

PLAN OF REMEDIAL WORK

**Marathon Electric Manufacturing Company
Wausau, Wisconsin**

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CONESTOGA-ROVERS & ASSOCIATES

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1.0 INTRODUCTION

Marathon Electric Manufacturing Company (Marathon Electric) and the City of Wausau (City) retained RMT, Inc. and Geraghty & Miller, Inc., respectively, to conduct a hydrogeological investigation on the west side of the Wisconsin River in Wausau, Wisconsin. The hydrogeological investigation encompassed the Marathon Electric Plant including the Old City Landfill and the area northeast of the Plant in the vicinity of City Well 6. Figure 1 presents a regional location map and Figure 2 locates the Marathon Electric Plant and the Old City Landfill.

The resulting hydrogeological investigation report⁽¹⁾ presented the following succinct findings and conclusions:

Geology

1. The bedrock surface slopes sharply toward the river locally and toward the south regionally. Previous investigations suggest the presence of a bedrock ridge south of City Well 6, which may influence deep groundwater flow.

Reference:

- (1) "Hydrogeological Investigation of the Alluvial Aquifer Beneath City Well 6, Wausau, Wisconsin", RMT, Inc. and Geraghty & Miller, Inc., June 1987.

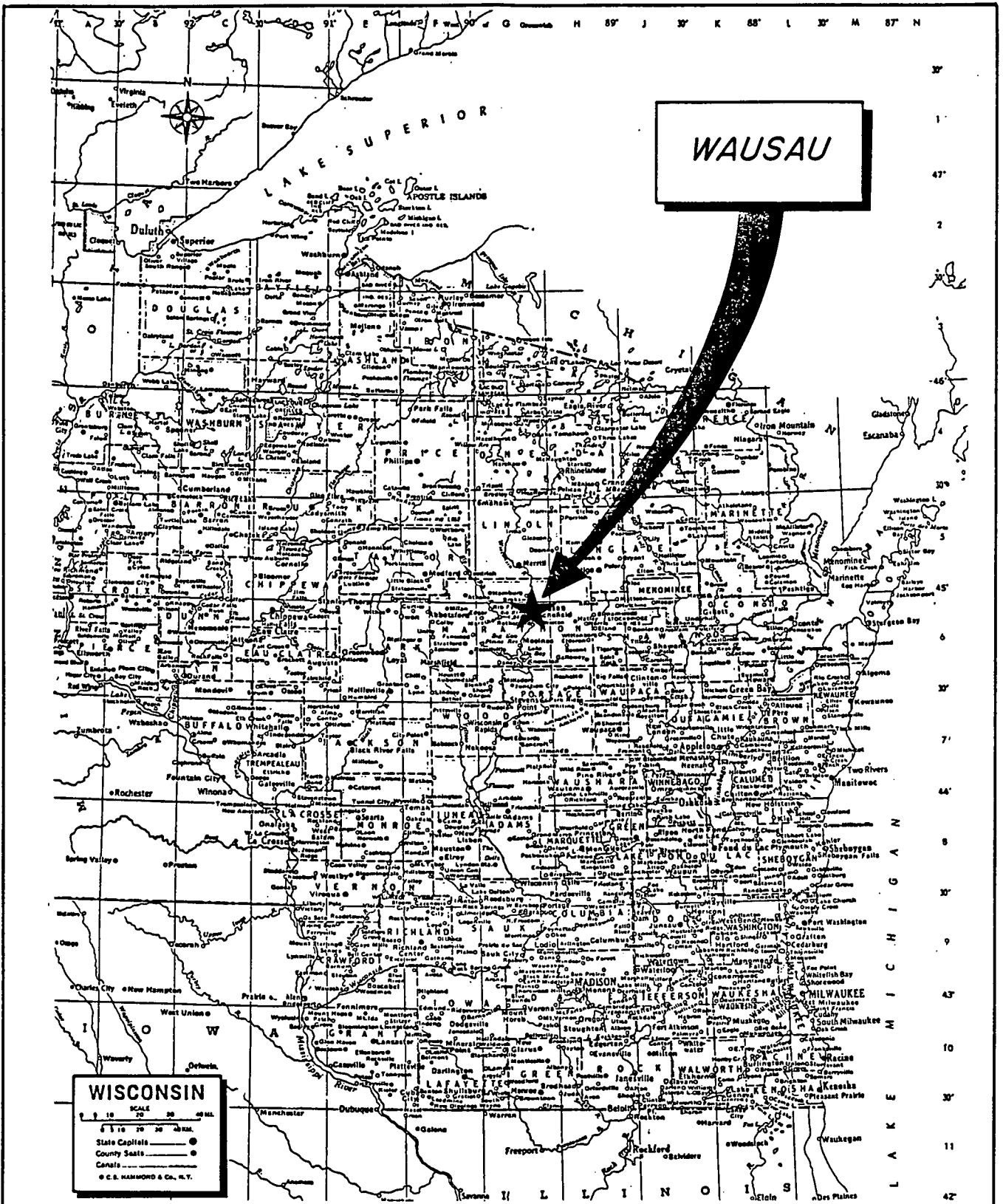
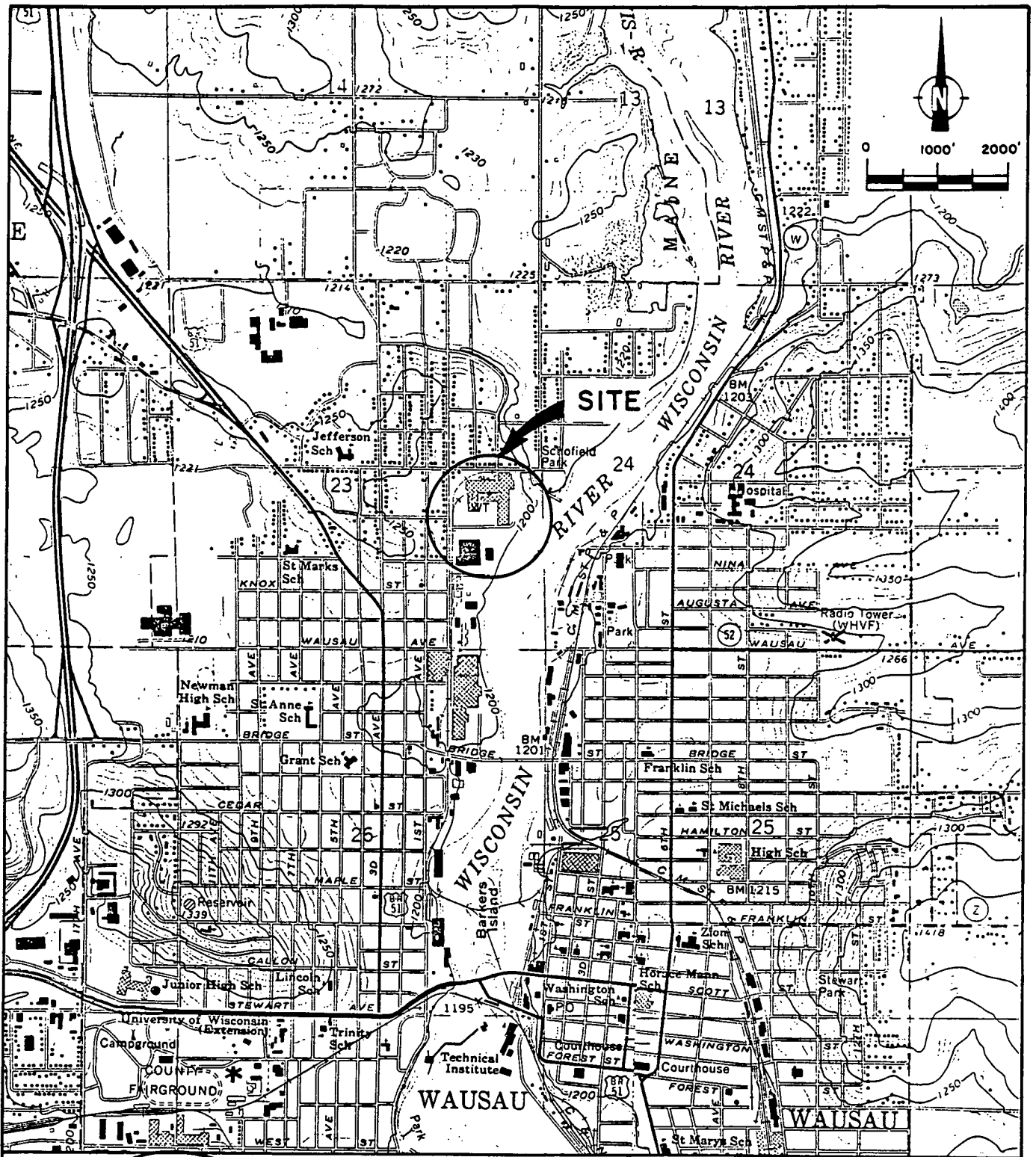


figure 1
 REGIONAL LOCATION MAP
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SOURCE : U.S.G.S. WAUSAU WEST QUADRANGLE MAP.



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figure 2
 SITE LOCATION
 Marathon Electric Manufacturing Co.

Hydrogeology

1. Groundwater under the southern part of the Marathon Electric/Old City Landfill property flows toward the Wisconsin River. Shallow groundwater flow discharges into the river.
2. Groundwater under the northern part of the Marathon Electric generally flows northeastward, toward the Wisconsin River, and under some conditions may flow to the north.
3. The radius of influence of City Well 6 extends at least as far south as Bos Creek. The shallow groundwater flow system appears to be influenced by Bos Creek, which may act as a recharge area during high creek levels and a discharge area during low levels.
4. The bedrock ridge south of City Well 6 may divert the flow of deep groundwater from the south toward the Wisconsin River. It is unknown to what extent deep groundwater may flow over or around the ridge.
5. Pumping test results indicate that the aquifer responded as an unconfined aquifer with delayed yield. The following aquifer characteristics were computed:

Average Transmissivity - 315,000 gpd/ft to
370,000 gpd/ft

Storage Coefficient - 0.34 (Late),
0.05 (Early)

Average Hydraulic Conductivity - 2,625 gpd/ft² to
3,083 gpd/ft²

Water Quality

1. Trichloroethylene (TCE) is a common industrial solvent and waste product. TCE has been found in City Well 6 at concentrations ranging from approximately 100 ug/L to 200 ug/L.
2. Samples collected from monitoring wells EPA 4C and EPA 7, located northwest of City Well 6, detected 20 to 60 ug/L TCE, indicating there may be a source of TCE to the west of City Well 6.
3. Samples collected from monitoring wells R-4D and R-2D found concentrations of TCE ranging from 3,190 ug/L to 1,140 ug/L, indicating a possible source of TCE to the south of City Well 6.
4. Drinking water currently supplied to the City of Wausau residents is within applicable Federal and State health-related standards and is tested on a regular basis so that adequate quality is maintained.

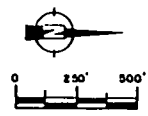
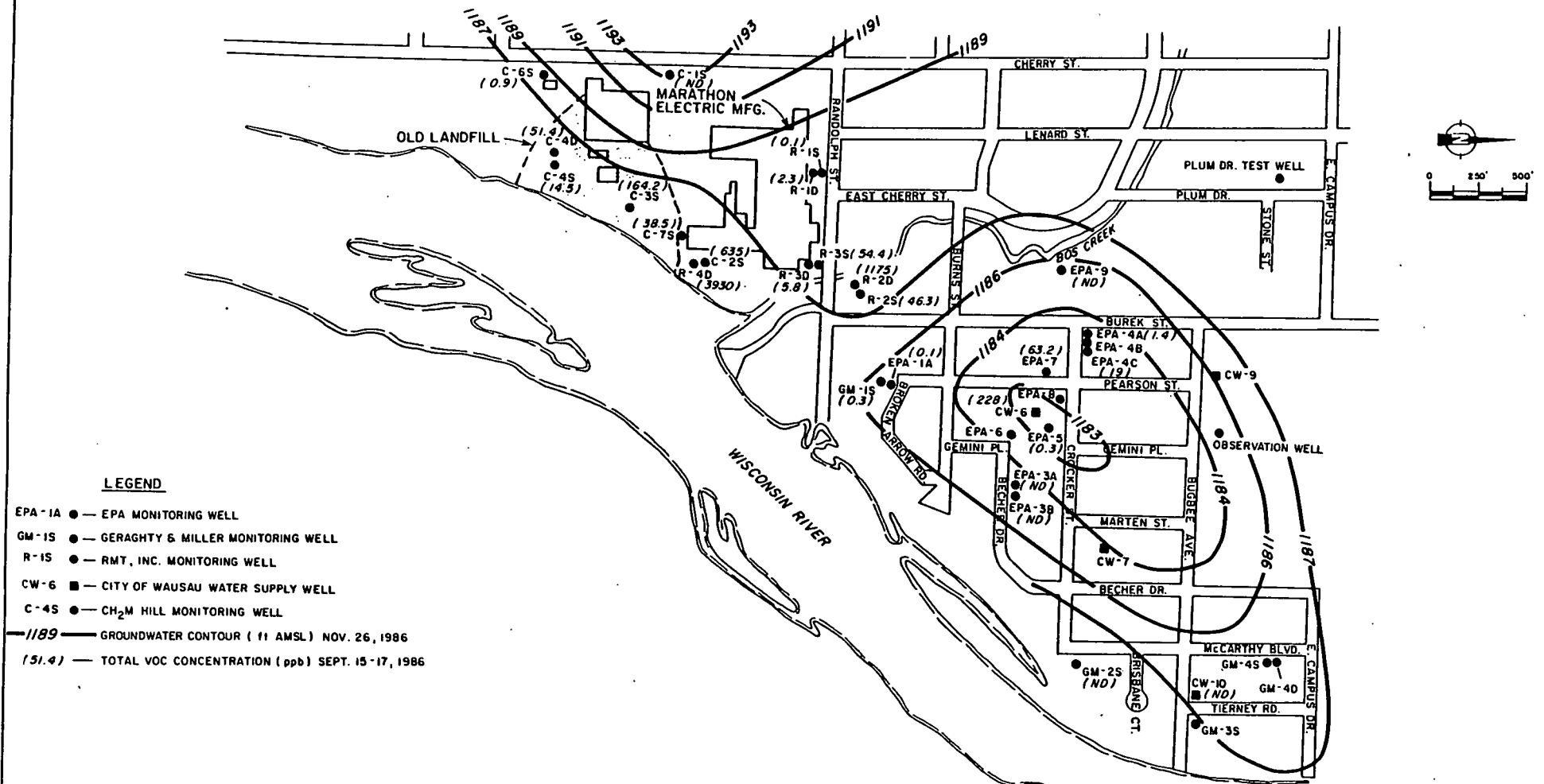
The report summarizes the extent of the hydrogeological investigation undertaken at the Marathon Electric Plant including the Old City Landfill. Figure 3 locates the wells installed in and around the Plant and characterizes groundwater quality at each well. Figure 3 also presents groundwater contours through the Plant.

The data summarized on Figure 3, and presented in detail in the hydrogeological report, shows the following:

- (1) In general, groundwater flow is across the Plant with discharge to the Wisconsin River.
- (2) Groundwater immediately north of the Plant has the potential to flow to City Well 6.
- (3) The discharge of VOCs to the river will not result in a measurable impact on surface water quality.

In this plan of work, Marathon Electric will address the removal of TCE which was found on or near the Plant. The remedial plan is designed to remove TCE that was found in the prior testing by the installation and pumping of an extraction well.

SOURCE: RMT INC. FIGURE 1, 5/14/87



LEGEND

- EPA-1A ● — EPA MONITORING WELL
- GM-1S ● — GERAGHTY & MILLER MONITORING WELL
- R-1S ● — RMT, INC. MONITORING WELL
- CW-6 ■ — CITY OF WAUSAU WATER SUPPLY WELL
- C-4S ● — CH₂M HILL MONITORING WELL
- 1189— GROUNDWATER CONTOUR (ft AMSL) NOV. 26, 1986
- (51.4) — TOTAL VOC CONCENTRATION (ppb) SEPT. 15-17, 1986

figure 3
 EXISTING GROUNDWATER CONTOURS AND
 CHEMICAL CONCENTRATIONS
 Marathon Electric Manufacturing Co.

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2.0 REMEDIAL WORK CONCEPT

The remedial plan incorporates the use of a groundwater extraction system to effectively remove the TCE that was found on and near the Marathon Electric property and allow storm sewer discharge of extracted groundwater to Wisconsin River.

In order to address the removal of TCE from the groundwater on or near the Plant, an iterative program of groundwater extraction will be implemented. The reason for using an iterative approach is twofold. Firstly, such an approach allows groundwater extraction to begin expeditiously. Secondly, while the initial groundwater extraction program is underway, the hydraulic characteristics of the groundwater regime can be evaluated and the need for expansion of the system, if any, can be determined under operating conditions rather than modelled or estimated conditions.

2.1 PHASE I REMEDIATION

The first phase of remediation will involve the installation of a groundwater extraction well, groundwater monitoring well and storm sewer discharge system.

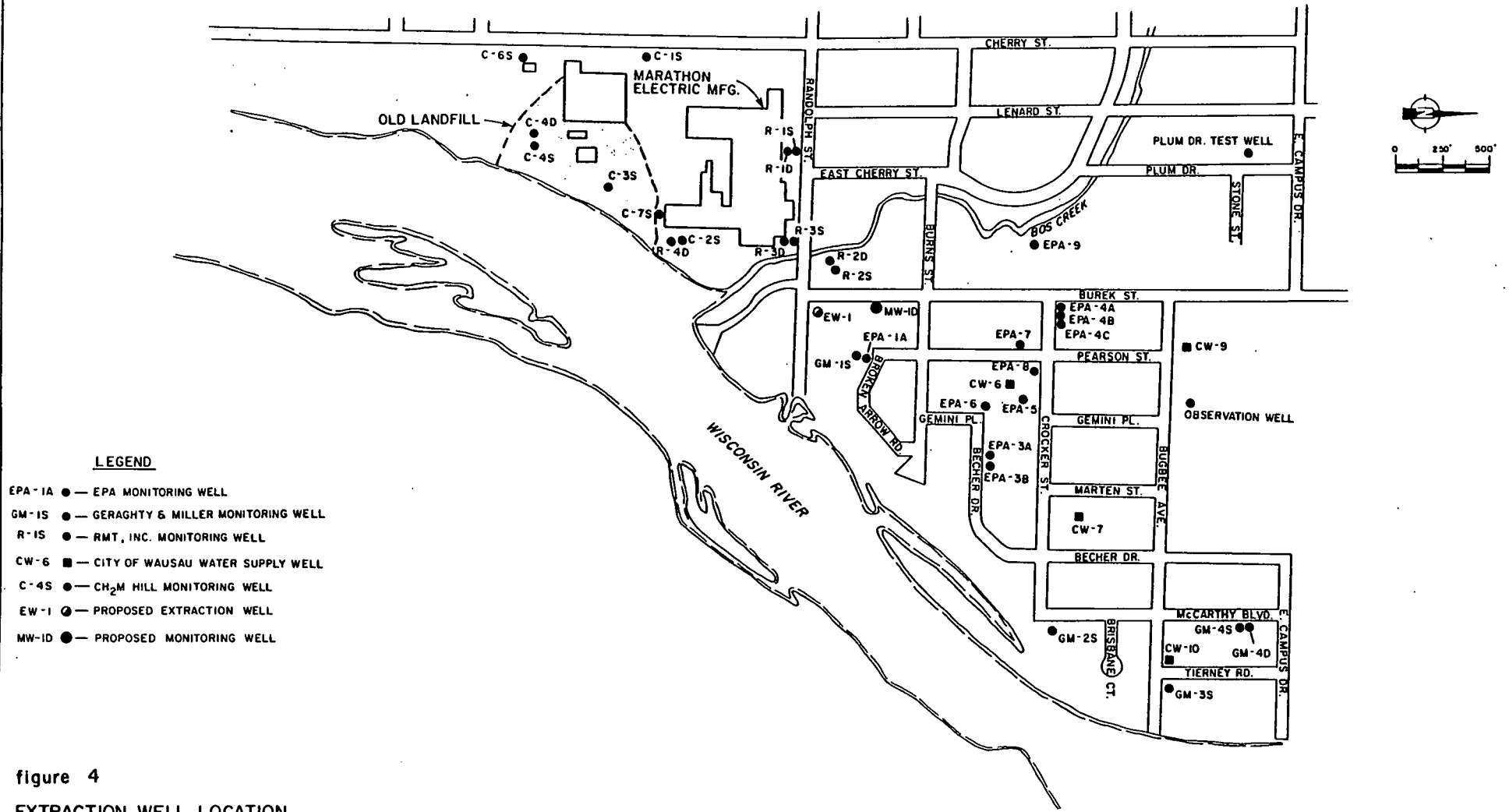
2.1.1 Extraction and Monitoring Wells

The maximum levels of TCE concentrations are present in the deep groundwater flow system, north and northeast of the Plant. Therefore, to provide maximum removal of TCE from this area, an extraction well (EW-1) is proposed to be installed east of Burek St. in the vicinity of existing well R-2D. The proposed extraction well is located on Figure 4.

Based on the hydraulic conductivity of 2,625 gpd/ft² (1.2×10^{-1} cm/sec) calculated during the hydrogeological investigation, a storage coefficient of 0.3, a saturated thickness of approximately 120 feet in the area of well R-2D, and a pumping rate of 500 gpm, associated drawdowns were calculated using the Theis equation (Theis, 1935). The predicted drawdowns were calculated after continuous pumping for 30 days, at which time it is assumed that equilibrium conditions exist. The predicted drawdowns for pumping at 500 gpm are summarized on Table 1.

Figure 5 illustrates water level conditions, based on predicted drawdowns, subsequent to start-up of the extraction well. As illustrated on Figure 5, it is anticipated that the extraction well pumping at a rate of 500 gpm will effectively remove the TCE from the groundwater. Also as illustrated on Figure 5, the extraction well system

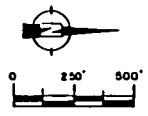
SOURCE: RMT INC. FIGURE 1, 5/14/87



LEGEND

- EPA-1A ● — EPA MONITORING WELL
- GM-1S ● — GERAGHTY & MILLER MONITORING WELL
- R-1S ● — RMT, INC. MONITORING WELL
- CW-6 ■ — CITY OF WAUSAU WATER SUPPLY WELL
- C-4S ● — CH₂M HILL MONITORING WELL
- EW-1 ● — PROPOSED EXTRACTION WELL
- MW-1D ● — PROPOSED MONITORING WELL

figure 4
EXTRACTION WELL LOCATION
Marathon Electric Manufacturing Co.



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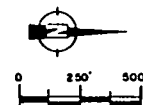
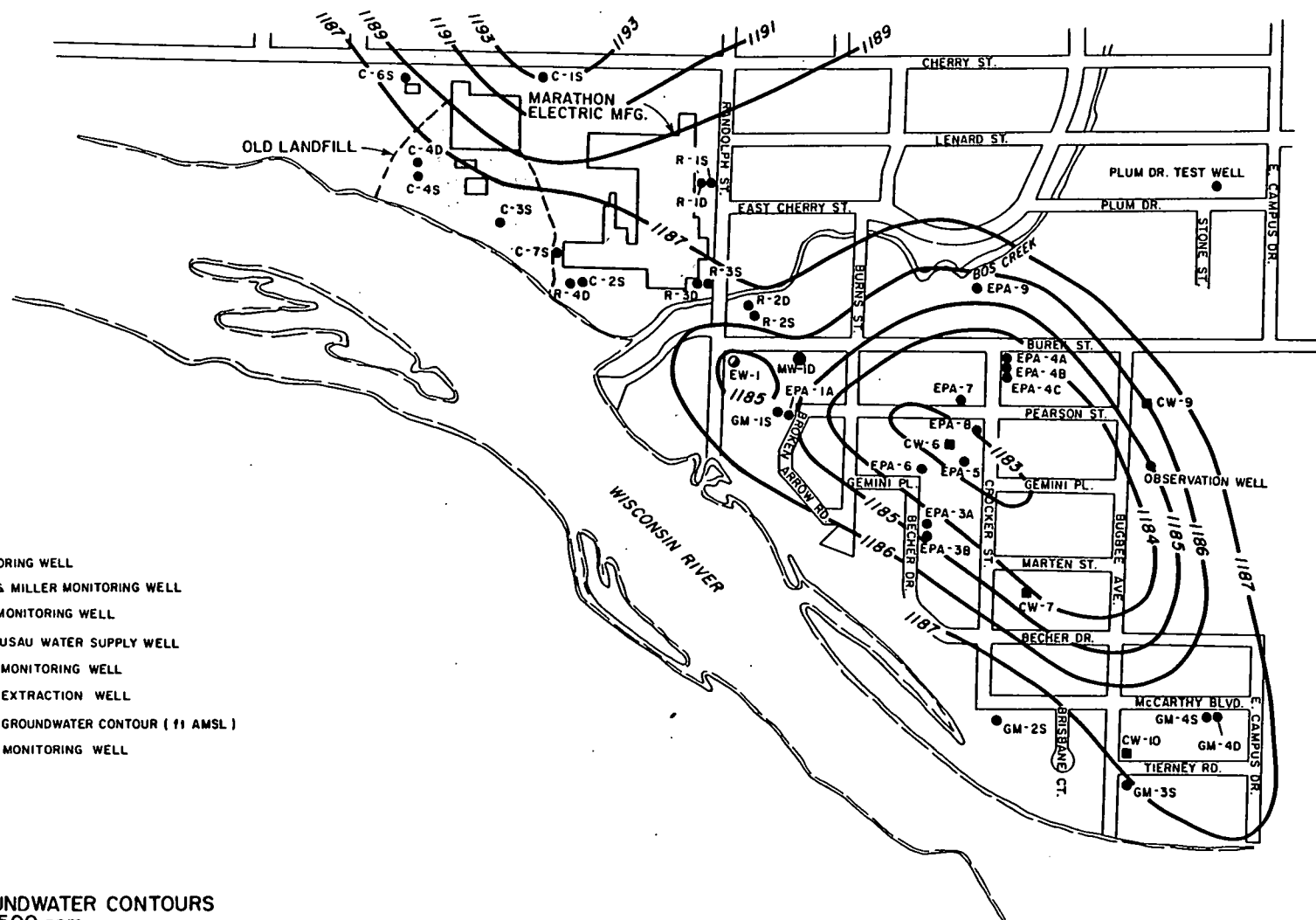
TABLE 1
PREDICTED DRAWDOWNS

<u>Distance From Extraction Well (ft)</u>	<u>Predicted Drawdown (ft)*</u>
25	1.86
50	1.59
100	1.32
200	1.05
300	0.89
400	0.78
500	0.70
600	0.63
700	0.57
800	0.52
900	0.47
1,000	0.44

Note:

* Predicted drawdown based on pumping rate of 500 gpm after continuous pumping for 30 days.

SOURCE: RMT INC. FIGURE 1, 5/14/87



LEGEND

- EPA-1A ● — EPA MONITORING WELL
- GM-1S ● — GERAGHTY & MILLER MONITORING WELL
- R-1S ● — RMT, INC. MONITORING WELL
- CW-6 ■ — CITY OF WAUSAU WATER SUPPLY WELL
- C-4S ● — CH₂M HILL MONITORING WELL
- EW-1 ○ — PROPOSED EXTRACTION WELL
- MW-1D ● — PROPOSED MONITORING WELL
- 1189 — PREDICTED GROUNDWATER CONTOUR (11 AMSL)
- MW-ID ● — PROPOSED MONITORING WELL

figure 5
 PREDICTED GROUNDWATER CONTOURS
 PUMPING RATE 500 gpm
 Marathon Electric Manufacturing Co.

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is not anticipated to affect groundwater flow under the southern part of the Marathon Electric Plant and the Old City Landfill property which flows toward the Wisconsin River.

Although it is anticipated that an extraction well pumping at 500 gpm will effectively remove contaminated groundwater, the well will be constructed to facilitate pumping at 800 gpm, should an increase in pumping rate be required (see Section 2.3).

The extraction well will be constructed of a 12-inch diameter, 70-foot long, stainless steel telescopic well screen with a 12-inch diameter black steel riser pipe. The riser pipe is sized to accommodate a submersible pump capable of pumping 800 gpm. The well will screen the bottom third of the saturated thickness of the aquifer. Extraction well details and specifications are presented in Appendix A.

A deep monitoring well (MW-1D) will be installed between the extraction well and City Well 6, as located, previously, on Figure 4. The monitoring well will serve to monitor the cone of containment resulting from pumping the extraction well.

2.1.2 Discharge System

The extracted groundwater will be discharged to the Wisconsin River via a forcemain to an existing 18-inch diameter storm sewer. The discharge point in the manhole will allow for free fall of water allowing for volatilization of contaminants. The discharge point at the river will be lined with raprap. The riprap will create turbulence, thus resulting in significant volatilization of the contaminants prior to mixing with Wisconsin River.

2.2 PHASE I - OPERATION AND MONITORING

Once the first phase of the extraction system is installed and operating, the extraction well and surrounding monitoring wells will be monitored.

Water samples will be collected from the extraction well weekly during the first month of operation and monthly thereafter for a period of five months. Water samples will be collected from monitoring wells MW-1D, R-1S, R-1D, R-2S, R-2D, R-3S, R-3D, R-4D, C-2S, GM-1S and EPA-1A monthly for a period of six months. Water samples will be analyzed for the following VOCs:

Trichloroethylene
Tetrachloroethylene
1,2-Dichloroethylene
Carbon Tetrachloride
Chloroform
1,1,1-Trichloroethene

Water level measurements will be measured monthly for a period of six months subsequent to start-up. All monitoring wells will be monitored.

2.3 PHASE II REMEDIATION

After six months of operation, the first phase of remediation, the need for supplementing the groundwater extraction system and the monitoring program will be evaluated and revised if necessary. The need for supplementing the groundwater extraction system could arise if the extraction system does not provide an effective groundwater barrier. If, for any reason, additional pumping would be required, the extraction system would be designed to allow an increase in the pumping rate of the well and/or add additional extraction well(s).

All of which is respectfully submitted

CONESTOGA-ROVERS & ASSOCIATES

A handwritten signature in blue ink, appearing to read 'F. A. Rovers', written in a cursive style.

Frank A. Rovers, P. Eng.

A handwritten signature in blue ink, appearing to read 'Ed Roberts', written in a cursive style.

Ed Roberts, B.A.Sc.

APPENDIX A

PROJECT SPECIFICATIONS

AND

DETAIL DESIGN

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PROJECT SPECIFICATIONS

Ps.1 SUMMARY OF WORK

Ps.1.01 DESCRIPTION OF PROJECT

This project consists of the supply and installation of a groundwater extraction and forcemain system as discussed in the Plan of Remedial Work. The project involves the supply and installation of one extraction well and pump chamber complete with pump and controls; forcemain from the well to an existing manhole, rip rap lined storm sewer discharge to the Wisconsin River and the supply and installation of one monitoring well.

Ps.1.02 LOCATION

Figures 1 and 2 in the Plan of Remedial Work locates the Site.

Ps.1.03 ACCESS TO SITE

Access to the Site is available via Randolph Street.

Ps.1.04 DESCRIPTION OF WORK

Works to be performed include but are not limited to the following:

- i) Mobilization of all material, equipment, plant and personnel necessary to perform the Works.
- ii) Supply and installation of extraction well and monitoring well.
- iii) Supply and installation of effluent forcemain and all related trenching.
- iv) Supply and installation of pump, controls, valves, pipe and appurtenances, and pump chamber at the extraction well.
- v) Supply and installation of electrical conduit, wiring and instrumentation for the system.
- vi) All other related and associated work as shown on the Drawings and specified herein.

Ps.1.05 DRAWINGS

Drawings issued with and forming part of the project specifications are listed below.

The Contractor shall perform works in accordance with Drawings. Such Drawings will be issued to the Contractor during progress of Works and will consist of bid Drawings revised as required by the Engineer and additional Drawings if required.

Revised "Approved for Construction" Drawings may be issued from time to time by the Engineer and such Drawings shall supercede previous revisions.

If revised "Approved for Construction" Drawings are issued which necessitate changes to the Contractor's shop drawings not yet submitted, no separate payment will be made for Contractor's expenses involved in revising such shop drawings.

<u>Drawing No.</u>	<u>Rev. No.</u>	<u>Date of Dwg. or Latest Rev.</u>	<u>Title</u>
A-1	0	Sept. 1987	Extraction Well and Discharge System Plan
A-2	0	Sept. 1987	Extraction Well and Discharge System Profile
A-3	0	Sept. 1987	Typical Extraction Well Detail
A-4	0	Sept. 1987	Extraction Well Chamber Detail - Profile View
A-5	0	Sept. 1987	Extraction Well Chamber Detail - Plan View
A-6	0	Sept. 1987	Forcemain Trench Cross-Section
A-7	0	Sept. 1987	Outlet Pipe Rip Rap Detail
A-8	0	Sept. 1987	Typical Monitoring Well Detail

Ps.2 GENERAL CONSTRUCTION REQUIREMENTS

Ps.2.01 EXISTING UTILITIES

It shall be the contractor's responsibility to field verify all existing utilities.

Existing aboveground utilities including but not limited to power transmission and distribution, telegraph, telephone, if shown on the Drawings or if easily identified, shall, at the Contractor's expense, be maintained, relocated, rerouted, removed and restored as may be necessary by the Contractor.

Existing major underground utilities and appurtenant structures whether shown on the Drawings or not shall, at the Contractor's expense, be maintained and restored by the Contractor.

Minor underground utility service lines adjacent to the Site, including but not limited to sanitary sewer services, gas services, water services, house or yard drains, and electric, cable television, or telephone services, shall be maintained, relocated, rerouted, removed and restored by the Contractor with the least possible interference with such services and in no case shall the interference of such service lines be considered for extra compensation under any of the special cases listed above. It is not anticipated that any of these utilities exist in the proposed work zone, but shall be Contractor field verified.

The right is reserved by owners of public utilities and franchises to enter upon any street, road, right-of-way, or easement for the purpose of maintaining their property during performance of the Works and for making necessary repairs caused by the work. The costs thus incurred shall be paid by the Contractor.

Ps.2.02 RESTORATION OF STRUCTURES AND SURFACES

1. Structures

The Contractor shall remove such existing structures as may be necessary for the performance of the work, and shall rebuild the structures thus removed in as good a condition as found with minimum requirements as herein specified. The Contractor shall also repair all existing structures which may be damaged as a result of the work under this Contract.

2. Curbs, Gutters, Driveways and Sidewalks

All curbs, gutters, driveways, sidewalks and similar structures that are broken or damaged by the installation of the work, unless shown otherwise, shall be reconstructed by the Contractor. Reconstruction shall be of the same kind of material with the same finish, and in not less than the same dimensions as the original work. All concrete shall be as specified by the Engineer if required. Repairs shall be made by removing and replacing the entire portions between joints or scores and not merely refinishing any damaged part. All work shall match the appearance of the existing improvements as nearly as possible.

3. Roads and Streets

All on-site roads and streets in which the surface is removed, broken or damaged, or in which the ground has caved or settled due to work under this Contract, unless shown otherwise, shall be completely resurfaced and brought to the original grade unless otherwise indicated. Before resurfacing material is placed, edges of pavements shall be trimmed back far enough to provide clean, solid, vertical faces, and shall be free of any loose material. Roadways other than the special haul routes shown on the Contract Drawings used by the Contractor for hauling materials, equipment, supplies, etc., shall be cleaned and repaired if the condition of the roadway is damaged or otherwise affected due to the Contractor's operations. These requirements are considered the Contractor's responsibility.

4. Cultivated Areas and Other Surface Improvements

All cultivated areas, either agricultural or lawns, and other surface improvements which are damaged by actions of the Contractor, unless otherwise shown, shall be restored as nearly as possible to their original condition. Altering of original conditions during restoration may be done only on written approval of the Engineer.

5. Existing Stakes and Marks

All section, section subdivision, plot, U.S.E.D, U.S.C. & G.S., U.S.G.S. and other official monuments or bench marks shall be carefully preserved or replaced. In the event any such monument or marker is disturbed as a result of the Contractor's operations, the Contractor shall replace or reset such monument or marker in a manner satisfactory to the Engineer. Replaced or reset monuments shall be of acceptable type and quality and shall be located so as to clear existing utilities or any other interferences. They shall be placed in a manner consistent with good and recognized engineering and surveying practice by a licenced surveyor.

Ps.2.03 COORDINATION WITH OTHER CONTRACTORS

The Contractor is advised that other Contractors may be working on the Site. The Contractor shall cooperate with and coordinate his activities with all other on-site contractors. No additional payment will be made for delays, changes in schedule, or any other work due to the fact that other contractors are working on site.

Ps.3 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

Ps.3.01 WORKING AREAS

Designated areas will be available at the Site for the Contractor's storage as required during performance of the Works. No other areas on Site shall be used by the Contractor.

Additional areas required on Site by the Contractor for any purpose shall be developed by the Contractor at his own expense subject to the Engineer's approval.

Ps.3.02 DEWATERING

The Contractor shall employ construction methods, plant, procedures and precautions that ensure the Works including excavations are stable, free from disturbance and dry.

Construction methods may include but are not limited to: sheeting and shoring; groundwater control systems; surface or free water control systems employing ditches, diversions, drains, pipes and/or pumps; and any other measures necessary to enable the whole of the Works to be carried out in the dry.

The Contractor shall control surface drainage including ensuring that gutters are kept open at all times, water is not directed across or over pavements or sidewalks except through approved pipes or properly constructed troughs and runoff from unstabilized areas is intercepted and diverted to a suitable outlet approved by the Engineer.

Ps.3.03 DUST CONTROL

The Contractor shall implement dust control measures as required and as determined by the Engineer to prevent generation of dust from construction activities. Dust control measures shall be available at all times during construction. Water used for dust control measures must be from an approved potable water source.

Ps.3.04 CONSTRUCTION UTILITIES AND MISCELLANEOUS FACILITIES

1. Power

The Contractor shall provide at his own expense all necessary power.

2. Water

The Contractor shall provide at his own expense all necessary connections to a potable water supply.

3. Sanitary Facilities

The Contractor shall provide sufficient sanitary facilities for workers in accordance with governing regulations and ordinances.

The Contractor shall post notices and take such precautions as required by local health authorities.

The Contractor shall maintain all work areas and premises in a sanitary condition.

4. Telephone

The Contractor shall provide at his own expense, a portable telephone service.

5. Parking

The Contractor shall maintain Contractor parking areas as approved by the Engineer.

6. Temporary Heating

The Contractor shall provide at his own expense, temporary heating, covering and enclosures as necessary, to protect all work and material against damage by dampness and cold and to facilitate completion of the work. The Contractor shall supply all labor, fuel, equipment and material required for temporary heating.

7. Guardrails and Barricades

Guardrails shall be maintained and barricades shall be erected around all excavations, open trenches and active work areas as approved by the Engineer. The Contractor shall provide, erect and remove all barricades and maintain guardrails required and as a result of these works.

Ps.4 EXTRACTION AND MONITORING WELL INSTALLATION

Ps.4.01 SCOPE OF WORK

The Work shall consist of the drilling, development and testing of 12-inch diameter extraction well and the drilling and development of a 2-inch diameter monitoring well. The wells are located on the Drawings.

Ps.4.02 LOCAL CONDITIONS

The Contractor shall satisfy himself regarding all local conditions affecting his work by personal investigation and neither the information contained in this section nor that derived from the Drawings, shall act to relieve the Contractor from any responsibility hereunder or from fulfilling any and all of the terms and requirements of the Contract.

The following information regarding sub-surface conditions is intended to assist the tenderer in preparing a bid. The Owner does not guarantee its accuracy, nor that it is necessarily indicative of the conditions to be encountered in the work carried out under the Contract.

The geological conditions in the area of the proposed well were investigated by RMT, Inc. The geology in the vicinity consists of alluvial sands and sand and gravels. The sands and sands and gravel are approximately 140 feet thick, at this location. Underlying the alluvial is bedrock, which consists of red granite.

Ps.4.03 EQUIPMENT

The Contractor shall supply drilling rigs and all necessary equipment appropriately sized to efficiently complete the Work.

Ps.4.04 WELL CONSTRUCTION STANDARDS

Extraction well and monitoring well installation shall be performed by a licensed well driller. Certification shall be presented to the Engineer on request. The Contractor shall be required to conform to well construction standards required by the Wisconsin Department of Natural Resources.

Ps.4.05 PERMITS, CERTIFICATES, LAWS AND ORDINANCES

The Contractor shall, at his own expense, procure all permits, certificates, and licenses required of him by law for the execution of his work. Any waivers from Department of Natural Resources

standards will be requested and obtained by the Contractor and submitted to the Engineer prior to commencement of site work. The Contractor shall comply with all Federal, State, and local laws, ordinances or rules and regulations relating to the performance of the work. Upon completion of the work, the Contractor shall submit soil samples, completion reports and other records required by the regulations.

Ps.4.06 PILOT HOLE

A pilot hole shall be drilled, in the location of the extraction well, to allow the Contractor to confirm the hydrogeologic suitability and to establish the final well depth, and length, etc. of the various components that comprise the well.

In the drilling, the Contractor will be required to provide representative samples of the aquifer material and shall make available to the Engineer the sieve analyses obtained in the pilot hole.

The method of sampling will be left to the discretion of the Contractor, however, the samples collected must be representative of the formation. The Contractor shall collect and store samples with sufficient frequency and at sufficient increments of depth to permit a thorough evaluation of the proposed screened portion of the aquifer. The samples shall be suitably bagged and accurately labelled with the name of the well and depth interval. The design criteria of slot size and screen interval will be the responsibility of the Engineer. If the pilot hole is to be abandoned, it shall be secured by grouting in a method acceptable to the Engineer.

Ps.4.07 EXTRACTION WELL INSTALLATION

The Extraction Well shall be completed in accordance with the details shown on the Drawings. The well shall be installed using normal or reverse circulation rotary methods.

The Contractor shall supply and install suitably sized surface casing, if necessary. A minimum 14-inch diameter borehole shall be drilled to a depth specified by the Engineer, to accommodate 12-inch nominal diameter casing. It is anticipated that the 12-inch casing will be set to a depth of approximately 70-feet below ground surface.

A 12-inch diameter, 70-foot long, telescopic stainless steel screen shall be installed in the well. The screen shall be fitted with a wash-down fitting, and shall be welded to the casing. The slot-size shall be determined by the Engineer on the basis of sieve analyses of samples collected from the pilot hole.

The formation shall be allowed to collapse around the well screen, or a sand pack may be installed to a height of two feet above the screen. The remaining annulus between the borehole and the casing shall be filled with cement/bentonite grout using a method approved by the Engineer.

Ps.4.08 MONITORING WELL INSTALLATION

The monitoring well shall be completed in accordance with the details shown on the Drawings. The well shall be installed using normal or reverse circulation rotary methods.

A minimum 6-inch diameter borehole shall be drilled to a depth specified by the Engineer, to accommodate a 2-inch nominal diameter casing. It is anticipated that the casing will be set to a depth of approximately 130 feet below ground surface.

A 2-inch diameter, 10-foot long stainless screen shall be installed in the well. The screen shall be welded to the casing.

The formation shall be allowing to collapse around the well screen, or a sand pack may be installed to a height of two feet above the screen. The remaining annulus between the borehole and the casing shall be filled with cement/bentonite grout using a method approved by the Engineer.

Ps.4.09 WELL CASING

The primary casing installed in the extraction well shall be nominal 12-inch diameter Sch.40 steel pipe meeting ASTM A-53. The primary casing installed in the monitoring well shall be nominal 2-inch diameter Sch.40 steel pipe meeting ASTM A-53. Sections of pipe shall be joined by welding or threaded and coupled.

Ps.4.10 WELL SCREEN

The extraction well shall be equipped with 12-inch diameter, Type 304 stainless steel continuous slot, wire wound well screen (UOP - Johnson or equivalent). The monitoring well shall be equipped with 2-inch diameter, stainless steel, No. 10 slot, 10-foot long well screen (UOP - Johnson or equivalent).

Ps.4.11 CEMENT/BENTONITE GROUT

The Contractor shall furnish and install a cement/bentonite grout seal in the annular space between the borehole and the well casing.

The cement/bentonite grout shall consist of a mixture of not more than six gallons of water per 94-pound sack portland cement and two percent bentonite and shall be installed by the "tremie" method, or by any

other method that introduces the cement grout from the bottom up and is approved by the Engineer.

Ps.4.12 WELL DEVELOPMENT

The extraction well and monitoring well shall be developed to an essentially sand free state after completion. All development waters may be discharged to the ground surface. The Contractor shall provide the Engineer with the method he proposes to use for well development and must receive approval on this method before commencing any well development.

Ps.4.13 EXTRACTION WELL TESTING

A pumping test shall be conducted on the extraction well to verify its yield and efficiency. Initially, a step-drawdown test, consisting of three 1-hour steps, shall be conducted on each well at pumping rates up to 800 gpm. A 24-hour constant rate pumping test shall be performed on the well, at a rate determined by the Engineer. Following pump shut down, water level recovery shall be taken for an additional eight hours, or until full recovery. Provisions shall be made by the Contractor to discharge pumping test waters into the existing storm sewer. The storm sewer manhole is located within 300 feet of the extraction well.

The Contractor shall furnish the test pump, discharge pipe, power supply and necessary valves and metering devices to control the flow rate. The Contractor shall also provide the necessary manpower and equipment to monitor the water levels in the pumped well.

The extraction well shall be protected with a welded plate.

Ps.4.14 PROTECTION OF WATER QUALITY

a) Foreign Substances

The Contractor shall take the necessary precautions to prevent contamination of the water in the wells by introduction of any foreign substances, including contaminated water, detergents, gasoline, cable lubricants and hammer oil. Any such substances required for the performance of the Work shall be precisely described and identified by the Contractor and approved by the Engineer prior to use.

b) Water for Drilling Operations

The Contractor shall be responsible for furnishing or arranging for water required for drilling or cleaning the wells. Water introduced into the wells during drilling and completion, whether in washing, grouting or other activities shall be obtained from portable water sources.

Ps.4.15 RECORDS AND SAMPLES

A log or record of the pilot hole, extraction well and the monitoring well shall be kept by the Contractor on a form suitable to the Engineer. This log shall indicate the general character, thickness and type of material encountered, the depth at which the water level stands in the wells at the beginning and end of each shift, pumping tests, stabilization test and the nature and extent of all other work performed, including the exact time spent on each time of work. The log shall be kept carefully and accurately at the time the work is being done. A copy of the log shall be maintained at all times at the job site and shall be available at any time for inspection by the Engineer. Upon completion of the work a complete copy shall be furnished to the Engineer, and the Contractor shall further file, as required by the well construction permit, the necessary log, test results and record of forms provided by the regulatory authority. Samples of all materials penetrated during drilling shall be saved and maintained on the job site by the Contractor. These samples shall be of at least one-pint size, shall be kept in sample bags or jars and shall be clearly labeled to show the depth and well from which collected. Upon completion of the Work, the Contractor shall submit these samples to the Engineer.

Ps.4.16 RECOVERY OF TOOLS

In the event of loss of tools or equipment during any phase of constructing a well, the Contractor shall not be entitled to any additional payment for time spent or expense incurred in an attempt to fish out or recover the tools or equipment prior to possible abandonment of a well.

Ps.4.17 ABANDONMENT OF A WELL BEFORE COMPLETION

In the event that the Contractor should fail to complete a well as specified, or should the Contractor abandon a well because of loss of tools or equipment, or for any other cause, the Contractor, if requested and as directed by the Engineer, shall fill the abandoned hole with cement-bentonite grout and salvage and remove such casing as can be salvaged. All salvaged casing or materials furnished by the Contractor shall remain his property. The cost of abandonment of an incomplete well, including the filling, shall be borne solely by the Contractor and no allowance or payments shall be made for the drilling, casing or other work performed by the Contractor on the abandoned well.

Ps.5 EXCAVATION, TRENCHING AND BACKFILLING

Ps.5.01 GENERAL

1. DESCRIPTION

A. Work Included

Work of this Section consists of the following items of work:

1. Trenching within the Works to the lines, grades and dimensions as specified and as shown on the Drawings and disposing of excess or unsuitable materials, as directed by the Engineer;
2. Supply and placement of imported bedding material to the lines, grades and dimensions as specified and as shown on the Drawings; and
3. Backfilling with imported and/or native material, to the lines, grades and dimensions as shown on the Drawings and as specified herein.

B. Related Work Specified In Other Sections

The following items of work associated with the Work of this Section are specified in other Sections as noted:

1. Pump Chamber - Section Ps.6

Supply and installation of pump chamber.

2. Forcemain - Section Ps.8

Supply and installation of forcemain.

C. Terminology

Common excavation shall mean excavation of materials of whatever nature, which are not included under definition of rock excavation, including dense tills, hardpan, frozen materials and partially cemented materials which can be ripped and excavated with heavy construction equipment.

Rock excavation shall mean excavation of material from solid masses of igneous, sedimentary or metamorphic rock which, prior to its removal, was integral to its parent mass, and boulders or rock fragments having individual volumes in excess of one (1) cubic yard.

Limit of excavation shall refer to the maximum amount of excavation necessary to construct the final work to the lines, grades and dimensions shown or implied on the Drawings and as specified herein.

Ps.5.02 PRODUCTS

1. GENERAL

A. Sources

All material provided under this Section shall be from a source or sources approved by the Engineer.

B. Unsuitable Material

All material provided under this Section shall be free of unsuitable materials as determined by the Engineer. Unsuitable materials include the following:

1. material containing loam, roots or organic matter;
2. frozen material or material containing snow or ice;
3. clays which are classified as inorganic clays of high plasticity in accordance with ASTM D2487;
4. soft and/or organic clays and silts of low strength;
5. frost susceptible silts or clays;
6. swelling clays;
7. rock and lumps of material with dimensions greater than 1/3 of the specified layer thickness before compaction;
8. trees, stumps, branches, or any other wood or lumber; and
9. wire, steel, cast iron, cans, drums or any other foreign materials.

2. BACKFILL

Approved native material free of unsuitable material shall be used as backfill unless specified otherwise.

3. COMMON FILL

Common fill if required, shall be a clean, well graded imported sand or gravel fill free of unsuitable material. The maximum aggregate size shall be 1 1/2 inches measured through any axis.

4. BEDDING

Bedding for forcemain shall be clean imported sand material with 100 percent passing a 3/8-inch sieve and 0 to 15 percent passing a Number 200 sieve, as approved by the Engineer.

5. TYPE 1 FILL

Type 1 fill if required, shall be clean, hard, durable crushed gravel or stone, free from shale, clay, friable materials, organic matter and other deleterious substances and graded within the following limits when tested to ASTM C136 and ASTM C117 and giving a smooth curve without sharp breaks when plotted on a semi-log grading chart in accordance with ASTM E11:

<u>ASTM Sieve Designation</u>	<u>% Passing</u>
1	100
3/4	75-100
3/8	50-100
No. 4	30-70
No. 10	20-45
No. 40	10-25
No. 200	3-8

Ps.5.03 EXECUTION

1. GENERAL

A. Existing Buried Utilities and Structures

The size, depth and location of existing utilities and structures as shown on the Drawings are approximate and are for guidance only. Completeness and accuracy of this information are not guaranteed.

Prior to commencing any excavation work, the Contractor shall notify applicable owners or authorities, and establish location and state use of buried utilities and structures. The Contractor shall clearly mark such locations to prevent disturbance during work.

The Contractor shall confirm locations of buried utilities and structures by careful test excavations and/or other suitable means.

The Contractor shall maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered. The Contractor shall obtain direction from the Engineer before moving or otherwise disturbing utilities or structures.

B. Existing Buildings and Surface Features

The Contractor shall conduct, with the Engineer, a condition survey of existing trees and other plants, grassed areas, fencing, service poles, wires, rail tracks and paving, survey bench marks and monuments which may be affected by the Work.

The Contractor shall protect existing buildings and surface features which may be affected by the work from damage while work is in progress and repair damage resulting from work to the Engineers approval.

Where excavation necessitates root or branch cutting, the Contractor shall do so only as approved by the Engineer.

C. Environmental Requirements

The Contractor shall dewater excavations in accordance with Section Ps.3.02. Water shall be disposed of as directed by the Engineer. Water shall not be disposed of in a manner which may be detrimental to public and/or private property, or to any portion of the work completed or under construction.

Open excavations shall be protected against damage due to surface run-on and runoff. The Contractor shall take all necessary precautions to prevent erosion of excavated or disturbed surfaces.

2. PREPARATION

Six inches of surficial soil or gravel, if present, shall be removed from the trenching area and stockpiled adjacent to the effected area for subsequent placement following backfilling.

The Contractor shall remove obstructions, ice and snow, from surfaces to be excavated, within the limits shown on the Drawings or as required to construct the finished Works as shown on the Drawings. The Contractor shall cut and remove pavement or sidewalk neatly along the limits of proposed excavation and dispose.

The Contractor shall obtain the Engineers approval of completed excavations prior to commencement of installations, bedding, or backfilling.

3. PERFORMANCE

A. Excavation and Trenching

The Contractor shall excavate to lines, grades, elevations and dimensions as shown on the Drawings and as required to complete the work. Concrete, masonry, paving, walks and other obstructions encountered during excavation shall be removed and disposed of as directed by the Engineer.

The Contractor shall not excavate more than 100 feet of trench in advance of pipe. The Contractor shall not leave any sections of the trench open at the end of each day's operation; open trenches shall be backfilled at the end of each day.

The limits of excavation shall be left undisturbed, evenly graded, and free of loose, soft or organic matter. The Contractor shall advise the Engineer when soil at the bottom of the trench appears unsuitable for the proposed installation.

Where unauthorized, over-excavation has occurred, the Contractor shall correct such over-excavation to the satisfaction of the Engineer, at no additional cost to the Owner. Correction of over-excavation may include placement of concrete or compacted granular backfill as directed by the Engineer.

The Contractor shall dispose off-site surplus excavated material.

B. Bedding

The trench shall be backfilled for the specified depth below the invert of the pipe with imported bedding as specified in Section Ps.5.02.4 prior to placement of pipe in the trench. Bedding material shall be placed in maximum 6-inch lifts and compacted to 95% Standard Proctor Density. Bedding material shall be placed to the specified depth above the top of the pipe as specified above and in accordance with Section Ps.5.03.3.C.

C. Backfilling

The Contractor shall not proceed with backfilling operations until the Engineer has inspected and approved the work.

All excavations shall be free from debris, snow, ice, water or frozen ground prior to commencement of backfilling.

The Contractor shall backfill around subsurface installations as follows:

- a) bedding material shall be placed as specified for the installation;
- b) backfill shall not be placed around, over or adjacent to cast-in-place concrete within 72 hours of placing concrete:
- c) layers shall be placed simultaneously, on all sides of the installed work, to equalize loading; and
- d) material shall be placed by hand, under, around and over installations until a minimum of two feet of cover is provided; backfill shall not be dumped directly on installations.

The Contractor shall place backfill in uniform layers not exceeding six inches compacted thickness. Each layer shall be compacted to a minimum of 95% Standard Proctor Density before successive layers are placed.

Ps.6 PUMPCHAMBER

Ps.6.01 GENERAL

1. Work Included

Work of this Section consists of the supply and installation of one pumpchamber for the protection of the extraction well and its mechanical and electrical components.

2. Related Work Specified Elsewhere

- i) Mechanical Components For Pumpchamber - Section Ps.7
- valves, meters, pumps, controls and miscellaneous appurtenances

Ps.6.02 PRODUCTS

1. Gravel Base

The base for the pumpchamber foundation shall meet the following gradation requirements.

<u>Sieve Size</u>	<u>% Passing by Weight</u>
2 inch	100
1/4 inch	30-65
No. 40	5-40
No. 200	0-10

All material furnished shall be well graded from coarse to fine and free from organic or other deleterious materials.

2. Pumpchamber

The pumpchamber shall have a precast reinforced 3,000 p.s.i. concrete monolithic base constructed as shown on the Drawings. The base shall be placed on six inches of granular base extending 12 inches beyond the outside diameter of the base as detailed on the Drawings.

The pumpchamber risers, top and base shall be precast reinforced concrete in accordance with ASTM Specification C-478, or latest revision and shall have rubber 'O' ring gaskets in all joints to ensure water tight joints.

The frame and cover for the pump chamber shall be a sealed unit.

The pumpchamber top shall be brought to final grade using Moduloc adjustment units or equivalent. Moduloc adjustment units shall be placed no more than five rows high and no less than two rows high.

Ps.6.03 EXECUTION

1. Installation

The pump chamber shall be installed according to the elevations and dimensions as shown on the Drawings.

Ps.7 MECHANICAL COMPONENTS FOR PUMPCHAMBER

Ps.7.01 GENERAL

1. Work Included

Work of this Section consists of the supply and installation of pump, riser pipe, valves, fittings and all other associated appurtenances.

2. Related Work Specified Elsewhere

- i) Pumpchamber - Section Ps.6
- ii) Forcemains - Section Ps.8.

Ps.7.02 PRODUCTS

1. Pump

The pumping unit shall be all stainless steel submersible pump complete with teflon seals and bearings as manufactured by Pleuger (QN83-1 + M6-42) or approved equivalent. The pump shall be 440 volt, triple phase shrouded motor. Pump horsepower shall be as specified on the Drawings.

The pump shall be supplied complete with electric cables as supplied by the pump manufacturer, suitable for submersible pump applications. The cable shall be 3-wire, twisted with cable size matched to cable length as recommended by the pump manufacturer. The cable shall be teflon coated.

The pumping unit shall be suspended by means of a Schedule 40 steel riser pipe which is connected to the pitless adapter with the pump positioned at the setting shown on the Drawings or as specified by the Engineer.

2. Piping

All riser pipe and miscellaneous piping within the pumpchamber shall be black carbon steel pipe conforming to ASTM A53, Grade B, electric resistance welded, Schedule 40.

3. Well Cap

The well cap for the extraction well shall be of the heavy duty sealed conduit type for use with the submersible pump.

4. Pitless Adaptor

The pitless adaptor shall be the heavy duty type as manufactured for use with the submersible pump and designed to eliminate all obstructions in the well casing. The pitless adapter shall be a field weld type using a bronzed locking wedge using teflon seals forced against 304 non-magnetic stainless steel flanged nipple and shall be Maass Model J (or equal), for 12-inch well casing size, with the water outlet and drop pipe size as shown on the Drawings. The drop pipe shall extend to the top of the casing to facilitate removal of the pump.

5. Steel Pipe Fittings

Fittings such as tees, reducers, wyes and bends shall be fabricated of steel to dimensions specified in the latest revision of ANSI B16.9 and the following data:

- i) diameter and grade equal to that of pipe being used;
- ii) design pressure of 150 pounds per square inch (psi);
- iii) wall thickness equal to or greater than the pipe; and
- iv) ends shall be threaded.

6. Gate Valve

The gate valve shall be from one manufacturer (Jenkins or equal) with the manufacturer's name, valve size and pressure clearly marked on the outside of the body. The valve shall be all iron, inside screws, travelling clip gates and solid wedge with rising stem.

7. Flow Control Valve

The flow control valve shall be a butterfly type with threaded inlet and outlet ports.

8. Flow Sensors

The flow sensors shall be Model MK515 Flow sensors for 1-inch pipe by Signet Flow Instrumentation or approved equivalent. Each sensor shall come complete with a matched Signet sensor installation fitting for use with 1-inch Schedule 40 steel pipe. The sensor shall be accurate to +1 percent over the full dynamic range of 1 to 30 fps. No external power or battery shall be required for the operation of the flow sensor.

9. Flow Rate Indicators

The flow rate indicators shall provide both accurate fluid flow rate and totalized flow volume reading. The indicators shall be the ACCUM-U-FLO MK575 as manufactured by Signet Flow Instrumentation or approved equivalent. The indicator shall include a 117 VAC to 12 VDC power converter. The totalized flow volume shall be presented on a 7-digit non-resettable counter.

10. Anchoring System

The Contractor shall supply and install by watertight connections consisting of flanged connections, hose-type connections, clamp-type connections or other flexible coupling, according to the manufacturers recommendations, the necessary anchoring for the submersible pump and electric cable for the pump setting as shown on the Drawings or as specified by the Engineer.

In general, the electric cable is to be securely clamped to the riser pipe every ten feet with the wire and riser pipe continuously wrapped with electrical tape for the initial ten feet above the pump.

11. Fitting and Valve Coating

All fittings and valves shall be coated with the following multi-coat vinyl system as manufactured by CARBOCINE of St. Louis, Missouri or approved equivalent.

- Primer Coat 2.5 mils, Rustbond 8HB
- Intermediate Coat 4 mils, Amercoat 936
- Finish Coat 4 mils, Amercoat 936

12. Joint Compound

Teflon tape shall be used as joint compound.

13. Well Caps

The extraction well casing shall be fitted with a sealed conduit well cap. The monitoring well casing shall be fitted with a vented well cap.

Ps.7.03

EXECUTION

1. Materials Handling and Storage

The safe delivery to the site of all materials in this section shall be the Contractor's responsibility. All materials shall be delivered to and stored on the site in a manner satisfactory to the Engineer. All materials shall be jointly inspected by the Engineer and the Contractor for damage in transit.

No defective material shall be delivered to the site and materials found defective at any time shall be removed immediately and replaced at the Contractor's expense.

The Contractor shall be responsible for the proper on-site storage of equipment and shall ensure that the equipment is protected against damage to the satisfaction of the Engineer. All materials damaged while being stored on the site shall be replaced by the Contractor at the Contractor's expense.

2. Installation

All pipes, valves, fittings and the pumping unit shall be installed according to the lines and elevations and dimensions as shown on the Drawings. All dimensioned pipes and fittings shall be installed before fitting make-up pieces and the whole shall be joined so that no stress or strain is created in the lines and associated fittings due to forcing parts into position. All pipes shall be carefully aligned and supported before joints are securely connected. Unless otherwise shown or specified, the pipe shall be supported at the center of the pumphouses.

Screwed joints in piping shall be made with full standard tapered threads with Teflon Tape applied to male threads only. Ream or file for full bore, clean and free from scale.

Temporary bracing and supports shall be provided to adequately support the pipe during installation. All permanent supports shall be in place before temporary bracing and supports are removed.

Care shall be taken that no foreign matter be left in the piping. After the piping has been assembled and properly aligned with equipment and connections, all joints shall be made tight to ensure no leakage.

The Contractor shall provide and install a suitable watertight seal at all manhole wall penetrations. The seal shall be on both the inside and outside and shall not damage the pumpchamber.

The well casing shall be cut to the appropriate height prior to installation of the pitless adaptor. The pitless adaptor shall be installed in accordance with manufacturer's instructions.

Ps.8 FORCEMAIN

Ps.8.01 GENERAL

1. Work Included

Work of this Section consists of the supply and installation of the forcemain, trenching and backfilling and tie-in to existing manhole and pumpchamber.

2. Related Work Specified Elsewhere

- i) Excavation, Trenching and Backfilling - Section Ps.5.
- ii) Pumpchamber - Section Ps.6
- iii) Mechanical Components For Pumpchamber - Section Ps.7

Ps.8.02 PRODUCTS

1. Effluent Forcemain Piping

All extraction system piping shall be PVC (Sch.80) bell and spigot piping conforming to latest revision of ASTM standards unless specified otherwise.

2. Pipe Fittings

Fittings such as tees, reducers, wyes, and bends shall be fabricated of PVC to dimensions to pipe manufacturers specifications and shall have diameter, grade, design pressure and wall thickness equal to or greater than the pipe.

Ps.8.03 EXECUTION

1. Forcemain Installation

Pipe shall be checked before being lowered into the trench to ensure that no foreign material, manufacturer's defects, or cracks exist that might prevent the proper jointing of the pipe or its operation.

No pipe shall be lowered into a trench until all rocks, clods and debris have been removed. The bottom of the trench shall be graded to give support to the line throughout its entire length. In all rock or gravel sections a six-inch thick sand padding shall be placed in the bottom of the trench in order to protect the pipe coating.

Pipe shall be jointed in strict accordance with the appropriate jointing specification. The open end of the pipe in the trench shall be suitably covered to prevent entrance of trench water and other material during periods when pipe is not being installed.

Precautions shall be taken to ensure that displacement of the pipe in the trench does not occur through soil displacement or flotation due to the presence of trench water. Pipe that has been displaced shall be removed from the trench and relaid.

Fittings shall be adequately supported to reduce the transmission of any undesirable load or stress on the adjoining pipe.

2. Pressure and Leakage Testing

The Contractor shall supply all necessary materials, equipment and labor to complete the necessary pressure and leakage testing of all piping systems.

Should any test disclose leakage, the Contractor shall, at his own expense, locate and repair the defects using new materials. No repair clamps or sleeves will be accepted.

Equipment in the pumpchamber shall be isolated from the forcemain during all pressure tests. Piping shall be tested to a hydrostatic pressure of 150 pounds per square inch (psi) maintained at the highest point in the system. The piping shall be considered to be free of leaks when no pressure or volume loss is detected within a 2-hour period, after steady temperature conditions have been established and source pressure is removed.

Piping tested prior to installation and backfilling must be tested following installation and backfilling.

3. Cleaning, Flushing and Purging Water From Forcemain

After pressure and leakage testing of the piping system, the Contractor shall clean all piping by flushing with potable water provided by the Contractor and then purge all standing water out of the systems to the satisfaction of the Engineer.

4. Restoration of Trenches

Restoration of all trenches shall be as shown on the Drawings and as specified herein. As a minimum, all trenches shall be restored to original conditions unless shown otherwise on the Drawings.

Restoration of all gravel works shall consist of 8 inches of approved crushed gravel. The crushed gravel shall be compacted to 100 percent Standard Proctor Density.

Restoration of lawns shall consist of 6 inches of topsoil and sod or as shown on the Drawings.

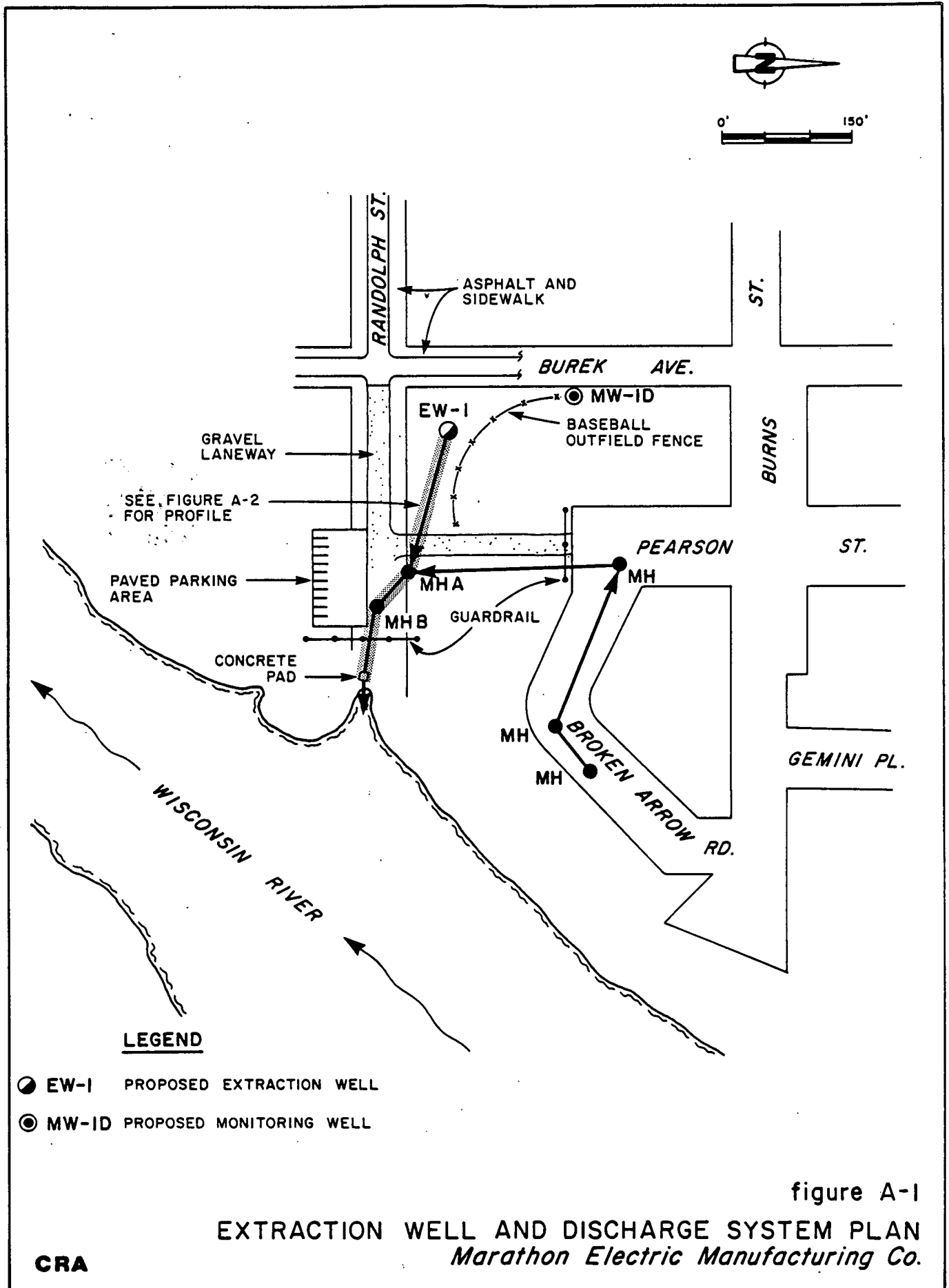
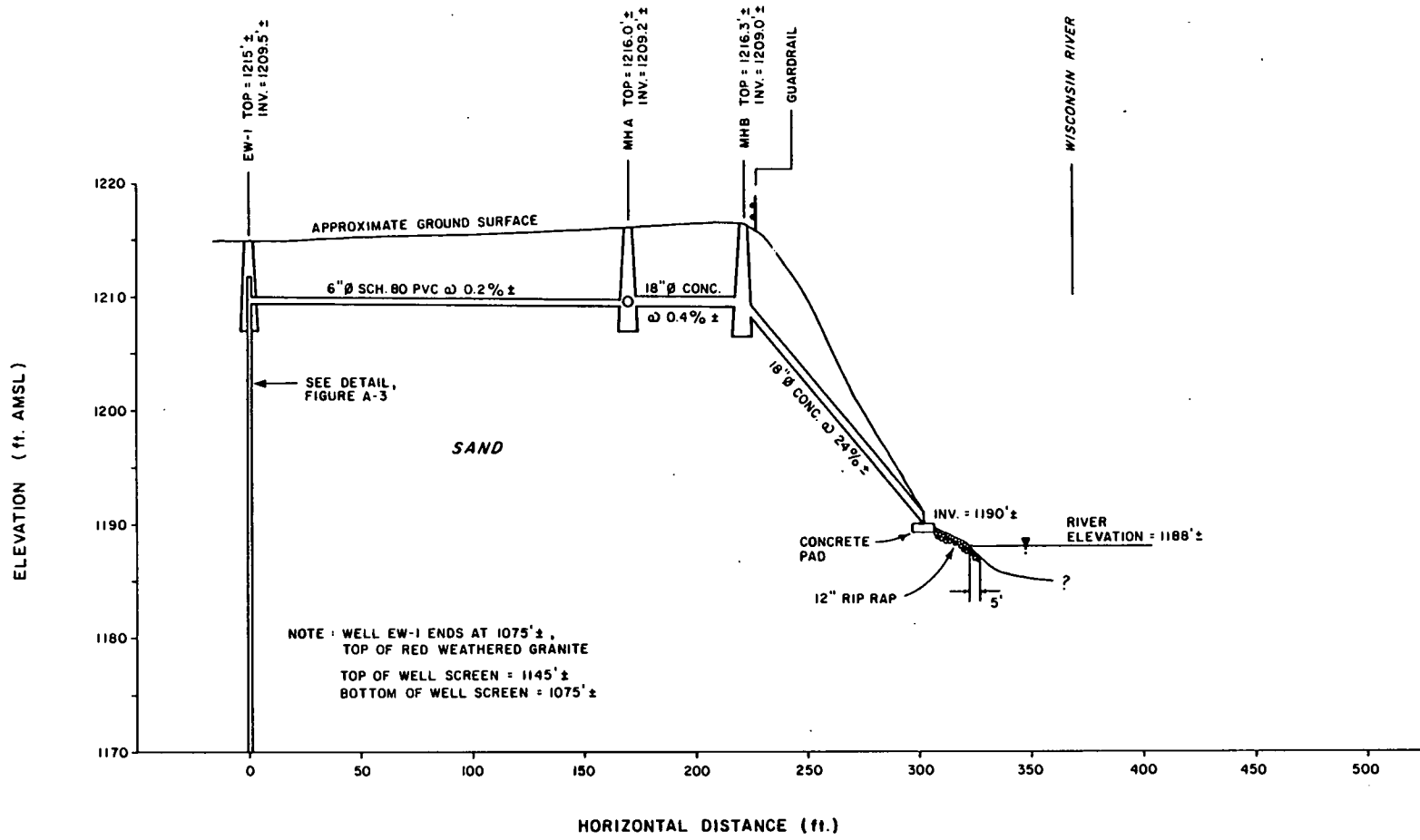


figure A-1

EXTRACTION WELL AND DISCHARGE SYSTEM PLAN
Marathon Electric Manufacturing Co.

CRA



NOTE : WELL EW-1 ENDS AT 1075' ±,
 TOP OF RED WEATHERED GRANITE
 TOP OF WELL SCREEN = 1145' ±
 BOTTOM OF WELL SCREEN = 1075' ±

SCALE : HOR. 1" = 50'
 VER. 1" = 10'

figure A-2

EXTRACTION WELL AND DISCHARGE SYSTEM PROFILE
 Marathon Electric Manufacturing Co.

CRA

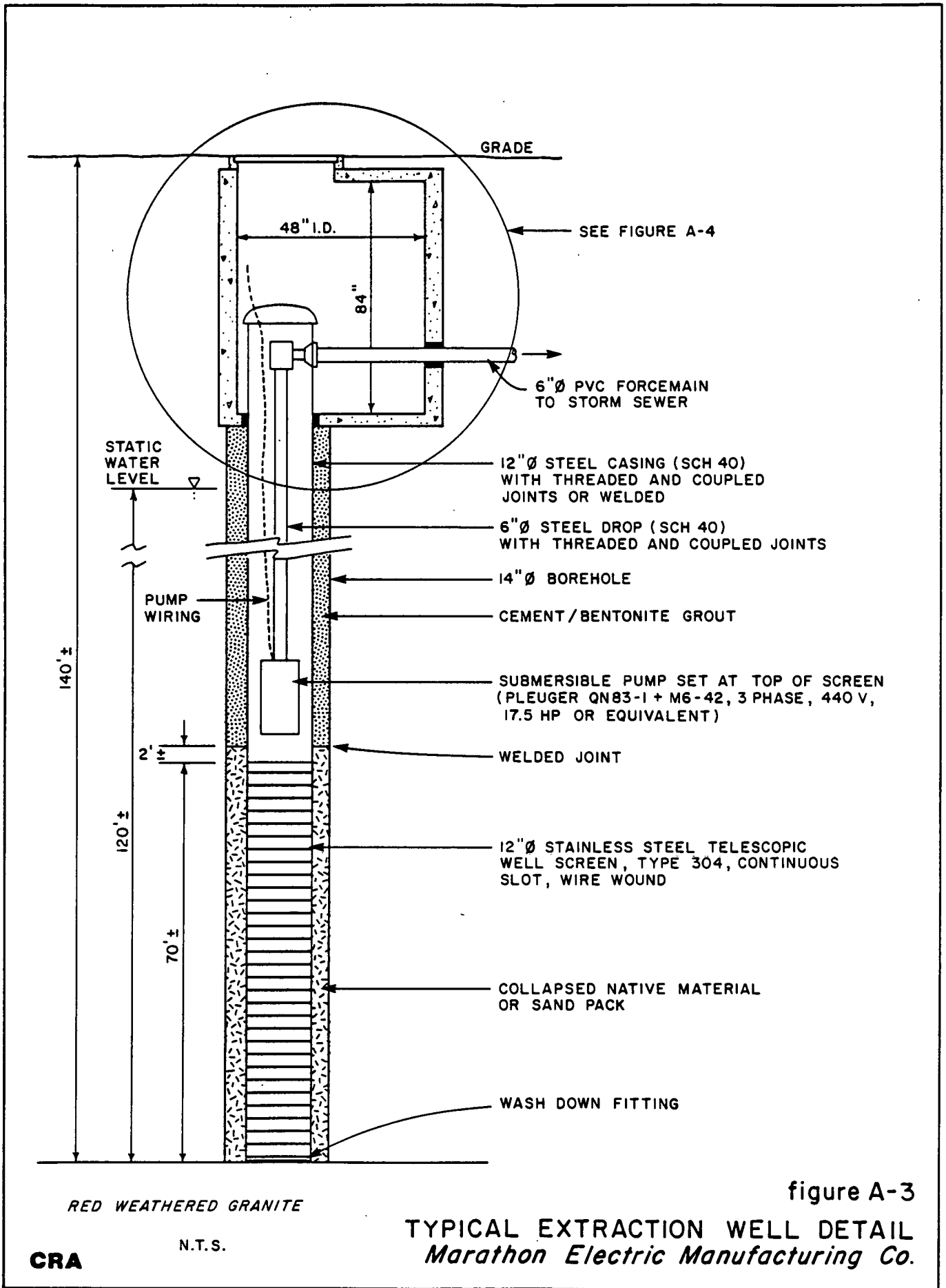


figure A-3

TYPICAL EXTRACTION WELL DETAIL
Marathon Electric Manufacturing Co.

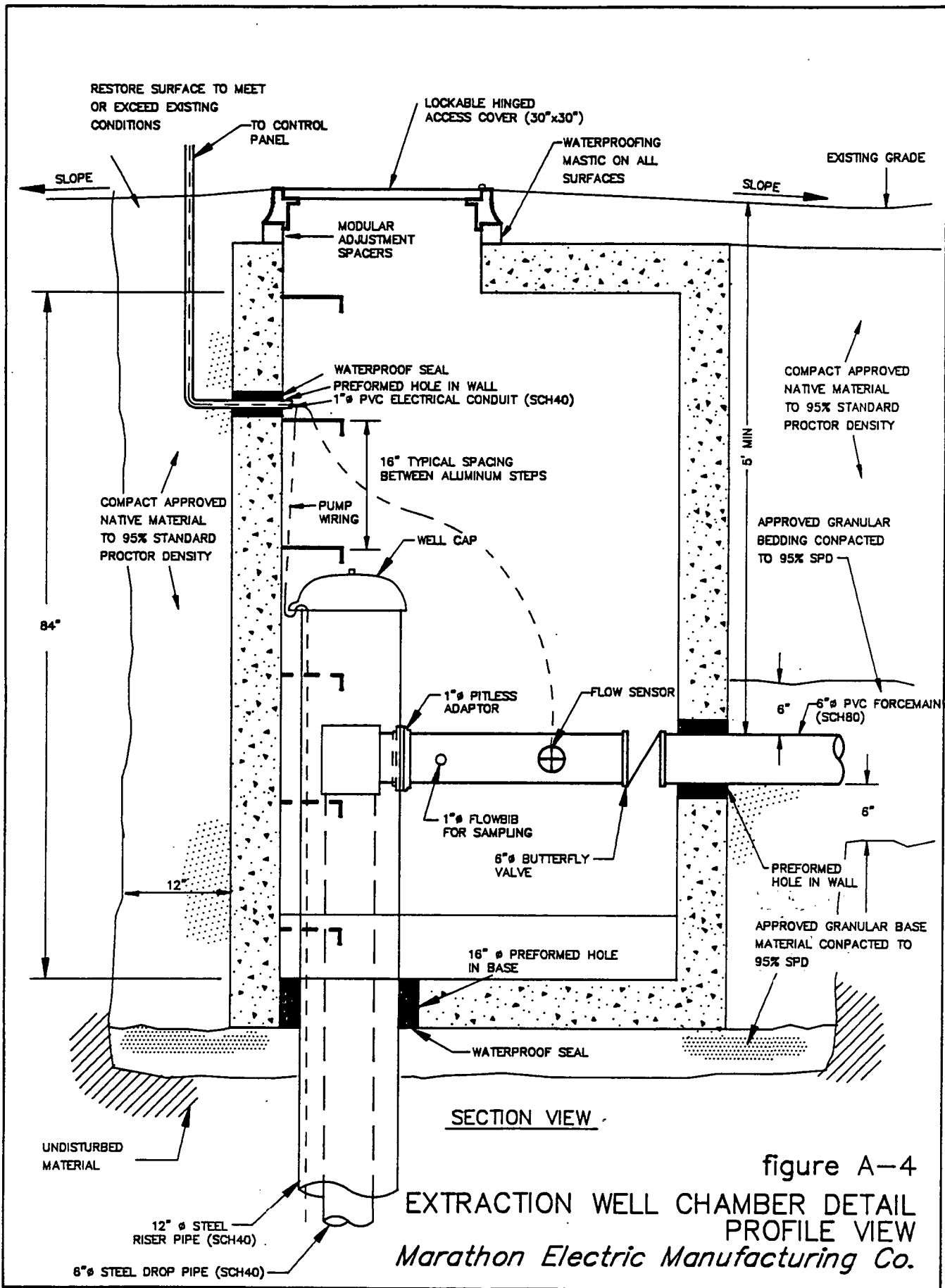


figure A-4
 EXTRACTION WELL CHAMBER DETAIL
 PROFILE VIEW
 Marathon Electric Manufacturing Co.

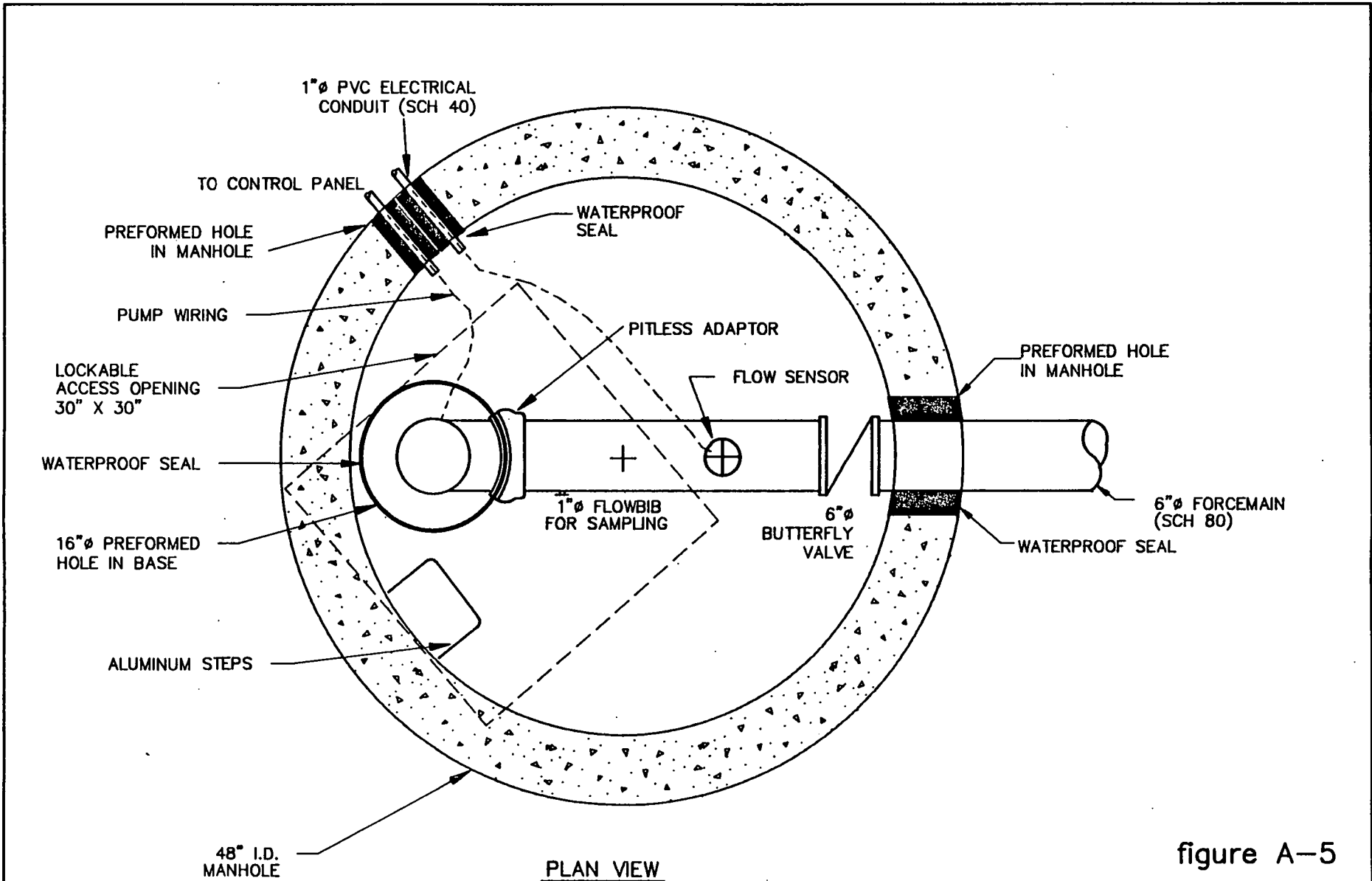
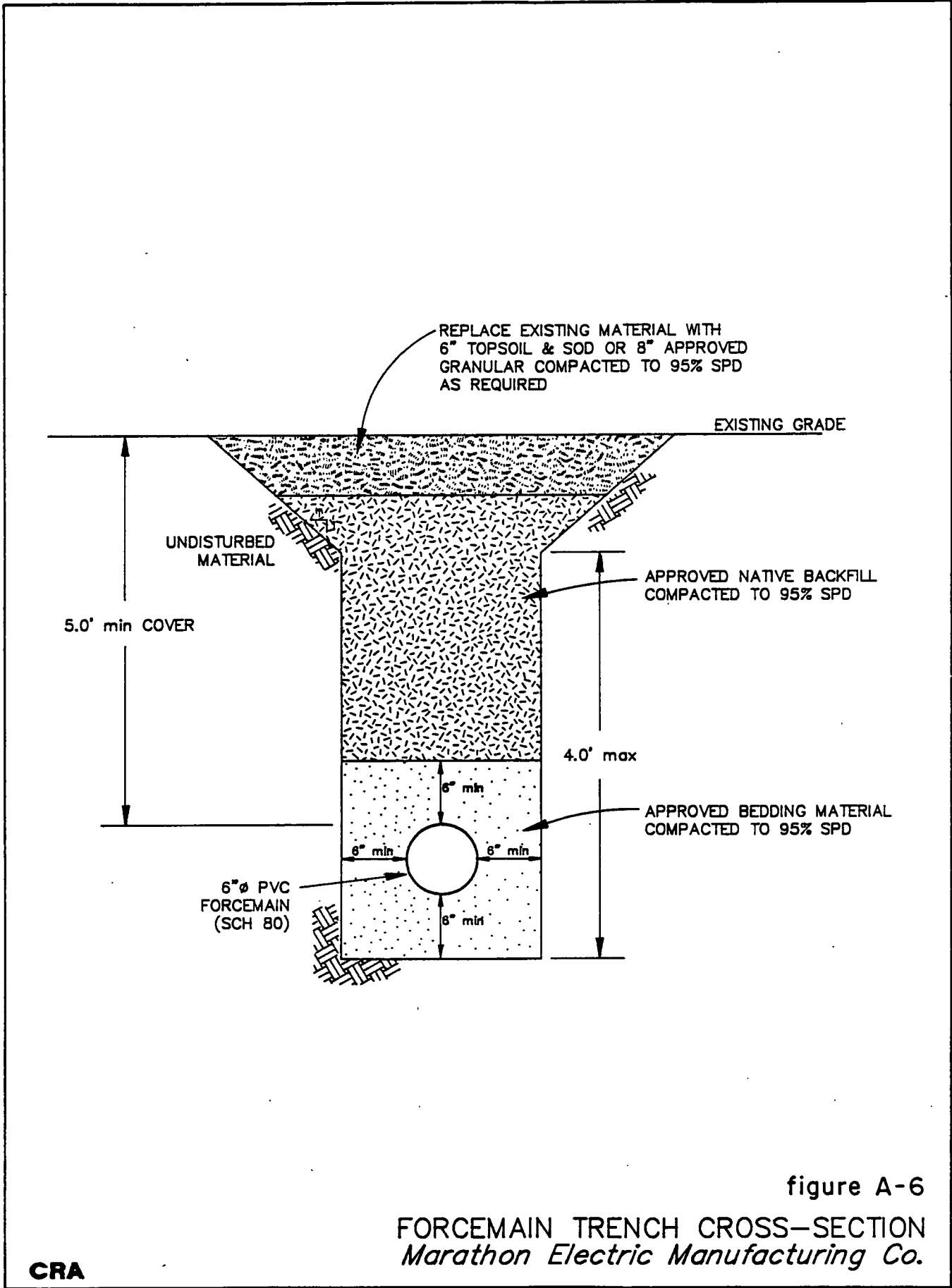


figure A-5

EXTRACTION WELL CHAMBER DETAIL
 PLAN VIEW
 Marathon Electric Manufacturing Co.

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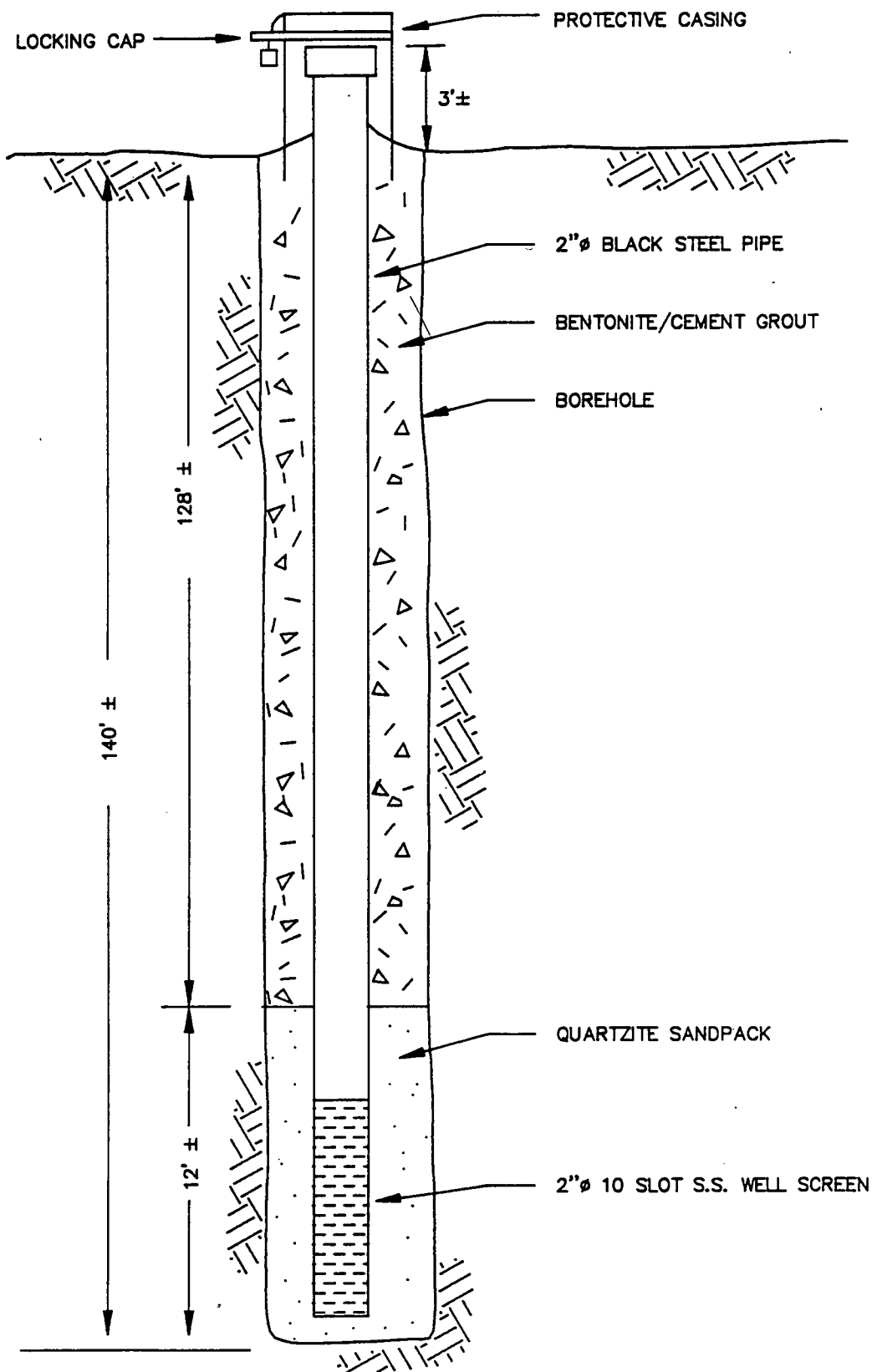


figure A-8
 TYPICAL MONITORING WELL DETAIL
 Marathon Electric Manufacturing Co.