Site:	Nor-Lake, Inc.
Location:	Hudson, St. Croix County, Wisconsin
Unit Evaluated:	Ordovician Prairie du Chien

File includes excerpts from:

Soil Exploration Company, 1985, Phase II Remedial Investigation Report, Nor-Lake Inc. Facility, Hudson, Wisconsin, on file at Wisconsin Department of Natural Resources.

- Text: introduction, hydrogeology discussion, pumping test discussion
- Tables: water-level elevations and pumping test drawdown
- Figures: site plan, potentiometric surface maps

Ayers Associates, 1988, Phase II Nor-Lake Contamination Study, prepared for Nor-Lake, Inc., Hudson, Wisconsin, on file at Wisconsin Department of Natural Resources.

- Table: Groundwater Elevations
- Water Table Figures

Ayers Associates, 1989, Nor-Lake Annual Ground Water Report, prepared for Nor-Lake, Inc., Hudson, Wisconsin, on file at Wisconsin Department of Natural Resources.

- Water Table Figures

Ayers Associates, 1990, 1990 Ground Water Report, Nor-Lake, Inc., Hudson, Wisconsin, on file at Wisconsin Department of Natural Resources.

- Summary text, water table figures, groundwater elevation table

Ayers Associates, 1991, 1991 Ground Water Report, Nor-Lake, Inc., Hudson, Wisconsin, on file at Wisconsin Department of Natural Resources.

- Summary text, groundwater elevation table, hydrograph

Delta Environmental Consultants, Inc., 1997, Nor-Lake, Inc., Phase II Evaluation of Remediation Systems, on file at Wisconsin Department of Natural Resources.

- Introduction, groundwater modeling discussion
- Figures: site plan and cross-sections
- Boring Logs

Ayers Associates, Inc., 2004, 2004 Annual Report, Nor-Lake, Inc. Hudson Wisconsin, on file at the Wisconsin Department of Natural Resources.

- Long-term hydrographs
- Figures: site plan, potentiometric surface maps

Miscellaneous site figures (unbound in WDNR file)

- Site plans, potentiometric surface maps, cross-sections, capture-zone maps, etc.

COPY

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PHASE II REMEDIAL INVESTIGATION REPORT

NOR-LAKE, INC. FACILITY

HUDSON, WISCONSIN

#120-12745

JUNE 3, 1985

121

SOIL EXPLORATION COMPANY

SOIL EXPLORATION company

662 CROMWELL AVENUE
ST. PAUL, MN 55114
PHONE 612/645-6446

a sister corporation to TWIN CITY TESTING AND ENGINEERING LABORATORY INC.

June 20, 1985

Wisconsin Department of Natural Resources
1621 Westgate Road
Eau Claire, Wisconsin 54703

Attn: Mr. John Grump

Subj: Phase II Remedial Investigation Report
Nor-Lake, Inc. Facility
Hudson, Wisconsin
#120-12745

OFFICERS:
CHARLES W. BRITZIUS
chairman of the board
NORMAN E. HENNING
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secretary/treasurer

HOME OFFICE:
ST. PAUL, MN

OFFICES IN:
MANKATO, MN
ROCHESTER, MN
WAITE PARK, MN

Dear Mr. Grump:

Enclosed is a copy of the Phase II Remedial Investigation Report for the Nor-Lake facility located in Hudson, Wisconsin. The data in this report is confidential and should be reviewed only by the personnel involved with the project.

Please contact us if you have any questions regarding the information in this report.

Very truly yours,

Soil Exploration Company

James P. Prieur

James P. Prieur
Supervisor, Hydrogeology Section

JPP/pw

Encs

AS A MUTUAL PROTECTION TO CLIENTS, THE PUBLIC AND OURSELVES, ALL REPORTS ARE SUBMITTED AS THE CONFIDENTIAL PROPERTY OF THE CLIENT.
AN EQUAL OPPORTUNITY EMPLOYER

PHASE II REMEDIAL INVESTIGATION REPORT

NOR-LAKE, INC. FACILITY

HUDSON, WISCONSIN

#120-12745

1.0 INTRODUCTION

1.1 Purpose

The purpose of this report is to present the results of the second phase of the remedial investigation performed by Soil Exploration Company (SEC) at the Nor-Lake, Inc. facility. The report expands on the data presented in the Phase I Hydrogeologic report dated October 24, 1984.

1.2 Scope of Work

The scope of work performed during the Phase II investigation included:

1. providing an alternate source of water at the Edna Smith residence,
2. completing two additional monitoring wells (MW-7 and MW-5S) and two additional test soil borings,
3. collection and analysis of ground water samples from all monitoring wells and selected residential wells,
4. performance of an aquifer pumping test on the Nor-Lake north well to determine aquifer characteristics and to assist in the design of the gradient control well,
5. preliminary design of a gradient control well and spray irrigation treatment system,
6. data evaluation, and
7. report presentation.

1.3 Site Description

The Nor-Lake facility is located in the Northwest 1/4 of Section 22, T29N, R19W approximately three miles east of Hudson in St. Croix County, Wisconsin. A site location map is presented in Figure 1. Surface elevation at this facility is approximately 920' above mean sea level (msl). The land surface generally slopes northwest towards the Willow River. Several depressions with elevations less than 860' msl are located north-northwest of the plant. A general site plan map including existing monitoring or water well locations is presented in Figure 2.

2.0 REGIONAL AND SITE GEOLOGY

The regional geology in the vicinity of the site was detailed in the October 24, 1984, SEC report #120-11970. In summary, the site area is underlain by pitted glacial outwash deposits composed of silt, sand, and gravel which are underlain in turn by dolomitic limestone of the Prairie Du Chien group or the Jordan Sandstone. The generalized stratigraphic column is presented in Figure 3.

Bedrock surface elevation in the vicinity of the site varies greatly as illustrated in Figure 4. The south wall of a buried bedrock channel runs across the study area. The buried channel cuts through the dolomitic limestone and is now filled with glacial outwash. This buried channel shown in Figure 4 is the southern edge of a regional channel which slopes to the

west-southwest towards the St. Croix River. The regional channel is illustrated in Figure 4 of the the 10-24-84 SEC report and in Borman, 1979.

Lithologic logs of all the borings completed to date are presented in Appendix A. Four geologic cross-sections of the site were prepared from the lithologic logs of the monitoring wells and area water well logs. Locations of the cross-sections are presented in Figure 5. The cross-sections are illustrated in Figures 6 through 9.

The Prairie Du Chien group consists mainly of the Shakopee and Oneota members. The Shakopee member is a light brown to buff, thin to thick bedded, cherty dolomite, commonly sandy and oolitic with shale partings. The Oneota member is light brownish gray to buff, thin to thick bedded, vuggy dolomite. (Kanivetsky and Walton, 1979) Fracture zones and solution channels were encountered during drilling in the upper dolomite.

The Late Cambrian Age Jordan Sandstone consists of white to yellow, quartzose, fine to coarse grained sandstone, which is massively to thinly bedded and varies from friable to well cemented (Kanivetsky and Walton, 1979). The Jordan Sandstone is underlain by the St. Lawrence formation which consists of dolomitic shale and siltstone.

3.0 HYDROGEOLOGY

3.1 Regional Hydrogeology

The investigation has focused on the two primary aquifers used in the vicinity of the site. They are they glacial drift aquifer and the bedrock

aquifer consisting of the Prairie Du Chien/Jordan aquifer. The glacial drift aquifer occurs when the water table is in the glacial outwash such as in the buried channel north of the plant. The ground water table directly below the plant is in bedrock. This is illustrated in the geologic cross-sections (Figures 6 through 9). The glacial drift, Prairie Du Chien, and Jordan aquifers are all hydrologically interconnected. No perched ground water zones were encountered in any of the site borings.

The Jordan aquifer is underlain by the St. Lawrence Formation which acts as a regional confining bed.

Ground water recharge is primarily through the infiltration of precipitation. Regional discharge zones are Willow Creek or the St. Croix River.

3.2 Monitoring Well Network

The monitoring well network at the Nor-Lake site consists of eight monitoring wells with supplemental data provided from fourteen water wells. Monitoring wells MW-5S, MW-7 and the deep Edna Smith well have been installed since the Phase I report. Well nests are now present at MW-5 and at the Edna Smith residence. Well locations are presented in Figures 2 and 10.

Monitoring well completion data sheets for all monitoring wells are presented in Appendix B. Monitoring well construction information is provided in Table 1 and are illustrated in the geologic cross-sections (Figures 6 through 9). Water well logs for wells used in this report are

provided in Appendix C. All available water wells logs of Nor-Lake area wells were provided in the October, 1984, SEC report.

3.4 Site Hydrogeology

Ground water elevation measurements were collected at a minimum of monthly intervals during this study. Representative ground water elevation data are presented in Table 2. Depth to ground water in the vicinity of the site range from 65' to 80'. Data collected to date, indicates a ground water flow direction generally towards the west as illustrated in Figure 10. However, this may vary with season between the northwest and southwest throughout the year.

The horizontal hydraulic gradient (change in head with distance) varies across the site from .008 to .01 ft./ft. A slight downward vertical potential gradient of .02 - .2 ft./ft. was observed in the drift wells at MW-5S and MW-5D. Vertical downward movement would be limited by the low vertical hydraulic conductivity of the silty sand. The saturated thickness of the Jordan Prairie Du Chien drift aquifers is approximately 180' to 220'. Regional hydraulic conductivity estimates for the unconsolidated glacial drift aquifer range from 7 ft./day to 670 ft./day (Borman, 1976). Hydraulic conductivity is a measure of the ability of porous media to transmit water. Hydraulic conductivity values for the bedrock aquifer varies from approximately 1 ft./day 270 ft./day. Wells open only to the Jordan Sandstone differed less in hydraulic conductivity then those open to both

the sandstone and dolomite or to the dolomite only. The maximum values were generally less than 13 ft./day for the sandstone. Differences in hydraulic conductivity in the dolomite are caused by fractures and solution channels which exist in the dolomite. Hydraulic conductivity in the buried channel located slightly north of the site would generally be expected to be less than the dolomite due to the amount of silt present in the sand and gravel.

An aquifer evaluation test was conducted between March 29 and April 1, 1985. The purpose of the pumping test was to determine aquifer properties at the site and to assist in the design of a gradient control well. The test was approximately 68 hours in duration and consisted of pumping the Nor-Lake north well at a discharge of approximately 70 gallons per minute. Monitoring well 3, located 220' from the pumping well, and the Nor-Lake south well, located 160' from the pumping well, were used as observation wells. The discharge water was piped outside of the radius of influence of the pumping well and allowed to aerate to eliminate any volatile organics present in the water.

Drawdown measurements demonstrated a response to pumping in both observation wells. The Nor-Lake south well showed a drawdown of over 0.7' after 70 minutes of pumping and 0.75' at the completion of the test. Monitoring well 3 indicated a total drawdown of 0.25' at the completion of the test. Both observation wells recovered to near static conditions during the recovery test which followed the termination of the pumping phase of the test. The drawdown measurements indicated delayed yield in the aquifer.

Drawdown measurements are provided in Appendix D. Barometric pressure measurements during the tests were obtained from the U.S. Weather Serivce. No significant changes in barometric pressure occurred during the testing.

The aquifer evaluation test results were evaluated using the Boulton method for unconfined unsteady state aquifers exhibiting delayed yield. Drawdown data was plotted against time for monitoring well 3 (MW-3) and the Nor-Lake South well. Corrections were made for partial penetration of the water well.

Evaluation results of the data collected at the Nor-Lake South well indicates a transmissivity of 626 gal./day ft. of hydraulic conductivity of 3.13 gal./day ft.^{2} assuming a saturated thickness of 200'. Specific yield for the test was approximately 0.25.

The aquifer evaluation test satisfied the conditions through the use of the Boulton method. These conditions include:

- the aquifer is unconfined, unsteady state in showing delayed yield,
- storage of water in the well is negligible,
- the aquifer is generally of consistent thickness in the vicinity of the radius of influence of the pumping well,
- the well was pumped at a constant rate, and

The well was partially penetrating which indicated the need for a correction factor to be used.

TABLE #1

MONITORING WELL CONSTRUCTION INFORMATION

Well Number	Top of Riser Elevation	Well Depth	Communication Zone
MW-1	923.12	109.5	813.6 - 823.6
MW-2	917.41	84.0	833.4 - 843.4
MW-3	909.93	89.0	820.9 - 830.9
MW-4	911.23	75.0	836.2 - 46.2
MW-5S	902.94	95.0	807.9 - 817.9
MW-5D	901.73	207.3	694.6 - 704.6
MW-6	916.27	88.0	828.3 - 838.3
Edna Smith Deep	915.82	240.0	670.8 - 687.3
Test Boring	908.22	163.0	-
North Well	915	128.0	787 - 853.0
South Well	918	147.0	771 - 875.0
Lumber Yard	920	141.0	779 - 880.0
Engle	910	200	-
Timmerman	910	180	-

Northwest Corner of Building at Loading Door = 920.00 msl.

TABLE #2

GROUND WATER ELEVATION DATA

Well Number	8-31-84	10-15-84	12-7-84	3-18-85	4-1-85
MW-1	836.11	835.98	835.59	835.90	835.58
MW-2	841.71	841.54	841.26	841.27	841.31
MW-3	837.25	837.12	836.82	837.00	836.96
MW-4	842.03	841.89	841.54	841.36	842.71
MW-5S	-	-	-	837.21	835.26
MW-5D	835.48	835.27	834.99	835.17	834.90
MW-6	835.37	835.18	834.89	835.05	834.99
MW-7	-	-	-	824.93	824.84
Edna Smith	-	-	-	825.61	825.48

AQUIFER EVALUATION RESULTS

3-30 - 4-2-85

NOR-LAKE, INC. SOUTH WELL

R = 166'

(Min) t	Depth to Water	Drawdown
0	85.60	-
1	85.90	.30
2	85.86	.26
3	85.95	.35
4	86.04	.44
5	86.08	.48
6	86.11	.51
7	86.14	.54
8	86.15	.55
9	86.16	.56
10	86.15	.55
15	86.19	.59
20	86.20	.60
30	86.25	.65
55	86.27	.67
70	86.31	.71
85	86.30	.70
105	86.25	.65
120	86.32	.72
195	86.35	.75
220	86.32	.72
555	86.35	.75
2590	86.36	.76

AQUIFER EVALUATION RESULTS

3-30 - 4-2-85

NOR-LAKE, INC.

MONITORING WELL #3

R - 220'

(Min) t	Depth to Water	Drawdown
0	72.912	-0-
1-7	72.915	.003
8	72.918	.006
9	72.92	.008
10	72.92	.008
15	72.92	.008
20	72.92	.008
30	72.92	.008
55	72.925	.013
60	72.925	.013
90	72.925	.013
120	72.925	.013
200	72.94	.028
570	72.94	.028
2590	73.16	.250

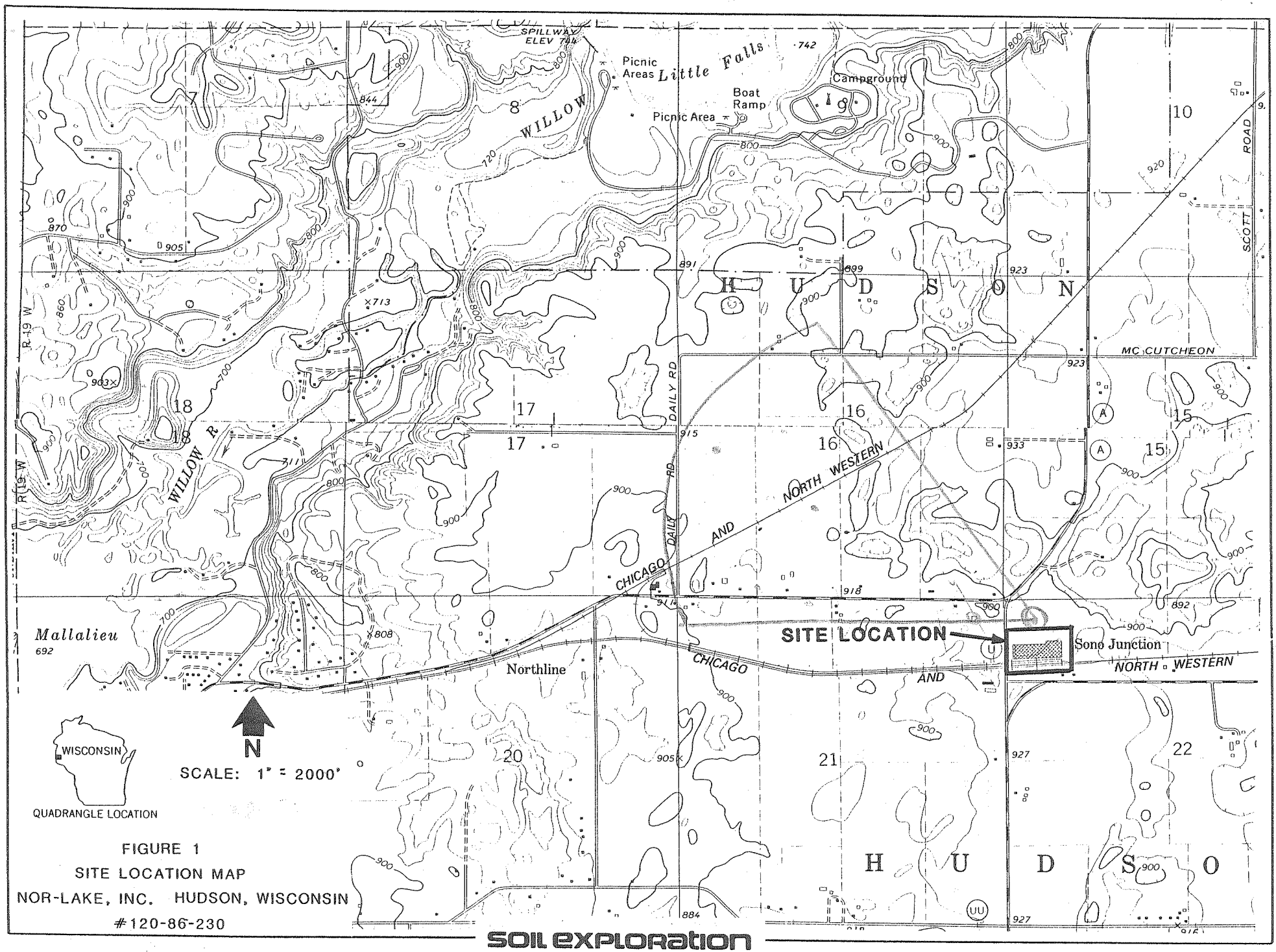


FIGURE 1
SITE LOCATION MAP
NOR-LAKE, INC. HUDSON, WISCONSIN
#120-86-230

SOIL EXPLORATION COMPANY

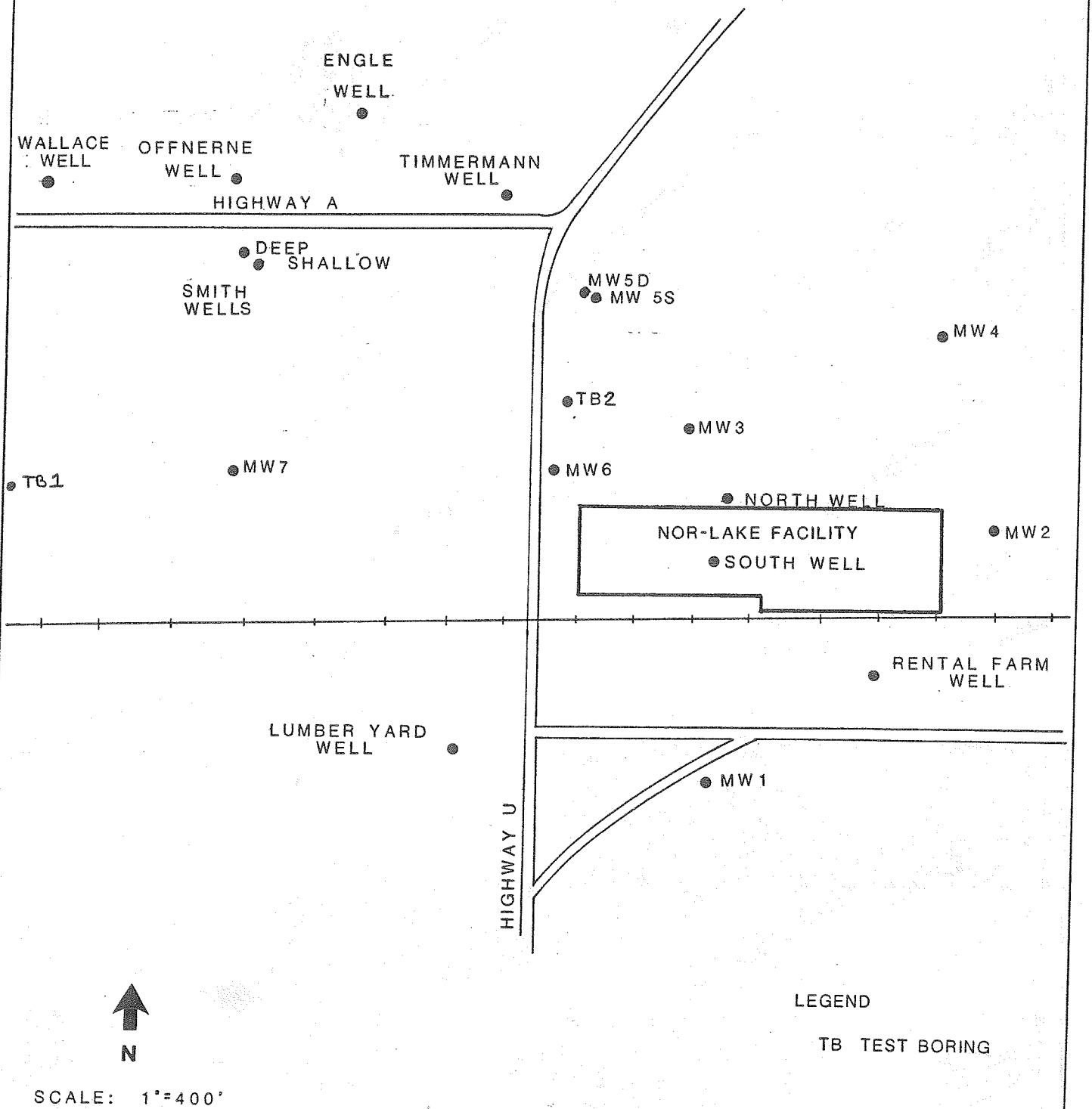
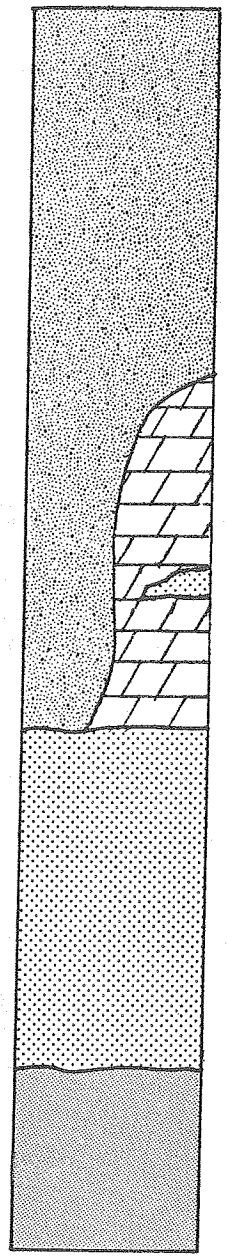


FIGURE 2
MONITORING AND WATER WELL LOCATIONS
NOR-LAKE, INC. HUDSON, WISCONSIN
#120-86-230

SOIL EXPLORATION COMPANY



GLACIAL DRIFT

Sand and Silt surficial aquifer

PRAIRIE DU CHEIN GROUP

Shakopee member. dolomite 50' thick - aquifer

New Richmond member - 0-10' of sandstone or sandy dolomite may be present.

Oneota member - dolomite 50±150' thick. Aquifer

JORDAN SANDSTONE

Fine to coarse grained sandstone - 90' thick. Aquifer

ST. LAWRENCE FORMATION

Dolomitic siltstone and dolomitic sandstone 50' thick. Aquitard

Not To Scale

FIGURE 3
GENERALIZED REGIONAL STRATIGRAPHIC COLUMN
NOR-LAKE INC.
HUDSON, WISCONSIN

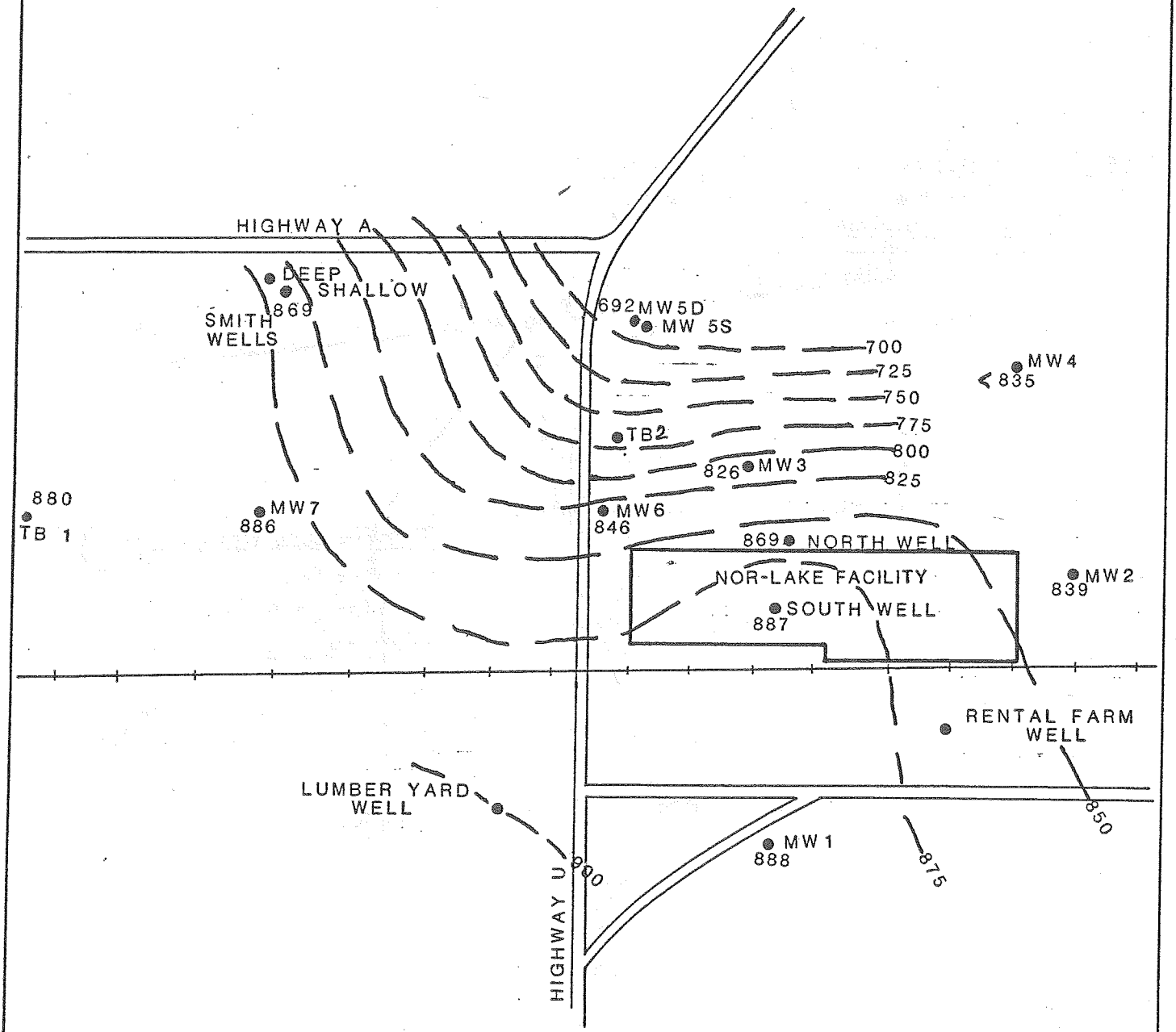


FIGURE 4 BEDROCK SURFACE MAP
NOR-LAKE, INC. HUDSON, WISCONSIN
#120-86-230

SOIL EXPLORATION COMPANY

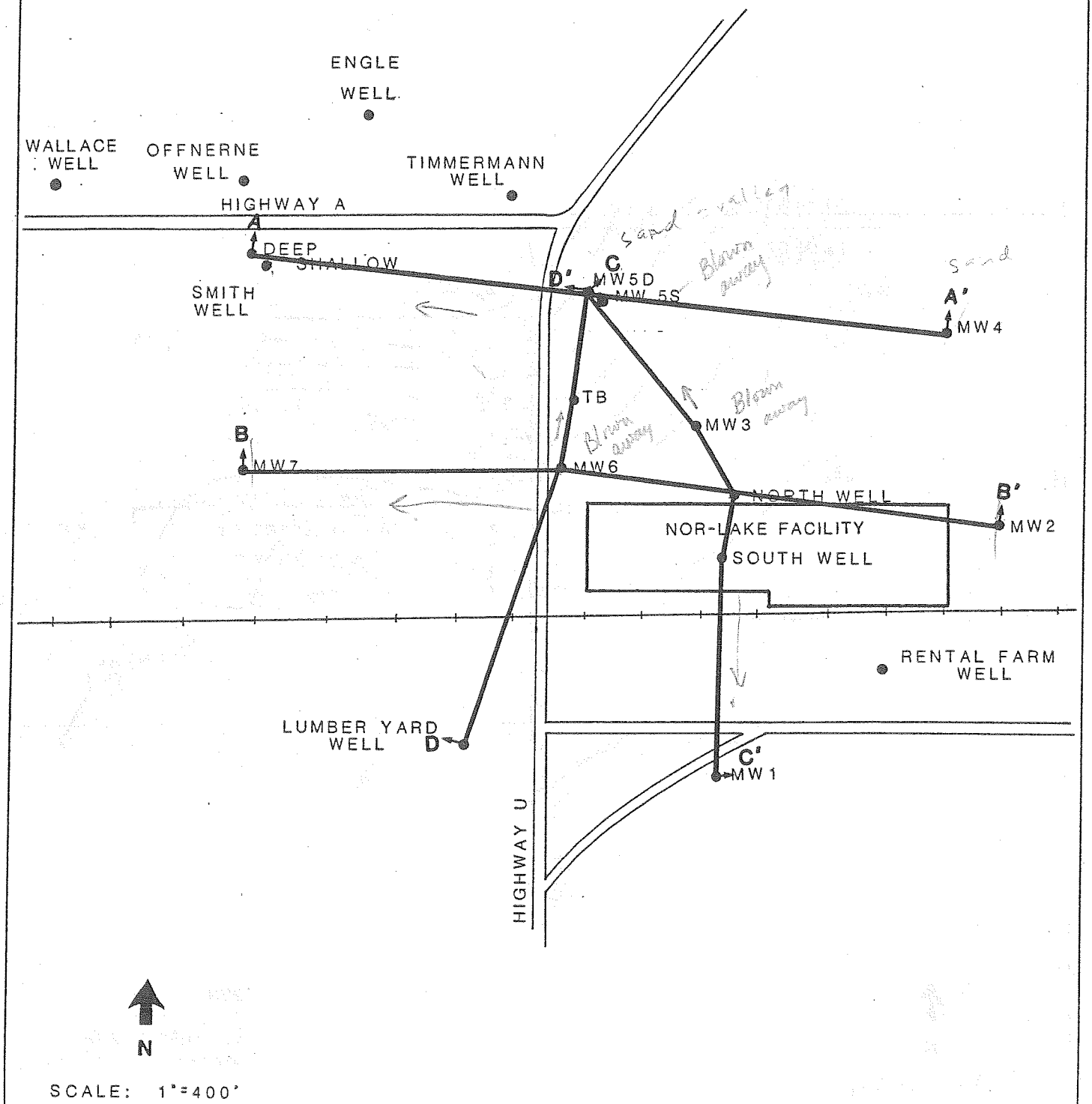


FIGURE 5
GEOLOGIC CROSS SECTION LOCATION MAP
NOR-LAKE, INC. HUDSON, WISCONSIN
#120-86-230

SOIL EXPLORATION COMPANY

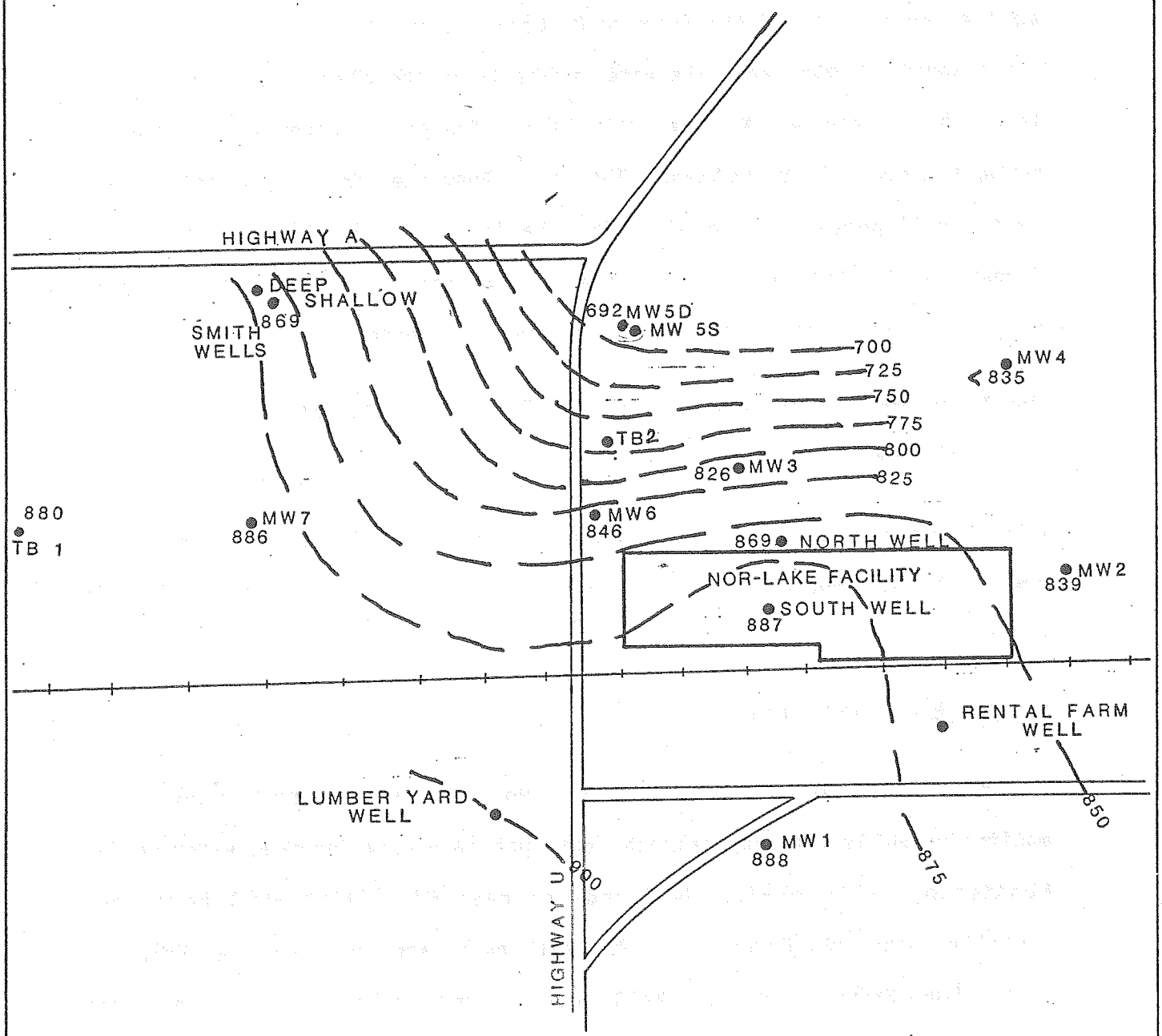
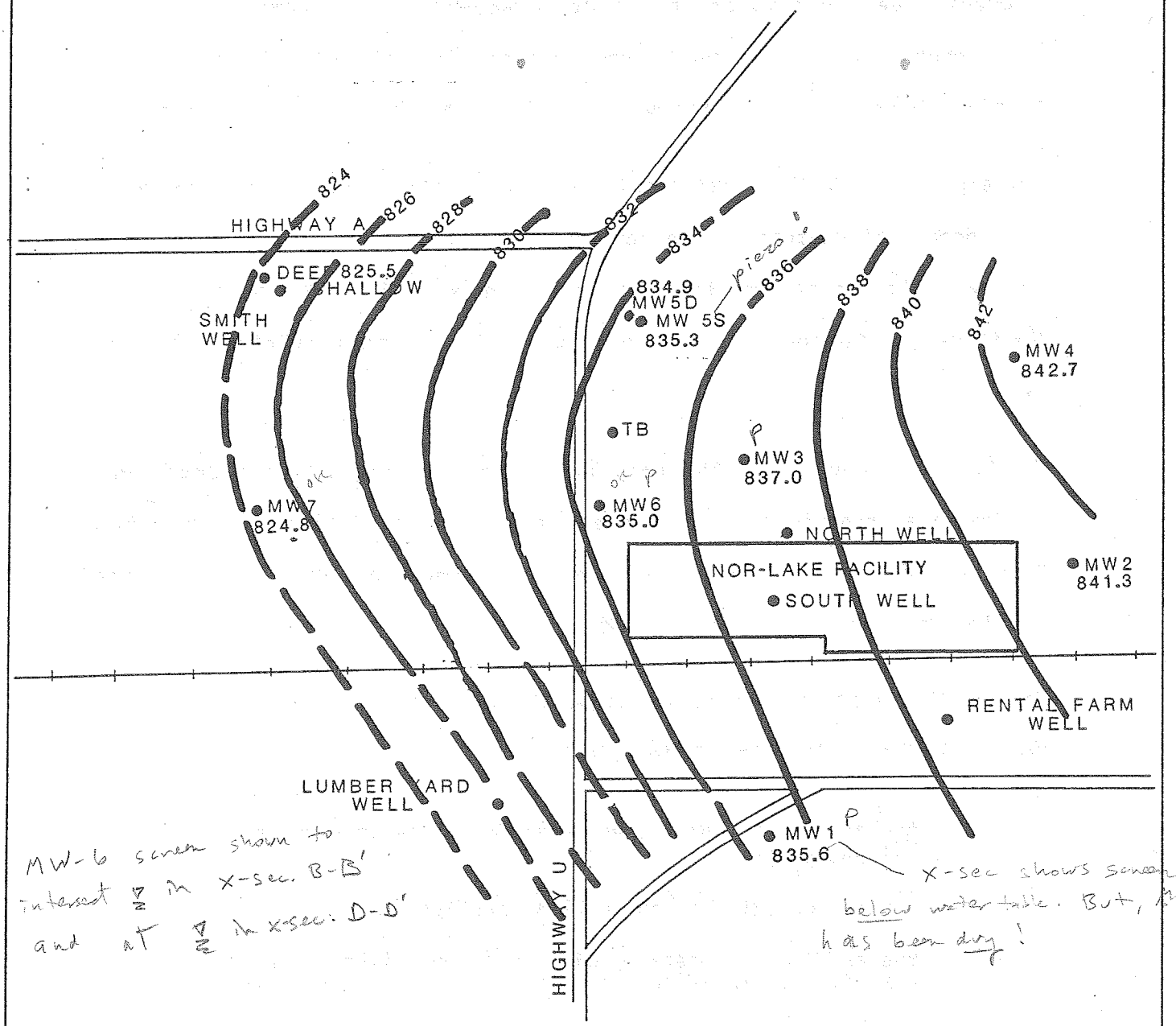


FIGURE 4 B ROCK SURFACE MAP
NOR-LAKE, IN HUDSON, WISCONSIN
0-86-230

SOIL EXPLORATION COMPANY

P = screened below ▽

Recovery well west of MW5?



MW-6 screen shown to intersect ▽ in x-sec. B-B' and at ▽ in x-sec. D-D'

x-sec shows screen below water table. But, MW-1 has been dry!

N

SCALE: 1"=400'
CONTOUR INTERVAL 2'

LEGEND

TB · TEST BORING

824.8 • GROUNDWATER ELEVATION 4/1/85

Note: Pump test on North Well Conducted between 3/29 and 4/1!

FIGURE 10
WATER TABLE CONTOUR MAP
NOR-LAKE, INC. HUDSON, WISCONSIN
#120-86-230

SOIL EXPLORATION COMPANY

141

file

NORLAKE™

October 19, 1988

Department of Natural Resources
1300 West Clairemont Avenue
Eau Claire, WI 54702-4001
Attn: Mr. Bill Evans

Dear Bill:

Attached is the Phase ~~III~~ II Nor-Lake Contamination Study. We have have put much time and effort in the preparation of this report and look forward to discussing it with you.

We appreciate all the help you and theWDNR staff have given us in the effort to resolve the issue. Hopefully, this report will shed more light on the subject.

Sincerely,

Nor-Lake, Incorporated
James K. Richardson, Jr.
President

cc Ayers Associates

NOR-LAKE, INCORPORATED
Second and Elm Streets
P.O. Box 248
Hudson, Wisconsin 54016
715-386-2323
-386-6149 FAX

PHASE II

NOR-LAKE CONTAMINATION STUDY

The second phase of the Nor-Lake Contamination Study, including the monitoring well installation and groundwater sampling and analysis is complete. Data from the first phase of the study was submitted to the Wisconsin Department of Natural Resources (WDNR) on August 30, 1988. This second report is more comprehensive and includes:

A. A Summary of Past Nor-Lake Activities
B. Current and Ongoing Nor-Lake Activities
C. Nor-Lake Conclusions
D. Nor-Lake Recommendations on Contamination Cause and Distribution

The results of the Nor-Lake effort and the conclusions reached are supported by the following exhibits, figures, or tables:

1. Exhibit 1; Nor-Lake Base Map
2. Figure 1; Groundwater Flow
3. Figure 2; Nor-Lake Groundwater Map
4. Figure 3; TCA Fall 1988
5. Figure 4; TCE Fall 1988
6. Figure 5; TCE 1988
7. Figure 6; TCA 1988
8. Figure 7; TCA 1986
9. Figure 7A; TCE 1986
10. Figure 8; Summary of 1,1,1 Trichloroethane (TCA) study at MW1, MW2, and MW3.
11. Figure 9; Summary of 1,1,1 Trichloroethane (TCA) study at MW4, MW5S, and MW5D.
12. Figure 10; Summary of 1,1,1 Trichloroethane (TCA) study at MW6, MW7, and MW8.
13. Figure 11; Summary of 1,1,1 Trichloroethane (TCA) study at MW9, MW10, and the Recovery Well.

854

OCT-19-'88 13:29 ID:NOR-LAKE INC OFFICE TEL NO:11

TABLE 1
NOR-LAKE WATER ELEVATION AND WATER QUALITY DATA
OBTAINED SEPTEMBER 8 AND 9, 1988

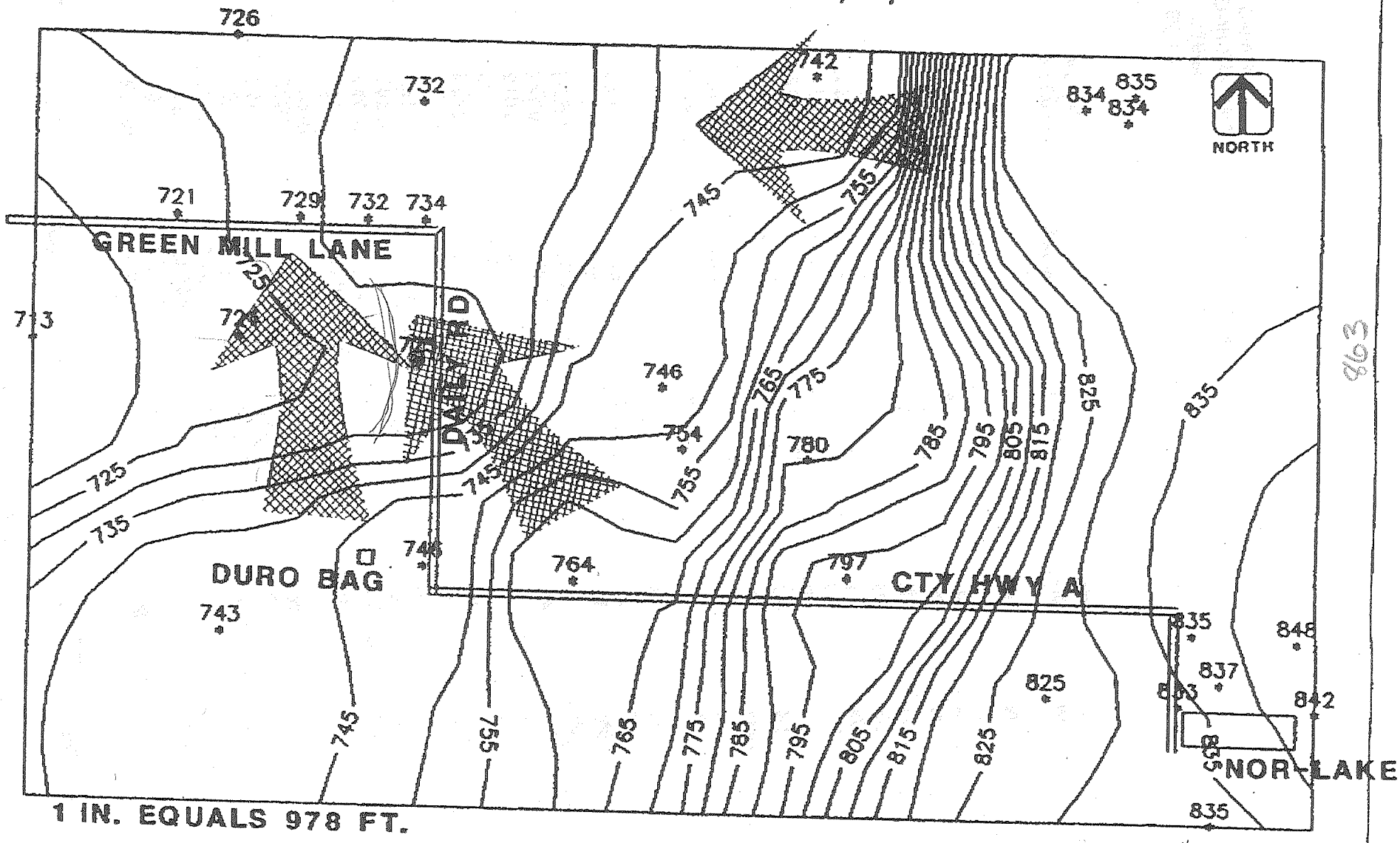
WELL I.D.	GRID	COORDINATES	WATER ELEVATION	TCA	TCE
MW 1			834.56	17	6•
MW 2	6230E	-700S	841.50	ND	ND•
MW 3	5550E	-510S	836.91	85	12•
MW 4	6100E	-200S	848.12	4	ND•
MW 5S	5350E	-160S	835.31	240	50•
MW 6	5260E	-670S	833.28	150	41•
MW 7	4330E	-630S	825.14	24	4•
MW 8	2630E	1050N	780.04	ND	ND•
MW 9	1750E	1110N	753.51	26	4•
MW 10	1600E	1550N	745.71	27	6•
E. Smith	4400E	-120S	- - -	38	25+
Wallace	2920E	190N	796.63	ND	ND
Waxon	2520E	-140S	- - -	8	7+
Jacobs	1750E	100N	- - -	3	3+
LaVenture	570E	200N	- - -	ND	ND*
Green	6310E	-1190S	- - -	8	4+
Nagle	6130E	-1200S	- - -	7	4+
Engle	4450E	350N	- - -	ND	ND*
Timmerman	5020E	80N	- - -	ND	ND*
Offnerne	4000E	120N	- - -	ND	ND*
Matz	1000E	125N	763.88	ND	ND*
Nuessmeier	-50W	200N	746.33	NS	NS
St. Croix Valley					
Cabinetry	-1450W	-300S	742.68	NS	NS
Langer	-75W	2700N	734.13	93	100*
Miller	-100W	3550N	732.39	ND	ND*
Gustafson	-480W	2700N	732.00	30	22*
Mealy	-950W	2700N	729.05	58	42*
Ross	-1800W	2700N	721.40	60	52*
Morrissey	-1350W	1850N	723.51	NS	NS
New Home	-1100W	1700N	725.36	NS	NS*
D. Price	-2800W	1800N	713.29	ND	ND*
Smith	-1400W	4000N	725.77	NS	NS
J. Margenau	2650E	3800N	742.00	NS	NS
Gabranski	4850E	3540N	834.14	NS	NS
Lundgren				NS	NS
Weigl					
Blue House	4900E	3700N	835.23	NS	NS
House #584	4550E	3600N	834.01	NS	NS

Near Nor-Lake to NW!

how shallow are wells?

+ Data from 9/9/88
• Data from 7/26/88
* Denotes WDNR Sample Analysis Results from 1986
ND Sample, No Detects
NS Not Sampled

GROUNDWATER FLOW 9/9/88



1 IN. EQUALS 978 FT.

FIGURE 1

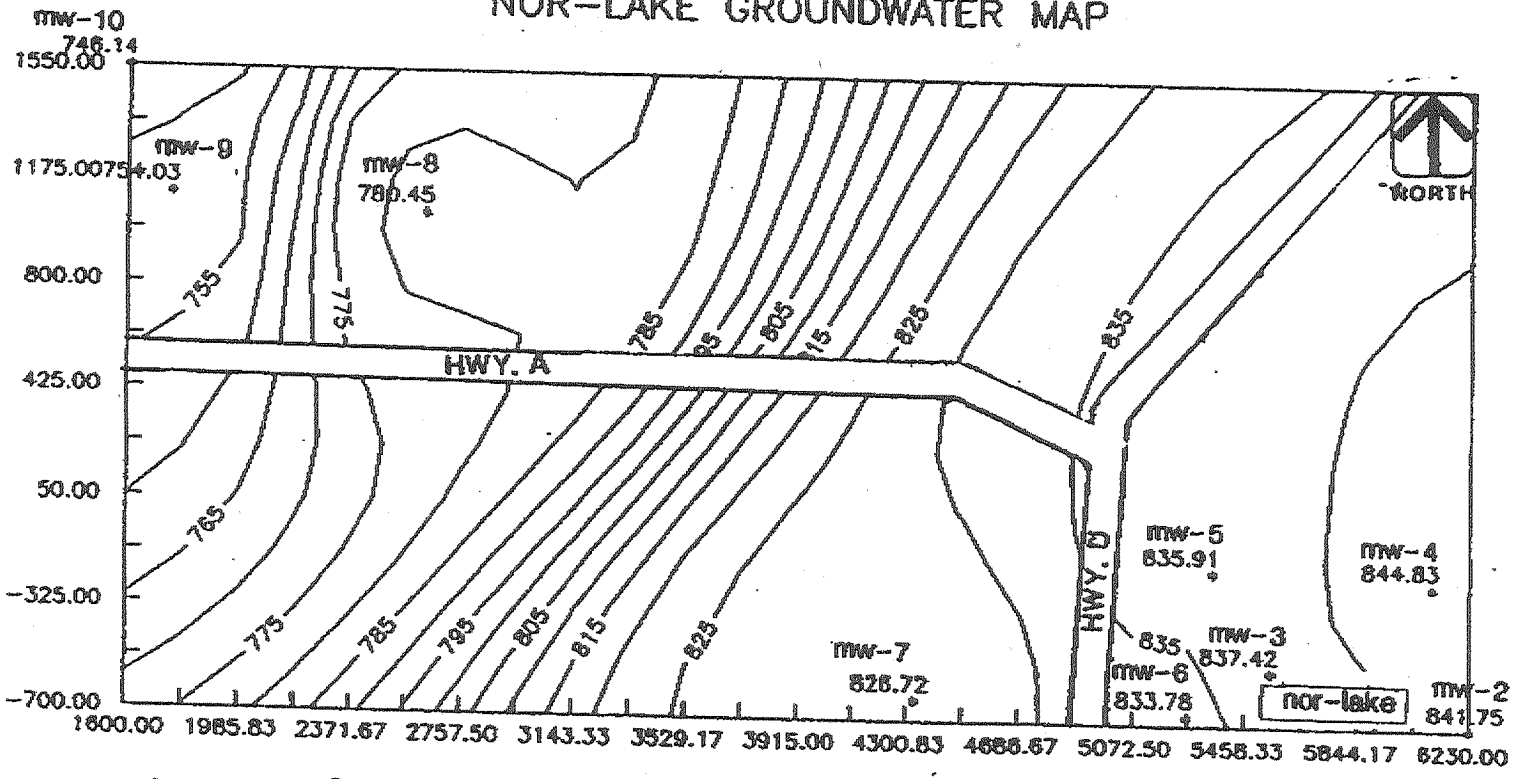
AYRES ASSOCIATES

Engineers
Architects
Planners
Surveyors

GENERATED 10/88

963

NOR-LAKE GROUNDWATER MAP



scale 1in.=661.5 ft.

FIGURE 2

GENERATED 10/88

AYRES ASSOCIATES

Engineers
Architects
Planners
Surveyors

'90

NOR-LAKE
ANNUAL GROUND WATER REPORT
1989

PREPARED FOR:

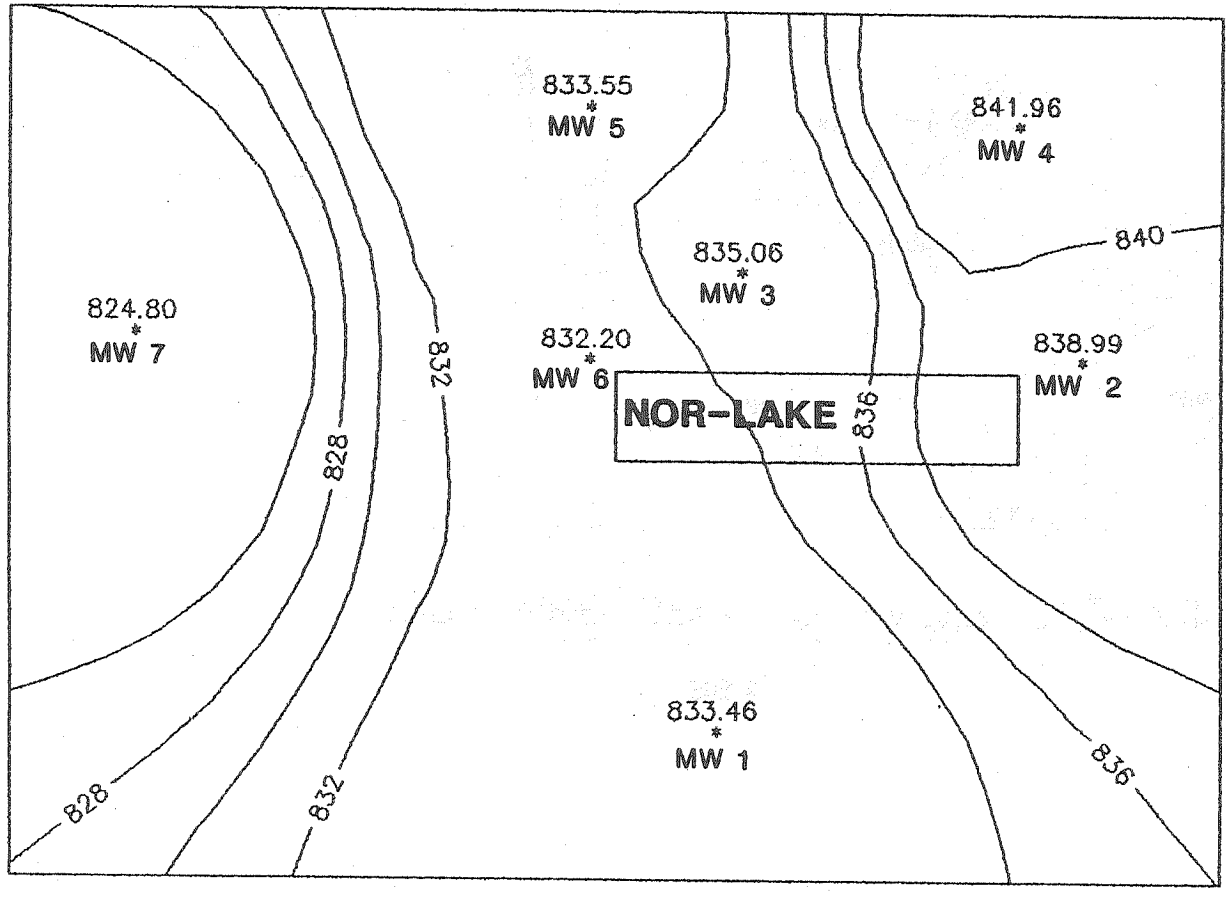
NOR-LAKE, INC.

PREPARED BY:

AYRES ASSOCIATES
EAU CLAIRE, WISCONSIN

FIG.9

NOR-LAKE GROUND WATER 12/19/89

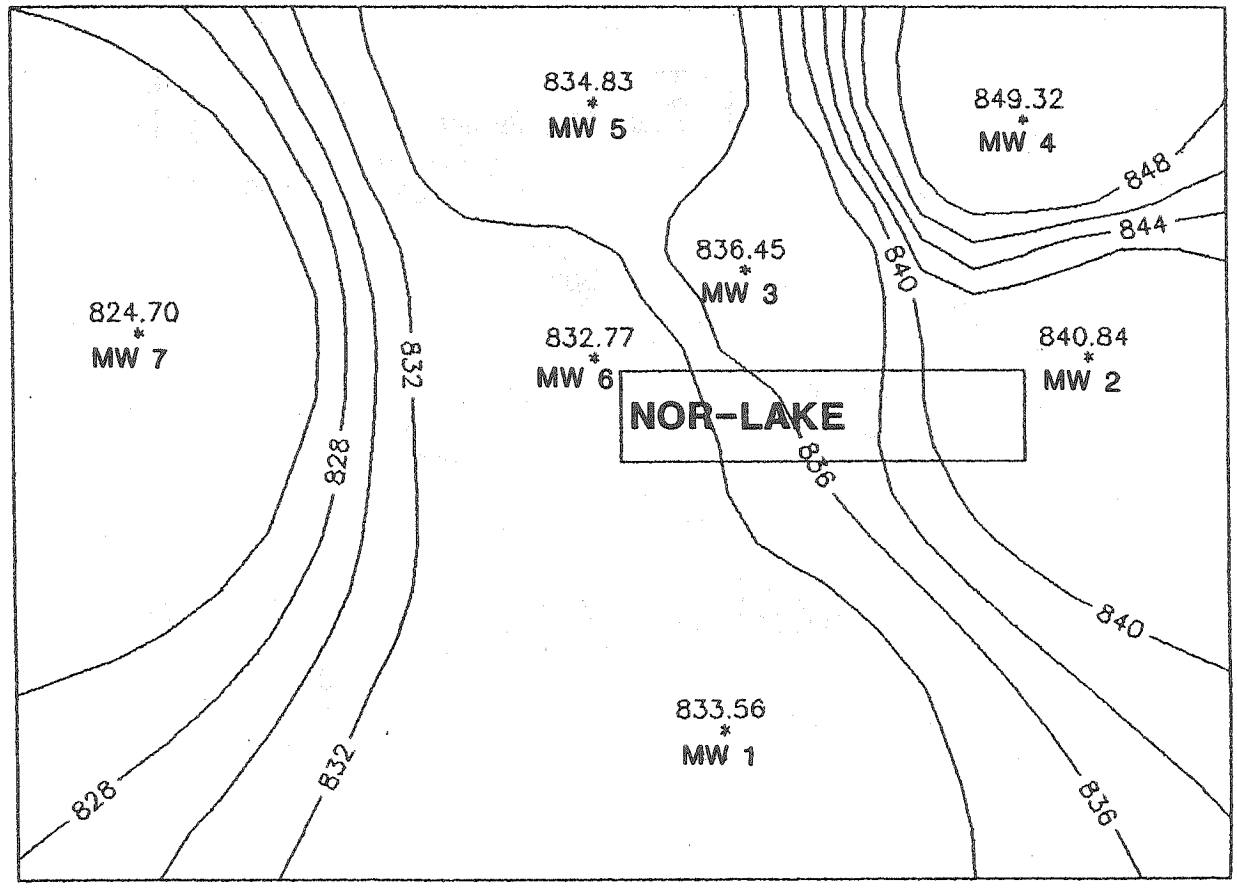


SCALE 80 FEET/INCH

936

FIG.8

NOR-LAKE GROUND WATER 6/21/89



SCALE 80 FEET/INCH

934

1st pl
'91

1990 GROUND WATER REPORT
NOR-LAKE, INC.
HUDSON, WISCONSIN

THIS REPORT PREPARED BY:

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Ayres Project No. 8739.00
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1.0 SUMMARY

In 1990, NOR-LAKE, Inc. has continued several ground water related activities including the following:

- On-site ground water pumping and treatment
- Monitoring well sampling
- Private water supply sampling and treatment (6 residences).

In addition, NOR-LAKE has repaired and upgraded half of the existing ground water treatment discharge structure and conducted a soil contamination investigation on the NOR-LAKE plant site.

In 1990, approximately 206 million gallons of water were pumped and treated with the NOR-LAKE ground water recovery system. Monitoring of private wells and monitoring wells for volatile organic compounds (VOC's) continues to indicate that VOC concentrations have stabilized or are declining. No problems occurred with treatment of private water supplies with activated carbon filters in 1990.

The ground water treatment system discharge had been in poor condition for the past year due to erosion problems along the PVC lined discharge chutes and basin. The south portion of the basin was relined with High Density Polyethylene (HDPE) and the PVC chute was replaced with a 1/2 culvert which conveys treated water to an infiltration area.

In May, 1990, Ayres completed a VOC contaminated soil investigation along the former septic system drain field located beneath the NOR-LAKE plant parking lot. The investigation revealed that some VOC contamination exists within 25-50 feet of the north edge of the NOR-LAKE plant and samples beyond this distance indicate sporadic detects of contamination.

Work planned for 1991 includes continued ground water pumping and treatment, continued private well and monitoring well sampling, continued treatment of private water supplies for VOC's and upgrading

NOR–LAKE GROUND WATER 6/18/90

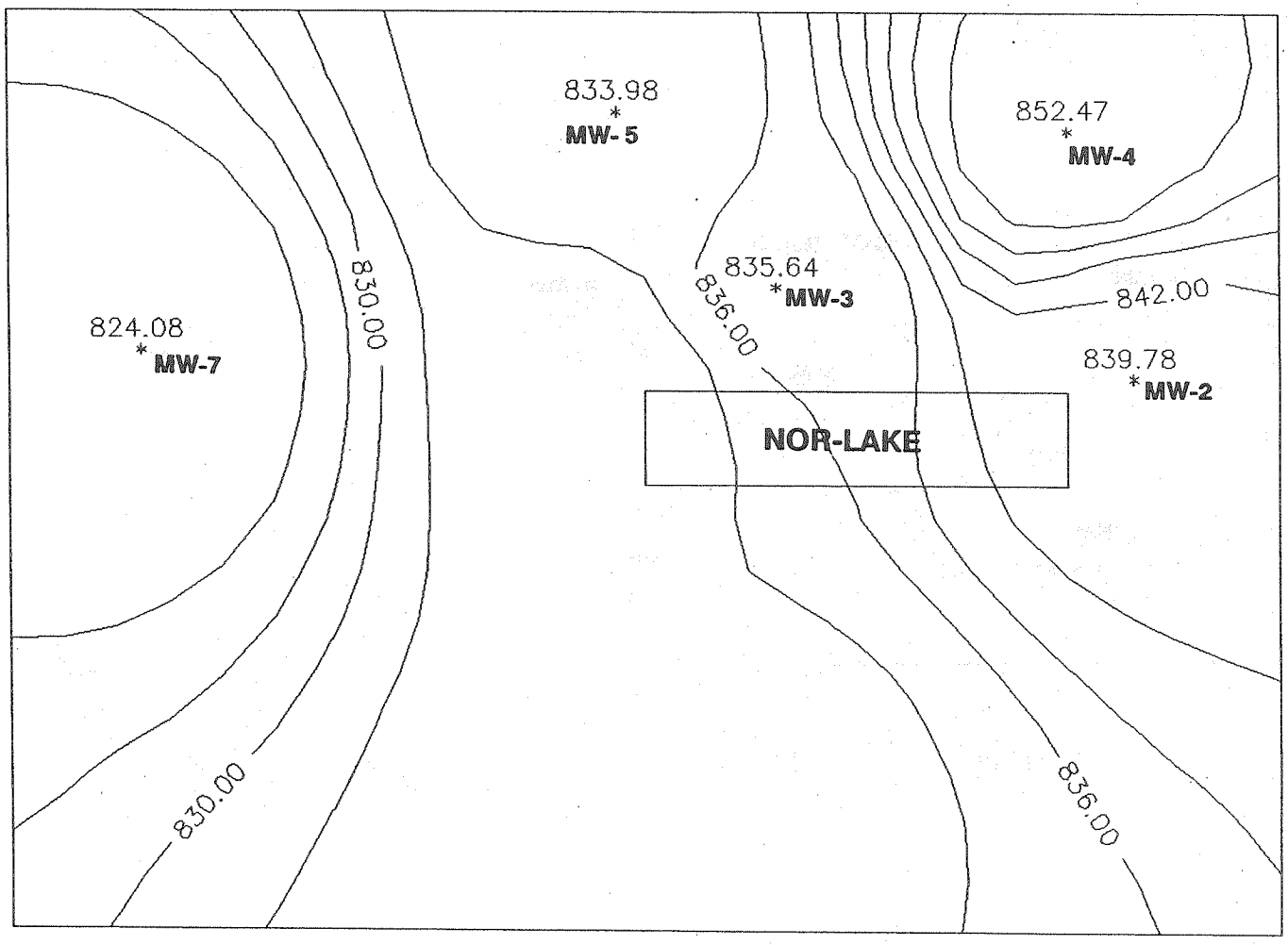

FIGURE 9

1002

High - 7'

High ≈1.0'

NOR–LAKE GROUND WATER 12/30/90

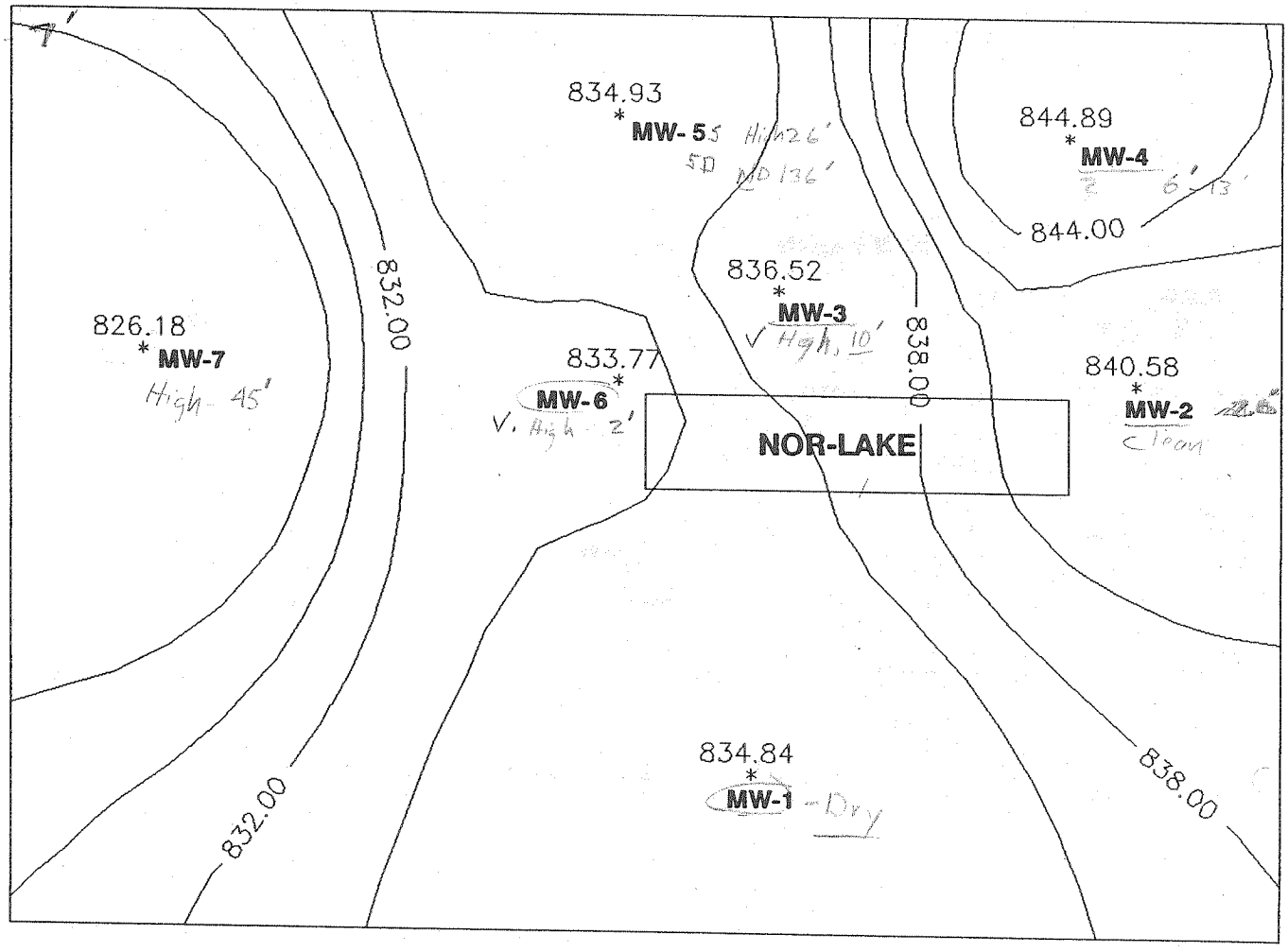

FIGURE 10

1003

TABLE 2

GROUND WATER ELEVATIONS

WELL NUMBER	DEPTH TO WATER FROM TOP OF CASING	GROUND WATER ELEVATION	DATE
MW-1	DRY	----	06/19/90
MW-1	91.87	834.84	12/20/90
MW-2	82.32	838.67	03/19/90
MW-2	81.21	839.78	06/19/90
MW-2	80.41	840.58	12/20/90
MW-3	80.28	833.26	03/19/90
MW-3	77.90	835.64	06/19/90
MW-3	77.02	836.52	12/20/90
MW-4	62.35	852.47	06/19/90
MW-4	69.93	844.89	12/20/90
MW-5S	73.32	833.36	03/19/90
MW-5S	72.70	833.98	06/19/90
MW-5S	71.75	834.93	12/20/90
MW-5D	71.20	834.13	06/19/90
MW-5D	70.23	835.10	12/20/90
MW-6	87.72	832.21	03/19/90
MW-6	DRY	----	06/19/90
MW-6	86.05	833.77	12/20/90
MW-7	92.45	824.08	06/19/90
MW-7	90.35	826.18	12/20/90
MW-8	130.60	779.29	06/19/90
MW-8	129.92	779.97	12/20/90
MW-9	164.64	752.29	06/19/90
MW-9	164.15	752.78	12/20/90
MW-10	173.60	744.71	06/21/90
MW-10	173.35	744.96	12/20/90

Recovery Well
217' Total
87' D to V
180' Pump
14" Hole to 77'
10" - 217

1991 GROUND WATER REPORT
NOR-LAKE, INC.
HUDSON, WISCONSIN

THIS REPORT PREPARED BY:

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anticipate full approval of the carbon treatment units from the Department of Industry, Labor, and Human Relations in 1992.

3.0 MONITORING WELL SAMPLING AND ANALYSIS

3.1 GENERAL

There are eleven monitoring wells in the NOR-LAKE monitoring system. Monitoring wells MW-2, MW-3, MW-5S, and MW-6 are on a quarterly sampling schedule (March, June, September, and December). Monitoring wells MW-1, MW-4, MW-5D, MW-7, MW-8, MW-9, and MW-10 are on a semi-annual monitoring schedule, June and December.

In 1991, the sampling schedule was modified at the request of Pat Collins, DNR Hydrogeologist-Baldwin. The March ground water sampling was completed as required, however, the June, September, and December rounds were modified to accommodate the DNR sampling schedule. The DNR was conducting a ground water investigation in the NOR-LAKE area in 1991, and Pat Collins requested that NOR-LAKE delay the normal June sampling to coincide with DNR ground water sample collection. DNR sampling was delayed and samples were not collected until October 1991. Therefore, NOR-LAKE also delayed September sampling so that all eleven monitoring wells would be sampled on the same date as DNR's monitoring. The delay in third quarter monitoring (conducted between October 15 and November 8) caused NOR-LAKE to delay December quarterly monitoring until February 1992. These changes reduced the number of sample rounds in 1991 to two rounds, March 18 and October and November.

3.2 GROUND WATER ELEVATIONS

Ground water elevations were collected on five separate dates in 1991, March 18, September 9, 10, and 24, and October 14. Ground water elevations for March and October are included in Table 4, "Ground Water Elevations". In addition, a plot of water elevation versus time in 1991 for monitoring wells MW-2,

MW-3, MW-5S, and MW-6 is included as Figure 9, "1991 Ground Water Elevations Versus Time".

Ground water elevation in 1991 generally increased from 1990 levels, with the exception of well MW-4, which experienced a decline in water level. December 1990 water levels compared to October 1991 water levels show an average increase in elevation of 1.18 feet excluding MW-4 which had a 2.95 feet drop in elevation for the same period. The well which experienced the greatest increase was well MW-7, +2.11 feet. Well 2 water level increased the least, +0.98 foot.

In addition to the increasing trend from 1990 levels to 1991 levels, the water levels fluctuation over the year. Water levels in March 1991 showed a decline in Wells 2, 3, and 6 compared to December 1990, and Well 5S showed an increase in elevation in the same period. No other water levels are available for this date. The next set of water levels were collected on September 9, just prior to conducting a pumping test with the recovery well. Water levels collected on the 10th, approximately 12 hours after pumping the recovery well at 600-700 gpm, showed a decline compared to September 9 levels. The graph in Figure 1 shows this slight decline. The decline may be due to the influence of the pumping well, an error in collecting readings, or a decline in the water table over this time period. Between September 9 and 10, wells showed an average decline of 0.29 ft., with the largest change in MW-1, 0.69 ft., and least at MW-4, which remained the same. The pumping was discontinued on the 11th due to some system problems, therefore, additional data was not available to substantiate this trend. It seems unlikely that the water levels up to 1,000 feet away in MW-7 and MW-1 could be affected so rapidly by pumping the recovery well. Future testing will provide data to evaluate this trend.

Historic ground water level trends at NOR-LAKE since 1984 have shown a decline from highs in 1984 to a low in 1988, 1989, and

early 1990, with recovery in water levels in late 1990 and 1991. Well MW-6 water level has fluctuated from a high of 838.54 in 1984 to a low of 832.77 in 1989; in October 1991, the water level had recovered to 834.86. All the monitoring wells show a similar trend with the greatest fluctuations in well screened in the dolomite bedrock, and less fluctuation in wells which are screened in the unconsolidated material.

The documented water level trend follows the local precipitation pattern. Precipitation was lower than normal in the late 1980's, resulting in decreased ground water recharge. The more pronounced fluctuation in water levels in the dolomite screened wells is expected, since recharge and discharge of ground water in the dolomite aquifer is related to fracture dominated flow. This type of flow is subject to rapid changes in water levels compared to unconsolidated aquifers.

Ground water flow direction in 1991 was plotted for the plant site for three dates, March 18, September 9, and October 15. The ground water contour maps for these three dates are included as Figures 10, 11, and 12. The three contour maps indicate westerly ground water flow across the site for the three dates, with slight variations in the gradient for each date due to seasonal changes in water levels.

3.3 MONITORING WELL ANALYTICAL RESULTS

The two rounds of ground water sampling in Spring (March) and Fall (October) of 1991 provided data for contaminant trend interpretation. These data, along with previous data collected from the monitoring wells, provide a basis for evaluating ground water trends at the NOR-LAKE plant site and off site at wells MW-7, MW-8, MW-9, and MW-10.

A summary of monitoring well TCE and TCA concentrations are contained in Appendix A, "TCE and TCA Summary". In addition,

TABLE 4
GROUND WATER ELEVATIONS

WELL NUMBER	TOP OF PROTECTIVE CASING	DEPTH TO WATER FROM TOP OF CASING	GROUND WATER ELEVATION	DATE
MW-1	926.71	90.45	836.26	10/14/91
MW-2	920.99	81.24	839.75	3/18/91
MW-2	920.99	83.00	837.99	10/14/91
MW-3	913.54	77.86	835.68	3/18/91
MW-3	913.54	76.01	837.53	10/14/91
MW-4	914.82	72.88	841.94	10/14/91
MW-5S	906.68	71.02	835.66	3/18/91
MW-5S	906.68	70.75	835.93	10/14/91
MW-5D	905.33	69.19	836.14	10/14/91
MW-6	919.93	86.74	833.19	3/18/91
MW-6	919.93	85.07	834.86	10/14/91
MW-7	916.53	88.24	828.29	10/14/91
MW-9	916.93	163.14	753.79	10/14/91
MW-10	918.31	172.34	745.97	10/14/91

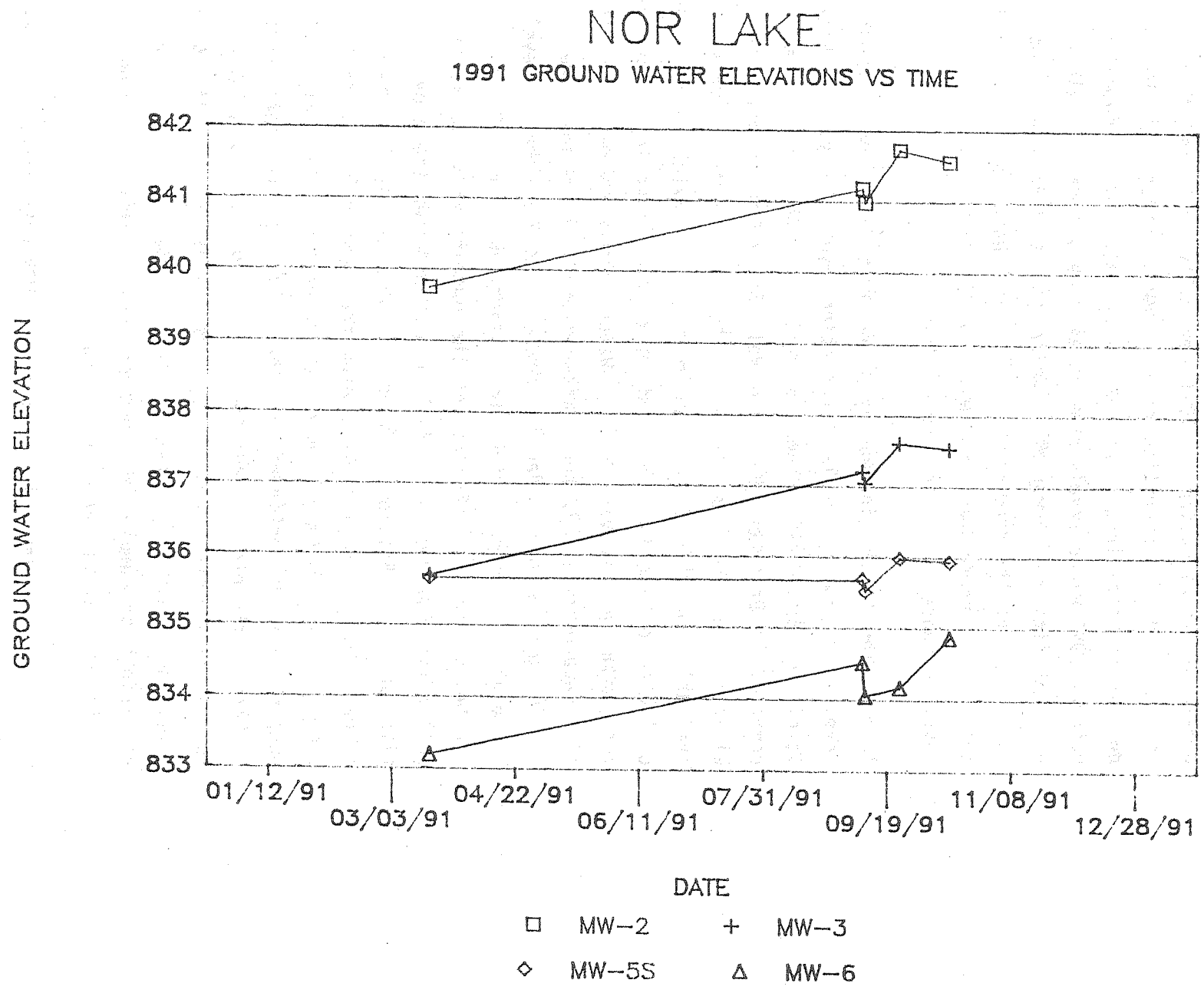

FIGURE 9

1242

NOR-LAKE, INC.

PHASE II
EVALUATION OF REMEDIATION SYSTEMS
DELTA PROJECT NO. A095-195

Prepared by:

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January 27, 1997

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K MLAEMW Ground Water Model Input Data
L Regression Curves
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NOR-LAKE, INC.

PHASE II

EVALUATION OF REMEDIATION SYSTEMS

DELTA PROJECT NUMBER A095-195

1.0 INTRODUCTION

Date?

1.1 Background

Nor-Lake, Inc. (Nor-Lake) is a manufacturer of commercial refrigerator systems and has an office and production facility located in Hudson, Wisconsin. In 1984, Nor-Lake discovered that the soil and ground water beneath and surrounding their production facility (Figure 1-1) was impacted with volatile organic compounds (VOC), such as 1,1-dichloroethane (DCA), trichloroethene (TCE), and 1,1,1-trichloroethane (TCA). As required by law, Nor-Lake reported this identified contamination to the Wisconsin Department of Natural Resources (WDNR). The source of these VOCs appear to have originated from the former use of solvents for degreasing operations and historical releases of these solvents to a septic tank and dry well/leach field system positioned beneath the north central portion of the facility. The septic system and dry well/leach field have since been abandoned.

In September 1984, WDNR staff formally notified Nor-Lake of their obligation to investigate the extent of contamination associated with the plant waste disposal activities and to develop soil and ground water cleanup plans. Nor-Lake retained an environmental consultant, Soil Exploration Company (also known as Twin City Testing), to conduct the initial investigation and prepare cleanup plans. Soil Exploration Company submitted the first investigative report in October 19, 1984, and followed up with a supplemental remedial investigation report containing a remedial action plan on June 4, 1985.

WDNR staff concurred with the investigative findings and the recommended remedial action plan, which called for the installation of a recovery well (RW-1) on the Nor-Lake property. RW-1 was installed in the fall of 1985, and pumping of the well began in April 1986. The recovery well pumped approximately 1,000 gallons per minute (gpm). The extracted ground water was treated by a fabricated aeration system that sprayed the water into the air. The aerated water was allowed to cascade down a series of lined chutes. These chutes discharged the water to a linear seepage ditch (approximately 500 feet in length) and in a small natural depression. All treatment and infiltration occurred on Nor-Lake properties.

The ground water pumping and treatment system operated for approximately 7 months (April through October) each year from 1986 through 1990. During this time, Nor-Lake continued to sample 10 on-site and off-site monitoring wells and up to 16 private wells for VOCs. In addition, they monitored the influent and effluent water quality of the aeration system and monitored and treated the plant drinking and process water supplies.

In 1991, the WDNR notified Nor-Lake that they must improve the VOC removal efficiency of the aeration system prior to restarting of the system. Nor-Lake retained Ayres Associates (Ayres) in 1991 to investigate several options to improve the treatment efficiency and to conduct pilot tests of the system. As a result of these investigations, the system did not operate in 1991.

In 1992, Nor-Lake signed a WDNR Consent Order agreeing to upgrade the existing ground water extraction and treatment system, install a soil vapor extraction (SVE) system, and install five more monitoring wells. Nor-Lake modified the ground water extraction and treatment system to incorporate two on-site wells: RW-1, modified to pump in the upper more-contaminated portion of the aquifer, and RW-2, formerly the plant's north well. The combined pumping rate of these two wells was approximately 300 gpm. The extracted ground water was treated with a manufactured aeration tower that achieved complete removal of VOCs prior to discharge to a seepage cell . This seepage cell was also modified in 1992. This system became operational on November 24, 1992, and has operated 365 days per year, 24 hours per day since that time, except for a few short 1 or 2 day maintenance periods.

In 1993, the SVE was installed north of the Nor-Lake plant. The system consists of 12 vapor extraction vents, all screened in the soil above the bedrock, and a 5-horsepower blower that maintains a vacuum on up to 6 vents at a time. The active vents are rotated monthly to change the air flow pattern and promote optimal VOC removal from the soil. This system began operation in September 1993 and generally has operated continuously since that time, except for some short term maintenance and test periods.

The monitoring wells (15) and private wells have been monitored over the period of remediation, and the results of testing have shown significant decreasing VOC concentration trends. In October 1995, the WDNR and Nor-Lake entered into a Stipulation Agreement. One aspect of the agreement addressed the need for an independent evaluation of the existing remediation systems at the Nor-Lake facility. Delta Environmental Consultants, Inc. (Delta), was retained by Nor-Lake to conduct this study with the field support of Ayres in 1996.

According to the Stipulation, Nor-Lake agreed to "conduct an evaluation of whether it is cost-effective to expand" its ground water extraction/treatment system and soil vapor extraction system through "increase(ing) the area of influence" of those existing systems (Nor-Lake vs. WDNR, 1995). As part of this, the stipulation required an evaluation of adding two recovery wells to the existing ground water extraction system, one located between RW-1 and MW-5S, and the other at the South Well.

To complete this evaluation, a two step process was conducted. First, the existing systems, contamination distribution, and hydrogeologic and geotechnical conditions were investigated to assess the effectiveness of the existing systems; these activities and results are described in Sections 2.0 through 5.0. Second, the costs of several alternative modifications to the systems were weighed in relation to the benefits derived; these are described in Section 6.0. Based on the results of the cost-benefit analysis, this report presents recommendations as required by the Stipulation; these are presented in Section 7.0.

2.0 SCOPE OF WORK

To complete the evaluation, two phases of work were completed. Phase I consisted of an analysis of existing information pertaining to the site. The results of the Phase I analysis were presented in a report titled *Evaluation of Remediation Systems at Nor-Lake Inc., Phase I, Historical Data and System Construction and Operations Review, Dated January 31, 1996.* This report presented a summary and discussion of existing information addressing:

- Nature and Location of Impacts
- Environmental Setting
- Remediation Systems

The Phase I Report also presented recommendations for additional tasks to be completed. These additional tasks comprise Phase II of the evaluation and include:

Task 1 - Collection of Additional SVE System Performance Data
Task 2 - Investigative Soil Borings and SVE Monitoring Points
Task 3 - Phase I SVE Pneumatic Testing
Task 4 - Gore-Sorber Pilot Study
Task 5 - Gore-Sorber Survey
Task 6 - Investigative Borings/Monitoring Wells
Task 7 - Phase II SVE Pneumatic Testing
Task 8 - Systems Evaluation and Modeling

The results of these tasks provide the basis for the conclusions and recommendations regarding possible modification or expansion of the two systems, and a cost benefit analysis. The results of each task are presented in the following sections of this report.

the extraction well is in Figure 3-8. The calculated effective radius of influence corresponding to 1 percent of the applied vacuum is 53 feet for the test.

3.8 Task 8 - Ground Water Extraction System Evaluation and Modeling

Purpose

The purpose of the ground water extraction system evaluation and modeling carried out in this project was to assess the effectiveness of capture of the existing ground water interception system and to determine if any modifications to the system would be advantageous. Specific objectives of the evaluation and model were to:

- Estimate the ground water flow directions and velocities in the vicinity of the Nor-Lake plant,
- Evaluate the effects of the existing interception wells,
- Estimate the capture zones for the existing interception wells, and
- Estimate the potential effects of modifications to the existing ground water interception system.

Methods

The modeling program used to develop this ground water model of the site vicinity is the Multiple-Layer Analytic Element Model for Windows (MLAEMW). This is a multi-aquifer, steady-state ground water flow program based upon the method of distributed singularities, also called the analytic element method. The analytic element method was developed at the University of Minnesota by Professor Otto D. L. Strack. The method and its application to ground water flow is described in Strack (1988).

MLAEMW includes a number of analytical functions, which can be used to represent or simulate different types of hydrogeologic features and processes. The different analytic elements to be used are placed into the aquifer domain at their geographic locations. These elements are placed within the area of interest and its vicinity so that the flow conditions within the area of interest sufficiently resemble those actually observed. The analytic element model approach simplifies the task of representing ground water flow conditions.

This approach is in contrast to conventional modeling approaches, which generally use either finite difference or finite element numerical approximation techniques. With these numerical approaches, the area to be modeled is subdivided into grids or networks of cells. Typically, hundreds to thousands of cells are required with boundary conditions defined for the outer perimeter of the model.

The analytic element approach was used because it offers several advantages for modeling the site's pumping systems. Because the model is analytic, head values and flow lines can be computed at any point in the modeled system. Determination of heads and flow patterns is useful near wells in unconfined aquifers where converging flow and changes in drawdown often result in errors with numerical models. Also, the model is not tied to any particular window onto the geographic area of the site vicinity, and the modeled area can be readily changed. For example, should the flow patterns in a particular subarea become important, the model can "zoom in" to a smaller window for closer scrutiny. Likewise, the model can "zoom out" to a larger window for evaluating the hydrogeologic setting of the site and assessing off-site ground water flow. This allows for a more flexible structure for the model and allows it to be used for a variety of purposes, as needed.

Model Assumptions

The model code and application make several assumptions. The model code assumes that the Dupuit-Forchheimer assumption is operative (*i.e.,* within the aquifer itself there are no vertical head gradients). Also, except for those elements that are otherwise designated, all elements fully penetrate the aquifer. The application assumes that the distribution of flow can be adequately simulated by representation of the hydrogeology described below.

Model Setup

The site model was developed by initially starting with a simple conceptual model and adding aquifer, surface hydrology, or cultural landmark features as they are found to be necessary. Because the model was focused on the Nor-Lake property, the hydrogeologic features in this immediate vicinity were represented in a more detailed and accurate manner while the hydrogeologic features more distant from the Nor-Lake vicinity were represented in a simpler, more approximate manner. This approach is commonly taken with analytic element models and helps keep the model from being overly complex. The initial parameter values were obtained from regional values and from the project's earlier system testing, described in 3.7, except where otherwise indicated with model calibration changing some of these values. The features ultimately included in the model are listed with their corresponding values.

Aquifer Base Elevation

The base elevation was defined for the combined alluvium-Prairie du Chien-Jordan (A-PC-J) aquifer. The combined aquifer was used initially because there is little local or regional information on subunits, which would lead to the aquifer being subdivided. More will be said about this in the model calibration section. The average base elevation was taken to be 560 feet above msl as determined from the observed A-PC-J contact at the plant's East Well (660 msl) and the inferred Jordan thickness of 100 feet.

Aquifer Thickness

The average aquifer thickness for the A-PC-J aquifer is assumed to be 350 feet, based on the base elevation and the general water table in the Nor-Lake vicinity.

Hydraulic Conductivity

The hydraulic conductivity for the combined A-PC-J aquifer was weighted to the value prevailing at the water table, so the Prairie du Chien value derived from the Task 7 pneumatic tests were preferentially relied upon. The initial conductivity for the aquifer was estimated to be 20 ft/day. For areas of thick alluvium, the hydraulic conductivity was estimated to be 100 ft/day, based upon hydraulic conductivity values obtained by Braun (1992). Slug tests in this study for wells completed in the alluvium ranged from 74 to 540 ft/day.

Porosity

The average porosity of the A-PC-J aquifer is assumed to be 10 percent. The average porosity of the A-PC-J aquifer is assumed to be 20 percent.

Inhomogeneities

The model uses inhomogeneity elements to change any one or any combination of the above-listed aquifer parameters within the inhomogeneity area. Two inhomogeneities were defined in the model and are described below.

North Alluvial Inhomogeneity

The buried tributary valley filled with alluvium, which lies immediately north of the Nor-Lake plant, was represented in the model as an inhomogeneity with an aquifer base of 560 feet msl, an aquifer thickness of 350 feet, and a hydraulic conductivity of 100 ft/day, which were tested by calibration.

South Alluvial Inhomogeneity

The buried tributary valley filled with alluvium which lies south of Nor-Lake and MW-1 was represented in the model as an inhomogeneity with an aquifer base of 560 feet msl, an aquifer thickness of 350 feet, and a hydraulic conductivity of 100 ft/day, which were tested by calibration.

St. Croix River, Willow River, and Associated Lakes

These streams are the natural points of discharge for the ground water flow system in the site vicinity. These were represented by a series of head-specified line sinks, positioned end-to-end to represent the streams' position and elevation along the respective reaches. The potentiometric head in these line sinks was set as the average elevation of the stream reach, as represented by the U. S. Geological Survey topographic maps of the site vicinity. This was an appropriate approach, given the natural and artificial pools along both of these rivers.

Net Infiltration

The net infiltration to the water table in the general vicinity was represented by a strength-specified areal element. This quadrilateral imposes a uniform infiltration flux to the ground water underlying the area. The net infiltration rate for the area was taken to be 6 inches per year. This is considered to be a representative value which past modeling experience has found to be within one-half order of magnitude of the actual value, when such information was available.

Pumping Wells

The interception well system and the plant East Well were represented by fully-penetrating wells. The wells' extraction rates used in the model were determined by their average pumping rates. The pumping rates used for RW-1, RW-2, and the East Well are 250, 50, and 10 gpm, respectively.

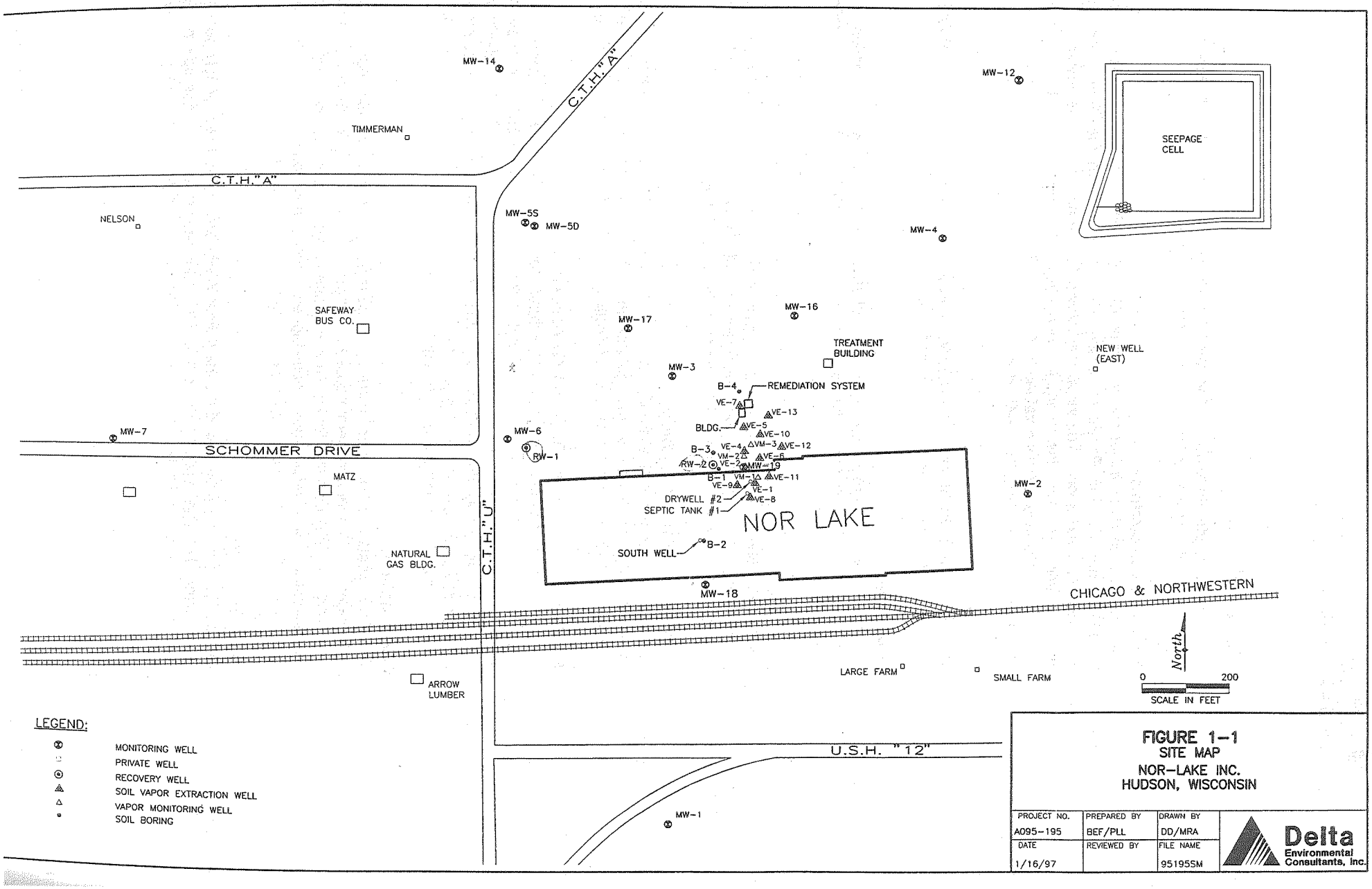
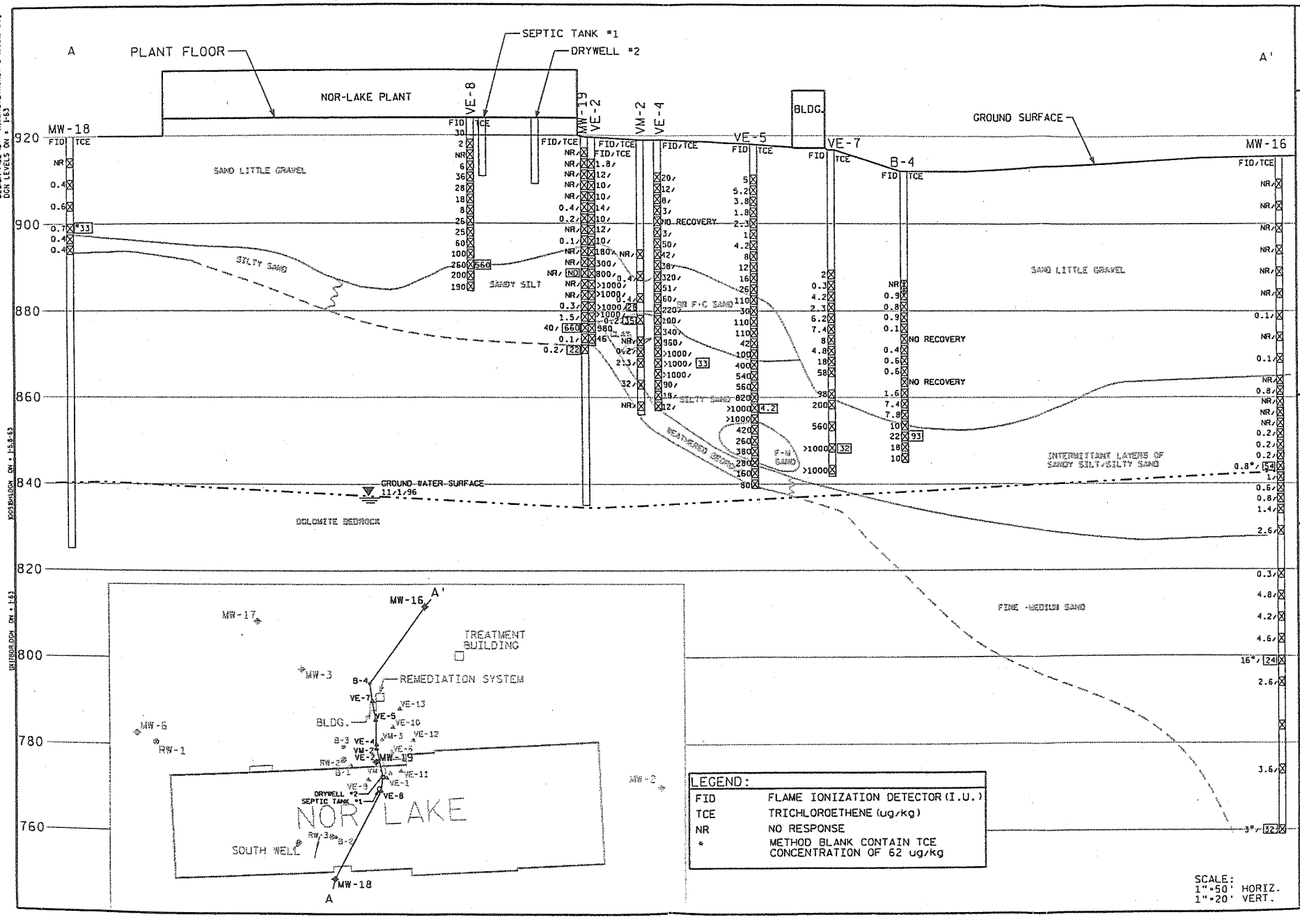
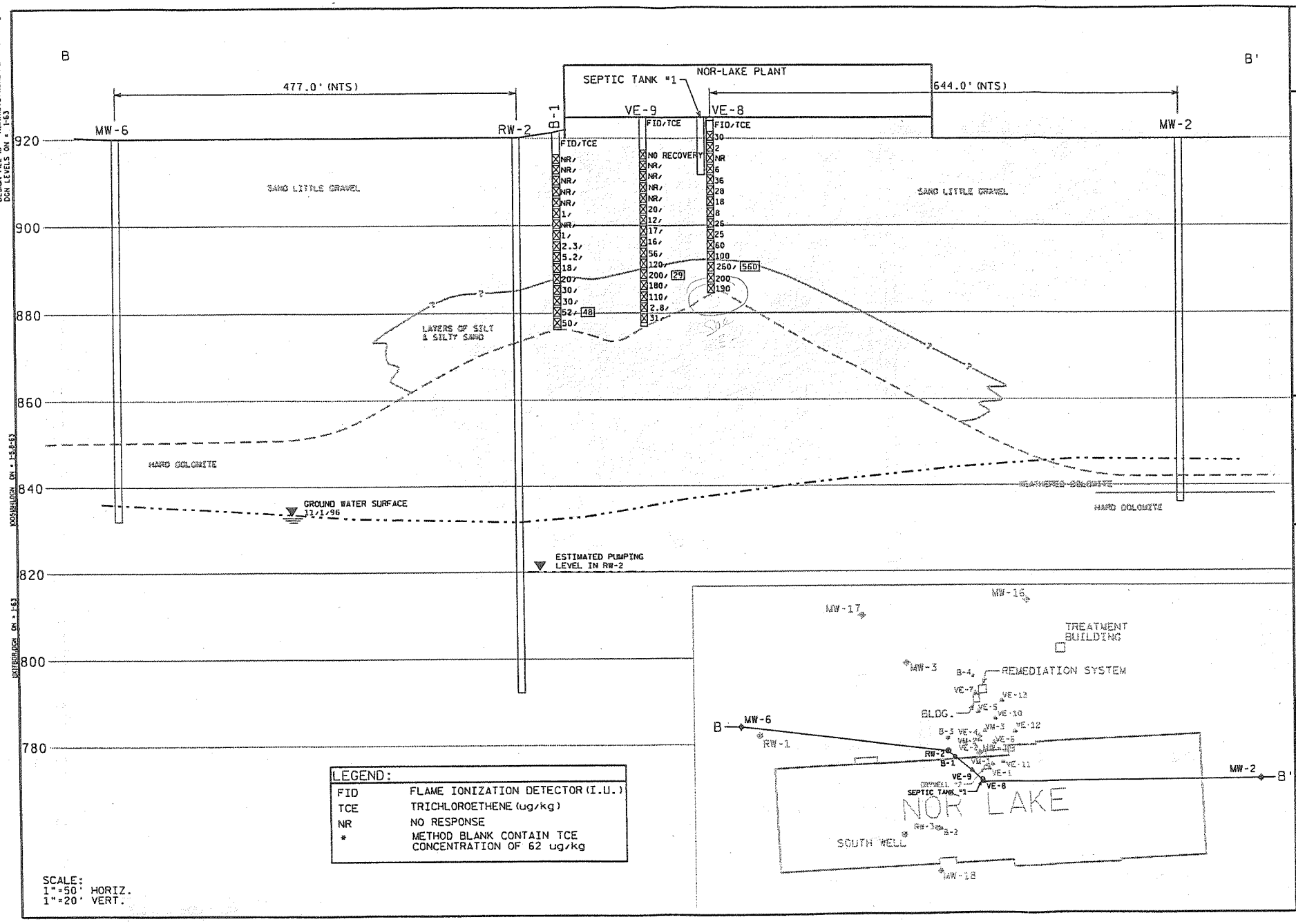


FIGURE 1-1
SITE MAP
NOR-LAKE INC.
HUDSON, WISCONSIN

PROJECT NO.	PREPARED BY	DRAWN BY
A095-195	BEF/PLL	DD/MRA
DATE	REVIEWED BY	FILE NAME
1/16/97		95195SM

Delta Environmental Consultants, Inc.


A
A'
PLANT FLOOR
NOR-LAKE PLANT
SEPTIC TANK #1
DRYWELL #2
BLDG.
GROUND SURFACE
MW-18
MW-19
VE-8
VE-2
VM-2
VE-4
VE-5
VE-7
B-4
MW-16
FID
TCE
SAND LITTLE GRAVEL
SILTY SAND
SANDY SILT
SILTY SAND
BEATHERED SANDY
F-M SAND
INTERMITTANT LAYERS OF SANDY SILT/SILTY SAND
FINE -MEDIUM SAND
NO RECOVERY
GROUND-WATER-SURFACE 11/1/96
DOLOMITE BEDROCK
920
900
880
860
840
820
800
780
760
MW-17
MW-3
MW-6
RW-1
TREATMENT BUILDING
REMEDIATION SYSTEM
BLDG.
NOR LAKE
SOUTH WELL
MW-2
LEGEND:
FID FLAME IONIZATION DETECTOR (I.U.)
TCE TRICHLOROETHENE (ug/kg)
NR NO RESPONSE
* METHOD BLANK CONTAIN TCE CONCENTRATION OF 62 ug/kg
SCALE:
1"=50' HORIZ.
1"=20' VERT.
CROSS SECTION A-A'
DRN. BY: ALE
CHK. BY: JAA
DATE: NOVEMBER 1996
AVES ASSOCIATES
WORK PLAN FOR
SOIL VAPOR EXTRACTION SYSTEM
NOR-LAKE INC.
HUDSON, WISCONSIN
FIGURE
3-1



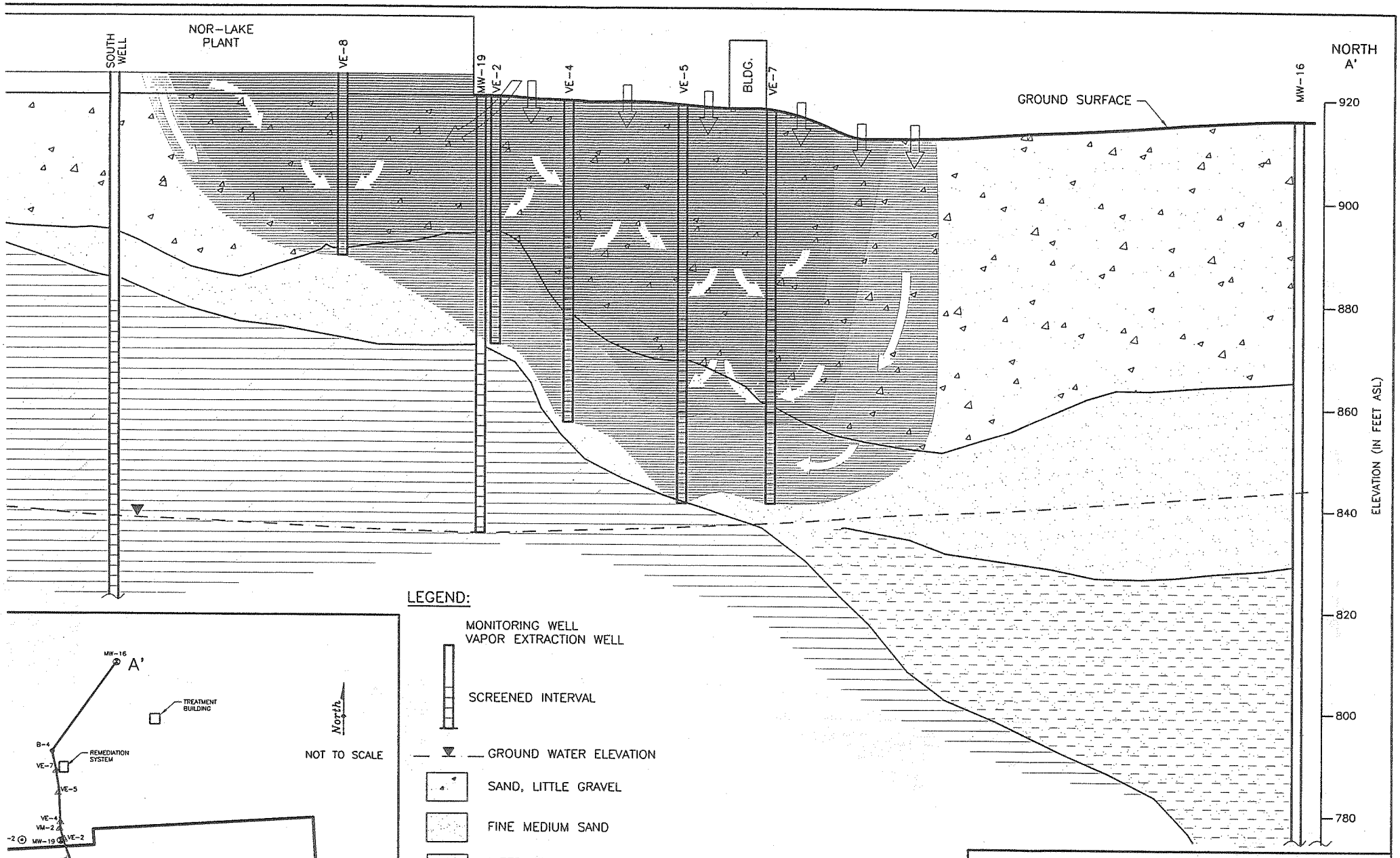
CROSS SECTION B-B'

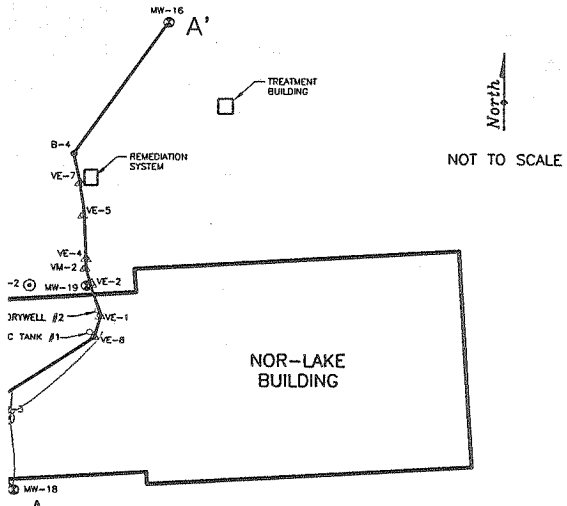
DRN. BY: LLE
CHK. BY: JAA
DATE: NOVEMBER 1996

AVRES ASSOCIATES

WORK PLAN FOR
SOIL VAPOR EXTRACTION SYSTEM
NOR-LAKE INC.
HUDSON, WISCONSIN

FIGURE
3-2





LOCATION MAP

LEGEND:

MONITORING WELL
VAPOR EXTRACTION WELL

SCREENED INTERVAL

GROUND WATER ELEVATION

SAND, LITTLE GRAVEL

FINE MEDIUM SAND

INTERMITTENT LAYERS OF SANDY SILT, SILTY SAND

FINE MEDIUM SAND

SVE FLOW PATH INTAKE PERCENTAGES

80% OF AIR INTAKE

10% OF AIR INTAKE

10% OF AIR INTAKE

VERTICAL SCALE (FEET) 20

HORIZONTAL SCALE (FEET) 50

FIGURE 3-6
ILLUSTRATION OF PREFERENTIAL FLOW PATHS TO SVE POINTS NOR-LAKE, INC. HUDSON, WISCONSIN

PROJECT NO.	PREPARED BY	DRAWN BY
A095-195	BEF	MRA
DATE	REVIEWED BY	FILE NAME
1/15/97		95195XC

Delta Environmental Consultants, Inc.

State of Wisconsin
Department of Natural Resources

Route To:
- ☐ Solid Waste
- ☐ Emergency Response
- ☐ Wastewater
- ☐ Haz. Waste
- ☐ Underground Tanks
- ☐ Water Resources
- ☒ Other

Soil Boring Log Information

Form 4400-122 7-91

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
NOR-LAKE		MW-16

Boring Drilled By (Firm name and name of crew chief)	Date Drilling Started	Date Drilling Completed	Drilling Method
Boart Longyear-Paul	9/18/96	9/20/96	HSA/Mud Rotar

DNR Facility Well No.	WI Unique Well No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-16	844.0 Feet MSL	915.0 Feet MSL	8.1 Inches

Boring Location
State Plane N, E
NW 1/4 of NW 1/4 of Section 22 T 29 N,R 26E
Lat ° ' "
Long ° ' "
Local Grid Location (If applicable)
Feet ☒ N ☐ S Feet ☒ E ☐ W

County	DNR County Code	Civil Town/City/ or Village
ST. CROIX	55	HUDSON

Sample Number	Length (in) Recovered	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200	RQD/ Comments
			4		SP									
1	8			*5 foot sample interval to 50 feet. Light brown fine to coarse sand, trace gravel.				NR		D				
			8		SW									
2	10		12	Light brown fine to coarse sand and gravel.				NR		D				
3	16		16					NR		D				
				Light brown fine to medium sand.	SP									
			20		SW									
4	20			Light brown fine to coarse sand and gravel.				NR		D				
			24		SP									
5	18							NR		D-M				
			28											
6	10			Light brown fine sand.				NR		M				
			32		SP									
7	16		36					0.1		M				
8	12		40					NR		M				
			44	Light brown fine to medium sand.										
9	16							0.1		M				
			48											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm
AYRES ASSOCIATES
3433 Oakwood Hills Parkway Eau Claire, WI 54701
Tel: (715) 834-3161 Fax: (715) 831-7500

This form is authorized by Chapters 144, 147 and 162, Wis. Stats. Completion of this report is mandatory. Penalties: Forfeit not less than $10 nor more than $5,000 for each violation. Fined not less than $10 or more than $100 or imprisoned not less than 30 days, or both for each violation. Each day of continued violation is a separate offense, pursuant to ss 144.99 and 162.06, Wis. Stats.

State of Wisconsin
Department of Natural Resources

Soil Boring Log Information Supplement

Form 4400-122A

7-91

Boring Number **MW-16** Use only as an attachment to Form 4400-122.

Sample Number	Length (in) Recovered	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200	RQD/ Comments
10	14			*2.5 foot sample interval to 80 feet.	SM									
			52	Brown silty sand.	ML			NR		M				
11	14			3 inches brown silt.	SP			0.8		M				
12	14		56	Light brown fine sand.	SP			NR		M				
13	20			Light brown fine sand, trace silt.	ML			NR		M				
14	20		60	Light brown fine to medium sand.	ML			NR		M				
15	16			Light brown very fine sand.	SM			0.2		M				
			64	Brown sandy silt.	ML			0.2		M				
16	18			Brown silt.	SP			0.2		M				
17	6		68	Brown silty sand.	ML			0.8		W				LAB SAMPLE
18	18			Brown very fine sand.	SP			1.0		W				
			72	Brown sandy silt.	SP			0.6		W				
19	21			Light brown fine sand.	SP			0.8		W				
20	12		76	2 inches brown silt.	SP			1.4		W				
21	16			Light brown fine to medium sand.	ML			2.6		W				
22	22		80	Brown fine sand.	ML			0.3		W				
				Brown fine sand, trace silt.	SW			4.8		W				
			84	Brown fine sand.	SW			4.2		W				
23	12			Brown sandy silt. *five foot sample interval to 100 feet.	SW			4.6		W				
			88	Brown silt.	SP			16		W				LAB SAMPLE
24	0			Brown fine to medium sand and gravel.	SP			2.6		W				
			92	No Recovery, Gravel in cuttings.	SP									
25	6			Light brown fine to medium sand.	SP									
			96	Brown fine to coarse sand and gravel.	SP									
26	16		100		SP									
27	10		104		SP									
			108		SP									
28	12				SP									
			112		SP									
29	12				SP									
			116		SP									
30	8		120	Brown fine to medium sand, trace gravel.	SP									
			124		SP									
			128		SP									

State of Wisconsin
Department of Natural Resources

Soil Boring Log Information Supplement
Form 4400-122A
7-91

Boring Number **MW-16** Use only as an attachment to Form 4400-122.

Sample Number	Sample Length (in) Recovered	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200	RQD/ Comments
31	12		132	Brown medium to coarse sand, trace gravel.	SP			2.0		W				
			136											
32	10		140					3.6		W				
			144											
			148	Brown fine to medium sand.										
			152											
33	18		156	END OF BORING @ 156 FEET.				3.0		W				LAB SAMPLE

State of Wisconsin
Department of Natural Resources

Route To:
- ☐ Solid Waste
- ☐ Emergency Response
- ☐ Wastewater
- ☐ Haz. Waste
- ☐ Underground Tanks
- ☐ Water Resources
- ☒ Other

Soil Boring Log Information

Form 4400-122 7-91

Facility/Project Name: NOR-LAKE	License/Permit/Monitoring Number	Boring Number: MW-17	
Boring Drilled By (Firm name and name of crew chief): Boart Longyear-Paul	Date Drilling Started: 9/24/96	Date Drilling Completed: 9/24/96	Drilling Method: HSA
DNR Facility Well No. / WI Unique Well No. / Common Well Name: MW-17	Final Static Water Level: 855.3 Feet MSL	Surface Elevation: 909.3 Feet MSL	Borehole Diameter: 8.1 Inches
Boring Location — State Plane: NW 1/4 of NW 1/4 of Section 22 T 29 N,R 26E; N, E	Lat ° ' " / Long ° ' "	Local Grid Location (If applicable): ☒ N Feet ☐ S; ☒ E Feet ☐ W	
County: ST. CROIX	DNR County Code: 55	Civil Town/City/ or Village: HUDSON	

Sample Number	Length (in) Recovered	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200	RQD/ Comments
			3	*5 foot sample interval to 50 feet.	SW									
1	10		6					0.1		D				
			9	Brown fine to medium sand and gravel.										
2	3		12					0.2		D				
3	14		15	Brown fine to coarse sand and gravel.	SW			0.1		D				
			18											
4	2		21	Brown fine to coarse sand and gravel, trace silt.	SW			0.2		D-M				
			24											
5			27	No Recovery	SP									
6	18		30	Brown fine to medium sand.	ML			0.5		D-M				
			33	Brown very fine sandy silt.	SP									
				Brown medium to fine sand.	SP									
			36	Brown very fine sand.	SP									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: [signature]

Firm: AYRES ASSOCIATES
3433 Oakwood Hills Parkway Eau Claire, WI 54701
Tel: (715) 834-3161 Fax: (715) 831-7500

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State of Wisconsin
Department of Natural Resources

Soil Boring Log Information Supplement
Form 4400-122A
7-91

Boring Number **MW-17** Use only as an attachment to Form 4400-122.

Sample Number	Length (in) Recovered	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200	RQD/ Comments
7	19							NR		D-M				
			39	Brown fine sandy silt.										
8	18							0.4		D-M				
			42	Brown silt.	ML									
					ML									
9	20		45					NR		M				
				Brown very fine sandy silt.										
			48											
10	22			*2.5 foot sample interval to 80 feet.										
			51	2 inches silty sand.	ML			NR		M				
				Brown very fine sandy silt.	ML									
11	22				ML			0.7		M/W				LAB SAMPLE
			54	2 inches silty sand.	ML									
12				Brown very fine sandy silt.	ML									
			57	No Recovery, pounded spoon twice.										
13	24			Brown very fine sandy silt.	ML			NR		W				
			60	12 inches brown silt.	ML									
14	23				ML			0.1		W				
				Brown very fine sandy silt.										
15	10		63					NR		W				
				Brown silt.										
16	24		66					NR		W				LAB SAMPLE
				END OF BORING @ 67 FEET.										

State of Wisconsin
Department of Natural Resources

Route To:
- ☐ Solid Waste
- ☐ Emergency Response
- ☐ Wastewater
- ☐ Haz. Waste
- ☐ Underground Tanks
- ☐ Water Resources
- ☒ Other

Soil Boring Log Information

Form 4400-122 7-91

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
NOR-LAKE		MW-18

Boring Drilled By (Firm name and name of crew chief)	Date Drilling Started	Date Drilling Completed	Drilling Method
Boart Longyear-Paul	9/18/96	9/23/96	HSA/Air Rotary

DNR Facility Well No.	WI Unique Well No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-18	841.0 Feet MSL	920.0 Feet MSL	10.0 Inches

Boring Location
State Plane N, E
NW 1/4 of NW 1/4 of Section 22 T 29 N,R 26E
Lat ° ' "
Long ° ' "

Local Grid Location (If applicable)
Feet ☒ N ☐ S
Feet ☒ E ☐ W

County	DNR County Code	Civil Town/City/ or Village
ST. CROIX	55	HUDSON

Sample Number	Length (in) Recovered	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200	RQD/ Comments
					SP									
			4.5	*5 foot sample interval to 20 feet.										
1	8							NR		M				
			9.0											
2	4			Brown medium to coarse sand and gravel.				0.4		M				
			13.5											
3	3							0.6		M				
			18.0											
4	10			*2.5 foot sample interval to bedrock				0.7		M				
5	8		22.5					0.4		M			LAB SAMPLE	
6	2				SM			0.4		M				
			27.0	Light brown silty sand and gravel (rock flour).										
				TOP OF BEDROCK AT 26 FEET.				NR		D				
			31.5											
			36.0											
			40.5											
			45.0	DOLOMITE BEDROCK.										
			49.5					0.4		D				
			54.0											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature: Aaron B. Dunne

Firm: AYRES ASSOCIATES
3433 Oakwood Hills Parkway Eau Claire, WI 54701
Tel: (715) 834-3161 Fax: (715) 831-7500

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State of Wisconsin
Department of Natural Resources

Soil Boring Log Information Supplement
Form 4400-122A
7-91

Boring Number **MW-18** Use only as an attachment to Form 4400-122.

Sample Number	Sample Length (in) Recovered	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200	RQD/ Comments
			58.5											
			63.0					NR		D				
				DOLOMITE BEDROCK										
			67.5											
			72.0											
			76.5					NR		W				
			81.0											
			85.5					NR		D				
			90.0											
			94.5					NR		M				
				END OF BORING @ 95 FEET.										

State of Wisconsin
Department of Natural Resources

Route To:
- ☐ Solid Waste
- ☐ Emergency Response
- ☐ Wastewater
- ☐ Haz. Waste
- ☐ Underground Tanks
- ☐ Water Resources
- ☒ Other

Soil Boring Log Information

Form 4400-122 7-91

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
NOR-LAKE		MW-19

Boring Drilled By (Firm name and name of crew chief)	Date Drilling Started	Date Drilling Completed	Drilling Method
Boart Longyear-Randy Radtke	10/23/96	10/24/96	HSA/Air Rotary

DNR Facility Well No.	WI Unique Well No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		MW-19	835.8 Feet MSL	919.6 Feet MSL	10.0 Inches

Boring Location
State Plane N, E
NW 1/4 of NW 1/4 of Section 22 T 29 N,R 26E
Lat ° ' "
Long ° ' "

Local Grid Location (If applicable)
Feet ☒ N ☐ S Feet ☒ E ☐ W

County	DNR County Code	Civil Town/City/ or Village
ST. CROIX	55	HUDSON

Sample Number	Length (in) Recovered	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200	RQD/ Comments
			1.5		SW									
1	14		3.0	Dark brown silty sand and gravel.				NR		M				
			4.5	Brown fine to medium sand.	SP									
2	18				SP			NR		M				
			6.0											
3	10		7.5	Dark brown sand and gravel.				NR		M				
			9.0	8 inches medium to coarse sand and gravel.	SP									
				2 inches light brown fine sand.	SP									
4	10		10.5	Light brown fine to medium sand.	SP			NR		M				
			12.0											
5	14		13.5		SP			NR		M				
6	12		15.0					0.4		M				
			16.5	(Sample #6-Grain Size Analysis-91.7% sand, 5.9% gravel, 2.4% silt)										
			18.0											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm AYRES ASSOCIATES
3433 Oakwood Hills Parkway Eau Claire, WI 54701
Tel: (715) 834-3161 Fax: (715) 831-7500

This form is authorized by Chapters 144, 147 and 162, Wis. Stats. Completion of this report is mandatory. Penalties: Forfeit not less than $10 nor more than $5,000 for each violation. Fined not less than $10 or more than $100 or imprisoned not less than 30 days, or both for each violation. Each day of continued violation is a separate offense, pursuant to ss 144.99 and 162.06, Wis. Stats.

State of Wisconsin
Department of Natural Resources

Soil Boring Log Information Supplement

Form 4400-122A 7-91

Boring Number **MW-19** Use only as an attachment to Form 4400-122.

Sample Number	Sample Length (in) Recovered	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200	RQD/ Comments
7	10							0.2		M				
			19.5	Light brown medium to coarse sand and fine gravel.										
8	12							NR		M				
			21.0											
			22.5											
9	10							0.1		M				
			24.0											
				Light brown fine sand.	SP									
10	20		25.5	Brown very fine sandy silt.	ML			NR		M				
				Light brown fine sand.	SP									
			27.0	Brown very fine sandy silt.	ML									
11	20				SM			NR		M				
			28.5	Light brown fine sand with silt. (Sample #11 grain size analysis, 91.5% sand, 8.5% silt)										
12	16		30.0	Brown very fine sandy silt.	ML			NR		M			LAB SAMPLE	
				2 inches sandy silt.	ML									
			31.5	Brown very fine sandy silt.	ML									
13	24		33.0	Light brown fine sand.	SP			NR		M				
				Brown very fine sandy silt.	ML									
			34.5	4 inches brown silt. (Sample # 13 grain size analysis, 72.3% silt, 23.6% sand, 4.1% gravel)	ML									
14	20		36.0	Brown very fine sandy silt.	SP			NR		M				
				Light brown fine sand.	ML									
			37.5	Brown silt.	SP									
15	24			Light brown fine sand.	ML			0.3		M				
			39.0	1 inch brown silt.	ML									
				Sandy silt.	SP									
16	20		40.5	Brown fine sand.	ML			1.5		M				
				Brown sandy silt.	ML									
			42.0	Light brown very fine sand with silt.	GM									
17	24			Brown silt and gravel.	ML			40		M			LAB SAMPLE	
			43.5	Light brown very fine sand.	SM									
				Brown silty sand.	ML									
18	20		45.0	Brown silt.	SP			0.1		M				
				Light brown fine sand.	SM									
			46.5	Brown silty sand, trace gravel.	ML									
				Brown very fine sandy silt.	SM									
			48.0		SW									
					SM									

State of Wisconsin
Department of Natural Resources

Soil Boring Log Information Supplement
Form 4400-122A 7-91

Boring Number **MW-19** Use only as an attachment to Form 4400-122.

Sample Number	Sample Length (in) Recovered	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200	RQD/ Comments
19	10			Brown silty sand.	SP			0.2		M				LAB SAMPLE
			49.5	Brown medium to coarse sand and gravel.										
				Brown silty sand.										
			51.0	Brown medium to coarse sand.										
				DOLOMITE BEDROCK										
			52.5											
			54.0											
			55.5					NR		D				
			57.0											
			58.5											
			60.0											
			61.5											
			63.0											
			64.5	DOLOMITE BEDROCK.				0.4		D				
			66.0											
			67.5											
			69.0											
			70.5											
			72.0											
			73.5											
			75.0					NR		D				
			76.5	DOLOMITE BEDROCK.										
			78.0											

State of Wisconsin
Department of Natural Resources

Soil Boring Log Information Supplement
Form 4400-122A
7-91

Boring Number **MW-19** Use only as an attachment to Form 4400-122.

Sample Number	Sample Length (in) Recovered	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200	RQD/ Comments
			79.5											
			81.0											
			82.5											
			84.0					0.3		D				
				END OF BORING @ 84.5 FEET										

State of Wisconsin
Department of Natural Resources

Route To:
- ☐ Solid Waste
- ☐ Emergency Response
- ☐ Wastewater
- ☐ Haz. Waste
- ☐ Underground Tanks
- ☒ Water Resources
- ☐ Other

Soil Boring Log Information

Form 4400-122 7-91

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
NOR-LAKE		VM-2

Boring Drilled By (Firm name and name of crew chief)	Date Drilling Started	Date Drilling Completed	Drilling Method
Boart Longyear-Rick O'Gorman	5/6/96	5/7/96	HSA

DNR Facility Well No.	WI Unique Well No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		VM-2	Feet MSL	918.7 Feet MSL	10.0 Inches

Boring Location
State Plane N, E
NW 1/4 of NW 1/4 of Section 22 T 29 N,R 26E

Lat ° ' "
Long ° ' "

Local Grid Location (If applicable)
165 Feet ☒ N ☐ S
84 Feet ☒ E ☐ W

County	DNR County Code	Civil Town/City/ or Village
ST. CROIX	55	HUDSON

Sample Number	Length (in) Recovered	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200	RQD/ Comments
				BLIND DRILL TO 25 FEET, SOIL DESCRIPTION FROM CUTTINGS	SP									
			3											
			6	Brown medium to coarse sand and gravel.	SP									
			9											
				Brown Fine to medium sand.										
			12											
			15											
			18	As Above										
			21											
			24											
1	12			Red Brown fine sand.	SP			NR		D				
			27		SP									
2	12		30	Light brown fine sand.				0.4		D				
				Light brown silty sand.	SM									
			33	Light brown sandy silt.	ML SP									
			36											

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm AYRES ASSOCIATES
3433 Oakwood Hills Parkway Eau Claire, WI 54701
Tel: (715) 834-3161 Fax: (715) 831-7500

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State of Wisconsin
Department of Natural Resources

Soil Boring Log Information Supplement

Form 4400-122A 7-91

Boring Number **VM-2** Use only as an attachment to Form 4400-122.

Sample Number	Sample Length (in) Recovered	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200	RQD/ Comments
3	14			Brown fine sand.	SM			0.4		D				
			39											
4	24			Brown sandy silt.	SP			0.2		D				
			42	Brown fine sand.	ML									
				Dark brown sandy silt.	SP									
			45	Brown fine sand.	SM									
5	24			Dark brown silty sand.	CL			NR		D-M				
				1" clay layer @ 45.5 feet.	ML									
6	20		48	Dark brown silt.	SP			0.2		D				
				Light brown fine sand.	ML									
7	16		51	Red brown silt.	SM			2.3		M				
				Tan silty sand.	ML									
			54	Red brown silt.	SM									
8	24			Tan silty sand.	SM			32		M/D				
			57	Red brown silty sand.	ML									
				1" of weathered rock @ 51 feet.	ML									
9	4		60	Red brown sandy silt.	SW			NR		D				
				Red brown sandy silt.										
				2" dolomite zone										
				Brown fine to medium sand and gravel.										
				Weathered Dolomite										
				AUGER REFUSAL @ 62 FEET.										

State of Wisconsin
Department of Natural Resources

Route To:
- ☐ Solid Waste
- ☐ Emergency Response
- ☐ Wastewater
- ☐ Haz. Waste
- ☐ Underground Tanks
- ☒ Water Resources
- ☐ Other

Soil Boring Log Information

Form 4400-122 7-91

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
NOR-LAKE		VM-3

Boring Drilled By (Firm name and name of crew chief)	Date Drilling Started	Date Drilling Completed	Drilling Method
Boart Longyear-Rick O'Gorman	5/6/96	5/7/96	HSA

DNR Facility Well No.	WI Unique Well No.	Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
		VM-3	Feet MSL	918.3 Feet MSL	10.0 Inches

Boring Location
State Plane N, E
NW 1/4 of NW 1/4 of Section 22 T 29 N,R 26E
Lat ° ' "
Long ° ' "
Local Grid Location (If applicable)
180 Feet ☒ N ☐ S
95 Feet ☒ E ☐ W

County	DNR County Code	Civil Town/City/ or Village
ST. CROIX	55	HUDSON

Sample Number	Length (in) Recovered	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200	RQD/ Comments
				BLIND DRILL TO 30 FEET, SOIL DESCRIPTION FROM CUTTINGS.	SP									
			3.5											
			7.0											
			10.5											
			14.0	Red brown fine to medium sand.										
			17.5											
			21.0											
			24.5											
			28.0											
1	20		31.5					0.5		D				
			35.0		SM									
2	22			Brown silty sand.	SP			0.4		D				
			38.5											
3	24		42.0					0.4		D				

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature

Firm
AYRES ASSOCIATES
3433 Oakwood Hills Parkway Eau Claire, WI 54701
Tel: (715) 834-3161 Fax: (715) 831-7500

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State of Wisconsin
Department of Natural Resources

Soil Boring Log Information Supplement

Form 4400-122A

7-91

Boring Number **VM-3**

Use only as an attachment to Form 4400-122.

Sample Number	Length (in) Recovered	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plastic Limit	P 200	RQD/ Comments
				Brown fine sand.										
4	24		45.5											
				Brown silty sand	SM			12		D				
			49.0	1" clay layer @ 50.5 feet.	ML									
5	18							36		D				
			52.5											
				Brown sandy silt.										
6	16		56.0											
				Brown silty sand, trace gravel.	SM			> 1000		D-M				
					ML									
7	24		59.5											
				Brown sandy silt.				120		D				
			63.0	Brown fine to medium sand and gravel.	SW									
					SM									
8	24													
			66.5	Weathered Dolomite										
9	12							1.0		D				
				Brown sandy silt, trace gravel.										
				Light brown fine sand with dolomite chips.				NR		D				
				AUGER REFUSAL @ 67 FEET.										

TR

2004 Annual Report

Nor-Lake, Inc.
Hudson, Wisconsin

Prepared for:

Nor-Lake, Inc.
Hudson, Wisconsin

February 2005

AYRES
ASSOCIATES

2004 Annual Report

Nor-Lake, Inc.
Hudson, Wisconsin

This report prepared by:

2/14/05

Lori A. Rosemore, P.G.
Hydrogeologist

This report reviewed by:

2/11/05

James A. Anklam, P.E.
Environmental Engineer

AYRES ASSOCIATES
Engineers/Architects/Scientists/Surveyors

3433 Oakwood Hills Parkway
P.O. Box 1590
Eau Claire, WI 54702-1590
(715) 834-3161, FAX (715) 831-7500

Ayres Associates Project No. 00-0000.00
c:\documents and settings\logergrenp\local settings\temporary internet files\olk173\lar050210r.doc

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Fllwt.tbl
01/21/2005
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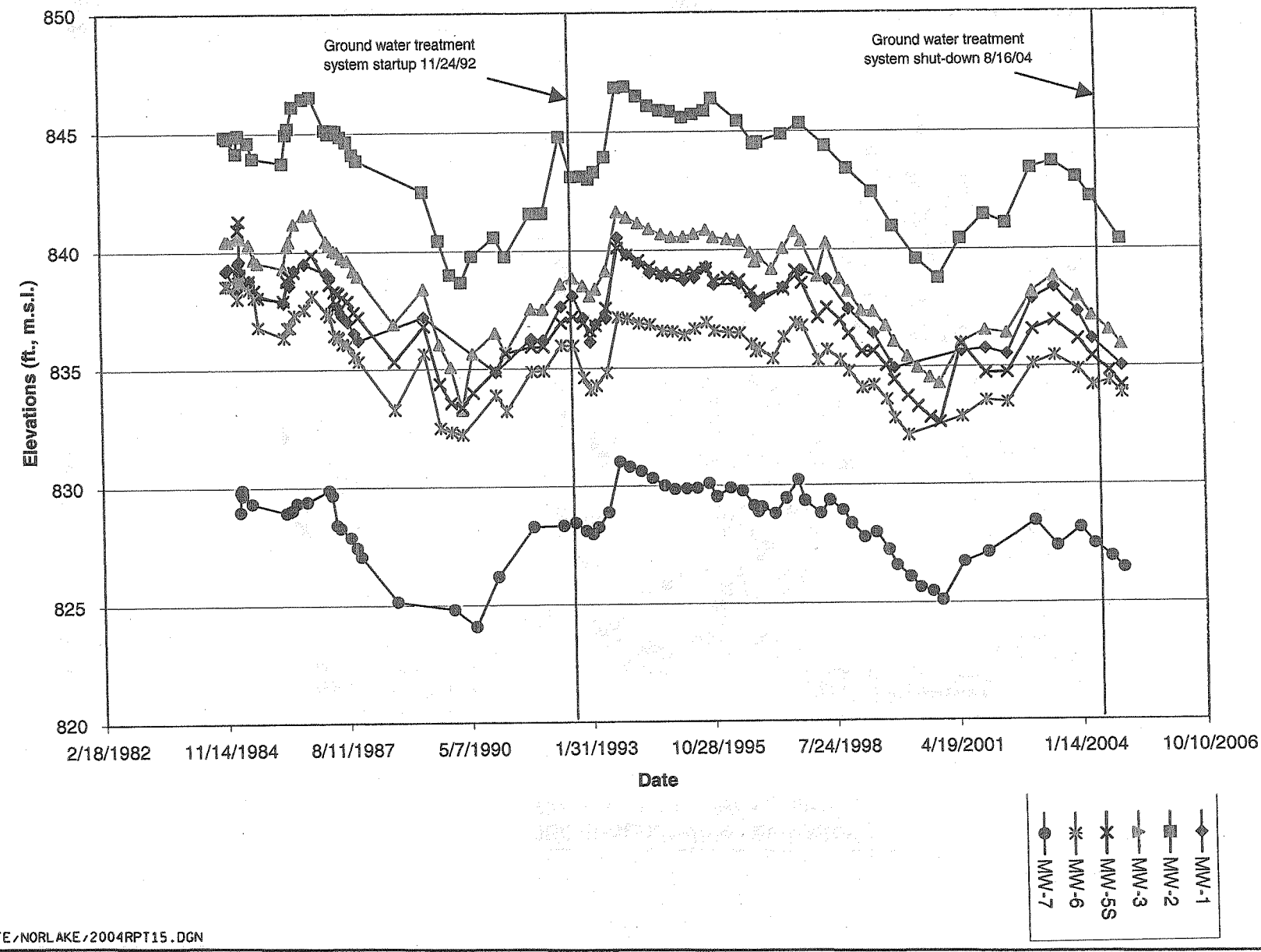
DGN LEVEL

2004 Ground Water Elevations
MW-1, MW-2, MW-3, MW-5S, MW-6, MW-7



2004 ANNUAL REPORT
NOR-LAKE, INC.
HUDSON, WISCONSIN

AVRES ASSOCIATES

DRN. BY: JCS
CHK. BY: LAR
DATE: JANUARY 2005

2004 GW ELEVATIONS
MW-1, MW-2, MW-3,
MW-5S, MW-6 & MW-7

FIGURE
4

K:/WASTE/NORLAKE/2004RPT15.DGN

D:±WASTE±2004rpt15.dgn 01/21/2005 Fllwt.tbl

Fllwt.tbl
01/21/2005
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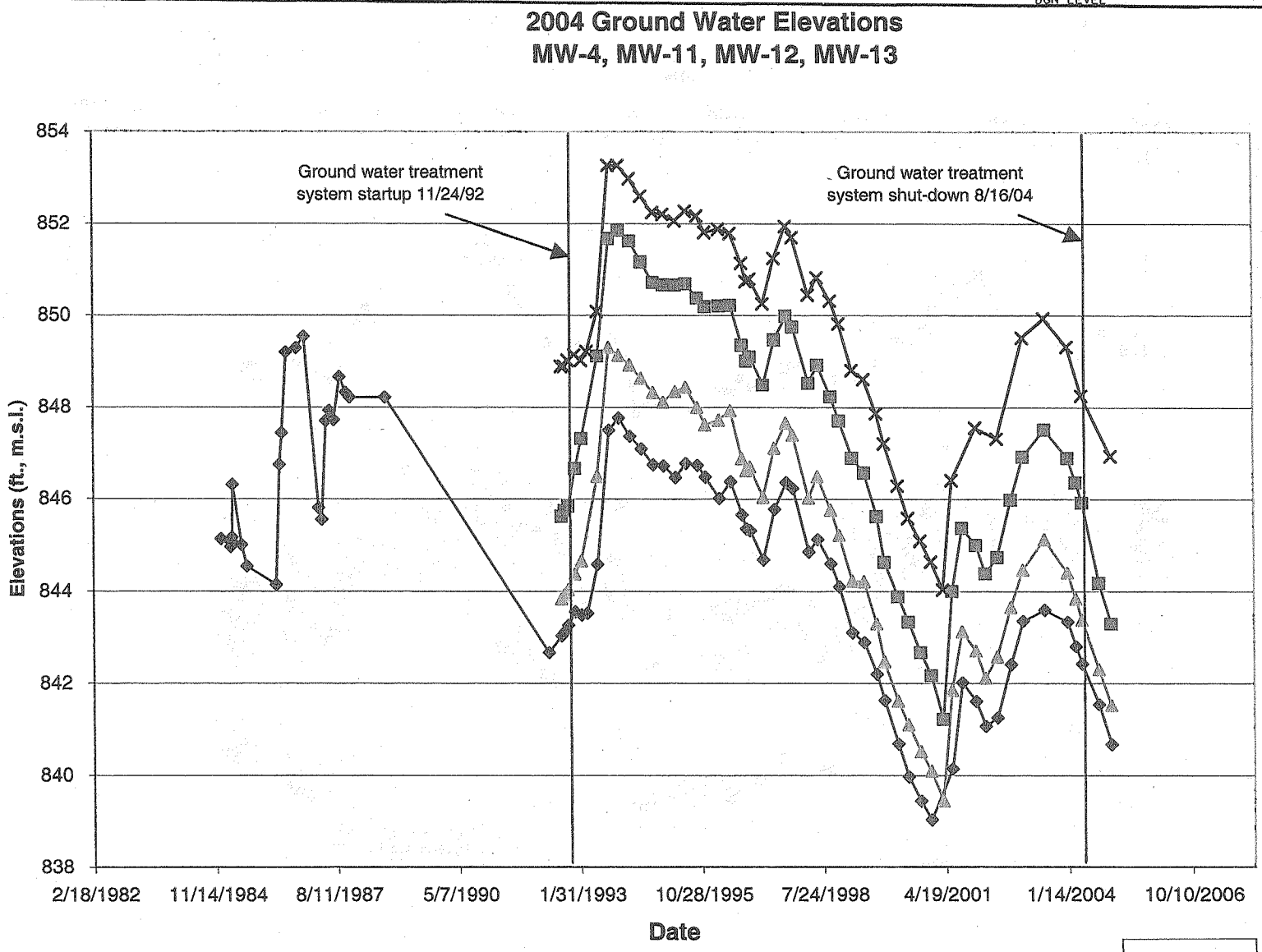
DGN LEVEL



2004 ANNUAL REPORT
NOR-LAKE, INC.
HUDSON, WISCONSIN

AVRES ASSOCIATES

DRN. BY: JGS
CHK. BY: LAR
DATE: JANUARY 2005

2004 GW ELEVATIONS
MW-4, MW-11,
MW-12 & MW-13

FIGURE
5

K:/WASTE/NORLAKE/2004RPT15.DGN

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Fllwt.tbl
01/21/2005
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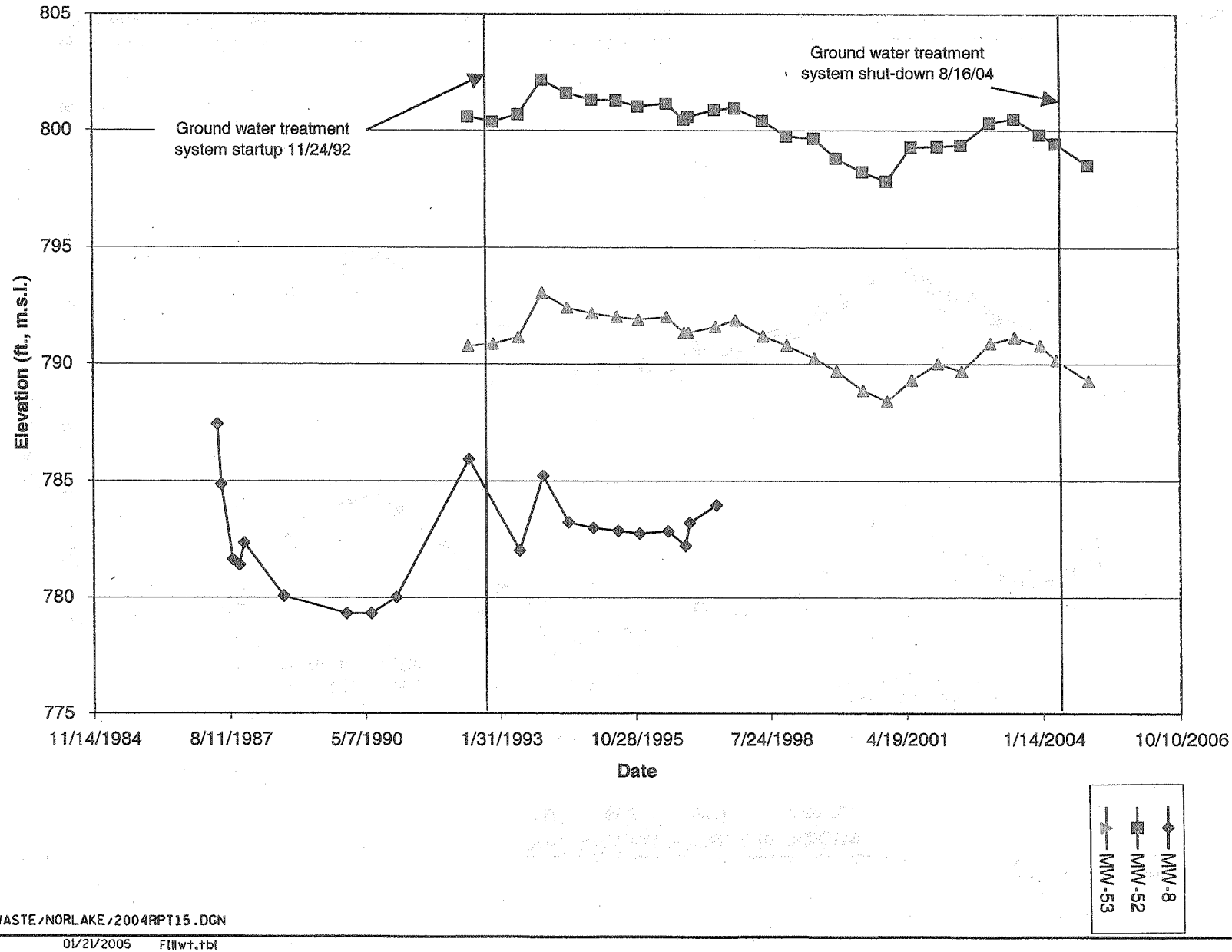
DGN LEVEL

2004 Ground Water Elevations
MW-8, MW-52, MW-53



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NOR-LAKE, INC.
HUDSON, WISCONSIN

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DRN. BY: JGS
CHK. BY: LAR
DATE: JANUARY 2005

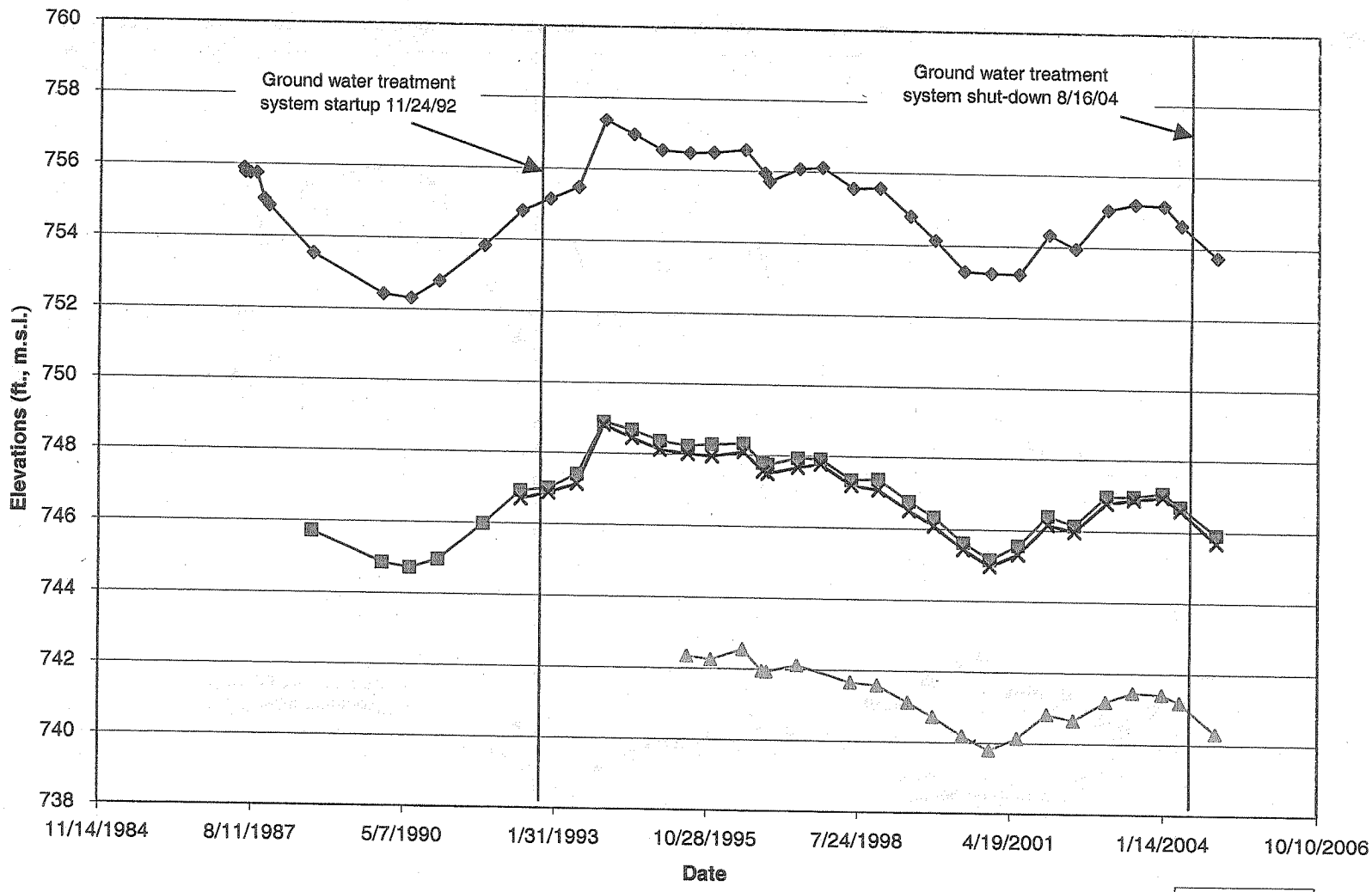
2004 GW ELEVATIONS
MW-8, MW-52 & MW-53

FIGURE
6

D:±WASTE±2004rpt15.dgn 01/21/2005 Fllwt.tbl

Fllwt.tbl
01/21/2005
D:\WASTE\2004rpt15.dgn
DGN LEVEL

2004 Ground Water Elevations
MW-9, MW-10, MW-51, MW-54



2004 ANNUAL REPORT
NOR-LAKE, INC.
HUDSON, WISCONSIN

AVRES ASSOCIATES

DRN. BY: JGS
CHK. BY: LAR
DATE: JANUARY 2005

2004 GW ELEVATIONS
MW-9, MW-10,
MW-51 & MW-54

FIGURE
7

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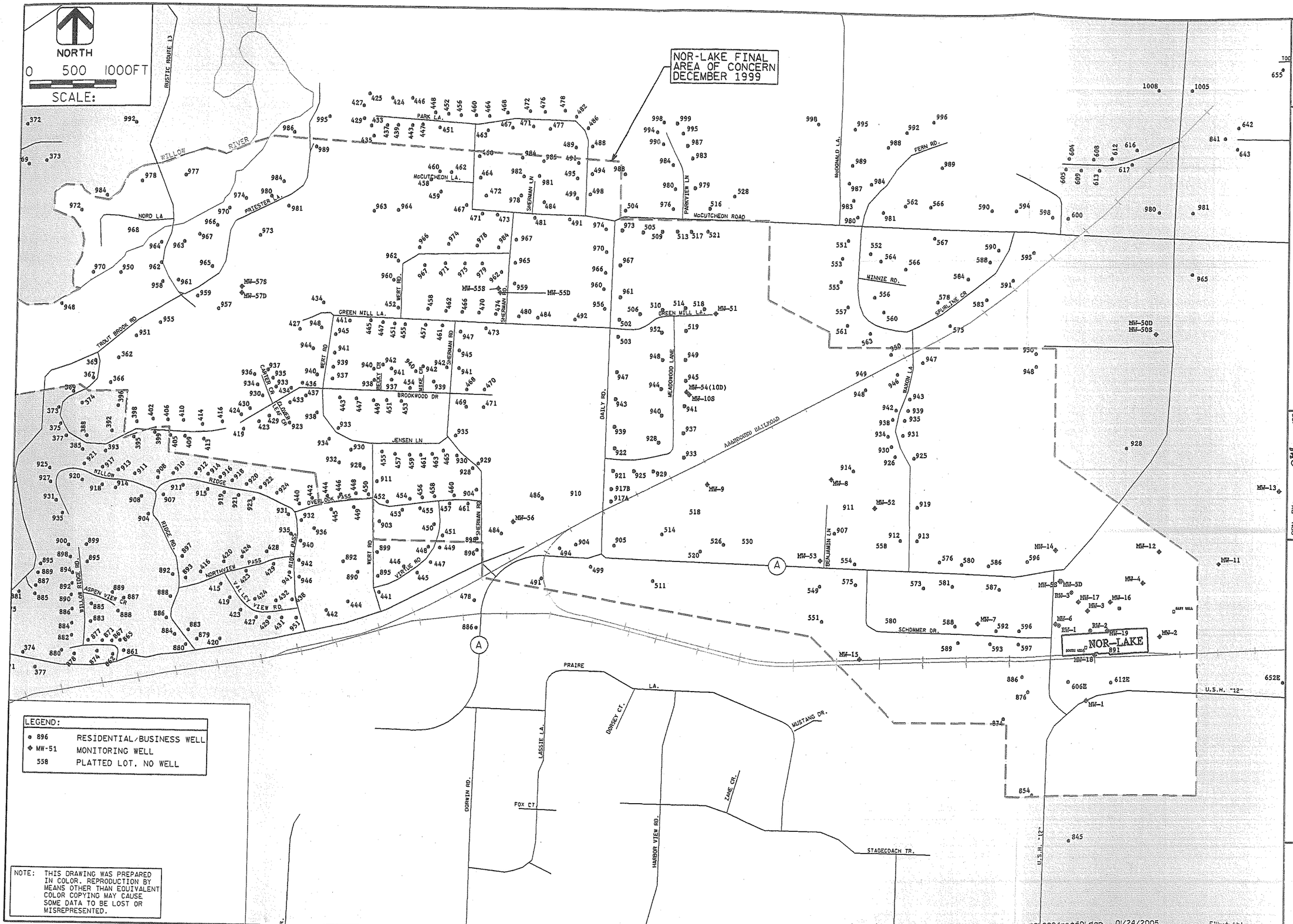


LEGEND:

• 896	RESIDENTIAL/BUSINESS WELL
◆ MW-51	MONITORING WELL
558	PLATTED LOT, NO WELL

NOTE: THIS DRAWING WAS PREPARED IN COLOR. REPRODUCTION BY MEANS OTHER THAN EQUIVALENT COLOR COPYING MAY CAUSE SOME DATA TO BE LOST OR MISREPRESENTED.

K:/WASTE/NORLAKE/2004RPTF01.DGN

SITE PLAN

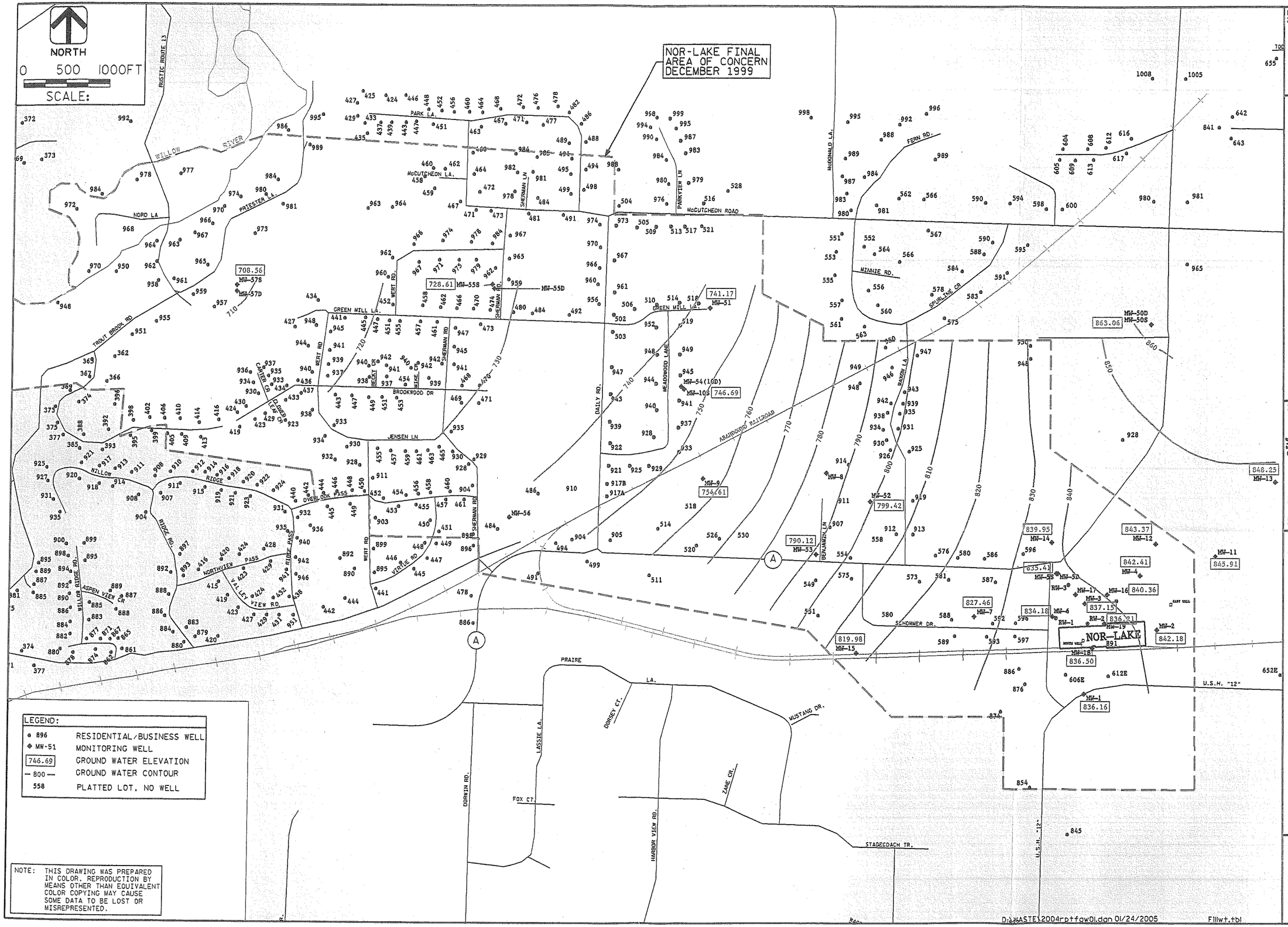
DRN. BY: JGS
CHK. BY: LAR
DATE: JANUARY 2005

AYRES ASSOCIATES

2004 ANNUAL REPORT
NOR-LAKE, INC.
HUDSON, WISCONSIN

FIGURE 1

D:\WASTE\2004rptf01.dgn 01/24/2005 Fillwt.tbl


NORTH
0 500 1000FT
SCALE:
NOR-LAKE FINAL AREA OF CONCERN DECEMBER 1999
K:/WASTE/NORLAKE/2004RPTGW01.DGN
GROUND WATER CONTOURS JUNE 2004
2004 ANNUAL REPORT NOR-LAKE, INC. HUDSON, WISCONSIN
FIGURE 2
DRN. BY: JCS
CHK. BY: LAR
DATE: JANUARY 2005
AMRES ASSOCIATES
LEGEND:
896 RESIDENTIAL/BUSINESS WELL
MW-51 MONITORING WELL
746.69 GROUND WATER ELEVATION
800 GROUND WATER CONTOUR
558 PLATTED LOT, NO WELL
NOTE: THIS DRAWING WAS PREPARED IN COLOR. REPRODUCTION BY MEANS OTHER THAN EQUIVALENT COLOR COPYING MAY CAUSE SOME DATA TO BE LOST OR MISREPRESENTED.
NOR-LAKE
WILLOW RIVER
PARK LA.
McCUTCHEON LA.
McCUTCHEON ROAD
NORD LA
PRIESTER LA.
TROUT BROOK RD
GREEN MILL LA.
BROOKWOOD DR
JENSEN LN
WILLOW RIDGE
OVERLOOK PASS
NORTHVIEW PASS
VALLEY VIEW RD.
ASPEN VIEW CR
WILLOW RIDGE RD.
RUSTIC ROUTE 13
SHERMAN RD
SHERMAN LN
PARKVIEW LN
McDONALD LA.
FERN RD.
MINNIE RD.
SPURLINE CR
BASON LA.
DAILY RD.
MEADOWOOD LANE
ABANDONED RAILROAD
BENJAMIN LN
SCHOMMER DR.
WERT RD
VIERE RD
CARTER CR
FLOWER LEAF CR
PRAIRIE LA.
DORSEY CT.
LASSIE LA.
MUSTANG DR.
ZANE CR.
DURWIN RD.
FOX CT.
HARBOR VIEW RD.
STAGECOACH TR.
U.S.H. "12"
708.56
728.61
741.17
746.69
754.61
790.12
799.42
819.98
827.46
834.18
835.41
836.16
836.21
836.50
837.15
839.95
840.36
842.18
842.41
843.37
845.91
848.25
863.06
MW-55S
MW-55D
MW-57S
MW-57D
MW-51
MW-54(100)
MW-105
MW-9
MW-56
MW-52
MW-53
MW-14
MW-12
MW-4
MW-11
MW-13
MW-16
MW-17
MW-3
MW-6
MW-7
MW-1
MW-2
MW-15
MW-18
MW-19
MW-50D
MW-50S
RW-1
RW-2
RW-3
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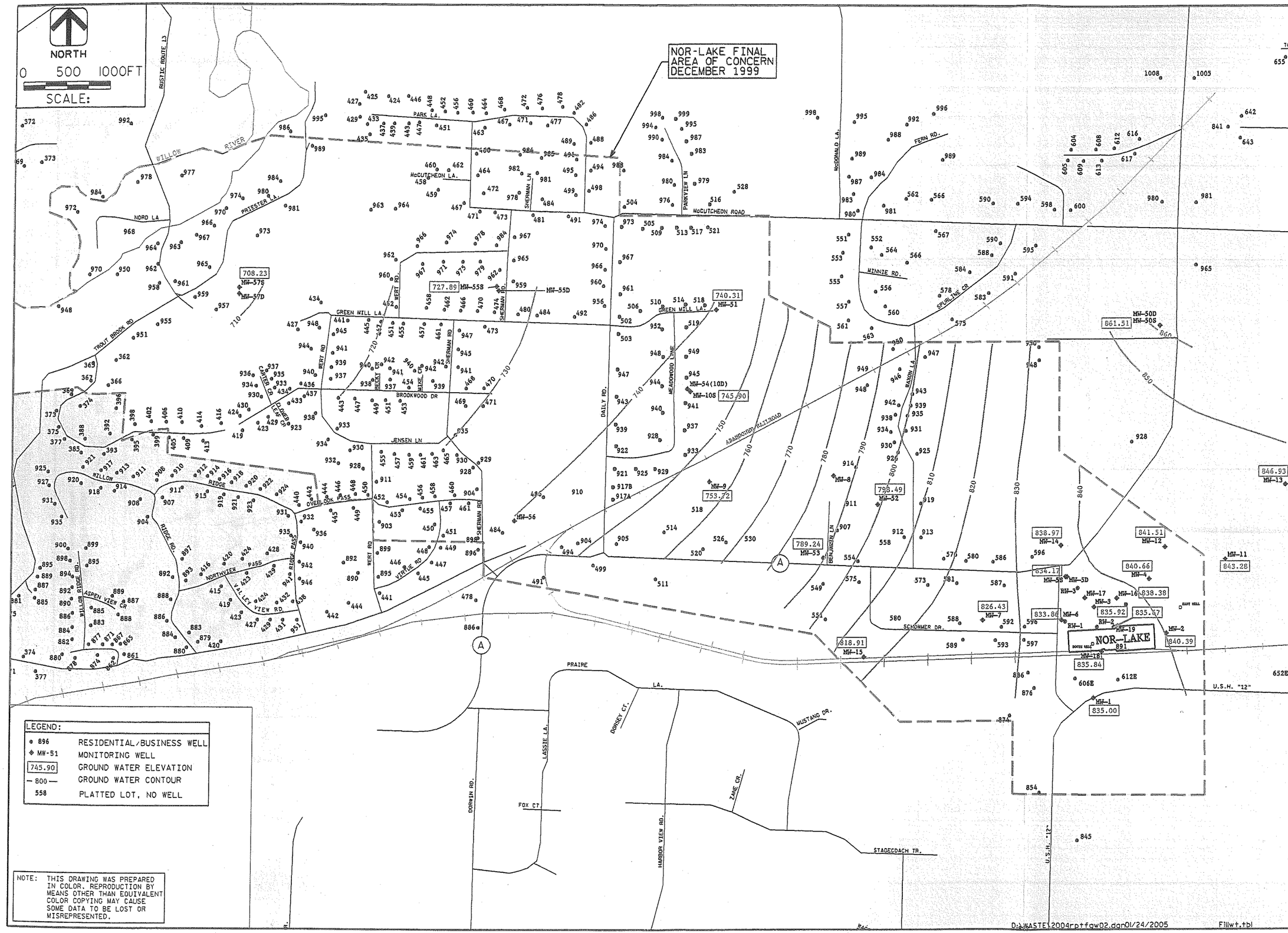


K:/WASTE/NORLAKE/2004RPTGW02.DGN

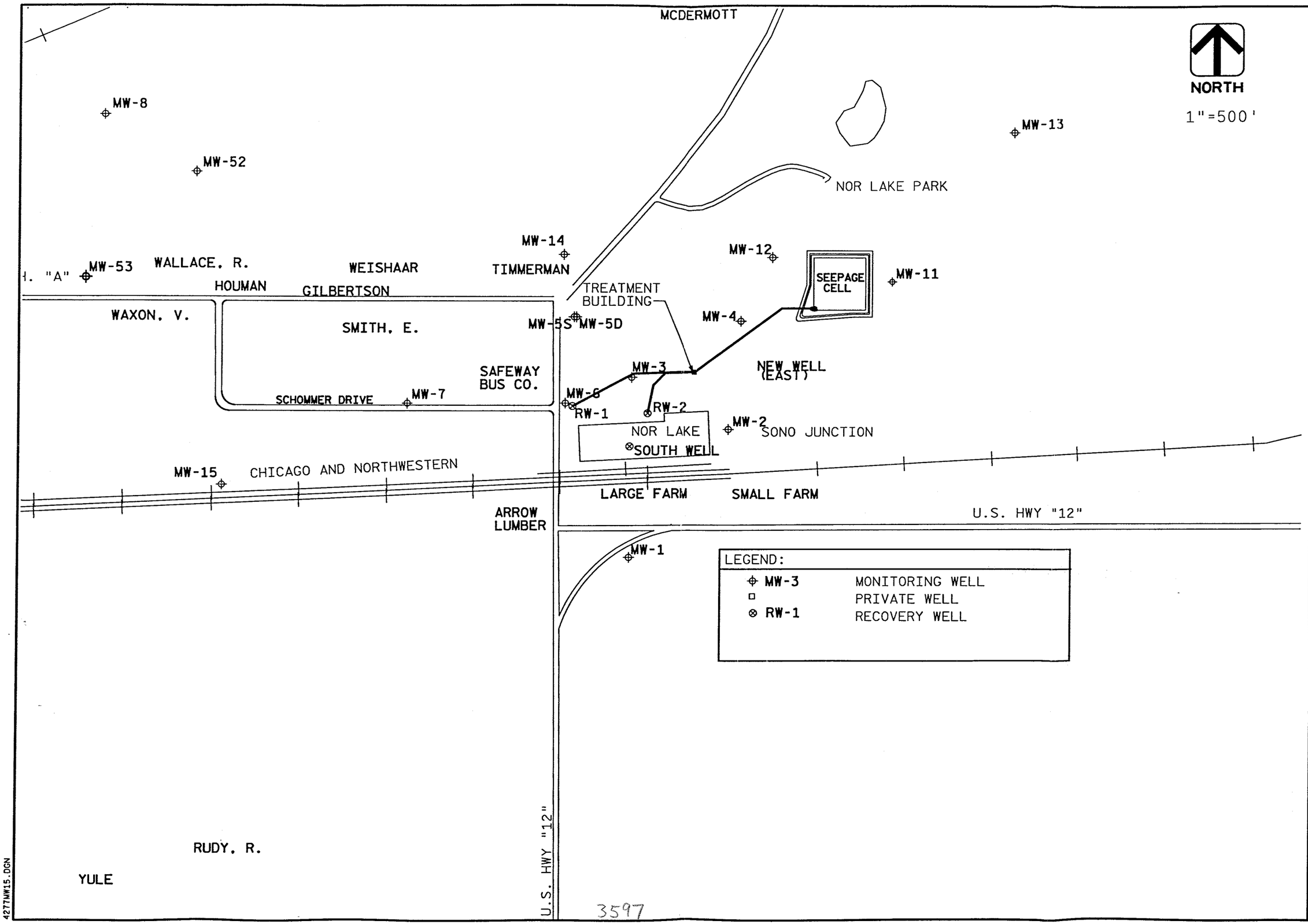
GROUND WATER CONTOURS DECEMBER 2004

DRN. BY: JCS
CHK. BY: LAR
DATE: JANUARY 2005

AYRES ASSOCIATES

2004 ANNUAL REPORT
NOR-LAKE, INC.
HUDSON, WISCONSIN

FIGURE 3



MONITORING WELL INSTALLATION (MW-15)

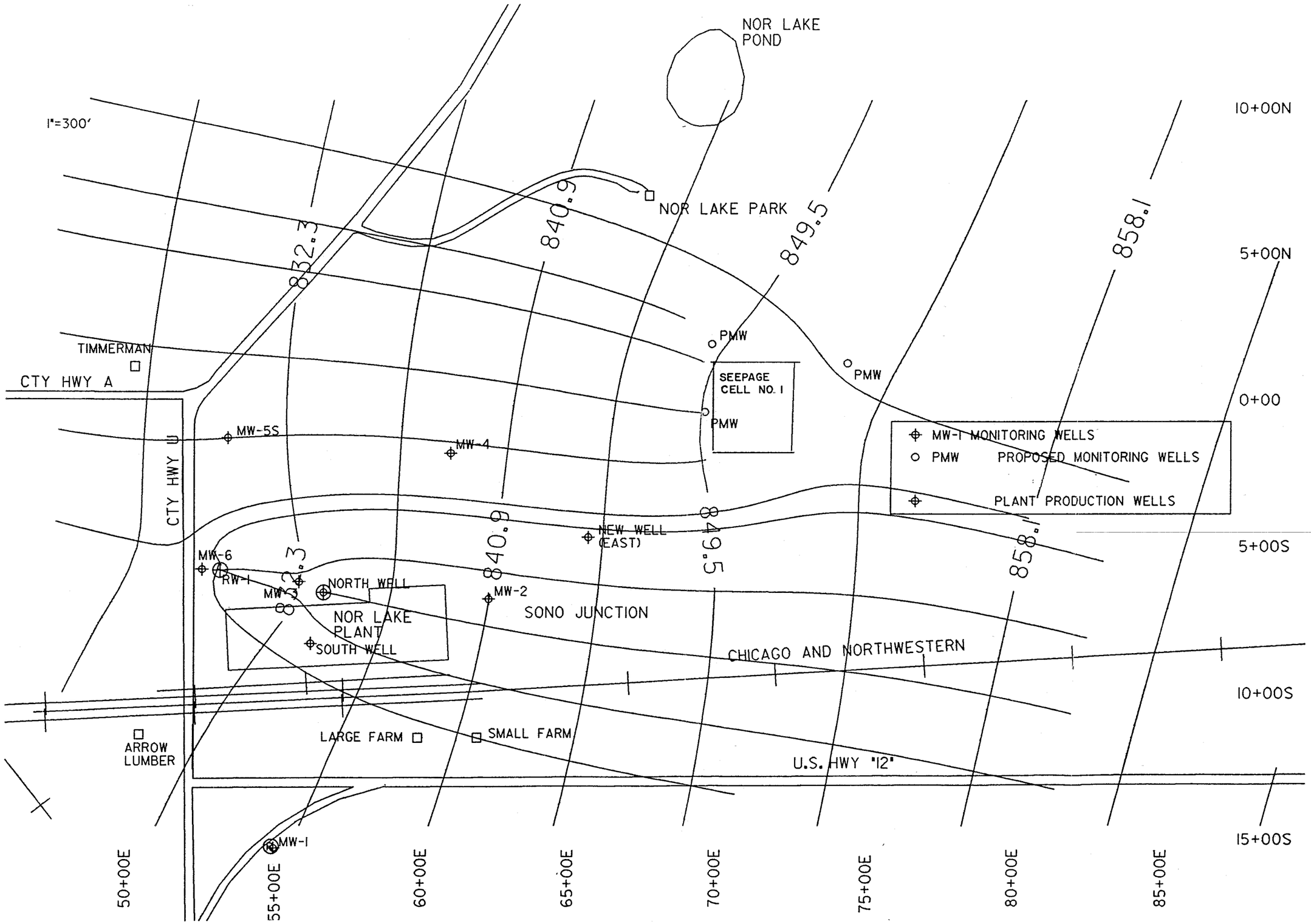
DRN. BY: MLE
CKD. BY: LAR
DATE: SEP. 1993

AYRES ASSOCIATES

NOR LAKE INC.
HUDSON, WISCONSIN

FIGURE 1

4277MW15.DGN



2806

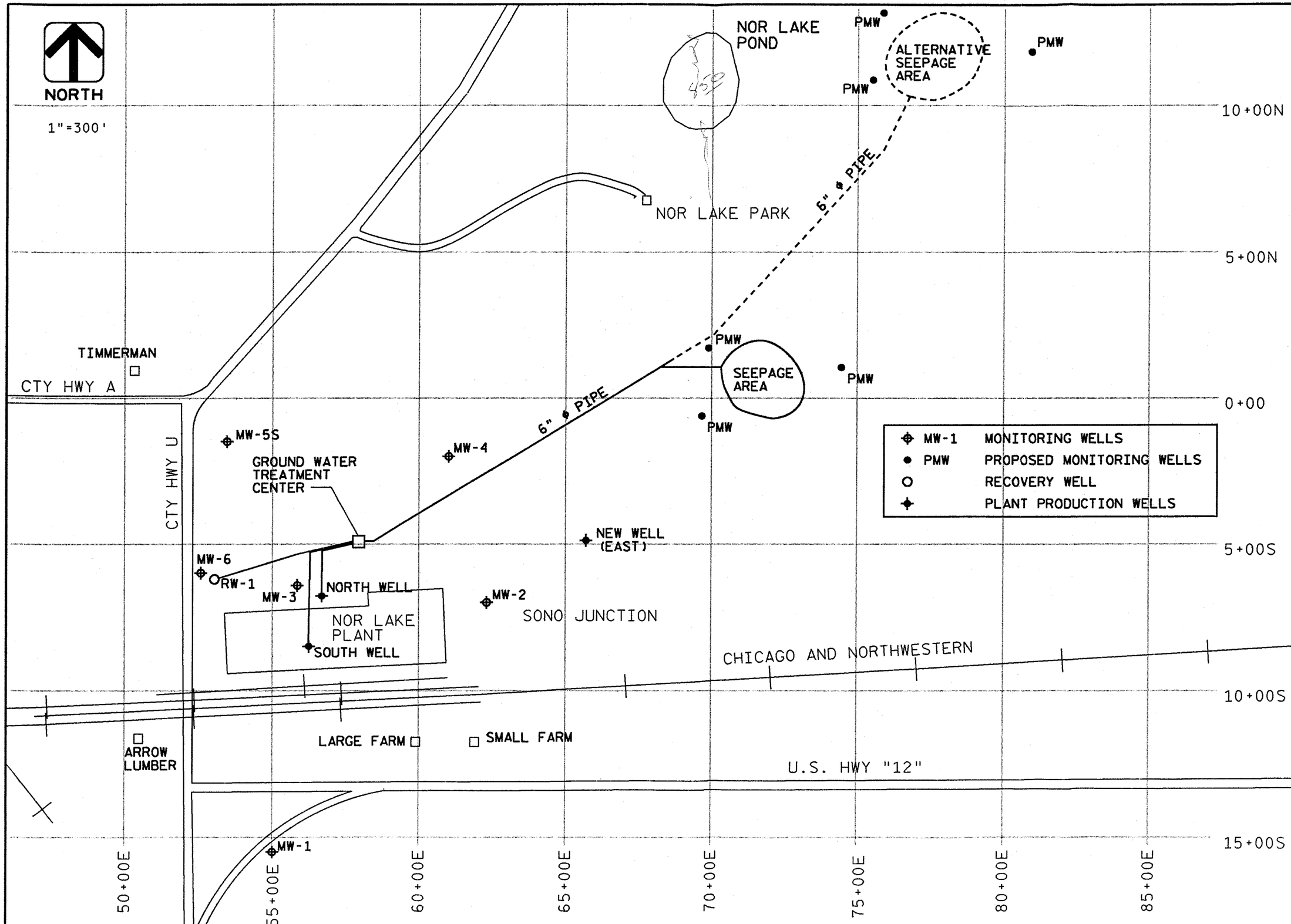
ZONE OF INFLUENCE

DWN. BY: MLE
CKD. BY: JAA
DATE: JUL 1992

AYRES ASSOCIATES

NOR-LAKE INC.
HUDSON, WISCONSIN

FIGURE
1



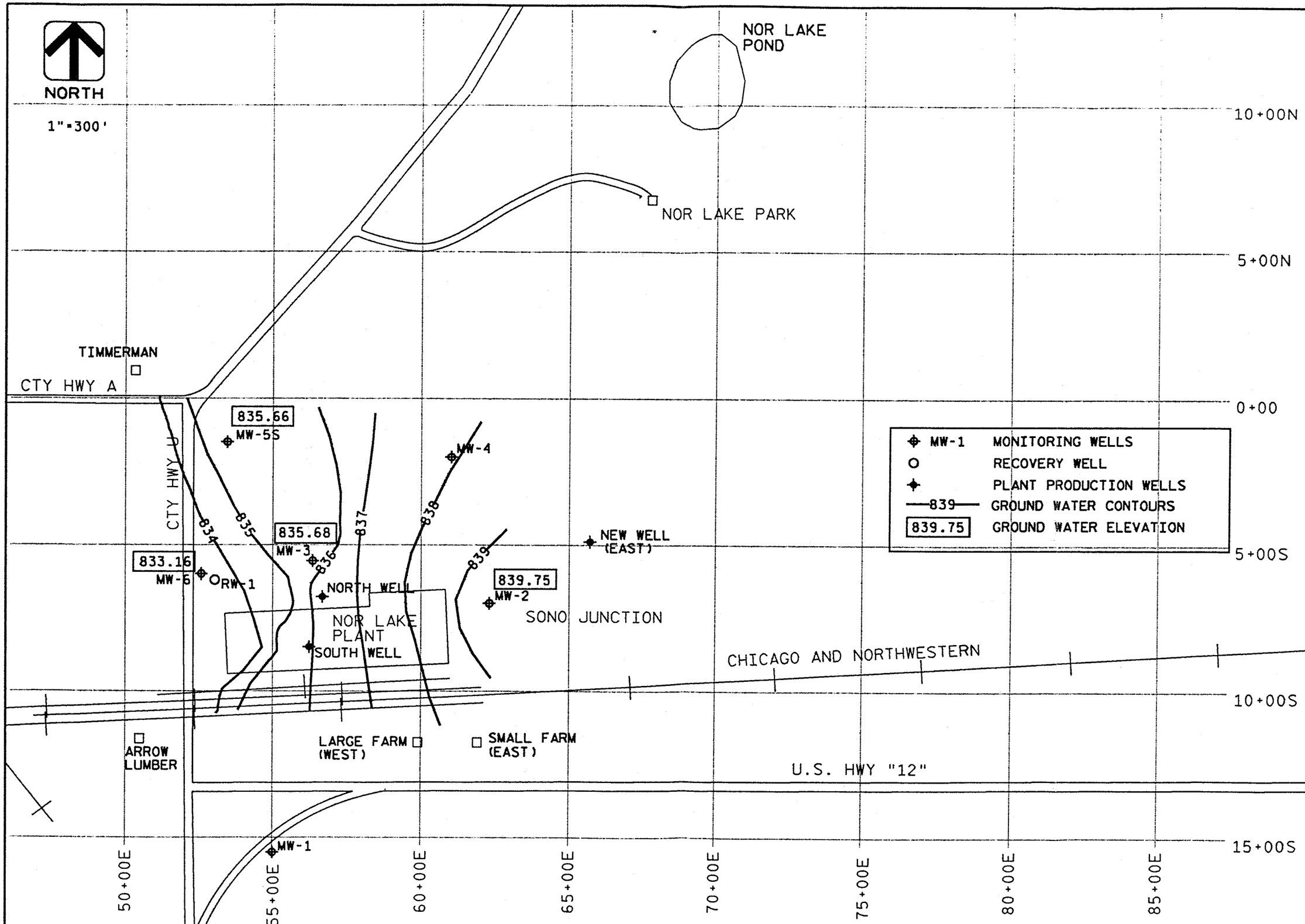
GROUND WATER TREATMENT

DRW. BY: MLE
CKD. BY: JAA
DATE: MAR 1992

AYRES ASSOCIATES

NOR LAKE INC.
HUDSON, WISCONSIN

FIGURE
2



GROUND WATER CONTOURS (3/18/91)

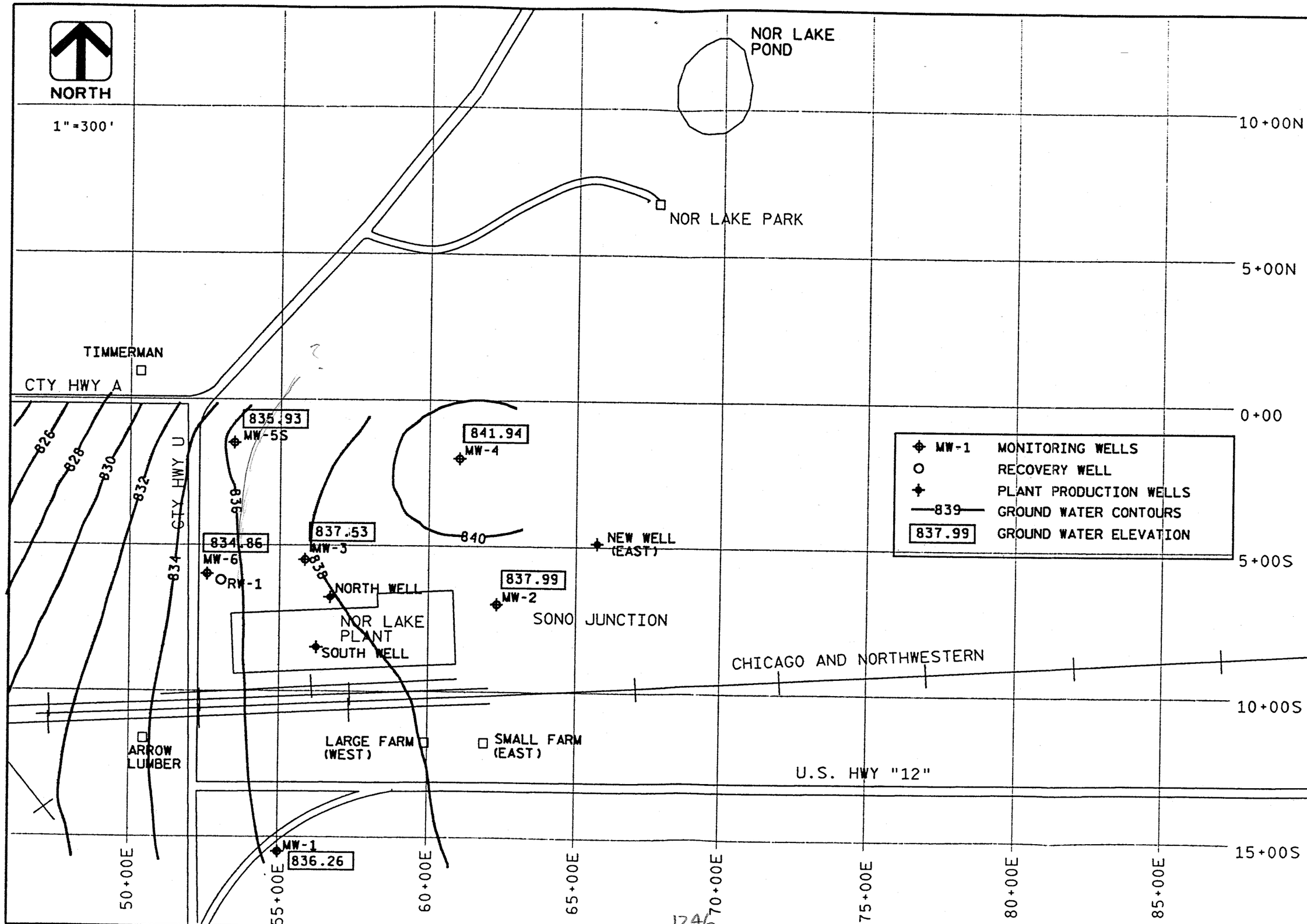
DRN. BY: MLE
CKD. BY: JAA
DATE: MAR 1992

AYRES ASSOCIATES

NOR LAKE INC.
HUDSON, WISCONSIN

FIGURE 10

1244



GROUND WATER CONTOURS (10/15/91)

pumping?

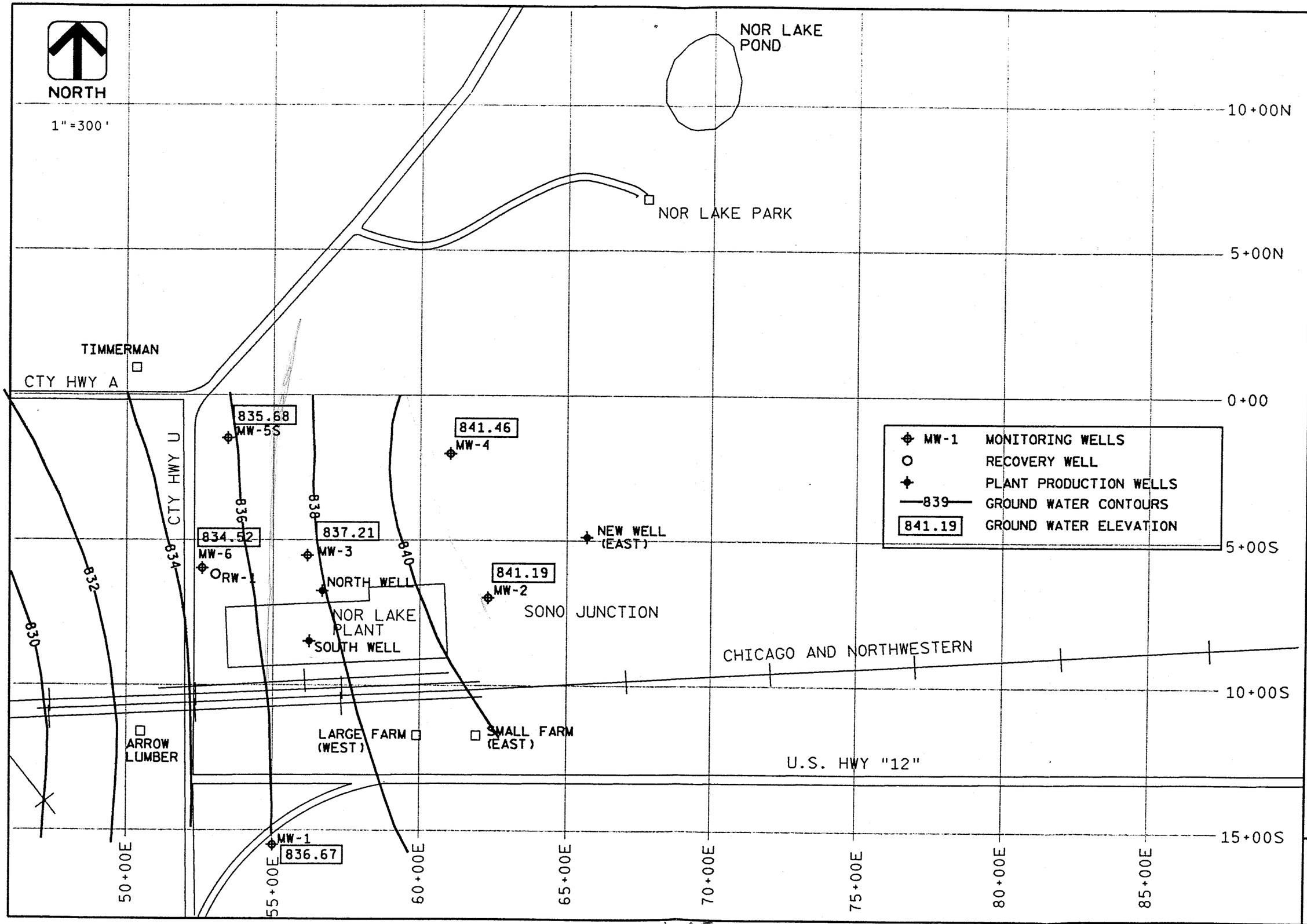
DRN. BY: MLE
CKD. BY: JAA
DATE: MAR 1992

AYRES ASSOCIATES

NOR LAKE INC.
HUDSON, WISCONSIN

FIGURE 12

1246



GROUND WATER CONTOURS (9/9/91)

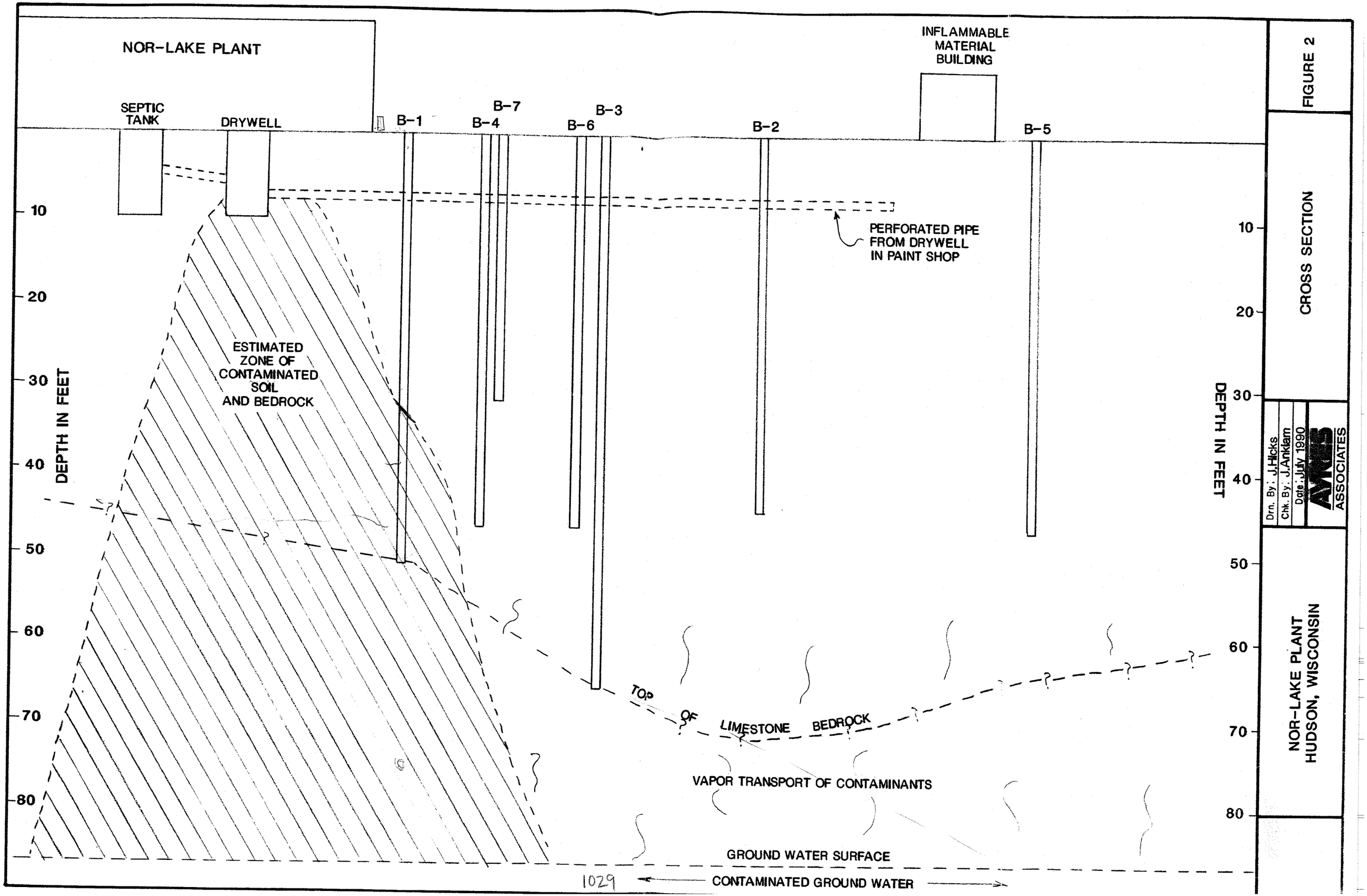
Are - pump?

DWN. BY: MLE
CKD. BY: JAA
DATE: MAR 1992

AYRES ASSOCIATES

NOR LAKE INC.
HUDSON, WISCONSIN

FIGURE 11


NOR-LAKE PLANT
SEPTIC TANK
DRYWELL
B-1
B-4
B-7
B-6
B-3
B-2
INFLAMMABLE MATERIAL BUILDING
B-5
PERFORATED PIPE FROM DRYWELL IN PAINT SHOP
ESTIMATED ZONE OF CONTAMINATED SOIL AND BEDROCK
DEPTH IN FEET
10
20
30
40
50
60
70
80
TOP OF LIMESTONE BEDROCK
VAPOR TRANSPORT OF CONTAMINANTS
GROUND WATER SURFACE
CONTAMINATED GROUND WATER
FIGURE 2
CROSS SECTION
Drn. By: J.Hicks
Chk. By: J.Anklam
Date: July 1990
ASSOCIATES
NOR-LAKE PLANT
HUDSON, WISCONSIN

1029

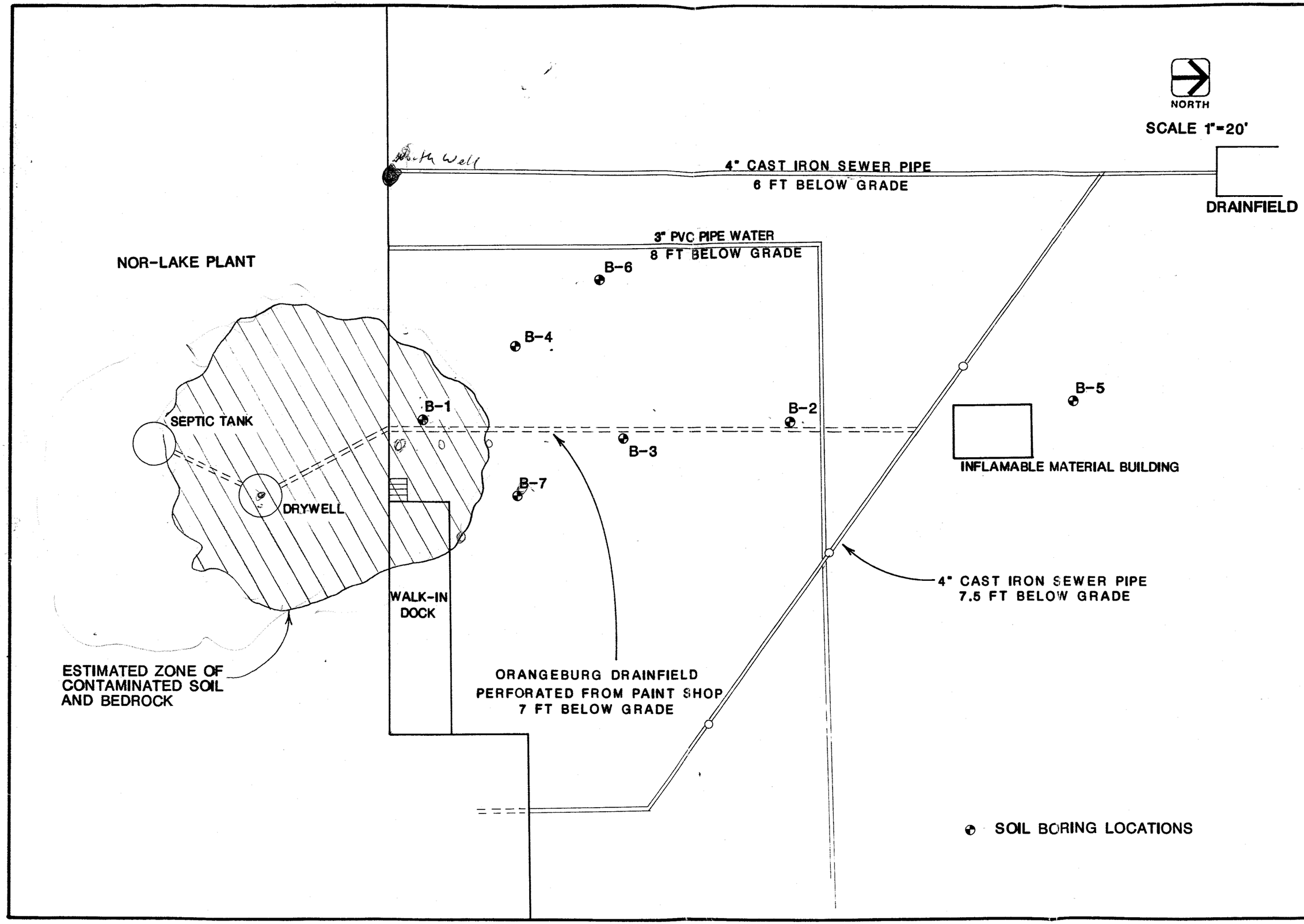


FIGURE 1

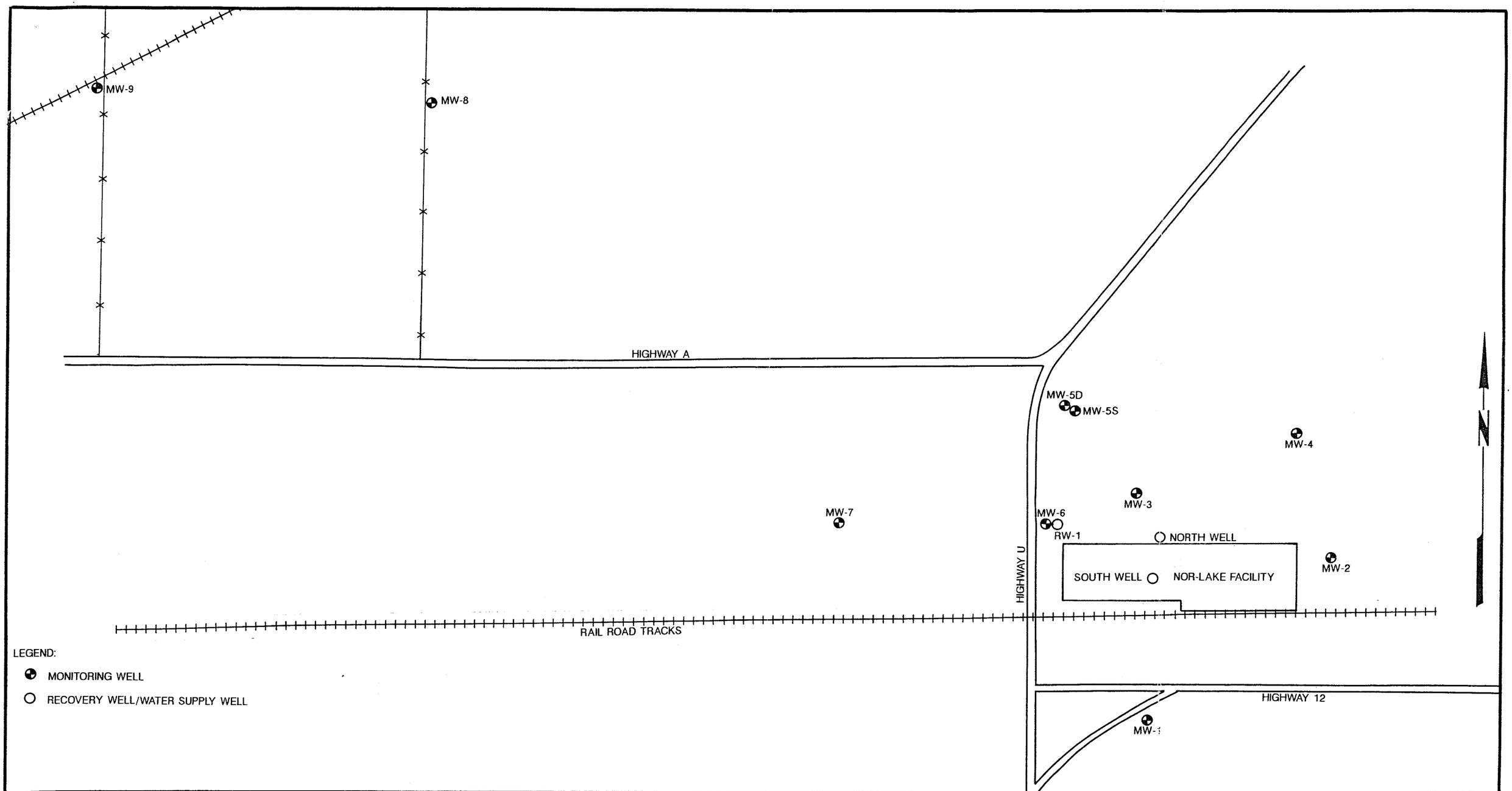
SITE PLAN

Drn. By: M. ZICH
Chk. By: J. ANKLAM
Date: July, 1990

AYRES ASSOCIATES

NOR-LAKE PLANT
HUDSON, WISCONSIN

1028



LEGEND:

- MONITORING WELL
- RECOVERY WELL/WATER SUPPLY WELL

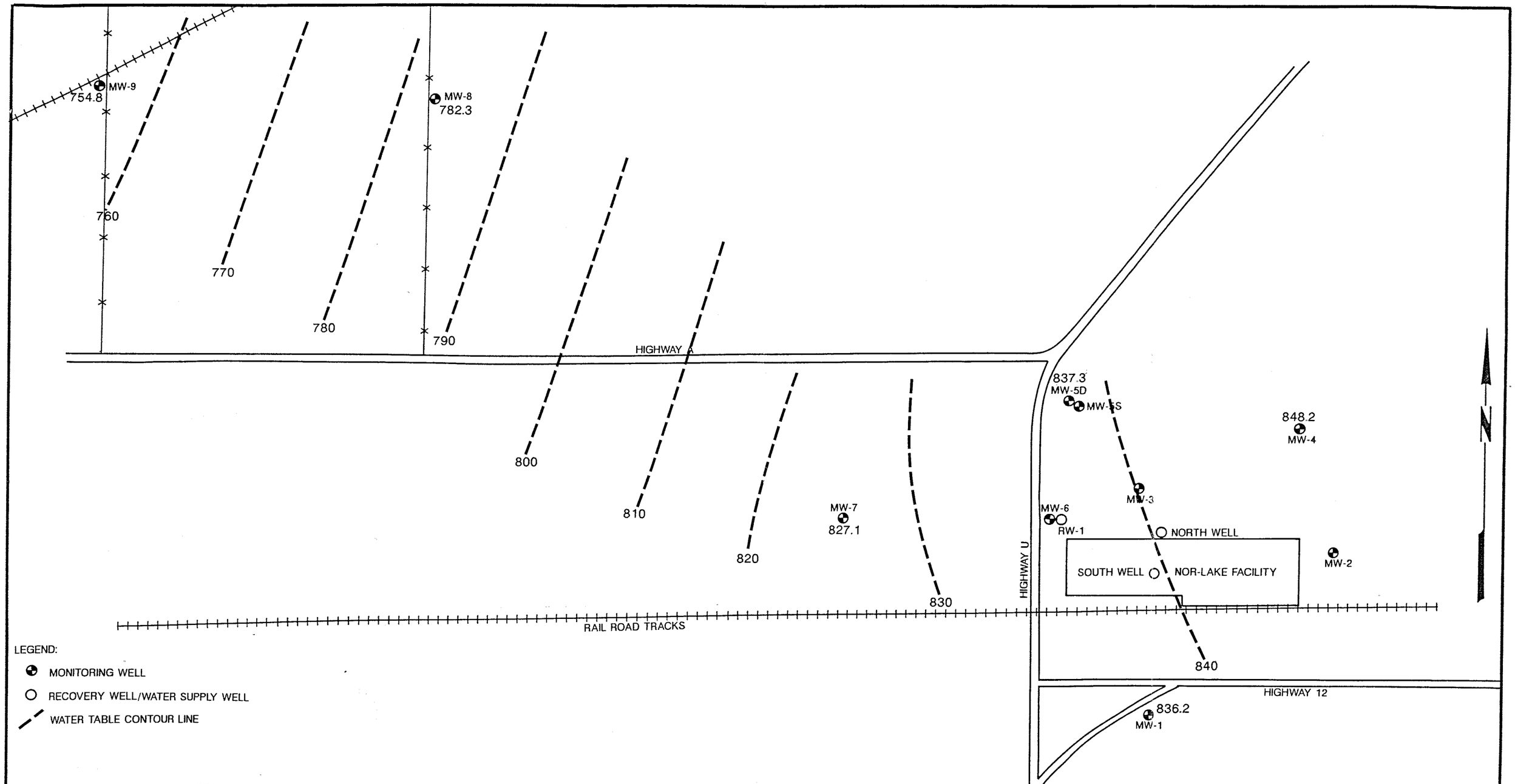
TWIN CITY TESTING CORPORATION

MONITORING & NOR-LAKE WELL LOCATION
NOR-LAKE INC.
HUDSON, WISCONSIN

DATE 2/3/88	FIGURE 2
PROJECT # 4231 88-230	
REVIEWED BY:	
DRAWN BY: J.A.W.	
SCALE 1"=400'	

454

ENV-D-87-5



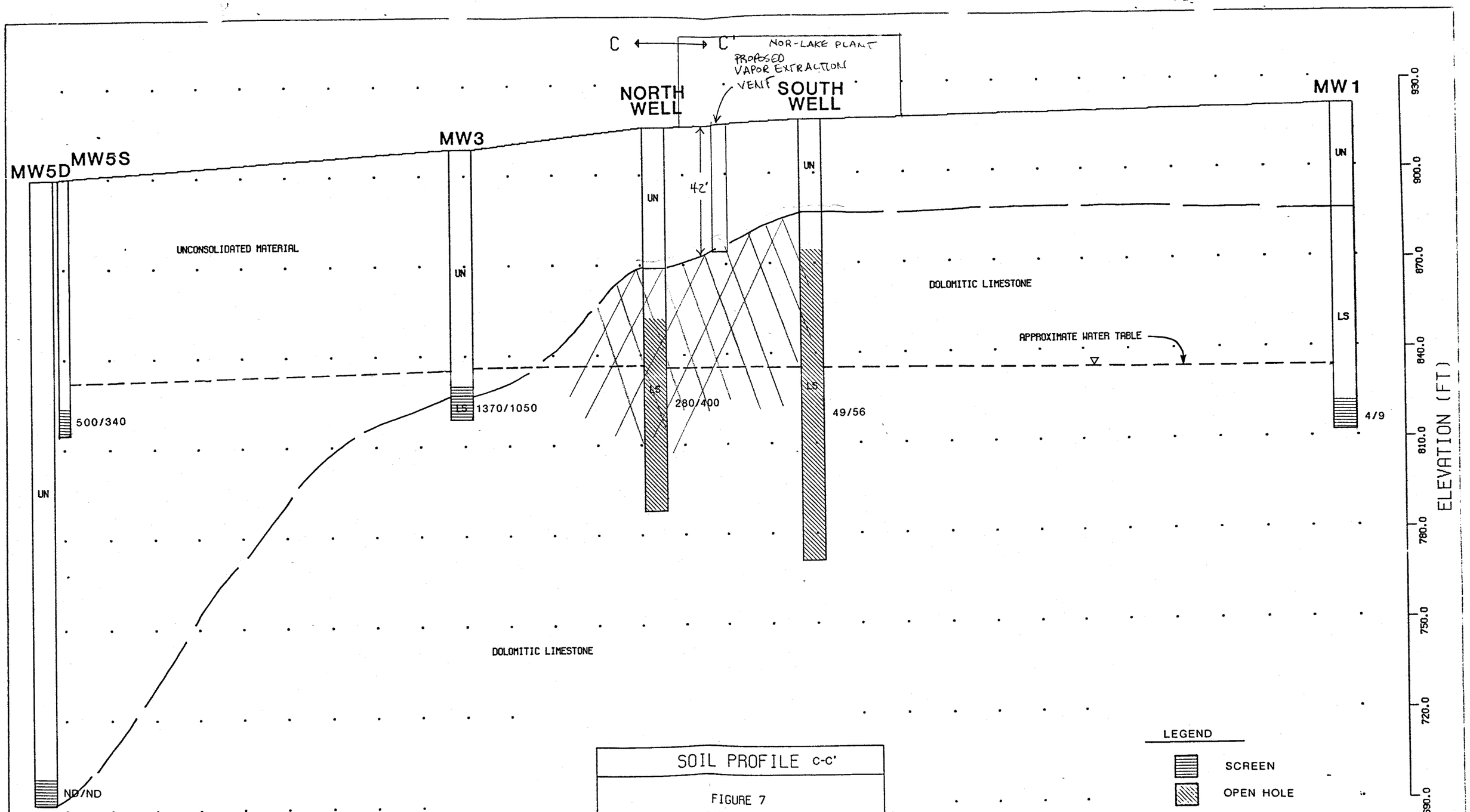
TWIN CITY TESTING CORPORATION

GROUND WATER ELEVATION MAP
NOR-LAKE INC.
HUDSON, WISCONSIN

DATE 2/3/88	FIGURE 6
PROJECT # 4231 88-230	
REVIEWED BY:	
DRAWN BY: J.A.W.	
SCALE 1"=400'	

458

ENV-D-87-5



SOIL PROFILE C-C'

FIGURE 7
NORLAKE, INC
W.O. 120-86-230

SOIL EXPLORATION COMPANY

SCALE: VERT: 1 IN = 30. FT
HORZ: 1 IN = 100. FT

NOTE: EXCEPT AT BORING LOCATIONS THE GROUND SURFACE, WATER LEVEL, AND BOUNDARIES BETWEEN SOIL LAYERS ARE INFERRED.

WATER TABLE EVALUATION AND CHEMICAL ANALYSIS RESULTS REPORTED IN PARTS PER BILLION. FROM APRIL 1985

2765