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**FMC** NORTHERN ORDNANCE DIVISION  
MINNEAPOLIS

**DESIGN & CONSTRUCTION**  
**Upgradient Monitoring Well MW5**  
FMC Northern Ordnance Division  
Fridley, Minnesota

**FMC Corporation**

Northern Ordnance Division  
4800 East River Road  
Minneapolis, Minnesota 55421  
612 571 9201 Telex 29 0432

3 January 1984  
E285-818.8a

**FMC**

CERTIFIED MAIL  
RETURN RECEIPT REQUESTED

P 272 157 459

Dale Wikre, Director  
Solid & Hazardous Waste Division  
Minnesota Pollution Control Agency  
1935 West County Road B2  
Roseville, MN 55113

Attention: Site Response Section

Director, Waste Management Division  
U.S. EPA Region V  
230 South Dearborn Street  
Chicago, IL 60604

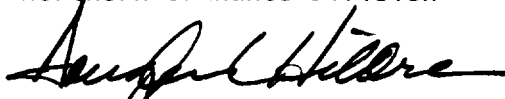
Attention: Remedial Response Branch

Subject:  
Upgradient Monitoring Well Installation Report

Dear Sirs:

Enclosed is the report entitled "Design and Construction Upgradient Monitoring Well MW5" as required under the Groundwater Protection Program pursuant to the Administrative Order and Interim Response Order by Consent between FMC, the Minnesota Pollution Control Agency, and the U. S. Environmental Protection Agency.

FMC CORPORATION  
Northern Ordnance Division



Douglas L. Hildre, PE  
Sr. Environmental Engineer

cc: W. E. Flynn-O & H  
E. B. Frost-K & E  
D. T. Richfield-MPCA w/o encl.  
N. Niedergang-EPA V w/o encl.

encl.

ds

**FMC** NORTHERN ORDNANCE DIVISION  
MINNEAPOLIS

**DESIGN & CONSTRUCTION**  
**Upgradient Monitoring Well MW5**  
**FMC Northern Ordnance Division**  
**Fridley, Minnesota**

**December 1984**  
**Ref. No. 1085-34**

**CONESTOGA-ROVERS & ASSOCIATES LIMITED**

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## 1.0 INTRODUCTION

On June 8, 1983 an Administrative Order and Interim Response Order by Consent (Consent Order) was signed by FMC Corporation (FMC), the United States Environmental Protection Agency, Region V (USEPA), and the Minnesota Pollution Control Agency (MPCA). In accordance with the terms of the Consent Order, FMC prepared and submitted a groundwater protection plan to the USEPA and MPCA. The groundwater protection program required the installation of a groundwater monitoring well network with monitoring wells located hydraulically upgradient of a containment and treatment facility constructed pursuant to the Consent Order.

This report presents the design and construction details for an upgradient monitoring well installed on FMC owned property.

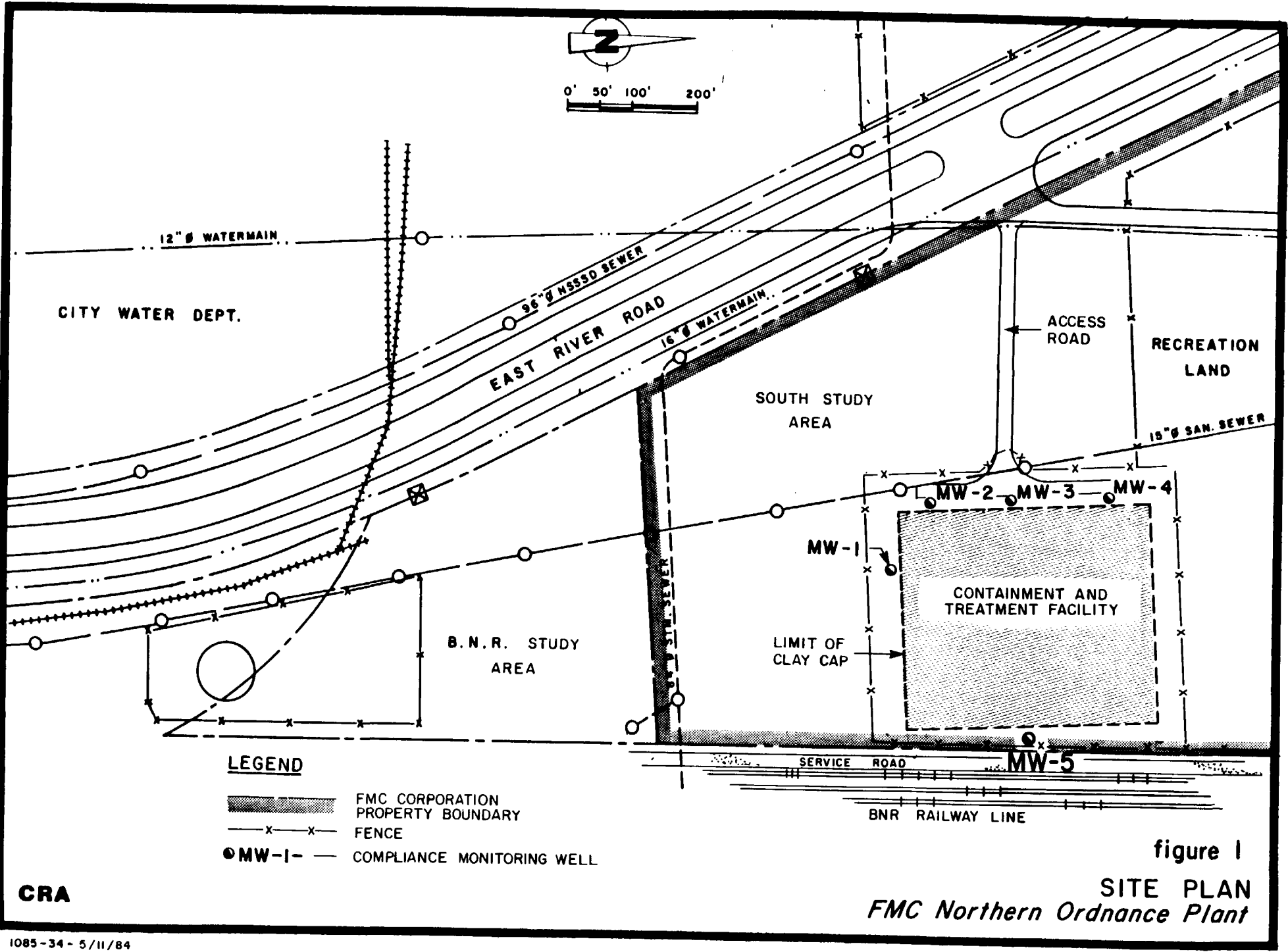
## 2.0 MONITORING WELL DESIGN AND INSTALLATION

### 2.1 WELL LOCATION


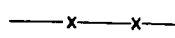
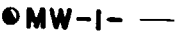
FMC has located one upgradient monitoring well (MW-5) within FMC owned property adjacent to the easterly boundary of the containment and treatment facility. Previous and ongoing groundwater monitoring programs have identified the selected location to be hydraulically upgradient from the FMC containment and treatment facility and, in combination with a second proposed monitoring well to be located in the BNR Marshalling yard, suitably positioned for providing groundwater quality and flow data in accordance with the requirements of the Consent Order. Figure 1 presents the general site location. Figure 2 illustrates the location of the installed monitoring well.

### 2.2 REGULATIONS FOR DESIGN AND INSTALLATION

The upgradient monitoring well was designed and installed in accordance with Standard for General Protection of Groundwater Quality and Resources as detailed in 7 MCAR 1.210 - 1.224 of the rules and regulations of the Minnesota Department of Health (MDH) and the MPCA draft guidelines entitled "Procedures for Groundwater Monitoring", July 1983. The design and location of the well was approved by the MPCA prior to installation.



**LEGEND**

-  FMC CORPORATION PROPERTY BOUNDARY
-  FENCE
-  MW-1- COMPLIANCE MONITORING WELL

**CRA**

**figure 1**  
**SITE PLAN**  
*FMC Northern Ordnance Plant*



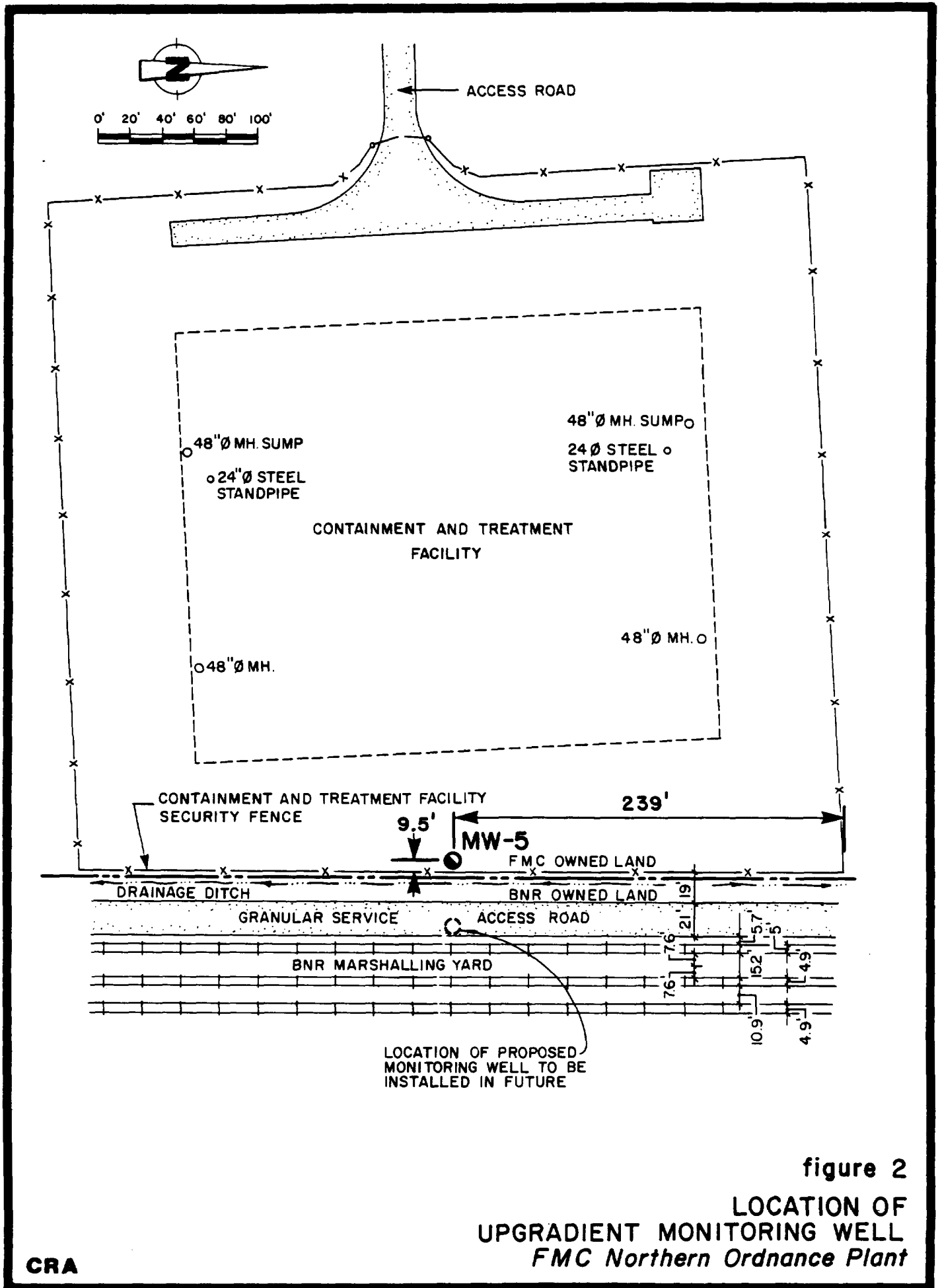


figure 2  
 LOCATION OF  
 UPGRADE MONITORING WELL  
 FMC Northern Ordnance Plant

CRA

## 2.3 MONITORING WELL INSTALLATION

### 2.3.1 General

Monitoring well MW-5 was installed during the period October 15 to October 18, 1984.

### 2.3.2 Split Spoon Sampling

Prior to well installation, FMC conducted split spoon sampling at the proposed well location. Soil samples were collected at 5-foot intervals from the ground surface to a depth of 45 feet, at which point bedrock was encountered. The split spoon sample obtained at the 45-foot depth contained white weathered sandstone. The presence of bedrock was confirmed by drilling testholes 15 feet north and 15 feet south of the well location. Refusal was encountered in the north and south testhole at 40'-3" and 47 feet, respectively. Following completion of the boreholes, cuttings were collected and disposed of on FMC property. The testholes were backfilled with cement bentonite grout.

A truck mounted drill rig equipped with 6-inch diameter hollow stem augers (3.75-inch diameter annulus) was used to advance the borehole at the well location to the desired sampling depths. Stainless steel

3-inch diameter split spoon sampling tools, driven with a 140-pound hammer dropped through a distance of 30 inches was used to obtain samples between the bedrock and existing ground. FMC retained geologic record samples for the full depth of the borehole at 5-foot intervals. The borehole log is presented within Appendix A.

Upon completion of sampling, the borehole was left open pending installation of the monitoring well.

### 2.3.3 Installation

Monitoring well MW-5 was installed through the annulus in the borehole from which split spoon samples were collected following reaugering of the 6-inch diameter borehole with 8-inch diameter augers. Bentonite slurry drilling fluid was utilized to maintain the borehole. Four-inch diameter threaded and coupled galvanized steel pipe was used as a riser. A 20-foot long Johnson 4-inch diameter stainless steel well screen was installed with the base of the screen in contact with the bedrock. The screen was threaded to the riser pipe. A No. 10 slot size for the well screen was selected on the basis of grain size analysis of soil sample selected from the saturated zone. The grain size distribution analysis is presented in Appendix B. Subsequent to screen installation, the annular space was packed with

silica sand and the native soils were allowed to collapse around it.

The annular space between the riser casing above the screen and the borehole wall was backfilled with a bentonite plug for a distance of two feet above the screen. The remaining annular void was backfilled to ground surface with a portland cement having 3-percent bentonite grout added using positive displacement methods. These procedures will seal the annular space above the groundwater sampling zone, preventing contamination from exterior sources.

Three steel, concrete filled well barriers were installed around the well in accordance with the regulations.

Drill cuttings were contained to the immediate vicinity of the well. Following well installation, cuttings were collected and disposed of on FMC property.

Figure 3 illustrates the as-constructed well installation. Appendix C contains the well driller's log for the completed well.

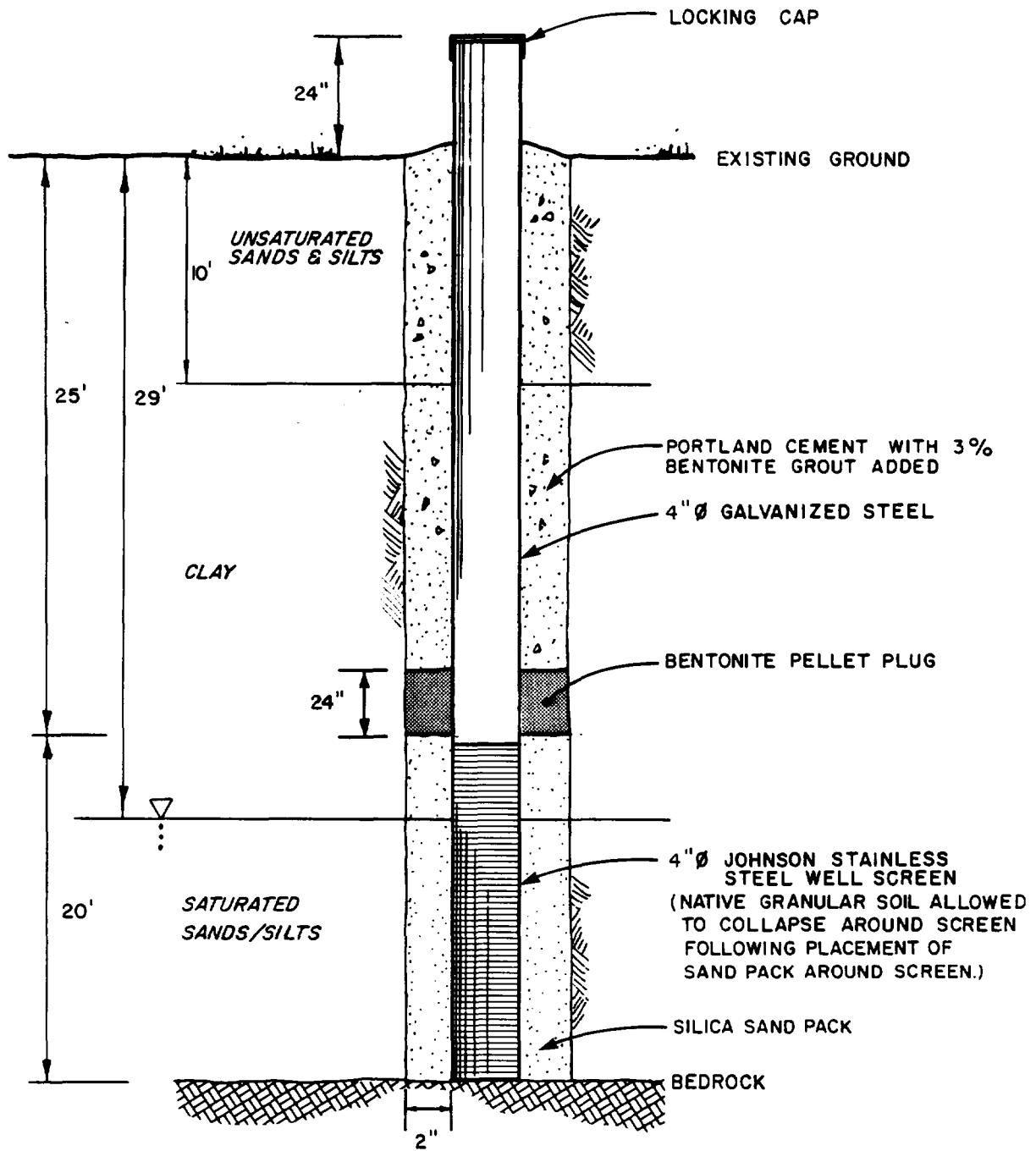


figure 3  
 MW-5 WELL CONSTRUCTION DETAILS  
 FMC Northern Ordnance Plant

#### 2.3.4 Well Development

The well was developed by pumping with a 2-inch diameter electric submersible pump. The well was developed in accordance with "Procedures for Groundwater Monitoring; MPCA Draft Guidelines" which use pH, temperature and conductance to confirm well stabilization. Table 1 presents the well stabilization data.

#### 2.3.5 Survey

Following installation, the monitoring well MW-5 was field surveyed for location and elevation. The top of the riser pipe was determined to be at an elevation of 838.54. The horizontal location was determined to be 415.76 feet left of baseline station 3+79.07, and approximately 239 feet south of the northeast corner of the containment and treatment facility boundary fence.

All of Which is Respectfully Submitted  
CONESTOGA-ROVERS & ASSOCIATES LIMITED

Don Robinson

Richard G. Shepherd, P. Eng.

TABLE 1

WELL MW-5 STABILIZATION DATA

<u>Time</u>	<u>Conductivity</u>	<u>pH</u>	<u>Temperature</u>	<u>Gallons</u>
3.45	480	7.4	11°C	5
3.50	480	7.6	11°C	10
3.55	480	7.7	10°C	15
3.59	480	7.7	10°C	20
4.03	1000	7.3	10°C	25
4.07	1000	7.1	11°C	30
4.11	1000	7.2	11°C	35
4.17	1100	7.0	11°C	40
4.22	1200	7.1	11°C	45
4.27	1200	7.1	11°C	50
4.31	1200	7.1	11°C	55
4.36	1200	7.1	11°C	60

APPENDIX A

MW-5 BOREHOLE LOG





PROJECT:  
 Number 82-361  
 Location New Brighton FMC  
 Client CRA

BORING:  
 Number \_\_\_\_\_ Surf. Elev. \_\_\_\_\_  
 Location \_\_\_\_\_

DEPTH	BPF	SAMPLE	ASTM	ADJ.	CL	GRAIN SIZE	INCLUSIONS	COLOR	BPF	MOIST.	CONS.	GEOL.
1						SILTY SAND, fine to medium-grained, with a trace of fine to medium Gravel, black, moist.						
2						SAND, fine to medium-grained, brown, moist.						
3						SILTY SAND, fine to medium-grained, dark brown, moist.						
4												
5	11	1				SAND, fine to medium-grained, with a trace of fine Gravel, waterbearing.						
6	11											
7												
8												
9												
10	5	2				SANDY CLAY, medium plasticity, gray, moist.						
11	9											
12												
13												
14												
15	8	3										
16	14	3" Samples										
17												
18												
19												
20	10	4										
21	13											
22												
23												
24												
25	7	5										
26	8											
27												
28												
29												
30	5	6										

751	DATE	TIME	W.L. CHECKS	DATE	TIME	DEPTH/AUGER
BR START	10-15-84		While Drilling			/
SR FINISH	10-15-84		After Last Sample			29' WL / 45'
In BPF column, please show DEPTH BACKFILL			Auger Pulled			5' WL
Recheck						
MARKS:						Toosoil Depth



OBJECT:  
 Number 82-361  
 Location New Brighton FMC  
 Client CRA

BORING:  
 Number \_\_\_\_\_ Surf. Elev. \_\_\_\_\_  
 Location \_\_\_\_\_

DEPTH	BPF	SAMPLE	ASTM	ADJ.	CL	GRAIN SIZE	INCLUSIONS	COLOR	BPF	MOIST.	CONS.	GEOL.
31												
32												
33												
34												
35	6	7					SLIGHTLY SILTY SAND, fine to medium-grained, brown, waterbearing.					
36	6											
37												
38												
39												
40	5	8					SLIGHTLY SILTY SAND, fine to medium-grained, sandstone weathered, brownish white, waterbearing.					
41	5											
42												
43												
44												
45	28	9					SAND, fine to medium-grained, with a trace of fine to medium Gravel, brown, waterbearing.					
46	100-3"											
47							REFUSAL at 45.5'.					
48												
49												
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

751	DATE	TIME	W. L. CHECKS	DATE	TIME	DEPTH/AUGER
BR	START	10-15-84	While Drilling			/
SR	FINISH	10-15-84	After Last Sample			/
In BPF column, please show depths between which jetting is used			DEPTH	BACKFILL	Auger Pulled	
					Recheck	
MARKS:						Toosoil Death

APPENDIX B

GRAIN SIZE ANALYSIS

DRILLER BRAUN ENGINEERING TESTING, INC.  
MINNEAPOLIS, MINNESOTA

ENGINEER

ANALYSIS BY ALBERT J. SMITH  
DATE 15 OCTOBER, 1984

JOB NAME FMC, PROJECT 82-361  
LOCATION FRIDLEY, MINNESOTA

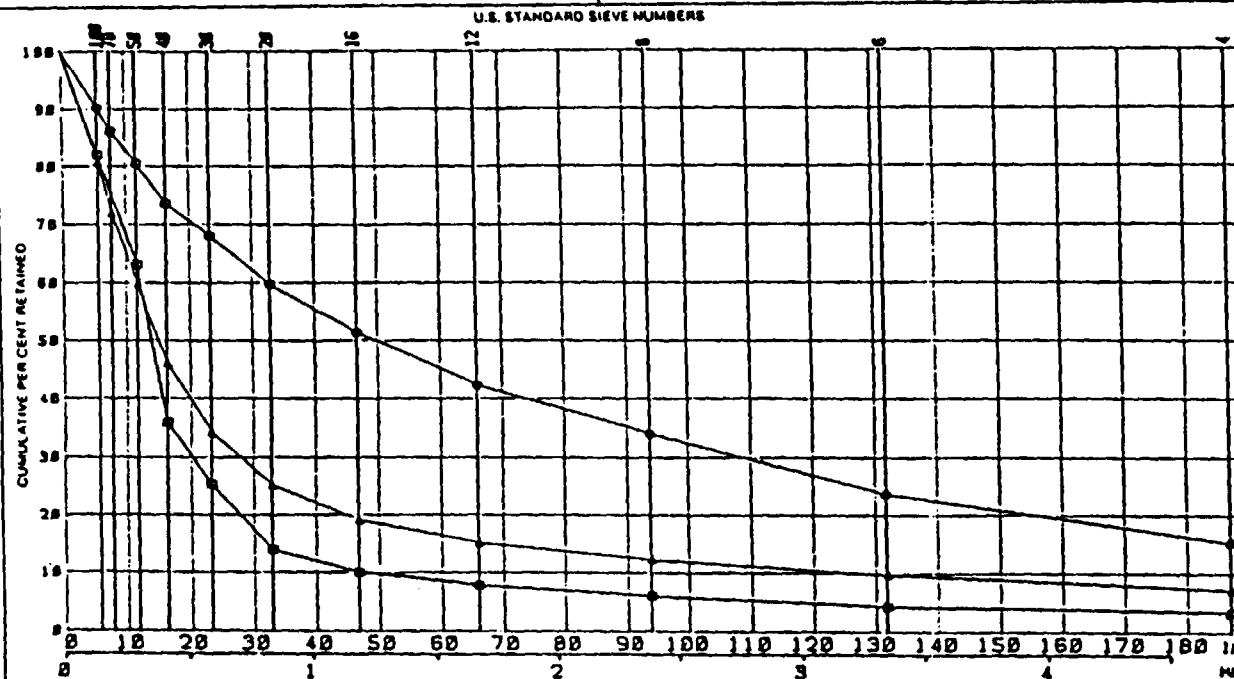
JOHNSON I.D. NUMBER 4298D  
SAMPLE SENT IN BY BRAUN ENGINEERING TESTING, INC.

### SAND ANALYSIS REPORT



Johnson Division  
P.O. Box 43118 St. Paul, Minn. 55164  
Tel. 612-636-3900  
800-328-9110  
Telex 297451

PAGE \_\_\_\_\_ OF \_\_\_\_\_



TEST HOLE DATA	WELL DATA
DIAMETER	CASING DIAMETER
DEPTH	DESIRED YIELD
DRILLING METHOD CORE BARREL	WELL APPLICATION
DRILLING FLUID	DESIGN RECOMMENDATIONS
GEOPHYSICAL LOGS	NATURAL DEVELOPED WELL.
STATIC WATER LEVEL	
COMMENTS	

SLOT OPENING AND GRAIN SIZE, IN THOUSANDTHS OF AN INCH AND MILLIMETERS	
0.075	0.15
0.3	0.6
1.18	4.75
4.75	19.0
19.0	76.2
76.2	304.8
304.8	1219.2
1219.2	4876.8
4876.8	19257.6
19257.6	76190.4
76190.4	300761.6
300761.6	1188486.4
1188486.4	4681945.6
4681945.6	18427782.4
18427782.4	72911129.6
72911129.6	288444518.4
288444518.4	1137778073.6
1137778073.6	4491112297.6
4491112297.6	17564451193.6
17564451193.6	69257784771.2
69257784771.2	271011171484.8
271011171484.8	1054044885939.2
1054044885939.2	4096177543756.8
4096177543756.8	15884710175027.2
15884710175027.2	61938840690108.8
61938840690108.8	242755362756435.2
242755362756435.2	943021450705740.8
943021450705740.8	3652085802782963.2
3652085802782963.2	14168343211131812.8
14168343211131812.8	54673372844511251.2
54673372844511251.2	211093491378045004.8
211093491378045004.8	8183741655113800193.6
8183741655113800193.6	31534966620455200771.2
31534966620455200771.2	121939866481820803049.6
121939866481820803049.6	4677194659271232117993.6
4677194659271232117993.6	180707786370449287119873.6
180707786370449287119873.6	69257784771419714875871.2
69257784771419714875871.2	267030739085678859503513.6
267030739085678859503513.6	10361230563427154382141377.6
10361230563427154382141377.6	39844922253308617528573511.2
39844922253308617528573511.2	152779689013234470114304049.6
152779689013234470114304049.6	586118756051337880455216199.2
586118756051337880455216199.2	22445882242053515218208647977.6
22445882242053515218208647977.6	86112328916021420872783079911.2
86112328916021420872783079911.2	32445882242053515218208647977.6
32445882242053515218208647977.6	121939866481820803049.6
121939866481820803049.6	4681945.6
4681945.6	19.0
19.0	0.75

COMBINED SAMPLE DEPTHS	PHYSICAL SAMPLE DESCRIPTION	CUMULATIVE PERCENT RETAINED															TOTAL WT.	SCREEN RECOMMENDATIONS		
		mm Inches U.S. Sieves	4.76 .187 4	3.36 .133 3	2.38 .094 8	1.68 .066 12	1.18 .047 18	.840 .033 20	.590 .023 30	.420 .018 40	.297 .012 50	.210 .008 70	.149 .006 100	.074 .003 200	.053 .002 270	DIAMETER 4"PS		SLOT	LENGTH	SETTING
45 FEET	○ SAND & GRAVEL, 41% > 3/8-INCH REMOVED.	15.3	23.6	34.8	42.4	51.4	59.7	68.1	79.6	86.6	90.1	90.3				144.8	0.010"	20 FT.	25 - 45 FT	
48 FEET	○ SAND & GRAVEL, 7% > 3/8-INCH REMOVED.	3.5	4.4	6.1	7.9	10.1	14.8	25.4	36.8	63.2		82.8				228.8				
35 FEET	△ SAND & GRAVEL	7.2	9.7	12.2	15.1	19.1	25.2	34.2	46.8	59.7	71.9	88.6				278.8				

SO MANY CONSIDERATIONS ENTER INTO THE MAKING OF A GOOD WELL THAT, WHILE WE BELIEVE SLOT SIZES FURNISHED OR RECOMMENDED FROM SAND SAMPLES ARE CORRECT WE ASSUME NO RESPONSIBILITY FOR THE SUCCESSFUL OPERATION OF JOHNSON WELL SCREENS.

APPENDIX C

WELL DRILLER'S INSTALLATION LOG

