70' ; 80-135'	Sand (SW) (washed sample) Analyzed by Rodgers and Co.

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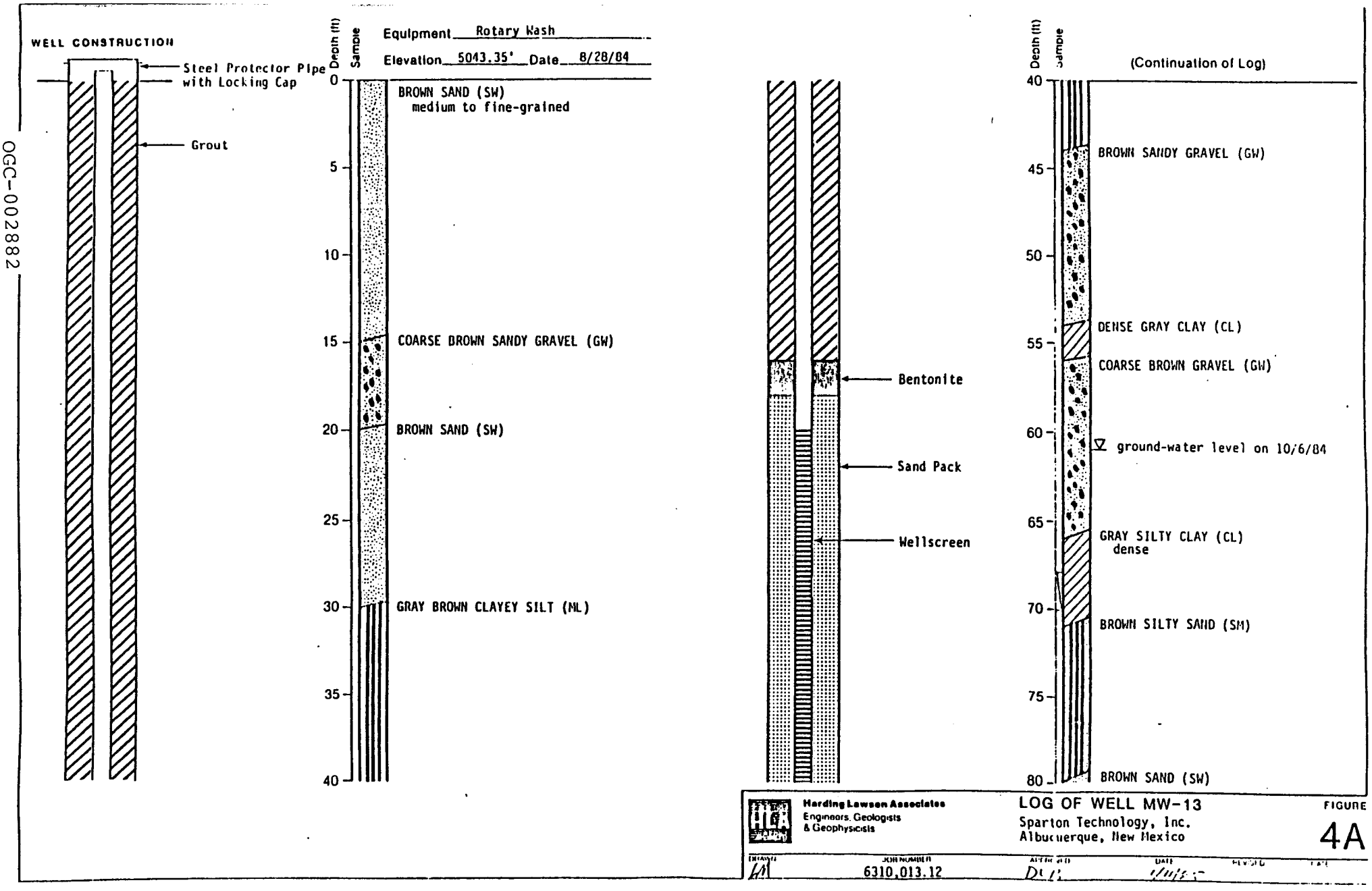
Engineers, Geologists & Geophysicists

Particle Size Analysis
Sparton Technology, Inc.
Albuquerque, New Mexico

OGC-002881

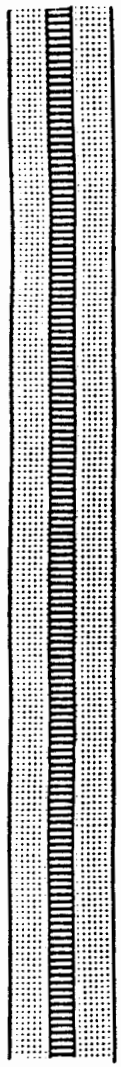
FIGURE 3

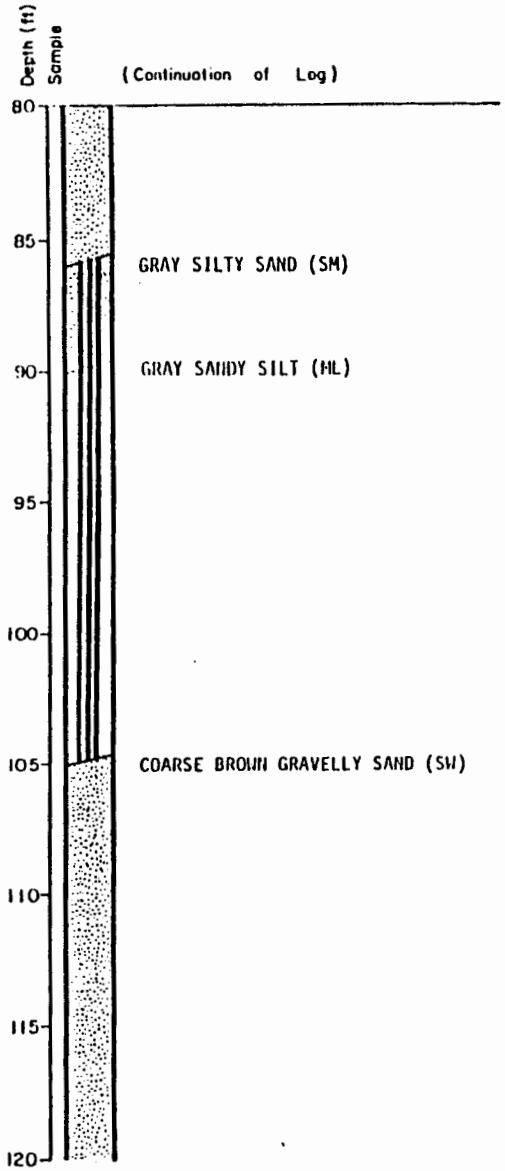
DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
LM	6310,013.12	DCR	[illegible]		

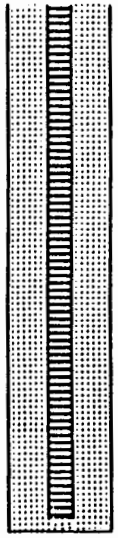

WELL CONSTRUCTION
Steel Protector Pipe with Locking Cap
Grout
Depth (ft)
Sample
Equipment Rotary Wash
Elevation 5043.35' Date 8/28/84
0
5
10
15
20
25
30
35
40
BROWN SAND (SW) medium to fine-grained
COARSE BROWN SANDY GRAVEL (GW)
BROWN SAND (SW)
GRAY BROWN CLAYEY SILT (ML)
Bentonite
Sand Pack
Wellscreen
(Continuation of Log)
40
45
50
55
60
65
70
75
80
BROWN SANDY GRAVEL (GW)
DENSE GRAY CLAY (CL)
COARSE BROWN GRAVEL (GW)
ground-water level on 10/6/84
GRAY SILTY CLAY (CL) dense
BROWN SILTY SAND (SM)
BROWN SAND (SW)
Harding Lawson Associates
Engineers, Geologists & Geophysicists
LOG OF WELL MW-13
Sparton Technology, Inc.
Albuquerque, New Mexico
FIGURE
4A
JOB NUMBER
6310,013.12

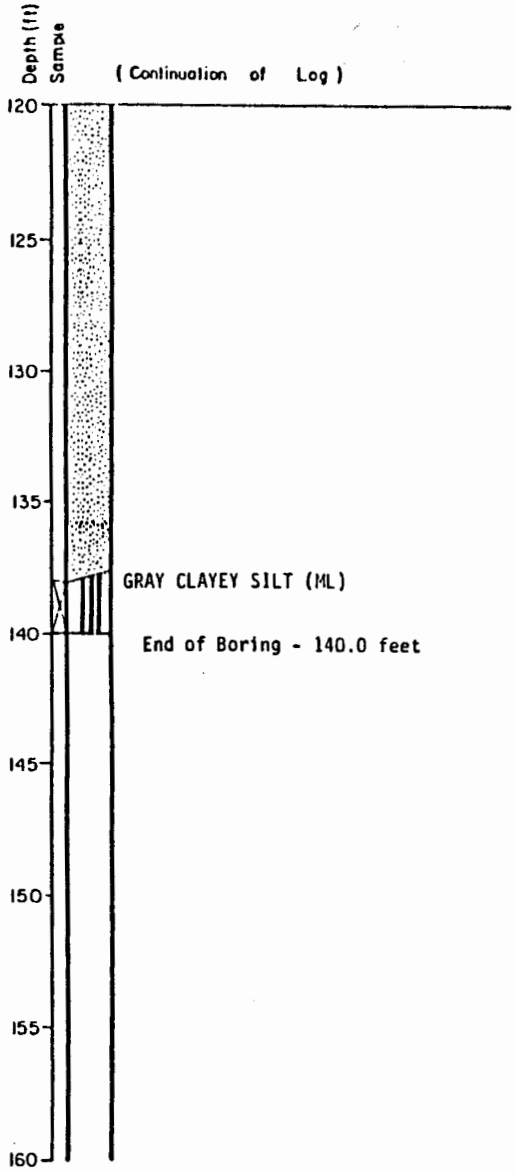
OGC-002882

WELL CONSTRUCT









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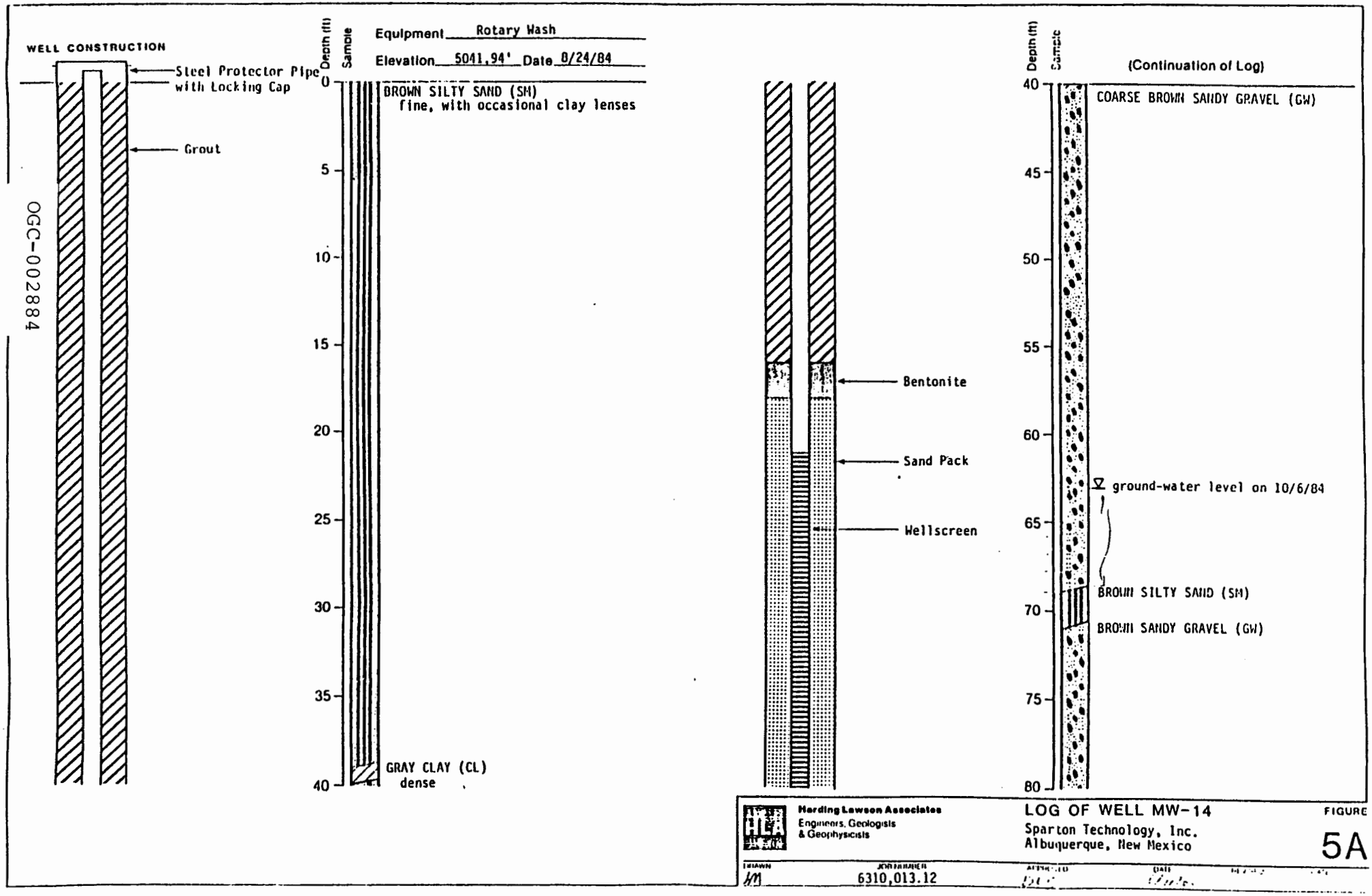
LOG OF WELL MW-13 (Cont'd)
Sparton Technology, Inc.
Albuquerque, New Mexico

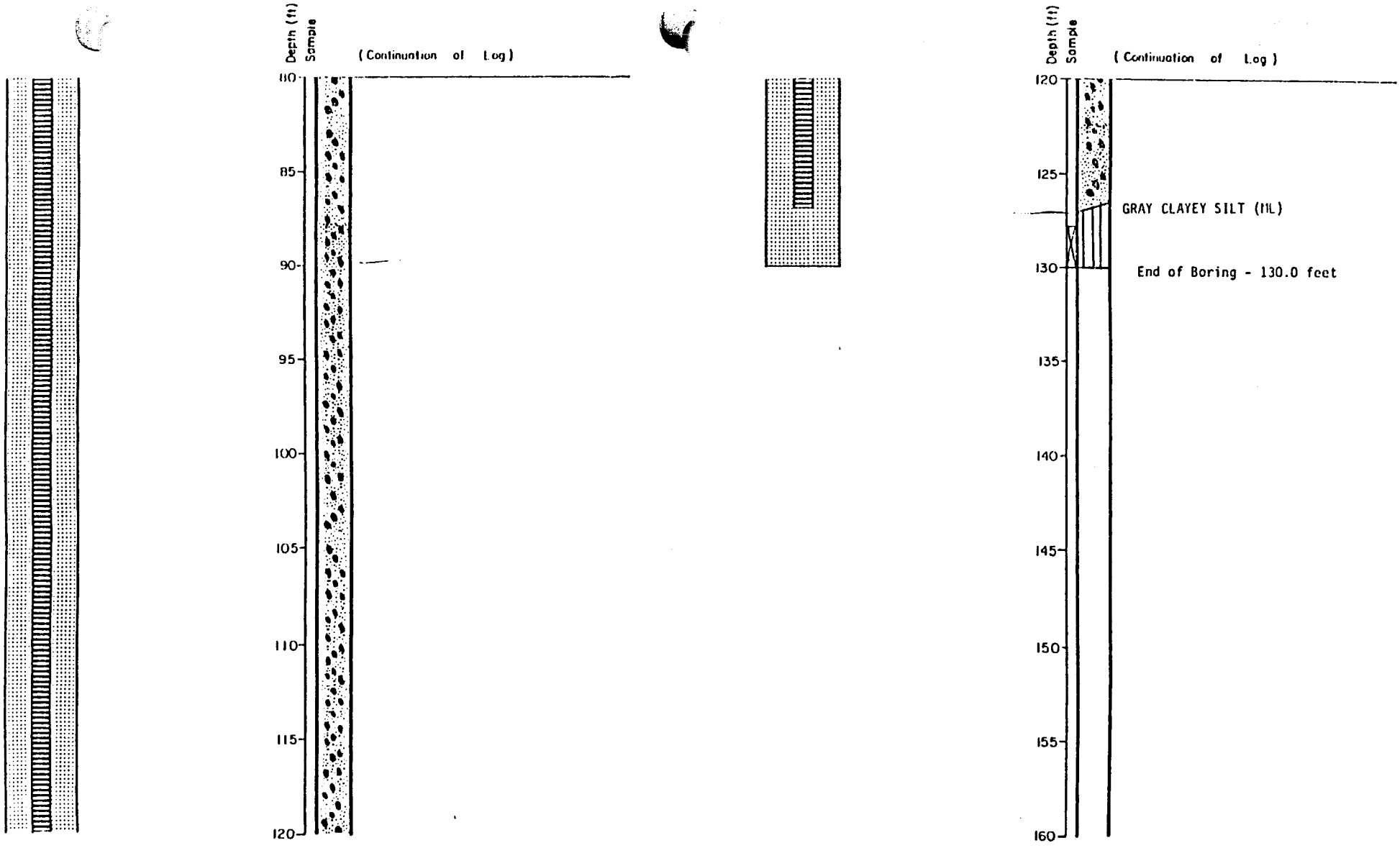
FIGURE 4B

LM 6310.013.12

OGC-002883


WELL CONSTRUCTION
Steel Protector Pipe with Locking Cap
Grout
Depth (ft)
Sample
Equipment Rotary Wash
Elevation 5041.94' Date 8/24/84
BROWN SILTY SAND (SM)
fine, with occasional clay lenses
GRAY CLAY (CL)
dense
0
5
10
15
20
25
30
35
40
Bentonite
Sand Pack
Wellscreen
(Continuation of Log)
COARSE BROWN SANDY GRAVEL (GW)
ground-water level on 10/6/84
BROWN SILTY SAND (SM)
BROWN SANDY GRAVEL (GW)
40
45
50
55
60
65
70
75
80
Harding Lawson Associates
Engineers, Geologists & Geophysicists
LOG OF WELL MW-14
Sparton Technology, Inc.
Albuquerque, New Mexico
FIGURE
5A
DRAWN
JOB NUMBER
6310,013.12
DATE

OGC-002884



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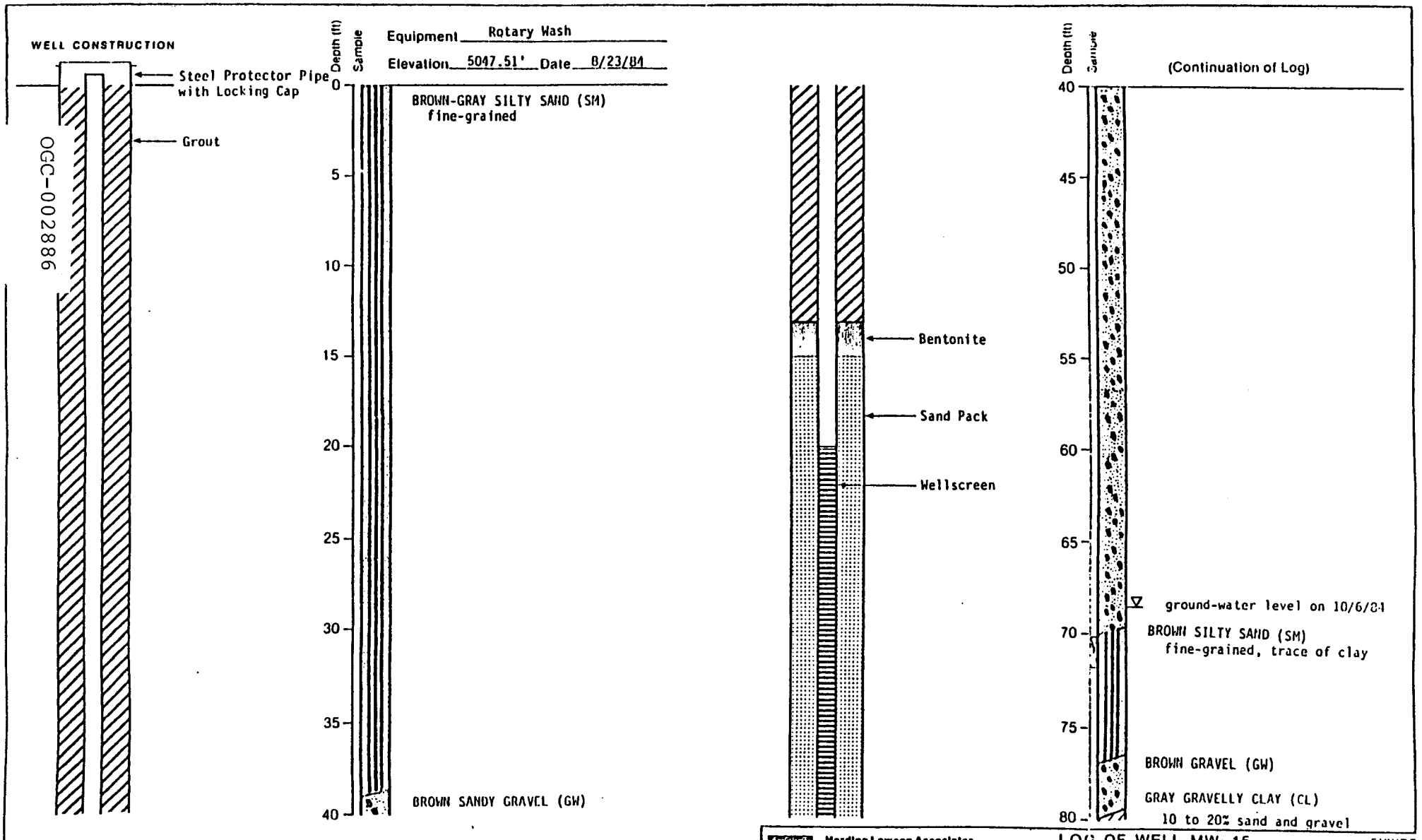
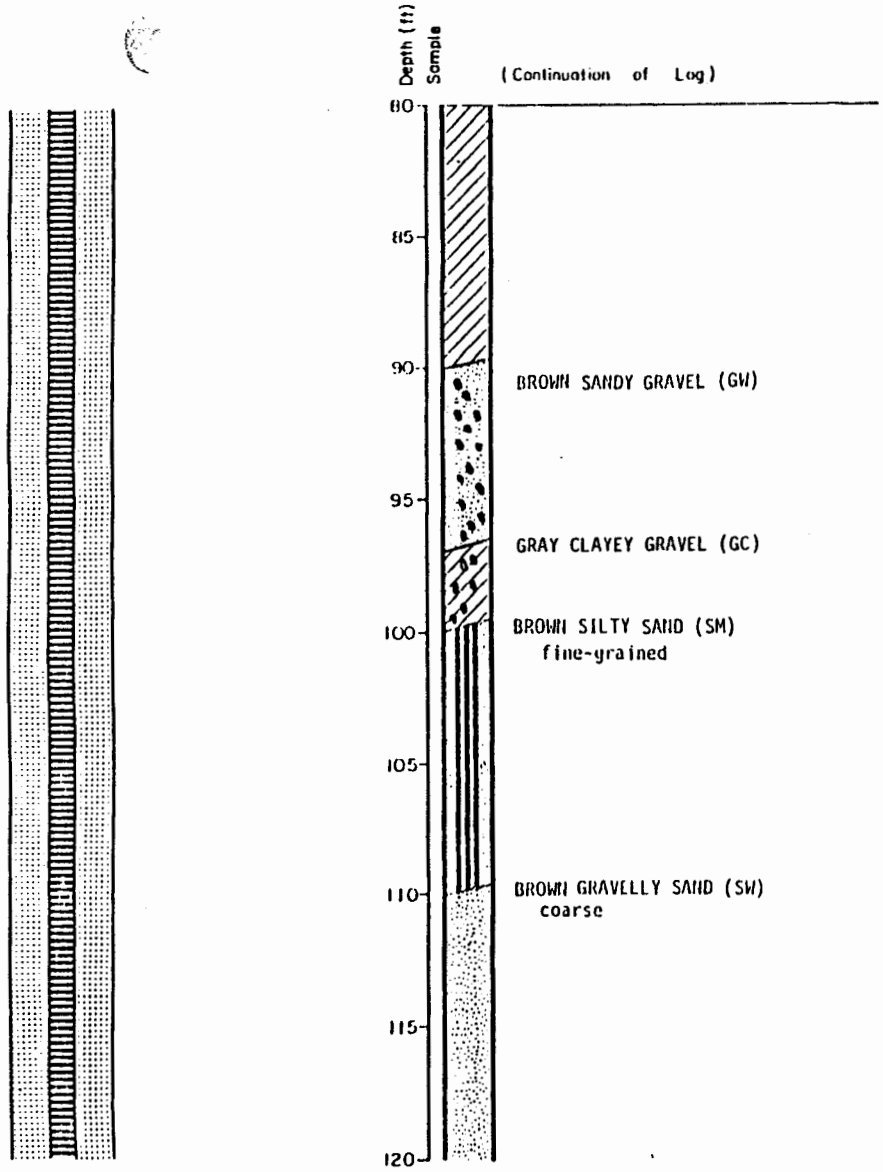
LOG OF WELL MW-14 (Cont'd)
Sparton Technology, Inc.
Albuquerque, New Mexico

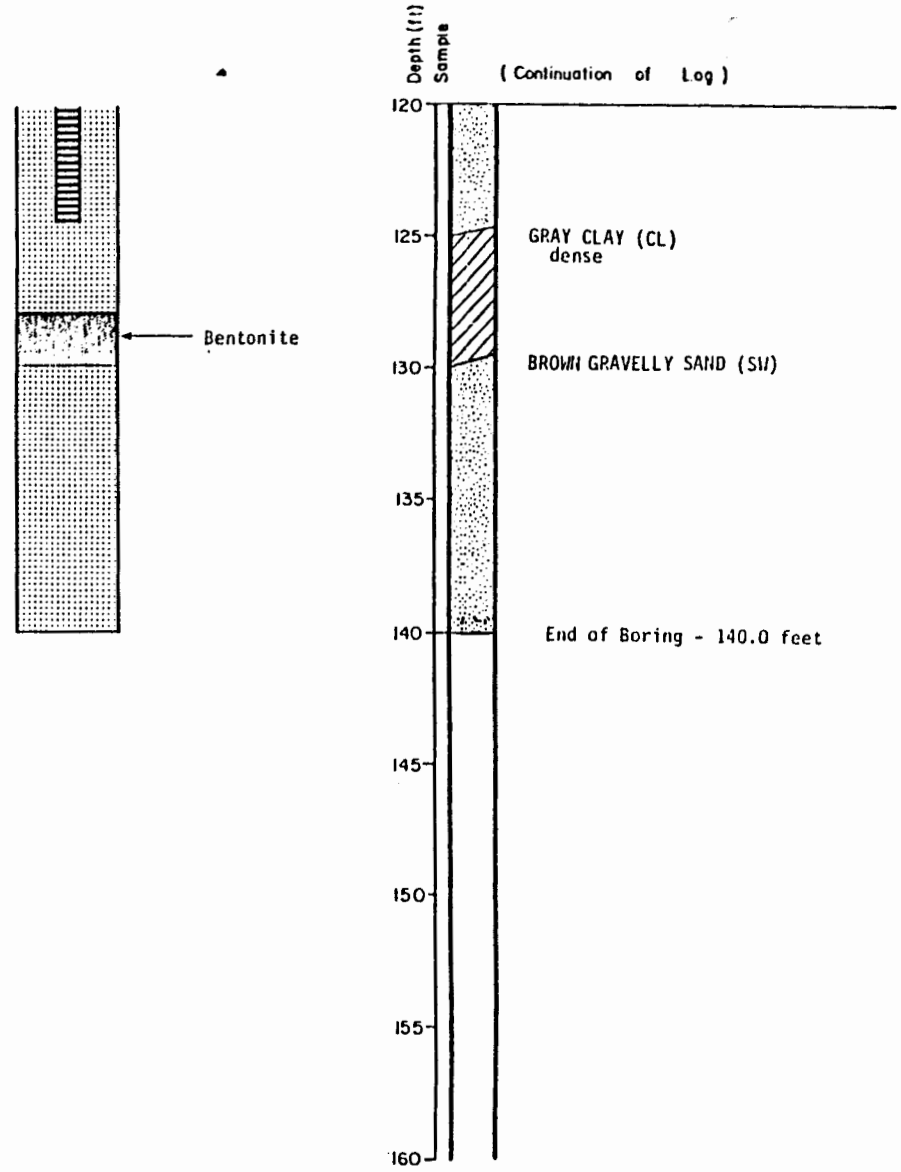
FIGU
51

OGC-002885


WELL CONSTRUCTION
Steel Protector Pipe with Locking Cap
Grout
Depth (ft)
Sample
Equipment Rotary Wash
Elevation 5047.51' Date 8/23/84
BROWN-GRAY SILTY SAND (SM)
fine-grained
BROWN SANDY GRAVEL (GW)
Bentonite
Sand Pack
Wellscreen
(Continuation of Log)
ground-water level on 10/6/84
BROWN SILTY SAND (SM)
fine-grained, trace of clay
BROWN GRAVEL (GW)
GRAY GRAVELLY CLAY (CL)
10 to 20% sand and gravel
Harding Lawson Associates
Engineers, Geologists & Geophysicists
LOG OF WELL MW-15
Sparton Technology, Inc.
Albuquerque, New Mexico
FIGURE
6A
JOB NUMBER
6310,013.12

OGC-002886





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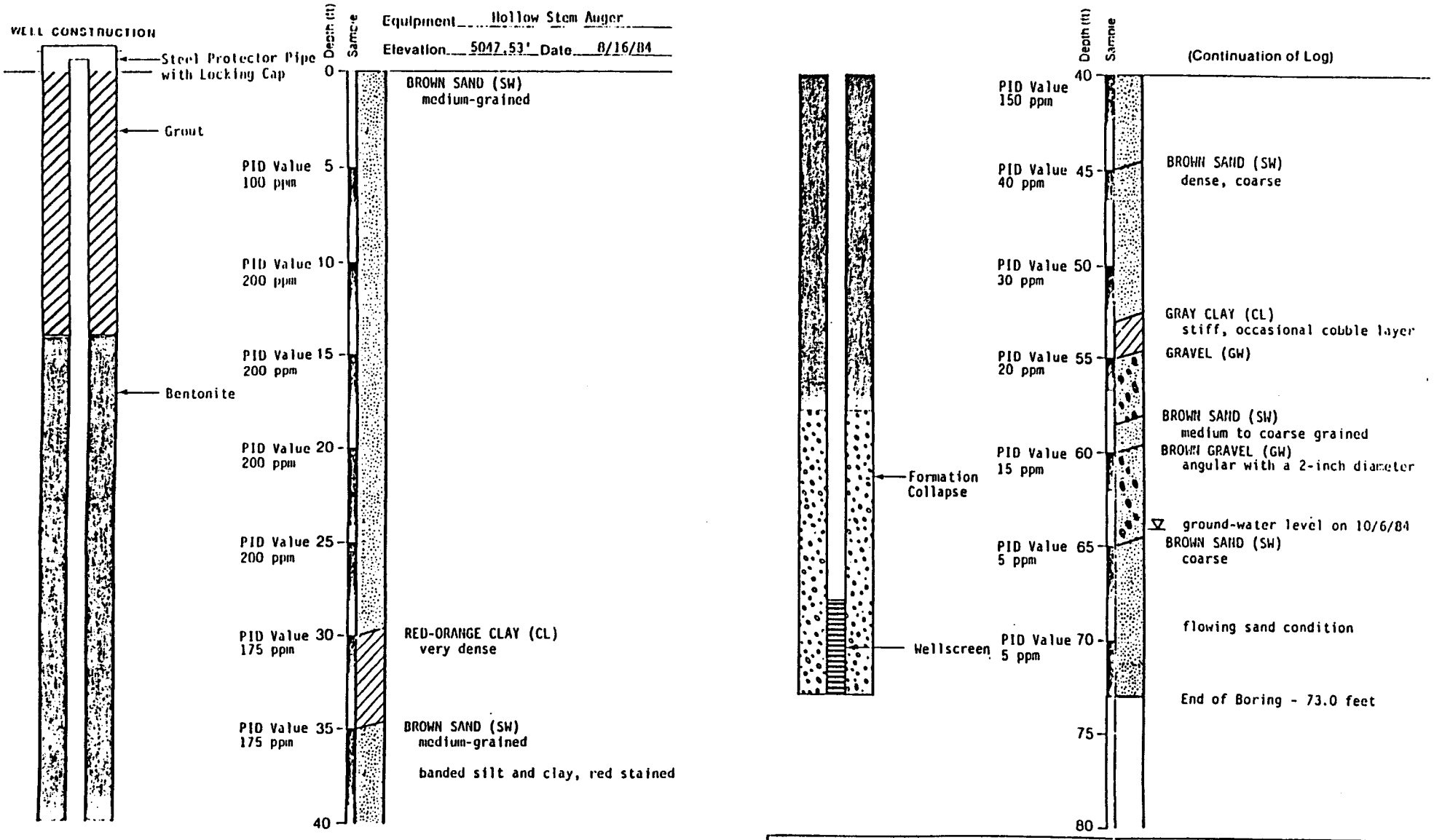
LOG OF WELL MW-15 (Cont'd)
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 6B

OGC-002887



NOTE: PID Values were obtained with an HNU Systems Model 101 with an 11.7eV lamp and are referenced to benzene.

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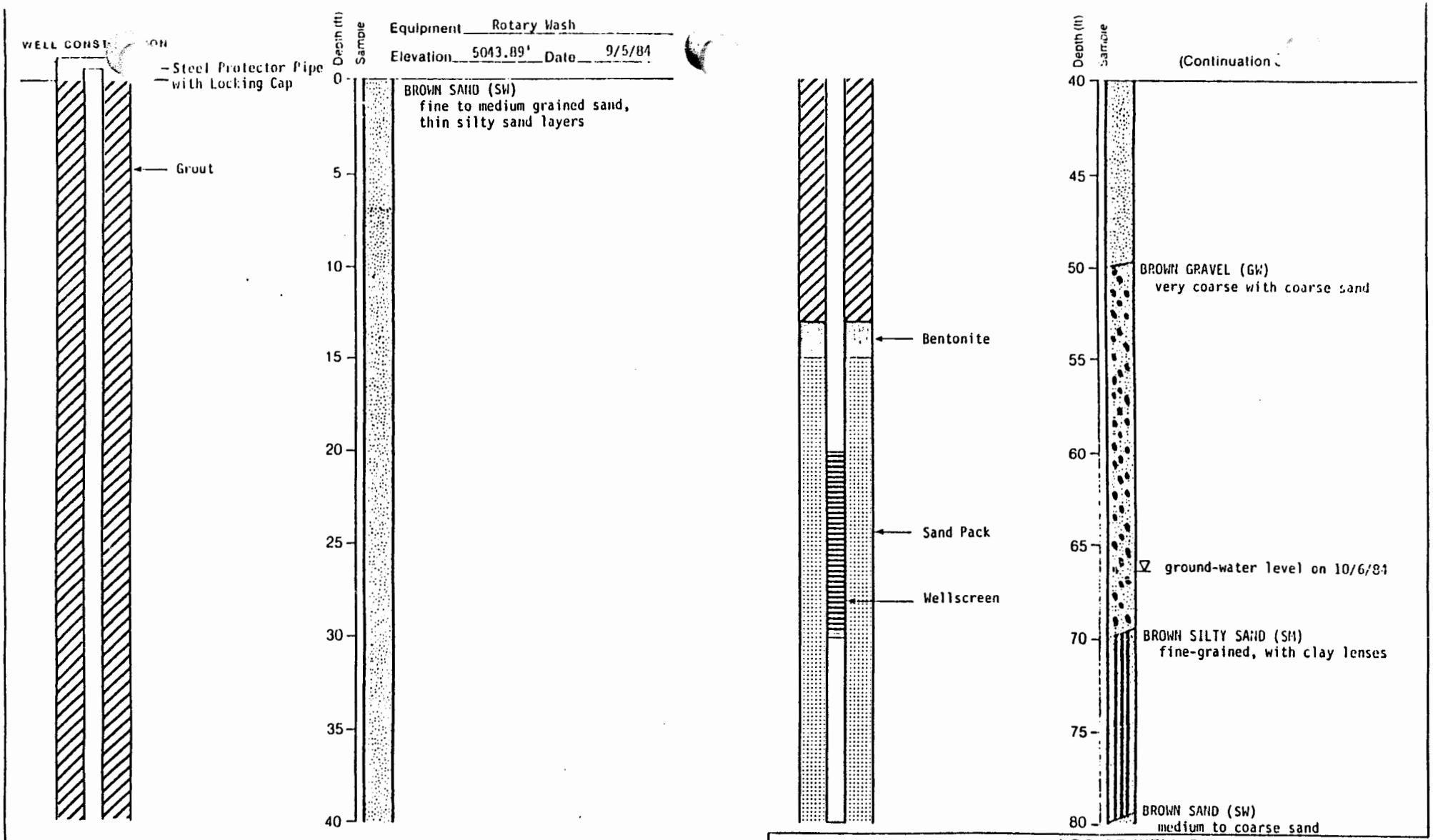
LOG OF WELL MW-16
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 7

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	6310,013.12				

OGC-002888



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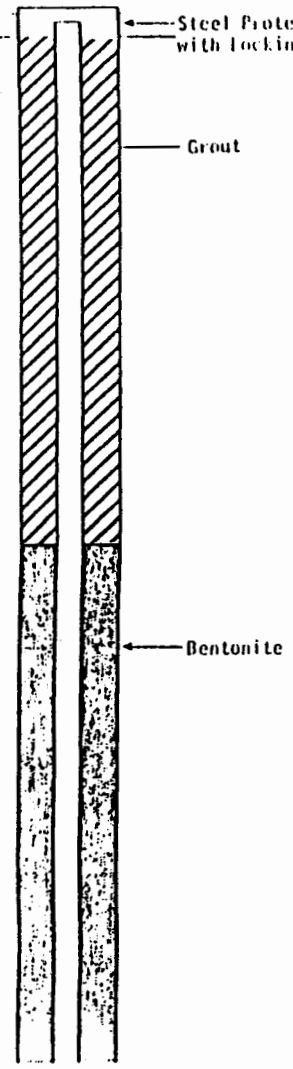
LOG OF WELL PW-1
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 9A

DRAWN
JOB NUMBER 6310,013.12
APPROVED
DATE
REVISED

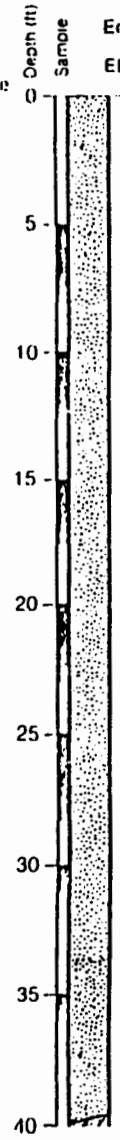
OGC-002889

WELL CONSTRUCTION



Equipment Hollow Stem Auger

Elevation 5049.30' Date 8/24/84

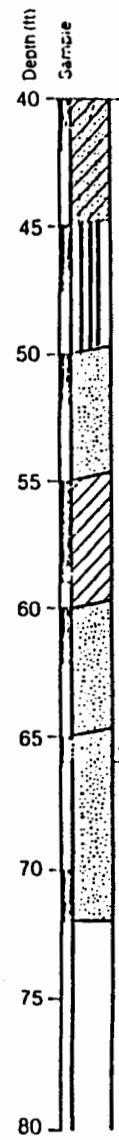


BROWN SAND (SW)
dry, medium grained

increases in density with depth

BROWN CLAYEY SAND (SC)
moist, fine-grained

(Continuation of Log)



GRAY CLAYEY SANDY SILT (ML)

BROWN SAND (SW)
coarse

GRAY CLAY (CL)
dry, dense

BROWN SAND (SW)
wet, coarse to medium grained, thin clay lenses, gravel layers

GRAY GRAVELLY SAND (SW)
saturated, coarse
ground-water level on 10/6/84

flowing sand condition

End of Boring - 72.0 feet

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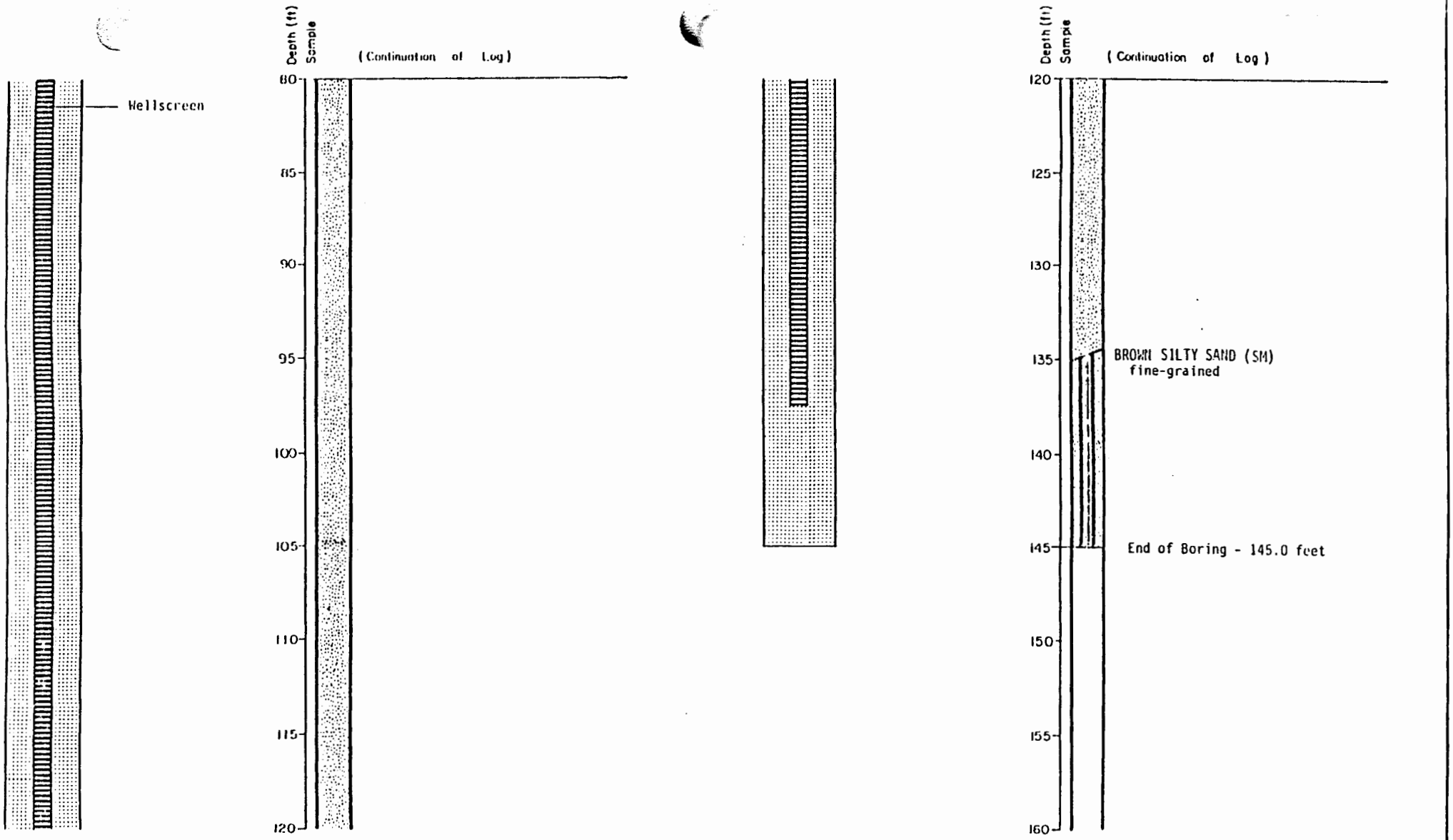
LOG OF WELL MW-17
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 8

DRAWN
JOB NUMBER 6310,013.12
APPROVED
DATE

OGC-002890



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& Geophysicists

LOG OF WELL PW-1 (Cont'd)

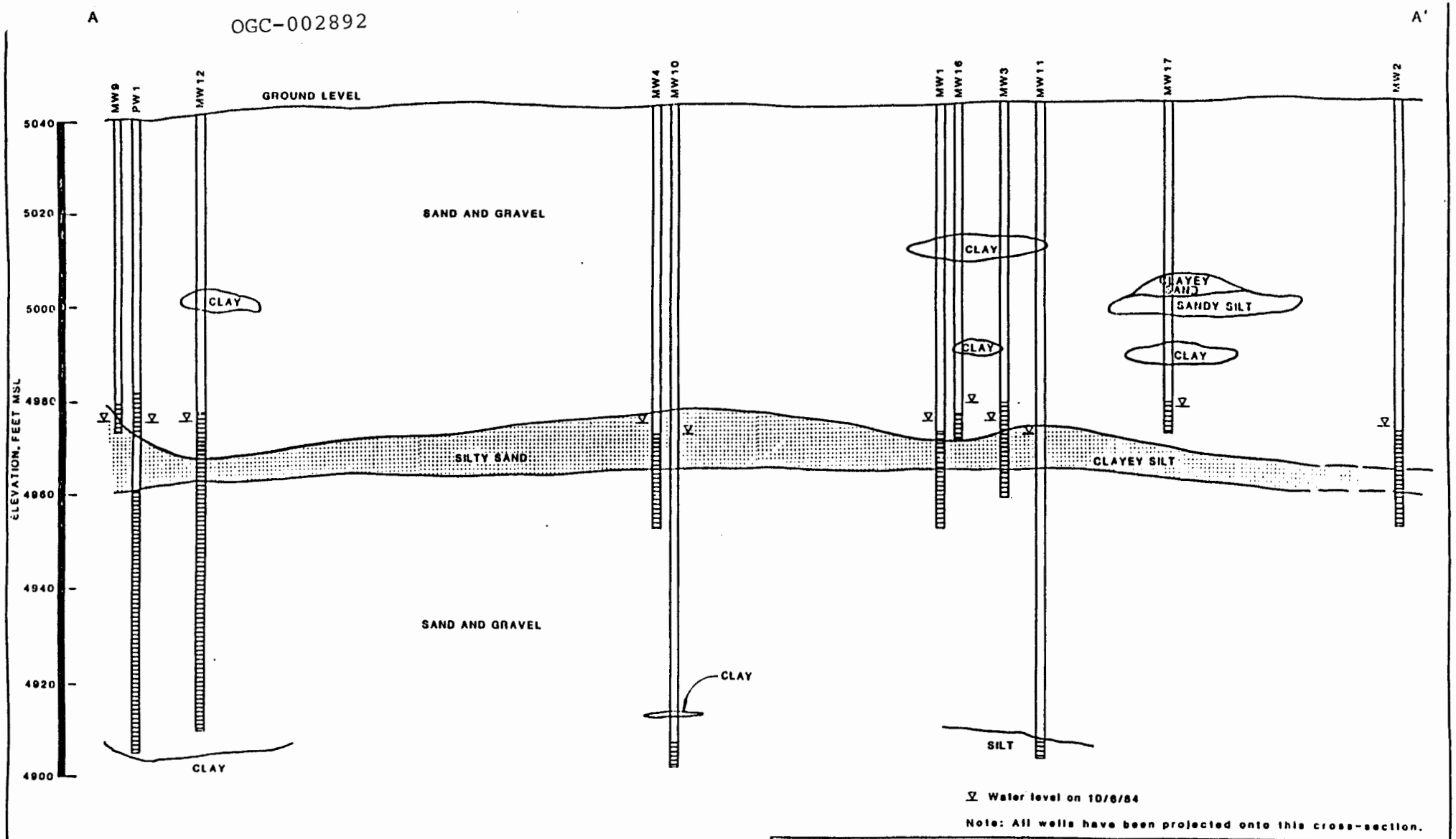
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE
9B

6310.013.12

OGC-002891

OGC-002892



50 0 50 100
scale HORIZONTAL feet

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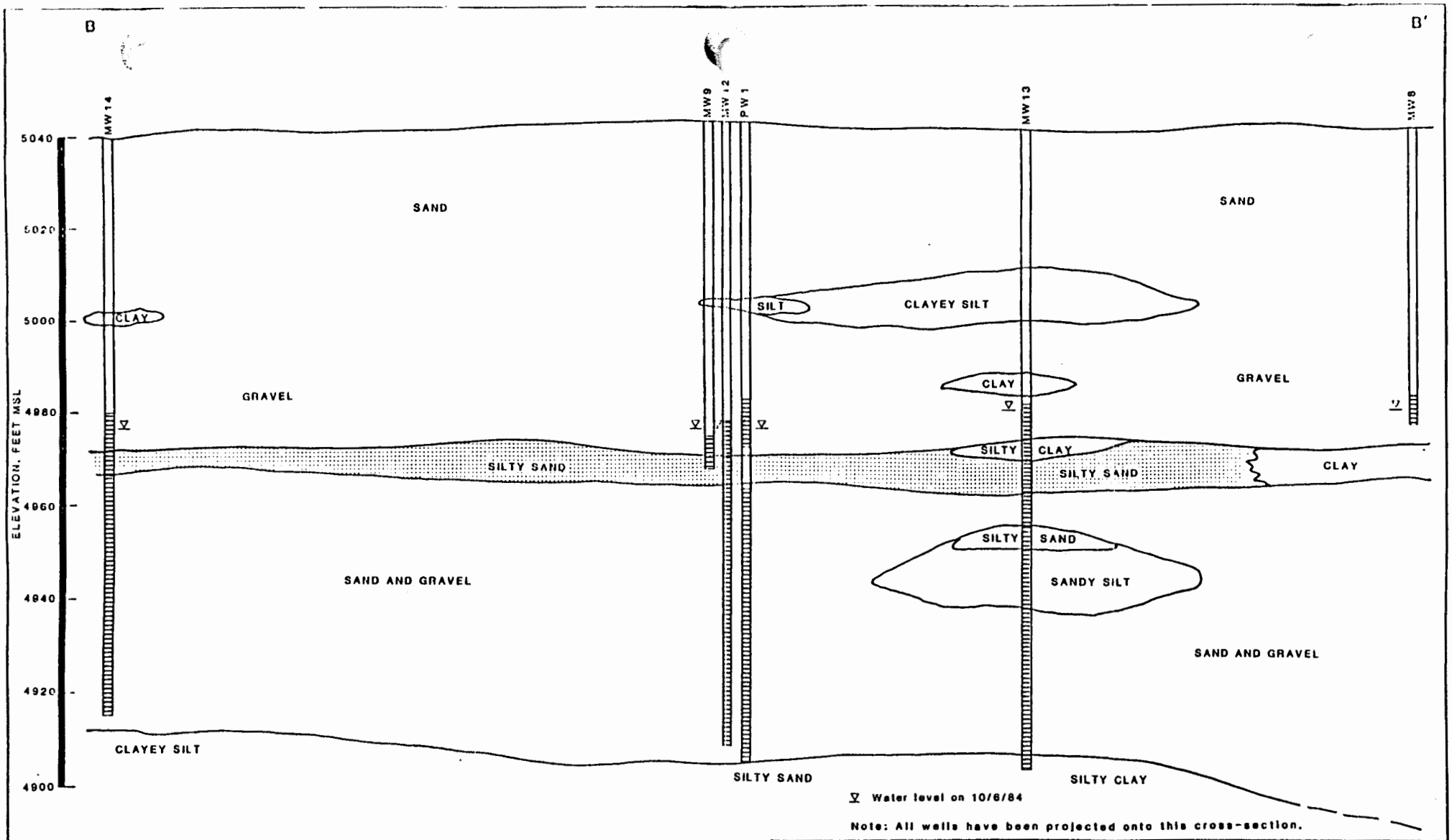
Engineers, Geologists & Geophysicists

GEOLOGIC CROSS-SECTION A-A'
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 10

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
D.K.K.	6310,013.12	DLB	1/11/85		



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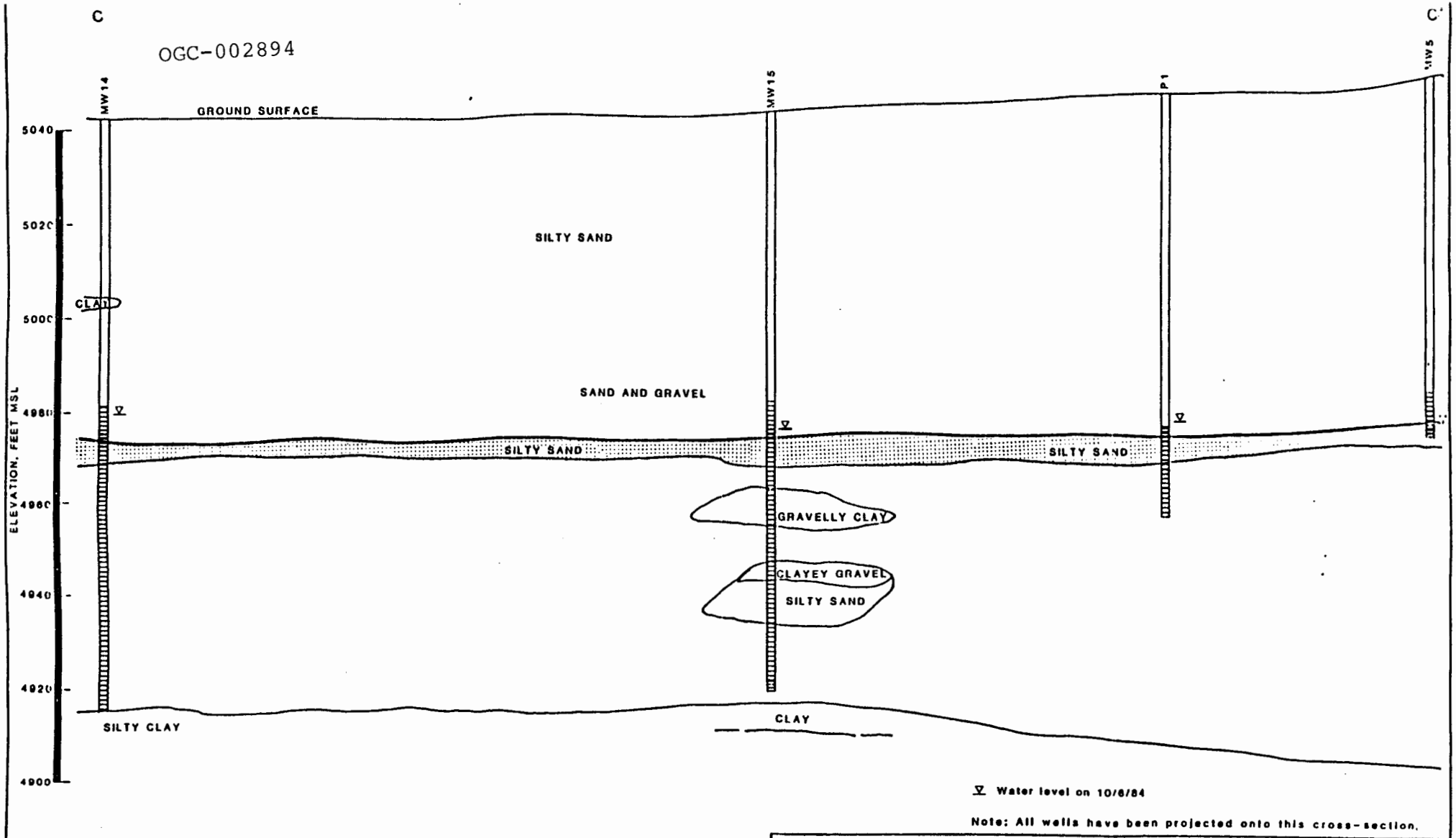
GEOLOGIC CROSS-SECTION B-B'
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 11

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
D.K.K.	6310,013.12	DCJ	1/11/85		

OGC-002893

OGC-002894



50 0 50 100
scale HORIZONTAL feet

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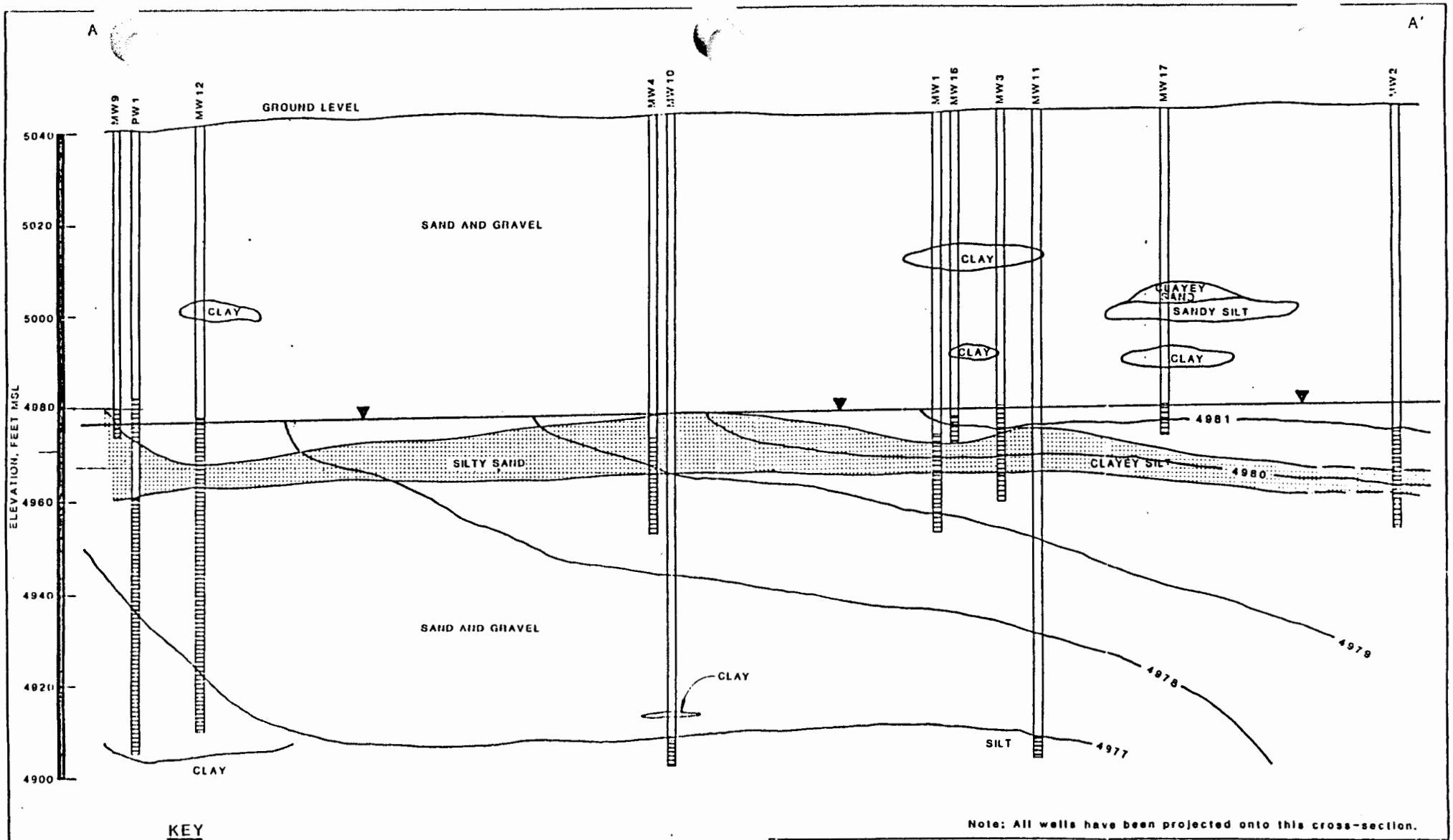
Engineers, Geologists & Geophysicists

GEOLOGIC CROSS-SECTION C-C'
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 12

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
D.K.K.	6310,013.12	DCG	1/11/85		



Note: All wells have been projected onto this cross-section.

KEY

Water Table

4977 Piezometric Head Contour in feet above MSL

50 0 50 100
scale HORIZONTAL feet

Harding Lawson Associates
Engineers Geologists & Geophysicists

STATIC PIEZOMETRIC HEAD

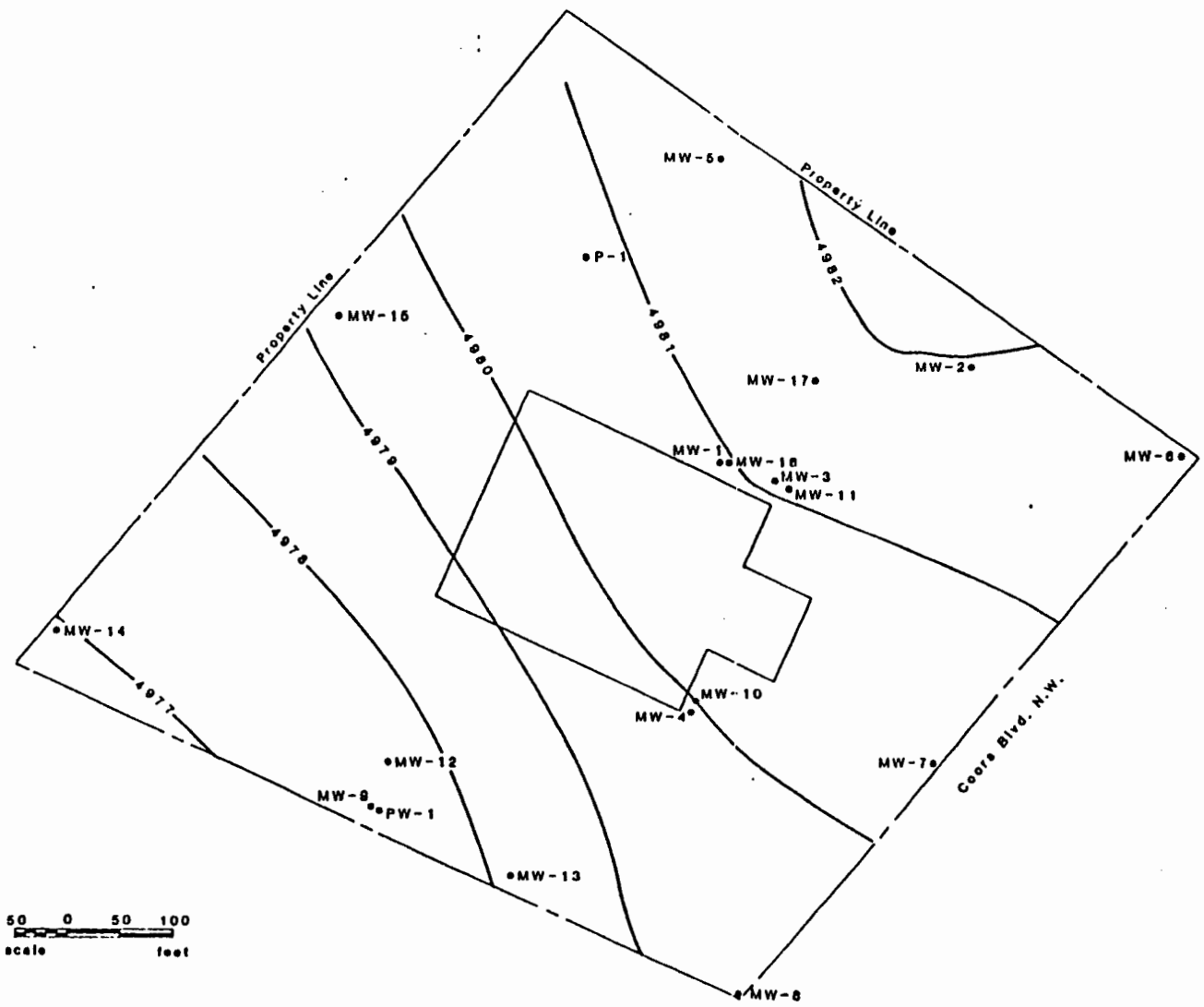
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 13

DRAWN DKK JOB NUMBER 6310,013.12 APPROVED DATE

OGC-002895

OGC-002896



KEY:

MW-1 ● Monitoring Well Location

--4980— Water Table Elevation, feet above MSL (10/6/84)

Contour Interval 1 Foot

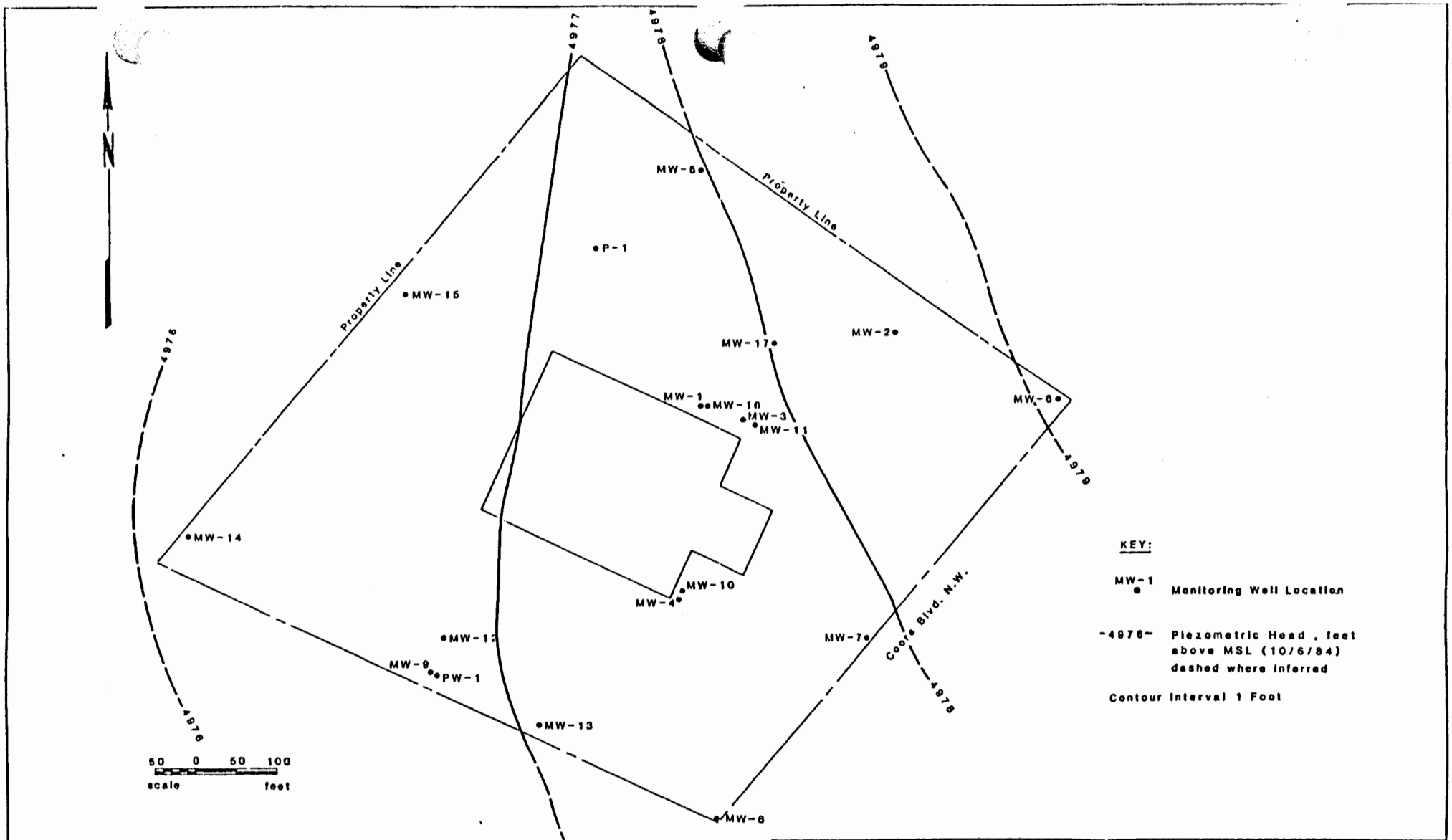
Reference: Sparton Tech. Inc. Survey by Denney-Gross & Assoc., Inc., Dated 10/5/84.

Harding Lawson Associates
Engineers, Geologists & Geophysicists

STATIC WATER TABLE IN UPPER AQUIFER
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 14

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	6310,013.12				



Reference: Sparton Tech. Inc. Survey by Denney-Gross & Assoc., Inc., Dated 10/5/84.

Harding Lawson Associates
Engineers, Geologists & Geophysicists

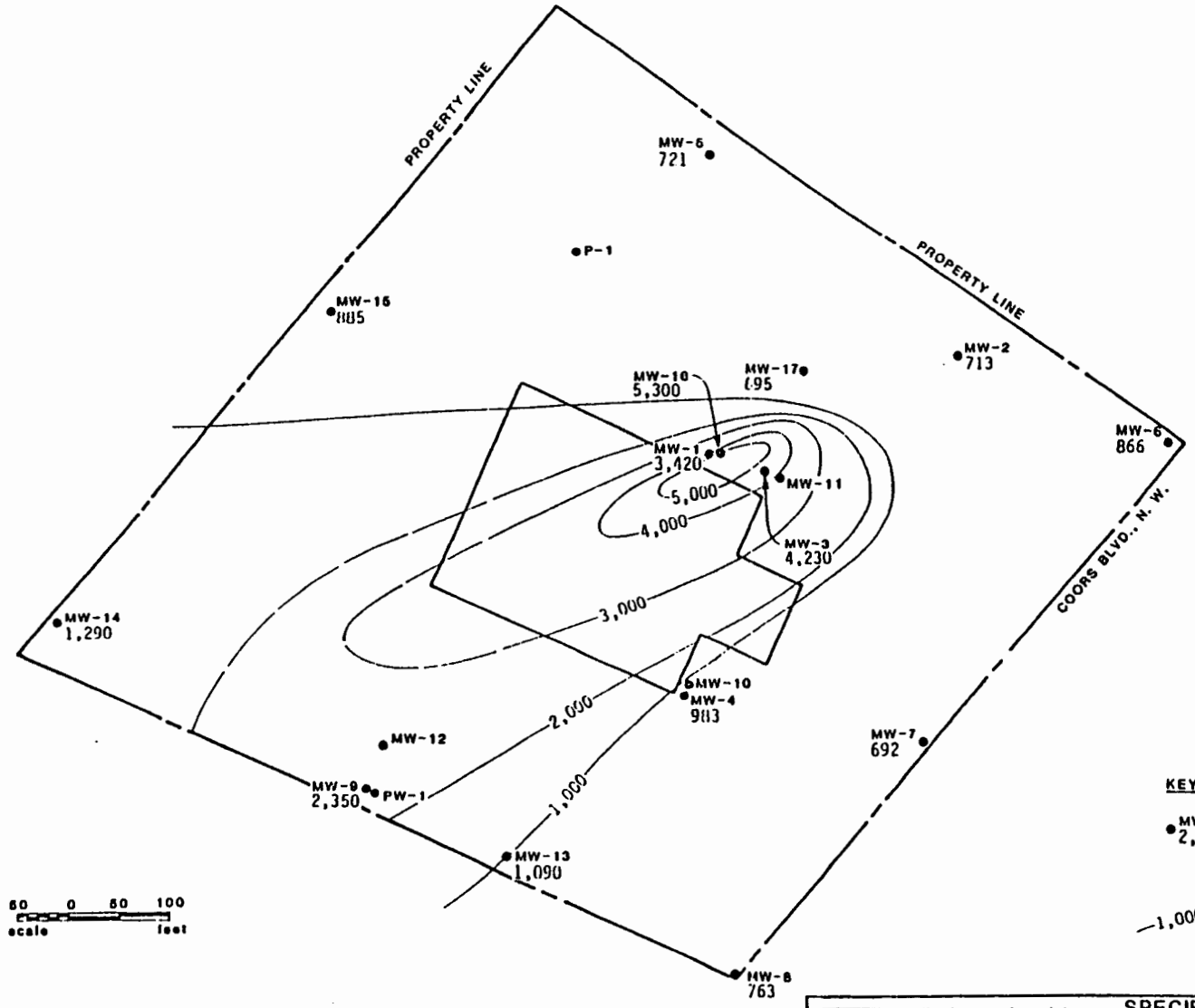
STATIC PIEZOMETRIC HEAD IN LOWER AQUIFER
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 15

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	6310,013.12				

OGC-002897

OGC-002898



KEY:

MW-1 2,350 — Monitoring Well Location/Specific Conductance in umho/cm

Sampling dates 10/4/84 through 11/29/84

1,000 — Specific Conductance Contour in umho/cm dashed where inferred

Contour interval as shown

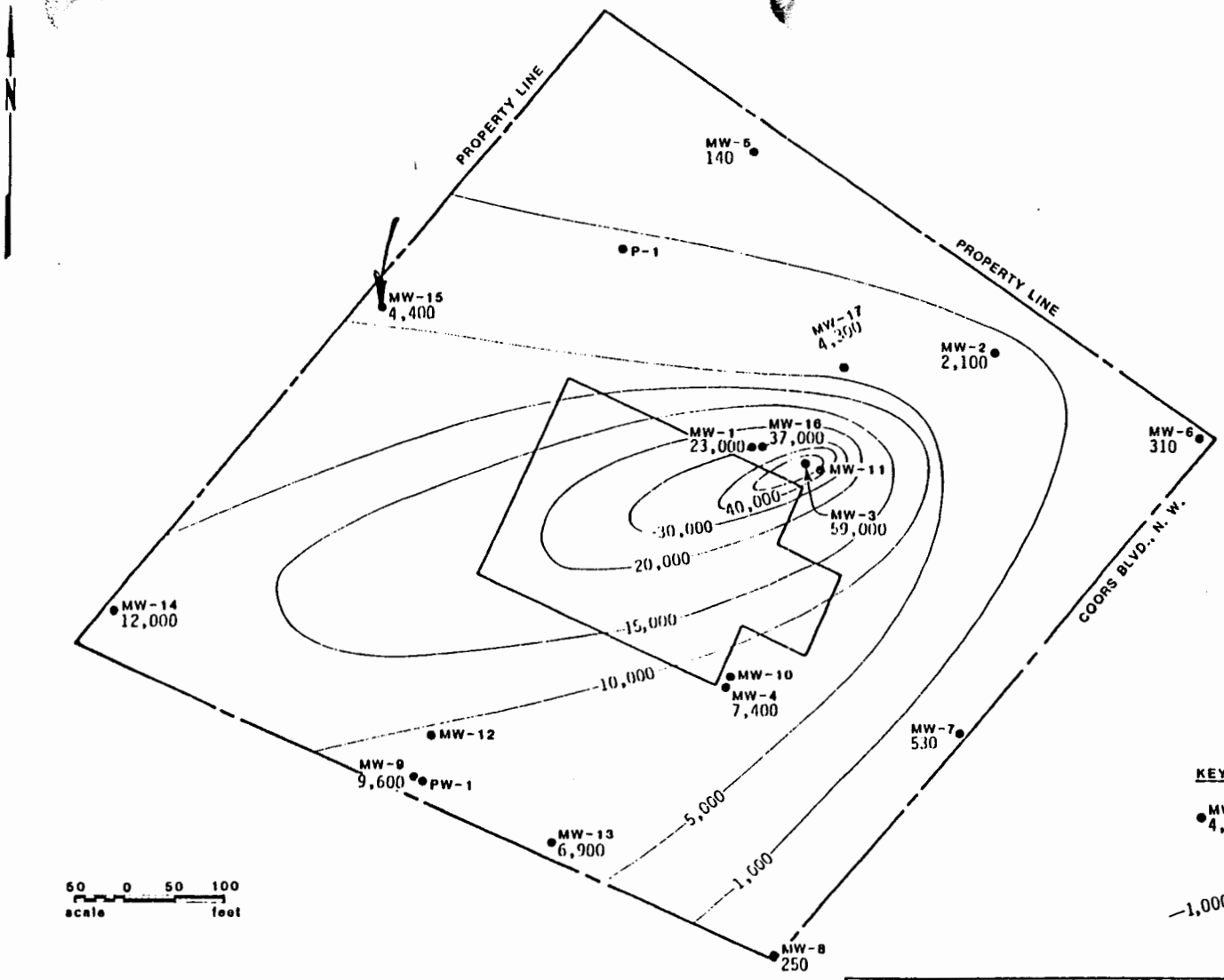
Reference: Sparton Technology, Inc. Survey by Denney-Gross & Assoc., Inc., Dated 10/5/84.

Harding Lawson Associates
Engineers, Geologists & Geophysicists

SPECIFIC CONDUCTANCE VALUES IN UPPER AQUIFER
Sparton Technology, Inc.
Albuquerque, New Mexico

16

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
JD	6310,013.12	JH.	3/85		



KEY:

MW-1 4,400 — Monitoring Well Location/Trichloroethylene Concentration in ug/l(ppb)

Sampling dates 10/4/84 through 11/29/84

—1,000— Trichloroethylene Contour in ug/l dashed where inferred

Contour interval as shown

Reference: Sparton Technology, Inc. Survey by Danney-Gross & Assoc., Inc., Dated 10/5/84.

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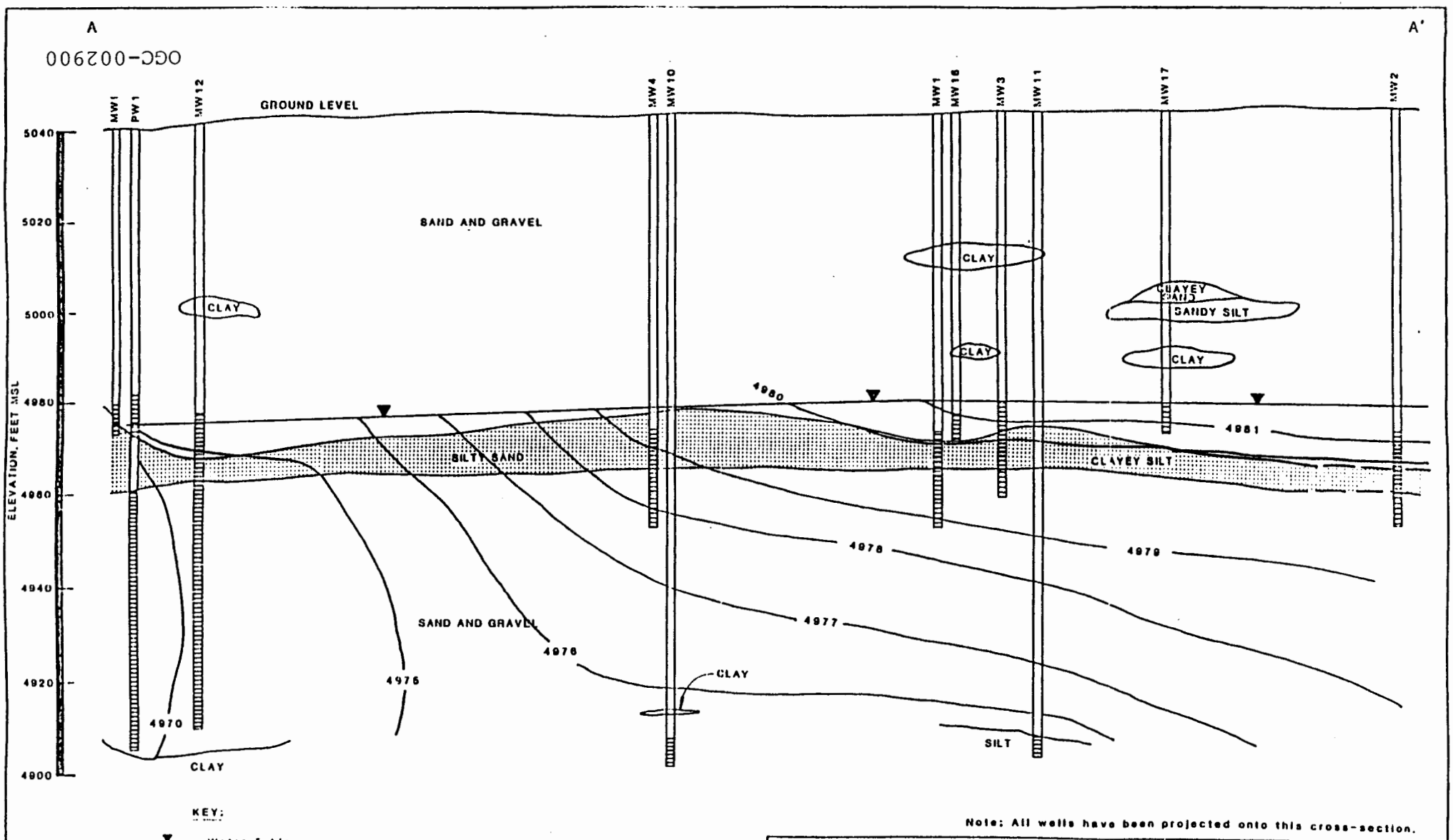
TRICHLOROETHYLENE CONCENTRATIONS IN UPPER AQUIFER
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 17

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
JD	6310,013.12	JL	3/85		

OGC-002899

OGC-002900



KEY:

Water Table

4978 Piezometric Head Contour in feet above MSL

Contour Interval as Shown

50 0 50 100
scale HORIZONTAL feet

Note: All wells have been projected onto this cross-section.

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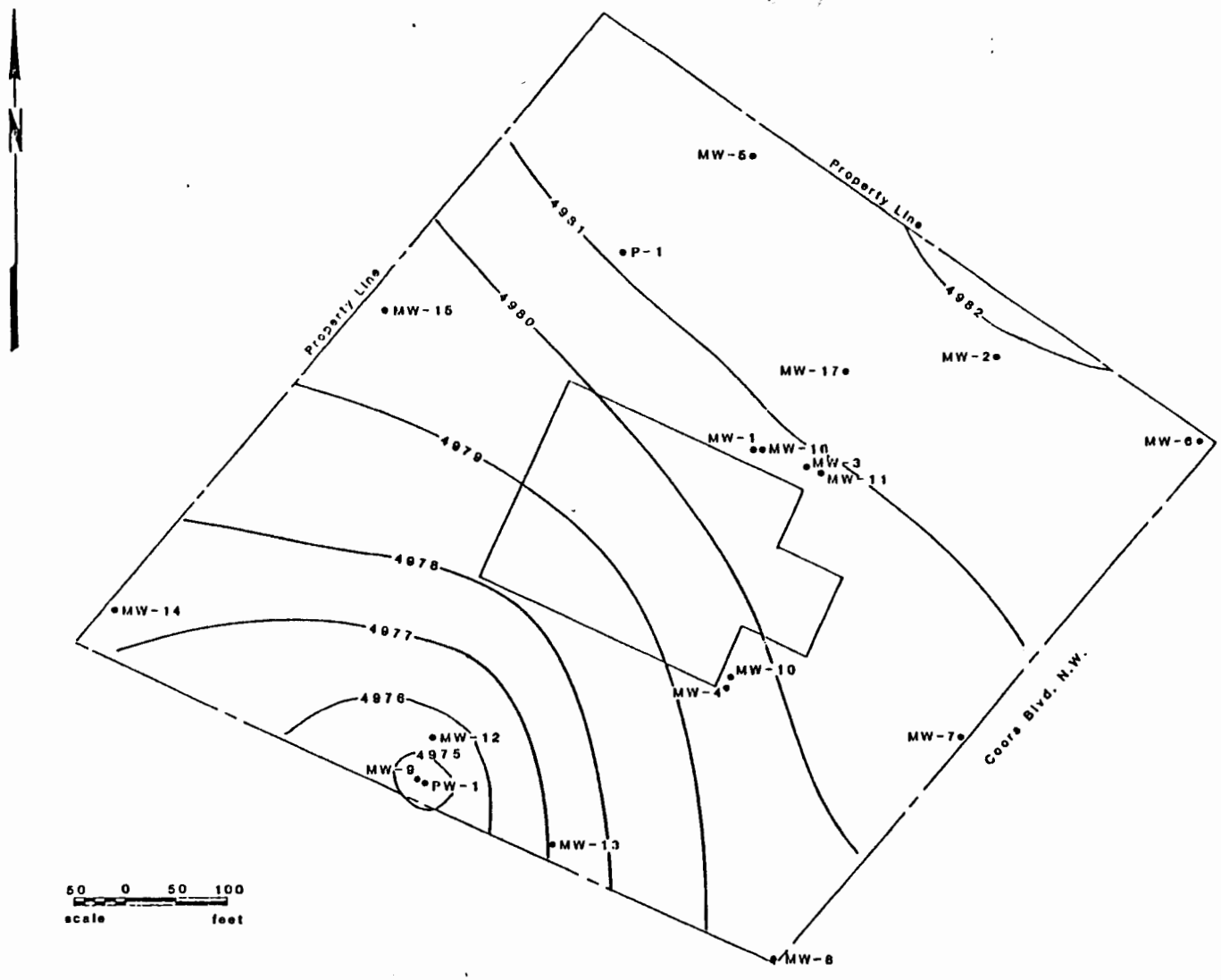
PIEZOMETRIC HEAD AT END OF PUMPING TEST
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 18

DRAWN DKK. JOB NUMBER 6310.013.12 APPROVED DATE



KEY:

MW-1 ● Monitoring Well Location

—4981— Water Table Elevation, feet above MSL (10/8/84)

Contour Interval 1 Foot

Reference: Sparton Tech. Inc. Survey by Denney-Gross & Assoc., Inc., Dated 10/8/84.

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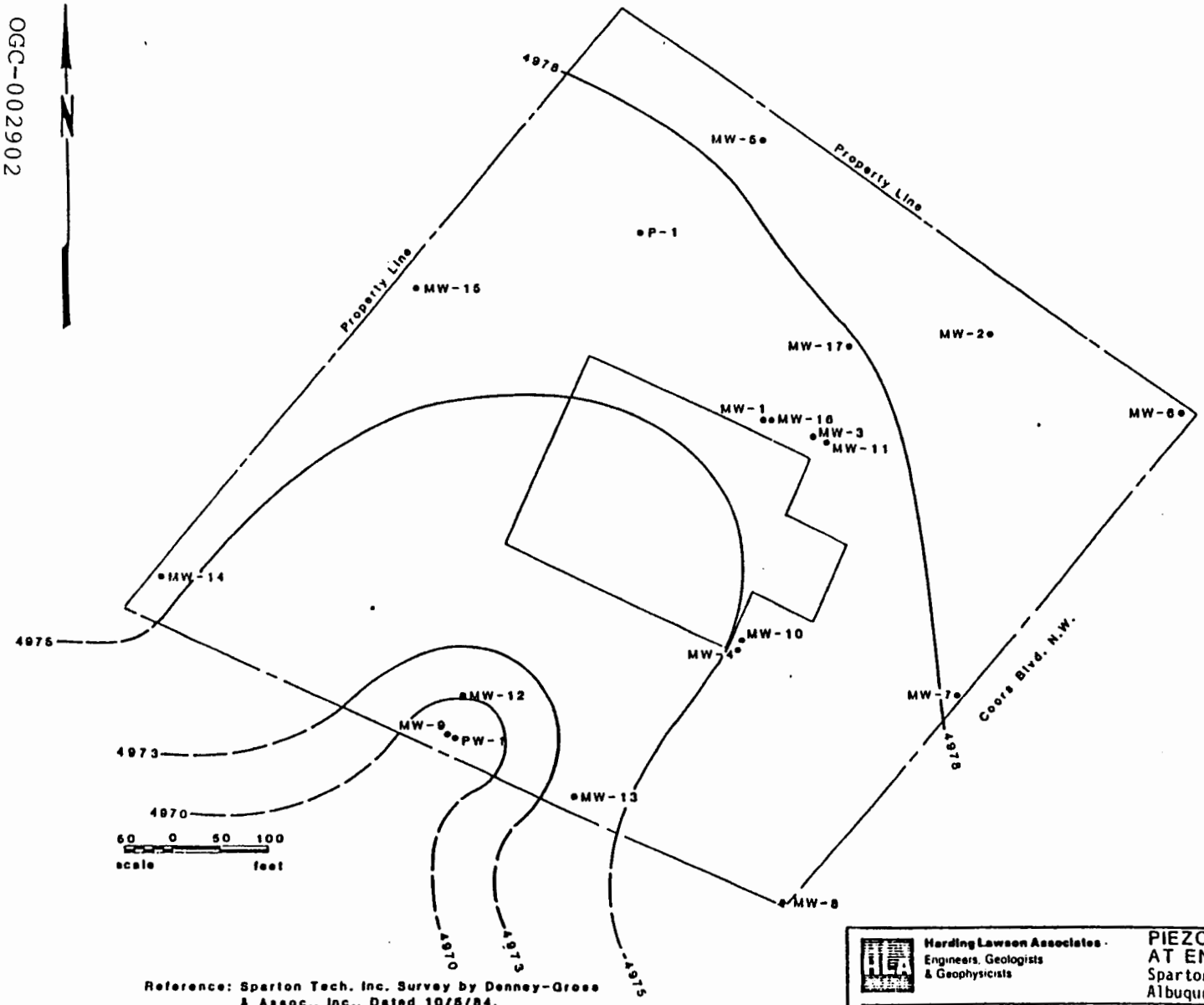
WATER TABLE IN UPPER AQUIFER AT END OF TEST
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 19

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	6310,013.12				

OGC-002901

OGC-002902



KEY:

MW-1 ● Monitoring Well Location

—4973— Piezometric Head, feet above MSL (10/8/84) dashed where inferred

Contour Interval as Shown

Reference: Sparton Tech. Inc. Survey by Denney-Grose & Assoc., Inc., Dated 10/5/84.

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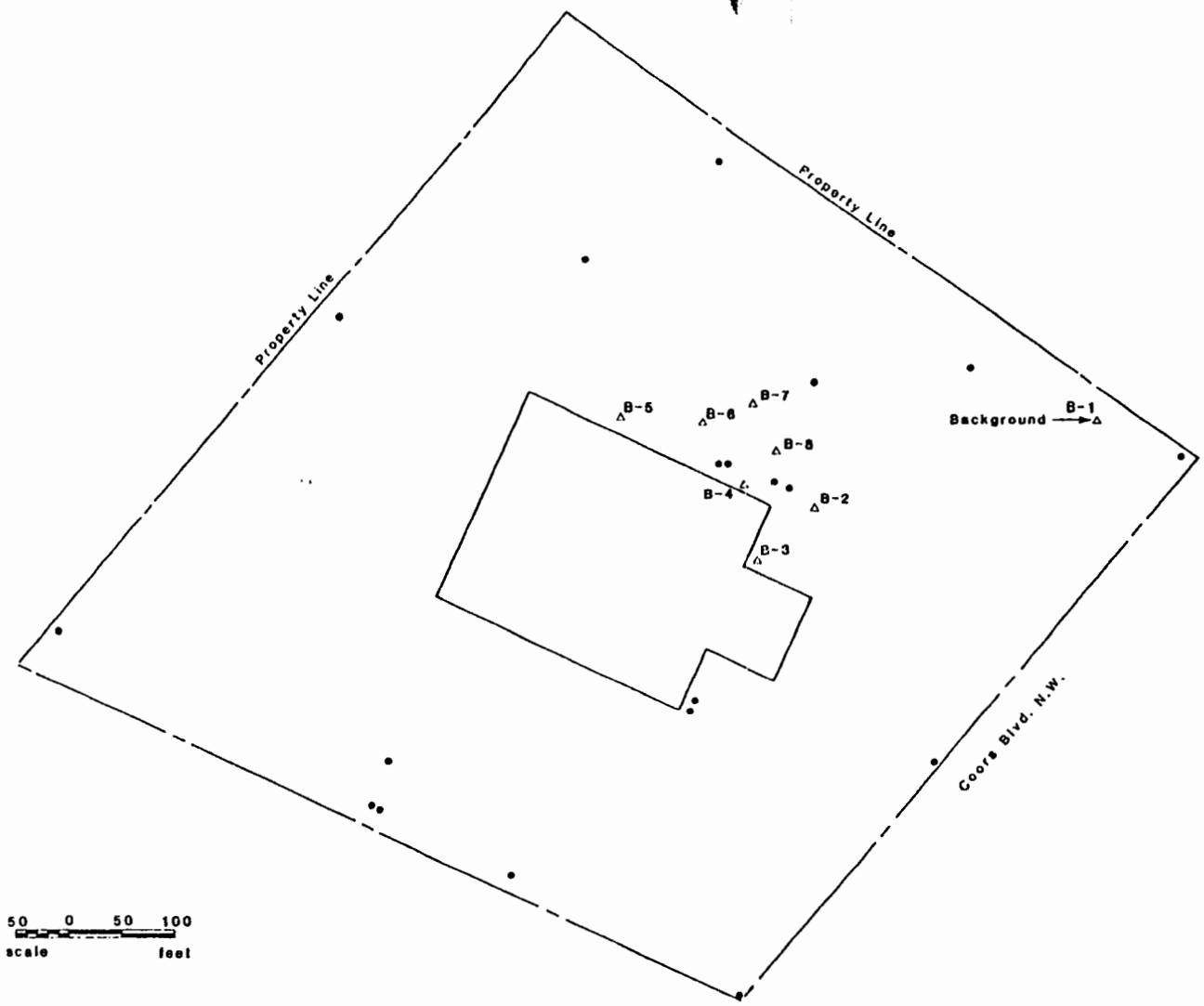
PIEZOMETRIC HEAD IN LOWER AQUIFER AT END OF TEST
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 20

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	6310,013.12				



KEY:

● Well Location

B-2 △ Proposed Soil Boring Location

Reference: Sparton Tech. Inc. Survey by Denney-Gross & Assoc., Inc., Dated 10/5/84.

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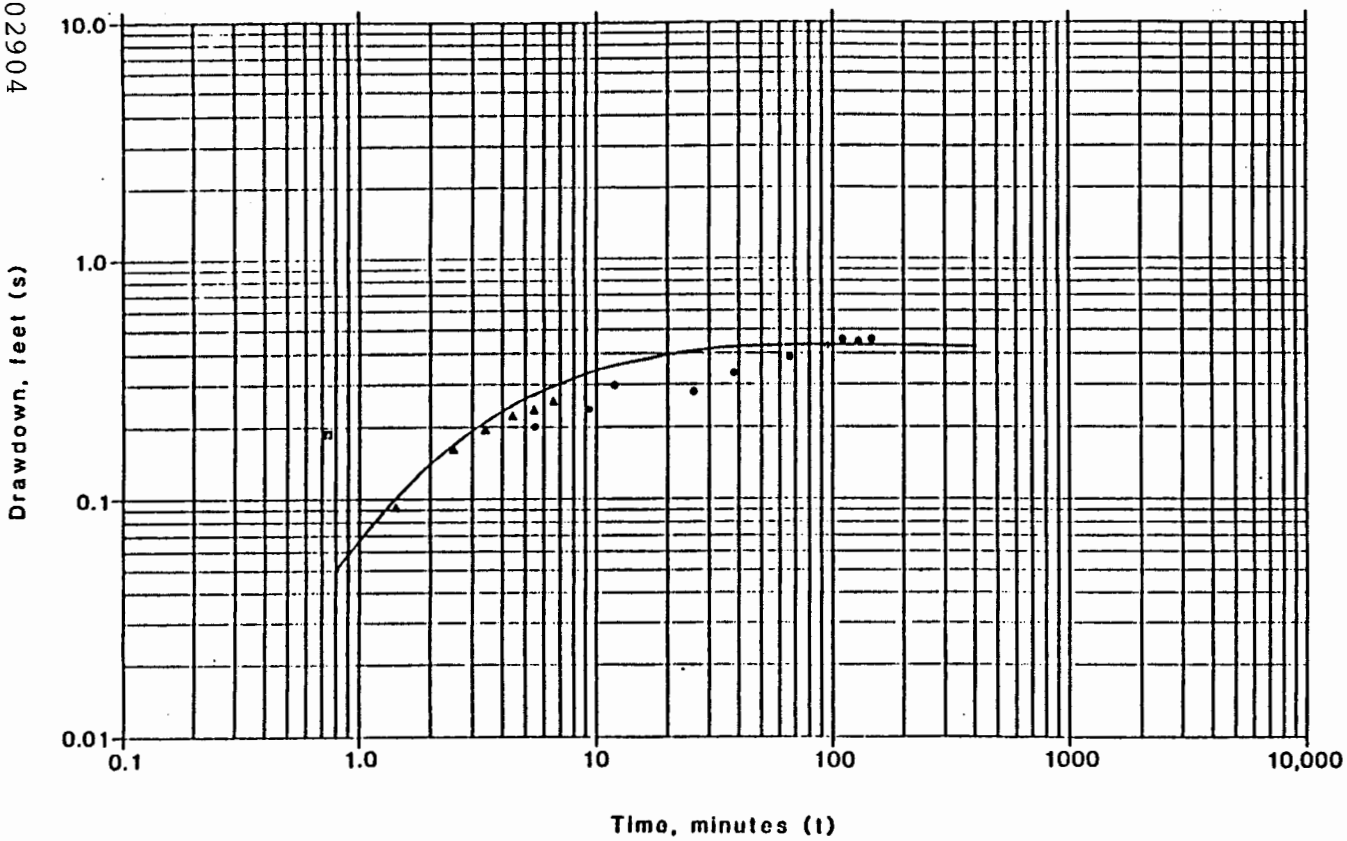
PROPOSED SOIL BORING LOCATIONS
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE 21

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
HM	6310,013.12	DB	1/4/85		

OGC-002903

OGC-002904



LEGEND:

- ● Drawdown Data
- ▲ Recovery Data
- ■ Match Point

CALCULATIONS:

$v = 0.2$

$L(u,v) = 1$

$1/u = 1$

$s = 0.18$ feet

$t = 7.2$ minutes

$Q = 180$ gpm

$r = 306$ feet

$T = \frac{114.6\ Q}{s} * L(u,v)$ gpd/ft

$T = 114{,}600$ gpd/ft

$S = \frac{T\ t\ u}{2963\ r^2}$

$S = 0.0033$

$K'/b' = \frac{T\ v^2}{1.87\ r^2}$ 1/day

$K'/b' = 0.026$/day

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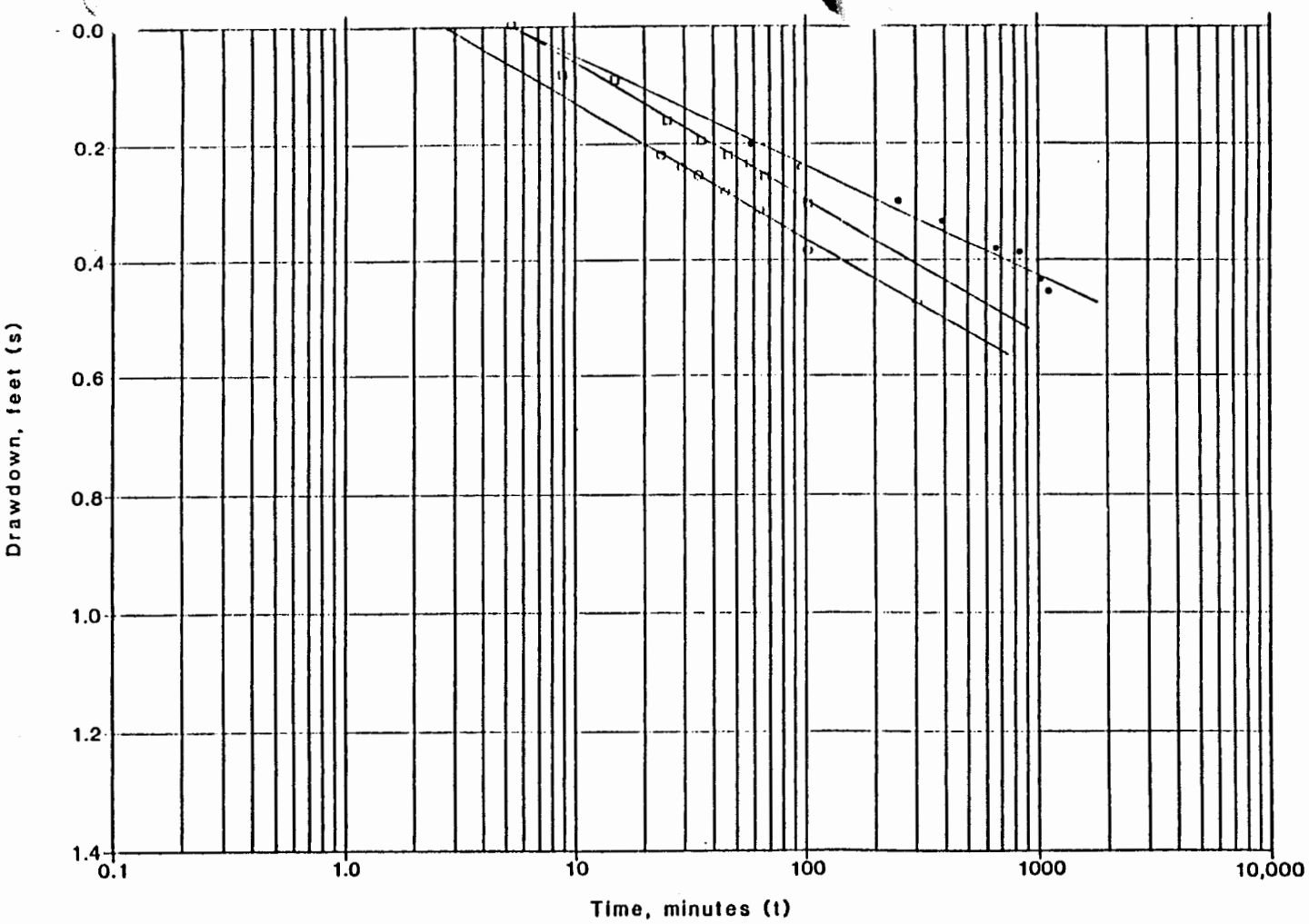
MW-4 PUMPING TEST DATA
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE E1

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	6310,013.12				



LEGEND:

- • Drawdown Data
- o Residual Drawdown Data
- □ Recovery Data

CALCULATIONS:

Q = 180 gpm

r = 306 feet

$T = \frac{264\ Q}{\Delta s}$ gpd/ft

$S = \frac{T\ to}{4790\ r^2}$

	Δs	to	T	S
•	0.205	5.2	232,000	0.0027
o	0.220	-	216,000	-
□	0.225	5.1	211,000	0.0024

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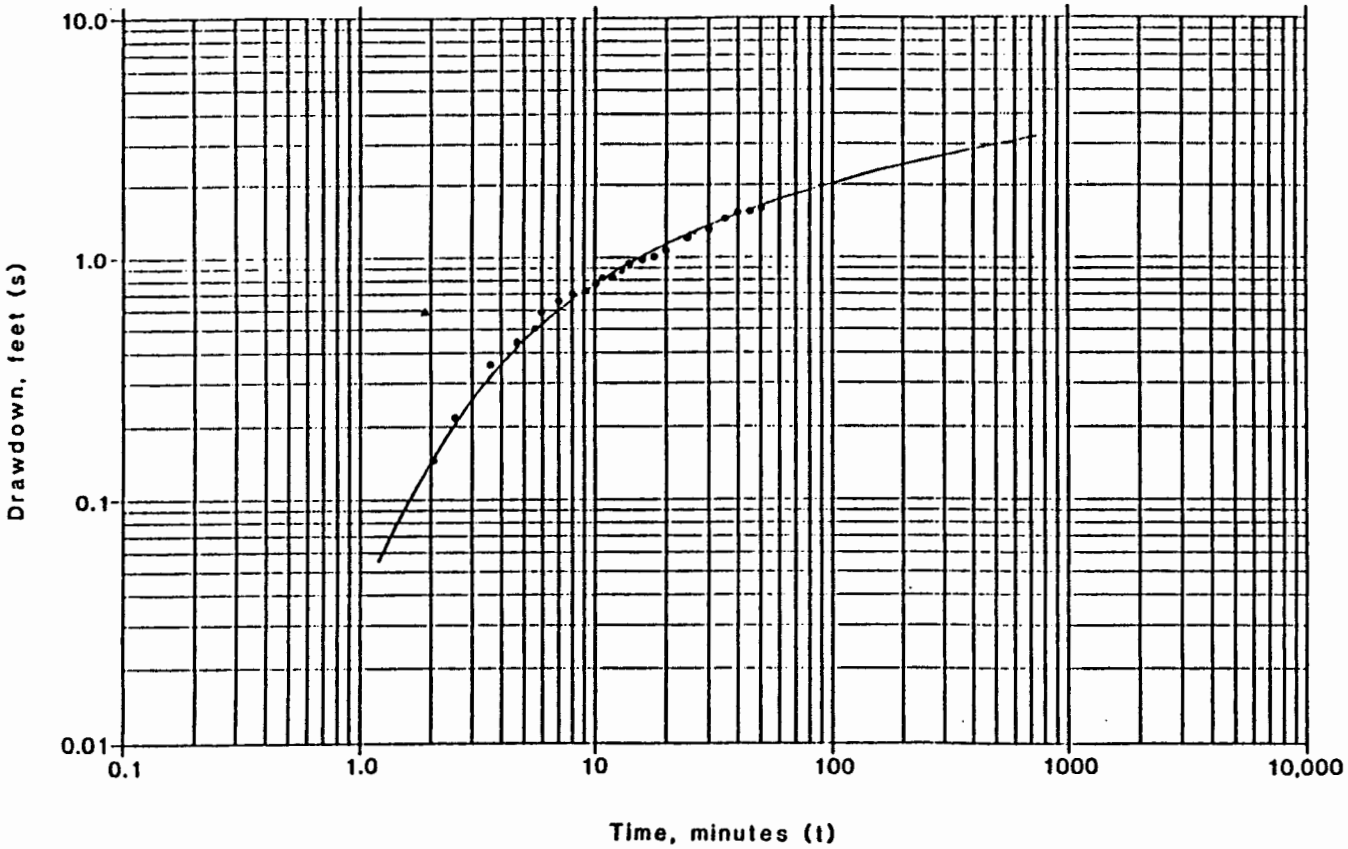
MW-4 PUMPING TEST DATA
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE E2

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
LM	6310,013.12	DLB	1/11/8		

OGC-002905

OGC-002906



LEGEND:

- • Drawdown Data
- ▲ Match Point

CALCULATIONS:

$v = 0$

$L(u,v) = 1$

$1/u = 1$

$s = 0.70$ feet

$t = 2.1$ minutes

$Q = 50$ gpm

$r = 8$ feet

$T = \frac{114.6\ Q}{s} * L(u,v)$ gpd/ft

$T = 9700$ gpd/ft

$S = \frac{T\ t\ u}{2963\ r^2}$

$S = 0.09$

$K'/b' = \frac{T\ v^2}{1.87\ r^2}$ 1/day

$K'/b' = 0$/day

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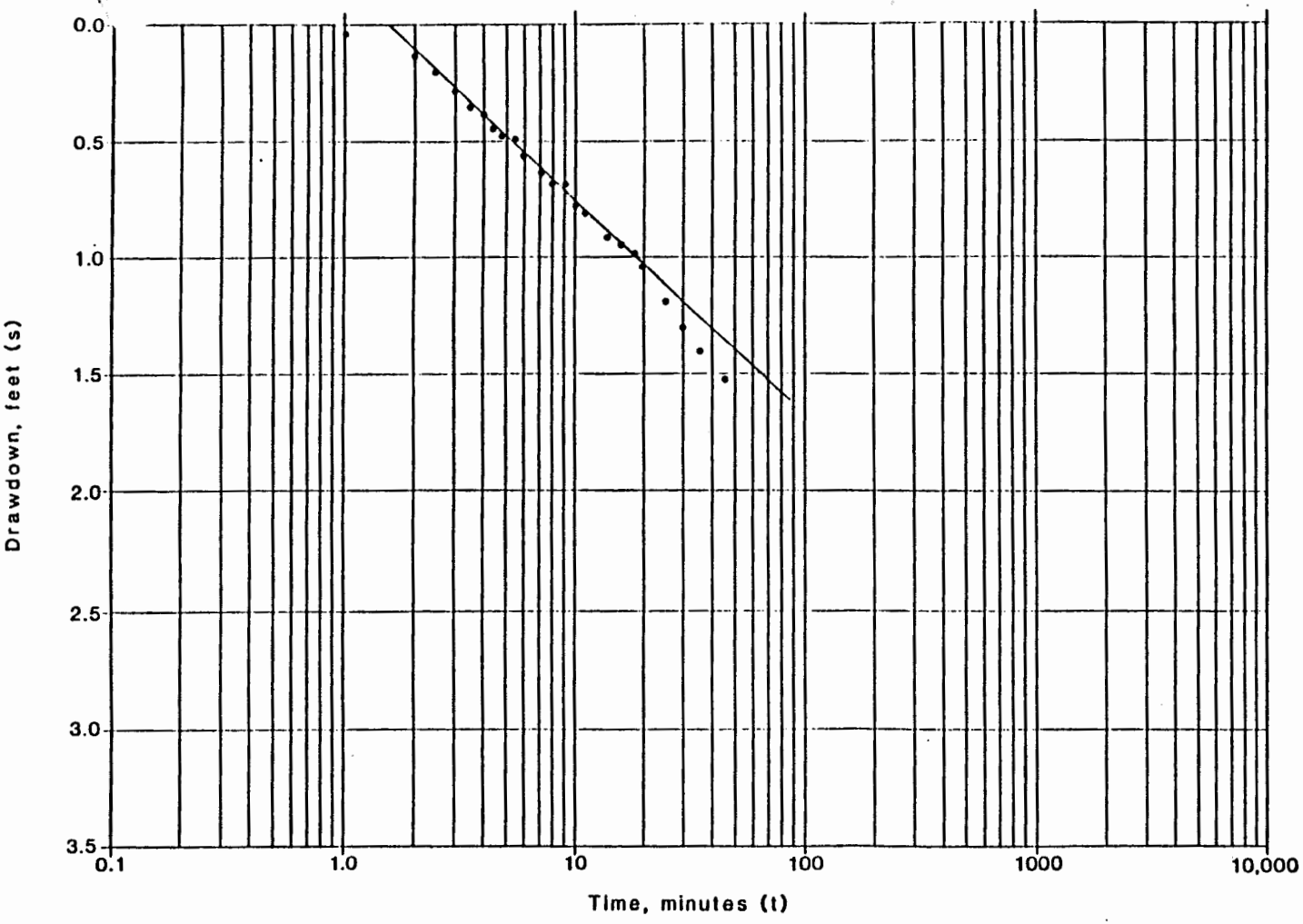
MW-9 PUMPING TEST DATA
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE E3

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
LM	6310,013.12				



LEGEND:

- Drawdown Data

CALCULATIONS:

$Q = 50$ gpm

$r = 8$ feet

$T = \frac{264\ Q}{\Delta s}$ gpd/ft

$S = \frac{T\ to}{4790\ r^2}$

	Δs	to	T	S
•	0.92	1.5	14,300	0.07

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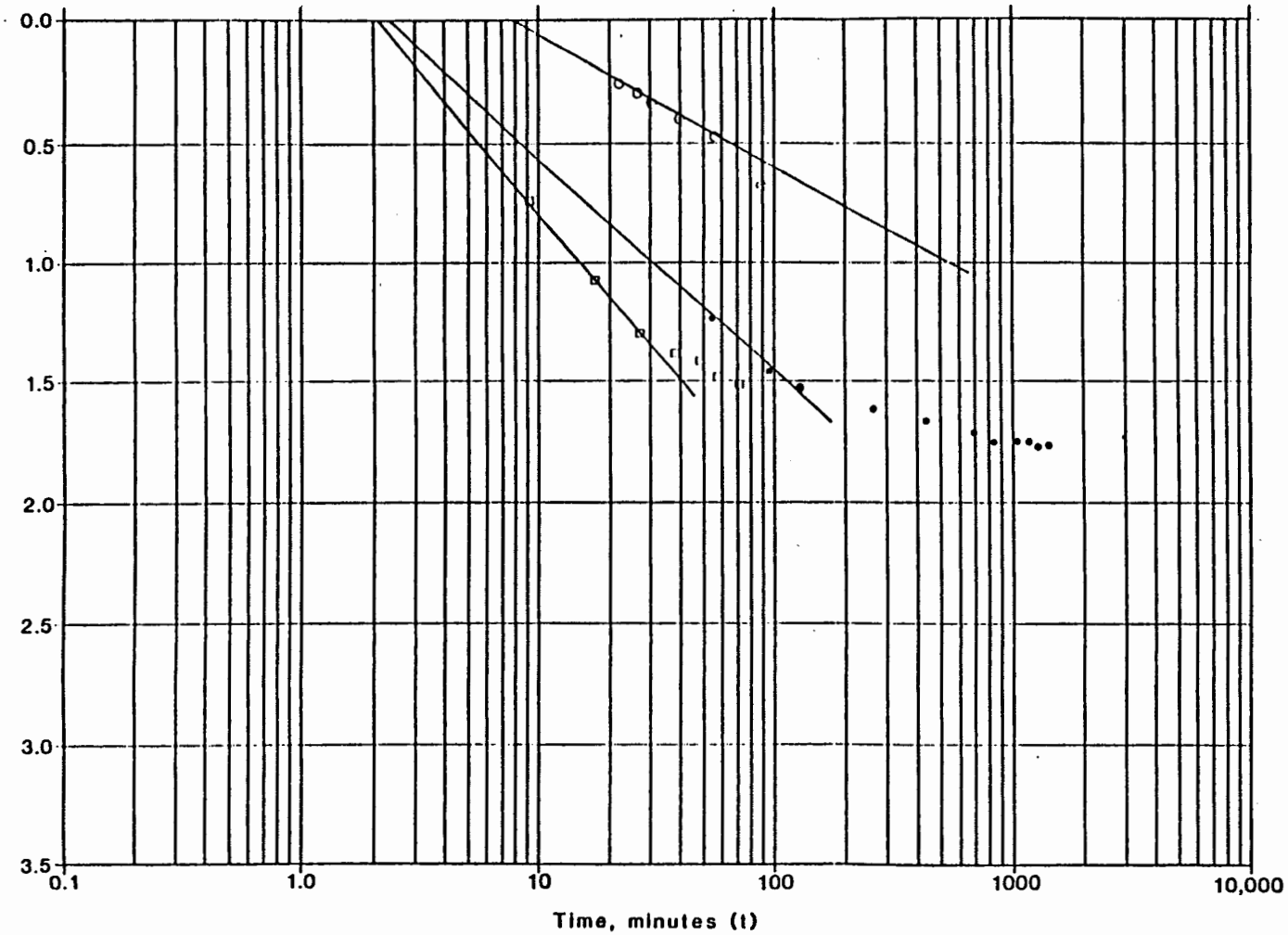
MW-9 PUMPING TEST DATA
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE E4

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
LM	6310,013.12	DLF	11/1/8		

OGC-002907

OGC-002908



LEGEND:

- • Drawdown Data
- o Residual Drawdown Data
- □ Recovery Data

CALCULATIONS:

Q = 180 gpm

r = 314 feet

$T = \frac{264\ Q}{\Delta s}$ gpd/ft

$S = \frac{T\ to}{4790\ r^2}$

	Δs	to	T	S
•	0.78	2.3	61,000	0.00030
o	0.55	-	86,000	-
□	1.16	2.1	41,000	0.00018

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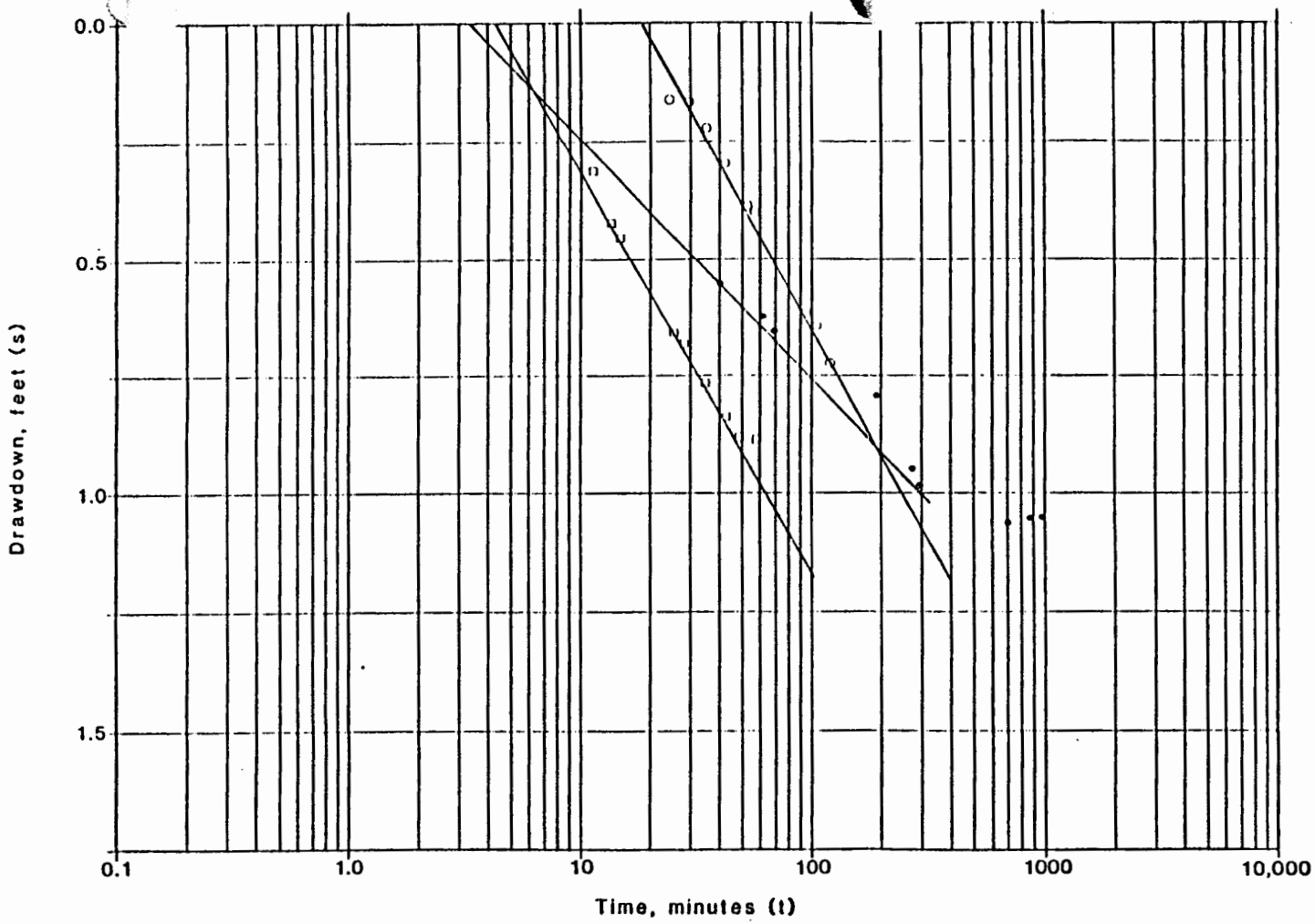
MW-10 PUMPING TEST DATA
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE E5

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	6310,013.12				



LEGEND:

- • Drawdown Data
- o Residual Drawdown Data
- □ Recovery Data

CALCULATIONS:

Q = 180 gpm

r = 488 feet

$T = \frac{264\ Q}{\Delta s}$ gpd/ft

$S = \frac{T\ to}{4790\ r^2}$

	Δs	to	T	S
•	0.52	3.6	91,000	0.00029
o	0.89	-	53,000	-
□	0.83	4.7	57,000	0.00023

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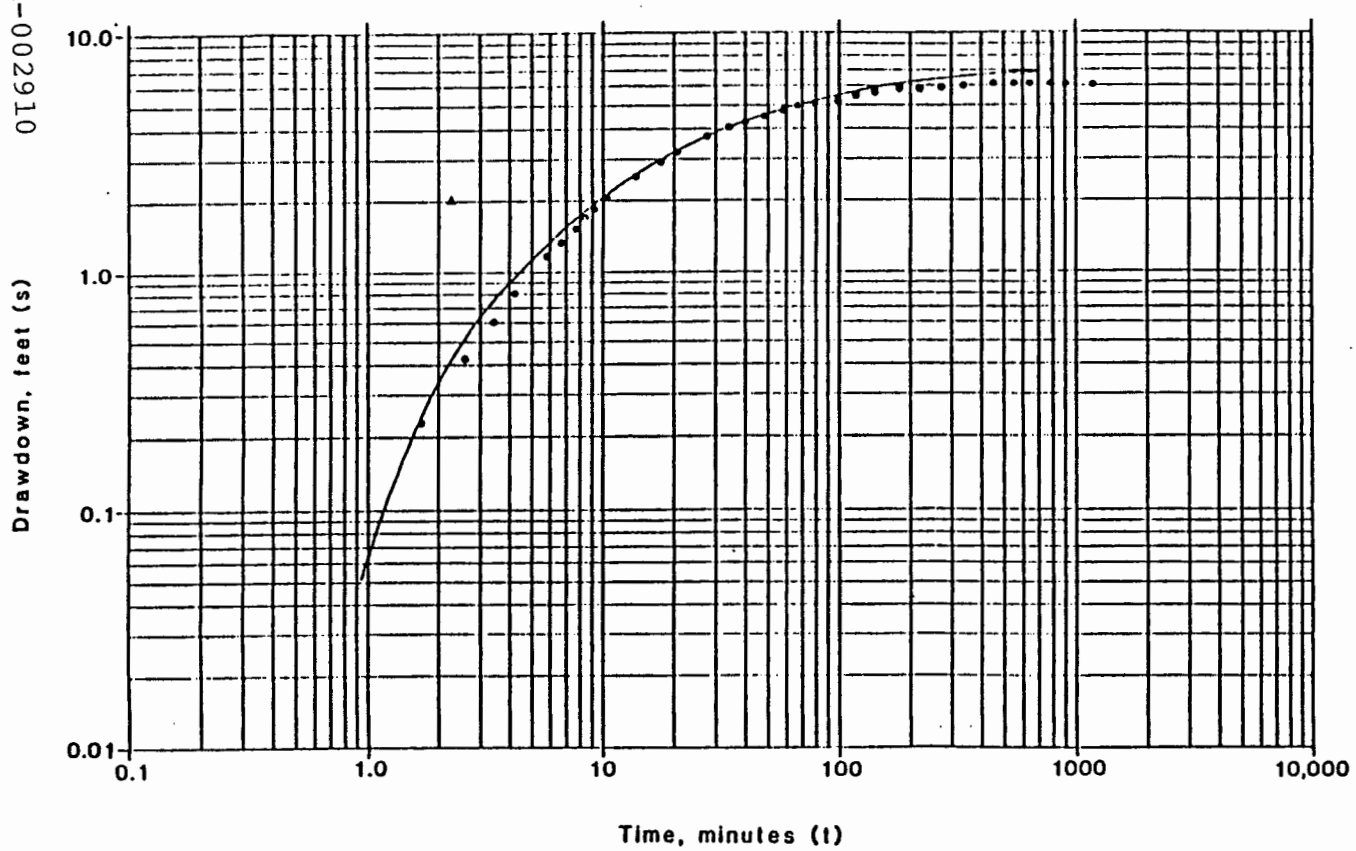
MW-11 PUMPING TEST DATA
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE E6

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
LM	6310,013.12				

OGC-002909

OGC-002910



LEGEND:

- • Drawdown Data
- ▲ Match Point

CALCULATIONS:

$v = 0.1$

$L(u,v) = 1$

$1/u = 1$

$s = 2.01$ feet

$t = 0.22$ minutes

$Q = 189$ gpm

$r = 44$ feet

$T = \frac{114.6\ Q}{s} * L(u,v)$ gpd/ft

$T = 10{,}800$ gpd/ft

$S = \frac{T\ t\ u}{2963\ r^2}$

$S = 0.00046$

$K'/b' = \frac{T\ v^2}{1.87\ r^2}$ 1/day

$K'/b' = 0.03$/day

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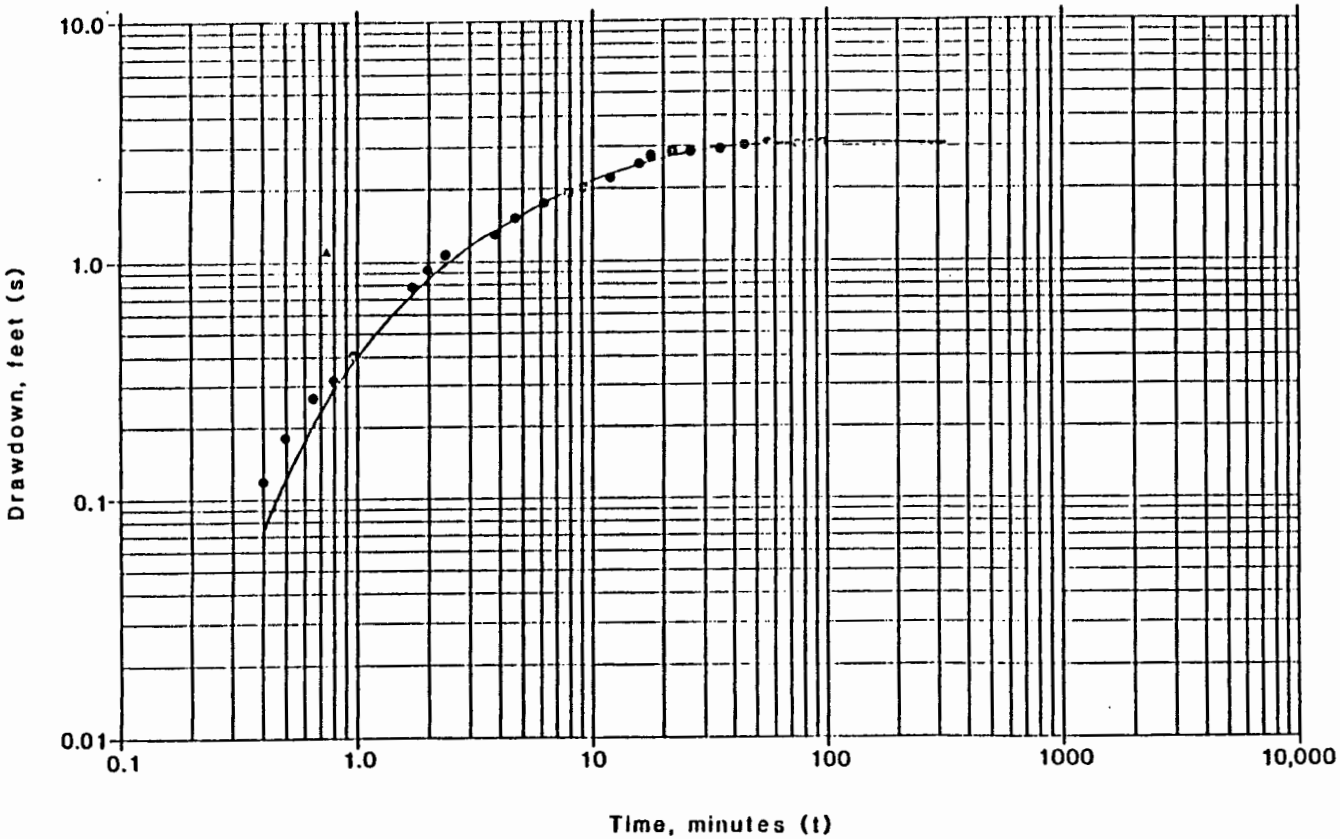
MW-12 PUMPING TEST DATA
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE E7

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
LM	6310,013.12	LMB			



LEGEND:

- ● Drawdown Data
- ▲ Match Point

CALCULATIONS:

$v = 0.15$

$L(u,v) = 1$

$1/u = 1$

$s = 0.77$ feet

$t = 1.07$ minutes

$Q = 189$ gpm

$r = 138$ feet

$T = \frac{114.6\ Q}{s} * L(u,v)$ gpd/ft

$T = 20{,}200$ gpd/ft

$S = \frac{T\ t\ u}{2963\ r^2}$

$S = 0.00028$

$K'/b' = \frac{T\ v^2}{1.87\ r^2}$ 1/day

$K'/b' = 0.013$/day

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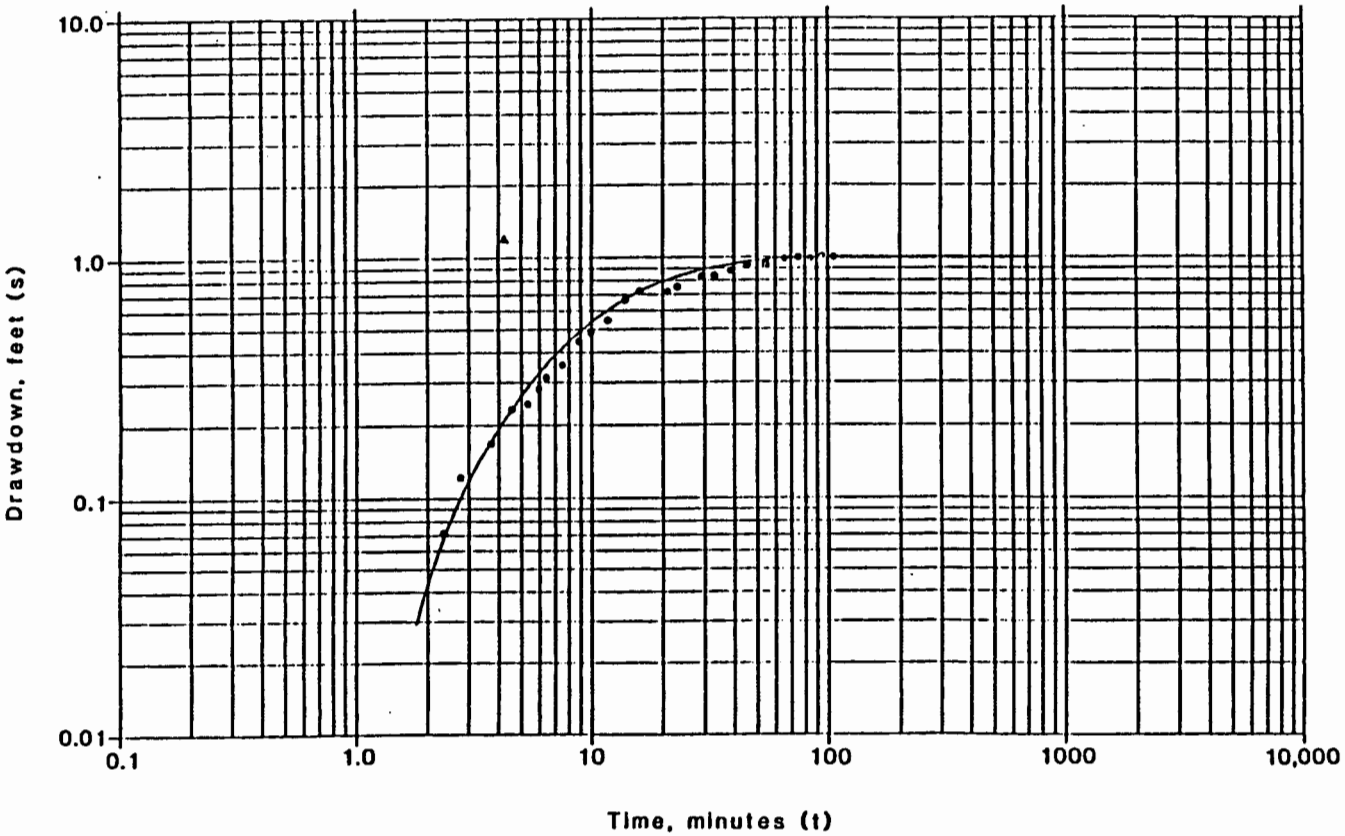
MW-13 PUMPING TEST DATA
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE E8

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
LM	6310,013.12				

OGC-002911



LEGEND:

- • Drawdown Data
- ▲ Match Point

CALCULATIONS:

$v = 0.5$

$L(u,v) = 1$

$1/u = 1$

$s = 0.51$ feet

$t = 2.9$ minutes

$Q = 189$ gpm

$r = 345$ feet

$T = \frac{114.6\ Q}{s} * L(u,v)$ gpd/ft

$T = 18{,}000$ gpd/ft

$S = \frac{T\ t\ u}{2963\ r^2}$

$S = 0.00023$

$K'/b' = \frac{T\ v^2}{1.87\ r^2}$ 1/day

$K'/b' = 0.0018$/day

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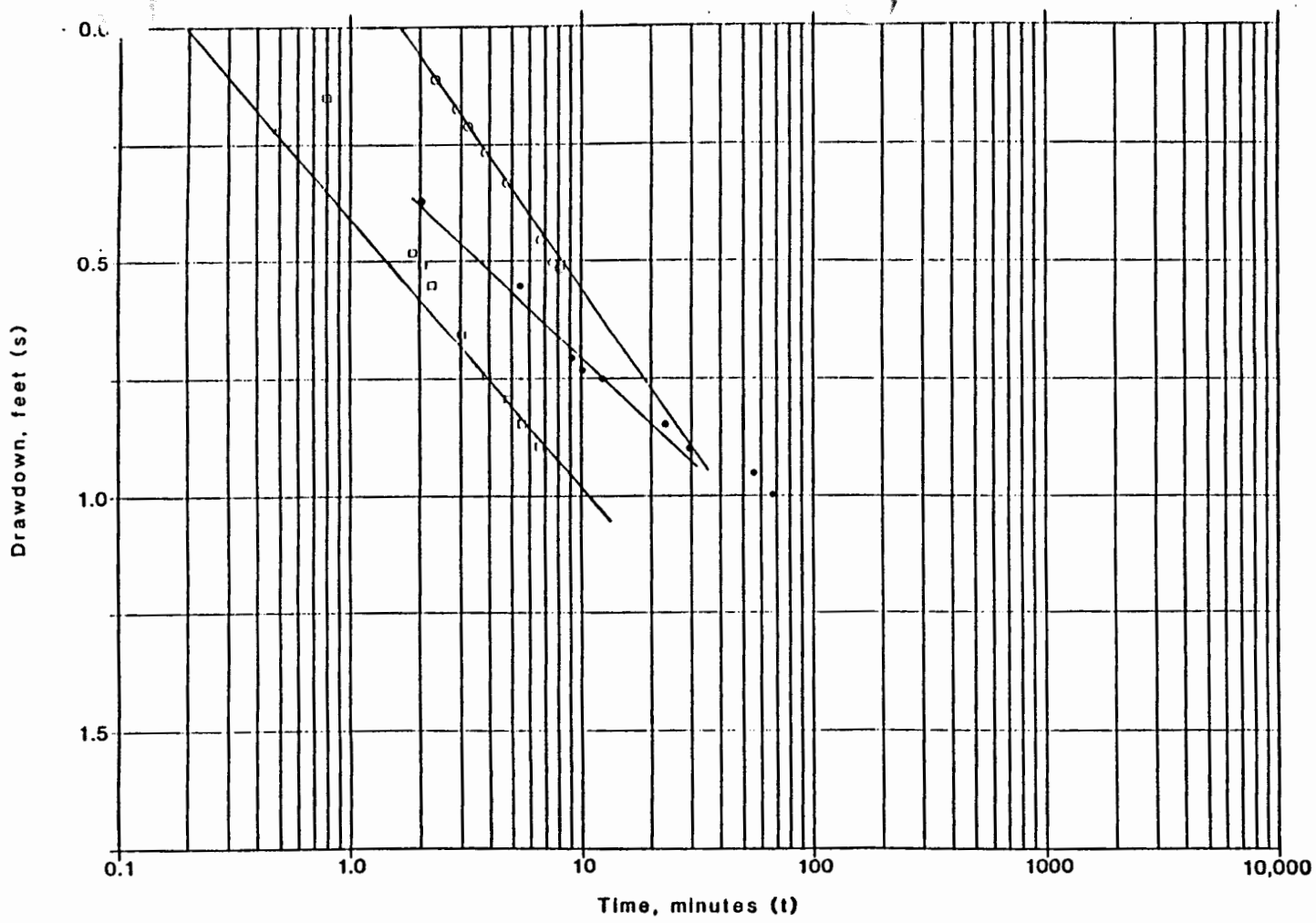
MW-14 PUMPING TEST DATA
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE E9

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	6310,013.12				



LEGEND:

- • Drawdown Data
- o Residual Drawdown Data
- □ Recovery Data

CALCULATIONS:

Q = 180 gpm

r = 456 feet

$T = \frac{264\ Q}{\Delta s}$ gpd/ft

$S = \frac{T\ to}{4790\ r^2}$

	Δs	to	T	S
•	0.46	3.4	103,300	0.00035
o	0.70	-	68,000	-
□	0.68	2.1	70,000	0.00015

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MW-15 PUMPING TEST DATA
Sparton Technology, Inc.
Albuquerque, New Mexico

FIGURE E10

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
LM	6310,013.12				

OGC-002912