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FMC

RESPONSE ACTION PLAN

Fridley, Minnesota

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1.0 INTRODUCTION

The FMC Site, located south of the main plant at the Northern Ordnance Division of FMC Corporation (FMC) in the City of Fridley, Anoka County, Minnesota, is comprised of two parcels of land. The northerly parcel (referred to hereafter as the FMC lands) is approximately 13 acres in size and is owned by FMC. The southerly parcel (hereafter referred to as the BNR lands) is approximately five acres in size and is owned by the Burlington Northern Railway. In the context of this report, reference to the Site shall collectively mean that total area comprising both the FMC and BNR lands. The Site is located in the Minneapolis area as shown on Figure 1. The Site boundaries and configuration are illustrated on Figure 2.

The Site was used for the burning and disposal of industrial wastes, including liquid wastes, between the mid-forties and 1969. Wastes disposed of at the Site included chlorinated and non-chlorinated solvents, oils, paint and paint sludges, cinders and construction rubble.

From the period December 1980 to present, several investigative programs have been completed by FMC to determine the impact on soil and groundwater at the Site from past waste disposal practices. These investigations identified the presence of volatile organic compounds (VOCs),

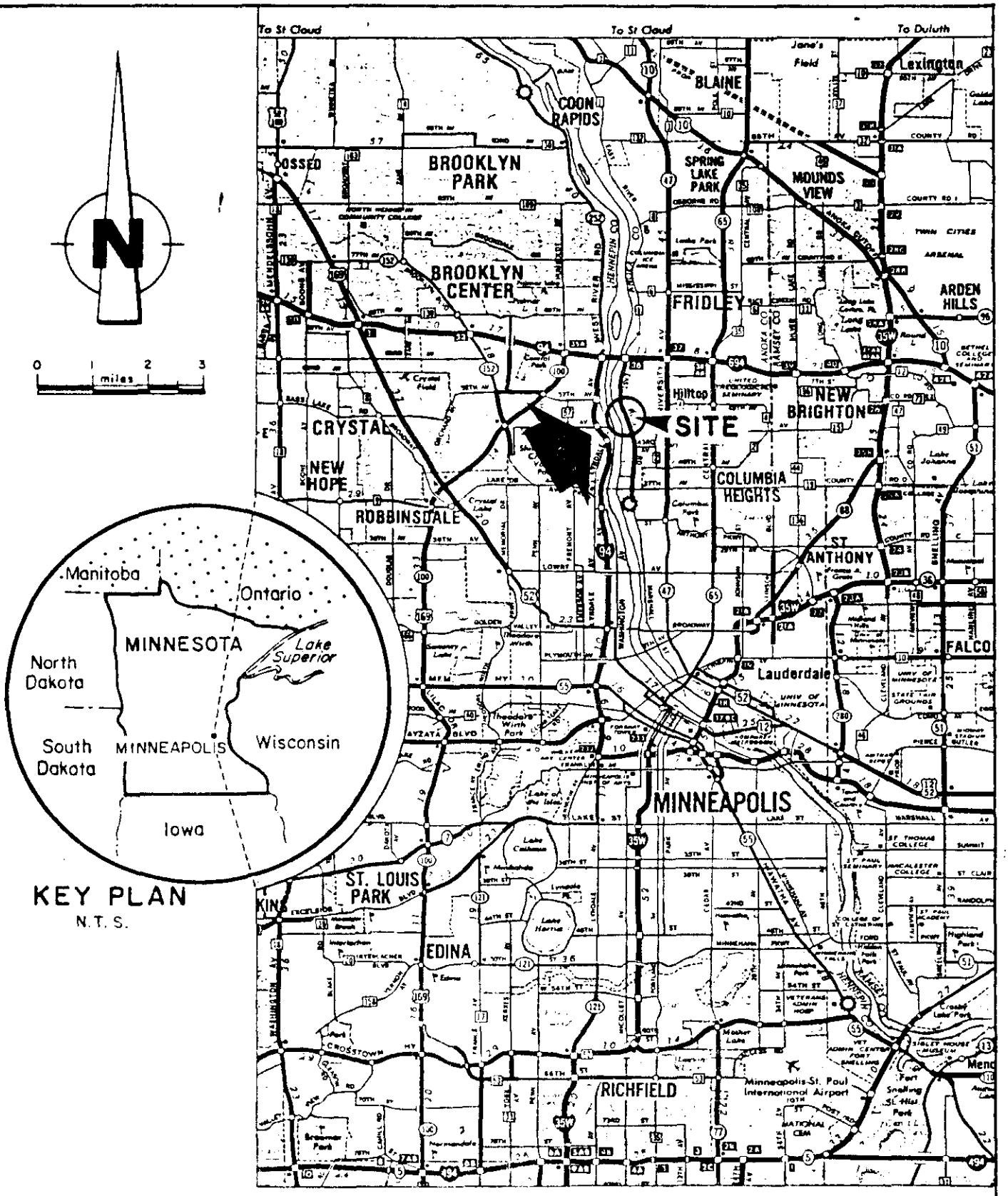

figure I

LOCATION PLAN

FMC Northern Ordnance Plant

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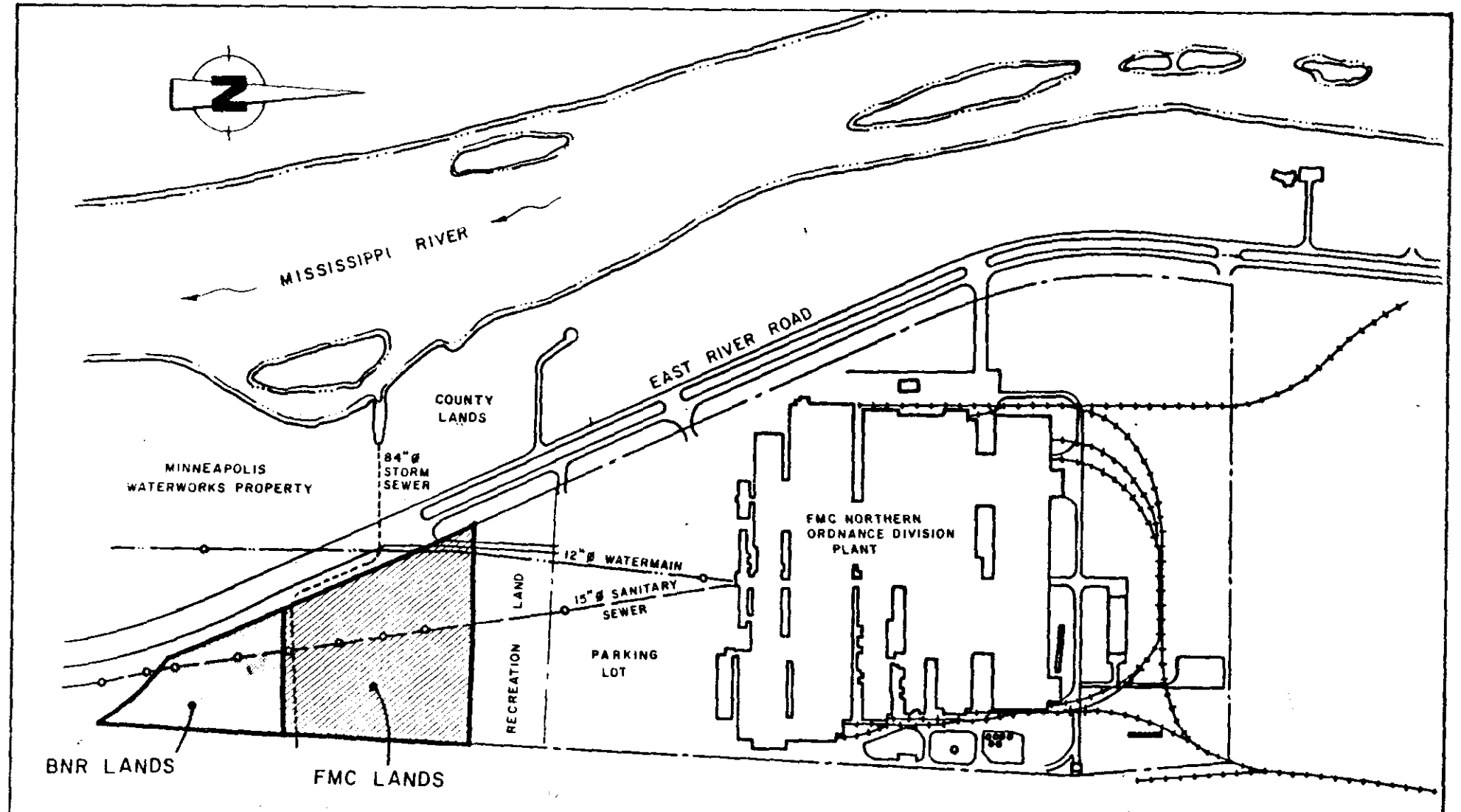

figure 2

SITE PLAN

FMC Northern Ordnance Plant

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primarily trichloroethylene (TCE), and lead and chromium in the unsaturated overburden soils, and VOCs in the groundwater underlying and adjacent to the Site.

As stipulated in an Administrative Order and Interim Response Order by Consent (Order) between the Minnesota Pollution Control Agency (MPCA), the United States Environmental Protection Agency, Region V (EPA), and FMC, the contaminated unsaturated overburden soil at the site having total volatile organic concentrations greater than 1 part per million (ppm), was excavated in June 1983 and placed in a constructed secure containment and treatment facility (CTF). The CTF was constructed on the FMC lands in accordance with RCRA design standards.

On August 31, 1984 FMC submitted to the EPA and MPCA a report (the ground water Remedial Investigation Final Report) entitled "Final Report, Phase I and II Investigation Programs, Northern Ordnance Division, FMC Corporation, Minneapolis, Minnesota, "S.S. Papadopolous, August, 1984.

On January 21, 1985 FMC submitted a Feasibility Study (FS) Report which FMC believes fulfills the requirements of the June 8, 1983 Order, but which the MPCA considered to be a partial groundwater FS. At the request of the MPCA, FMC submitted additional information to

* Are these [illegible] true and/or a necessary part of the RAP?

the MPCA and EPA on May 6, 1985. The MPCA staff considers the January 21, 1985 FS Report combined with the additional information to constitute a complete FS. The FS was conducted following procedures outlined in the National Contingency Plan (NCP), 40 CFR § 300.68 (f-i). The additional information submitted by FMC on May 6, 1985 contained information and analysis regarding the following groundwater response action alternatives:

i) excavation and disposal;

ii) capping;

iii) physical containment;

iv) hydraulic containment;

v) groundwater treatment;

vi) alternative water source supply; and,

vii) in-situ biological treatment.

The groundwater FS submitted by FMC combined with the additional information submitted to the EPA and MPCA contained sufficient information and analysis to allow the MPCA director to review and approve, disapprove or modify FMC's recommended groundwater response action alternative(s) in accordance with the NCP.40 CFR § 300.68 (j). The MPCA Director approved an alternative involving contaminated groundwater hydraulic containment and treatment. This alternative has been approved in accordance with the NCP to provide for implementation of reasonable and necessary

* Can MPCA director do + disc. [illegible] ie EDD.

response actions to minimize the migration of contaminated groundwater from the FMC Site to ensure adequate protection of the existing Minneapolis drinking water intake and to ensure protection of the alluvial aquifers which will allow for future use of these resources upon completion of the response actions.

The following presents the Response Action Plan (RAP) which describes components of the final Site remediation. This RAP has been prepared in accordance with the Response Action Work Plan (RAWP) approved by the MPCA on April 8, 1986 following FMC negotiations with MPCA staff. The letter of approval for the RAWP is contained in Appendix A.

2.0 EXISTING SITE CONDITIONS

2.1 GENERAL

A description of the Site, the Site history and an accounting of previous investigations and remedial actions undertaken are presented in the previously referenced FS report.

The following description of the Site hydrogeologic conditions and the distribution of the contaminants in the groundwater beneath it are summarized from the FS report referenced above.

2.2 HYDROSTRATIGRAPHY

A river-connected sand and gravel aquifer system underlies the Site, and is in turn underlain by water bearing bedrock units; the St. Peter Sandstone and the Prairie du Chien Formations. The surficial aquifer system consists of a water table aquifer and a deeper confined aquifer separated under the Site by a clay aquitard. The clay aquitard thins westward across the Site and pinches out west of the Site. The average thickness of the aquitard is 15 feet; however, it has been identified to be as much as

30-feet thick on Site. The aquifer materials consist of sands with occasional sandy gravels and silts.

The confined aquifer underlying the Site ranges in thickness from 5 to 75 feet with thicknesses typically in excess of 45 feet at the downgradient Site boundary. The saturated thickness of the surficial aquifer, where present along the southwest Site boundary, has been identified to be as deep as 35 feet. Elsewhere on Site, the surficial aquifer is of limited extent and thickness.

Representative single well response (slug) test results indicate that field hydraulic conductivities for the surficial aquifer range from 89 to 320 ft/day (3.1×10^{-2} to 1.1×10^{-1} cm/sec). Similarly, for the confined aquifer, field hydraulic conductivities range from six to 65 ft/day (2.1×10^{-3} to 2.3×10^{-2} cm/sec).

The transmissivity of the bedrock (Prairie du Chien Formation) is estimated to be in the order of 4,400 ft^2/day (4.7×10^{-3} m^2/sec).

2.3 GROUNDWATER FLOW SYSTEM

Groundwater generally flows westward and discharges to the nearby Mississippi River. The local flow

direction in the surficial aquifer situated in the southern portion of the Site (BNR lands) is directed southward, controlled by the surface configuration of the underlying aquitard.!

Flow within the confined aquifer is generally horizontal (westward?) with a component of downward flow at the eastern Site boundary and an upward (discharge) component at and beyond the western Site boundary.

2.4 CONTAMINANT DISTRIBUTION

The primary contaminant of concern in the groundwater (estimated to be in excess of 98 percent of the contaminant mass) at this Site is trichloroethylene (TCE).

Other contaminants detected in the groundwater at the Site are:
1,1-dichloroethane; 1,2-dichloroethane;
1,1,1-trichloroethane; 1,1,2-trichloroethane;
1,1-dichloroethylene; 1,2-dichloroethylene;
tetrachloroethylene; benzene; toluene and xylene. These volatile organics are distributed in a horizontal plane as monitored by the existing monitoring well network. The data indicate a typical range in concentrations from several thousand parts per billion in "hot spot" areas to tens of

parts per billion adjacent to the Mississippi River (see Figure 3). Concentrations for individual sampling events range from a high in excess of 50,000 ppb at Well 46 to below the analytical quantification limit at a number of wells located on and off site.

The Site has four distinct zones of contamination, which are:

1) Surficial Aquifer: This area of contamination is well defined, discreet in location and found in the general vicinity of the southwest sector of the Site (Wells 36 and 46 on BNR lands). It is conservatively anticipated that average VOC concentrations in this zone are on the order of 10 to 20 parts per million (ppm). This zone underlies a former drummed waste disposal area.

2) Confined Aquifer, Well 15: This area of contamination is relatively discreet in location horizontally but is not well defined vertically. The area is located in the west central part of the Site (FMC lands) just north of the surficial aquifer contamination. It is conservatively anticipated that the average VOC concentrations in this zone are on the order of 5 to 10 ppm. This area underlies a former waste burning pit.

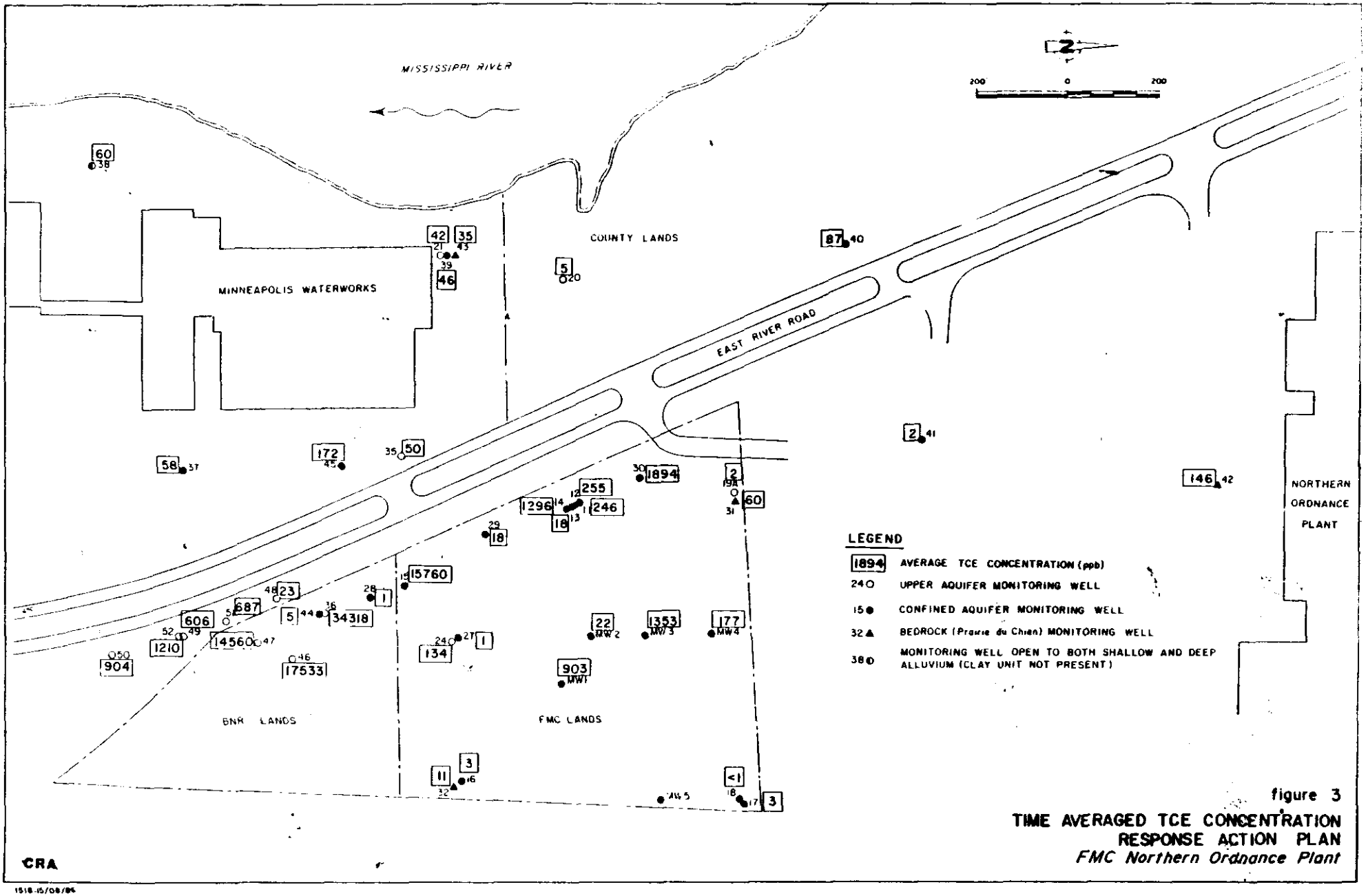

figure 3
TIME AVERAGED TCE CONCENTRATION
RESPONSE ACTION PLAN
FMC Northern Ordnance Plant

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3) Confined Aquifer, Wells 14 to 30: This area of contamination is relatively diffused over the northern third of the Site. The area is located in the northwestern part of the Site (FMC lands) north of the Well 15 contamination zone. Concentrations appear to be, on the average, in the range of 0.4 to 0.8 ppm, an order of magnitude or more lower than the two "hot spots" zones of contamination, described above.

4) Prairie de Chien Aquifer: Contamination in this aquifer has been reported to range from 146 ppb adjacent to the Naval Industrial Reserve Ordnance Plant (NIROP) at the northerly boundary of the Site (upgradient), to 35 ppb adjacent to the Mississippi River. MPCA considers the contamination in this aquifer to orginate from the NIROP Site and is addressing this contamination through a Request for Response Action (RFRA) issued for that Site.

Does U.S. EPA agree with this? What technical information is assumed to be based?

The distribution of TCE in the surficial and confined aquifers is illustrated on Figure 4.

2.5 PREVIOUS SITE RESPONSE ACTIONS

Between June and September 1983, a remedial construction program was carried out in accordance with the

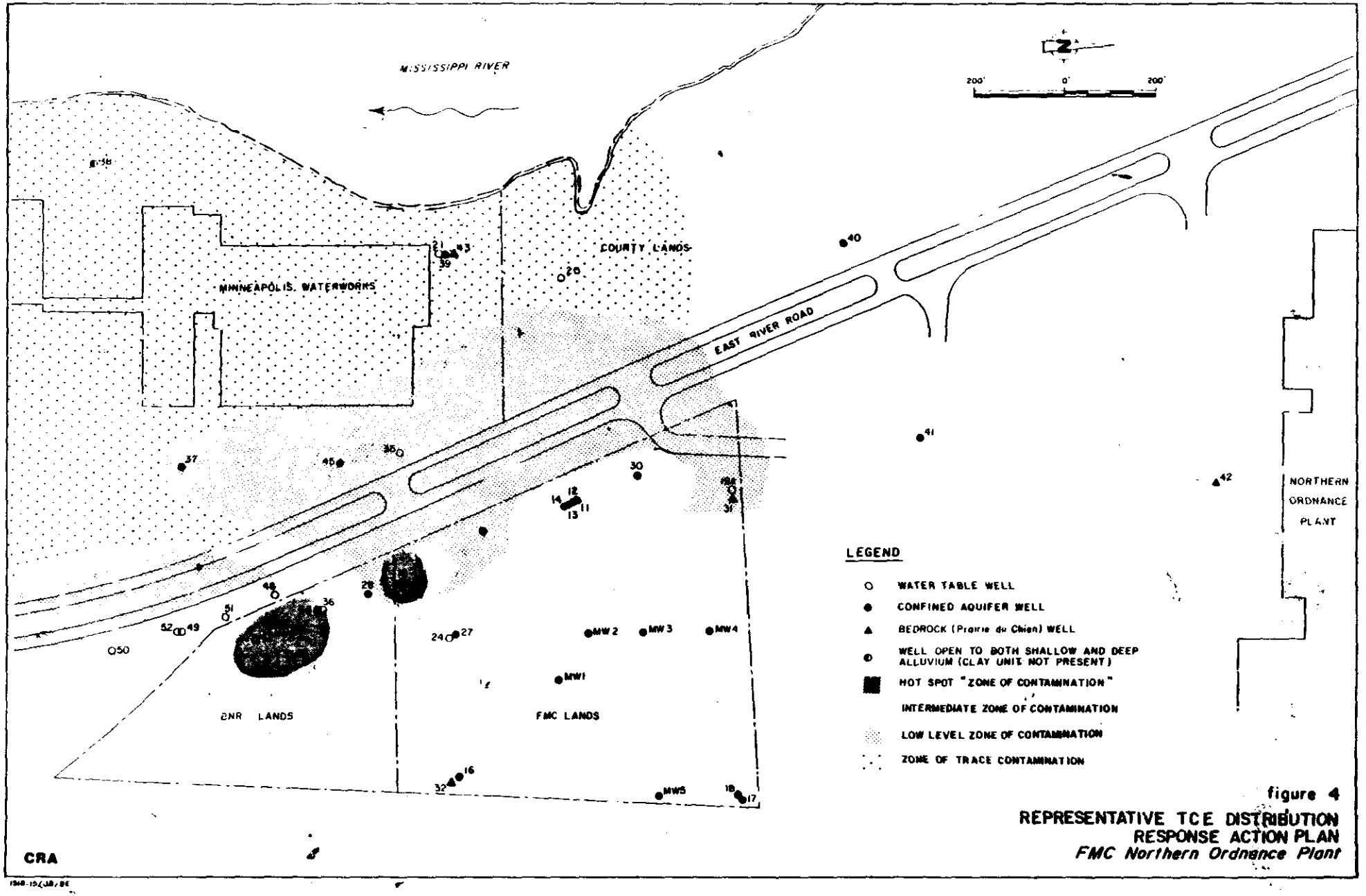

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figure 4
REPRESENTATIVE TCE DISTRIBUTION
RESPONSE ACTION PLAN
FMC Northern Ordnance Plant

Order between the MPCA, EPA and FMC. Construction tasks required by and carried out under the Order included:

i) Construction of a secure containment and treatment facility for the containment of soils identified to be contaminated with volatile organics and/or lead and chromium. The CTF was constructed as a double-lined facility having a low-permeability clay and high density polyethylene underliner and overliner, and provision for leachate collection and leak detection. All components of the CTF were designed and constructed to comply with standards for a RCRA hazardous waste in-ground storage facility.

ii) Excavation and placement of contaminated soils having total volatile organic concentrations greater than 1 ppm within the CTF by June 30, 1983.

iii) Excavation, overpacking, sampling and disposal of drummed waste at an off-Site, EPA approved disposal facility.

iv) Construction of a gas extraction and treatment system to treat, by activated carbon, volatile organic contaminants removed from the CTF.

v) Restoration and revegetation of all excavated areas.

In total, approximately 38,600 cubic yards of contaminated soils were excavated from the unsaturated zone at the Site and placed in the CTF. All areas of contaminated soil excavation were backfilled with overburden material excavated during the CTF construction.

Previous investigative work, which had been carried out at the Site prior to the remedial construction identified isolated areas containing buried drummed waste on the FMC lands. Under the Remedial Action Plan, all drums were to be excavated, overpacked and disposed of at an EPA approved facility.

During the remedial construction, isolated areas of buried drummed waste were encountered in the BNR lands. These drums were handled in the same manner as the drums excavated from the FMC lands. In total, 44 drums were eventually removed from the Site, and disposed of by SCA Chemical Waste Services, Model City, New York.

Transport and disposal was documented using Minnesota and New York State hazardous waste manifests.

The gas extraction and treatment system, constructed as part of the CTF, was designed for continuous operation, drawing volatile organic vapors from the CTF through a series of gas extraction wells. The organic vapors are treated by carbon absorption using activated carbon filters. The gas extraction system is intended to reduce the quantity of volatile contaminants in the CTF over time, in turn reducing the long-term potential for adverse impact to the environment by the contained soils.

All work carried out under the remedial action program was observed and approved by representatives of the MPCA. The completed work is being monitored under a groundwater protection plan, which has been approved by the MPCA and EPA.

3.0 SCOPE OF GROUNDWATER RESPONSE ACTION

The purpose of the Response Action Plan as negotiated between FMC and the MPCA is to minimize the release of contaminants from the FMC Site and endeavor to achieve compliance with drinking water quality criteria at existing and potential receptors. To do this, contaminant mass will be removed from aquifers at the Site to meet the objectives outlined below.

3.1 GROUNDWATER RESPONSE ACTION OBJECTIVES

The objectives of the groundwater response action to be completed at the Site include the following:

i) reduction in the levels of total VOC concentration to 270 ppb or less in the surficial and confined aquifers at the discrete "hot spot" source areas described in Section 2.4;

was this cleanup level revised?

ii) reduction of total VOC concentrations in the confined aquifer in the north west portion of the Site;

what levels?

iii) implementation of a monitoring program in the vicinity of the surficial aquifer, and the confined aquifer at Well 15, to confirm the effectiveness of the response actions at the Site;

iv) implementation of a monitoring program in the confined aquifer in the vicinity of Wells 14 and 30; and

v) completion of all work undertaken at the Site in a manner which minimizes adverse impacts to public health and welfare, and the surrounding environment.

3.2 MAJOR COMPONENTS OF THE RESPONSE ACTION

The following components will be constructed and/or implemented in order to satisfy the response action objectives:

i) groundwater extraction wells will be installed and operated in the surficial and confined aquifer systems;

ii) a pumping system will be installed to remove groundwater from the extraction wells and discharge pumped groundwater to a gravity drain system;

iii) the extraction well pumping system will have provision for manual shut-off, flow control valves, flow recorder, sampling ports and high/low shut-off control at each individual extraction well;

* no treatment of GW before discharge to sanitary sewer. Will this comply with CWA? what about TCE volatilization in sanitary sewer?

iv) a gravity drain discharge system will be constructed to collect the extracted groundwater and direct it to the existing 15-inch diameter sanitary sewer which traverses the Site; and

v) a monitoring system to determine effectiveness of the response action.

4.0 DESCRIPTION OF RESPONSE ACTION COMPONENTS

4.1 EXTRACTION WELL SYSTEM

4.1.1 Performance and Design Criteria

The design of the extraction well system will be based on the following performance and design criteria:

i) The extraction wells will be located centrally within each of the discrete zones of groundwater contamination upgradient of the Site boundary.

upgradient ?

ii) The system will establish and maintain an inward hydraulic gradient horizontally and vertically to ensure that the contaminated groundwater is removed while the system is operational.

P-22

what about TCE concentrations outside of capture zones?

iii) The system is designed to reduce TCE concentrations to 270 ppb in the surficial aquifer within the capture zones of the extraction wells installed on BNR lands, and in the confined aquifer within the capture zone of the extraction well adjacent to Well 15 on FMC lands.

what does this mean?

iv) The system will be cost-effective.

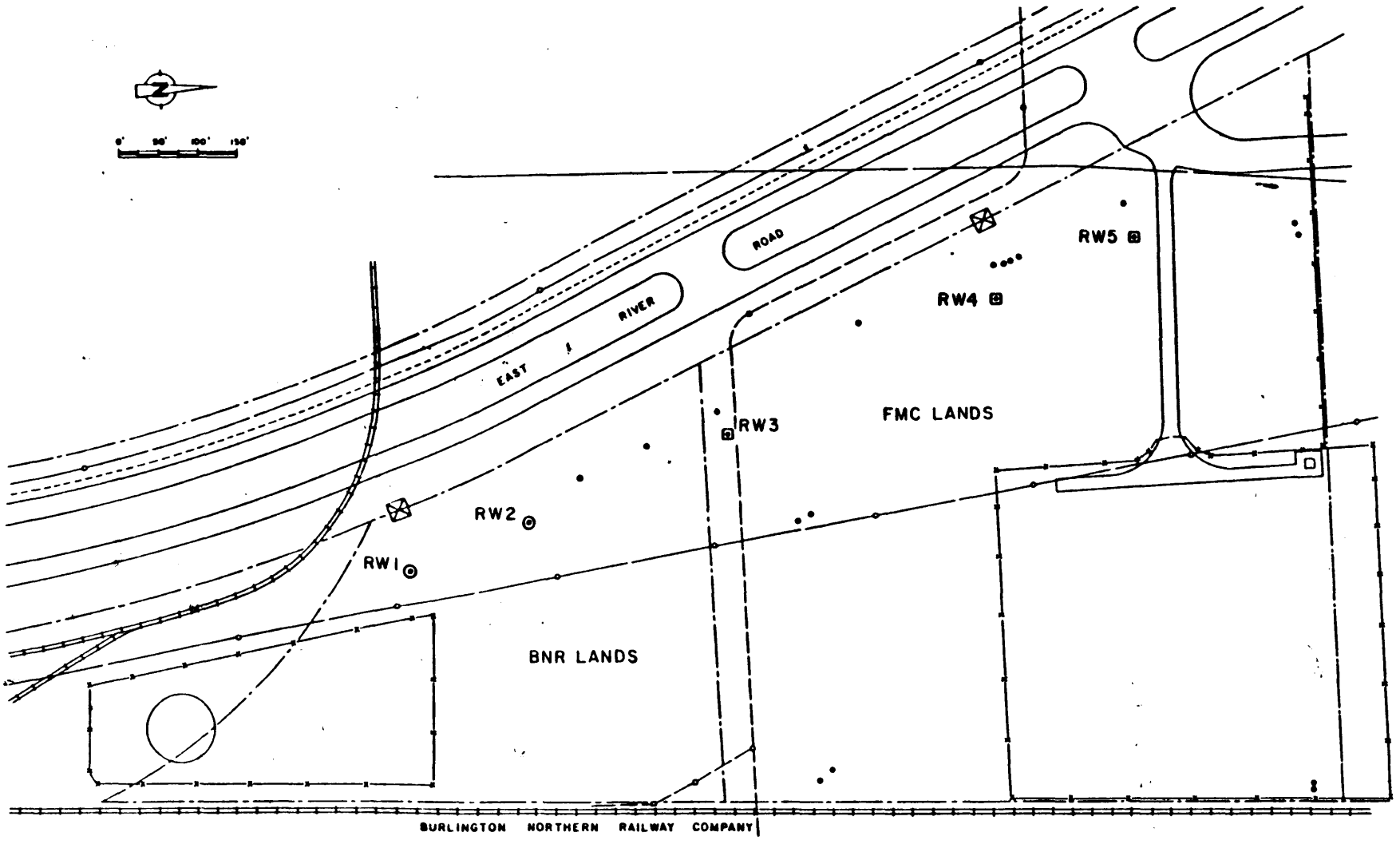
statement is redundant.

v) The system is designed to achieve performance criteria within both shallow and deep aquifers at discrete zones of contamination between two and five years after initiation of pumping.

4.1.2 System Components

Five extraction wells, RW1 through RW5, will be installed near the downgradient Site boundary. Two of these, RW1 and RW2, will remove groundwater from the surficial aquifer on BNR lands. The remaining wells, RW3 through RW5, will extract groundwater from the confined aquifer on FMC lands. The well locations are illustrated on Figure 5.

The two wells extracting from the surficial aquifer on BNR lands (RW1 and RW2), will be screened continuously from five feet above the water table to the clay aquitard underlying the surficial saturated zone. Split spoon sampling will be conducted for all wells to confirm the characteristics of the aquifer in the vicinity of the screened interval. An additional five feet of casing will be extended into the clay aquitard below the well screen to accommodate the well pump. The three wells extracting groundwater from the confined aquifer on the FMC lands, (RW3, RW4 and RW5) will extend to approximately one-third of the confined aquifer.



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- CONFINED AQUIFER EXTRACTION WELLS
- SURFICIAL AQUIFER EXTRACTION WELLS
- EXISTING GROUNDWATER MONITORING WELLS

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figure 5

EXTRACTION WELL LOCATIONS

FMC Northern Ordnance Plant

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Each well will be constructed with 6-inch diameter telescopic stainless steel well screens, and 6-5/8-inch diameter welded joint black steel well casings. At the extraction well locations constructed into the confined aquifer, the overburden material between the ground surface and the aquitard will be cased off with a 12-inch diameter steel casing. This casing will prevent any release of contaminants, which could potentially exist in the overburden material, to the confined aquifer. Wells will be installed in accordance with Standards for General Protection of Groundwater Quality and Resources as detailed in MR4725 of the rules and regulations of the Minnesota Department of Health Water Well Construction Code. Figures 6 and 7 illustrate the extraction well construction details.

4.2 PUMPING SYSTEM

The pumping system for removing groundwater from the extraction wells with subsequent discharge to the gravity sewer collection and discharge system, will consist of the following major components:

i) Four-inch diameter submersible pump with check valve,

ii) a sample pipe and gate valve in the piping leading to the gravity discharge system manhole,

APPENDIX A

LETTER OF APPROVAL

OF.

RESPONSE ACTION WORK PLAN

AUGUST 26, 1986

FROM: KERRY STREET (SHE-12) 6-7240
CERCLA ENFORCEMENT SECTION

TO: ADDRESSEES

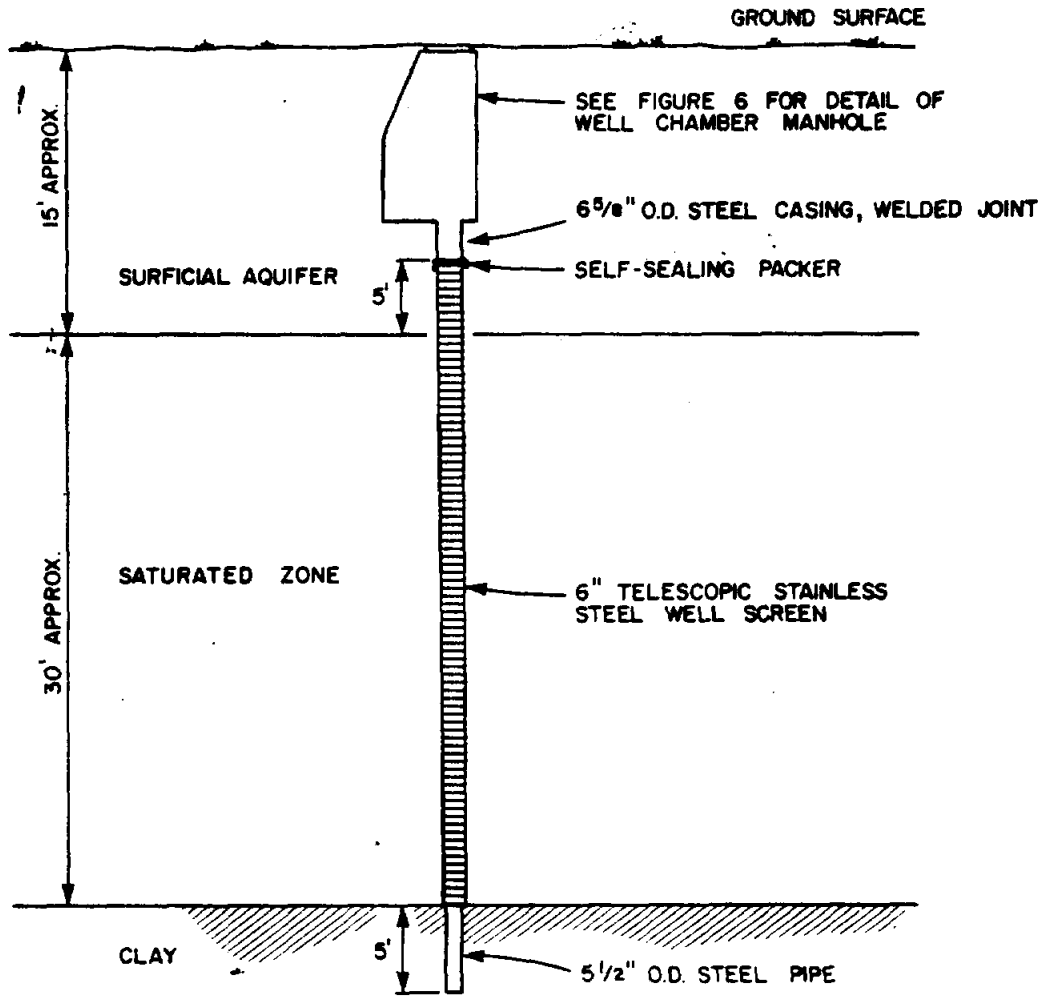
SUBJECT: FMC SUPERFUND SITE, FRIDLEY, MN

ATTACHED FOR YOUR REVIEW IS THE PROPOSED REMEDIAL ACTION PLAN FOR THE SITE. THE MPCA EXPECTS TO SUBMIT THE UPDATED ENFORCEMENT DECISION DOCUMENT, WHICH IS TO FURTHER SUPPORT THE PROPOSED ACTION, BY EARLY SEPTEMBER. I WILL TRANSMIT COPIES FOR YOUR REVIEW AS SOON AS THEY ARE RECEIVED.

PLEASE HAVE COMMENTS PREPARED BY SEPTEMBER 15, 1986.

ADDRESSEES: JERRI-ANNE GARL, WATER (5WG) 2 COPIES
RICH RUPERT, RCRA (5HS)
ROGER GRIMES, ORC (5CS)
MARY TYSON, SMS (5HR)

c: DON, NORM, KATE SELLERS (WH 527)



N.T.S.

figure 6

SURFICIAL AQUIFER EXTRACTION WELL DESIGN

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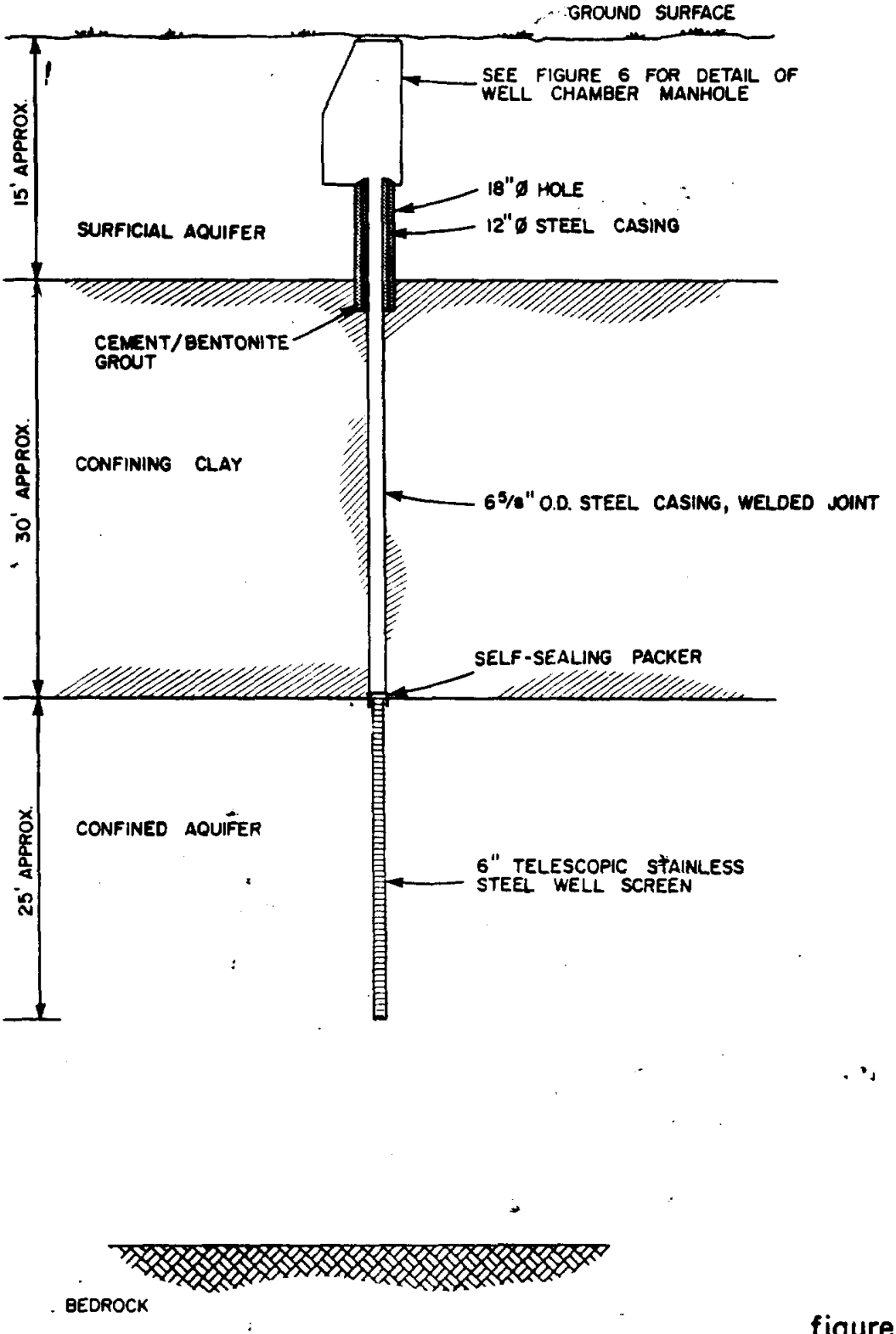

N.T.S.

figure 7

CONFINED AQUIFER EXTRACTION WELL DESIGN

FMC Northern Ordnance Plant

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iii) a flow control valve located downstream from the well head,

iv) a flow sensor located downstream of the control valve,

v) a gate valve located downstream of the flow control sensor,

vi) a high/low pump down control switch,

vii) a pump lock-off-stop switch, and

viii) a 2-inch diameter stainless steel discharge pipe to the gravity drain system.

The entire extraction well pumping system will be housed in a 48-inch diameter reinforced concrete manhole well chamber. Components of the extraction well pumping system are illustrated on Figure 8.

Each extraction well will be pumped initially at a rate of 20 gallons per minute (gpm) for a total combined extraction rate of 100 gpm. The pumping system, however, will have the capacity to pump each well at 30 gpm, should conditions warrant. Pumping each extraction well at 20 gpm will result in a radius of capture of approximately 111 feet for the surficial aquifer wells and approximately 121 feet for the confined aquifer wells. The resulting zones of capture for each extraction well are illustrated on Figures 9 and 10.

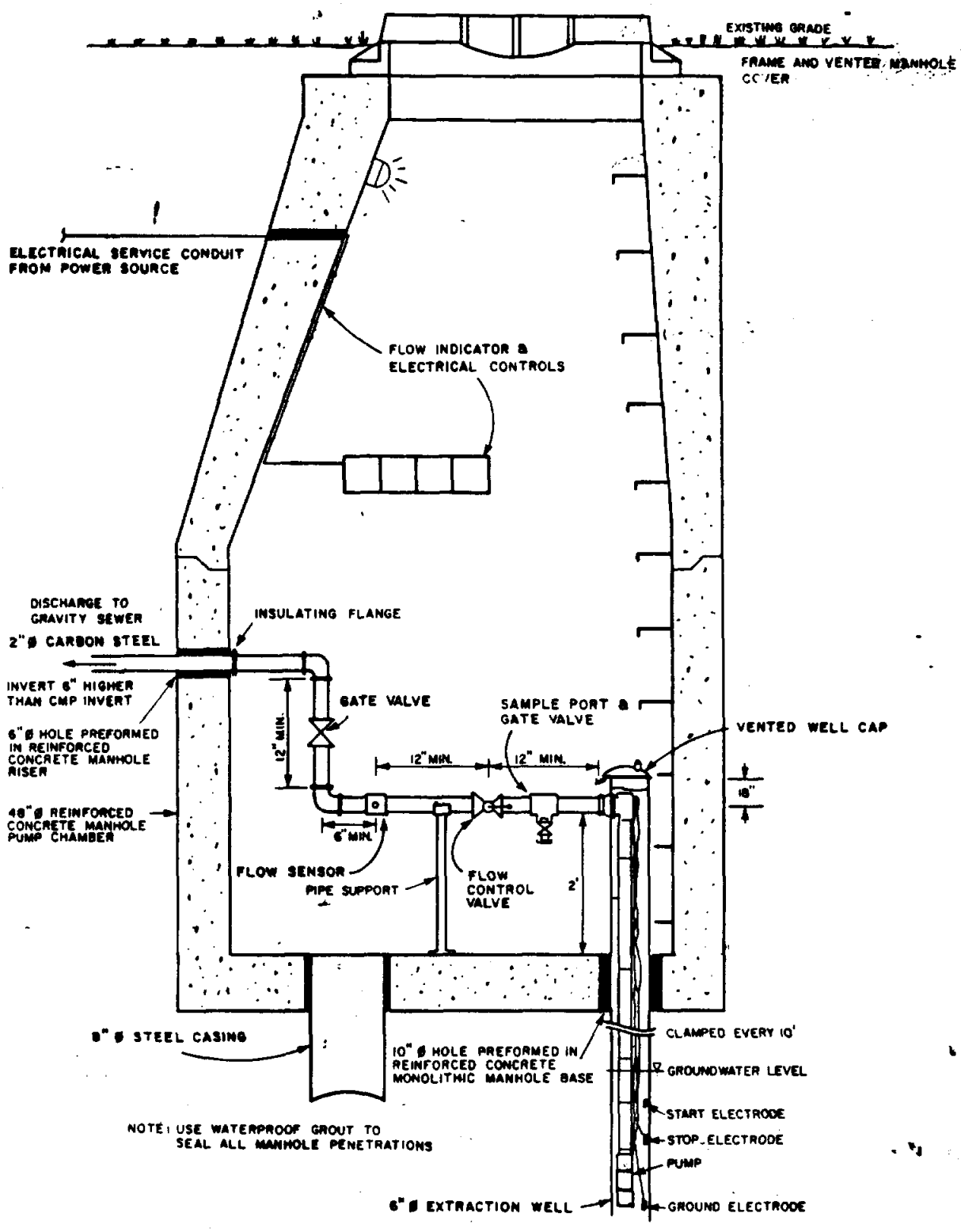

figure 8

EXTRACTION WELL CHAMBER DETAIL

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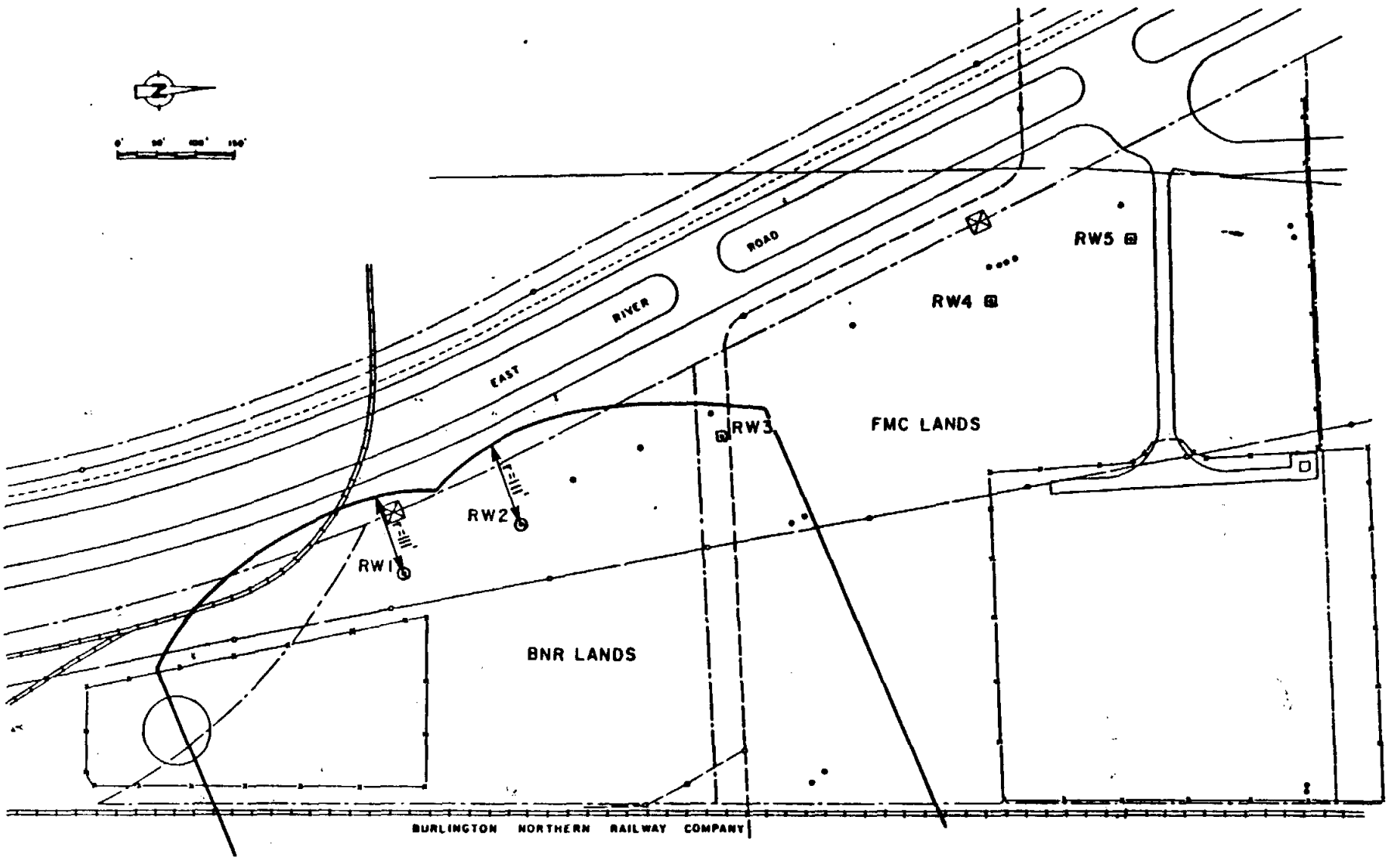

LEGEND

- ⊙ SURFICIAL AQUIFER EXTRACTION WELL
- ⊡ CONFINED AQUIFER EXTRACTION WELL
- • EXISTING GROUNDWATER MONITORING WELLS

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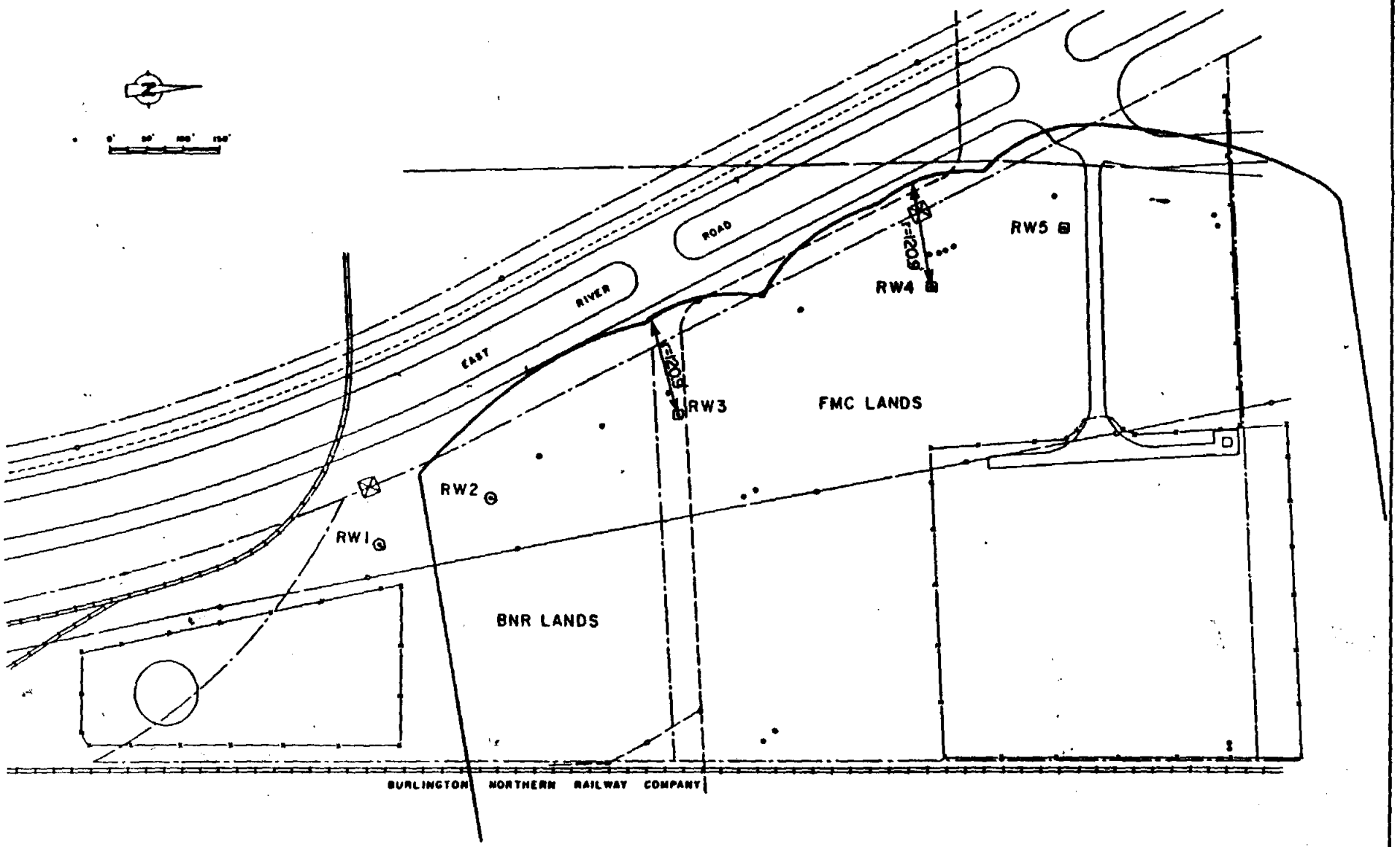
figure 9

SURFICIAL AQUIFER
EXTRACTION WELL CAPTURE ZONES
FMC Northern Ordnance Plant

1518-20 - 16/06/86



LEGEND

- ⊙ SURFICIAL AQUIFER EXTRACTION WELL
- ⊡ CONFINED AQUIFER EXTRACTION WELL
- • EXISTING GROUNDWATER MONITORING WELLS

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figure 10

CONFINED AQUIFER
EXTRACTION WELL CAPTURE ZONES
FMC Northern Ordnance Plant

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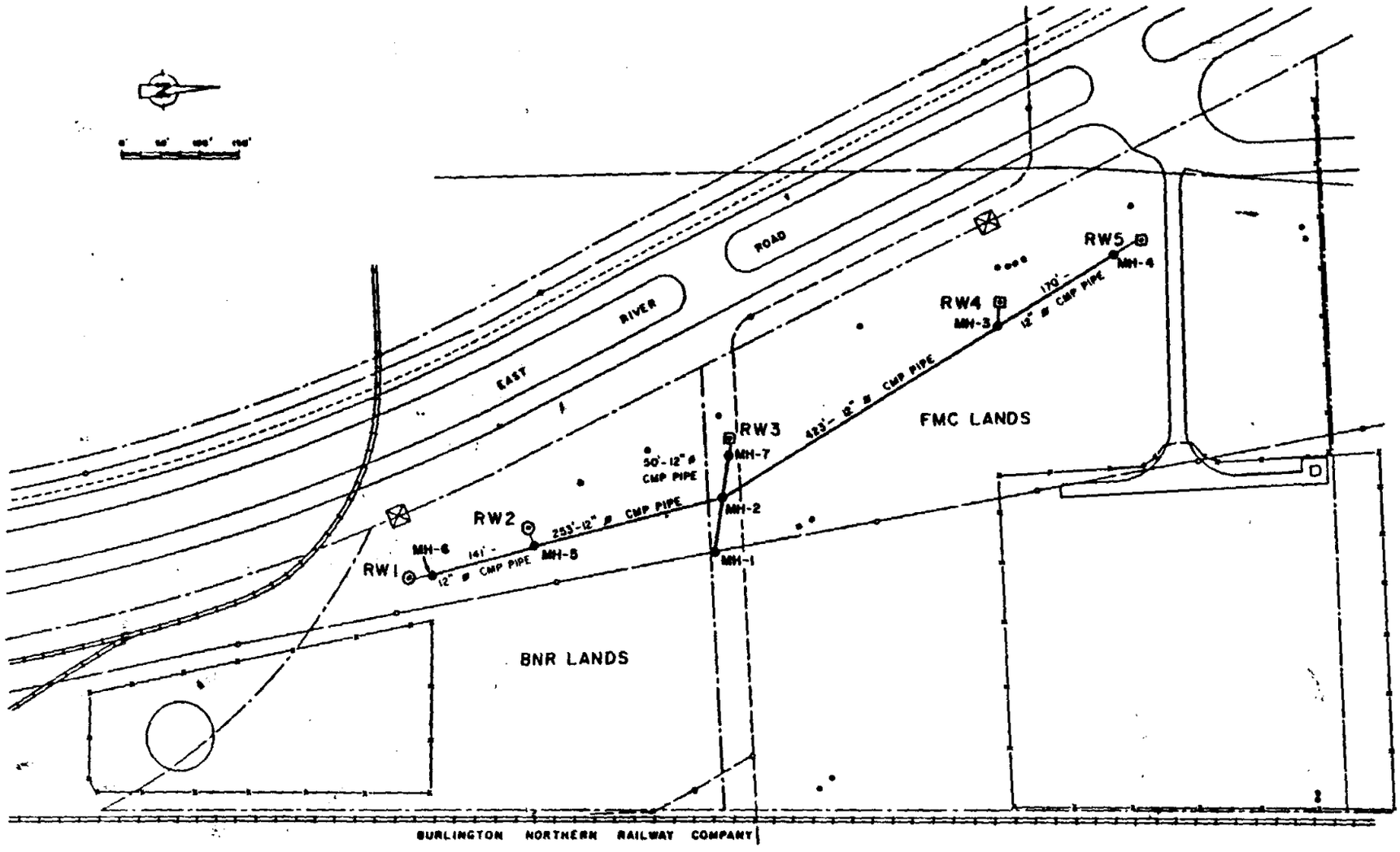
The 20 gpm removal rate at each extraction well will lead to the removal of approximately 7.6 to 10 pore volumes per year from the capture zones for the two surficial aquifer wells, and 1.5 pore volumes per year for the confined aquifer wells. Discussion of the system operation is presented in Section 6.0.

Pumping rates provided herein will be confirmed by field pumping tests conducted on the installed extraction wells. Pumping tests will be adjusted as necessary on the basis of field test data, following review and approval by MPCA.

4.3 COLLECTION AND DISCHARGE SYSTEM

The groundwater extracted by the pumping system described in Section 4.2 will flow by gravity from the pump chambers through a network of corrugated metal pipe (CMP) sewers constructed with watertight joints as shown on Figure 11. Manhole chambers will be constructed at each discharge point from the well pump chambers and at each confluence of two or more lines. Grades and elevations of each collection sewer segment are detailed on Figures 12 and 13. The discharge from each extraction well will be directed to a single effluent discharge point into the 15-inch diameter sanitary sewer line which traverses the Site from



LEGEND

- ⊙ SURFICIAL AQUIFER EXTRACTION WELL
- ⊡ CONFINED AQUIFER EXTRACTION WELL
- • EXISTING GROUNDWATER MONITORING WELLS
- ——• GRAVITY DRAIN DISCHARGE LINE

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figure 11

GROUNDWATER DISCHARGE SYSTEM

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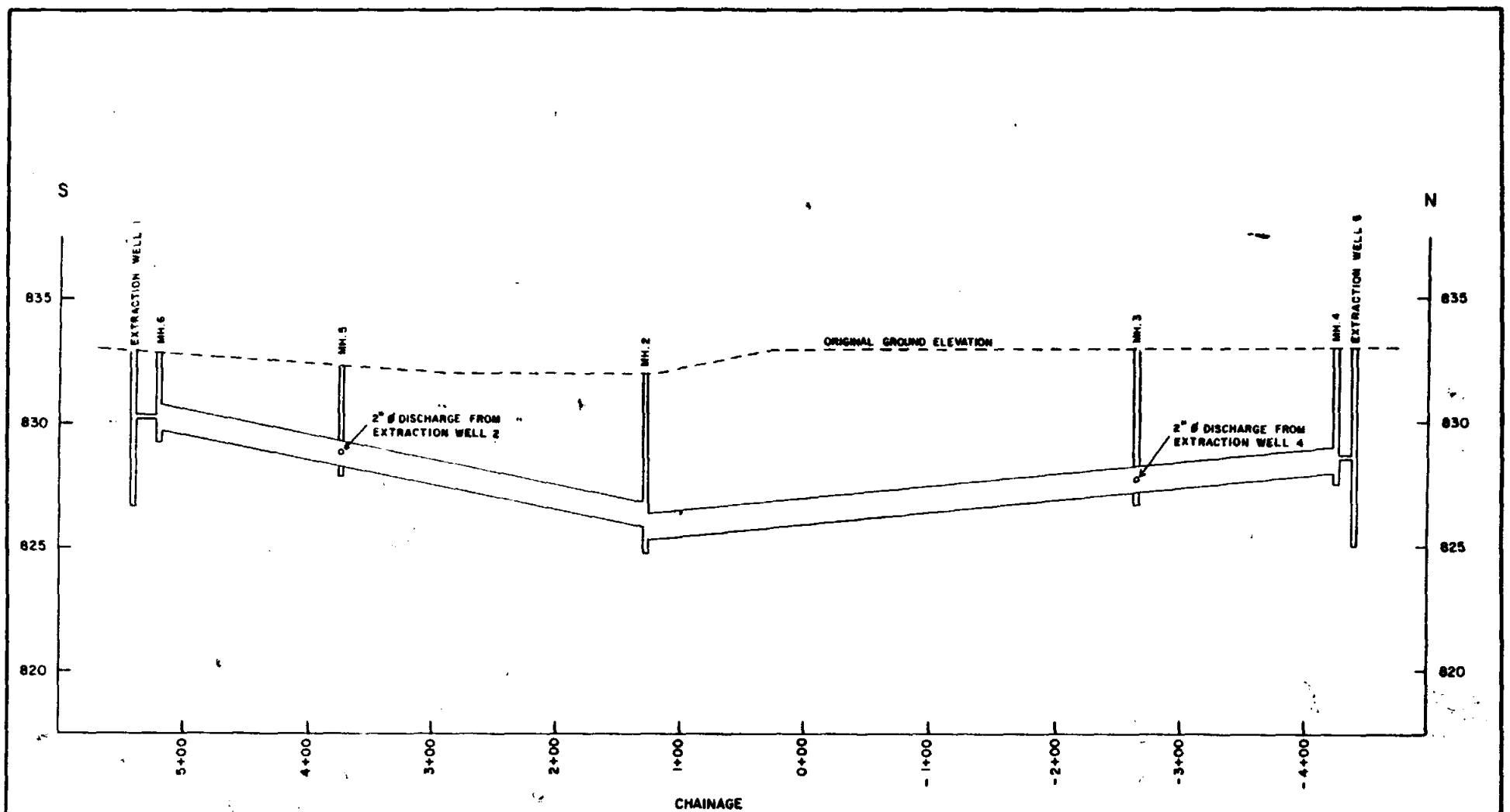

figure 12

GROUNDWATER DISCHARGE SYSTEM PROFILE
NORTH – SOUTH LINE
FMC Northern Ordnance Plant

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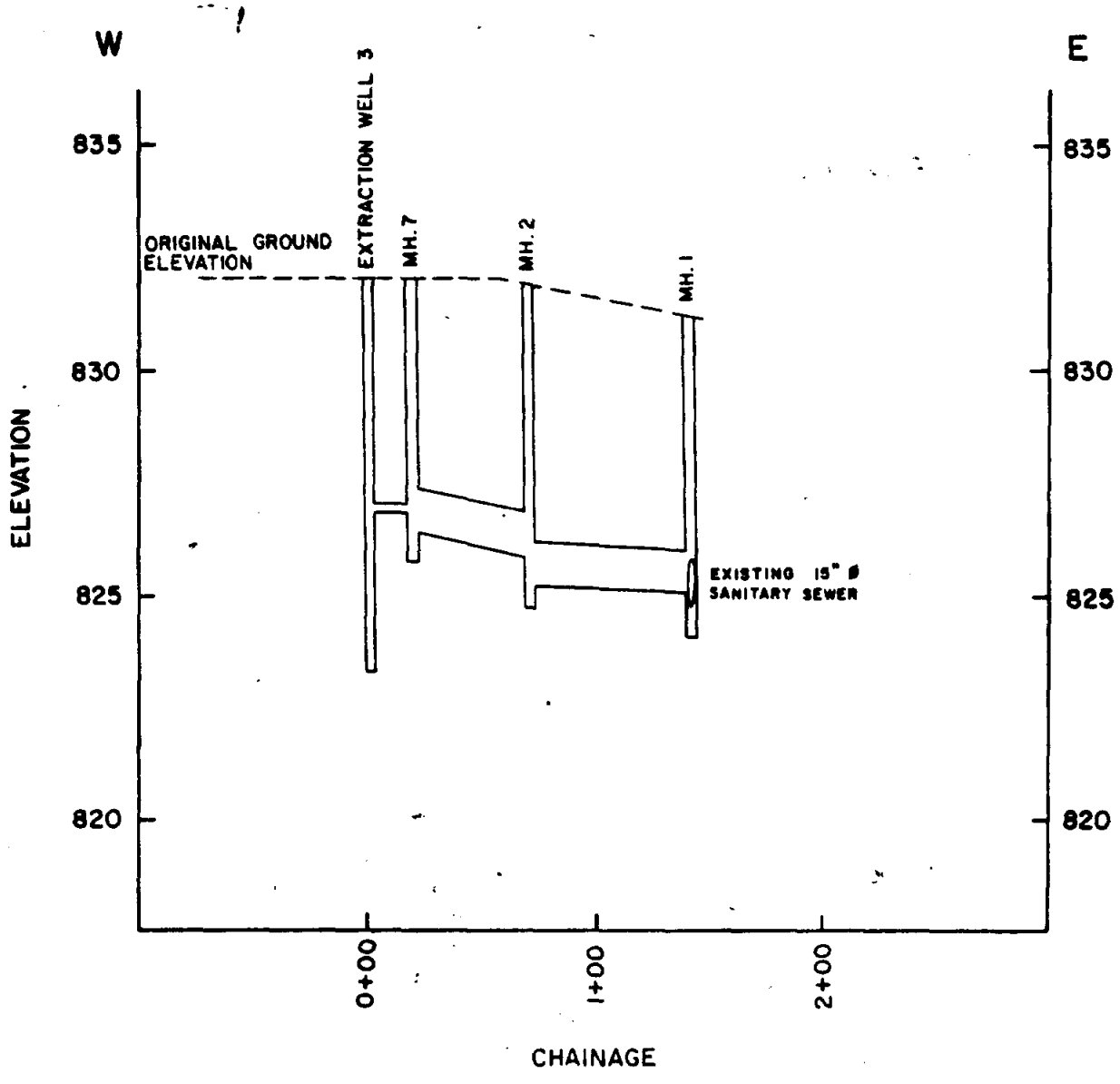

figure 13

GROUNDWATER DISCHARGE SYSTEM PROFILE
EAST–WEST LINE
FMC Northern Ordnance Plant

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north to south. The discharge will be at an existing manhole immediately north of the southern boundary of the FMC lands.

During the initial period of system operations, it is estimated that the maximum TCE concentration in discharged groundwater will not exceed 15 ppm. It is anticipated that TCE concentrations in discharge groundwater will show a rapid and continuous decline over time.

Discharge flows of extracted groundwater to the sanitary sewer will be controlled during times of high flow upstream of the discharge point to ensure that the total flow does not exceed the maximum allowable flow dictated by the hydraulic capacity of the sewer and the Metropolitan Waste Control Commission (MWCC). Discharge to the sewer upstream of the proposed discharge point from the extraction system is exclusively from the FMC Northern Ordnance Division plant north of the Site. Discharge rates into the sanitary sewer measured at the NOD plant over the last few years indicate that the sanitary sewer has the capacity to handle maximum flows from the FMC plant combined with the design flows from the groundwater extraction system.

In the event that FMC must temporarily reduce discharge rates to the sewer, FMC shall, as soon as possible, temporarily increase pump-out rate to compensate for the reduced pump-out rate.

4.4 MONITORING PROGRAM

Monitoring at the Site will require implementation of three individual programs:

i) A program for monitoring (VOC concentration and flow rate) extracted groundwater as it is removed from each of Wells RW1, and RW2 and RW3 and for monitoring the total flow discharged to the sanitary sewer for the duration of system operation.

ii) A monitoring program to confirm the hydraulic containment of the surficial and confined aquifers at the Site for the duration of system operation.

iii) Monitoring of confined wells (to be installed) downgradient of Wells 14 to 30 and existing wells 45 and 51.

4.4.1 Extracted Groundwater Monitoring

Extracted groundwater will be monitored to determine flow rate and contaminant concentration. Flow meters will be located at each well head for the duration of system operation. Effluent discharge flow rate at the FMC Northern Ordnance Division plant will be monitored and recorded on a daily basis.

Sampling and analysis of extracted groundwater will take place bi-weekly for the first three months of system operation, monthly for the following three months, and quarterly thereafter until groundwater extraction is complete. Groundwater samples will be collected at each extraction well using the sampling port in the well chamber manhole. Combined discharge samples will be collected at the effluent discharge manhole junction at the MWCC sanitary sewer. As requested by the MWCC, collected samples will be analyzed for priority pollutant volatile organics using USEPA Method 624 for the first three months of operation. A revised list of parameters will be determined for analyses for subsequent rounds based on the VOC concentrations and constituents detected in the initial three month sampling program.

4.4.2 Hydraulic Containment Monitoring

Hydraulic containment monitoring will consist of collection of water level data from bundle piezometers and existing monitoring wells. Existing monitoring wells have been chosen such that maintenance of the inward gradients can be confirmed. Figure 14 presents the hydraulic monitoring piezometer and well network.

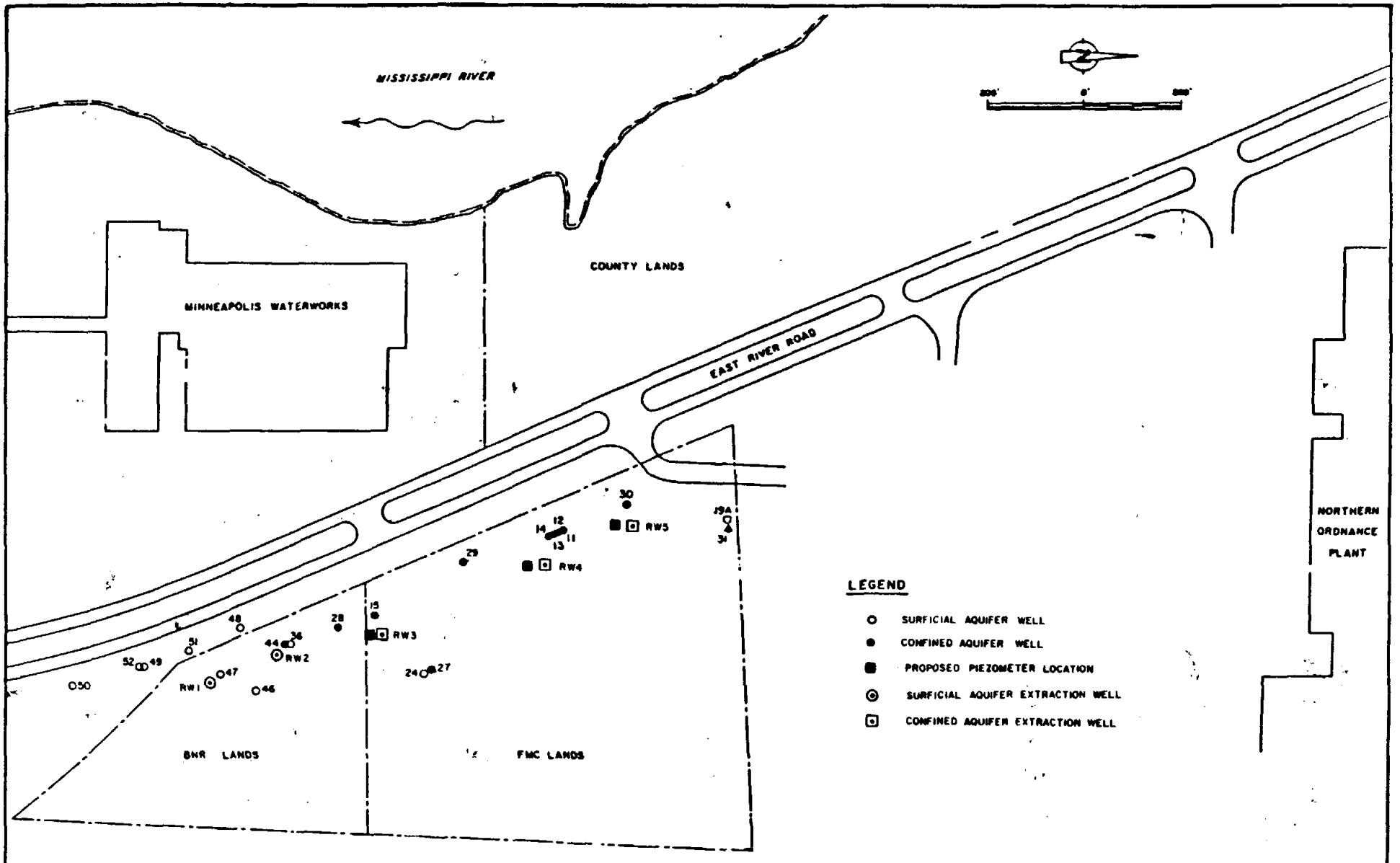

figure 14

HYDRAULIC CONTAINMENT MONITORING LOCATIONS

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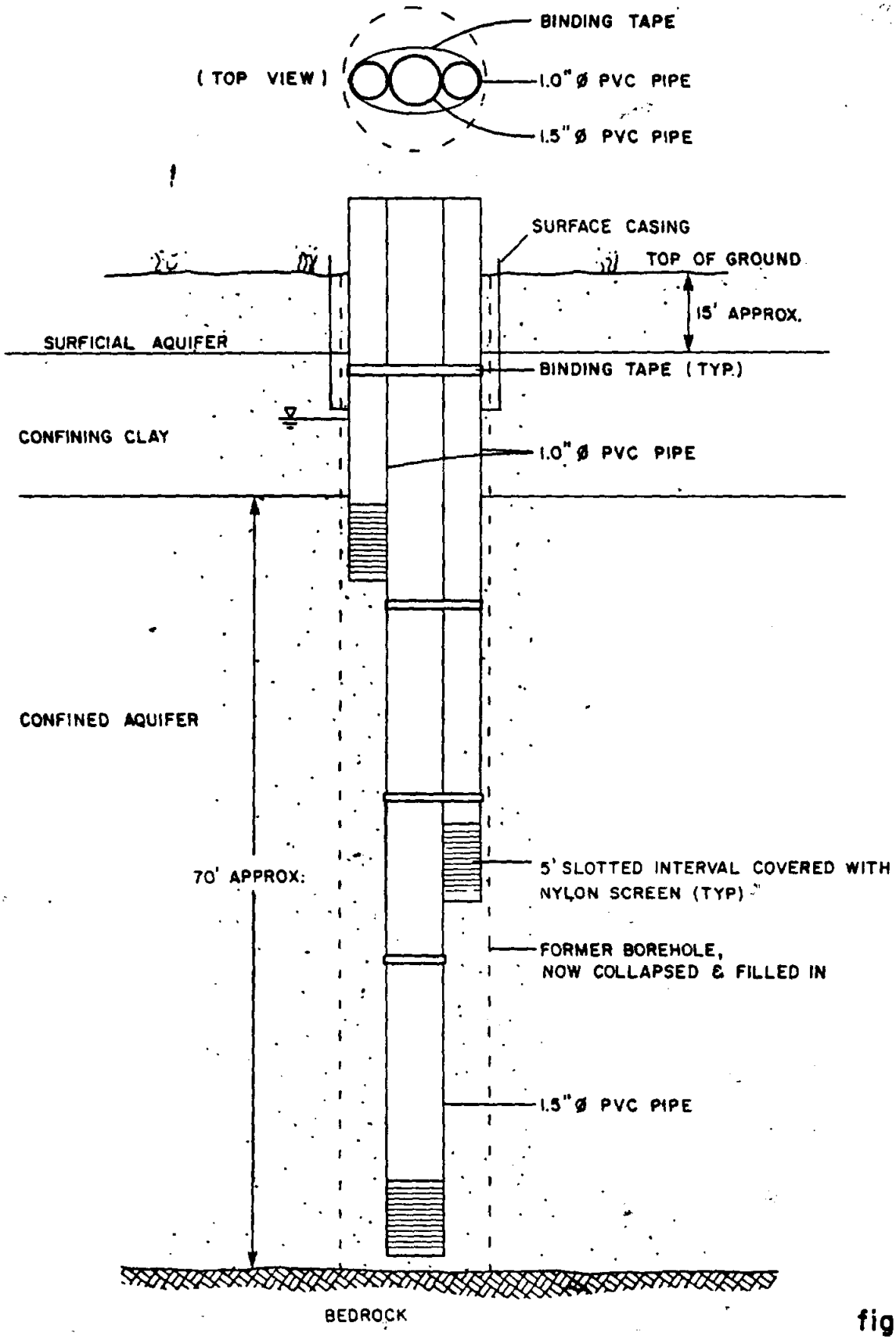
Bundle piezometers will be installed to provide water level data (i.e. vertical flow gradients) from which a periodic assessment of hydrogeologic changes within the aquifer can be made. The hydraulic effectiveness of the recovery well system will then be known, and modifications to the individual well pumping rates can be made, if necessary. Locations of bundle piezometer installations are shown in Figure 14. Figure 15 illustrates construction and installation details of the bundle peizometers.

Water levels will be measured at bi-weekly intervals for the first year of operation and at monthly intervals thereafter. Following any significant modification of the extraction system, or if water levels at one or more points in the monitoring network are unstable, the frequency of water level measurement will be returned to bi-weekly intervals at the locations in question.

4.4.3 Groundwater Monitoring

Groundwater monitoring of the confined aquifer downgradient of the Well 14 - 30 area, downgradient of the well 15 area and near the discharge point of the shallow unconfined aquifer on the BNR lands will be conducted for a minimum of five years following system operation shutdown at extraction wells RW-4 and RW-5. The monitoring



N.T.S.

figure 15

TYPICAL BUNDLE PIEZOMETER INSTALLATION

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wells used in this program will include two new wells to be installed at the locations shown on Figure 16. The new monitoring wells will be constructed as 4-inch diameter wells with stainless steel screens. The entire depth of the aquifer will be screened. Figure 17 illustrates the construction details for the proposed monitoring wells.

All wells will be sampled annually for a period of five years following system operation shut down at extraction wells RW-4 and RW-5. Annual evaluation and monitoring reports shall be submitted to the MPCA Director. After five years of monitoring, FMC may propose changes in the monitoring program, including termination of the monitoring program, in the annual report. Samples collected at the termination of groundwater extraction shall be analyzed for priority pollutant volatile organics. A parameter list for post extraction shutdown monitoring will be developed by FMC and submitted to the MPCA for approval at that time.

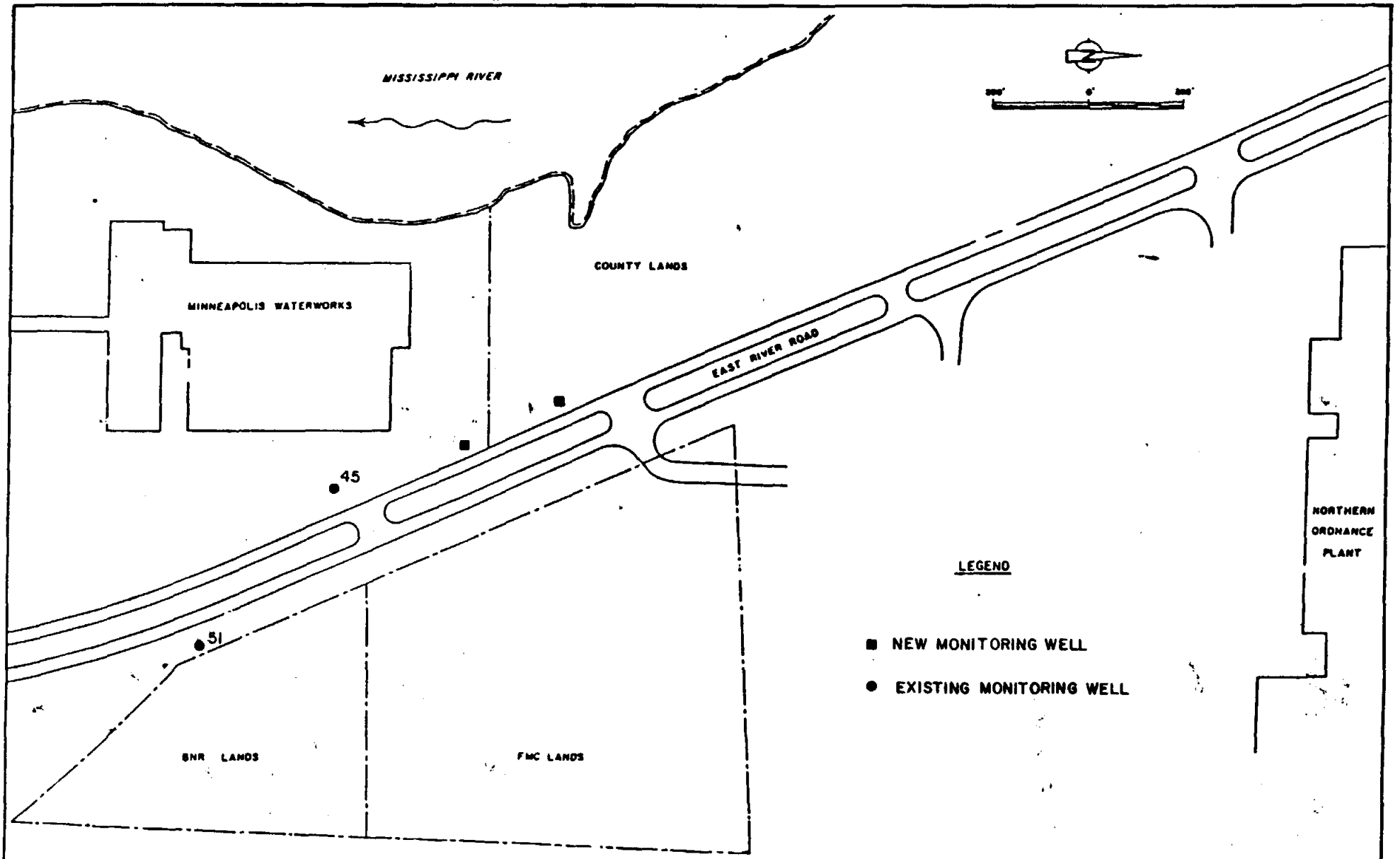

figure 16

LONG-TERM MONITORING WELL LOCATIONS

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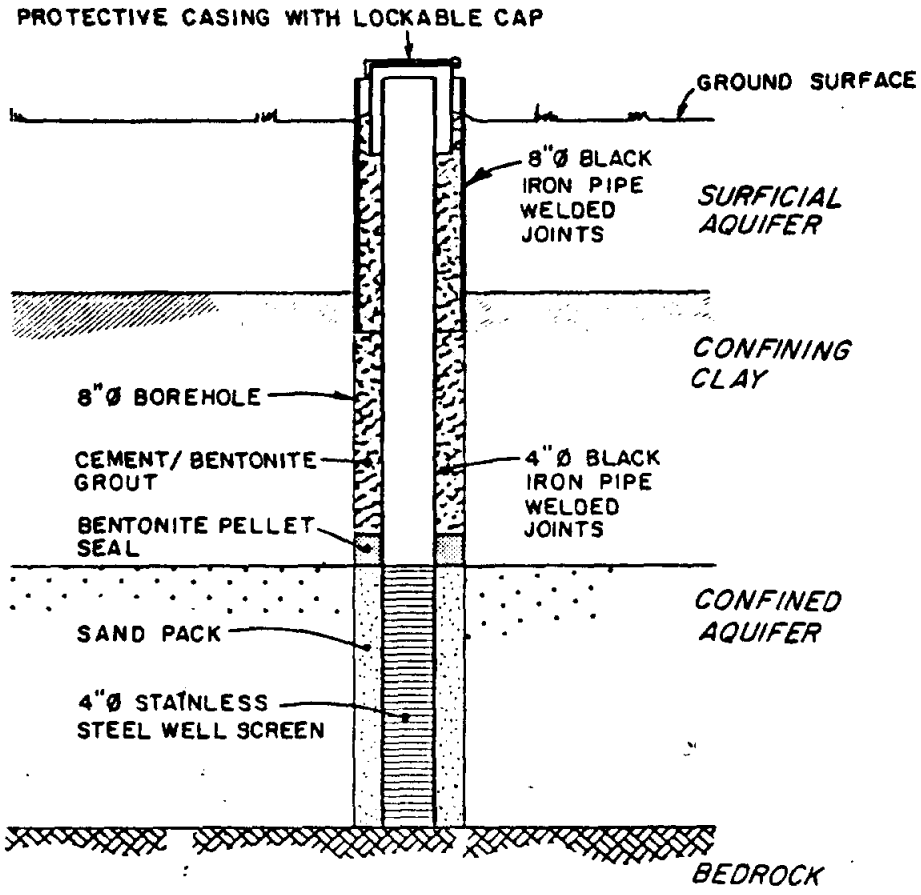

figure 17

PROPOSED MONITORING WELL INSTALLATION

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5.0 PERMITS AND AGREEMENTS

Prior to commencement of the response action at the Site, attainment of the following agreements will be required;

i) Minnesota Department of Health approval for all extraction and monitoring well installations;

ii) a discharge agreement with the MWCC for discharging groundwater to the 15-inch diameter sanitary sewer at the Site;

iii) an access agreement with the Burlington Northern Railway for work to be performed on BNR lands;

iv) an access agreement with Anoka County for installation of the monitoring wells west of East River Road; and

v) Minnesota Department of Natural Resources groundwater appropriation permit.

If, through no fault of FMC, attainment of any of the agreements detailed above are delayed or not completed, the MPCA shall grant an appropriate extension of time and shall assist FMC in the attainment of the specified agreements or in the attainment of alternate agreements acceptable to FMC.

6.0 DURATION OF SYSTEM OPERATION

The design of the proposed groundwater extraction system is based on several assumptions concerning the behavior of contaminants in a hydrogeologic environment. Monitoring data may indicate that , from time to time, adjustments are required to optimize the performance and efficiency of the system. Such adjustments to the system will be determined by FMC and may include the addition of or the removal from service of extraction wells and changes to the well extraction rates. To provide a basis for any adjustments that may be required, water-level and water-quality data obtained under the regular monitoring schedule and from special sampling events will be evaluated periodically.

All groundwater extraction wells will operate for minimum period of two years. If the TCE concentration performance criterion has not been achieved at Wells RW-1 and RW-2, or at Well RW-3 at the end of two years, groundwater extraction will continue from the well or wells in which the concentration level has not been achieved for the relevant aquifers.

a) The TCE concentration criterion of 270 ppb is achieved for three consecutive quarters; or

b) The TCE concentrations is effectively constant and the average TCE concentration in the non-complying aquifer at the down gradient Site boundary is 270 ppb or less; or

c) Groundwater extraction has proceeded for a period of five years and a health-risk based assessment of the actual or potential impact of contaminants remaining in the non-compliance area(s) conducted at that time indicates that there is less than a 10^{-6} risk to actual receptors or receptors for which there is an adopted implementation or use schedule.

What about AW-3. why?

Groundwater extraction at Wells RW-4 and RW-5 will be considered completed at the time that groundwater extraction at wells RW-1 and RW-2 ceases.

The determination of whether the concentration of TCE within the aquifers has become effectively constant will be made on Wells RW1 and RW2 on BNR lands, and Well RW3 on FMC lands. The determination of whether the concentration at a well is effectively constant will be made as follows:

i) Samples will be taken at the locations and frequencies stated in Section 4.1.1.

ii) Data from the 12 most recent samples will be plotted.

iii) If the curve suggested by these data is linear, then a straight line using a least squares regression model will be fitted to the data and the slope of the fitted curve will be computed as the estimated slope.

iv) If the data suggests a non-linear form, then an exponential curve being a least squares regression model will be fitted to the data. The estimated slope will be the first derivative of the curve at a value of time half way between the last two datum points.

v) The estimated slope shall be deemed to be zero if (a) the slope is less than or equal to zero and greater than or equal to negative 0.025 ppm/year, and (b) the rate of change of that slope is equal to zero or indicates a continuously decreasing concentration.

vi) The concentration at a well will be deemed to be effectively constant if the estimated slope is deemed to be zero.

7.0 QUALITY ASSURANCE PROJECT PLAN

A Quality Assurance Project Plan (QAPP) will be prepared in conjunction with the remedial design for response action at the Site. This QAPP will be implemented for the duration of the response action and during the long-term monitoring program, and will be submitted to MPCA as part of the detailed specifications provided for in Section 8 below. The QAPP will be consistent with the intent and stated goals of the Interim Guidelines and Specification for preparing Quality Assurance Project Plans (QAM-005/80) prepared by the USEPA.

8.0 DETAILED SPECIFICATIONS AND WORKING DRAWINGS

Detailed specifications and working drawings for the response action to be implemented will be prepared and submitted to MPCA within 30 days of the MPCA approval of this Response Action Plan.

9.0 HEALTH, SAFETY AND PERSONNEL HYGIENE

A stringent health, safety and personnel hygiene program will be enforced during implementation of the Plan to protect on-site workers, the general public and the environment at large. This program, to be submitted as a portion of the detailed specifications described in Section 8.0, will address the following areas:

i) Entry and exit medical surveillance for on-site staff;

ii) Site personnel training;

iii) Respiratory protection;

iv) Work zone ambient air monitoring;

v) Delineation of uncontaminated and potentially contaminated areas;

vi) Prevention of contaminant migration;

vii) Decontamination of personnel, materials and equipment;

viii) Security

ix) Contingency planning.