NORTH COUNTY REGIONAL
WATER TREATMENT PLANT
INJECTION WELL CONSTRUCTION AND TESTING
TECHNICAL SPECIFICATIONS

M&A **MISSIMER & ASSOCIATES, INC.**
Environmental and Groundwater Services

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WATER TREATMENT PLANT
INJECTION WELL CONSTRUCTION AND TESTING
TECHNICAL SPECIFICATIONS

prepared for

Collier County Utilities Division
Water and Wastewater Services
2800 North Horseshoe Drive
Naples, Florida 33942

May, 1991

MISSIMER & ASSOCIATES, INC.
428 Pine Island Road, S. W.
Cape Coral, Florida 33991

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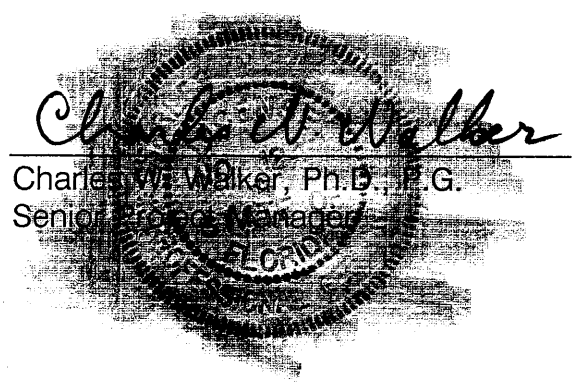

Charles W. Walker, Ph.D., P.G.
Senior Project Manager

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May 17, 1991

Mr. Greg Rawl
South Florida Water Management District
Post Office Box 24680
West Palm Beach, Florida 33416-4680

RE: Application Submittal for Two Class I Test/Injection Wells - Collier County Utilities North County Regional Water Treatment Plant (NCRWTP)

Dear Mr. Rawl:

Enclosed is the completed application for the construction and testing of Class I injection wells. Accompanying the application is a check for $3000.00 for the application fee.

I would like to clarify a couple of points presented in our "Conceptual Design Program" previously submitted to the TAC. The "Area of Review" encompasses a radius of one mile from the injection well sites. Within this radius there are no known faults and no wells known to penetrate the injection zone or confining sequence below the USDW. The first 4 wells listed in Table I (1040, 1053, 1074 and 1167) are shallow test wells with the deepest well being 80 feet deep.

The enclosed revised "Technical Specifications" incorporates the items discussed at the May 7, 1991 TAC pre-application meeting. For example, several logs of oil and oil-test wells were obtained for better stratigraphic control, with this information presented in Figures A-1 and A-2. The conductor casing length in both the injection well and monitor well has been charged to about 300 feet from 60 feet in order to case through the Peace River Formation clays and dolosilts (See Figure 2).

Please feel free to contact me should you have any questions or comments regarding this matter.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng
encl.

pc: Fred Bloetscher, Collier County Utilities

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01000 – GENERAL

01010 INTRODUCTION AND SCOPE: The work described in these Specifications and accompanying plans is for the construction and testing of one Class I injection well and one dual completion monitor well to be drilled upon permitting, for the Collier County North County Regional Water Treatment Plant, in Collier County, Florida. The new injection well system will go "on-line" as soon as it is completed and approved by the Florida Department of Environmental Regulation (FDER). An additional Class I injection well will be constructed with future water treatment plant expansion.

The wells shall be drilled into aquifers containing saline water under pressure. The shallow aquifer contains potable water at the well site; it is required that the saltier water from the deep aquifers be handled so that there shall be no spills upon the ground. Requirements are set forth in these specifications regarding the handling of salty water, drilling fluids and drill cuttings. Requirements also are set forth for controlling the flow of the well during construction to retain spillage of water from drilling and related operations. Water-table monitor wells will be installed around each pad. Due precautions should be taken to prevent spills; any spillage of fluids shall be returned to the closed circulation system. In the event of any unusual events occurring during construction activities (e.g. on-site spills, artesian flows, large volumes of circulation losses, etc.) the contractor will inform the Consultant so that the FDER and other applicable agencies may be notified.

At the completion of drilling, the Contractor shall remove the closed circulation system and it's appertuances which are not part of the completed well, and leave the site in good condition, acceptable to the owner. After demobilization is complete, the drilling pad should be clean and free of debris, though it is not intended to be in "like-new " condition at that time.

01020 OUTLINE SPECIFICATIONS OF WELLS

A. Construction Schedule

The Contractor shall submit a detailed construction schedule before any site work has commenced. The construction schedule shall include a proposed spud date for the initial injection well.

B. Site Preparation and Mobilization

1. Site clearing, excavation, and placing of structural fill, as necessary.
2. Set pit pipe.
3. Construction of pad and water table monitor wells.
4. Equipment set-up.

C. Drilling and Testing of IW-1

1. Drill nominal 46-inch diameter hole to a depth of approximately 300 feet below land surface. Conduct inclination surveys at 60 feet intervals.
2. Set and cement in place 38-inch diameter, 0.375-inch wall thickness steel casing to approximately 300 feet below land surface. Conduct temperature log after each stage of cementing.
3. Drill a 12-1/4-inch diameter pilot hole from 300 feet below land surface to approximately 1350 feet below land surface.
4. Ream a nominal 36-inch diameter hole from 300 feet below land surface to approximately 1350 feet below land surface. Conduct inclination surveys at 60 feet intervals and run caliper log upon completion.
5. Set and cement in place a 30-inch diameter, 0.375-inch wall thickness steel surface casing to approximately 1350 feet below land surface. Conduct temperature log after each stage of cementing.

   NOTE: Drilling of the Dual Completion Deep Monitor Well beyond this point will not be allowed until the base of the Underground Source of Drinking Water, (USDW) has been determined in the injection well and approval has been received from the FDER.
6. Drill a 12-1/4-inch diameter pilot hole from approximately 1350 feet below land surface to approximately 3300 feet below land surface, collecting cores and conducting drill stem tests as directed by the Consultant. Conduct inclination surveys at 60 feet intervals.
7. Conduct geophysical logging as directed by the Consultant.
8. Set bridge plug at approximately 2850 feet below land surface and cement in place with a minimum of 20 feet of ASTM Type II sulfate resistent cement.
9. Ream nominal 30-inch diameter hole from the bottom of the 34-inch diameter casing seat to approximately 2800 feet below land surface. Conduct inclination surveys at 60 feet intervals during reaming and conduct caliper log upon completion.
10. Set 20-inch diameter, 0.500-inch wall thickness steel casing to approximately 2800 feet below land surface and cement in place from approximately 2800 feet below land surface to approximately 200 feet below land surface. Conduct temperature log after each stage of cementing.
11. Conduct cement-bond log on the 20-inch diameter casing.
12. Conduct pressure test of 20-inch diameter casing.
13. Cement final 200 feet of 20-inch diameter casing to surface. Conduct temperature log after each stage of cementing.

14. Ream nominal 20-inch diameter hole from the bottom of the 20-inch diameter casing shoe to a depth of approximately 3300 feet below land surface. Conduct inclination surveys at 60 feet intervals.
15. Collect water samples from the injection zone.
16. Conduct video television survey from the surface to the total depth of the well.
17. Run casing scraper inside 20-inch diameter casing.
18. Install packer at approximately 2750 feet below land surface.
19. Install 16-inch diameter injection casing liner to approximately 2550 feet below land surface.
20. Conduct pressure test on annulus between 20-inch diameter casing and 16-inch diameter casing liner.
21. Conduct controlled injection test.
22. Conduct video television survey from surface to the total depth of the packer.
23. Conduct temperature log.
24. Conduct radioactive tracer survey (RATS).

D. Drilling and Testing of the Dual Completion Deep Monitor Well

1. Install pit pipe.
2. Drill nominal 34-inch diameter hole to approximately 300 feet below land surface. Conduct inclination surveys at 60 feet intervals.
3. Set and cement in place 24-inch diameter, 0.375-inch wall thickness steel conductor casing to approximately 60 feet below land surface. Conduct temperature log after each stage of cementing.
4. Drill nominal 24-inch diameter hole from 60 feet below land surface to approximately 1000 feet below land surface. Conduct inclination surveys at 60 feet intervals.
5. Set and cement in place 16-inch diameter, 0.375-inch wall thickness steel casing to approximately 1000 feet below land surface. Conduct temperature log after each stage of cementing.

   NOTE: Drilling on the monitor well beyond this point will not be allowed until the depth of the base of the USDW has been determined and concurrence has been received from the Florida Department of Environmental Regulation.
6. Conduct cement-bond log on 16-inch diameter casing.
7. Conduct pressure test on 16-inch diameter casing.
8. Drill nominal 16-inch diameter hole from 1000 feet below land surface to approximately 2200 feet below land surface. Conduct inclination surveys at 60 foot intervals.

9. Conduct geophysical logs:
   a) caliper log
   b) gamma-ray log
   c) temperature (pumping)
   d) flow meter (pumping)
10. Set 2200 feet of 6-5/8-inch diameter, 0.562-inch wall thickness steel monitor casing and cement in place from base of casing to 1100 feet below land surface.
11. Conduct cement bond logs in 6-5/8-inch diameter casing.
12. Conduct pressure test on 6-5/8-inch diameter casing.
13. Drill nominal 6-inch diameter hole to 2300 feet below land surface.
14. Conduct geophysical logs:
   a) caliper log
   b) gamma-ray log
   c) temperature (pumping)
   d) flow meter (pumping)
15. After ensuring that both monitor zones are open to the formation and are producing water, they are to be disinfected.

    NOTE: The Contractor must keep in mind that this is a test-injection well program and that the depths are approximate. In addition, the Contractor should be aware that the sequence of testing such as coring, geophysical logging, and injection tests described in this outline may be changed in order of occurrence, or deleted, and additional testing may be added.

E. Drilling and Testing of IW-2

(Same procedure as IW-1, but to be constructed at a later date).

01030 LOCAL GEOLOGIC CONDITIONS: It is anticipated that the boreholes will encounter beds of limestone, sandstone, clay, and minor amounts of unconsolidated shell and sand to a depth of 270 feet below land surface. Below this depth, clays and marls with variable amounts of sand, limestone, and shell are present to a depth of approximately 1250 feet. Permeable zones contain brackish water under pressure and flowing conditions may be present. It is intended that 30-inch diameter surface casing should case off squeezing clays of the Hawthorn Formation. Below approximately 1250 feet, interbedded layers of limestone and dolomite may be found and cavities may be encountered. Information regarding subsurface conditions is intended to assist the Contractor in preparing his bid. The Owner or Consultant does not guarantee its accuracy or that it is necessarily indicative of conditions to be encountered in drilling the well. The Contractor shall satisfy himself regarding all local conditions affecting his work by personal investigation and neither the information on local geology, nor that derived from maps or plans nor from the Owner on his agents or employees shall act to relieve the Contractor of any responsibility hereunder or from fulfilling any and all of the terms and requirements of the contract and Specifications.

01040 SITE PREPARATION: Within the limits of the staging area as shown on the contract drawings, the Contractor shall clear and grub trees (as directed), stumps, down timber, brush, and other objects standing on or protruding from the ground. All roots shall be grubbed and removed to a minimum of 18 inches below the surface of the ground. Holes caused by grubbing operations shall be filled to the elevations shown on the drawings. All material and debris resulting from clearing and grubbing operations shall be burned or otherwise disposed of in a manner approved by the Consultant. It shall be the responsibility of the Contractor to obtain any permits that are required for these procedures.

The Contractor will be required to construct and maintain an all-weather temporary access road. The Contractor shall include the cost of this road in the lump-sum pay item for mobilization and demobilization.

During site preparation, the Contractor shall have a bench mark installed by a registered professional surveyor.

The cost for all site preparation shall be included in the lump-sum pay item for Mobilization and Demobilization, as shown in the Bid Proposal.

01050 DRILLING PAD: At the site of the injection well and deep monitor well, the Contractor shall build a suitable concrete pad as work floor for each drilling rig to retain all drilling fluids in the vertical and horizontal directions. The pad shall have approximate dimensions of 160 feet by 70 feet and be formed with 2 feet of curbing to contain spills of water and drilling fluids including a method of returning them to the required closed-circulation system. The Contractor shall submit complete construction details prepared, signed and sealed by a professional engineer, and receive approval before beginning construction.

The cost of the drilling pad shall be included in the lump-sum pay item for Mobilization and Demobilization of each well.

01060 WATER SUPPLY: It shall be the responsibility of the Contractor to provide all pumping and piping to perform the injection test. The responsibility shall be upon the Contractor to provide and maintain, at his own expense, an adequate supply of water for domestic consumption at the construction site. Any necessary permits required to obtain a water supply shall be obtained by the Contractor at his expense. The cost for all water supply shall be included in the lump-sum price for the injection well.

01070 ELECTRICITY: All electricity required by the Contractor shall be furnished at his own expense. All temporary lines will be furnished, installed, connected, and maintained by the Contractor at his cost in a

workmanlike manner satisfactory to the Owner and Consultant and shall be removed by the Contractor in like manner at his expense at the completion of the work.

01080 WATER–TABLE MONITOR WELLS: The Contractor shall install four small-diameter monitor wells in the area around the injection well drilling pad. The purpose of these wells will be to monitor the water-table aquifer for increases in chlorides due to spills of salty water during drilling operations and (possibly) to pump out the shallow aquifer to reduce any containment level to background if a spill occurs. The shallow monitor wells shall be sampled by the Consultant at least once each week during routine operations and at least once each day in the event of a spill of salty water on the ground. Daily groundwater sampling from the shallow monitor wells shall continue until the site cleanup is deemed to be complete by the FDER. The Contractor shall be financially responsible for the cost of all clean-up activities, which shall be implemented as soon as possible after discovery, attributable to his drilling operations at the site including installation and pumping of additional monitor wells, if necessary.

These wells shall be cased with 2-inch diameter Schedule 80 PVC pipe to a depth approximately 15 feet, or tapping the water table. The bottom ten feet of PVC pipe shall be slotted as shown on contract drawings. The size of the slots shall be compatible with the gravel used, and shall be approved by Consultant before installation.

PVC casing shall be lowered into a predrilled hole and cemented in place, in accordance with the detail shown on the drawings. Each well casing shall be provided with an access box at the surface as called for on the contract drawings.

After completion, each monitor well shall be pumped until the water is clear and a one-quart sample shall be collected, properly labeled, and transmitted to the Consultant. No work other than pad construction may be performed until the monitor wells have been completed and the water samples are received by the Consultant, allowing the Consultant to analyze each water sample for chlorides (mg/L), conductivity (μmhos),temperature (° F), and water table altitude referenced to NGVD, and deliver the results to the TAC (Technical Advisory Committee). Cost of the monitor wells for the entire job will be included in the lump-sum price for the injection well.

01090 DAILY LOG: The Contractor shall maintain a detailed log of his operations on each rig during the construction of the injection wells and the deep monitor well. The logs shall be on IADC (International Association of Drilling Contractors) Forms and shall give a brief description of all formations encountered, footage and size of hole drilled, depth and sizes of all casings installed in the wells, fluid losses, complete

record of drilling fluid added, water-level changes and the depths at which they occurred, cementing operations, repair time and other such pertinent data as may be required by the consultant. All depths shall be referred to NGVD (National Geodetic Vertical Datum). Two copies of each daily log shall be submitted to the Consultant on a daily basis. At least one copy of the geolograph (drilling time chart recorder) chart shall be provided to the Consultant by the Contractor each day.

01100 AS–BUILT DRAWING: Upon completion of the work, the Contractor shall supply the Consultant with reproducible record drawing of each well. The drawings shall show hole and casing diameters and depths and other information that may be required by the Consultant and regulatory agencies, including well head details. The record drawing shall be prepared, signed, and sealed by a professional engineer licenced to practice in the State of Florida.

01110 REMEDIAL WORK: If remedial work proves to be necessary to make a well acceptable and come within the regulations and/or Specifications because of accident, loss of tools, defective material, or for any other cause, the Contractor shall propose a method of correcting the problem, in writing. Suggested methods shall be reviewed and approved by the Consultant before work proceeds. Such work shall be performed at no additional cost to the Owner and it shall not extend the length of the Contract. The Contractor is notified that all specifications shall be met, including hole straightness and setting of casings to the points designated by the consultant.

01120 ABANDONMENT OF WELL BY CONTRACTOR: Any hole in which the Contractor voluntarily stops work, and/or fails to complete in a satisfactory manner, in accordance with the regulations and/or Specifications and approved changes, shall be considered as abandoned by him. If the Owner declares the hole abandoned by the Contractor, then no payment will be made for the abandoned hole. All abandoned holes shall be properly plugged and sealed by the Contractor at his own cost in accordance with federal, state, and local regulations. All salvageable material furnished by the Contractor shall become the property of the Owner. The Contractor shall submit his plan of action for abandonment and plugging. Casings may be removed only with the permission and approval of the Consultant.

01130 FIELD OFFICE: The Contractor shall provide a suitable, weatherproof field office for the use of the Consultant and his representatives. It shall be located in a position which in the opinion of the Consultant is adequate for supervision and inspection of the work, including at least one full-size window facing the injection-well drilling rig. The Contractor shall furnish an entire field-office trailer consisting of at least three rooms. The trailer shall be supplied with the following: at least one telephone, a private telephone line, outdoor colored light indicating incoming calls, local telephone service, $200 per month in long-distance telephone service, a

photocopying machine, two desks (at least one unattached), chairs, a four-drawer legal-size filing cabinet, and janitor service. The cost of this field office and maintenance thereof shall be included in the lump-sum price of the wells. The office shall be fully functional, including utility hook-ups, before any drilling may commence.

01140 GUARANTEE: The Contractor guarantees that the work and service to be performed under the Contract and all workmanship, materials, and equipment performed, furnished, used, or installed in the work shall be free from defects and flaws, and shall be performed and furnished in strict accordance with the Contract Documents; that the strength of all parts of all manufactured equipment shall be adequate and as specified; and that performance test requirements of the Contract Documents shall be fulfilled. The Contractor shall repair, correct, or replace all damage to the work resulting from failures covered by the guarantee. The guarantee shall remain in effect for one year from the date of final acceptance by the Owner.

01150 STANDBY TIME: The Consultant may order the Contractor to stop his operations so that extra work not included in the Specifications such as testing and additional data collection can be performed. The Consultant will advise the Contractor when he proposes to do this and will schedule his request so that it causes a minimum of delay. The Contractor will be reimbursed at hourly rates which will be listed in the Bid Proposal Form. All extra work must be approved in advance by the Consultant in writing.

The Contractor shall include the cost of 120 hours of standby time in the lump-sum price of the injection well, and 60 hours of standby time in the lump-sum price of the monitor well.

02000 – OPERATING REQUIREMENTS

02010 GENERAL: It is essential that salty or brackish water produced from any source during the drilling operations is prevented from contaminating the shallow aquifer which contains fresh water. Any water produced during the drilling shall be confined to the circulation systems and drilling pads.

The drilling will be accomplished using circulation systems designed and constructed so that under no conditions shall there be an overflow. The Contractor shall be required to take all necessary steps to prevent accidental spillages from occurring. Tanks for the circulation system shall be steel and leakproof. The entire circulation system for each well shall be within the curbed drilling pad. The Contractor shall submit plans for the circulation system to the Consultant for approval. In no case will a system capable of storing less than 2000 cubic feet (15,000 gallons) of fluid and cuttings be considered. Written approvals from the Consultant will be required before the Contractor is allowed to proceed.

Flowing conditions in the injection well shall be kept under control at all times. Drilling mud only may be used as weight material to keep the drilling fluid at a density necessary to suppress the flow. Salt and naturally occurring brines such as those produced from oil wells shall not be used as drilling fluid or weight material. The use of salt as a drilling mud additive will not be allowed. As flowing conditions are anticipated during the drilling of the injection well and the deep monitor well, the Contractor shall furnish and install a suitable blowout preventer for each well. The blow-out preventer to be provided will be commercially available, hydraulically operated, single annular preventer, or approved equivalent. Manufacturers specifications pertaining to the type of preventer proposed for use by the drilling contractor shall be approved by the Consultant before drilling of each well commences and shall be used during drilling operations below 30-inch diameter casing in the injection well and below the 16-inch diameter casing in the monitor well to ensure the Contractors capability to control potential flowing conditions prior to penetrating the Floridan Aquifer. When no work is being done on a well, a preventer shall be put in place. Each crew from each well will also test the operation of the blow-out preventer on the well once per week in the presence of the Consultant to demonstrate proficiency in its operation.

Drill cuttings and drilling fluid shall be removed from each drilling site and disposed of at an approved location. The Contractor shall furnish to the Consultant and Owner, prior to beginning construction, the name and location of his disposal site along with documentation that the site has been approved by the appropriate regulatory agencies. The fluid displaced from the borehole during cementing operations shall be considered excess drilling fluid and shall be disposed in a approved manner. All costs of disposal shall be included in the lump-sum price of each well.

When all casings are being set and cemented in place, it is the Contractor's responsibility to insure that these operations are conducted in such manner that the casing collapse and burst strengths (with safety factor) are not exceeded and the casings are not caused to fail. A temperature log shall be run at the appropriate time interval after completion of pumping, as per cementing company recommendations.

02020 EQUIPMENT REQUIREMENTS: Equipment in first-class working order shall be provided. The Contractor shall use his own drilling equipment having the minimum capabilities necessary to do the described work. No unnecessary delays or work stoppages will be tolerated because of equipment failure. They will not be considered a valid reason for extending the length of the contract. The Contractor shall be held responsible and payment may be withheld for damages to a well due to any cause of negligence, faulty operation, or equipment failure.

The Contractor shall provide and operate equipment capable of handling the largest load that will be placed upon the rigs drilling and supporting equipment. If conditions develop in the field that prove the rigs and supporting equipment that had been supplied by the Contractor are incapable of completing a well, the Contractor will be required to provide a larger rig with the necessary capacity at his own cost.

The drilling rigs employed in drilling the injection wells and the deep monitor well shall each use a geolograph capable of recording drilling time and weight of the tool string. This information shall be recorded continuously by the Contractor and records or copies furnished to the consultant daily. Each rig's chart recorder shall be fully functional before drilling of the monitor well or the injection well commences, and shall continue to record during all drilling , reaming, cementing, bit trips, and casing runs, etc.

02030 DRILLING METHODS: The conventional mud-rotary method will be employed for all drilling of each well, through the setting of the conductor casings, to approximately 300 feet below land surface. All drilling below this point shall be done by the reverse circulation rotary method, and there shall be no discharge of drilling fluids and/or formation fluid. During all reaming operations, the Contractor must incorporate the use of a lead bit or stinger and staged drilling assembly to facilitate the tracking of the pilot holes. A closed-circulation system shall be used for the drilling fluids, employing suitable devices such as screens, shale shakers, and settling tanks to remove cuttings. There are no means of handling or disposing of drilling fluids on the site. A method of drilling fluid, cuttings, formation water, or waste disposal shall be submitted for Florida Department of Environmental Regulation approval prior to the start of construction.

02040 CONDITIONS AND HAZARDS: The Contractor should be advised and be aware of difficult drilling conditions and problems he may encounter during the drilling, construction, and testing of the wells. Typical

examples he may have to cope with include, but are not limited to, lost circulation; cavities and fractured zones in the Floridan aquifer; and squeezing zones and potential sand intervals in the Hawthorne clays with attendant caving problems. A priority requirement of these Specifications is the drilling of straight holes and setting of all casings to specified depths. Hole straightness, which will permit casings to be set at specified depths and facilitate achievement of proper cement seals, shall not be sacrificed for drilling speed. These and other pertinent factors shall be taken into consideration by the Contractor in planning and executing the work. The goal of this program is the successful completion of the three wells described in these Contract Documents. In the event of any problems or difficulty which, in the Consultant's opinion, may jeopardize the successful completion of a well in accordance with construction permit, current regulations, or Contract Documents and approved changes, it is the Contractor's responsibility to perform such surveys and testing as necessary to demonstrate the problem has been solved and that the well is in compliance with the Contract Documents. The Contractor shall bear all costs of testing, surveys and work deemed necessary by the Consultant, Owner and/or the appropriate regulatory agencies to confirm that the problem has been resolved or corrected and that the construction is in compliance with the Technical Specifications and any approved changes and appropriate regulations. In the event a problem occurs, the Contractor will be notified in writing by the Consultant. The Contractor will submit to the Consultant his plan of action to identify and/or solve the problem and the Consultant will review the plan of action. In the event the problem is considered serious enough to jeopardize successful completion of the well, in accordance with the drawings and Specifications, the Consultant may request technical concurrence from the regulatory and scientific agencies in accordance with the construction permits. No monies will be paid for the time spent by the Contractor during the entire period of review approval. The Consultant will notify the Contractor that:

a. Plan of action is acceptable;
b. Plan of action is acceptable with Consultant's suggested modifications;
c. Plan of action is not acceptable.

Under (a), the Contractor shall proceed with the plan of action. The Contractor shall bear all costs of surveys associated with detecting the problem, implementing his plan of action, and tests to confirm the plan of action was carried to successful completion and to obtain approval of the Consultant.

Under (b), the Contractor shall resubmit his plan of action with necessary backup and justification of revised plan of action. The Consultant shall notify the Contractor that the revised plan of action is (a) acceptable or (c) not acceptable.

If the plan of action is not acceptable to the Consultant and the Contractor elects to pursue the unacceptable plan of action, then two options exist for the Consultant.

OPTION 1: If unacceptable plan of action jeopardizes the well construction, completion, or operation in the Consultant's opinion, and the Contractor elects to implement the unacceptable plan of action, the Consultant may declare the well abandoned by the Contractor. A determination shall be made by the Consultant whether to abandon the well or attempt to correct the existing well. The Contractor shall bear all costs of rig time, etc., from original verbal notification and all cost of either abandoning the well or taking steps to complete a successful well.

OPTION 2: If the unacceptable plan of action does not jeopardize the well construction, completion, or operation in the Consultant's opinion, the Contractor may, at his own risk, proceed with his plan of action. The Contractor shall bear all costs associated with his plan of action including testing, remedies, surveys, and programs to solve the problem. When completed, the Contractor shall notify the Consultant that the problem has been solved. The Contractor shall bear all costs of testing, surveys, and work deemed necessary by the Consultant and that the Consultant is satisfied that the problem has been solved by the Contractor, then the Contractor shall proceed with the construction of the well, bearing all costs of the plan of action and the Consultant's program to confirm successful completion.

02050 STRAIGHT HOLE REQUIREMENTS: Priority requirements of these Specifications is the drilling of straight holes, positive documentable proof that all pilot holes have been wiped out or covered by the reaming operations, and setting the casing to the required depths. The Contractor will be required to perform the schedule of surveys as specified in this section. To insure that the casing and tubing can be set to the required depths and properly cemented, all of the holes shall be drilled so that they are straight. Hole straightness, which will allow setting the casing at the required depths and provide positive documentable assurance that the pilot hole has been wiped out by the reaming operations, shall not be sacrificed for drilling speed or any other reason.

During all drilling in the injection well, the Contractor shall perform inclination surveys at intervals of 60 feet as the drilling and reaming progresses. These surveys shall be performed using a wire-line instrument equipped with an inclination unit having a range of from 0 to 1.5 degrees of inclination from the vertical and with a survey record which shall be capable of being read to the nearest 10 minutes of angle.

All holes for the injection well and the monitor well shall be round, straight, and true line. No dog-legs or departures from a straight line shall be permitted which will interfere or prevent casings from being set to their

required depths. The maximum allowable inclination from the vertical at any portion of a hole or survey point shall be one (1) degree; the maximum allowable difference between any two successive survey points shall be 0.5 degree (30 minutes). Any deviation greater than one (1) degree or difference greater than 0.5 degree (30 minutes) between two surveys shall be corrected by the Contractor at his own expense.

Should the inclination surveys or the results of the drilling of any of the pilot and/or reamed holes indicate that conditions have been or are being created that would prevent the casings from being set to their prescribed depths and properly cemented or prevent the well from being properly and successfully completed, the Contractor shall take steps to straighten the hole or correct the drift or deviation at his own expense so that casing can be installed to the prescribed depths and allow for proper cementing.

Unless he can demonstrate competence in the use of the surveying equipment, the Contractor shall utilize the services of a qualified technician employed by and experienced in the survey and in the maintenance of the equipment. The technician shall remain on the job until the drilling crews are proficient in the use of the equipment, as judged by the Consultant. The equipment shall be kept on the job at all times. The costs for surveys described in this section, including those required to diagnose a problem and demonstrate the effectiveness of any remedial work, or demonstrate that no problem has occurred shall be the responsibility of the Contractor.

The following are the minimum survey requirements:

Injection Well

1. Nominal 46-inch diameter hole from land surface to 300 feet.
   A. Inclination survey at 60 feet intervals during drilling.
2. Nominal 12-1/4-inch diameter pilot hole from 300 feet to 1350 feet.
   A. Inclination survey at 60-feet intervals during drilling.
3. Nominal 36-inch diameter pilot hole from 300 feet to 1350 feet.
   A. Inclination survey at 60-feet intervals during drilling.
4. Nominal 12-1/4-inch diameter pilot hole from 1350 feet to 3300 feet.
   A. Inclination surveys at 60-feet intervals during reaming.
5. Nominal 30-inch diameter hole from 1350 feet to 2800 feet.
   A. Inclination surveys at 60-feet intervals during drilling.
6. Nominal 20-inch diameter hole from 2800 feet to 3300 feet.
   A. Inclination surveys at 60-feet intervals during drilling.

Monitor Well

1. Nominal 34-inch diameter hole from land surface to 300 feet.
   A. Inclination survey at 60-feet intervals during drilling.
2. Nominal 24-inch diameter hole from 60 feet to 1000 feet.
   A. Inclination surveys at 60-feet intervals during drilling.
3. Nominal 16-inch diameter hole from 1000 feet to 2200 feet.
   A. Inclination surveys at 60-feet intervals during drilling.

During the drilling operations, the Contractor shall submit the record of each inclination survey to the Consultant on the site. The Consultant shall analyze the data and shall notify the Contractor of the survey results within one hour. In the event other duties delay the Consultant from interpreting the data, the Contractor should have a qualified crew member proficient in the interpretation of the raw data. The Contractor may continue drilling during this one-hour period. In the event the survey data indicate hole drift of departure in excess of the specified limits, the Contractor shall take the following steps.

1. Run additional surveys to demonstrate that the hole is within the specified limits.
2. If instrument is indicating that the hole is not meeting the specified limits, then the Contractor shall re-ream the hole and repeat the survey. This process will be repeated or other actions taken by the Contractor to meet the specified limits.
3. If the Contractor feels that the instrument is in error, it will be his responsibility to obtain a new instrument to confirm the survey data. If a new instrument requires 24 hours or less to be shipped to the site, the Contractor may, with the Consultant's approval, continue the drilling operation. However, this does not relieve the Contractor of his responsibility of maintaining the hole within the specified limits. The Contractor shall bear all of the costs of repeated surveys, re-reaming the hole, or other steps required to meet the specified limits. No standby time will be paid for time spent during these procedures.

02060 FORMATION SAMPLES: Two sets of formation samples (drilled cuttings) shall be collected from each well at intervals of 10 feet and at every formation change and drilling break. The samples shall be preserved in cloth sample sacks to be furnished by the Contractor. The samples containers shall be plainly marked with the well identification and shall show the depth below the ground surface from which they were taken. The Contractor shall collect the samples, deliver them to the Consultant's field office, and provide facilities for storage while the samples remain on site, in a manner acceptable to the Consultant. Upon completion of drilling and upon authorization by the Consultant, the Contractor shall forward the formation samples to the Florida Bureau of Geology in Tallahassee along with any appropriate well completion reports. If sample storage

becomes a problem on the site, samples may be forwarded to the Florida Bureau of Geology as work progresses following accepted procedures and with the approval of the Consultant. Additionally, one 16-ounce sample of drilling fluid shall be collected from the discharge of the rig's circulation system every 30 feet. This "mud" sample also shall be delivered to the Consultants representative for analysis. The drilled cuttings and drilling mud samples must be delivered to the Consultant's field office within 30 minutes after being collected.

02070 CEMENTING PROCEDURES: Cementing will be completed by an approved company, expert in well cementing such as Halliburton Services, unless the Contractor can demonstrate that he has the equipment and expertise to perform these operations. Cementing will be accomplished in stages by means of a collarless tremie pipe. Before and after each stage of cementing, the Contractor shall conduct a temperature log. Before each cementing stage, the Contractor shall tag the top of the cement with a collarless tremie pipe. The method of cementing applies to all cementing procedures in all casing.

Cementing procedures shall be continuous for each stage after cementing begins. If loss of circulation or no return of cement is encountered, the Consultant shall be notified immediately of what remedial measures are underway to re-establish the circulation and complete the cementing program according to well design and specifications.

During the cementing of all strings of casing, the Contractor will be responsible for having a sample from each cement stage collected (both dry and mixed). Mixed cement samples shall include at least three, 2-inch cubes of each blend from each cement stage. The cost of collection and analysis should be included in the lump-sum price and the results should be submitted to the Consultant as soon as they are available. The top 200 feet of annulus in the injection well, between the 30-inch diameter casing and the 20-inch diameter injection casing shall not be cemented until after the completion of the cement bond log. If good bonding between casing, cement, and formation is not obtained, remedial work shall be done to the satisfaction of the Consultant. In addition, the Consultant, may require temperature or cement bond logs to substantiate the effectiveness of any remedial grout work done. These operations shall be performed at the Contractor's expense.

During all stages of cementing, the Contractor will use a pre-flush or spacer. The Contractor shall submit the technical specifications of the pre-flush to the consultant for approval before cementing begins.

When the casings are being set and cemented in place, it is the Contractor's responsibility to insure that these operations are conducted in such a manner that the casing collapse and burst strengths (with safety factor) are not exceeded and the casings are not caused to fail.
Cement shall be pumped or placed so that excessive pressures will not result and affect the bond.

03000 – GEOPHYSICAL LOGGING & TESTING

03010 GEOPHYSICAL LOGGING: The Contractor shall employ the services of an approved company to obtain geophysical logs of the injection well and the monitor well. The Contractor shall prepare and condition each hole to insure it is open and can be logged with a minimum of delay. The following logs shall be run in the injection well at the stages listed and their cost shall be included. No payment will be made for logs which are unusable or inaccurate due to poor performance of the logging equipment.

Following the completion of each of the stages of the 12-1/4-inch diameter pilot holes below the 30-inch diameter casing to a total depth of approximately 3300 feet below land surface, the following geophysical logs will be performed:

Dual-induction
Borehole-compensated sonic - VDL
Caliper
Gamma ray
Flow meter (pumping - as conditions permit)
Temperature (pumping - as conditions permit)

Following the completion of cementing the 20-inch diameter injection casing in place:

Cement bond

Note: After the last stage of cement has been placed, a minimum of 24 hours shall be allowed to pass prior to beginning each Cement Bond Log.

Following the completion of the injection testing and TV Survey:

Temperature

The Contractor also will perform caliper logs on all boreholes before the installation of all casing.

The contractor will perform temperature logs after each stage of cementing on all casings.

In the Deep Monitor Well, following the completion of each of the stages of the 12-1/4-inch diameter pilot holes below the 24-inch diameter casing to a total depth of approximately 2200 feet below land surface, and in the nominal 6-inch diameter open hole below final casing, the following geophysical logs will be performed:

Caliper

Gamma Ray

Flow meter (pumping - as conditions permit)

Temperature (pumping - as conditions permit)

Following the completion of cementing the 16-inch diameter casing in place, and following completion of cementing the 6-inch diameter casing in place:

Cement bond

Note: After the last stage of cement has been placed, a minimum of 24 hours shall be allowed to pass prior to beginning each Cement Bond Log.

The Contractor shall furnish 15 field copies of various logs to the Consultant and shall provide a written evaluation of their quality as well. Twenty-four copies of the finished logs shall be provided to the Consultant as soon as possible after logging along with copies of the original films or mylar of the logs.

03020 CORES: Cores shall be taken during the drilling of the 12-1/4-inch diameter pilot hole in the injection well. Four-inch diameter cores, at least 10 feet long, shall be taken at points designated by the Consultant (a minimum 10-foot barrel is to be as manufactured by the Christianson Diamond Products Company or approved equal) The taking of cores will be observed by technicians from the manufacturer of the coring tool unless the Contractor can demonstrate previous experience. Coring points are to be determined from information derived during drilling operations and as directed by Consultant. All cores will be stored in wooden boxes with lids, marked with the appropriate well designation, and the depth from which they are taken. Tops and bottoms of the cores are to be marked. After collection, boxing, and labeling, each core will be furnished to the Consultant. The Consultant will then select a maximum of three representative sections of each core on which the Contractor will have laboratory analyses conducted to determine vertical and horizontal permeability, porosity, specific gravity, elastic modules, and compressive strength. The Contractor shall submit the name of the laboratory for approval to the Consultant before analyses. The cost of the five cores and fifteen analyses is to be included in the lump-sum price for the Injection Well.

03030 TELEVISION SURVEY: Following completion of the nominal 12-1/4-inch diameter pilot hole to a depth of 2800 feet below pad level in the injection well, the Contractor shall have a television survey performed on the entire well from the top of the 30-inch diameter injection casing to the bottom of the hole (1350-2800), and following completion of the nominal 20-inch diameter open hole below the 20-inch diameter injection casing, the Contractor shall have a television survey performed on the entire well from the top of the 20-inch diameter injection casing to the bottom of the open hole (surface-3300), and following completion of the injection test,

from the top 16-inch diameter injection tubing to the bottom of the tubing mandril [polished bore recepticle (approximately 2800 feet)], by a qualified service company using equipment capable of surveying and recording to the required depth. The Contractor may use his own equipment providing it is capable of surveying as required and the Contractor shall furnish proof of capability of the equipment. Copies of the Video Television Survey shall be provided by the Contractor for distribution. It is the Contractor's responsibility to make all arrangements and scheduling for the television survey.

It is the Contractor's responsibility to insure that the borehole fluid is of sufficient clarity (as determined by the Consultant) to allow a television survey to be conducted. The Contractor shall pump into each injection well a quantity of clear water not less than three volumes of the entire borehole.

While pumping in the water and during the television survey, the well may be under artesian pressure and may flow. The Contractor shall be required to provide and use a stripper head assembly and any other equipment necessary to keep any flow under control at all times.

Costs for pumping clear water into borehole to achieve the desired level of clarity; for the television surveys and tapes (including time spent waiting for the television equipment); and for rig and crew labor for all activities associated with preparing for, performing, and dismantling equipment related to the television survey shall be included in the lump-sum price of the injection well.

03040 SINGLE–PACKER DRILL STEM TESTS: The Contractor shall perform five single-packer drill stem tests in the injection Well as directed by the Consultant. To perform the single-packer drill stem tests, the Contractor shall employ the services of an approved company recognized as expert in this form of testing, such as, but not limited to, Baker Tools or TAM International. The open-hole single-packer drill stem tests shall be conducted such that the hydrologic properties of the formation can be determined and a representative water sample can be collected for analysis. The Consultant will select the depth intervals to be tested during the drilling of the 12 1/2-inch diameter pilot holes.

The tests shall be performed using an inflatable packer on drill pipe with the upper 250 feet consisting of casing or drill pipe with a six-inch inside diameter to facilitate the installation of a four-inch diameter submersible pump which shall be set at an elevation of approximately 250 feet below land surface. The Submersible pump shall have the capability of pumping at rates between 25 and 100 gpm (gallons per minute). An in-line propeller-type flow meter capable of recording total flow and discharge will be used. The internal surfaces of drill pipe, casings, and other fittings used for the packer tests shall be free of rust, scale, and other material that could be dislodged and interfere with a test. Should a test fail because of the presence of any of these materials in

the tools or pipe, the Contractor will not be reimbursed for the test and he will be required to clean the pipe, re-set it and the packer, and re-run the test successfully as part of the contract requirements at his own cost.

After successfully inflating and setting the packer and before the Contractor conducts a four-hour pumping test and a three-hour recovery test for each single-packer drill stem test, he shall develop each zone so that it is free of any drilling mud/fluids (and producing representative formation water) and allow the water level in the pipes to return to static conditions to the satisfaction of the Consultant. It is anticipated that rates of between 25 and 100 gpm will be obtained during the pumping test. The Contractor shall be responsible for providing all necessary pumps, equipment, pipelines, meters, gauges, and appurtenances necessary for testing as described and will provide access for water-level measurements using M-scope, tape, or electronic probe.

Just prior to completion of each pumping test, the Contractor shall have a State-certified laboratory collect a water sample from the discharge and have the following analyses performed by a State-certified laboratory acceptable to the Consultant.

Total Dissolved Solids
Chloride
Conductivity
Sulfate

The Contractor shall include the cost of five single-packer drill stem tests and five sets of water-quality analyses in the lump-sum price for each injection well. If more or less tests are performed, a credit or charge will be provided for in the contract.

03050 INJECTION TEST: After the completion of the injection well, an injection test shall be run for a period of at least 12 hours. Water for the injection test will be available from Collier County. A maximum of 12 MGD will be obtainable at the plant site from a pipeline to be constructed from the Golden Gate Wellfield. The injection test will be conducted at a rate of 6.3 MGD for a minimum of 12 hours. The Contractor shall provide a layout drawing of his piping for approval by the Consultant. Just prior to the last trip out of the hole on the injection well, the Contractor shall collect a five-gallon sample from the discharge of the circulation system and deliver it to the Florida Department of Environmental Regulation, or their designated laboratory. Prior to conducting the TV Survey and injection test, the Contractor shall have a water sample collected by employing the following procedure, the blow-out preventer shall be installed and the return line from the closed circulation system will be shut, forcing the injection zone to develop when pumping begins. A volume equal to at least 3 times the volume of the drill pipe must be removed. The Contractor shall then have a water sample collected

from the well and have it analyzed for the primary and secondary drinking water standards and organic compounds for EPA (Environmental Protection Agency) Test Method 608, 624, and 625 constituents. EPA Test Method 625 shall include both acid and base neutral extractable organics. The Laboratory will follow all quality assurance guidelines set forth by the State of Florida. Additionally, the following constituents will be included:

Specific Gravity	
Water Temperature	Total Phosphorus
pH	Total Nitrogen
Turbidity	Nitrate
Color	Nitrite
Sulfate	Organic Nitrogen
Iron	Ammonia
Total Dissolved Solids	Conductivity
Total Hardness	Calcium
Hydroxide	Magnesium
Non-carbonate Hardness	Carbonate
Bicarbonate	Potassium
Sodium	Chloride

The Contractor shall also collect for the U.S. Geological Survey a minimum one gallon water sample for analysis.

The Contractor shall be responsible for providing all necessary pipelines, meters and gauges necessary for the testing and should include these in the lump-sum price of the injection well.

The Contractor shall furnish and install in the pipeline an in-line propeller-type flow meter capable of recording instantaneous flow rates and of totalizing flow. The flow meter shall have an accuracy of +/- five percent of the maximum test rate. The flow meter shall be sufficiently removed from obstructions in the pipeline, valves, elbows, reductions, to allow the meter to perform within specifications. Manufacturers specifications shall be submitted to the Consultant prior to installation for approval.

To the extent possible, the speed of the pump and motor shall remain constant throughout the test. The pumping rate shall be controlled and adjusted by means of a gate valve in the pipeline. The valve shall be installed between the injection pump and the flow meter. The pumping rate shall not be adjusted by changing the speed of the motor or pump, except when absolutely necessary.

During the injection test, bottom-hole pressure and temperature shall be monitored, and recorded at land surface in the injection well, and the dual-completion deep monitor well. The Contractor shall employ the services of a company specializing in furnishing and operating the equipment used in collecting this information. An approved pressure gauge and recording system capable of accurately measuring and detecting pressure changes of as little as 0.01 psi (pounds per square inch) such as the Baker Tools RES-300 or Geophysical Research Corp. EPG-520 system will be used. The data recording system shall record in real time and continuous delta time. No interruptions of data recording will be permitted if delta time will rezero after interruption for equipment service or any other reason. The Contractor shall provide the Consultant with technical data on the pressure-measuring and recording system for approval before the injection tests. The system will be installed in the injection well at top of the injection zone at a depth determined by the Consultant. Access to the monitor well during the test also will be required to allow water levels to be measured. The separate dual-completion monitor well shall be completed before the injection test. The Contractor shall also provide a means to monitor annular pressure throughout the duration of the injection testing.

The pressure-recording system will be operated for a period of 48 hours prior to the start of the injection test (to collect information on natural bottom-hole pressure fluctuations), during the entire injection test, and for a 24-hour period after the injection test. the Consultant shall be furnished a copy of all of the basic data recorded as part of the injection tests in hard copy and in ASCE Format on a 3-1/2-inch disk. During the injection test, well-head pressure and annular pressure gauges must be in good working order and they must be accessible. The Contractor shall submit verification of pressure gauge calibration to the Consultant prior to commencement of the injection test.

The costs for these shall be included in the lump-sum price of the injection well. For time spent more or less than specified, the Contractor shall be paid or credit given on the basis of an hourly charge to be listed in the Contract.

03060 MONITOR WELL WATER QUALITY ANALYSES: After disinfection, the monitor zones will be developed by pumping or other approved means until conductivity and chloride measurements of the discharged water from each zone have stabilized as determined by the Consultant, in order to insure that representative formation water samples can be collected. Upon stabilization, the casings will be pumped until 10 times the calculated casing volume has been displaced. If the casings are not open to the formations or are incapable of yielding a representative water sample from the monitor zones, the Contractor shall employ such procedures as are necessary to open up the casing so that representative water samples may be collected. These procedures shall be conducted at no additional cost to the Owner and shall be approved in writing by the Consultant prior to implementation. No standby time will be paid for the time spent during these procedures.

After the monitor casings have been demonstrated to be functioning and have been disinfected, they shall be pumped to remove any fluid that may have been introduced into the disinfection. Upon concurrence of the Consultant that representative water is being produced from each monitor zone, the Contractor shall have a State-certified laboratory collect a sample from each tube in the presence of the Consultant's representative and have the following analyses performed on each monitor zone by a State-certified laboratory approved by the Consultant.

The samples collected from the monitor zones shall be analyzed for all constituents listed in the Section 17-550.310 (primary standards) and 17-550.320 (secondary standards) FAC, including analysis for microbiological, radionuclides, BOD, and constituents listed under EPA Methods 608, 624, and 625. EPA Test Method 625 shall include both acid and base neutral extractable organics. The laboratory will follow all quality assurance guidelines set forth by the State of Florida. The constituents are as follows:

Specific Gravity	1,2-Dichloropropane
Water Temperature	Trihalomethane
Arsenic	Trichloroethylene
Barium	Tetrachloroethylene
Cadmium	Carbon Tetrachloride
Chromium	Vinyl Chloride
Lead	1,1,1-Trichloroethane
Mercury	1,2- Dichloroethane
Nitrate (as N)	Benzene
Selenium	Ethylene Dibromide
Silver	Chloride
Sodium	Color
Fluoride	Copper
Hydrogen Sulfide	Alkalinity
Soluble Orthophosphate	COD (Chemical Oxygen Demand)
Ammonium	pH
Organic Nitrogen	TOC (Total Organic Carbon)
Antimony	Acidity
Magnesium	
Calcium	Total Suspended Solids
Potassium Total	Kjeldahl Nitrogen, as N
Bicarbonate	Dissolved Oxygen

Bromide	Total Phosphorus, as P
Endrin	Corrosivity
Lindane	Foaming agents
Methoxychlor	Iron
BOD	N-Nitrososodimethylamine
Toxaphene	Manganese
2,4-Dichlorophenoxyacetic Acid	Odor
2,4,5-TP (Silvex)	pH (in field)
Turbidity	Sulfate
Total Fecal	TDS
Radium 226	Zinc
Radium 228	Bromodichloromethane
Gross Alpha	Bromoform
Beta Particles	Chlorobenzene
Photonradioactivity	Chloromethane
Trichlorofluoromethane	2-Chloroethylivinyl ether
Acenaphthylene	Chloroform
Acenaphthylene	Dibromochloromethane
Anthracene	1,2 Dichlorobenzene
Aldrin	1,3 Dichlorobenzene
Benzol(a)anthracene	1,4 Dichloroethane
Benzol(b)Fluoranthene	1,1 Dichloroethane
Benzol(k)Fluoranthene	1,1 Dichloroethene
Benzol(a)pyrene	trans-1,2-Dichloroethene
Benzol(ghi)perylene	cis-1,3 Dichloropropene
Benzyl butyl Phthalate	trans-1,3 Dichloropropene
α-BHC	Ethyl Benzene
ß-BHC	Methylene Chloride
τ-BHC	1,12,2-Tetrachloroethane
Bis(2-chloroethoxy)methane	Tetrachloroethane
Bis(2-chloroisopropyl)phthalate	Toluene
4-Bromophenol phenyl ether	1,1,2-Trichloroethane
Chlordane	Trichloroethene
2-Chloronaphthalene	Nitrobenzene
4-Chlororphenyl phenyl ether	N-Nitrosodi-n-propylamine

Chrysene	PCB-1016
4,4-DDD	PCB-1221
4,4-DDE	PCB-1232
4,4-DDT	PCB-1242
Dibenzo(a,h)anthracene	PCB-1248
Di-n-butyphthalate	PCB-1254
3,3 Dichlorobenzidine	PCB-1260
Dieldrin	Phenanthrene
Dimethyl Phthalate	Pyrene
Dimethyl phthalate	1,2,4 Trichlorobenzene
2,4-Dinitrotoluene	4-Chloro-3-methylphenol
2,6-Dinitrotoluene	2-Chlorophenol
Di-n-octylphthalate	2,4-Dichlorophenol
Endosulfean sulfate	2,4-Dimethylphenol
Endrin aldehyde	2,4-Dinitrophenol
Fluoranthene	2-methyl-4,6-dinitrophenol
Fluorene	2-nitrophenol
Heptachlor	4-nitrophenol
Heptachlor epoxide	Pentachlorophenol
Hexachlorobenzene	Phenol
Hexachlorobutadiene	2,4,6-Trichlorophenol
Hexachloroethane	Benzidine
Indeno (1,2,3-cd)pyrene	Benzidine
Isophorone	Endosulfan I
Naphthalene	Endosulfan II
Hexachlorocyclopentadiene	Bromomethane
N-Nitrosodiphenylamine	Chloromethane
Bis(2-chloroethy)ether	

The Contractor shall include the cost for the collection and chemical analyses for one set of samples from the shallow monitor zone and one set from the deep monitor zone in the lump sum price of the monitor well. Additionally, the Contractor shall collect for the U.S. Geological Survey a minimum one gallon sample for analysis from each monitoring zone.

03070 RADIOACTIVE TRACER SURVEY: Upon completion of the injection test and TV survey, a radioactive tracer survey shall be performed in the injection well. The Contractor shall employ the services of a company specializing in furnishing and operating the equipment used in collecting this information. The tests shall be conducted as directed by the consultant, according to the following procedure outline. The costs for these services shall be included in the lump-sum price of the injection well.

The geophysical tool supplied must be capable of ejecting the radioactive tracer and simultaneously monitoring the gamma-ray detectors. Film documentation of the radioactive tracer injection time must be provided and the tracer injection time must be calibrated to $\pm$ 1 millisecond. No time lag between ejection and monitoring is permitted. A casing collar locator (CCL) shall be positioned below tool to precisely locate the bottom of the casing. The tool shall be configured such that one gamma-ray detector shall be located above the ejector chamber and the two detectors shall be located below the ejector.

The RATS (radioactive tracer survey) testing will be conducted following the injection test.

1). Water from the utility will be used for the 36-hour injection test immediately prior to RATS testing so a sufficient fresh-water "bubble" will be established.

2). The combination gamma-ray/casing collar locator/temperature/radioactive slug ejector tool will be used to log in the hole, recording temperature from surface to a depth approximately 10 feet below the casing.

3). A background gamma ray log will be conducted in the interval beginning at total depth of the temperature log to approximately 1500 feet above the casing seat (bottom of casing). A casing collar locator log will be used.

4). The tracer ejector should be positioned within 1 foot below the bottom of the casing, with one gamma-ray detector above the ejector (GRT), and two gamma-ray detectors below the ejector [(GRM) and (GRB)].

5). Time-drive monitoring will begin without pumping, and a slug of tracer material will be ejected. The tracer material slug will be a volume of Iodine 131 equivalent to approximately 2.0 to 3.0 millicuries. This release may be confirmed by detectors GRM and GRB. Detector GRT, located inside the casing, above the ejector will monitor the fluid in the casing to confirm the absence of tracer material rising upward inside the casing.

6). Gamma-ray levels will be monitored for 60 minutes; if tracer is detected, by detector GRT, the combination logging tool will be raised to follow the tracer.

7). A gamma-ray log will be run to approximately 1000 feet above the casing seat (or to a depth above the top of the confining sequence - to be determined during the drilling of the injection well).

8). The tracer ejector should be positioned approximately 5 feet above the bottom of the casing, with one gamma-ray detector above the ejector (GRT), and two gamma-ray detectors below the ejector [one inside the casing above the casing seat (GRM) and one outside the casing below the casing seat (GRB)].

9). A low injection rate will be established. The velocity will be approximately 0.1 foot per second, or approximately 55 gallons per minute.

10). Time-drive monitoring will begin and a slug of tracer material (similar to that used in Item 5) will be ejected. This release will be confirmed by detectors GRM and GRB.

11). Gamma-ray levels will be monitored for 30 minutes.

12). A gamma-ray log will be run to the same depth determined in Item 7.

13). The combination logging tool will be repositioned as described in Item 8.

14). A high injection rate (approximately 4375 gal/min) then will be established.

15). Time-drive monitoring will begin; a slug tracer material will be ejected (similar to that used in item 5); and the release of the tracer material will be confirmed by detectors GRM and GRB.

16). Gamma-ray levels will be monitored for five minutes.

17). A gamma-ray log will be run to the same depth determined in Item 7.

18). Repeat as necessary.

19). Pumping shall cease.

20). Repeat Items 4, 5 and 6. A larger volume of radioactive material (approximately 4.0 to 5.0 millicuries) will be released.

21). A gamma-ray log will be run up to approximately 1500 feet.

03080 ADDITIONAL TESTING BY OUTSIDE AGENCIES OR SERVICES; The Consultant and/or the Owner may issue written authorization for additional testing and for logging to be performed by outside agencies, the Consultant's staff, or competent testing firms. The Contractor shall be given due notification of the test program and the firm or agency performing the test. The Contractor shall be compensated for standby time during any such well testing or logging.

In the event a tool owned by the outside firm or agency is lost in the well and cannot be retrieved, the Contractor shall be compensated for correcting the situation (if necessary). The Contractor shall be reimbursed for all costs incurred for rental of extra tools and equipment used during these operations.

The Contractor shall be responsible for and shall receive no additional compensation for cleaning the well of debris or loose well material which is dislodged during the test. The condition of the well is the Contractor's responsibility and no compensation shall be made for maintaining a clean hole.

03090 PRESSURE TESTING; Following the cement bond log, the 20-inch diameter casing shall be pressure tested and following the installation of the tubing and packer, the annulus between the 16-inch diameter tubing and the 20-inch diameter casing shall be pressure tested. In each case, the casing shall be filled with water and place under a minimum of 150 psi (pounds per square inch) and a maximum of 225 psi. No pressure change in excess of 5% of the initial test pressure is allowed in sixty minutes. If a pressure change in excess of 5% of the initial test pressure occurs, the test shall be repeated under controlled conditions to the satisfaction of the Consultant and the regulatory agencies. If the pressure changes or if there is some other indication of leakage, the Contractor shall take steps to locate the leak and make repairs in a manner satisfactory to the Consultant. Pressure testing shall be witnessed and certified in writing by the Consultant and FDER also will witness the pressure test following reasonable prior notice.

Following the cement bond logs of the 16-inch diameter monitor well casing, the 16-inch diameter casing shall be pressure tested. The casing shall be filled with water and placed under a minimum of 150 psi and a maximum of 225 psi. No pressure change in excess of 5% of the initial test pressure is allowed in sixty minutes. If a pressure change occurs, the test shall be repeated under controlled conditions to the satisfaction of the Consultant and the regulatory agencies. If the pressure changes or if there is some other indication of leakage, the Contractor shall take steps to locate the leak and make repairs in a manner satisfactory to the Consultant. Pressure testing shall be witnessed and certified in writing by the Consultant and FDER also will witness the pressure test following reasonable prior notice.

Following the cement bond logs of the 6-inch diameter monitor well casing, the 6-inch diameter casing shall be pressure tested. The casing shall be filled with water and placed under a minimum of 150 psi and a maximum of 225 psi. No pressure change in excess of 5% of the initial test pressure is allowed in sixty minutes. If a pressure change occurs, the test shall be repeated under controlled conditions to the satisfaction of the Consultant and the regulatory agencies. If the pressure changes or if there is some other indication of leakage, the Contractor shall take steps to locate the leak and make repairs in a manner satisfactory to the Consultant. Pressure testing shall be witnessed and certified in writing by the Consultant and FDER also will witness the pressure test following reasonable prior notice.

The Contractor shall submit verification of pressure-gauge calibration to the Consultant prior to commencement of each pressure test. The cost of the pressure tests of the injection well shall be included in the lump-sum price of the injection well. The cost of the pressure test of the monitor well shall be included in the lump-sum price of the monitor well.

04000 – MATERIALS SPECIFICATIONS

Injection Well Materials

04010 CASING: All injection well casing and tubing shall be new. The Contractor may propose to the Consultant the use of well casing of a higher grade. The casings shall have the mimimum standards in the following specifications. Before casings are installed in the well, the Contractor shall supply the Consultant with mill certificates.

04011 PIT CASING: The Contractor shall install a pit casing with an inside diameter sufficient to accommodate a 46-inch diameter drilling bit. The material, length, and method of installation shall be at the Contractor's option subject to approval by the Consultant. The cost of the pit casing shall be included in the lump-sum price of the injection well.

04012 CONDUCTOR CASING: The conductor casing shall be new, unused, steel, random length, 38-inch diameter, 0.375-inch wall thickness, and shall conform to API 5L Grade B, ASTM A53 Grade B or Spiral Weld A139 Grade B standards. The casing shall be plain end beveled for welding and shall be joined together by certified welders. The Contractor must provide the Consultant proof of welders' certifications before any welding may be started. The Contractor shall include the cost for 350 feet of conductor casing in the lump-sum price of the injection well.

04013 SURFACE CASING; The surface casing shall be new, unused steel, random length, 30-inch diameter, 0.375-inch wall thickness, and shall conform to either API 5L Grade B, ASTM A53 Grade B or Spiral Weld A139 Grade B standards. The casing shall be plain end and beveled for welding and shall be joined together by certified welders. The Contractor shall include the cost for 1400 feet of surface casing in the lump-sum price of the injection well.

04014 INJECTION CASING; The injection casing shall be new, unused seamless steel, random length, 20-inch diameter, 0.500-inch wall thickness, and shall conform to either API 5L Grade B or ASTM A53 Grade B standards. The casing shall be plain end and beveled for welding and shall be joined together by certified welders. Prior to installation of the final casing into the well, it shall be sand blasted to remove any traces of mill varnish from its exterior surface. The Contractor shall have sand blasting done at such a time as to allow the appropriate amount of rust (to facilitate proper cement bond) to have formed before installation of casing. The top 21 feet of injection casing shall be reinforced to ensure support of the well-head and the injection tubing. The the cost of 2800 feet of injection casing shall be included in the lump-sum price of the injection well.

04015 INJECTION TUBING: The injection tubing shall be new, unused, seamless, random length, 16-inch diameter, 0.500-inch wall thickness, plain end and beveled for welding and shall conform to either API5L Grade B or ASTM A53 Grade B standards. The Contractor shall include the cost of 2800 feet of injection tubing in the lump-sum price of the injection well.

04020 CENTRALIZERS; All casing of the injection well shall be fitted with Halliburton-type centralizers with steel straps at 0, 90, 180, and 270 degrees around the casing at each position. The centralizers shall be located as follows.

Conductor Casing:

1). One set at 20 feet above the bottom end of the casing
2). Three sets at 40-foot intervals above the bottom centralizer and at approximate intervals of 200 feet thereafter
3). The topmost centralizer to be at a depth of 20 feet below land surface

All centralizers shall be in a precise vertical alignment, one above the other, to allow for the placement of tremie pipes in the annuli. The cost of all centralizers shall be included in the lump-sum price of the injection well.

04030 CEMENT; Sulfate-resistant cement shall be used for all cementing of casings and hole plugging. ASTM Type II, or API Class B, can be used with additives and lost-circulation materials as necessary and approved by the Consultant. Organic polymers, peanut shells, and cotton seed hulls may not be used as lost circulation materials. Gel may be used in concentrations up to a maximum of 12 percent. Cement emplaced at the bottom 100 feet of the intermediate and bottom 200 feet of the surface and final casing in the injection well shall be neat. However, lost-circulation material such as Flocele and gilsonite may be used as needed. At the Contractor's option, all conductor casing may be cemented with neat cement. All cement mixtures shall be approved by the Consultant in advance of placement. Prior to commencement of cementing operations, Contractor shall submit written procedure for each stage of each casing string. Mixed cement shall include cement and all additives and lost circulation material approved by the Consultant. The Contractor shall include the cost of 28,000 cubic feet of mixed cement in the lump-sum price of the injection well.

04040 WELL HEAD COMPLETION; The Contractor shall finish the injection well head with a casing head recepticle and casing hanger as shown in the contract drawings or approved equal and a 16-inch gate valve. The casing head receptacle shall be set 1 foot above pad level on casing reinforced with gussets as shown in the contract drawings. The 16-inch gate valve shall conform to AWWA-C-504-80. The valve shall provide

bidirectional bubble-type sealing at 150-psi differential pressure. The Contractor shall include the cost of these items in his lump-sum price for the injection well.

04050 INJECTION TUBING/FINAL CASING ANNULAR FLUID; The fluid placed between the 16-inch diameter injection tubing and the 20-inch diameter final casing must be potable water treated with a corrosion and bacteria inhibiting product such a NL Baroid's Baracor 100. Any product used must meet with prior approval of the Consultant. The Contractor shall include the cost of treating 300 barrels of annular fluid in his lump-sum price for the injection well.

04060 INJECTION TUBING PACKER; The injection tubing packer shall be retrievable PBR packer with seal bore like a T.I.W. Type LH Packer with JGS holddowns, polished barrel, and 4-unit seal assembly or approved equal.

05000 MATERIALS SPECIFICATIONS MONITOR WELL MATERIALS

05010 CASING; All monitor well casing and tubing shall be new. The Contractor may propose to the Consultant the use of well casing of a higher grade. The casings shall have minimum standards in the following specifications. Before casings are installed in the well, the Contractor shall supply the Consultant with Mill certificates.

05011 PIT CASING; The Contractor shall install a pit casing with an inside diameter sufficient to accommodate a 34-inch diameter drilling bit. The material, length, and method of installation shall be at the Contractor's option subject to approval by the Consultant. The cost of the pit casing shall be included in the lump-sum price of the monitor well.

05012 CONDUCTOR CASING; The conductor casing shall be new, unused, steel, random length, 24-inch diameter, 0.375-inch all thickness, and shall conform to API 5L Grade B or Spiral Weld A139 Grade B standards. The casing shall be plain end and beveled for welding and shall be joined together by certified welders. The Contractor must provide the Consultant proof of welders' certifications before any welding may be started. The Contractor shall include the cost of 350 feet of conductor casing in the lump-sum price of the monitor well.

05013 SURFACE CASING: The surface casing shall be new, unused steel, random length, 16-inch diameter, 0.375-inch wall thickness, and shall conform to either API 5L Grade B, ASTM A53 Grade B or Spiral Weld A139 Grade B standards. The casing shall be plain end beveled for welding and shall be joined together by certified welders. The Contractor shall include the cost for 1000 feet of surface casing in the lump-sum price of the monitor well.

05014 MONITOR CASING: The monitor casing shall be new, unused, seamless steel, random legnth, 6-5/8-inch diameter, 0.562-inch wall thickness, and shall conform to either API 5L Grade B or ASTM A53 Grade B Standards. The casing shall be plain end and beveled for welding. Prior to installation of the final casing in the well, it shall be sand blasted to remove any traces of mill varnish from the exterior surfaces of the bottom 500 feet. The top 1000 feet (approximate) of casing shall be coated with an epoxy polyamide coating to protect the uncemented portions of the casing. The Contractor shall have sand blasting done at such a time as to allow the appropriate amount of rust (to facilitate proper cement bond) to have formed before installation of casing. The Contractor shall include the cost of 2200 feet of monitor casing in the lump-sum price of the monitor well.

05020 CENTRALIZERS: All casing of the monitor well shall be fitted with Halliburton-type centralizers with shell straps at 0, 90, 180, and 270 degrees around the casing at each position. The centralizers shall be located as follows:

Conductor Casing:

1). One at 20 feet above the bottom end of the casing
2). Two at 40-foot intervals above bottom centralizer
3). One at 20 feet below land surface

All other casings and tubings:

1). One at 20 feet above the bottom end of the casing
2). Three at 40-foot intervals above the bottom centralizer and at approximate intervals of 200 feet thereafter
3). The topmost centralizer to be at a depth of 20 feet below land surface

All centralizers shall be in a precise vertical alignment, one above the other, to allow for the placement of tremie pipes in the annuli. The cost of all centralizers shall be included in the lump-sum price of the monitor well.

05030 CEMENT: Sulfate-resistant cement shall be used for all cementing of casings and hole plugging. ASTM Type II, or API Class B, can be used with additives and lost-circulation materials as necessary and approved by the Consultant. Organic polymers, peanut shells, and cotton seed hulls may not be used as lost circulation materials. Gel may be used in concentrations up to a maximum of 12 percent. Cement emplaced at the bottom 200 feet of the surface and final casing shall be neat. However, lost-circulation material such as Flocele and gilsonite may be used as needed. At the Contractor's option, all conductor casing may be cemented with neat cement. All cement mixtures shall be approved by the Consultant in advance placement. Prior to commencement of cementing operations, the Contractor shall submit a written procedure for each stage of each casing string. Mixed cement shall include cement and all additives and lost circulation material approved by the Consultant. The Contractor shall include the cost of 7,500 cubic feet of mixed cement in the lump-sum price of the monitor well. The first cementing stage for each casing string will be pressure grouted.

05040 COATING: Before the 6-5/8-inch diameter monitor tubing for the deeper zone is installed in the monitor well, the entire casing string shall be coated with an epoxy-polyamide coating such as Tnemec Series 66 Hi-Build Epoxoline as manufactured by Tnemec Company, Inc., 2101 State Road 434 West, Longwood, Florida. The coating on the monitor tube shall have a minimum thickness of 6.0 mils when dry. The Contractor shall

exercise care while making up the tubing and replace any coating that may be damaged during this operation. After all applications of the coating, the Contractor shall have the coating holiday checked and certified as to its integrity before the tubing is installed in the well. The costs of all coating for the 6-5/8-inch diameter tubing shall be included in the lump-sum price of the monitor well.

05050 DISINFECTION: Following approval by the Consultant of the tests indicating that the monitor tubes are open and in contact with the formation, the Contractor shall disinfect the monitor tubes accordance with Section 1-7 of the AWWA Standard for Deep Wells. The Contractor shall submit to the Consultant for approval his written procedure for disinfection prior to its implementation. The Contractor shall notify the Consultant in writing at least 24 hours in advance of the implementation of the approved disinfection procedures. The Contractor shall include all costs for disinfection in the lump-sum price of the monitor well.

CONTRACT DRAWINGS

1). Site Plan

2). Injection Well and Deep Monitor Well Construction Details

3). Injection Well, Well-head Construction Details

4). Temporary Concrete Drill Pad Location Plan

5). Drill Pad Construction Details

6). Water-Table Monitoring Wells Construction Details

7). Injection Tubing Packer Construction Details

8). North-South Cross-Section. Stratigraphic Correlation and Water Quality

A-1). Map Showing Locations of Stratigraphic Control Well and Cross-Section Line

A-2). Stratigraphic Cross-Section A-A'

CONTRACT TABLES

1). Membrane Softening Concentrate Composition

2). Odor Control System Concentrate Composition

3). Future R.O. Concentrate Composition

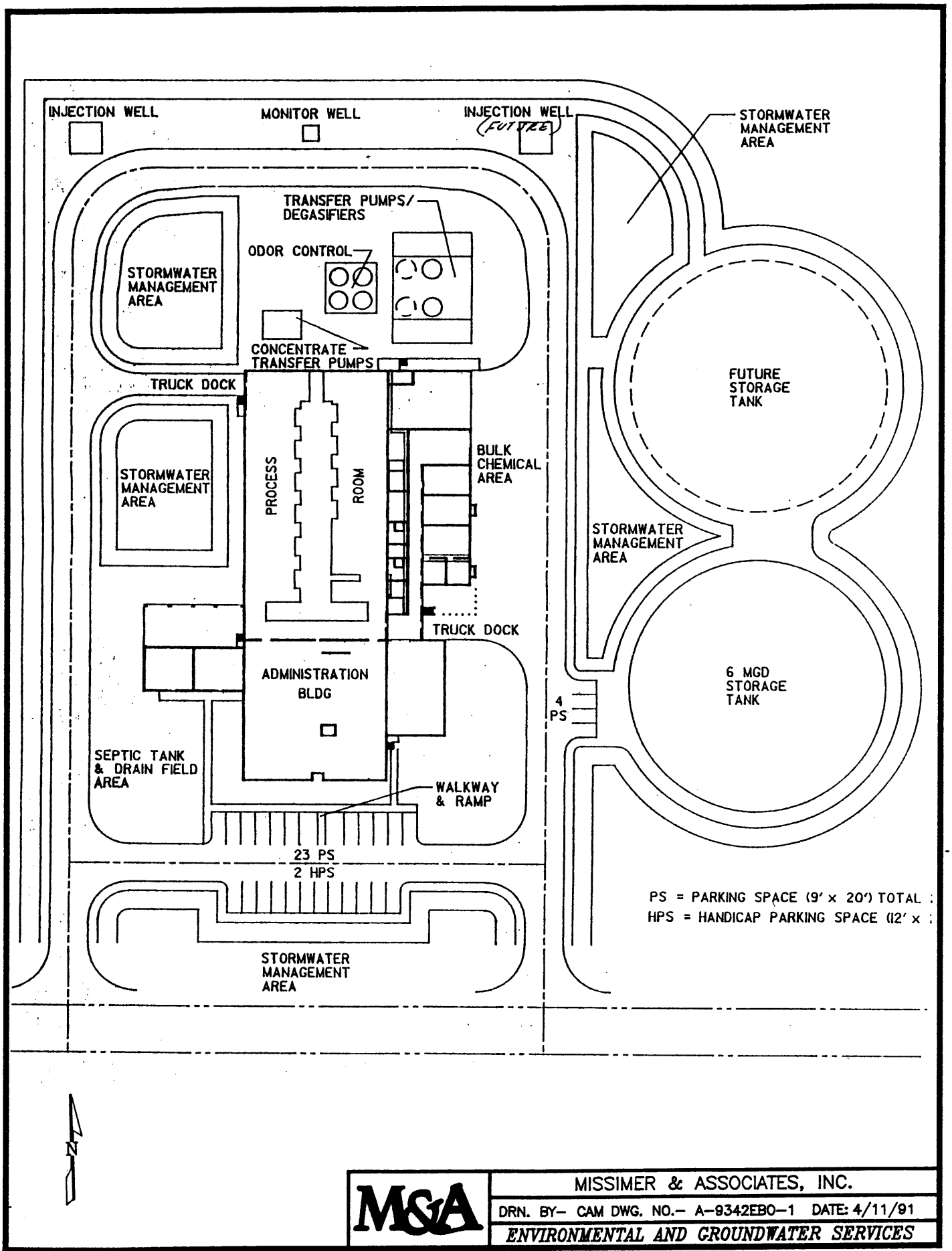


FIGURE 1. SITE PLAN

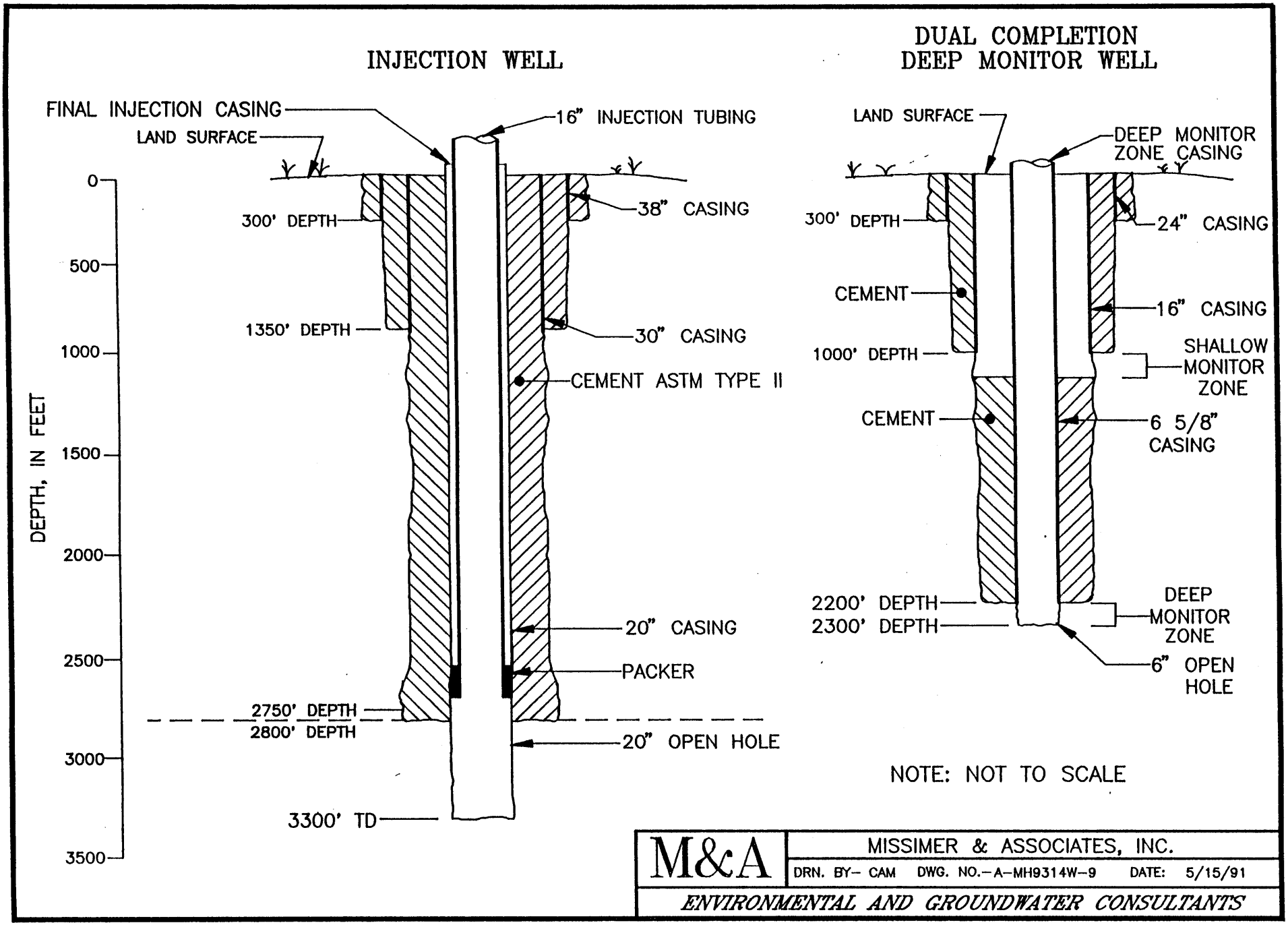


FIGURE 2. PROPOSED CONSTRUCTION DETAILS OF THE INJECTION WELL AND ZONE MONITOR WELL.

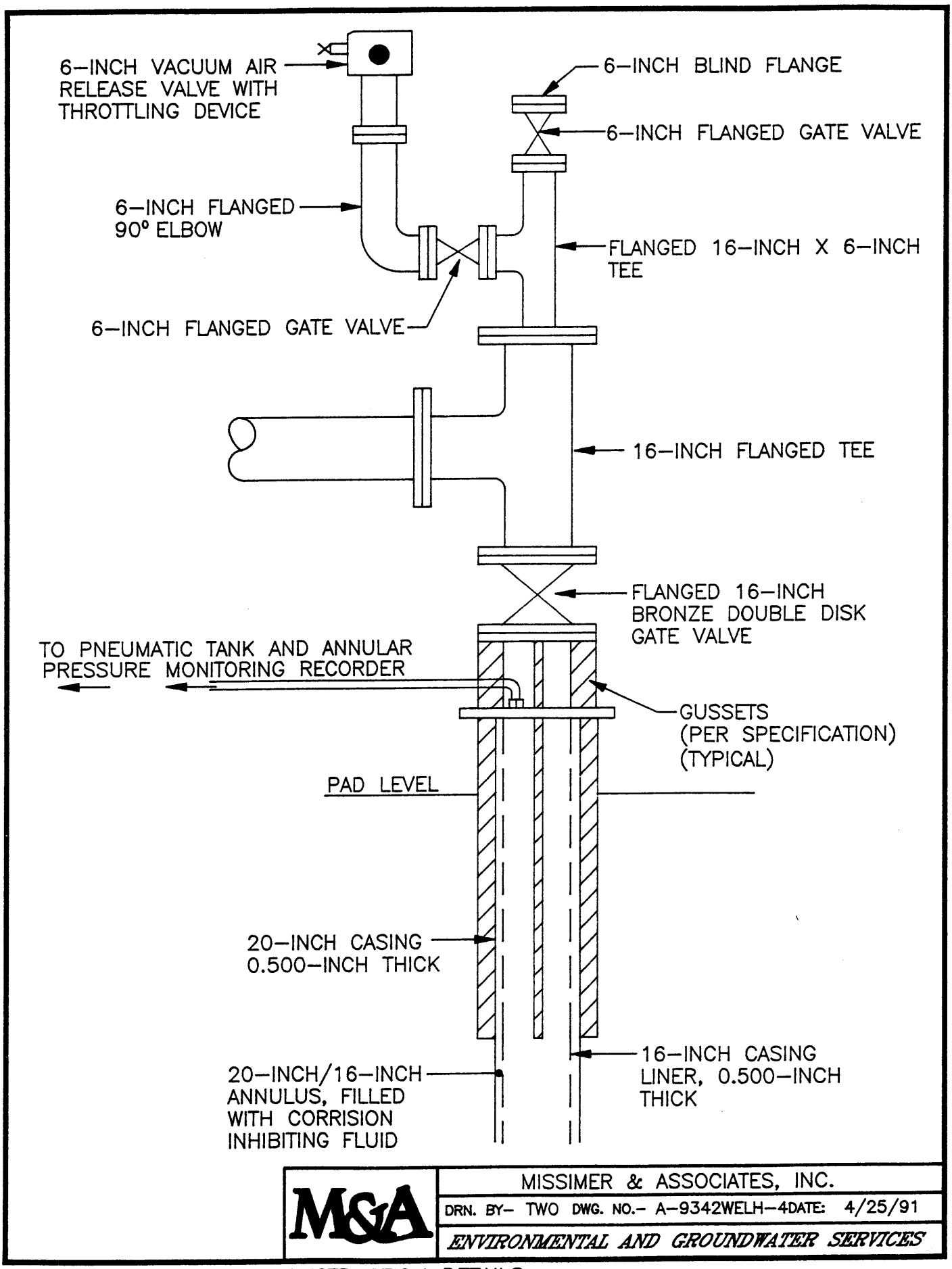


FIGURE 3. WELL HEAD CONSTRUCTION DETAILS.

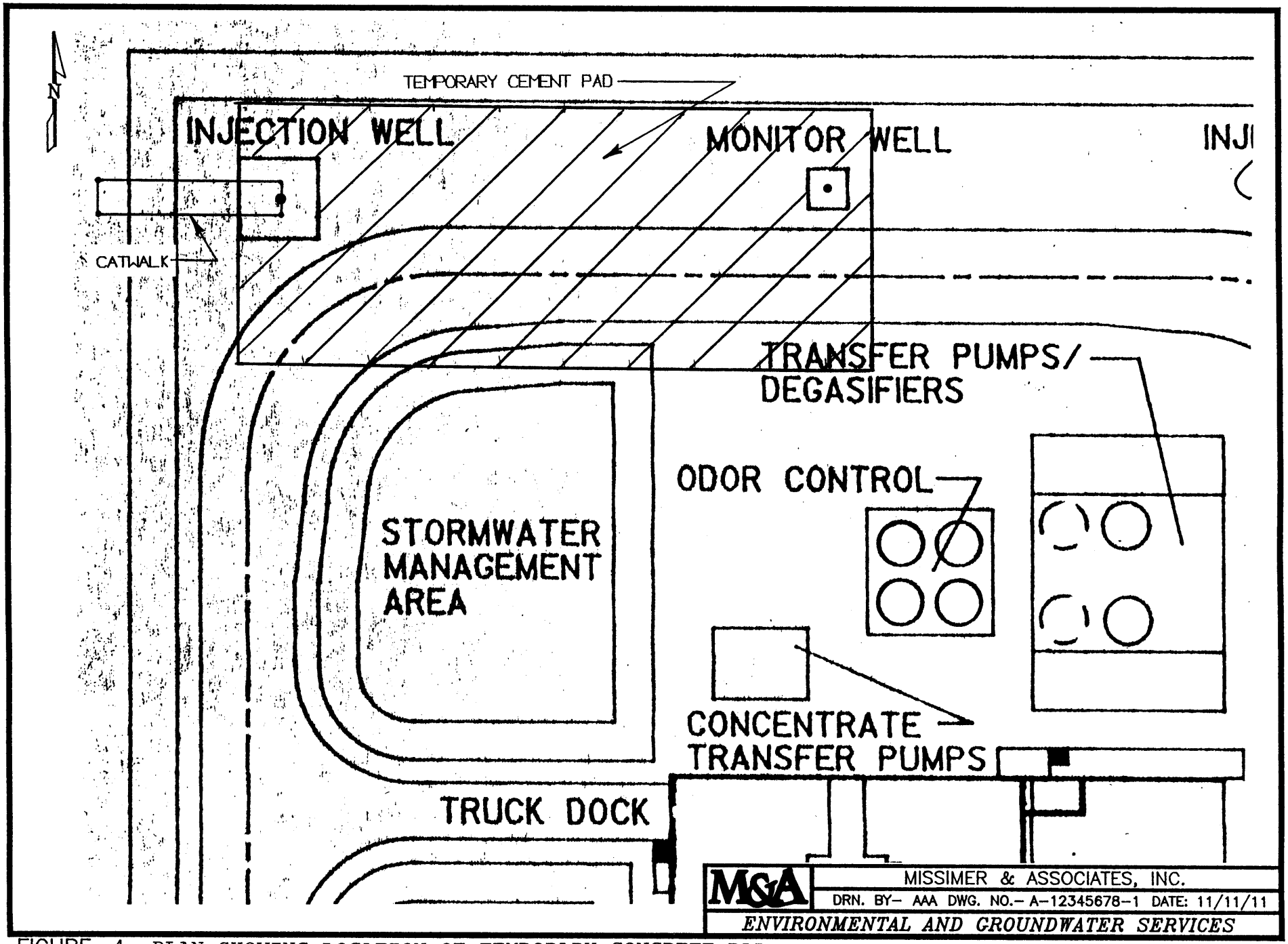
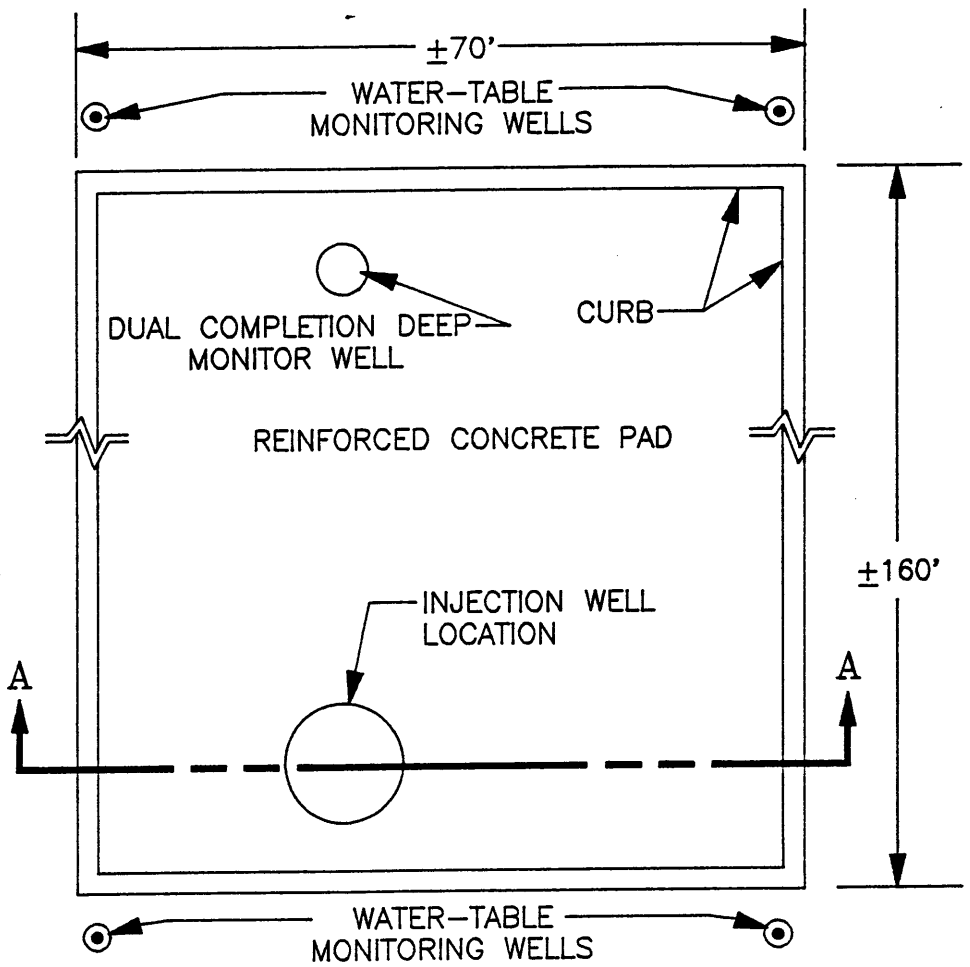


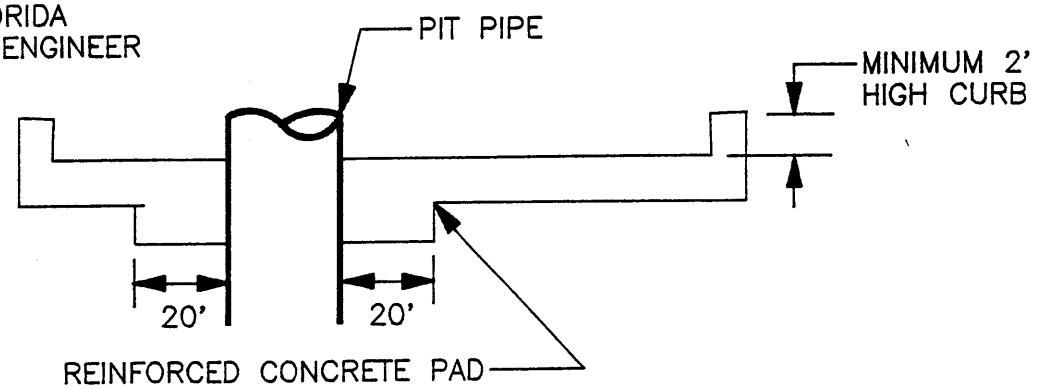
FIGURE 4. PLAN SHOWING LOCATION OF TEMPORARY CONCRETE PAD FOR WELL CONSTRUCTION AND TESTING



PLAN VIEW

NOTE:
CONTRACTOR TO SUBMIT DESIGN DETAILS OF CONCRETE PAD TO SUPPORT DRILLING EQUIPMENT SEALED BY FLORIDA PROFESSIONAL ENGINEER

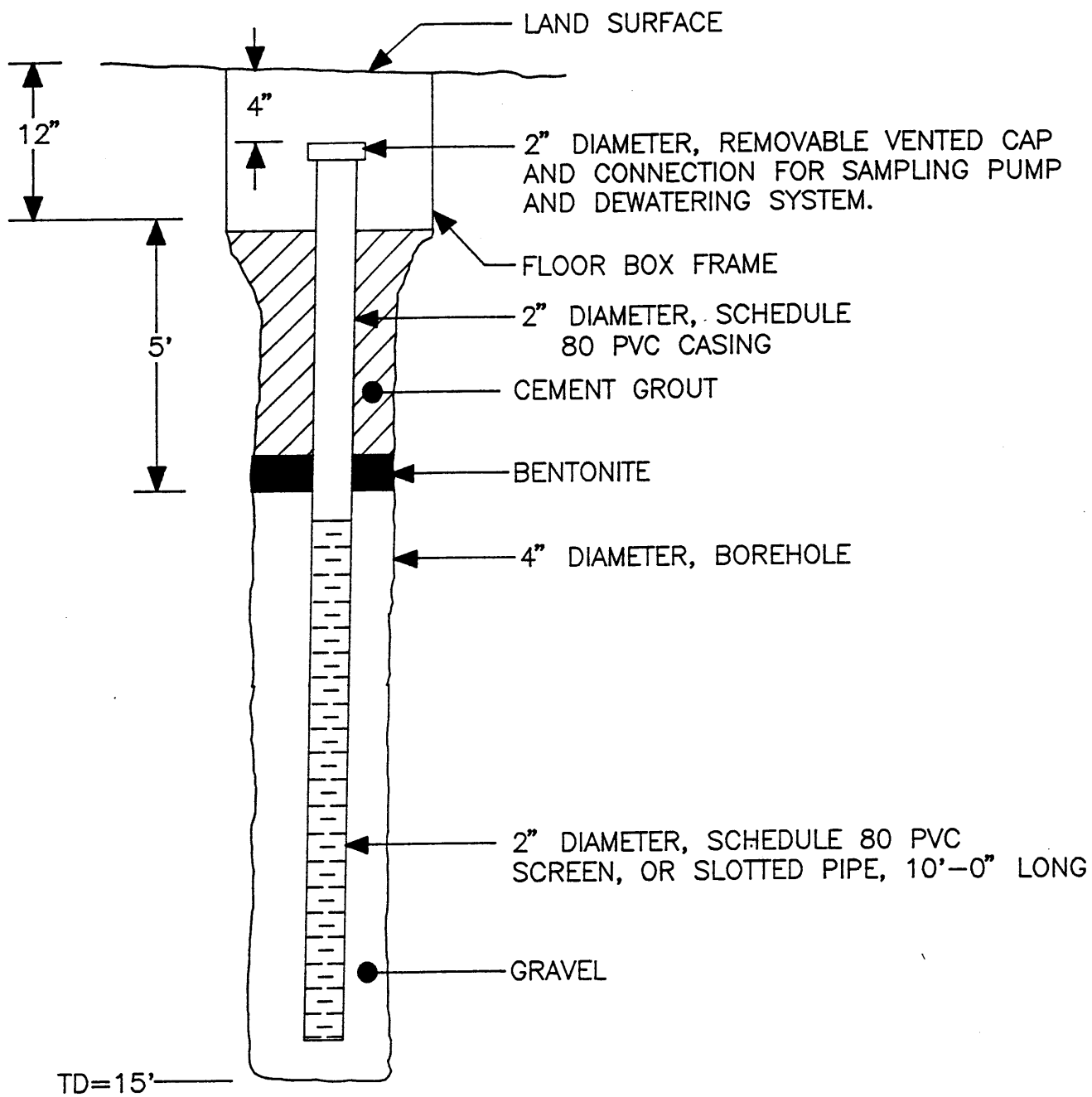
NOTE:
NOT TO SCALE



CROSS SECTION A–A

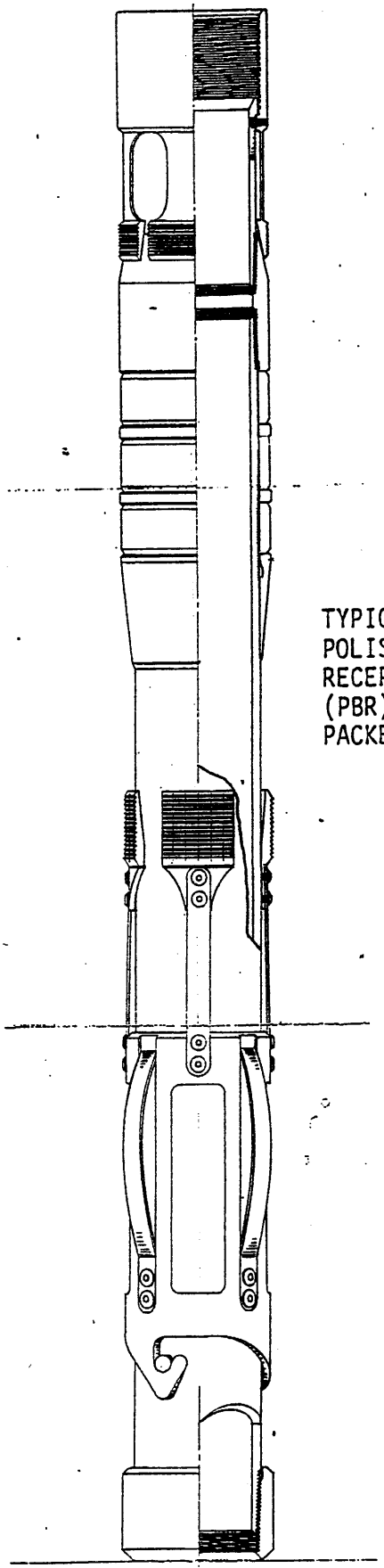
M&A	MISSIMER & ASSOCIATES, INC.
	DRN. BY– TWO DWG. NO.–A–9342DP–1 DATE: 4/23/91
	ENVIRONMENTAL AND GROUNDWATER CONSULTANTS

FIGURE 5. DRILL PAD CONSTRUCTION DETAILS.

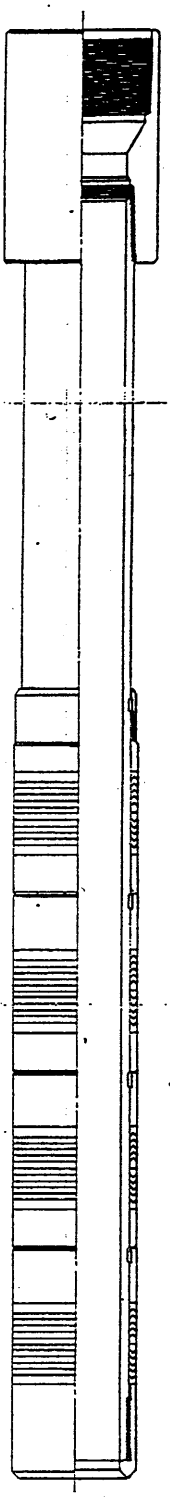


M&A	MISSIMER & ASSOCIATES, INC.
	DRN. BY-TWO DWG. NO.- A-9342IWEL-3 DATE: 4/25/91
	ENVIRONMENTAL AND GROUNDWATER CONSULTANTS

FIGURE 6. INJECTION WELL DRILLING PAD WATER-TABLE MONITORING WELL CONSTRUCTION DETAILS.



TYPICAL
POLISHED BORE
RECEPTICLE
(PBR), TYPE
PACKER



TYPICAL
SEAL ASSEMBLY
O-RING TYPE

M&A

MISSIMER & ASSOCIATES, INC.

DRN. BY- CAM DWG. NO.- A-9342EBO-1 DATE: 4/11/91

ENVIRONMENTAL AND GROUNDWATER SERVICES

FIGURE 7. TYPICAL PBR TYPE PACKER WITH SEAL BORE ASSEMBLY.

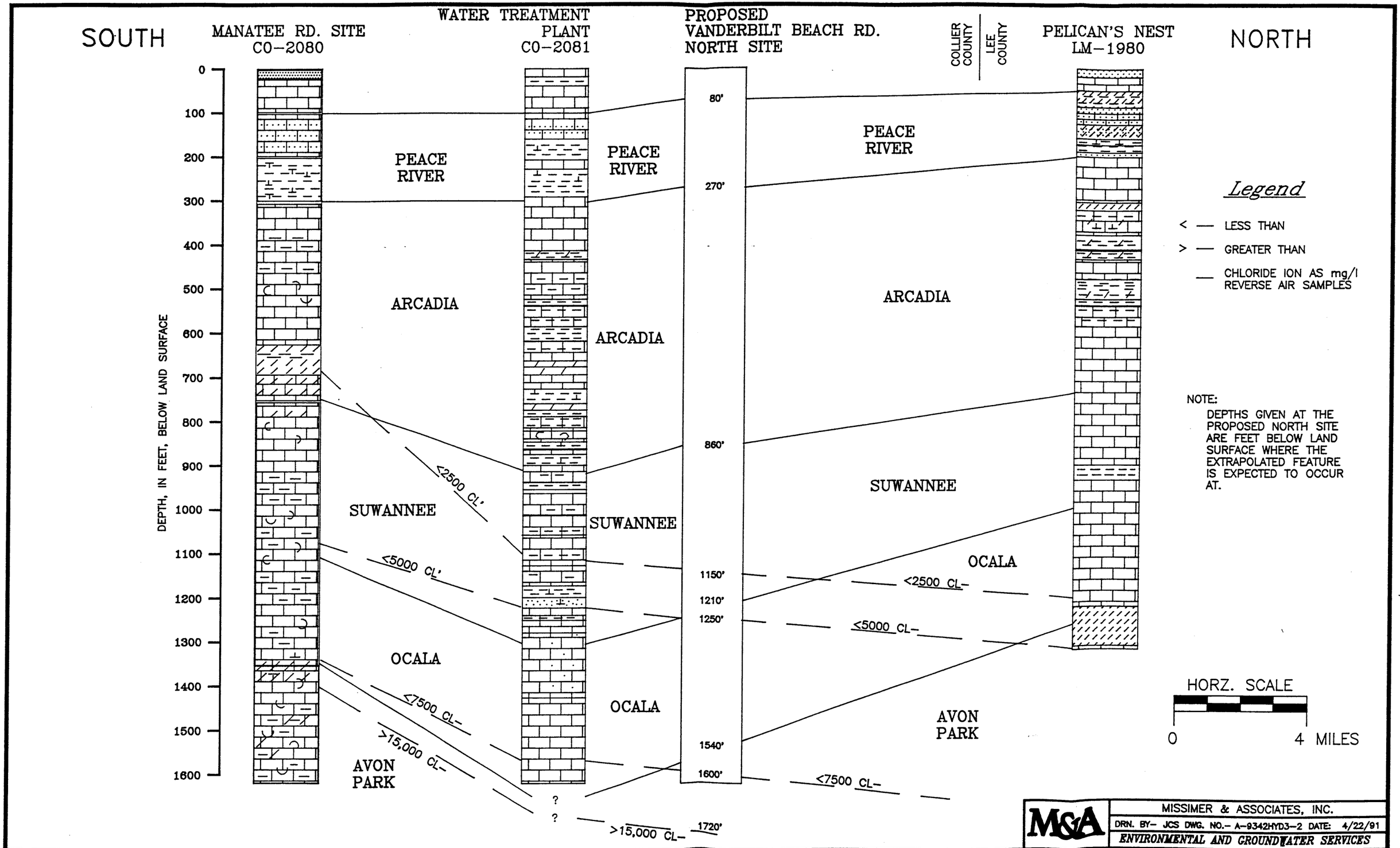


FIGURE 8. NORTH – SOUTH CROSS SECTION. STRATIGRAPHIC CORRELATION AND WATER QUALITY.

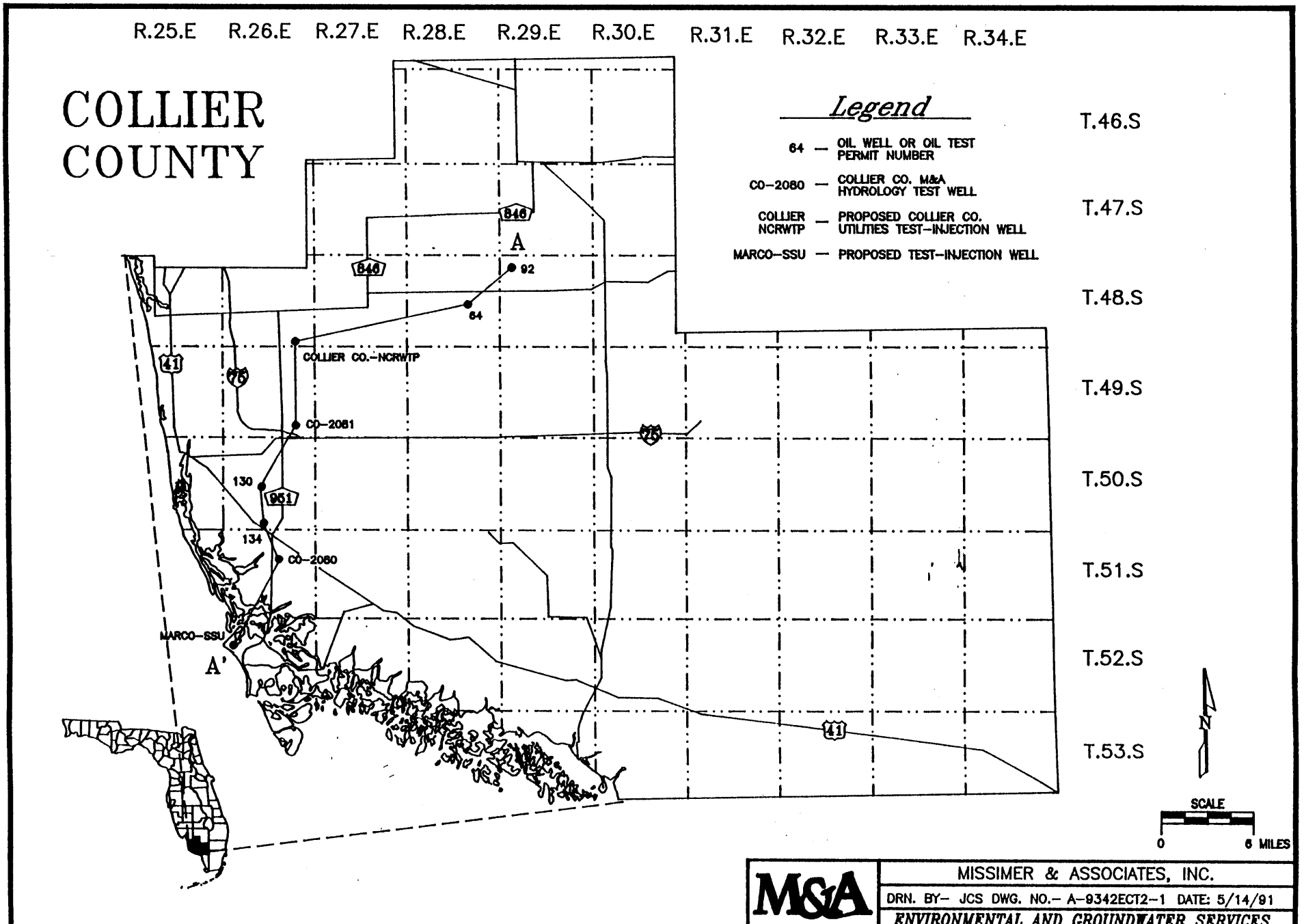


FIGURE A-1. MAP SHOWING LOCATIONS OF STRATIGRAPHIC CONTROL WELLS AND CROSS-SECTION LINE.

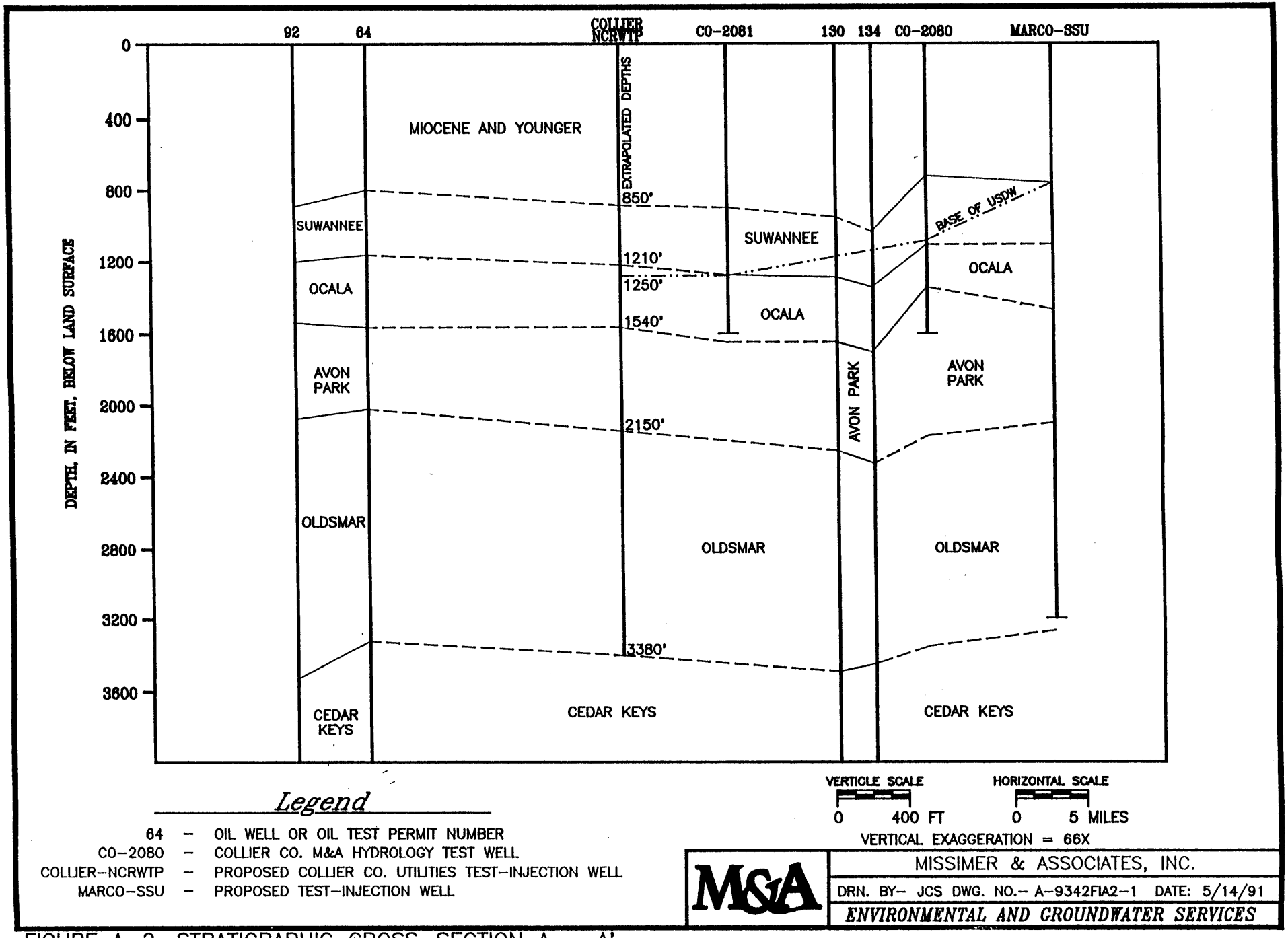


FIGURE A-2. STRATIGRAPHIC CROSS-SECTION A – A'.

TABLE 1. Membrane Softening Concentrate Composition

HYDRANAUTICS DESIGN PROGRAM - VERSION 4.05 (1990) 02-14-91
Calculation was made by: IAN WATSON

Project name : COLLIER COUNTY-FINAL DESIGN ARRAY SOFTENING Permeate flow : 2000000 GPD

Feedwater temperature : 25.0 C
Raw water pH : 7.20
Acid dosage, ppm(100%): 178.3 H2SO4
Acidified feed CO2,ppm : 194.8

Recovery : 90.0%
Element age : 3.0 years
Flux decline coefficient : -0.030
3-yr salt passage increase factor :1.5

Feed Pressure : 115.2 psi

Concentrate Pressure : 55.8 psi

Pass	Feed Flow Total gpm	Feed Flow Vessel gpm	Conc. Flow Total gpm	Conc. Flow Vessel gpm	Beta	Conc. Press. psi	Element Type	Element No.	Array
1	1543.2	48.2	607.6	19.0	1.21	93.2	8040-LSY-PVD1	192	32x6
2	607.6	38.0	265.9	16.6	1.17	73.9	8040-LSY-PVD1	96	16x6
3	265.9	33.2	154.3	19.3	1.09	55.8	8040-LSY-PVD1	48	8x6

	Raw water		Feed water		Permeate		Concentrate	
Ion	mg/l	ppm*	mg/l	ppm*	mg/l	ppm*	mg/l	ppm*
Ca	81.6	203.5	81.6	203.5	25.4	63.4	587.3	1464.6
Mg	16.7	68.7	16.7	68.7	4.5	18.7	126.2	519.2
Na	41.2	89.6	41.2	89.6	18.7	40.8	243.3	528.8
K	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NH4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Sr	0.6	0.6	0.6	0.6	0.0	0.1	5.2	5.9
CO3	0.2	0.3	0.0	0.0	0.0	0.0	0.1	0.1
HCO3	341.6	280.0	120.1	98.5	89.2	73.1	398.3	326.5
SO4	13.9	14.5	188.6	196.5	1.9	2.0	1869.0	1946.9
Cl	37.6	53.0	37.6	53.0	33.6	47.3	73.9	104.2
F	0.2	0.5	0.2	0.5	0.1	0.4	0.7	1.7
NO3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SiO2	17.8		17.8		15.9		35.0	
TDS	551.4		504.4		189.5		3338.9	
pH	7.2		6.0		5.9		6.5	

Notes: *ppm as CaCO3. Calculated concentrations are accurate to +/- 10%

	Raw water	Feed water	Concentrate
CaSO4/Ksp*100,%	0.5	6.1	97.3
SrSO4/Ksp*100,%	0.2	2.7	54.4
BaSO4/Ksp*100,%	5.7	67.9	1269.7
SiO2 sat.,%	14.2	14.2	28.0
Langelier ind.	0.06	-1.59	0.25
St f & Davis ind.	0.12	-1.55	0.06
Io c strength	0.01	0.01	0.09
Osmotic press.,psi	3.9	3.3	19.8

TABLE 2. Odor Control System Concentrate Composition

CALVERT Odor Control System

Material Balance Based on reactions (A) and (B):

	Stage #1	Stage #2	
Air flow rate, scfm	48,000	48,000	
Inlet H2S, lb/day	1,201.0	240.2	
Outlet H2S, lb/day	240.2	6.0	
H2S removed, lb/day	960.8	234.2	
Reaction A:			TOTAL
NaOH, lb/day	2.261	0	2.261
Na2S, lb/day	2.204	0	2.204
H2O, lb/day	1.017	0	1.017
Reaction B:			
NaOCl, lb/day	0	513	513
S, lb/day	0	220	220
NaCl, lb/day	0	403	403
H2O, lb/day	0	124	124

Complete Material Balance:

Total H2S removed, lb/day	1,195
Chemicals required:	
A. NaOCl:	
NaOCl, lb/day	513
Excess Chemical, % (Note 1)	20%
NaOCl, lb/day (total)	616
NaOCl, gal/day, 12.5%	580
NaOCl, 30 day supply, gal (12.5%)	17,387
B. NaOH:	
NaOH, lb/day	2,481
Excess Chemical, % (Note 1)	20%
NaOH, lb/day (total)	2,977
NaOH, gal/day, 50%	476
NaOH, 30 day supply, gal (50%)	14,291
End Products:	
C. Na2S, lb/day	2,204
D. S, lb/day	220
F. NaCl, lb/day	403
G. H2O, lb/day	1,141
H. Water thru nozzles, lb/day	48,038
	52,007

Exit Stream Concentration, % weight

C. Na2S, %	4.24%
D. S, %	0.42%
F. NaCl, %	0.77%
G. H2O, %	94.56%
H. Water thru nozzles, lb/day	100.00%

Note 1: We have included 20% excess chemical which may be consumed in partially reacting with CO2, and/or losses.

TABLE 3. Future R.O. Concentrate Composition

HYDRANAUTICS DESIGN PROGRAM - VERSION 4.05 (1990) 02-14-91
Calculation was made by: IAN WATSON

Project name : COLLIER CO, FUTURE RO

Permeate flow : 2000000 GPD

Feedwater temperature : 25.0 C
Raw water pH : 7.40
Acid dosage, ppm(100%): 57.9 H2SO4
Acidified feed CO2,ppm : 64.5

Recovery : 70.0%
Element age : 3.0 years
Flux decline coefficient : -0.030
3-yr salt passage increase factor : 1.5

Feed Pressure : 258.3 psi

Concentrate Pressure : 217.2 psi

Pass	Feed Flow Total gpm	Feed Flow Vessel gpm	Conc. Flow Total gpm	Conc. Flow Vessel gpm	Beta	Conc. Press. psi	Element Type	Element No.	Array
1	1984.1	36.7	724.9	13.4	1.16	244.6	8040-LSZ-CPA2	324	54x6
2	724.9	40.3	595.2	33.1	1.02	217.2	8040-LSZ-CPA2	108	18x6

	Raw water		Feed water		Permeate		Concentrate	
Ion	mg/l	ppm*	mg/l	ppm*	mg/l	ppm*	mg/l	ppm*
Ca	131.2	327.2	131.2	327.2	2.0	5.1	432.6	1078.8
Mg	151.1	621.8	151.1	621.8	2.3	9.6	498.2	2050.3
Na	1725.0	3750.0	1725.0	3750.0	124.9	271.5	5458.6	11866.4
K	52.0	66.7	52.0	66.7	4.7	6.0	162.4	208.3
NH4	1.2	3.3	1.2	3.3	0.1	0.3	3.7	10.4	
[illegible]	0.1	0.1	0.1	0.1	0.0	0.0	0.3	0.2
	15.6	17.8	15.6	17.8	0.2	0.3	51.4	58.7
CO3	0.2	0.3	0.0	0.0	0.0	0.0	0.2	0.3
HCO3	197.4	161.8	125.8	103.1	14.3	11.8	385.8	316.2
SO4	464.4	483.8	521.1	542.8	8.6	9.0	1716.9	1788.5
Cl	2978.0	4200.3	2978.0	4200.3	192.7	271.8	9477.1	13366.8
F	0.9	2.4	0.9	2.4	0.1	0.3	2.7	7.2
NO3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SiO2	19.3		19.3		0.6		62.9	
TDS	5736.4		5721.3		350.7		18252.9	
pH	7.4		6.5		5.6		7.0	

Notes: *ppm as CaCO3. Calculated concentrations are accurate to +/- 10%

	Raw water	Feed water	Concentrate
CaSO4/Ksp*100,%	4.6	5.1	22.9
SrSO4/Ksp*100,%	34.4	38.4	170.7
BaSO4/Ksp*100,%	286.3	319.9	1370.7
SiO2 sat.,%	15.4	15.4	50.3
Langelier ind.	0.15	-0.95	0.51
Stiff & Davis ind.	-0.10	-1.20	-0.21
I[illegible]ic strength	0.11	0.11	0.36
O[illegible]otic press.,psi	59.9	59.7	192.5

M&A **MISSIMER & ASSOCIATES, INC.**

Environmental and Groundwater Services

Post Office Box 151306
Cape Coral, Florida 33915-1306

428 Pine Island Road, S.W.
Cape Coral, Florida 33991

(813) 574-1919
Fax (813) 574-8106

January 25, 1991

RECEIVED

JAN 28 1991

WATER USE DIVISION

Mr. Greg Rawl
South Florida Water Management District
Post Office Box 24680
West Palm Beach, Florida 33416-4680

Re: Permitting of Underground Injection Control, Class V Well through the FDER Technical Advisory Committee (TAC)

Dear Mr. Rawl:

We are now completing Phase I of our investigation of the "Deep Aquifer Hydrogeologic Study" for the Collier County Utilities Department. This phase includes the drilling and testing of two 1600+ feet deep wells in the western portion of the county. A prime objective of Phase I is to evaluate the lower aquifers for parameters relavent to an Aquifer Storage and Recovery (ASR) project.

Enclosed is a preliminary report of our findings and recommendations concerning potential ASR zones at both sites. In brief, we have chosen the Manatee Road site to initiate the ASR program. The primary aquifer to be tested is what we have termed "Hawthorn Zone II" lying at a depth of about 465 feet to 520 feet below land surface. Native water quality in this zone is about 2300 mg/l chloride ion and a conductivity of about 8000 umhos/cm. Although not yet analyzed, the TDS is probably around 4500 mg/l.

Should testing of Zone II indicate that it is not a viable ASR zone, we have chosen as an alternate zone, the Lower Hawthorn Aquifer. The same ASR well could be deepened to this zone without significant loss of well efficiency. Native water quality is about twice as saline as Zone II, having about 4000 mg/l chloride ion.

Construction of the ASR well would begin upon approval of the Technical Advisory Committee. Once completed, a series of aquifer performance and injection and recovery tests will be

conducted. This data will then be used to generate a series of hydraulic and solute transport computer models. This modeling effort will be used to design final configuration of wells as well as determining optimum injection and recovery rates.

Please feel free to contact me should you have any questions or comments relating to this cover letter or the preliminary report. I look forward to meeting you and working with you on this very beneficial Southwest Florida project.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:lk

Enclosure

pc: Fred Bloetscher, Collier County Utilities Division

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

SOUTH FLORIDA
DISTRICT

2269 BAY STREET
FORT MYERS, FLORIDA 33901

APPLICATION TO CONSTRUCT/OPERATE/ABANDON CLASS I, III, OR V INJECTION WELL SYSTEMS

PART I. Directions

A. All applicable items must be completed in full in order to avoid delay in processing this application. Where attached sheets or other technical documentation are utilized in lieu of the blank space provided, indicate appropriate cross-reference in the space and provide copies to the department in accordance with (C) below. Where certain items do not appear applicable to the project, indicate N/A in the appropriate spaces. When this form is used in conjunction with DER Form 17-1.205(1), duplicative information requests need to be completed only once.

B. All information is to be typed or printed in ink.

C. Four (4) copies of this application and four (4) copies of supporting information such as plans, reports, drawings and other documents shall be submitted to the appropriate District/Subdistrict office. An engineering report is also required to be submitted to support this application pursuant to the applicable sections of Florida Administrative Code Rule 17-28. The attached lists* shall be used to determine completeness of supporting data submitted or previously received. A check for the application fee in accordance with Florida Administrative Code Rule 17-4.05 made payable to the Department shall accompany the application.

D. For projects involving construction, this application is to be accompanied by four (4) sets of engineering drawings, specifications and design data as prepared by a Professional Engineer registered in Florida, where required by Chapter 471, Florida Statutes.

E. Attach 8 1/2" x 11" USGS site location map indicating township, range and section and latitude/longitude for the project.

PART II. General Information

A. Applicant: Name Collier Co. Utilities Divn. Title _____

Address 2800 North Horseshoe Drive

City Naples Zip 33942

Telephone Number 813/643-8480

B. Project Status: [X] New [ ] Existing

[ ] Modification (specify) _____

*"Engineering and Hydrogeologic Data Required for Support of Application to Construct, Operate and Abandon Class I, III, or V Injection Wells"

C. Well Type:

( ) Exploratory Well (X) Test/Injection Well

D. Type of Permit Application:

( ) Class I Exploratory Well Construction and Testing Permit

( ) Class I Test/Injection Well Construction and Testing Permit

( ) Class I Well Operating Permit

( ) Class I Well Plugging and Abandonment Permit

( ) Class III Well Construction/Operation/Plugging and Abandonment Permit

(X) Class V well Construction Permit

( ) Class V Well Operating Permit

( ) Class V Well Plugging and Abandonment Permit

E. Facility Identification:

Name: Collier County Pump and Storage Facility

Facility Location: Street: Manatee Road

City: Naples County: Collier

SIC Code: _____

F. Proposed facility located on Indian Lands: Yes_____ No X

G. Well Identification:

Well No. 1 of 1 Wells
(total #)

Purpose (Proposed Use): Aquifer Storage and Recovery

Well Location: Latitude: 26°2'31" N Longitude 81°41'15" W

(attach separate sheet, if necessary, for multiple wells.)

Subpart B. General Projection Description:

(1) Describe the nature, extent and schedule of the injection well project. Refer to existing and/or future pollution control facilities, expected improvement in performance of the facilities and state whether the project will result in full compliance with the requirements of Chapter 403, Florida Statutes, and all rules and regulations of the Department. Attach additional sheet(s) if necessary or cross-reference the engineering report.

A pilot project to determine the feasibility of storing potable wate

in a saline Hawthorn Aquifer followed by the recovery of this water.

Project described in detail in Phase I Preliminary Report and Addendum to that report.

PART III Statement by Applicant and Engineer

A. Applicant

I, the owner/authorized representative* of Collier County Water-Sewer District certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. I understand that this certification also applies to all subsequent reports submitted pursuant to this permit. Where construction is involved, I agree to retain the design engineer, or other professional engineer registered in Florida, to provide inspection of construction in accordance with Florida Administrative Code ~~Rule~~ 17-28.34(1)(c).

Signed _____ Date _____

FREDERICK BOOGTSCHER 813-643-8490

Name and Title (Please Type) Telephone Number

*Attach a Letter of Authorization.

B. Professional Engineer Registered in Florida

This is to certify that the engineering features of this injection well have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgement, that the well, when properly maintained and operated, will discharge the effluent in compliance with all applicable statutes of the State of Florida and the rules and regulations of the Department. It is also agreed that the undersigned will furnish the applicant a set of instructions for proper maintenance and operation of the well.

Signed: Lloyd E. Horvath

Lloyd Horvath, P.E.
Name (Please Type)

Missimer & Associates, Inc.
Company Name (Please Type)

P.O. Box 151306, Cape Coral, FL 33915
Mailing Address (Please Type)

(Please Affix Seal)

FLORIDA REGISTRATION NUMBER 25260 Date: 2-14-91 Phone No. 813 574 1919

(16) Expected changes in pressure, native fluid displacement, direction of movement of injection fluid.

(17) A proposed monitoring plan, which includes a plan for detecting migration of fluids into underground sources of drinking water, a plan to detect water quality violation in the monitoring wells, and the proposed monitoring data to be submitted.

Operation Phase

(1) The following information shall be provided to the Department prior to granting approval for the operation of the well or well field:

a. All available logging and testing program data and construction data on the well or well field;

b. A satisfactory demonstration of mechanical integrity for all new wells pursuant to Florida Administrative Code Rule 17-28.13(6)(b);

c. The actual operating data, including injection pressure versus pumping rate where feasible, or the anticipated maximum pressure and flow rate at which the permittee will operate, if approved by the Department;

d. The results of the formation testing program;

e. The actual injection procedure;

f. The status of corrective action on defective wells in the area of review.

Plugging and Abandonment Phase

(1) The justification for abandonment.

(2) A proposed plan for plugging and abandonment describing the preferred and alternate methods.

a. The type and number of plugs to be used;

b. The placement of each plug including the elevation of the top and bottom;

c. The type and grade and quantity of cement or any other approved plugging material to be used;

d. The method for placement of the plugs.

(3) The procedure to be used to meet the requirements of Florida Administrative Code Rule 17-28.27.

* (F) **CLASS V WELL CONSTRUCTION PERMIT.** (This form should be used for Class V wells instead of Form 17-1.209(1) when there is a need for a Technial Advisory Committee and an engineering report.)

(1) Type and number of proposed Class V Wells:

Wells Receiving Domestic Waste _____ Salt-water Intrusion Barrier Wells _____

Cooling Water Return Flow Wells, Open-looped System _____ Subsidence Control Wells _____

Sand Backfill Wells _____

Experimental Technology Wells _____

Radioactive Waste Disposal Wells* _____

Other non-hazardous Industrial or Commercial Disposal Wells (explain) _____

Wells used to inject spent brine after halogen recovery _____

Borehole Slurry Mining Wells _____

Other (explain) Potable water storage and recovery

*Provided the concentrations of the waste do not exceed drinking water standards contained in Chapter 17-22, F.A.C.

(2) Project Description: Please see Phase I Preliminary Report & Addendum

a. Description and use of proposed injection system;

b. Nature and volume of injected fluid (The Department may require an analysis (including bacteriological analysis) in accordance with Florida Administrative Code Rule 17-4.27(2)(c));

c. Proposed pretreatment.

(3) Water well contractor's name, title, state license number, address, phone number and signature. Attached

(4) Well Design and Construction Details. (For multi-casing configurations or unusual construction provisions, an elevation drawing of the proposed well should be attached.) Please see Phase I Preliminary Report & Addendum

a. Proposed total depth; 520 feet

b. Proposed depth and type of casing(s); 465 feet - Fiberglass

c. Diameter of well; 16" to 100 ft, 12" from 100 ft. to 465 ft.

d. Cement type, depth, thickness; Neat, to 465 ft., minimum 3" thick

e. Injection pumps (if applicable):_____gpm @____psi
Controls:_____
_____
_____

(5) Water Supply Wells - When required by Florida Administrative Code Rule 17-4.27, attach a map section showing the locations of all water supply wells within a one (1) mile radius of the proposed well. The well depths and casing depths should be included. When required by Rule 17-4.27(2)(g), results of bacteriological examinations of water from all water supply wells within one (1) mile and drilled to approximate depth of proposed well should be attached. Please see Phase I Preliminary Report & Addendum.

(6) Area of Review (may be required at Department's discretion).

Include the proposed radius of the area of review with justification for that radius. Provide a map showing the location of the proposed injection well or well field area for which a permit is sought and the applicable area of review. Within the area of review, the map must show the number or name, and location of all producing wells, injection wells, abandoned wells, dry holes, surface bodies of water, springs, public water systems, mines (surface and

subsurface), quarries, water wells and other pertinent surface features including residences and roads. The map should also show faults, if known or suspected. Only information of public record and pertinent information known to the applicant is required to be included on this map.

(G) **CLASS V WELL OPERATION PERMIT** (Final report of the construction that includes the following information may be submitted with the application to operate.)

(1) Permit Number of Class V Construction Permit:_____

(2) Owner's Name:_____

(3) Type of Well:_____

(4) Construction and Testing Summary:

a. Actual Dimensions:

Diameter _____ inches; Well Depth _____ feet; Casing Depth _____ feet.

_____ _____ _____

_____ _____ _____

b. Results of Initial Testing.

(5) Proposed Operating Data:

a. Injection Rate (GPM);

b. Description of injected waste;

c. Injection pressure and pump controls.

(6) Proposed Monitoring Plan (If any):

a. Number of monitoring wells;

b. Depth(s);

c. Parameters;

d. Frequency of sampling;

e. Instrumentation (if applicable) Flow_____

Pressure_____

(H) **CLASS V WELL PLUGGING AND ABANDONMENT PERMIT**

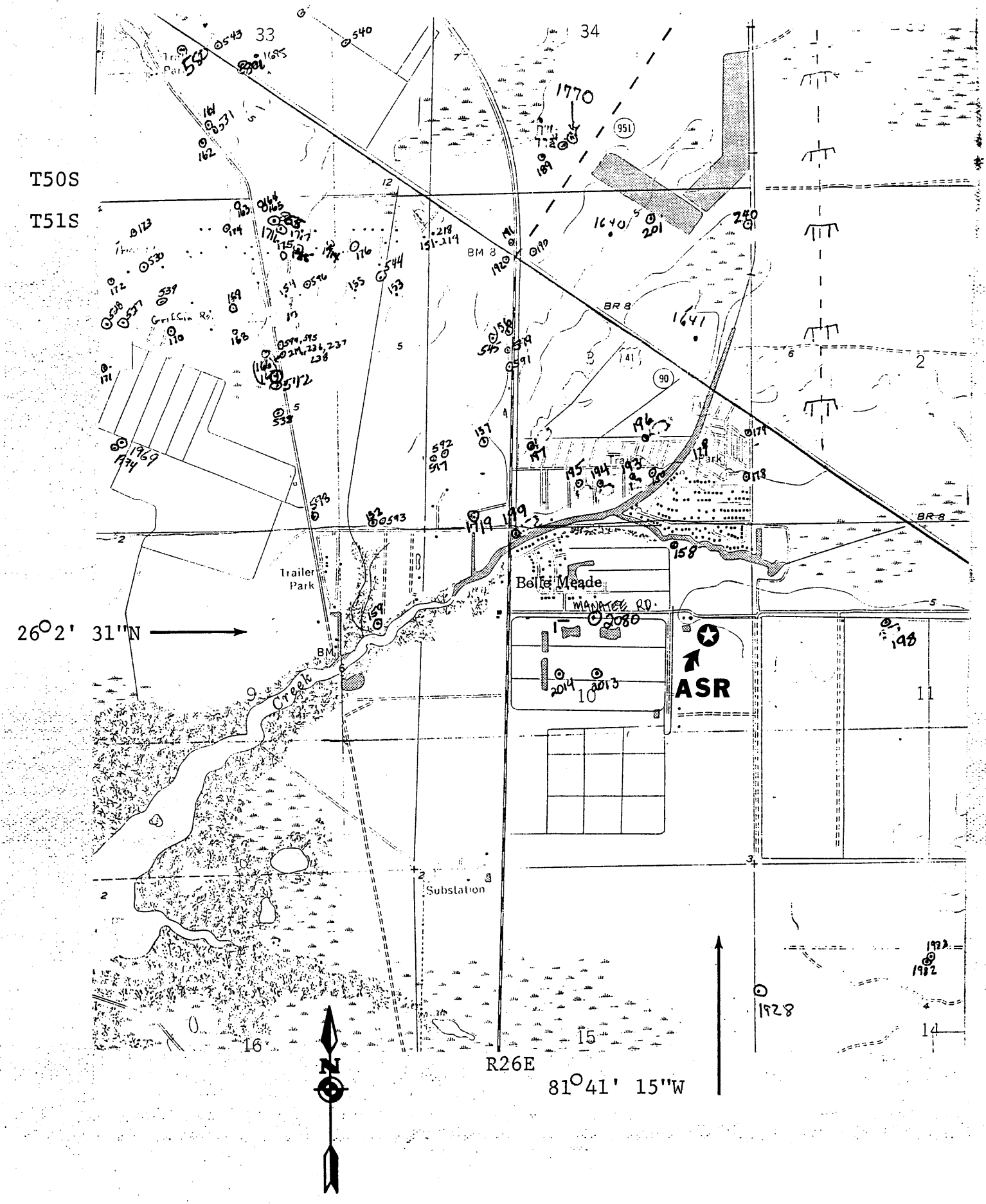
(1) Permit number of Class V construction or operating permit.

(2) Type of well.

(3) Proposed plugging procedures, plans and specifications.

(4) Reasons for abandonment.

COLLIER COUNTY UTILITIES-MANATEE ROAD ASR SITE



YOUNGQUIST
BROTHERS,
INC.

February 13, 1991

COLLIER COUNTY UTILITIES
MANATEE ROAD SITE
CLASS V GROUP II WELL CONSTRUCTION

State Licence # 2172
Collier County Licence # 900570

Don W Douglas
Project Manager
DWD/clr

15000 PINE RIDGE ROAD • FORT MYERS, FL 33908 • (813) 489-4444

M&A **MISSIMER & ASSOCIATES, INC.**

Environmental and Groundwater Services

Post Office Box 151306
Cape Coral, Florida 33915-1306

428 Pine Island Road, S.W.
Cape Coral, Florida 33991

(813) 574-1919
Fax (813) 574-8106

February 14, 1991

Mr. Greg Rawl
South Florida Water Management District
Post Office Box 24680
West Palm Beach, Florida 33416-4680

Re: Collier County Utilities Class V Well Permitting - TAC

Dear Mr. Rawl:

In response to instructions given to us during our meeting of February 5, 1991, I am submitting to you our addendum to the report titled "Phase I - Deep Aquifer Hydrogeologic Study, Collier County, Florida - Preliminary Report". Several TAC members requested certain additional information associated with the testing and well construction of this Aquifer Storage and Recovery (ASR) project. Therefore, these additional items are addressed in this addendum to the preliminary report.

Also enclosed is the completed application for construction and testing of the Class V, Group 2 well.

I appreciate very much your timeliness of this review process. Please feel free to contact me should you have further questions or comments. When we get to the drilling and testing stage, you are welcome to visit the project site at your convenience.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D.
Senior Hydrogeologist

CWW:lk

Enclosures

ADDENDUM TO REPORT
PHASE I - DEEP AQUIFER HYDROGEOLOGIC STUDY, COLLIER COUNTY, FLORIDA
PRELIMINARY REPORT

prepared for

Collier County Utilities Division
Water and Wastewater Services
2800 North Horseshoe Drive
Naples, Florida 33942

February, 1991

by

Missimer & Associates, Inc.
428 Pine Island Road, S.W.
Cape Coral, Florida 33991

Project Number
H89-342

Charles W. Walker, Ph.D
Senior Hydrogeologist

W. Kirk Martin, P.G.
Professional Geologist #079

INTRODUCTION

This addendum to the report titled "Phase I - Deep Aquifer Hydrogeologic Study, Collier County, Florida Preliminary Report" is intended to clarify or answer items discussed during the February 5, 1991 Technical Advisory Committee meeting at Fort Myers, Florida. The initial report describes the hydrogeology of the Manatee Road project site, construction plans for 1 ASR test-production well and 2 monitor wells, and the testing and sampling program. Questions regarding some aspects of the report are answered below.

MANATEE ROAD ASR TESTING PROGRAM

1. Well Inventory

A well inventory and water use assessment are presented in the original report (pages 6-9). A question was raised about the one mile radius "area of review", specifically the area south of the project site. There is no record of any well having been drilled or utilized in an area at least 2 miles to the south of the project site.

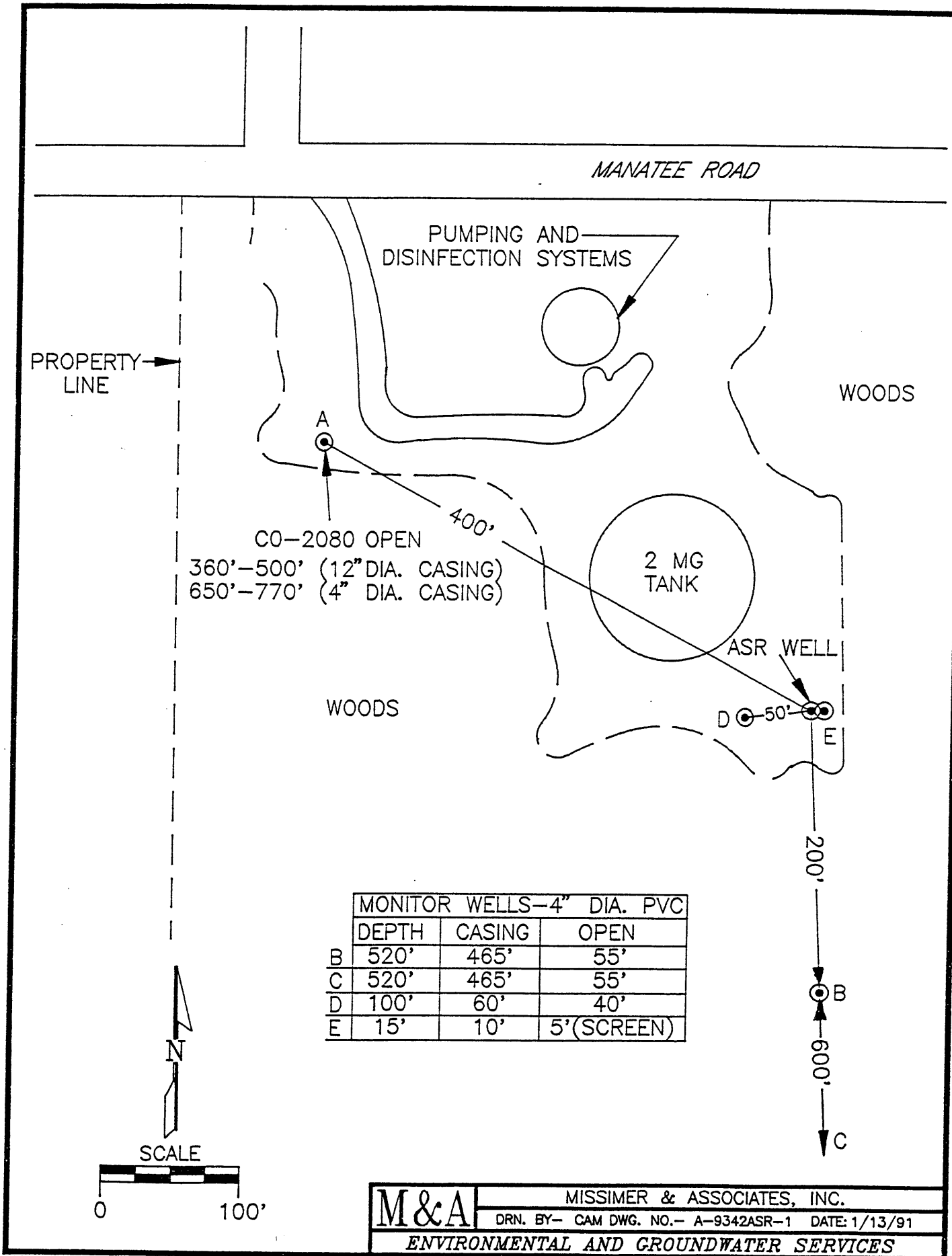
2. Supervision of Well Construction

A hydrogeologist or hydrologist will be on-site during the entire well construction operation. Drill cuttings will be collected and construction records will be maintained for the well. The construction of additional observation wells at the site will also be supervised.

3. ASR Well and Monitor Well Locations and Construction

Two additional monitor wells were added to the ASR construction plans at the request of the TAC. This includes a well to monitor water quality and static water level of the Lower Tamiami Aquifer (Surficial Aquifer System) above the injection zone. Also included is a very shallow monitor well located next to the drill pad to enable the monitoring of shallow water quality during the drilling and testing periods.

The location and construction details of 4 proposed monitor wells, the existing monitor well (CO-2080) and the proposed ASR test-production well are shown in Figure A-1. Also displayed in this figure are the locations of the 2 MG storage tank and the pumping and disinfection station which will be utilized in the ASR project.



	MONITOR WELLS—4" DIA. PVC		
	DEPTH	CASING	OPEN
B	520'	465'	55'
C	520'	465'	55'
D	100'	60'	40'
E	15'	10'	5'(SCREEN)

M&A MISSIMER & ASSOCIATES, INC.
DRN. BY- CAM DWG. NO.- A-9342ASR-1 DATE: 1/13/91
ENVIRONMENTAL AND GROUNDWATER SERVICES

FIGURE A-1. PROPOSED ASR WELL AND MONITORING WELL LOCATIONS.

4. Geophysical Logging

Geophysical logs will be obtained from the ASR well through all depth intervals except the upper 40 to 50 feet. The following logs will be run: fluid resistivity, spontaneous potential, single point resistance, gamma ray, temperature, caliper, and flow meter. A Widco model 1200 geophysical logging unit will be used.

5. Aquifer Performance Testing/Injection and Recovery Testing

An aquifer performance and/or injection test shall be first conducted at the site. This involves the continuous pumping of the test-production well or injection into a well for a period of up to 72 hours. The pumping or injection rate is maintained at a constant rate and would be continuously monitored. Water level recorders and/or pressure transducers will be utilized to measure the decline or increase in pressure in the test-production well and the observation wells. All measurement equipment will be provided by Missimer & Associates, Inc. Subsequently, the ASR well will be tested on several occasions with periodic injection and recovery of water to model the capacities of the wells and to assess movement of the injected water and potential recovery efficiencies.

Additionally, the three monitor wells open to the injection zone will be periodically geophysically logged

during the long term injection/recovery cycles with the fluid resistivity tool. This logging will provide information as to the vertical distribution of water quality within the ASR zone.

Water samples will be collected from the ASR well during its construction while drilling by the reverse-air rotary methods. Also during drilling, water samples will be taken on a weekly basis from the shallow monitor well located next to the drill rig. Following completion of the ASR well and all monitoring wells, water samples will be taken by use of the geophysical logging unit (grab samples), well flows, and by pumping when necessary. Chloride ion concentration and conductivity analyses will be performed on the samples. These data will provide baseline water quality in the ASR zone, water-table aquifer at depth, and the shallow ground water.

During the aquifer performance testing/injection and recovery testing, water samples will be taken periodically from all 5 wells. All samples will be analyzed for chloride ion and conductivity. Prior to introducing the recovered water into the utilities distribution system, a complete analysis for the primary and secondary drinking water standards will be conducted. The analysis results will be submitted to the DER. Two subsequent complete analyses of the standards for the recovered water will be performed prior to applying for the Class V well operation permit.

6. Confining Beds Above and Below Injection Zone

There is some concern regarding the amount and efficiency of confinement below and above the Hawthorn Zone II ASR zone. In this project it is important to have sufficient confinement so as not to lose the injected potable water. Any loss can only improve the quality of the native water, but will result in less recoverable potable water. The original report discusses the confining horizons qualitatively (pages 29-35). Only after we conduct the aquifer performance test (APT) on the ASR can a quantitative approach be undertaken to characterize the nature of the confining beds.

7. Data Compilation and Analysis

All hydrogeologic data collected during construction of the test production and observation wells will be compiled and analyzed by a qualified hydrogeologist. Detailed geologist's logs will be prepared for each well and the relationship of the nature of the production/injection zone would be described.

The aquifer test data will be analyzed to calculate aquifer hydraulic coefficients of the production/injection aquifer. This will include a calculation of transmissivity, storage coefficient, and leakance.

8. Recovered Water Quality Safeguards

(Refer to 2-19-91 letter to Charles W. Walker from Michael R. Newman).

COLLIER COUNTY GOVERNMENT

UTILITIES DIVISION
WATER AND WASTEWATER SERVICES

2800 NORTH HORSESHOE DRIVE
NAPLES, FL 33942
(813) 643-8480

A CERTIFIED BLUE CHIP COMMUNITY

February 19, 1991

Mr. Charles W. Walker, Ph. D., PG
Senior Hydrologist
Missimer & Associates, Inc.
428 Pine Island Road, S.W.
Cape Coral, FL 33991

RE: Deep Aquifer Hydrogeological Study
Utilities Division File No. 228.05

Dear Buzz:

After reviewing your attached facsimile of February 7, 1991 outlining Dr. Ahmadi's desire for assurances that water quality safeguards be provided for this project, I would offer the following comments. As it is assumed by this writer that primary and secondary water quality analysis parameters and testing intervals will be established by the Department of Environmental Regulation, indicator parameters including disinfection monitoring and chloride concentrations will be the only parameters addressed in these comments.

Chloride contamination of the proposed ASR system is most possible under two cases; upconing, which is unlikely due to the relative thinness of the aquifer being utilized, and if the transition zone between the source water and the injected water begins to interfere with the cone of influence created by the ASR system itself. To offset concerns related to this indicator parameter, I would suggest that a continuous on-line conductivity meter be incorporated into the ASR discharge piping design. The information generated by this device could then be telemetered by the existing equipment back to the Regional Water Treatment Plant offering 24-hour continuous monitoring. In addition, this device could be designed to automatically discontinue operation of the ASR system, should water quality parameters related to conductivity be violated.

As for bacterial disinfection residual monitoring, should this be demonstrated to be of concern after completion of the upcoming pilot study, the discharge piping design from the ASR well could be modified to circulate all water withdrawn from the ASR system throughout the existing 2 MGD ground storage tank after chlorination. Based on the Manatee Road facility's existing pumping capability of 1,600 gpm, this scenario would provide a theoretical disinfection contact time of 20.8 hours. The effluent withdrawn from this storage tank would then be

monitored by the existing automatic residual monitoring equipment to ensure adequate bacterial disinfection. This system could also be modified to automatically shutdown this facility's pumping equipment, should disinfection residual parameters be violated.

Other continuous monitoring may be possible, however, the two indicator parameters discussed, in combination with the normal Department of Environmental Regulation required testing, should be sufficient to ensure water quality entering the County's water distribution system.

If I can be of any further assistance to you, please let me know.

Sincerely,

Michael R. Newman
Water Director

MRN/jo