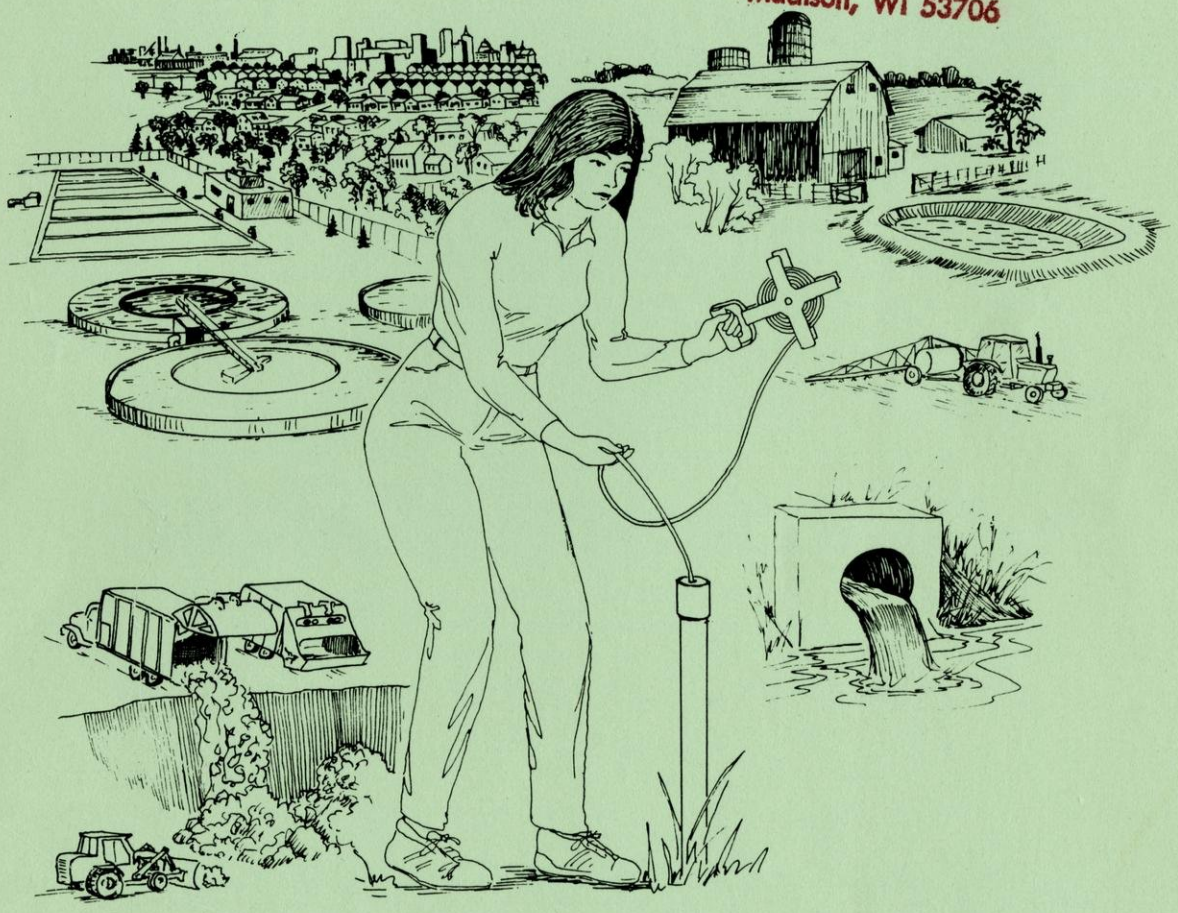
Investigation of large scale subsurface soil absorption systems. [DNR-042] 1989

Peerenboom, Daniel

Madison, Wisconsin: Wisconsin Department of Natural Resources, 1989

Wisconsin Groundwater Management Practice Monitoring Project No. 39



GROUNDWATER
Wisconsin's buried treasure

Wisconsin Department of Natural Resources

INVESTIGATION OF LARGE SCALE

SUBSURFACE SOIL ABSORPTION SYSTEMS

Wisconsin
Department of Natural Resources
February, 1989

Principal Investigator

Daniel Peerenboom
Municipal Wastewater Section
Bureau of Wastewater Management

Table of Contents

Abstract

The promulgation of Chapter NR 140, Wisconsin Administrative Code, Groundwater Quality, established groundwater quality standards for substances detected in, or having a reasonable probability of entering, the groundwater resources of the state. In addition changes to Chapter NR 200, Wisconsin Administrative Code, require that large scale subsurface systems with design flows greater than 8,000 gallons per day (gpd) must apply for and obtain WPDES permits from the Wisconsin Department of Natural Resources (DNR) in order to lawfully discharge pollutants to the waters of the state.

Very little is known about the long term operation and treatment capabilities of these systems and the impact of these discharges on groundwater. In order to evaluate the performance of these systems the Department has been monitoring two large scale subsurface soil absorption systems. The two facilities being studied are located at the Village of Wyeville, which has a mound system, and the Town of Scott Sanitary District Number 1, which has an absorption bed system.

The findings of the evaluation indicate that:

A. Neither system has exhibited ponding at current loading rates. Groundwater mounding does appear to be occurring but has not adversely affected the hydraulic performance of either system.

B. The Village of Wyeville system has exceedances of the enforcement standard (ES) for nitrate+nitrite-N and preventive action limit (PAL) exceedances for total dissolved solids (TDS), conductivity, total nitrogen, and ammonia. If regulated by the DNR the point of standards application (POSA) used for this facility would be the property boundary and these exceedances are being detected at the facility's POSA. The establishment of an alternative concentration limit (ACL) which is allowed under Chapter NR 140, Wis. Adm. Code, for TDS would reduce, but not eliminate PAL exceedances for TDS.

C. The Town of Scott system has exceedances of the (ES) for nitrate+nitrite-N and TDS, and has (PAL) exceedances for chloride, total nitrogen, and ammonia-N. The POSA for this facility would be the property boundary and monitoring results from wells located at the POSA indicates exceedances of the (ES) for nitrate+nitrite-N and PAL exceedances for total nitrogen and nitrate+nitrite-N.

Acknowledgement

This research project has been a collective effort with staff time, equipment, funding and facilities provided by the Department's Bureaus of Wastewater Management, Solid Waste Management, and Water Resources Management, and the Southern District Office. The expertise of the University of Wisconsin's Geological Survey for the installation of monitoring wells and Laboratory of Hygiene for the analyses of samples were essential to the project and was greatly appreciated. In addition, Tony Hendricks of the Municipal Wastewater Section deserves special recognition for his many contributions to the project.

Finally, the residents of both the Village of Wyeville and the Town of Scott Sanitary District No. 1 should be commended for their willingness to participate in the project. The cooperation and candor from both communities was deeply appreciated and made the project possible.

List of Tables

List of Figures

I. Introduction

"Investigation of Large Scale Subsurface Soil Absorption Systems"

The promulgation of Chapter NR 140, Wisconsin Administrative Code, Groundwater Quality, established groundwater quality standards for substances detected in or having a reasonable probability of entering the groundwater resources of the state. In addition recent changes to Chapter NR 200, Wisconsin Administrative Code, require that large scale subsurface systems with design flows greater than 8,000 gpd must obtain Wisconsin Pollutant Discharge Elimination System (WPDES) permits in order to lawfully discharge pollutants to the waters of the state.

There are approximately 150 large scale systems in the state, many of which have been in operation for less than five years, and very little is known about their operation or the impacts to groundwater. The evaluation of these types of systems is necessary in order to assess their conformance with groundwater quality standards; to develop monitoring requirements to be included in WPDES permits; to develop pollutant transport models; and to evaluate the design of these systems in terms of their ability to meet groundwater quality standards.

The two facilities being evaluated are the Village of Wyeville's mound system and the Town of Scott Sanitary District Number 1's absorption bed system. The two types of systems being evaluated, mounds and absorption beds, are the two most common types of large scale systems being used in Wisconsin.

II. Objectives

The objectives of this evaluation of large scale subsurface soil absorption systems are to:

A. Assess the impacts of the discharges on the quality of groundwater and the capability of large scale subsurface soil absorption systems to meet the groundwater quality standards of Chapter NR 140, Wis. Adm. Code.

B. Develop monitoring requirements to be included in WPDES permits for large scale subsurface soil absorption systems.

C. Develop pollutant transport models to be used to project the movement of contaminants through groundwater.

D. Evaluate the existing design criteria for large scale subsurface soil absorption systems to assess their ability to provide adequate wastewater treatment.

III. Facilities Description

The Village of Wyeville is located in Monroe County, Wisconsin, and has a population of about 163 people. The Village's wastewater treatment needs are served by a small diameter low pressure collection system which conveys flows to a community septic tank/dosing chamber from which flow is pumped into any of the three mounds. A summary of the facility design and current operation is presented in Table 1. A plan view of the system is shown in Figure 1 and a diagram of the groundwater flow patterns at the site is shown in Figure 2. A description of the monitoring well system is presented in Table 2. Each mound has an absorption bed 40 feet by 216.5 feet for a total absorption area for the three mounds of 25,980 square feet.

The Town of Scott Sanitary District Number 1 is located in Sheboygan County, Wisconsin, and has a population of about 200 people. The Sanitary District's wastewater treatment needs are served by septic tanks at each residence which discharge to small diameter gravity sewers that convey flows to a centrally located lift station. From the lift station the wastewater is pumped to a dosing chamber equipped with an automatic syphon which controls the discharge to any of three absorption beds. The summary of the facility design and current operation is presented in Table 3. A plan view of the system is shown in Figure 3 and a diagram of the groundwater flow patterns at the site are shown in Figure 4. Each of the subsurface beds has an absorption area of about 19,000 sq. ft. with a total absorptive area for the three bed system of about 57,000 square feet. A description of the monitoring well system is presented in Table 4.

IV. Procedures

Beginning in November, 1986 through June, 1988 sampling was conducted at each site on ten occasions. Groundwater samples were collected from all monitoring wells at each site and grab samples of septic tank effluent were taken for analyses.

During sampling the depth to groundwater at each well was recorded and any evidence of effluent ponding in the absorption beds was noted. Data which was gathered in the field for each sample included pH, temperature and specific conductance. The samples were filtered and cooled before delivery to the State Lab of Hygiene where the following analyses were performed:

- BOD_5
- Chlorides
- Total Dissolved Solids
- Total Suspended Solids
- Ammonia - N
- Nitrate+Nitrite-N
- Total Kjeldahl-N

Sampling was done in accordance with Wisconsin Department of Natural Resources "Groundwater Sampling Procedures."

TABLE 1
VILLAGE OF WYEVILLE
COMMUNITY MOUND SYSTEM

	Design	Current
Flow*	17,600 gpd	7,000 gpd
Organic Loading		
BOD	49 lb/day	16 lb/day
SS	43 lb/day	2.2 lb/day
Hydraulic Loading**	1.0 gpd/sq. ft.	0.33 gpd./sq. ft.

* Average daily flow volumes during study period.
** Hydraulic loading rates based on discharging all flow to two of the three absorption areas available on a rotation type operation.

TABLE 2
VILLAGE OF WYEVILLE
MONITORING WELL SYSTEM

Well Number and Type	Well Depth	Screen Length	Horizontal Distance to Nearest Absorption Bed (Approximate)
W101 Background	16'2"	9'	215'
W102 Downgradient	19'6"	9'	46'
W103 Downgradient	16'5"	9'	33'
W104 Downgradient	16'10"	9'	84'
W105 Background	11'8"	5'	340'
W106 Downgradient	19'4"	5'	44'
W107 Downgradient	19'5"	5'	31'
W108 Downgradient	11'7"	5'	30'
W109 Downgradient	23'6"	5'	86'

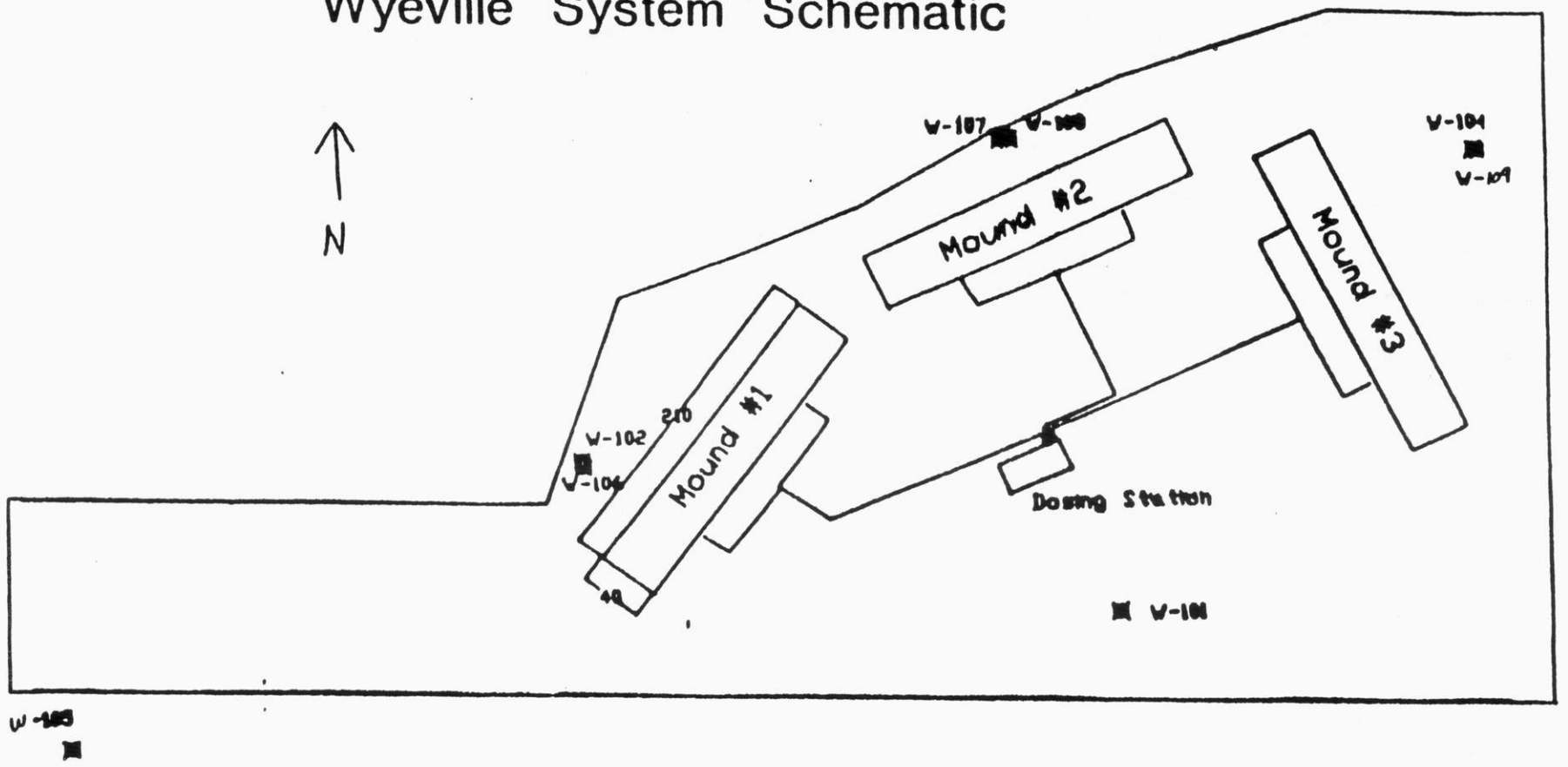

Wyeville System Schematic
N
W-107
W-108
W-104
W-109
Mound #2
Mound #3
Mound #1
W-102
210
W-106
Dosing Station
48
W-101
W-105

Figure 1

Wyeville Groundwater Flow Pattern

(Flow generally to the North)

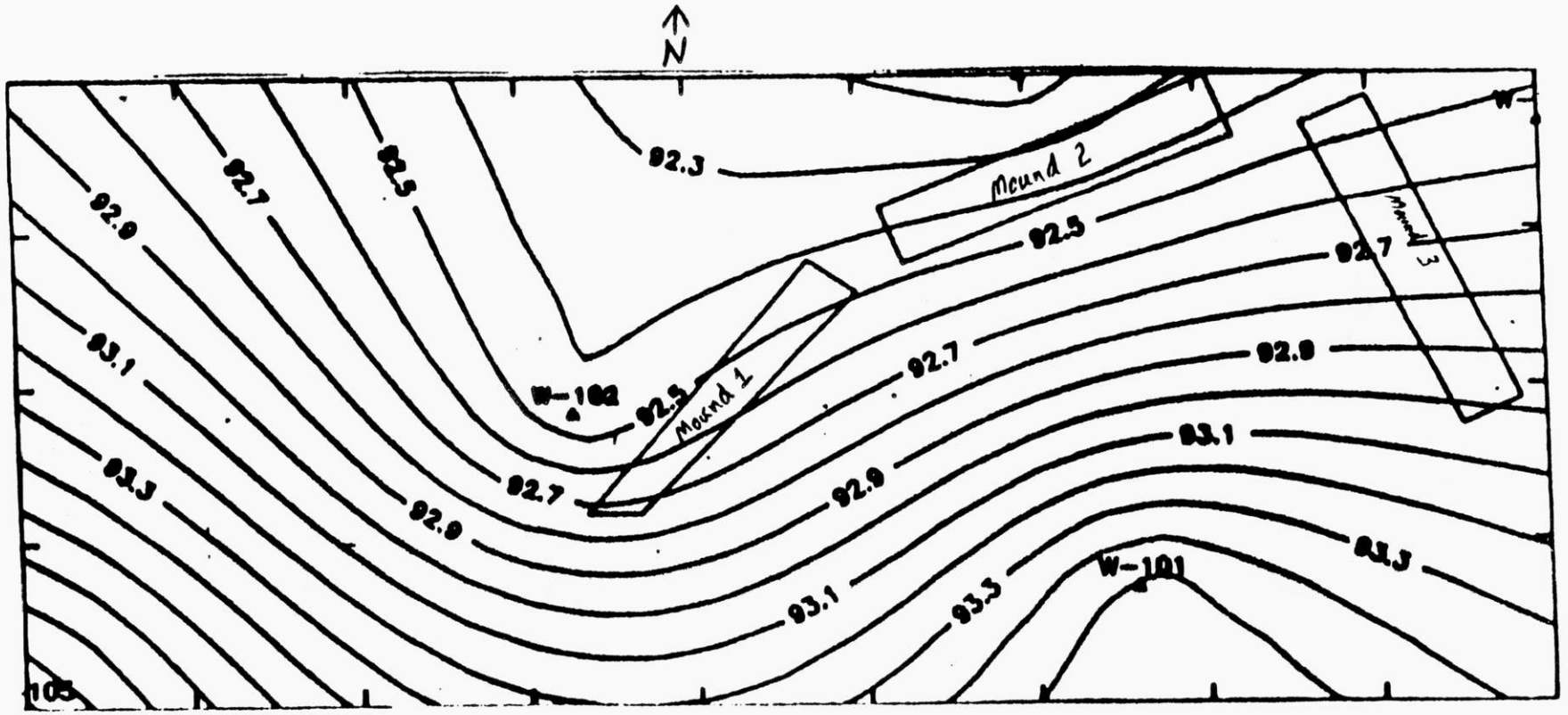


Figure 2

TABLE 3
TOWN OF SCOTT
INGROUND PRESSURIZED BED SYSTEM

	Design	Current
Flow*	29,500 gpd	12,500 gpd
Organic Loading		
BOD	37 lb/day	14 lb/day
SS	43 lb/day	3.8 lb/day
Hydraulic Loading**	0.77 gpd/sq. ft.	0.33 gpd./sq. ft.

* Average daily flow volume during study period.
** Hydraulic loading rates based on discharging all flow to two of the three absorption areas available on a rotation type operation.

TABLE 4
TOWN OF SCOTT SANITARY DISTRICT
MONITORING WELL SYSTEM

Well Number and Type	Well Depth	Screen Length	Distance to Absorption Bed (Approximate)
S101 Downgradient	21'2"	5'	10'
S102 Downgradient	22'2"	5'	14'
S103 Downgradient	21'7"	5'	10'
S104 Downgradient	19'2"	5'	10'
S105 Downgradient	21'2"	5'	10'
S106 Downgradient	19'6"	5'	110'
S107 Background	15'7"	5'	360'
S108 Downgradient	23'1"	5'	125'
S109 Downgradient	17'6"	5'	120'

Tn. of Scott System Schematic

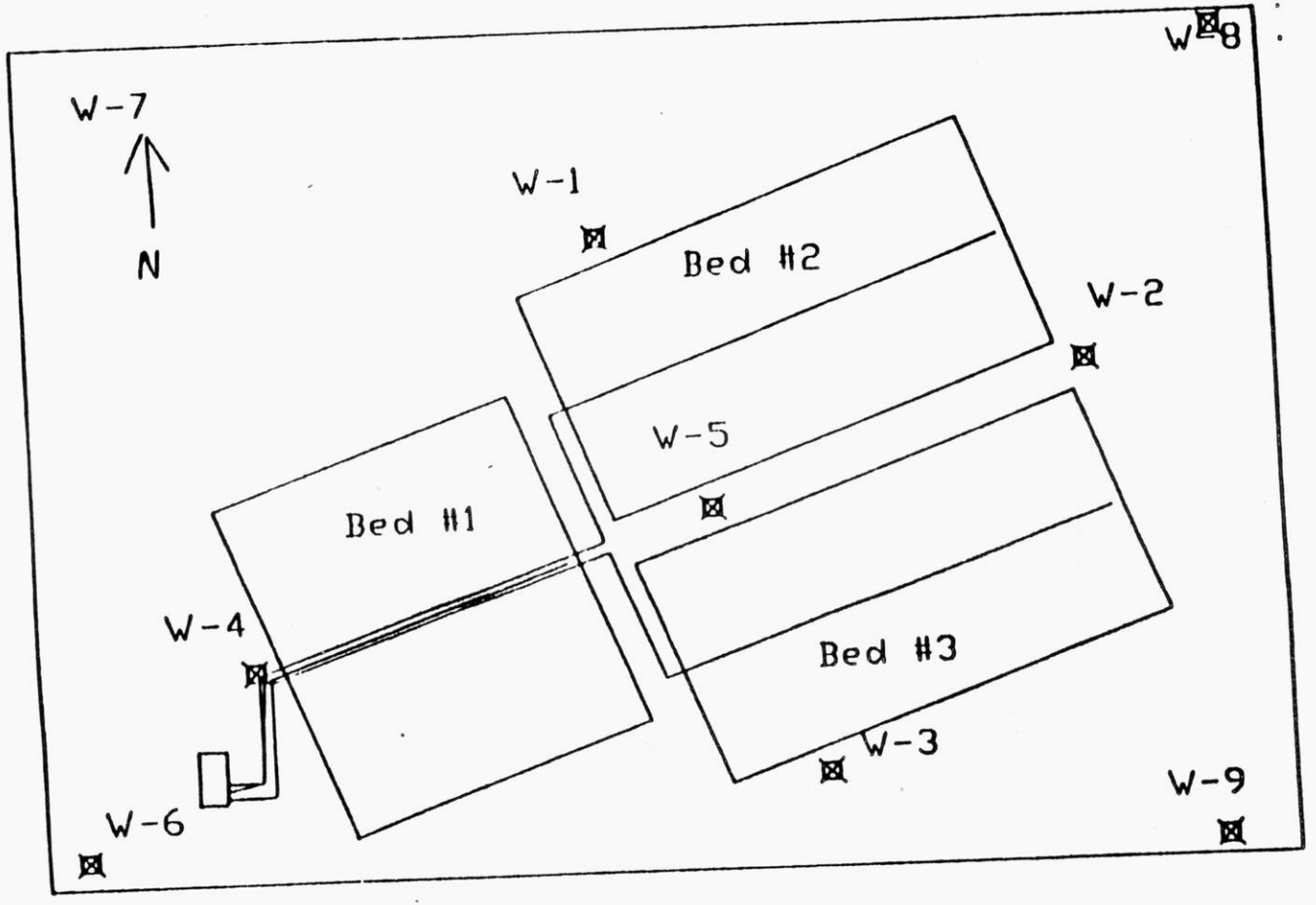


Figure 3

Tn. of Scott Groundwater Flow Pattern

(Flow generally to the South)

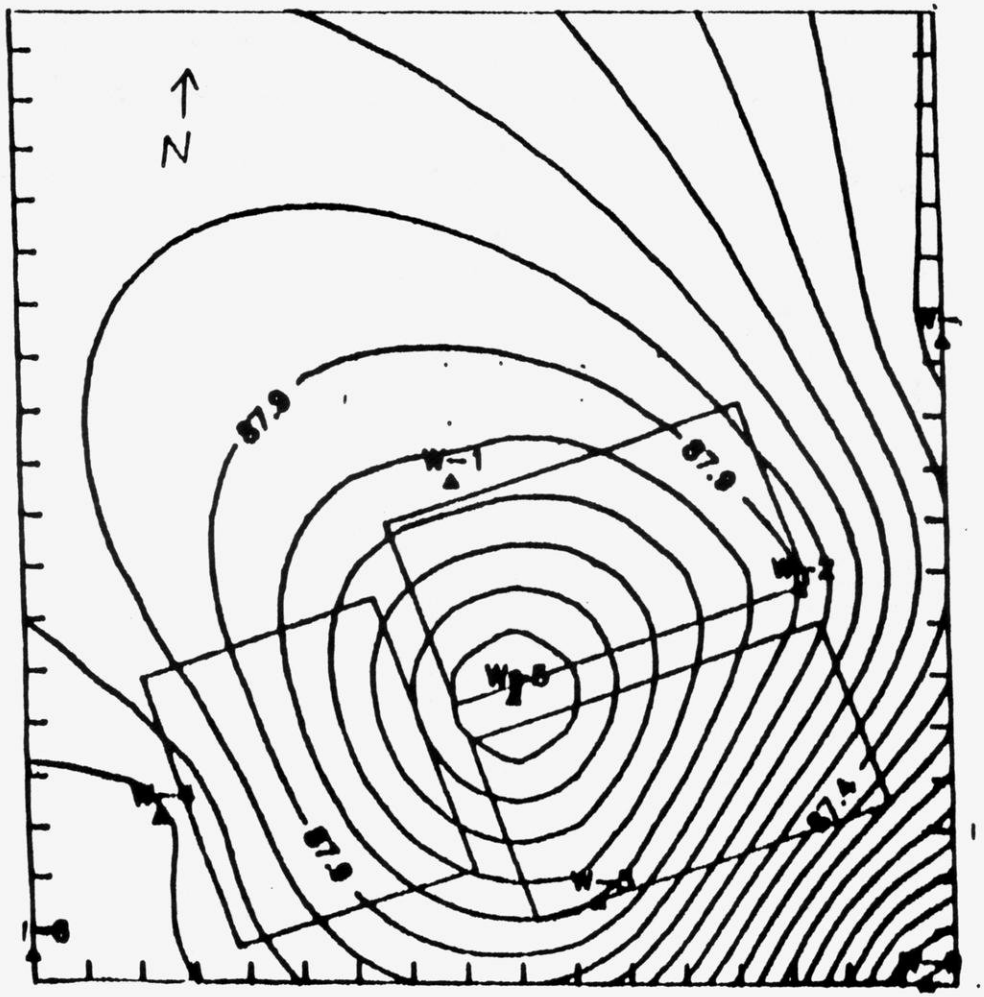


Figure 4

V. Results

The results of the groundwater monitoring indicate that the discharges from both systems have had an impact on groundwater quality.

VILLAGE OF WYEVILLE

The groundwater monitoring data at the Village of Wyeville's system is presented in Appendix A and a discussion of the results is presented below.

Biochemical Oxygen Demand (BOD_5)

The mean BOD_5 concentration of the septic tank effluent is 248 mg/l and the means of the two background monitoring wells are less than the detection level of 3 mg/l. In addition, the mean BOD_5 concentrations of all downgradient monitoring wells is less than 3 mg/l. Therefore, no significant impact from the BOD_5 of septic tank effluent was observed.

Chlorides

The mean chloride concentration of the septic tank effluent is 123 mg/l and the means of the two background monitoring wells are both less than 2 mg/l. The means of the downgradient wells range from 61 to 109 mg/l. No significant differences in downgradient chloride concentrations with well screen depth were observed. The results indicate that the groundwater concentration of chloride downgradient has been increased relative to background levels, but did not exceed the PAL of 125 mg/l.

Total Dissolved Solids (TDS)

The mean TDS concentration of the septic tank effluent is 486 mg/l and the means of the two background wells are 45 and 56 mg/l, respectively. The means of the downgradient wells range from 288 to 391 mg/l. No significant differences in downgradient TDS concentrations with well screen depth were observed. The results indicate that the concentration of TDS downgradient has increased relative to background levels. The mean TDS concentrations at all downgradient wells exceed the PAL of 250 mg/l but no exceedances of the ES of 500 mg/l were detected. However if an ACL is calculated exceedances of the PAL would occur at only two downgradient wells. The procedures used to develop ACL's are presented in Appendix C.

Temperature

Septic tank effluent temperatures often differed from groundwater samples, however no significant differences between background and downgradient groundwater temperatures were observed.

pH

The median pH value of the septic tank effluent is 7.0 and the median values of the background wells are 5.3 and 5.5, respectively. The median values of the downgradient wells ranged from 4.8 to 5.5. Although all downgradient wells are within the PAL of 1.0 standard pH unit of the median values of the background wells, six of the seven downgradient wells had lower median pH values than either of the background wells. The lower pH values observed in the downgradient wells may be due in part to carbon dioxide liberated during the oxidation of organic matter discharged in the septic tank effluent.

Conductivity

The mean conductivity of the septic tank effluent is 788 umhos/cm and the means of the background wells are 34 and 39 umhos/cm, respectively. The mean conductivities of the downgradient wells range from 351 to 514 umhos/cm. Based on the conductivity levels of the downgradient wells, relative to the background wells, it does appear that groundwater quality has been affected by the septic tank effluent, and PAL exceedances are occurring at all the downgradient wells.

Total Kjeldahl Nitrogen (TKN)

The mean TKN concentration of the septic tank effluent is 65 mg/l and the means of the background wells are 0.3 and 1.2 mg/l, respectively. The means of the downgradient wells range from 0.4 to 9.7 mg/l. There is no clear relationship between the TKN concentrations in the downgradient wells with either well screen depth or distance from the mounds. However, the downgradient TKN concentrations are higher than the background levels which indicates that nitrogen contained in the septic tank effluent is reaching the downgradient wells in the form of either ammonia or organic nitrogen.

Ammonia - Nitrogen

The mean ammonia (NH_3-N) concentration of the septic tank effluent is 55 mg/l and means the of the two background wells are both less than the detection limit of 0.1 mg/l. The means of the downgradient wells range from less than 0.1 to 8.5 mg/l. It is likely that most ammonia in the septic tank effluent is nitrified as it passes through unsaturated soils. However, the monitoring data does indicate that a significant amount of ammonia is reaching the groundwater and PAL exceedances of an increase of greater than 2 mg/l were observed at four of the downgradient wells.

Nitrate+Nitrite-N

The mean nitrate+nitrite-N concentration in the septic tank effluent is less than 1.0 mg/l and the means of the two background wells are also less than 1.0 mg/l. The means of the downgradient wells range from 18.9 to 31.0 mg/l. The nitrate+nitrite-N levels observed in all downgradient wells exceed the ES of 10 mg/l specified in Chapter NR 140, Wis. Adm. Code. The source of the nitrate+nitrite-N being detected downgradient is most likely ammonia from the septic tank effluent which was nitrified as it passed through unsaturated soils.

Town of Scott Sanitary District Number 1

The groundwater monitoring data from the Town of Scott Sanitary District Number 1 system is presented in Appendix B and a discussion of the results is presented below.

Biochemical Oxygen Demand (BOD_5)

The mean BOD_5 concentration of the septic tank effluent is 144 mg/l and the mean of the background samples is less than the detection level of 3 mg/l. In addition the mean BOD_5 concentration of all downgradient monitoring wells are less than 3.0 mg/l. Therefore, it does not appear that there has been a significant impact from the BOD_5 discharged from the dosing tank.

Chlorides

The mean chloride concentration of the dosing tank effluent is 197 mg/l and the mean of the background well is 21.0 mg/l. The means of the downgradient wells range from 11.0 mg/l to 129 mg/l. The wells located in close proximity to the absorption beds have the highest concentrations while wells located more distant from the absorption beds have lower chloride concentrations. The mean chloride concentration at one well does exceed the PAL of 125 mg/l but if an ACL is calculated for this well an exceedance would not occur. However, these results do indicate that downgradient chloride levels have been increased relative to background levels.

Total Dissolved Solids (TDS)

The mean TDS concentration of the dosing tank effluent is 972 mg/l and the mean of the background well is 510 mg/l. The means of the downgradient wells range from 491 to 1,031 mg/l. The wells located in close proximity to the absorption beds have the highest concentrations while the wells located more distant from the absorption beds have lower TDS concentrations. The results indicate that downgradient TDS levels have been increased relative to background levels. The mean TDS concentrations of all wells exceeds the PAL of 250 mg/l, however if an ACL was calculated exceedances would still occur at four wells which are located in close proximity to the absorption beds. The procedures used to develop ACL's are presented in Appendix C.

Temperature

Dosing tank effluent temperatures often differed from the temperatures of groundwater samples, however no significant differences between background and downgradient groundwater temperatures were observed.

pH

The median pH value of the dosing tank effluent is 7.6 and the median value of the background well is 7.1. The median values of the downgradient wells ranged from 6.9 to 7.4. No significant differences between background and downgradient median pH values were observed.

downgradient wells ranged from 6.9 to 7.4. No significant differences between background and downgradient median pH values were observed.

Conductivity

The mean conductivity of the dosing tank effluent is 1,191 umhos/cm and the mean of the background well is 700 umhos/cm. The mean conductivities of the downgradient wells range from 660 to 1,243 umhos/cm. However, based on the conductivity levels of the downgradient wells, relative to the background well, it does appear that groundwater quality has been affected by the dosing tank effluent.

Total Kjeldahl Nitrogen (TKN)

The mean TKN concentration of the dosing tank effluent is 55 mg/l and the mean of the background well is 0.3 mg/l. The means of the downgradient wells range from 0.3 to 3.5 mg/l. The wells located in close proximity to the absorption beds have higher concentrations while the wells more distant from the absorption beds have lower TKN concentrations.

The majority of the TKN in the dosing tank effluent is in the form of ammonia with a smaller portion as organic nitrogen. The TKN concentrations in all the wells are significantly less than in the effluent which would seem to indicate that a high level of nitrification is occurring.

Ammonia - Nitrogen

The mean ammonia concentration of the septic tank effluent is 44 mg/l and the mean of the background well is less than the detection limit of 0.1 mg/l. The means of the downgradient wells range from less than 0.1 mg/l to 2.7 mg/l. The mean ammonia concentration at one well exceeds the PAL of 2 mg/l. The wells located in close proximity to the absorption beds have the highest concentrations while the wells located further from the absorption beds have lower ammonia concentrations. These results indicate that although the effluent being discharged may be affecting groundwater quality the ammonia levels are not yet significant.

Nitrate+Nitrite-N

The mean nitrate+nitrite-N concentration in the septic tank effluent is less than 1.0 mg/l and the mean of the background well is 1.5 mg/l. The means of the downgradient wells range from 3.2 mg/l to 36.6 mg/l. The mean nitrate+nitrite-N levels observed in six of the eight downgradient wells exceed the enforcement standard of 10 mg/l nitrate+nitrite-N specified in Chapter NR 140, Wis Adm. Code. The five wells in close proximity to the absorption beds all exceed the nitrate+nitrite-N enforcement standard and one well that is located at the property boundary also exceeds the enforcement standard. The source of the nitrates being detected downgradient is probably ammonia from the dosing tank effluent which has been nitrified as it passes through unsaturated soils.

VI. Summary

This investigation of these large scale soil absorption systems has indicated that both systems are being hydraulically loaded well below the design loading rates. The systems appear to be capable of functioning hydraulically at the current loading rates although groundwater mounding was observed to be occurring.

The evaluation of the monitoring data which has been gathered at the two sites indicates that groundwater quality is being impacted by the operation of these systems. The most significant impacts on the groundwater which have been observed are elevated levels for chlorides, TDS, and nitrogen compounds downgradient of the discharge points, and these data are presented in Tables 5 and 6. No significant impacts were observed for BOD_5, pH, or temperature.

The groundwater chloride concentrations downgradient were substantially higher than the background levels at both facilities. All downgradient wells at the Village of Wyeville exceed the PAL for TDS. The establishment of an ACL for TDS would reduce the number of exceedances so that exceedances would occur at only one well which is located about 44 feet from a mound. By definition TDS are soluble ions, these ions are not necessarily adsorbed readily to soil particles or attenuated by microbial activity. The elevated TDS concentrations in the groundwater downgradient of the facilities would appear to be a direct result of the effluent discharges.

All but one of the wells at the Town of Scott site, including the background well, exceed the PAL for TDS. This is due in part to the naturally higher TDS levels caused by the sandstone/limestone geology in the area. The downgradient TDS levels are increased even higher from the TDS in the effluent being discharged. If an ACL is established, only the wells in close proximity to the absorption beds would have exceedances while no exceedances would occur at wells located at the property boundary.

The groundwater monitoring for the nitrogen series compounds at both facilities has indicated that exceedances of both PAL and enforcement standards are occurring downgradient of the facilities as a result of the effluent being discharged.

At the Village of Wyeville site the PAL and the ES for nitrate+nitrite-N and the PAL for total nitrogen are being exceeded at all downgradient wells and the PAL for ammonia-N is being exceeded at four of the seven downgradient wells. These results seem to indicate that most, but not all, of the organic-N and ammonia-N in the effluent is being nitrified to nitrate+nitrite-N. Nitrate+nitrite-N is highly soluble and is not readily adsorbed to soil particles and is therefore being detected at high levels downgradient of the facility. In

Table 5
Village of Wyeville
Groundwater Monitoring Results*

Well	Chloride	Nitrate	TKN	Ammonia	TDS
W101**	1	<0.1	1.2	<0.1	45
W102	75	20.5	5.4	5.0	332
W103	78	28.7	8.0	7.3	326
W104	61	30.7	2.5	2.3	322
W105**	1	<0.1	0.3	<0.1	56
W106	109	20.5	3.8	3.2	391
W107	105	21.3	4.5	3.8	358
W108	87	31.0	9.7	8.5	356
W109	63	18.9	0.4	<0.1	288
PAL	125	2.0	(Background plus 2.0)		250
ES	250	10.0			500

* All results are mean values and are reported in mg/l

** Background wells

Table 6
Town of Scott Sanitary District Number 1
Groundwater Monitoring Results*

Well	Chloride	Nitrate	TKN	Ammonia	TDS
S101	116	29.7	0.7	0.3	996
S102	122	25.4	3.5	2.7	987
S103	97	18.4	0.5	<0.1	775
S104	129	35.9	2.4	1.8	1030
S105	111	36.6	1.2	0.7	1031
S106	55	15.7	0.4	<0.1	587
S107**	21	1.5	0.3	<0.1	510
S108	45	3.2	0.4	<0.1	491
S109	11	4.3	0.5	<0.1	569
PAL	125	2.0	(Background plus 2.0)		250
ES	250	10.0			500

* All results are mean values and are reported in mg/l.

** Background well

NOTE: Wells S101-S105 are located 10 to 14 feet from the nearest absorption bed and wells S106, S108, and S109 are located 110 to 125 feet from the absorption beds.

addition, the detection of ammonia-N at the downgradient wells could be an indication that incomplete oxidation is occurring which could indicate the presence of anaerobic conditions and possibly saturated soils.

At the Town of Scott site exceedances of the PAL and enforcement standards are occurring for nitrate+nitrite-N at all downgradient wells and PAL exceedances for total nitrogen and ammonia-N have been detected at several downgradient wells. The causes of the exceedances are most likely the same as those previously described for the Village of Wyeville system.

VII. Conclusions

The findings of the evaluation indicate that:

A. Neither system has exhibited ponding at current loading rates and groundwater mounding does appear to be occurring but has not adversely affected the hydraulic performance of either system.

B. The Village of Wyeville system has exceedances of the enforcement standard (ES) for nitrate+nitrite-N and preventive action limit (PAL) exceedances for total dissolved solids (TDS), conductivity, total nitrogen, and ammonia-N. The point of standards application (POSA) for this facility is the property boundary and these exceedances are being detected at the facility's POSA. The establishment of an alternative concentration limit (ACL) for TDS would reduce, but not eliminate TDS exceedances.

C. The Town of Scott system has exceedances of the ES for nitrate+nitrite-N and TDS, and PAL exceedances for chloride, total nitrogen, and ammonia-N. The POSA for this facility is the property boundary. Monitoring at wells located at the POSA indicate exceedances of the ES for nitrate+nitrite-N and PAL exceedances for total nitrogen and nitrate+nitrite-N.

Therefore it is concluded that although both facilities evaluated have had adequate hydraulic performance to date, it does not appear that either of these systems is meeting all of the groundwater quality standards specified in chapter NR 140, Wis Adm. Code, based on the parameters monitored during this study.

VII. Recommendations

This investigation has indicated that there is a need for a better understanding of how these systems function, to determine how they impact groundwater, and to consider modifications that can be made to improve their performance. Therefore it is recommended that:

A. B. The data generated by this investigation be used to develop pollutant transport models to project the movement of contaminants through the groundwater.

E, C. Design criteria be developed which will enhance the capability of these systems to meet groundwater standards.

C, D. Other technologies be evaluated which could be used in conjunction with or to replace these systems, in order for the groundwater standards to be achieved.

APPENDIX A

Village of Wyeville

Septic Tank Effluent and Groundwater Monitoring Data

VILLAGE OF WYEVILLE
GROUNDWATER DISCHARGE MONITORING

SEPTIC TANK

DATE	11-04-86	01-26-87	03-10-87	04-13-87	05-11-87	06-08-87	08-19-87	11-11-87	02-23-88	06-07-88		MAX	MIN	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)	240	310					210	170	310			310	170	248.00	55.281
CHLORIDE (mg/l)	110	110	110				140	130	130	130		140	110	122.86	11.606
NITRATE (mg/l) (NO3+NO2 as N)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0		
TKN (mg/l)	60	74	70				52	78	74	50		78	50	65.43	10.513
AMMONIA (mg/l) (NH3-N)	54	62	58				47	62	59	41		62	41	54.71	7.401
TSS (mg/l)		38	86				96	56	72	56		96	38	67.33	19.619
pH (s.u.) (field)	6.8	7.2	6.8				6.9	7.3	7.5	6.8		7.5	6.8	7.00	MEDIAN
TEMPERATURE (Celsius)		5.5	5.1				20	12	3.8	20.5		20.5	3.8	11.15	6.940
CONDUCTIVITY (uMHOS/CM) (field - uncorrected)	800						980		650	720		980	650	787.50	123.161
TOTAL SOLIDS (mg/l)			550				556	588	614			614	550	577	25.788
TDS (mg/l)			464				460	532	542	434		542	434	486	42.697

VILLAGE OF WYEVILLE
GROUNDWATER DISCHARGE MONITORING
WELL #101 Background

DATE	11-04-86	01-26-87	03-10-87	04-13-87	05-11-87	06-08-87	08-19-87	11-11-87	02-23-88	06-07-88	MIN	MAX	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	<3.0		<3.0			<3.0	3.4	<3.0		<3.0	3.4	0.38	1.069
CHLORIDE (mg/l)	1.4	1.7	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	1.7	0.98	0.296
NITRATE (mg/l) (NO3+NO2 as N)	0.1	0.1	0.1	<0.1	0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	0.20	0.06	0.066
TKN (mg/l)	0.6	<0.2	0.2	10	<0.2	0.2	0.2	0.2	0.2	<0.2	<0.2	10.0	1.16	2.951
AMMONIA (mg/l) (NH3-N)	0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	<0.1	0.10	0.04	0.049
TDS (mg/l)	108	40	40	42	40	44	36	34	34	30	30	108	44.80	21.451
pH (s.u.) (field)	5.2	5.1	4.9	5.7 (lab)	5.5	5.3	5.3	5.5	5.8	5.4	4.90	5.80	5.30	MEDIAN
TEMPERATURE (Celsius)		5.4	5		11	13.7	15	11.6	5.8	16.8	5.0	16.8	10.54	4.330
CONDUCTIVITY (uMHOS/CM) (field - uncorrected)	40				37	30	38	31	30	30	30	40	33.71	4.096
DEPTH TO WATER (ft)	7.21	8.53	8.65	8.12	7.08	8	9	10.79	10.21	9	7.08	10.79	8.66	1.119
WATER ELEVATION (ft)	92.79	91.47	91.35	91.88	92.92	92	91	89.21	89.79	91	91.88	89.21		
TOTAL RESIDUE														
TDS (mg/l)														

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING - RELATIVE ELEV. 100)

VILLAGE OF WYEVILLE
GROUNDWATER DISCHARGE MONITORING

WELL #W102 Downgradient

DATE	11-04-86	01-26-87	03-10-87	04-13-87	05-11-87	06-08-87	08-19-87	11-11-87	02-23-88	06-07-88	MIN	MAX	AVERAGE	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	<3.0		<3.0			<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	---
CHLORIDE (mg/l)	97	55	91	54	41	29	100	140	66	79	29.00	140.00	75.200	31.304
NITRATE (mg/l) (NO3+NO2 as N)	4.6	13.6	7.9	14.1	23	40	28	32	39	2.8	2.80	40.00	20.500	13.156
TKN (mg/l)	4.2	1.6	3.3	2.1	4.1	3.6	8.6	16	8.5	2.4	1.60	16.00	5.440	4.211
AMMONIA (mg/l) (NH3-N)	3.6	1.5	2.8	1.7	4.1	3.4	7.8	15	7.9	1.9	1.50	15.00	4.970	3.989
TDS (mg/l)	322	246	286	236	274	346	480	502	386	246	236.00	502.00	332.400	91.380
pH (s.u.) (field)	5.7	5.1	5.2	5.6 (lab)	6.2	5.4	5.5	5.9	5.9	5.4	5.10	6.20	5.500	MEDIAN
TEMPERATURE (Celsius)		6.1	6.1		13	14	16.2	12.8	5.6	16.3	5.60	16.30	11.263	4.301
CONDUCTIVITY (uMHOS/CM) (field - uncorrected)	428				330	390	680	715	390	260	260.00	715.00	456.143	160.821
DEPTH TO WATER (ft)	9.69	10.56	10.29	9.83	9.54	9.94	10.42	11.96	11.42	11.06	9.54	11.96	10.471	0.753
WATER ELEVATION (ft)	92.41	91.54	91.81	92.27	92.56	92.16	91.68	90.14	90.68	91.04	92.56	90.14		

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING - RELATIVE ELEV. 102.1)

VILLAGE OF WYEVILLE
GROUNDWATER DISCHARGE MONITORING

WELL #103 Downgradient

DATE	11-04-86	01-26-87	03-10-87	04-13-87	05-11-87	06-08-87	08-19-87	11-11-87	02-23-88	06-07-88	MIN	MAX	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)		<3.0									---	---	<3.0	---
CHLORIDE (mg/l)		100	65	68							65.00	100.00	77.667	15.839
NITRATE (mg/l) (NO3+NO2 as N)		31	27	28							27.00	31.00	28.667	1.700
TKN (mg/l)		9.2	7.2	7.5							7.20	9.20	7.967	0.881
AMMONIA (mg/l) (NH3-N)		8	6.9	7							6.90	8.00	7.300	0.497
TDS (mg/l)		366	310	302							302.00	366.00	326.000	28.472
pH (s.u.) (field)		5.1 (lab)	5.9	4.8							4.80	5.90	4.800	MEDIAN
TEMPERATURE (Celsius)			14	15.5							14.00	15.50	14.750	0.750
CONDUCTIVITY (uMHOS/CM) (field - uncorrected)			440	430							430.00	440.00	435.000	5.000
DEPTH TO WATER (ft)		8.75	8	6.67							6.67	8.75	7.807	0.860
WATER ELEVATION (ft)		91.5	92.25	93.58							93.58	91.5		
TOTAL RESIDUE														
TDS (mg/l)														

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING - RELATIVE ELEV. 100.25)

VILLAGE OF WYEVILLE
GROUNDWATER DISCHARGE MONITORING

WELL #104 Downgradient

DATE	11-04-86	01-26-87	03-10-87	04-13-87	05-11-87	06-08-87	08-19-87	11-11-87	02-23-88	06-07-88	MIN	MAX	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	<3.0		<3.0			<3.0	<3.0	<3.0		<3.0	<3.0	<3.0	---
CHLORIDE (mg/l)	36	22	82	43	55	78	28	130	91	47	22.00	130.00	61.200	31.909
NITRATE (mg/l) (NO3+NO2 as N)	25	15.1	45	37	40	28	11.9	32	52	20.7	11.90	52.00	30.670	12.339
TKN (mg/l)	0.2	0.2	0.3	0.4	0.3	0.2	0.6	0.7	18	4.4	0.20	18.00	2.530	5.298
AMMONIA (mg/l) (NH3-N)	<0.1	0.1	0.1	<0.1	0.1	0.2	0.2	0.6	18	4	0.00	18.00	2.330	5.350
TDS (mg/l)	202	164	398	300	418	398	204	458	436	244	164.00	458.00	322.200	105.885
pH (s.u.) (field)	4.8	4.7	4.5	5.3	5.6	4.8	5.1	4.7	5.7	5.3	4.50	5.70	4.800	MEDIAN
TEMPERATURE (Celsius)	12	6.2	5.2		13	13	15.9	12.5	5	18.1	5.00	18.10	11.211	4.447
CONDUCTIVITY (uMHOS/CM) (field - uncorrected)	255				420	380	197	600	490	195	195.00	600.00	362.429	143.067
DEPTH TO WATER (ft)	7.81	9.17	9.27	8.75	7.83	7.58	9.6	11.29	10.75	9.73	7.58	11.29	9.178	1.177
WATER ELEVATION (ft)	92.53	91.17	91.07	91.59	92.51	92.76	90.74	89.05	89.59	90.61	92.76	89.05		

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING - RELATIVE ELEV. 100.34)

VILLAGE OF WYEVILLE
GROUNDWATER DISCHARGE MONITORING

WELL #105 Background

DATE	11-04-86	01-26-87	03-10-87	04-13-87	05-11-87	06-08-87	08-19-87	11-11-87	02-23-88	06-07-88	MIN	MAX	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	6.1		3.7			<3.0	3.1	<3.0		<3.0	6.10	2.150	2.337
CHLORIDE (mg/l)	1.4	2.5	1.4	1.6	1.3	1.2	1	1.2	1.7	1.5	1.00	2.50	1.480	0.392
NITRATE (mg/l) (NO3+NO2 as N)	0.1	<0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	<0.1	<0.1	0.20	0.090	0.054
TKN (mg/l)	0.5	0.2	0.2	0.4	0.3	0.2	0.3	0.2	0.2	0.2	0.20	0.50	0.270	0.100
AMMONIA (mg/l) (NH3-N)	<0.1	<0.1	<0.1	0.1	0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	0.10	0.040	0.049
TDS (mg/l)	134	62	52	44	46	40	40	54	50	42	40.00	134.00	56.400	26.695
pH (s.u.) (field)	5.9	5.5	5.3	6.1 (lab)	5.7	5.4	5.9	5.6	5.9	5.4	5.30	6.10	5.500	MEDIAN
TEMPERATURE (Celsius)		5	4.2		12	14	16.4	10.8	4.4	16	4.20	16.40	10.350	4.830
CONDUCTIVITY (uMHOS/CM) (field - uncorrected)	45				42	30	45	49	30	35	30.00	49.00	39.429	7.149
DEPTH TO WATER (ft)	5.21	6.79	5.83	5.75	4.38	6.38	6.66	8.56	8.06	7.71	4.38	8.56	6.533	1.242
WATER ELEVATION (ft)	93.92	92.34	93.3	93.38	94.75	92.75	92.47	90.57	91.07	91.42	94.75	90.57		

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING - RELATIVE ELEV. 99.13)

VILLAGE OF WYEVILLE
GROUNDWATER DISCHARGE MONITORING

WELL #106 Downgradient

DATE	11-04-86	01-26-87	03-10-87	04-13-87	05-11-87	06-08-87	08-19-87	11-11-87	02-23-88	06-07-88	MIN	MAX	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	4.6		<3.0			<3.0	<3.0	<3.0		<3.0	4.6	0.460	1.380
CHLORIDE (mg/l)	110	110	110	110	100	80	83	130	140	120	80.00	140.00	109.300	17.675
NITRATE (mg/l) (NO3+NO2 as N)	2.8	3.1	4.7	5.9	11.6	28	71	31	24	23.2	2.80	71.00	20.530	19.734
TKN (mg/l)	0.5	0.8	0.8	1	0.9	1.8	2.6	9	9.6	11	0.50	11.00	3.800	4.039
AMMONIA (mg/l) (NH3-N)	0.1	0.4	0.1	0.1	0.5	1.2	2.1	8	9.7	10	0.10	10.00	3.220	4.009
TDS (mg/l)	296	294	304	298	338	374	680	468	450	412	294.00	680.00	391.400	114.508
pH (s.u.) (field)	5.1	4.8	4.7	5.3 (lab)	5.7	5	4.9	5	5.3	5.1	4.70	5.70	5.000	MEDIAN
TEMPERATURE (Celsius)		6.3	6.3		11.5	13	16	13	16.4	17.1	6.30	17.10	12.450	3.984
CONDUCTIVITY (uMHOS/CM) (field - uncorrected)	400				460	420	600	680	525	510	400.00	680.00	513.571	92.455
DEPTH TO WATER (ft)	8.39	9.21	8.83	8.5	7.92	8.6	9.8	10.6	10	9.75	7.92	10.60	9.160	0.808
WATER ELEVATION (ft)	92.37	91.55	91.93	92.26	92.84	92.16	90.96	90.16	90.76	91.01	92.84	90.16		

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING - RELATIVE ELEV. 100.76)

VILLAGE OF WYEVILLE
GROUNDWATER DISCHARGE MONITORING

WELL #107 Downgradient

DATE	11-04-86	01-26-87	03-10-87	04-13-87	05-11-87	06-08-87	08-19-87	11-11-87	02-23-88	06-07-88	MIN	MAX	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	<3.0		<3.0			<3.0	<3.0	<3.0		<3.0	<3.0	0.000	0.000
CHLORIDE (mg/l)	110	110	110	110	110	110	110	120	91	70	70.00	120.00	105.100	13.494
NITRATE (mg/l) (NO3+NO2 as N)	24	12.2	11.5	11.2	12	12.2	16.5	27	42	44.5	11.20	44.50	21.310	12.164
TKN (mg/l)	1.5	3.6	4.1	3.6	3.2	3	6	7	6.7	6.4	1.50	7.00	4.510	1.780
AMMONIA (mg/l) (NH3-N)	1	3	3.5	2.5	2.6	2.5	5.2	5.6	5.9	6	1.00	6.00	3.780	1.668
TDS (mg/l)	356	324	312	318	334	328	340	390	444	438	312.00	444.00	358.400	46.362
pH (s.u.) (field)	4.6	4.5	4.6	5.2 (lab)	5.6	4.8	4.8	4.8	5.1		4.50	5.60	4.800	MEDIAN
TEMPERATURE (Celsius)		7.6	6.4		14	16	17	13.1	6.1	18.4	6.10	18.40	12.325	4.635
CONDUCTIVITY (uMHOS/CM) (field - uncorrected)	445				450	430	490	580	460	495	430.00	580.00	478.571	46.806
DEPTH TO WATER (ft)	7.08	8.24	7.92	7.83	7.08	7.67	8.38	9.83	9.33	9.08	7.08	9.83	8.244	0.879
WATER ELEVATION (ft)	92.15	90.99	91.31	91.4	92.15	91.56	90.85	89.4	89.9	90.15	92.15	89.4		

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING - RELATIVE ELEV. 99.23)

VILLAGE OF WYEVILLE
GROUNDWATER DISCHARGE MONITORING

WELL #108 Downgradient

DATE	11-04-86	01-26-87	03-10-87	04-13-87	05-11-87	06-08-87	08-19-87	11-11-87	02-23-88	06-07-88	MIN	MAX	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	<3.0		3.7			<3.0	<3.0	<3.0		<3.0	3.70	0.529	1.295
CHLORIDE (mg/l)	100	98	100	100	72	99	100	110	51	38	38.00	110.00	86.800	23.220
NITRATE (mg/l) (NO3+NO2 as N)	36	7	14.8	30	29	37	25	31	52	48	7.00	52.00	30.980	12.925
TKN (mg/l)	10	6	7.8	11	10	14	12	14	4.8	7.7	4.80	14.00	9.730	2.991
AMMONIA (mg/l) (NH3-N)	9.4	5.4	6.9	9.1	7.5	13	11	11	4.5	7.3	4.50	13.00	8.510	2.540
TDS (mg/l)	378	268	306	360	334	366	360	382	428	382	268.00	428.00	356.400	42.283
pH (s.u.) (field)	4.6	4.4	4.7	5 (lab)	5.6	4.8	4.7	4.8	5	4.4	4.40	5.60	4.800	0.332
TEMPERATURE (Celsius)		5.9	5		14	17	17.9	13.1	4.5	18.7	4.50	18.70	12.013	5.617
CONDUCTIVITY (uMHOS/CM) (field - uncorrected)	600				440	550	610	580	390	240	240.00	610.00	487.143	127.135
DEPTH TO WATER (ft)	7.17	8.1	8.04	8	7.25	7.88	8.5	9.88	9.5	9.04	7.17	9.88	8.336	0.852
WATER ELEVATION (ft)	92.32	91.39	91.45	91.49	92.24	91.61	90.99	89.61	89.99	90.45	92.32	89.61		

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING - RELATIVE ELEV. 99.49)

VILLAGE OF WYEVILLE
GROUNDWATER DISCHARGE MONITORING

WELL #109 Downgradient

DATE	11-04-86	01-26-87	03-10-87	04-13-87	05-11-87	06-08-87	08-19-87	11-11-87	02-23-88	06-07-88	MIN	MAX	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	3.1		<3.0			<3.0	<3.0	<3.0	<3.0	<3.0	3.10	0.443	1.085
CHLORIDE (mg/l)	2.1	6	22	38	61	46	99	110	120	130	2.10	130.00	63.410	45.605
NITRATE (mg/l) (NO3+NO2 as N)	2.5	5.6	11.5	15	20	27	44	39	12.8	11.4	2.50	44.00	18.880	13.077
TKN (mg/l)	0.4	0.2	0.4	0.4	0.4	0.3	0.6	0.2	0.4	0.6	0.20	0.60	0.390	0.130
AMMONIA (mg/l) (NH3-N)	<0.1	<0.1	<0.1	0.1	0.1	0.2	0.1	0.1	0.1	<0.1	<0.1	0.20	0.070	0.064
TDS (mg/l)	52	78	140	196	398	270	552	446	364	388	52.00	552.00	288.400	159.067
pH (s.u.) (field)	5.1	4.9	4.7	5 (lab)	5.6	5	4.7	4.8	5.4	4.8	4.70	5.60	4.900	MEDIAN
TEMPERATURE (Celsius)		6.8	6.3		14	13	16.4	12.3	6.2	18	6.20	18.00	11.625	4.366
CONDUCTIVITY(uMHOS/CM) (field - uncorrected)	45				320	330	600	490	350	320	45.00	600.00	350.714	159.159
DEPTH TO WATER (ft)	6.81	8.17	8.19	7.75	6.79	8.63	8.56	10.17	9.71	8.75	6.79	10.17	8.353	1.033
WATER ELEVATION (ft)	92.42	91.06	91.04	91.48	92.44	90.6	90.67	89.06	89.52	90.48	92.44	89.06		

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING - RELATIVE ELEV. 99.23)

APPENDIX B

Town of Scott Sanitary District No. 1

Dosing Tank Effluent and Groundwater Monitoring Data

TOWN OF SCOTT

SEPTIC TANK

SAMPLE DATE

PARAMETER	11-06-86	02-03-87	03-17-87	8-11-87	2-16-88	6-14-88	6-28-88	MAXIMUM	MINIMUM	MEAN (MEIDAN)	STANDARD DEVIATION
BOD5 (mg/l)	86	180	160	150	110	180		180	86	144.33	35.127
CHLORIDE (mg/l)	230	320	370	110	20	130		370	20	196.67	122.157
NITRATE (mg/l) (NO3+NO2 AS N)	<1.0	<1.0	<1.0	<1.0	<1.0		<1.0	<1.0	<1.0	<1.0	---
TKN (mg/l)	65	56	48	60	54		46	65	46	54.83	6.543
AMMONIA (mg/l) (NH3-N)	49	48	41	46	44		38	49	38	44.33	3.859
T.S.S. (mg/l)		36	60		24	44		60	0	32.80	20.143
TOTAL SOLIDS (mg/l)	1020	1190	1190					1190	1020	1133.33	80.139
T.D.S. (mg/l)		1156	1130	820	926	828		1156	820	972.00	144.759
pH (FIELD)	7.7	7.6	7.6	7.5		7.7	7.6	7.7	7.5	7.60	MEDIAN
TEMP. (C) (FIELD)	13.8	6.1	6.7	17.3		17.8	25	25	6.1	14.45	6.594
CONDUCTIVITY (FIELD) (UNCORRECTED) (UMHOS/CM)	1600					1450	1100	1600	1100	1383.33	209.497

TOWN OF SCOTT

WELL #S101 Downgradient

SAMPLE DATE

PARAMETER	11-06-86	02-03-87	03-17-87	04-20-87	05-18-87	06-15-87	08-11-87	11-04-87	2-23-88	06-14-88	06-28-88	MAXIMUM	MINIMUM	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	<3.0					<3.0	3.1	<3.0	<3.0		3.1	<3.0	0.517	1.155
CHLORIDE (mg/l)	51	120	130	170	140	110	100	77	130	130		170.0	51	115.800	31.833
NITRATE (mg/l) (NO3+NO2 AS N)	18.5	17.1	18.6	19.1	22	33	46	46	35		42	46.0	17.1	29.730	11.405
TKN (mg/l)	0.8	1.5	1.2	0.6	0.6	0.6	0.8	0.3	0.2		0.4	1.5	0.2	0.700	0.379
AMMONIA (mg/l) (NH3-N)	0.1	1.2	0.8	0.2	0.4	<0.1	0.1	<0.1	<0.1		<0.1	1.2	<0.1	0.280	0.389
T.D.S. (mg/l)	714	878	940	1070	1040	1060	1092	1020	1030	1120		1120.0	714	996.400	115.937
pH (FIELD)	6.9	6.5	6.8		6.9	6.8	6.9	6.8	7.3	7	7	7.3	6.5	6.900	MEDIAN
TEMP. (C) (FIELD)	14.4	9.9	8.1		9.8	13	14.2	14.7	6.3	16	20.4	20.4	6.3	12.680	3.972
CONDUCTIVITY (FIELD) (UNCORRECTED) (uMHOS/CM)	1000				960	1200		1290	1090	1500	1300	1500.0	960	1191.429	176.184
DEPTH TO WATER (ft)	16.79	18.04	17.85	17.42	17.75	17.98	18.19	18.65	18.17	18.79	19.08	19.1	16.79	18.065	0.612
WATER ELEVATION (ft)	89.82	88.57	88.76	89.19	88.86	88.63	88.42	87.96	88.44	87.82	87.53	87.53	89.82		

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING - RELATIVE ELEV. 106.6)

TOWN OF SCOTT

WELL #S102 Downgradient

SAMPLE DATE

PARAMETER	11-06-86	02-03-87	03-17-87	04-20-87	05-18-87	06-15-87	08-11-87	11-04-87	2-16-88	06-14-88	06-28-88	MAXIMUM	MINIMUM	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	5.5					3.1	<3.0	<3.0	<3.0		5.5	<3.0	1.229	2.046
CHLORIDE (mg/l)	79	110	140	140	150	150	180	100	74	98		180.0	74	122.100	33.071
NITRATE (mg/l) (NO3+NO2 AS N)	22	13.4	15.4	35	21	16	4.6	41	46		40	46.0	4.6	25.440	13.300
TKN (mg/l)	2.5	1.2	2.2	2.2	2.4	3.8	3.2	3.8	8		5.5	8.0	1.2	3.480	1.881
AMMONIA (mg/l) (NH3-N)	1.6	0.8	1.8	2.3	1.8	2.4	2.1	2.9	6.5		4.8	6.5	0.8	2.700	1.611
T.D.S. (mg/l)	788	850	894	1050	1020	1130	996	1180	978	980		1180.0	788	986.600	114.011
pH (FIELD)	6.8	6.7	6.9		7	7.1	7	7	7.3	7.3	7.1	7.3	6.7	7.000	MEDIAN
TEMP. (C) (FIELD)	14	8.7	8.6		10.2	15	14.1	13.2	7.6	17.9	19.4	19.4	7.6	12.870	3.820
CONDUCTIVITY (FIELD) (UNCORRECTED) (uMHOS/CM)	1130				1120	1480		1310	1050	1450	1150	1480.0	1050	1241.429	159.143
DEPTH TO WATER (ft)	17.56	18.88	18.85	17.42	18.92	19.15	19.56	21.04	19.67	20.21	20.42	21.0	17.42	19.244	1.061
WATER ELEVATION (ft)	89.22	87.9	87.93	89.36	87.86	87.63	87.22	85.74	87.11	86.57	86.36	85.74	89.36		

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING -RELATIVE ELEV. 106.78)

TOWN OF SCOTT

WELL #S103 Downgradient

SAMPLE DATE

PARAMETER	11-06-86	02-03-87	03-17-87	04-20-87	05-18-87	06-15-87	08-11-87	11-04-87	2-16-88	06-14-88	06-28-88	MAXIMUM	MINIMUM	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	<3.0					<3.0	11	<3.0	<3.0		11.0	<3.0	1.833	4.099
CHLORIDE (mg/l)	84	78	82	110	120	110	120	79	43	140		140.0	43	96.600	26.904
NITRATE (mg/l) (NO3+NO2 AS N)	21	5.7	10.1	12.7	10	5	9.4	40	19.8		50	50.0	5	18.370	14.379
TKN (mg/l)	0.6	0.4	0.5	0.4	0.3	0.2	1	0.6	<0.2		0.7	1.0	0	0.470	0.265
AMMONIA (mg/l) (NH3-N)	0.1	<0.1	0.1	0.1	<0.1	<0.1	0.1	0.1	<.1		<0.1	0.1	<.1	0.045	0.050
T.D.S. (mg/l)	512	622	662	782	824	848	866	912	610	1110		1110.0	512	774.800	167.220
pH (FIELD)	7.3	7	7		7.1	7.1	7.2	7.6	7.6	7.1	7.2	7.6	7	7.100	MEDIAN
TEMP. (C) (FIELD)	12.5	8.7	7.9		10	14	13.5	13.8	7.9	17.8	21.1	21.1	7.9	12.720	4.117
CONDUCTIVITY (FIELD) (UNCORRECTED) (uMHOS/CM)	1050				900	1150		1180	710	1550	1200	1550.0	710	1105.714	243.713
DEPTH TO WATER (ft)	17.09	18	18.21	17.96	17.92	18.23	18.71	19.62	17.92	18.58	18.92	19.6	17.09	18.287	0.628
WATER ELEVATION (ft)	88.94	88.03	87.82	88.07	88.11	87.8	87.32	86.41	88.11	87.45	87.11	86.41	88.94		

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING - RELATIVE ELEV. 106.03)

TOWN OF SCOTT WELL #104 Downgradient

PARAMETER	SAMPLE DATE 11-06-86	02-03-87	03-17-87	04-20-87	05-18-87	06-15-87	08-11-87	11-04-87	2-16-88	06-14-88	06-28-88	MAXIMUM	MINIMUM	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	<3.0					<3.0	<3.0	<3.0	<3.0		<3.0	<3.0	<3.0	---
CHLORIDE (mg/l)	120	130	150	140	140	130	140	130	90	120		150.0	90	129.000	15.780
NITRATE (mg/l) (NO3+NO2 AS N)	51	14.4	23	29	40	34	47	51	33		37	51.0	14.4	35.940	11.338
TKN (mg/l)	4.4	1.6	1.5	1.4	2.1	2.6	2.8	5	1.6		0.5	5.0	0.5	2.350	1.331
AMMONIA (mg/l) (NH3-N)	3	1.3	1	1	1.8	2	2	4.6	1.7		<0.1	4.6	<0.1	1.840	1.188
T.D.S. (mg/l)	1040	914	1010	1000	1090	1050	1080	1060	876	1180		1180.0	876	1030.000	82.748
pH (FIELD)	6.9	6.7	6.7		7.1	7.1	7	7.2	7.4	7.1	7.1	7.4	6.7	7.100	MEDIAN
TEMP. (C) (FIELD)	13	8	7.4		9	13.5	13.1	13.9	6.6	16	21.6	21.6	6.6	12.210	4.372
CONDUCTIVITY (FIELD) (UNCORRECTED) (uMHOS/CM)	1400				1120	1280		1330	710	1450	1200	1450.0	710	1212.857	230.262
DEPTH TO WATER (ft)	16.29	17.75	17.84	17.92	17.42	17.83	18.42	18.79	17.06	17.71	18	18.8	16.29	17.730	0.629
WATER ELEVATION (ft)	89.01	87.55	87.46	87.38	87.88	87.47	86.88	86.51	88.24	87.59	87.3	86.51	89.01		

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING - RELATIVE ELEV. 105.3)

TOWN OF SCOTT

WELL #105 DOWNGRADIENT

SAMPLE DATE

PARAMETER	11-06-86	02-03-87	03-17-87	04-20-87	05-18-87	06-15-87	08-11-87	11-04-87	2-16-88	06-14-88	06-28-88	MAXIMUM	MINIMUM	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	<3.0					<3.0	<3.0	<3.0	<3.0		<3.0	<3.0	<3.0	---
CHLORIDE (mg/l)	92	90	110	120	150	150	130	110	82	81		150.0	81	111.500	24.549
NITRATE (mg/l) (NO3+NO2 AS N)	33	17.7	11.6	34	59	56	43	48	31		33	59.0	11.6	36.630	14.475
TKN (mg/l)	1.9	0.4	0.6	0.5	0.9	1.2	1.9	3.4	0.4		0.5	3.4	0.4	1.170	0.923
AMMONIA (mg/l) (NH3-N)	1	0.1	0.1	0.1	0.6	<0.1	1.4	3			<0.1	3.0	<0.1	0.700	0.939
T.D.S. (mg/l)	930	826	812	982	1280	1230	1156	1120	984	994		1280.0	812	1031.400	152.090
pH (FIELD)	6.9	6.8	7		7	6.9	7	7	7.4	7.2	7.2	7.4	6.8	7.000	MEDIAN
TEMP. (C) (FIELD)	13.4	9.6	8.1		10	16	13.1	13.2	7.7	13.2	18.9	18.9	7.7	12.320	3.348
CONDUCTIVITY (FIELD) (UNCORRECTED) (UMHOS/CM)	1300				1370	1400		1320	910	1300	1100	1400.0	910	1242.857	162.368
DEPTH TO WATER (ft)	13.81	15.67	15.54	15.21	15.33	15.65	15.91	16.29	16.69	17.25	17.33	17.3	13.81	15.880	0.956
WATER ELEVATION (ft)	90.51	88.65	88.78	89.11	88.99	88.67	88.41	88.03	87.63	87.07	86.77	86.99	90.51		

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING -RELATIVE ELEV. 104.32)

TOWN OF SCOTT WELL #106 Downgradient

PARAMETER	SAMPLE DATE 11-06-86	02-03-87	03-17-87	04-20-87	05-18-87	06-15-87	08-11-87	11-04-87	2-16-88	06-14-88	06-28-88	MAXIMUM	MINIMUM	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	<3.0					<3.0	<3.0	<3.0	<3.0		<3.0	<3.0	<3.0	---
CHLORIDE (mg/l)	38	56	55	61	66	70	67	54	34	50		70.0	34	55.100	19.000
NITRATE (mg/l) (NO3+NO2 AS N)	15.2	13.5	12.6	13.7	13.4	13.5	13.4	13.8	21		27	27.0	12.6	15.710	7.165
TKN (mg/l)	0.4	0.4	0.4	0.3	0.2	0.3	0.6	0.2	0.3		0.6	0.6	0.2	0.370	0.200
AMMONIA (mg/l) (NH3-N)	0.1	<0.1	0.1	0.1	<0.1	<0.1	0.1	<0.1	<0.1		<0.1	0.1	0	0.040	0.050
T.D.S. (mg/l)	490	550	552	568	618	634	608	594	592	664		664.0	490	587.000	245.000
pH (FIELD)	7.1	6.5	7.1		7.1	7	7.3	7.2	7.8	7.2	7	7.8	6.5	7.100	MEDIAN
TEMP. (C) (FIELD)	12.7	8.1	7.9		9	11.7	12.9	13	7.8	16.9	19.1	19.1	7.8	11.910	6.350
CONDUCTIVITY (FIELD) (UNCORRECTED) (uMHOS/CM)	800				700	875		800	690	1000	850	1000.0	690	816.429	400.000
DEPTH TO WATER (ft)	14.4	15.67	15.83	15.83	15.5	15.83	14.59	16.77	15.64	16.29	16.58	16.8	14.4	15.721	7.200
WATER ELEVATION (ft)	88.69	87.42	87.26	87.26	87.59	87.26	88.5	86.32	87.45	86.8	86.51	86.32	88.69		

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING - RELATIVE ELEV. 103.09)

TOWN OF SCOTT WELL #107 Background

PARAMETER	SAMPLE DATE 11-06-86	02-03-87	03-17-87	04-20-87	05-18-87	06-15-87	08-11-87	11-04-87	2-16-88	06-14-88	06-28-88	MAXIMUM	MINIMUM	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	<3.0					<3.0	<3.0	4.9	<3.0		4.9	<3.0	0.817	---
CHLORIDE (mg/l)	8	11	14	15	20	24	28	30	29	33		33.0	8	21.200	4.000
NITRATE (mg/l) (NO3+NO2 AS N)	0.9	1.1	1.2	1.1	1.2	1.5	1.9	2	2		2.4	2.4	0.9	1.530	0.424
TKN (mg/l)	0.4	0.4	0.2	0.3	0.4	0.3	0.5	0.2	0.2		0.3	0.5	0.2	0.320	0.200
AMMONIA (mg/l) (NH3-N)	0.1	<0.1	0.1	0.1	<0.1	<0.1	0.1	<0.1	<0.1		0.05	0.1	0	0.045	0.050
T.D.S. (mg/l)	444	486	510	500	536	540	542	528	502	512		542.0	444	510.0	222.0
pH (FIELD)	7.1	6.4	6.9		6.9	6.8	7.1	7.1	7.6	7.2	7.2	7.6	6.4	7.100	MEDIAN
TEMP. (C) (FIELD)	12.9	7.2	6.7		9	12.8	13	12.8	6.6	15.3	26.4	26.4	6.6	12.270	6.450
CONDUCTIVITY (FIELD) (UNCORRECTED) (uMHOS/CM)	720				620	800		710	600	750	700	800.0	600	700.0	360.0
DEPTH TO WATER (ft)	11.19	12.13	12.42	12.67	12.58	12.75	13.24	13.75	13.42	13.75	13.92	13.9	11.19	12.89	5.60
WATER ELEVATION (ft)	88.48	87.54	87.25	87	87.09	86.92	86.43	85.92	86.25	85.92	85.75	85.75	88.48		

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING - RELATIVE ELEV. 99.67)

TOWN OF SCOTT

WELL #S108 Downgradient

SAMPLE DATE

PARAMETER	11-06-86	02-03-87	03-17-87	04-20-87	05-18-87	06-15-87	08-11-87	11-04-87	2-16-88	06-14-88	06-28-88	MAXIMUM	MINIMUM	MEAN	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	<3.0					<3.0	<3.0	<3.0	<3.0		<3.0	<3.0	<3.0	---
CHLORIDE (mg/l)	44	42	43	44	46	46	45	46	43	50		50.0	42	44.900	2.166
NITRATE (mg/l) (NO3+NO2 AS N)	3.4	2.8	2.7	2.8	2.7	2.7	2.9	3.4	3.8		4.8	4.8	2.7	3.200	0.645
TKN (mg/l)	0.4	0.4	0.6	0.3	0.4	0.4	0.6	0.2	0.3		0.5	0.6	0.2	0.410	0.122
AMMONIA (mg/l) (NH3-N)	0.1	<0.1	0.1	0.1	<0.1	<0.1	0.1	<0.1	0.1		<0.1	0.1	<0.1	0.050	0.050
T.D.S. (mg/l)	470	456	474	464	514	526	514	506	482	502		526.0	456	490.800	23.224
pH (FIELD)	7.2	7	7.1		7.3	7.4	7.4	7.4	7.7	7.5	7.5	7.7	7	7.400	MEDIAN
TEMP. (C) (FIELD)	11.7	8	7.8		10	14	13.7	12.9	6.6	18.2	21.3	21.3	6.6	12.420	4.447
CONDUCTIVITY (FIELD) (UNCORRECTED) (uMHOS/CM)	740				420	710		700	590	800	650	800.0	420	660.000	124.231
DEPTH TO WATER (ft)	17.75	18.75	19.13	19.25	19.17	19.31	19.7	20.33	19.75	20.33	20.7	20.7	17.75	19.470	0.791
WATER ELEVATION (ft)	88.22	87.22	86.84	86.72	86.8	86.66	86.27	85.64	86.22	85.64	85.27	85.27	88.22		

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING - RELATIVE ELEV. 105.97)

TOWN OF SCOTT

WELL #S109 Downgradient

SAMPLE DATE

PARAMETER	11-06-86	02-03-87	03-17-87	04-20-87	05-18-87	06-15-87	08-11-87	11-04-87	2-16-88	06-14-88	06-28-88	MAXIMUM	MINIMUM	MEAN (MEDIAN)	STANDARD DEVIATION
BOD5 (mg/l)	<3.0	<3.0					<3.0	<3.0	3.1	<3.0		3.1	<3.0	0.517	1.155
CHLORIDE (mg/l)	11	15	15	14	11	12	11	10	4.1	6.1		15.0	4.1	10.920	3.385
NITRATE (mg/l) (NO3+NO2 AS N)	3.3	3.3	3.9	5.5	5.4	5.4	4.8	4.6	3.5		3.7	5.5	3.3	4.340	0.857
TKN (mg/l)	0.5	0.4	0.4	0.4	0.4	0.4	0.8	0.3	0.4		0.8	0.8	0.3	0.480	0.166
AMMONIA (mg/l) (NH3-N)	0.1	<0.1	0.1	0.1	<0.1	<0.1	0.1	<0.1	<0.1		<0.1	0.1	<0.1	0.040	0.049
T.D.S. (mg/l)	422	422	470	556	582	1180	564	584	406	508		1180.0	406	569.400	213.826
pH (FIELD)	7.3	7.1	7.3		7.3	7.4	7.4	7.5	7.9	7.6	7.5	7.9	7.1	7.400	MEDIAN
TEMP. (C) (FIELD)	12.2	8	6.4		9	13.5	14.2	13.8	6.5	20.5	25.9	25.9	6.4	13.000	5.937
CONDUCTIVITY (FIELD) (UNCORRECTED) (uMHOS/CM)	700				600	700		760	450	800	600	800.0	450	668.333	115.530
DEPTH TO WATER (ft)	12.6	13.63	13.75	13.83	13.83	14.04	14.57	15.04	14.38	15	15.17	15.2	12.6	14.167	0.728
WATER ELEVATION (ft)	87.44	86.41	86.29	86.21	86.21	86	85.47	85	85.66	85.04	84.87	84.87	87.44		

(DEPTH TO GROUNDWATER MEASURED FROM TOP OF CASING - RELATIVE ELEV. 100.04)

APPENDIX C

NR 140.28 Exemptions

Alternate Concentration Limits

Appendix C

NR 140.28 Exemptions
Alternate Concentration Limits

Chapter NR 140, Wisconsin Administrative Code, Groundwater Quality, sets two levels of standards for over 40 different parameters of health and welfare concern and indicators of water quality status which do not affect the health or welfare of the user. The two levels are preventive action limits (PALs) and enforcement standards. The PALs are 10 to 50 percent of the enforcement standard and serve as an early indicator of contamination. This code also sets responses to exceedances, and provides for exemptions to the standards under certain conditions. For every exemption given, an alternate concentration limit (ACL) is also given to replace the standard that applies at the well(s) in question.

There are three cases in which the exemption can be granted, if certain criteria are met. The first case is where the background concentration is below the PAL. The second case is where the background concentrations are above the PAL but less than the enforcement standard. The third case is where the background concentrations are above the enforcement standard. The criteria which must be met vary slightly depending on whether the parameter is of public health or welfare concern and what the background concentration is, but in general include:

1. That the concentration is being minimized to the extent technically and economically feasible.

2. That the concentration will not exceed a certain limit at the point where standards are applied, and,

3. That no threat to public health or welfare will occur.

Example: Alternate Concentration Limits

ACL Calculates (Potential ACL's)

Village of Wyeville (2 background wells)

Total Dissolved Solids (TDS)

Well 105	Well 101
n = 10	n = 10
x = 56.4	x = 44.8
S.D. = 26.7	S.D. = 21.45

The A.C.L. is the greater of the following 2 equations:

ACL = BG + S.D. + PAL
or BG + 2 (S.D.)

Well 105

ACL = 333 or 110

Well 101

ACL = 316 or 88

Criteria to be met include:
under NR 140.28(2) BG < PAL

(a) increase will be minimized to extent technically and economically feasible

(b) compliance with the PAL is not technically or economically feasible

(c) the enforcement standard will not be attained or exceeded

(d) any increase is not a threat to public health or welfare

Alternatives include: 1) combining the data from the two (2) wells and determining an ACL, 2) dropping the first sample value and calculating a PAL based on 9 values per well or combine for 18 values/2 wells.

1 ACL - 105: n = 20, SD = 25.5, x = 50.6, ACL = 326 — n = 18, SD = 7.86, x = 42.7, ACL = 301

2 ACL - 101: 333 — n = 10, SD = 26.7, x = 56.4; n = 10, SD = 21.95, x = 44.8, ACL = 316 — or — 305 — n = 9, SD = 7.4, x = 48, ACL = 305; n = 9, SD = 4.52, x = 37.7, ACL = 293

The standard deviations, and so subsequent PALs decrease noticeably. A student-t test should be done to see if the first value is within the 95% confidence interval. That first value may just reflect well construction impacts.

At any rate, the greatest ACL used/calculated would only replace the PAL, and since ES exceedances are not occurring (infrequent, at wells 106, 107, 108), criteria "(c) the enforcement standard will not be attained or exceeded" should be met.

8908\ww97485E.agh
PC22

050871- Investigation of Large Scale Subsurface Soil Absorption Systems