April 8, 1985
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Client

DEPARTMENT OF NATURAL RESOURCES
P. O. BOX 310
ANTIGO, WISCONSIN 54409

Project

SUBSURFACE EXPLORATION AND TESTING PROGRAM TO EVALUATE GROUNDWATER QUALITY AND PRE-TREATMENT DESIGN PROGRAM AT THE WAUSAU CHEMICAL FACILITY IN WAUSAU, WISCONSIN

STS JOB 12776A

APRIL 3, 1985

STS Consultants Ltd.

STS Consultants Ltd.
Consulting Engineers

540 Lambeau
Green Bay, Wisconsin 54303
(414) 494-9656

April 3, 1985

Department of Natural Resources
P. O. Box 310
Antigo, Wisconsin 54409

Attention: Mr. Jack Saltes

STS Job 12776-A

RE: Subsurface Exploration and Testing Program to Evaluate Groundwater Quality and Preliminary Extraction and Pre-treatment Design Program at the Wausau Chemical Facility in Wausau, Wisconsin.

Gentlemen:

As we indicated in our recent letter to the Wisconsin DNR dated March 13, 1985, we completed the subsurface exploration, preliminary engineering evaluation and design analysis for the above referenced project on behalf of Charne, Glassner, Tehan, Clancy and Taitelman, legal council to Wausau Chemical. Five copies of the report are enclosed.

If you have any questions concerning this report, please feel free to contact us at your convenience.

Very truly yours,

STS CONSULTANTS LTD.

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Project Engineer

Douglas J. Hermann, P. E.
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MG/dw

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INTRODUCTION

The Wausau Chemical Corporation is located on the east bank of the Wisconsin River at 2001 River Drive, which is in the NW1/4, of the NW1/4 of Sec. 25, T29N, R7, east of the City of Wausau, Marathon County, Wisconsin.

In August, 1983, STS consultants Ltd. was requested to review the available site information collected by the City of Wausau in relation to groundwater contamination problems at the Wausau City Municipal wells 3 and 4. The findings of this review were presented to Wisconsin Department of Natural Resources on September 12, 1983 in the Rhinelander District Office. In brief, water samples from eight City of Wausau monitoring wells were collected and analyzed. The chemical analysis was performed by Zimpro Lab, State Lab and H/R* Lab, and was presented in a table in that report. According to this analysis, trichlorethylene was found in the aquifer but at a low concentration. Perchloroethylene and dichloroethylene were found in higher concentrations in the Wergin pumping well and monitoring wells 6 and 7 adjacent to that location. Higher dichloroethylene concentrations were observed at City pumping well 4. Furthermore, the major content of this report was presented to the DNR in a meeting at Rhinelander on September 16, 1983. Correspondence is presented in Appendix A.

On December 19, 1983, during extremely cold weather, an accidental release of tetrachloroethylene (perchloroethylene) occurred during routine operations. It was reported that 800 to 900 gallons of commercial grade product was lost. The immediate response of the Wausau Chemical personnel

recovered most of the product in snow and surface soils. Wausau Chemical subsequently completed a clean-up program to excavate the remaining contaminated soils above the water table within the tank farm area and disposed these soils at a secure landfill site.

The clean-up effort along with a plan of study for overall local groundwater quality proposed by STS Consultants Ltd. was approved by the Wisconsin DNR (see DNR letter dated March 10, 1984 and DNR follow-up letter dated April 23, 1984).

Following these developments, STS Consultants Ltd. proceeded with the exploration, testing and groundwater quality study as proposed. The result of this study, prepared by STS, was forwarded to the Wisconsin DNR by Charne, Glassner, Tehan, Clancy and Taitelman (CGTC & T) with a letter dated July 31, 1984. In brief, as a part of this observation, five soil borings were conducted and five galvanized wells were installed (Wausau Chemical Wells B-1, B-2, B-3, B-3A, B-3B). Following the well installations, frequent water level measurements were taken and compared to the operations of pumping wells No. 3 and 4 and river elevations. Two sets of groundwater samples were collected and analyzed. Water samples from deep Wausau Chemical wells B-3 and B-3A had no contamination. Slight contamination was observed in Wausau Chemical Wells (WCW) B-1 and B-2. The greatest contamination was observed in WCW B-3B which is about 24 feet deep and is the closest and shallowest well to the tank farm. The chemical analysis was performed by Zimpro.

In a meeting with the DNR on August 24, 1984, the preliminary report dated July 25, 1984 and future plan of observation was discussed and coordinated.

In a letter to Wausau Chemical dated August 28, 1984, the Department of Natural Resources (DNR) presented their view on the report of July 1984 and agreed with the proposed additional well installations and recommended collection of additional information to define the impact of extraction on the area before proceeding with extraction wells. On September 17, 1984, in a letter to CGTC & T, DNR reiterated their agreement to the extraction program, however, the DNR suggested that a thorough knowledge of the extent of contamination is needed to plan for extractions and/or treatment design. This letter is included in Appendix A along with the STS November 12, 1984 response letter.

Following the above developments, STS proceeded with the installation of the additional observation wells, groundwater level measurements, water chemical analysis, data interpretation and preliminary design of the extraction and treatment program which are presented in this report.

FIELD PROCEDURES

The new field exploration work for this report consisted of drilling and installing 9 monitoring wells (B-3C (29 feet), B-4 (53.7 feet), B-4A (18.8 feet), B-5 (53.6 feet), B-5A (18.7 feet), B-6 (53.3 feet), B-6A (21.6 feet), B-7 (53 feet), and B-7A (18.6 feet). The boring surface elevations were surveyed with respect to the Wausau City datum, and are given on the soil boring logs.

The soil borings were conducted with a truck mounted Mobile B-61 rotary drilling rig. Borings 4, 5, 6, and 7 were drilled to the depth of 53.5 feet for the installation of the deep wells. Borings 4A, 5A, 6A, and 7A were drilled to a depth of 18.5 to 21.6 feet for the installation of shallow wells.

Only deep borings were sampled and tested for soil classifications. The subsoil consisted of 2 to 7 feet of fill or possible fill, medium dense to very dense sand with gravel. The fill or possible fill was underlain by a fine to coarse sand extending to the termination depth of the borings. The relative density of this layer ranged from very dense at the top to dense at the bottom. Soil boring logs and details of laboratory and field procedures are included in the Appendix B.

Observation wells were installed in each of the soil borings. The well locations are shown on the Well Location Diagram in Appendix C. These wells essentially consisted of 2 inch diameter Schedule 40 steam cleaned

galvanized pipes with well screens. Only Well B-3C was installed with PVC pipe. The well details are shown on the Well Installation Diagram in Appendix C. The wells were developed after installation by pumping 200 to 300 gallons from the well at rates ranging from 5 to 10 gallons per minute. Each of the wells was purged until the discharge water was clear.

In addition to the Wausau Chemical monitoring wells which were installed by STS, there are EPA and City of Wausau (Wergin) monitoring wells. EPA Wells 7A, 9A, 10A, 10B, 11, 12, 13 and 14 are located to the east of Wisconsin River. Wergin wells (City of Wausau wells) are located to the northeast of Wausau Chemical and there are 7 monitoring wells. These wells are shown on the Well Location Diagram in the Appendix C. Well depths and screen lengths are given in Table 1.

TABLE 1

WAUSAU WELL DEPTH AND SCREEN LENGTH

EPA's Monitoring Wells	Wausau Chemical's Monitoring Wells	Wergin Well Monitoring Wells	City of Wausau's Municipal Wells
1 143' - 10'	8 23.5' - 10'	1 40' - 5'	3 95' - 40'
2 43' - 10'	B1 23' - 10'	2 40' - 5'	4 132' - 40'
3 149' - 10'	B2 24' - 10'	3 40' - 5'	6 143' - 40'
3A 75' - 10'	B3 161' - 3'	4 40' - 5'	7 100' - 40'
4 117' - 10'	B3A 65' - 3'		
4A 60' - 10'	B3B 24' - 10'	5 37' - 5'	8 98' - 30'
4B 40' - 10'	B3C 29' - 10'	6 41' - 5'	9 105' - 40'
5 45' - 10'	B4 53.7' - 3'	7 48' - 5'	
6 45' - 10'	B4A 18.8''-10'		
7 45' - 10'	B5 53.6' - 3'		
8 45' - 10'	B5A 18.7' - 10'		
9W 50' - 15'	B6 53.3' - 3'		
7A 70' - 10'	B7A 18.6' - 10'		
9 135' - 10'	8 = PVC Well		
10A 70' - 10'			
10B 35' - 10'			
11 40' - 10'			
12 70' - 10'			
13 45' - 10'			
14 45' - 10'			

* Except or the Wausau Chemical monitoring wells, the rest of the data cannot be verified by STS.

** Well names follows DNR names.

ANALYSIS AND RESULTS

Chemical Analysis

Groundwater samples and soil samples from WCW B-4, B-5, B-5A, B-6, B-6A, and B-7A were collected on September 26, 1984, September 27, 1984 and October 1, 1984 and delivered to Zimpro, Inc. for volatile organic compound analysis. In addition, groundwater samples from WCW B-3B were collected on October 30, 1984 and sent to Zimpro, Inc. for chemical analysis.

In addition to samples taken from monitoring wells, a series of samples were taken from both the City of Wausau water and wastewater treatment plant. Influent and effluent from the water treatment plant were taken on August 7, 1984 to August 10, 1984 and from wastewater treatment plant were taken on September 27, 1984 and September 28, 1984 and delivered to Zimpro, Inc. for chemical analysis.

The results of all available groundwater and soil chemical analyses including EPA analysis are presented in Appendix C, Tables 6 to 10. The soil samples from Boring B-3C (near the tank farm) and sludge filter cakes from the Wausau Wastewater Treatment Plant were analyzed using EPA methods 5030 and 8010. Various compounds were detected in these samples with tetrachloroethylene, toluene, and 1,1,1-trichloroethane being the most prominent. Levels in most samples are fairly low with the exception of samples 2 and 3.

The water samples were analyzed for volatile organics using EPA Method 601 (10.2 ev) photoionization and a Hall detector in series.

No significant contamination level was detected in any of the samples from deep wells (Wells 4, 5, 6 and 7). The concentration level of the sample from Well B-6A was, trichloroethylene, 1070 μg/l, tetrachloroethylene, 1730μg/l, and dichloroethylene, 391 μg/l. Sample analysis from well B-5A which is located to the northeast of Wausau Chemical showed tetrachloroethylene concentrations of 244 μg/l. Sample analysis from Well B-4A which is 19 feet deep and is located to the west of Wausau Chemical showed no significant contaminant. Similarly, sample analysis from well 7-A which is 18.5 feet deep and is located to the southwest of municipal pumping well No. 4, showed no significant contamination level. For more analysis details please refer to Zimpro, Inc. analysis in Appendix C.

Groundwater Flow Regime

Groundwater level data measured from the Wausau Chemical monitoring wells and other EPA and City of Wausau (Wergin) monitoring wells, were collected and analyzed. Most of the groundwater data was provided to STS by the DNR. Using this data, the groundwater level to the east of Wisconsin River and in the vicinity of municipal wells No. 3 and 4, was interpreted and plotted. Three groundwater contour maps for the dates of 10-15-84, 1-14-85, and 1-21-85, were drawn and are presented in Appendix C. These groundwater contour maps represent the groundwater levels when #3 and #4 pumping wells were operating. These contour maps generally show a groundwater divide near the north end of the Wausau Chemical building with water north of the divide flowing northeast toward pumping well #3. Water south of the divide flows south toward pumping well #4.

It should be noted that due to the variations in the pumping rate of wells 3 and 4, and other variations in surface and groundwater, some variations in the groundwater flow regime may take place. The extent of these variations is unknown. However in general, due to drawdown caused by pumping wells 3 and 4, groundwater flow in the vicinity of these wells is toward the wells. Both wells receive a majority of recharge from the Wisconsin River.

Permeability Measurement

Using the observation wells, permeability measurement tests were performed in Wells 1, 3, 3A, 3C, 4, 4A, 5, 6, 7 and 7A (NAVFAC DM-7). Assuming an isotropic medium (horizontal permeability=vertical permeability), and using a NAVFACS DM-7 method of analysis, the permeability of the soil was calculated and summarized in Table 6 in Appendix B. In Figure 2 in Appendix B, permeability is plotted versus depth.

Results

The result of chemical analysis indicates that the highest contamination was observed in the vicinity of the former Wausau Chemical tank farm at shallow depths (less than 20 feet below the groundwater table) and is mainly limited to the south end of the Wausau Chemical building near the Wausau Chemical tank farm.

Groundwater level and groundwater chemical data indicate some migration of contaminant toward pumping well 4. However, contamination at Well 7A which is southwest of municipal pumping well #4, cannot be related to the Wausau

Chemical spill at the tank farm based on our knowledge of historical pumping. This observation supports the presence of one or more additional contamination sources south of pumping well #4.

Furthermore, recently installed EPA wells 10A, 10B, 11 and 13 observed some contamination directly east of pumping well #4. The historical pumping record and well drawdown at pumping wells #3 and #4 do not support a groundwater flow path from the tank farm to EPA wells 10A, 10B, 11 and 13. Based on the available information, it appears that other contamination sources are located east, southeast or northeast from pumping well #4.

Proposed Extraction and Treatment Program

A clean-up program is proposed consisting of the following phases.

1. Extraction and Monitoring
2. Pretreatment and Monitoring
3. Discharge to Sanitary Sewer

These phases are schematically shown on Figure 1. A description of each feature follows:

Extraction and Monitoring

Groundwater extractions will consist of installing a series of wells in a defined area which extract groundwater by pumping simultaneously from a cluster of wells. Since the contaminants are shallow, wells will be designed to pump water from shallow depths. Our preliminary calculations indicated that a cluster of wells consisting of six wells pumping at a 16

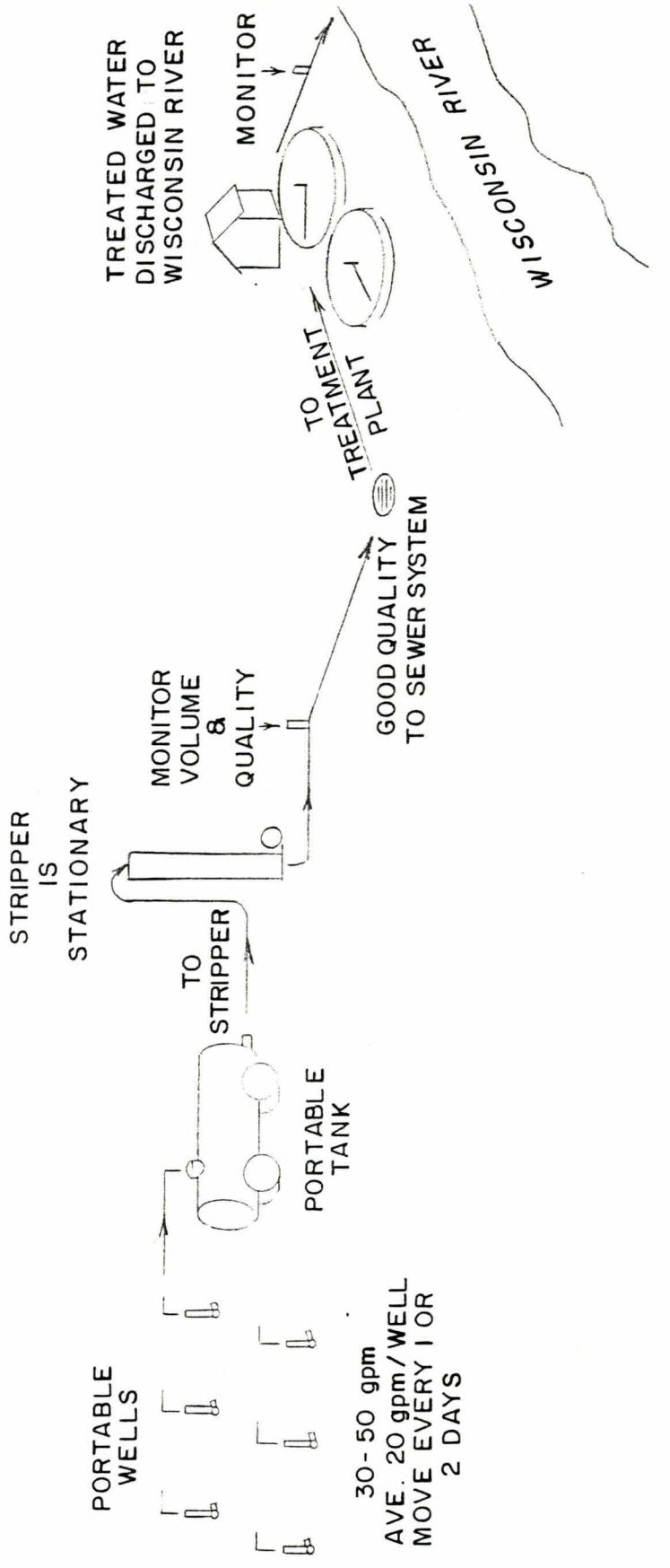


FIGURE 1

EXTRACTION AND TREATMENT OF
TETRACHLOROETHYLENE
WAUSAU, WISCONSIN

STS CONSULTANTS LTD.
540 LAMBEAU STREET
GREEN BAY, WIS. 54303

foot spacing with float controls, will produce a satisfactory drawdown. Our preliminary calculations using available information indicates that a pumping rate of 30-50 gpm/per pump will produce 6 to 8 feet of drawdown at well locations after 6 to 8 hours. However, this estimate is based on many assumptions. We recommend monitoring during the extraction program to determine the drawdown, radius of influence, etc. which may allow a greater spacing or other adjustments in the extraction procedure.

Monitoring will not be limited to the groundwater flow measurement and drawdown. During the extraction program, periodic water analysis will be performed. Extraction will continue as long as this procedure proves to be effective by pumping contaminated groundwater with a decreasing trend in concentration. Once no improvement in water quality is observed (no change in the water quality from two consecutive groundwater extraction samples), extraction at that location will be terminated.

The extraction program will start at the the old tank farm spill location and expand if necessary to areas located immediately east and south of the spill site.

Extracted water will be transferred to a portable tank with a built-in pump. The water from this tank will be pumped to a stationary air stripper for volatile organic compound pretreatment. Other tanks will also be available at the site for auxiliary storage if pretreatment or discharge to the Wausau City sewer must be delayed.

Pretreatment by Air Stripping and Monitoring

Air stripping pretreatment is a technique used to remove the volatile organic compounds from the contaminated water. An air stripping unit is normally designed to remove about 90 to 98 percent of volatile organic compounds such as cis-dichloroethene, trichloroethene, tetrachloroethene, toluene, xylene, benzene etc. from the groundwater (See reference Appendix D). Air stripping techniques have also effectively been used to treat the influent to the Wausau Water Treatment Plant for most of the summer of 1984. The unit was designed to handle flows of 1500 gpm and removes 95% of influent trichloroethylene concentration of 200 μg/l. This unit effectively removed 96 to 98 percent of volatile organic compounds from influent. Table 2 presents some performance data. The advantages to air stripping are its general low maintenance and overall effectiveness in removing volatile organic compounds.

This information indicates that air stripping can effectively remove volatile organic compound from the extracted water at Wausau Chemical. If the pretreated water is discharged to the sewer, then any residue should be substantially removed at Wausau Wastewater Treatment Plant in the activated treatment phase.

A monitoring program will be scheduled to determine the contaminant level for the influent and effluent from the air stripper. The effluent from air stripper should satisfy the requirement for discharging to the sewer system. If this requirement is not achieved, the extraction rate will be

TABLE 2

WAUSAU WATER UTILITY ANALYSIS (ug/l)

	Detection Limit	Air-stripper Influent 8-7-84	Air-stripper Effluent 8-7-84	Plant Effluent 8-8-84	Air-stripper Influent 8-8-84	Air-stripper Effluent 8-8-84	Air-stripper Influent 8-8-84	Air-stripper Effluent 8-9-84	Air-stripper Effluent 7:15 a.m. 8-10-84	Air-stripper Effluent 12:20 p.m. 8-10-84	Plant Effluent 8-10-84
Benzene	0.2				X	X	X	X	X	X	X
1,2-Dichloroethane	0.2				X	X	X	X	X	X	X
Cis 1,2-Dichloroethylene	0.3	X	X	X	77	4.7	70	2.9	2.9	2.5	X
Ethylbenzene	0.2				7.0	3.7	6.1	X	X	X	X
Tetrachloroethylene	0.1	0.2	X	0.2	69	0.8	69	1.0	0.9	1.0	0.2
Toluene	0.1				44	2.1	31	1.0	0.9	0.8	X
Trichloroethylene	0.1	X	X	X	67	1.8	66	1.2	1.1	1.0	X
Vinylchloride	0.1				7.3	X	7.0	X	X	X	X
m-xylene	0.3				11	0.7	11	1.7	2.0	X	X
o & p-xylene(as o-xylene)	0.3				14	0.9	13	X	X	X	x
Analytical No.		5613*	5614*	5622*	5664	5665	5677	5676	5693	5710	5711

X = not detected

* VOC's only requested

modified to achieve this requirement. The feasibility of discharging to the Wausau Wastewater Treatment Plant will be discussed in the following section.

Discharge to Waste Water Treatment Plant

Currently, the Wausau Wastewater Treatment Plant is operating below hydraulic capacity. With the cooperation and help from personnel from Wausau Treatment Plant, samples of the various wastes were collected and analyzed for volatile organic compounds. The results are presented in Table 3. These results indicate that the plant has been receiving and handling influent with variable levels of volatile organic compounds, especially trichloroethylene, tetrachloroethylene and toluene.

Therefore, it appears that air stripping followed by sewer discharge is the most viable alternative for treatment of the groundwater at Wausau Chemical. The stripper can provide high removal rates and eliminate the problem of airborne volatile organics filling the sewer. The use of the treatment plant will provide final treatment and some flexibility when groundwater effluent concentrations vary.

Impact on the Waste Water Treatment Plant

In order to assess the impact of pretreated groundwater on the biological treatment process at Waste Water Treatment Plant, a series of BOD tests were performed. In these tests, diluted groundwater (representing air stripped groundwater) was mixed with Waste Water Treatment Plant influent. The results are compared with the same amount of distilled water mixed with

TABLE 3

WASTEWATER TREATMENT PLANT WATER SAMPLES (ug/l)
(CITY OF WAUSAU)

	Detection Limit	WWTP Eff. #1 10:20 AM 9/27/84	WWTP Influent 10:15 AM 9/27/84	Zimpro 5-10% Oxidized 10:25 AM 9/27/84	WWTP Influent 11:00 AM 9/28/84	WWTP Effluent 10:50 9/28/84	Zimpro 5-10% Oxidized 10:55 9/28/84	Filter Press Cake 9/27/84
Benzene	0.1	X	X	785.	X	X	2720.	X
Bromoform	0.5	X	X	X	X	X	X	X
Bromomethane	1.0	X	X	X	X	X	X	X
Carbon Tetrachloride	0.1	X	X	0.5	X	X	X	X
Chlorobenzene	0.1	X	X	X	X	X	X	X
Chloroethane	1.0	X	X	X	X	X	X	X
2-Chloroethylvinyl Ether	2.0	X	X	X	X	X	X	X
Chloroform	0.1	2.5	12.4	8.3	10.0	2.4	X	X
Chloromethane	6.0	X	X	X	X	X	X	X
Dibromochloromethane	0.1	X	X	X	X	X	X	X
1,2-Dichlorobenzene	0.3	X	X	X	X	X	X	X
1,3-Dichlorobenzene	0.3	X	X	X	X	X	X	X
1,4-Dichlorobenzene	0.3	1.3	3.7	30.2	1.5	1.4	X	X
Dichlorobromomethane	0.1	X	X	X	X	X	X	X
1,1-Dichloroethane	0.1	0.2	0.3	X	0.3	0.2	X	X
1,2-Dichloroethane	0.3	X	X	X	X	X	X	X
1,1-Dichloroethylene	0.5	X	0.9	X	X	X	X	X
1,2-Dichloroethylene	0.3	0.3	8.2	10.0	9.5	X	X	X
Dichloromethane	0.2	1.8	1.4	1.7	21.7	4.3	X	X
1,2-Dichloropropane	0.5	X	X	X	X	X	X	X
cis-1,3-Dichloropropene	0.3	X	X	X	X	X	X	X
trans-1,3-Dichloropropene	1.0	X	X	X	X	X	X	X
Ethylbenzene	0.2	X	3.7	X	7.0	X	X	X
1,1,2,2-Tetrachloroethane	0.1	X	X	X	X	X	X	X
Tetrachloroethylene	0.1	2.0	52.1	X	40.6	3.1	X	1.3
Toluene	0.1	0.3	72.1	899.	24.4	0.4	X	X
1,1,1-Trichloroethane	0.1	1.1	24.0	3.5	12.7	1.0	2.3	2.0
1,1,2-Trichloroethane	0.1	X	X	X	X	X	X	X
Trichloroethylene	0.1	0.6	7.9	X	48.6	0.4	X	X
Vinyl Chloride	0.1	X	0.4	10.3	4.4	X	9.5	X
m-Xylene	0.3	X	2.9	X	4.4	X	X	X
o & p-Xylene (as o-Xylene)	0.3	X	0.8	X	2.4	X	X	X
Zimpro Analytical No.		6968	6969	6970	7044	7045	7046	6971

X = Not detected

TABLE 4

BOD TEST RESULTS

Sample Description	Avg. BOD mg/l	Variations in Duplicates (mg/l)
1. 10% distilled water & 90% plant influent	168	4
2. 10% diluted groundwater & 90% plant influent	166	4
3. 5% distilled water & 95% plant influent	170	6
4. 5% diluted groundwater & 95% plant influent	172	2
5. Plant influent	190	3

Waste Water Treatment Plant effluent. The results showed no inhibitory effects from mixing diluted water with Waste Water Treatment Plant effluent. The results are summarized in Table 4.

The capacity of the Wausau Waste Water Treatment Plant to treat VOC contamination was also estimated based on a comparison of the average and maximum concentrations of VOC in the influent. Since the maximum concentration apparently does not limit biological treatment, this increment was presumed to be a safe loading level to the Wausau Waste Water Treatment Plant. Assuming a 5.12 mgd discharge rate and the measured differences between the average and maximum VOC concentration the following minimum allowable loading rates were determined.

Perchloroethylene Waste Water Treatment Plant Capacity

$((52.1-46.4) \times 10^{-9}) \times 8.3$ lbs/gal. x 5.12 mgd = .2 lbs/day

Trichloroethylene Waste Water Treatment Plant Capacity

$((48.6-28.3) \times 10^{-9}) \times 8.3$ lb/gal. x 5.12 mgd = 0.8 lbs/day

Xylene Waste Water Treatment Capacity

$((6.8-5.3) \times 10^{-9}) \times 8.3$ lb/gal. x 5.12 mgd = .06 lb/day

Toluene Waste Water Treatment Plant Capacity

$((72.1-48.2) \times 10^{-9}) \times 8.3$ lb/gal. x 5.12 mgd = 1 lb/day

Dichloroehylene Waste Water Treatment Plant Capacity

$((9.5-8.8) \times 10^{-9}) \times 8.3$ lb/gal. x 5.12 mgd = .03 lb/day

With the above minimum limits, the pretreatment performance for the maximum and average groundwater concentrations at B-3B will utilize the following design criteria. Table 5 summarizes these results.

TABLE 5

Required Pretreatment Efficiency for Well B-3B Groundwater

	Maximum GW VOC	Average GW VOC
Perchloroethylene	97%	95%
Trichloroethylene	86%	79%
Xylene	100%	99%
Toluene	83%	72%
Dichloroethylene	99%	99%

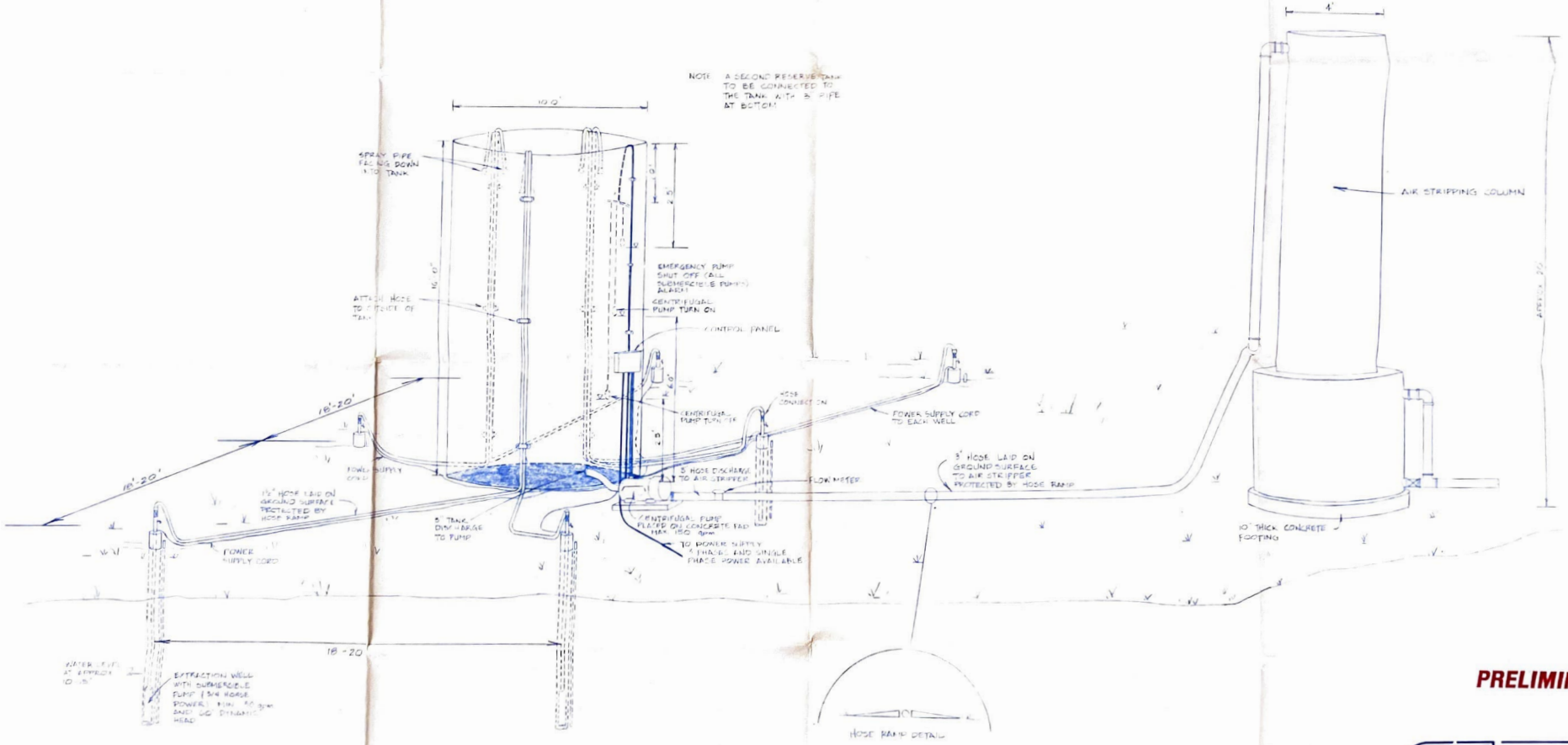
General Qualifications

The analysis and recommendations submitted in this report are based on data obtained from soil borings and wells. Variations can occur between these borings, the nature and extent of which may not become evident until extraction. If variations are encountered, it may be necessary to make a re-evaluation of the recommendations of this report after making on-site observations and noting the characteristics of these variations.

Water level readings have been made in the borings at the times and under the conditions stated on the boring logs. This data has been reviewed and an interpretation made in the text of this report. However, it must be noted that the seasonal and annual fluctuations in the level of the groundwater will likely occur.

This report has been prepared in accordance with generally accepted engineering practices to preliminarily understand the nature and extent of the

problem. No other warranty, expressed or implied, is made. The scope of this report is limited to the specific project site and data collected. In the event that any changes in the contamination levels are observed we should be informed so the changes can be reviewed and the conclusions of this report modified and approved in writing by the Engineer.



PRELIMINARY

STS Consultants Ltd.
540 Lambeau St. Green Bay, Wisconsin
ph.414-494-9656

SCALE	DATE 4-21-95	DRAWN BY J.T	APPROVED BY
REVISIONS DATE	BY	DESCRIPTION	

WAUBAU CHEMICAL

PROPOSED EXTRACTION SYSTEM

DRAWING NUMBER 12776 A

APPENDICES

Appendix A

Letter dated September 13, 1983 from STS to DNR
Letter dated March 10, 1984 from DNR to Wausau Chemical
Letter dated April 23, 1984 from DNR to Wausau Chemical
Letter dated September 17, 1984 from DNR to Charne, Glassner, Tehan, Clancy & Taitelman
Letter dated November 12, 1984 from STS to DNR

Appendix B

1. Soil Boring Logs
2. Permeability Test Results (Table 6 and Figure 2)
3. General Notes
4. Field Procedures
5. Procedures Regarding Field Logs, Laboratory Data Sheets and Samples
6. Unified Soil Classification Chart

Appendix C

1. Well Installation Diagrams
2. Well Location Diagrams
3. Groundwater Contours
4. Result of Chemical Analysis (Tables 7 to 10)

Appendix D

1. Reference Material on Air Stripper

APPENDIX A

Letter dated September 13, 1983 from STS to DNR
Letter dated March 10, 1984 from DNR to Wausau Chemical
Letter dated April 23, 1984 from DNR to Wausau Chemical
Letter dated September 17, 1984 from DNR to Charne, Glassner, Tehan, Clancy & Taitelman
Letter dated November 12, 1984 from STS to DNR

STS Consultants Ltd.
540 Lambeau
Green Bay, Wisconsin 54303
(414) 494-9656

September 13, 1983

Department of Natural Resources
P. O. Box 818
Rhinelander, Wisconsin 54501

Attn: Mr. Ed Kreul

STS Job 1081P

RE: Groundwater Contamination at Pumping Wells 3 and 4 in Wausau, Wisconsin.

Gentlemen:

On behalf of Wausau Chemical, we are forwarding herewith a proposed agenda for a September 16th meeting for 10:00 AM at your Rhinelander Office. We plan to discuss our preliminary findings as a result of reviewing existing data collected by the City of Wausau.

Yours very truly,

STS CONSULTANTS LTD.

Douglas J. Hermann, P. E.
Vice President-Environmental Division

DJH/cs

cc: Wausau Chemical
Attn: Mr. Art Flashinski

AGENDA

September 16, 1983 Meeting
Wausau Chemical and Department of Natural Resources

Preliminary Findings

1. Review of water levels and reservoir monitoring wells with respect to time and the pumping of city well 3.

2. Analysis of pumping tests conducted in pumping wells 3 and 4 and the Wergin well.

3. Contour maps of the cone of drawdown caused by pumping the Wergin well, pumping well 3 and the drawdown of the reservoir.

4. Analysis of the concentration of perchloroethylene, trichloroethylene and dichloroethylene with respect to time at the monitoring and pumping wells.

Proposed Plan of Study

1. Study objectives

2. Proposed well locations

Doug Herman

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES
North Central District Headquarters
Box 818
Rhinelander, Wisconsin 54501
(715)362-7616

Carroll D. Besadny
Secretary

March 10, 1984

Mr. James Cherwinka, President
Wausau Chemicals Corporation
Box 953, 2001 River Drive
Wausau, Wisconsin 54501

Dear Mr. Cherwinka:

The morning of February 24, 1984, Mr. Art Flashinski of your firm and your consultant, Mr. Doug Herman of STS Consultants, Ltd., met with several members of our staff. The three primary topics of discussion are addressed individually below.

Spill Prevention and Containment

The conceptual plans for spill containment which Mr. Flashinski presented appear reasonable. The two projects proposed are replacement of current bulk product storage with a new tank farm and automatic pH adjustment of cleaning waters prior to discharge to the sanitary sewer. Before we deem the proposed tank farm and pH adjustment facilities adequate for spill containment, our staff must review detailed engineering plans. Also, two concerns with the conceptual plan must be addressed.

Art was, at the time, uncertain about the handling of rainfall and snow melt. If the tank farm is left uncovered, considerable volumes of water contaminated with product will accumulate in the spill containment sump. This water must be disposed of in an environmentally acceptable fashion.

The current tank farm plan includes a hazardous waste storage area which will share a liquid collection sump with the tank farm. Hazardous waste storage and handling facilities must conform to appropriate standards. Please contact Mr. Jim Anklam of our Antigo Area Office to assure all applicable requirements are met.

Art Flashinski presented us with a tank farm project timetable as follows:

Plan and Specifications Completion....April 1, 1984
Completion of DNR Review.....May 1, 1984
Bid Submittal.....May 15, 1984
Bid Completion.....June 1, 1984
Begin Construction.....June 10, 1984
Complete Construction.....July 10, 1984

We trust you will closely adhere to the timetable you have proposed.

December 19, 1983, PERC Spill

No substantial work has yet been done to mitigate effects of the December 19, 1983, tetrachloroethylene (PERC) spill. Some options were discussed at our February 24 meeting.

Immediate action to reduce migration of the spilled material to groundwater must be taken. Mr. Flashinski agreed to cover the affected area with an impervious tarp to limit or eliminate percolation through the contaminated soil. By March 1, 1984, about half of the tank farm had been covered and Mr. Flashinski agreed, in a telephone conversation on March 8, 1984, to cover the remaining area as soon as possible. Reduction of contaminant mobility is, of course, only a temporary remedy which must be followed by a permanent solution.

We discussed some possible solutions. Each alternative included excavation of part or all of the contaminated soil as well as groundwater rehabilitation.

In the absence of further soil analyses, all soil above groundwater and within the concrete wall surrounding the tank farm must be excavated. If further soil analyses show a perimeter at which PERC concentrations fall below 1000 ug/g of soil, excavation may cease at that perimeter. 1000 ug/g is being accepted as a cut off point only because the volume of contaminated soil is very large and remedial actions must include groundwater rehabilitation as well as excavation.

The excavated soil may be stored on site provided storage facilities receive Department approval prior to use. Planning work must commence immediately to allow excavation at the earliest possible date. Please coordinate storage facilities planning through Mr. Anklam of our Antigo Office.

Wausau Chemicals has expressed an interest in treating the soil on site. Before this approach may be sanctioned by the Department, results of a pilot study must be reviewed by our Solid Waste staff. Pilot work must include reduction of PERC concentrations in representative soil samples to 1000 ug/g, 500 ug/g, 100 ug/g and 50 ug/g on a dry weight basis. I strongly urge you to maintain contact with Department staff during the course of pilot work planning and implementation in order to minimize delays.

Approxpriate groundwater rehabilitation efforts will depend on results of the groundwater investigation work proposed by Mr. Herman. Once sufficient data is collected from that investigation, you will be expected to quickly assemble a rehabilitation plan.

Overall Groundwater Study

The study plan submitted by Mr. Herman is accepted in concept as a reasonable first step in evaluating Wausau Chemical Company's relationship to local groundwater contamination. Installation of the initial three wells proposed by Mr. Herman will be completed no later than March 31, 1984. It is agreed that the use of drilling muds is not adviseable in this case. Even the use of water as a drilling fluid is likely to obscure chemical data obtained unless the water used is proven to be organic free. The Wausau Municipal supply contains significant concentrations of some of the materials of interest making it unacceptable for use as a drilling fluid. Dry installation where possible is highly preferred.

I hope you are now clear on what must be done from this point. If not, contact me as soon as possible. Let us smoothly and quickly resolve this situation to the satisfaction of all involved.

Sincerely,

Ed Kreul
Environmental Engineer

EK:kjh
cc: Dale Urso, Rhinelander
John Baltus, Antigo
Paul Didier, Madison-SW/3
Linda Wymore, Madison-LEG/5
Doug Herman, STS Consultants, Ltd., 540 Lambeau, Green Bay, WI 54303

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES
North Central District Headquarters
Box 818
Rhinelander, Wisconsin 54501
(715)362-7616

Carroll D. Besadny
Secretary

April 23, 1984

3210

Mr. James Cherwinka, President
Wausau Chemicals Corporation
Box 953
2001 River Drive
Wausau, Wisconsin 54401

Dear Mr. Cherwinka:

The excavation of contaminated soil at Wausau Chemicals the week of April 1 represents a fine and responsible effort on the part of your firm. Art Flashinski and other involved members of your staff should be commended. Removal of that most contaminated soil reduces the risk of significant groundwater contamination as a result of your tetrachloroethylene spill of December 19, 1983. Gary Kulibert of this Department will be your contact for coordination of continuing storage and disposal of the excavated material.

To complete our documentation of the incident, we will need all of the relevant data, as well as some type of final report on the excavation. Some pieces of information we require are:

- Results of analyses performed on soil samples from the excavation site, as well their locations.

- Analysis results for samples collected during soil borings conducted on February 16, 1984.

- Boring logs from the February 16, 1984 borings.

As this information is essential to our evaluation of the effectiveness of your excavation, I must ask that we receive this data and your final report no later than May 1, 1984.

Your recent installation of monitoring wells on the Wausau Chemical Company property is also commendable. Nonetheless, we are concerned that the location of the nested well is not as was planned for in Doug Herman's proposal of December 13, 1983. This change may make installation of additional sampling points necessary, depending on the finding of this initial groundwater investigation work.

Because we are very interested in the findings of your investigation, we would like relevant data as it becomes available, rather than waiting for a final report at the conslusion of the initial investigation. Relevant data includes well logs and as-built plans for each of the monitoring wells, the results of any soil analyses performed, and results of any groundwater analyses. This information and any other information relevant to this project should be supplied to us as soon as it becomes available.

In an attempt to avoid further losses of product to the environment, Wausau Chemicals Company has agreed to relocate its bulk storage tank farm. My March 10, 1984 letter outlines a project timetable to which Mr. Flashinski agreed during a meeting at your plant February 24, 1984. That schedule begins with completion of plans and specifications by April 1, 1984. We have not, to date, received a copy of those plans or any explanation of their absence. I trust you can get the tank farm project back on schedule. If you feel you cannot, please contact us within seven days of receipt of this letter with a revised proposal.

Control of discharge to the sanitary sewer must also be addressed. The acidity of sewered material in the past has caused corrosion of collection facilities. The pH of discharge to the sanitary sewer should be kept as close to 7.0 as possible and must lie between 6.0 and 9.0 in order to conform with the Wausau Sewer use ordinance.

If you would like to discuss any of the matters dealt with herein, please do not hesitate to contact our staff. Jack Saltes in our Antigo Offce will be assuming what were my responsibilites and will, therefore, be your primary contact. If you have need for my assistance in the future, I will be receptive to those requests.

Sincerely,

Ed Kreul
Environmental Engineer

James Blankenheim
Staff Specialist (Law Enforcement)

EK/JB:ck

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES
Carroll D. Besadny
Secretary

BOX 7921
MADISON, WISCONSIN 53707

September 17, 1984 IN REPLY REFER TO: 4400

Mr. Raymond Krueger, Attorney
Charne, Glassner, Tehan, Clancy and Taitelman
211 West Wisconsin Avenue
Milwaukee, WI 53203

RE: Subsurface Exploration and Testing Program to Evaluate Groundwater Quality at Wausau Chemical Facilities, Wausau, Wisconsin

Dear Mr. Krueger:

The Bureau of Solid Waste Management, Wisconsin Department of Natural Resources has completed its review of the July 25, 1984 report titled, "Subsurface Exploration and Testing Program, Evaluate Groundwater Quality, Wausau Chemical Facility, Wausau, Wisconsin", prepared by STS Consultants, LTD, and received on August 1, 1984. The following represents the Department's comments regarding the information submitted:

Site Description

Site History and Location The Wausau Chemical corporation is located on the east bank of the Wisconsin River at 2001 River Drive, which is in the NW 1/4 of the NW 1/4 of Section 25, Township 29 North, Range 7 East in the City of Wausau, Marathon County, Wisconsin. The property is occupied by the Wausau Chemical manufacturing facility, a tank farm immediately south of the plant building, an empty barrel storage area east of the building and an additional tank storage area north-northeast of the plant. The City of Wausau water treatment plant borders Wausau Chemical Corporation on the south. Municipal Well #3 is approximately 800 feet north-northeast of the plant building and Municipal well #4 is approximately 400 feet south of the plant building. Chemical spills at the plant grounds have been documented in the past. In 1975, groundwater samples from an excavation site south of the tank farm revealed high levels of tetrachloroethylene, trichloroethylene, toluene and xylene. The latest spill, involving 800 to 900 gallons of tetrachloroethylene (PCE), occurred on December 19, 1983. Clean up of the spill involved immediate removal of snow and surficial soil and, in April 1984, removal of approximately 1000 cubic yards of subsoil from the tank area. The soil was disposed of in a hazardous waste landfill. Soil tests conducted by the Department in the tank pad area revealed the presence of tetrachloroethylene, trichloroethylene, toluene, ethylbenzene, and xylenes.

Geology and Hydrogeology STS Consultants Ltd. installed five galvanized steel wells at three locations east of the plant in March 1984 to define groundwater quality and local geology in the vicinity of the December 19 spill. Water quality tests and elevation measurements were conducted on these five wells

and on a PVC well located west of the water treatment plant. Subsurface soils are generally composed of poorly sorted fine to coarse grained sand (SP, SP-SM). One boring (B-3) extended to 163 feet; it is claimed that bedrock was encountered at this point although the driller's log does not indicate such.

Water level measurements were taken almost daily for the month of April 1984. Although the report does not define groundwater flow direction, it appears that groundwater in the vicinity of Wausau Chemical Corporation is moving south due to the influence of pumping Municipal Well #4.

Groundwater Quality Water quality samples were collected on May 16 and 30, 1984. A number of volatile organic compounds were detected in both sampling rounds: tetrachloroethylene (PCE), trichloroethylene (TCE), xylenes, toluene, ethylbenzene, dichloroethylene, 1, 1, 1-trichloroethane and vinyl chloride. All six monitoring wells show varying levels of contamination with the shallow water table observation well closest to the tank farm (B-3B) exhibiting the highest levels. The three other shallow water table wells (B-1, B-2 and the PVC well) have approximately equal concentrations of VOC's (with the exception of PCE and TCE which are much higher in the vicinity of the tank farm). The two deep piezometers (next to the tank pad) had low, but detectable amounts of VOC.

In addition, a groundwater sample was collected on July 2, 1984 from an excavated trench on the east side of the water treatment plant. Contaminants detected in this sample were the same as those listed above with the exception of ethylbenzene and xylenes. The volatile organic compounds with highest concentration was PCE at 360 ppb.

Conclusion

The City of Wausau water supply has had significant concentrations of VOC contaminants for at least the last two years. City wells #3,4 and 6 are highly contaminated. Well 6 is on the west side of the Wisconsin River while wells 3 and 4 are north and south, respectively, of Wausau Chemical. The report does not address the possible connection between the contamination of City wells 3 and 4 and the chemical spills that have occurred at Wausau Chemical. The report concludes "...it appears that the volatile organics are confined to a limited area on Wausau chemical property in the upper portion of the aquifer." Based on water quality analyses from the PVC well and excavations near the treatment plant, it is clear that contaminants have migrated beyond Wausau Chemical property. The deeper levels of the aquifer have also been impacted, as evidenced by contaminant levels in the deep piezometers and Municipal Wells #3 and #4. Given the permeability of the aquifer, the location of Municipal Wells #3 and #4 and probable groundwater flow paths to the pumping wells, it appears that activities at Wausau Chemical have affected water quality at Municipal Well #4 and perhaps at Municipal Well #3.

The report recommends that a shallow groundwater extraction well be installed near well B-3B to remove contaminated water from the upper portion of the aquifer and that the water be appropriately treated. While the Department agrees that an groundwater extraction program needs to be implemented, the vertical and horizontal extent of contamination must be defined before a complete remedial action program can be designed.

Recommendations

In order for Wausau Chemical Corporation to "restore the environment to the extent practicable", as it is required to do by section 144.76, Wisconsin Statutes, additional work must be done to define the extent of groundwater contamination in the vicinity of Wells 3 and 4. This work should be undertaken as soon as possible so that restoration of the environment may begin. As discussed at the August 21, 1984 meeting which included yourself, Doug Hermann of STS, Art Flashniski of Wausau Chemical and Department personnel, the following actions were agreed upon:

1. Four additional well nests shall be installed (see Attachment):

Approximate Well Location	Approximate Depth of Shallow Well	Approximate Depth of Deep Well
150 feet Southwest of Well #4	25'	50' to 60'
100 feet West of Wausau Chem.	25'	50' to 60'
150 to 200 feet Northeast of Well #4 (near the SE corner of the treatment plant)	25'	60' to 70'
150 feet East-Northeast of the NE corner of the Wausau Chemical building	25'	60' or 70'

All the wells shall be constructed of galvanized steel with 10 foot wire wrapped well screens. The deep piezometers shall be sealed with bentonite pellets approximately 2 feet above the well screen. The wells shall be installed by driving casing; in no case shall drilling muds be used in the drilling process.

2. If the equipment is available, water or sediment samples collected during the drilling process shall be field analyzed for the presence of volatile organic contaminants with an organic vapor analyzer (OVA) or an H-nu meter.

3. Water elevations shall be measured at least once per week for two months on all new and existing monitoring wells. The pumping rates of Municipal Wells #3 and #4 shall be noted for each water level measurement. Groundwater elevations shall be recorded as "feet above mean sea level" (measured to the nearest 0.01 foot).

4. Water quality analysis for volatile organic chemicals shall be performed on all new and existing monitoring wells and on municipal well #4 at least once per month for two months.

5. A pump test shall be performed on Municipal Well #4 provided the test does not interfere with the City's ability to provide water to the residents of Wausau. Water levels should be measured in all the water table

observation wells at the site. Municipal Well #4 should be turned off and allowed to recover prior to the test and accurate records should be kept of pumping activity at Municipal Well #3. If possible, Well #3 should be turned off or be pumped at a steady rate during the entire pump test. Analysis of the pump test should define the cone of depression, the maximum influence of the well, and the influence of the river on the system.

6. Five copies of the results of the additional field work outlined in this letter shall be submitted to the Department. The report shall include: soil boring logs, well construction details, water elevation measurements, direction of groundwater flow and affect of Wells #3 and #4 on groundwater flow, water quality results, an analysis of the pump test data and an analysis of the vertical and horizontal extent of VOC contamination.

7. A shallow discharge well may be designed and installed near the tank farm pad. All necessary permits must be applied for and received prior to pumping the well. Treatment of the contaminated groundwater shall be addressed by Wausau Chemical. In no case shall the relief well be pumped before the background data (outlined in numbers 1 through 6 above) is collected.

You should be aware that further remedial measures, such as additional shallow or deep discharge wells, may be required in the contaminated area.

If you have any questions regarding this letter, please call Jack Saltes at (715) 627-4317, Bill Dobbins at (715) 362-7616 or Terry Evanson at (608) 266-0941.

Sincerely,
Bureau of Solid Waste Management

Richard E. O'Hara

Richard O'Hara, Chief
Hazardous Waste Management Section

ROH:cr/4704T

Attach.

cc: Dale Urso - ADD NCD
Bill Dobbins - NCD
Jack Saltes - Antigo Area Engineer
Gary Kulibert - NCD
Terry Evanson-SW/3
Lee Boushon - WS/2
Briand Wu - EPA/Region V
Doug Hermann - STS, LTD

STS Consultants Ltd.
Consulting Engineers

540 Lambeau
Green Bay, Wisconsin 54303
(414) 494-9656

November 12,1984

Ms. Theresa Evanson
Department of Natural Resources
Bureau of Solid Waste Management
P. O. Box 7921
Madison, Wisconsin 53707

STS Job 12776-A

RE: September 17, 1984 DNR Review Letter.

Dear Ms. Evanson:

On September 25, 1984, we discussed by telephone, the September 17th review letter for the Wausau Chemical Facilities in Wausau, Wisconsin. I have belatedly summarized our conversation below as the completed field work was somewhat different than described in the September 17th letter.

Page 2, Paragraph 1

STS Boring B-3 was extended to 163 feet. A bedrock or boulder was encountered at 161 feet and was drilled with a tri-cone rock bit to the termination of the boring. The B-3 boring log has been revised to reflect the bedrock or boulder.

Page 2, Paragraph 2

The groundwater flow may not be due exclusively to the influence of pumping well No. 4.

Page 2, Paragraph 3

Although detectable amounts of VOC's were encountered in two deep piezometers, this may not be caused by the aquifer but instead by cross-contamination from the drilling operations. It is impossible to install a well without some cross-contamination, particularly when the detection limits are at the part per billion level.

Page 2, Paragraph 4

We understand that the volatile organics analyzed from an excavated trench on July 2nd were the following:

Volatile Organic Parameter	Concentration in Parts per Billion
1,1,1 dichloroethylene	0.8
1,2 dichloroethane	0.2
1,2 dichloroethylene	110
toluene	0.1
1,1,1 trichloroethane	7.7
trichloroethylene	110
vinylchloride	3.2
perchloroethylene	360

Page 2, Paragraph 5

Due to the influence of pumping wells 3 and 4 and the lack of significant contamination in deep piezometers, we do not agree that the deep piezometers have been impacted by activities at Wausau Chemical facilities. Similarly, we consider it premature to conclude that the contamination observed in the water treatment plant foundation excavations in 1975, or the water quality in the

PVC well are the result of off-site contamination at the Wausau Chemical property.

Page 3, No. 1

Four additional well nests have been installed at the approximate well locations with a 40 to 50 feet offset southwest from the northeast location, yet in line with the flow path from the tank farm area to pumping well No. 3. Also, the depths of these piezometers were revised to 53 feet as the materials were ordered prior to your September 17th letter. We recognize that the piezometers are slightly shallower, but we consider this an advantage in better defining the limits of contamination. Also, the deep piezometers have a 3-foot screen with a No. 60 gauze (approximately equivalent to No. 20 screen size). The shallow wells have a No. 20-10 foot long screen. Each of the wells was flushed and then developed with a minimum of 100 gallons at approximately 10 to 20 gallons per minute. You indicated that the above well development and sampling protocol was adequate for DNR interpretation.

Page 3, No. 2

The Department did not provide an OVA analyzer, therefore this work was not conducted.

Page 3, Item 3

We expect that any water levels are primarily a function of pumping activity in pumping wells No. 3 and 4. As an alternate, we have measured the water levels 3 or 4 times after well installation. Also, it has been impossible to measure the groundwater elevations to the nearest 0.01 foot. Instead we agreed that all groundwater elevations would be recorded to the nearest 0.02 or 0.03 foot. You have agreed to the above frequency and adequacy of water

level measurement. The Department may at their discretion take more frequent water level readings.

Page 3, Item 4

You have requested that both the new and the existing monitoring wells be monitored and analyzed twice. In Rhinelander, we agreed that the new wells would be monitored twice, but we did not agree that the existing wells would be monitored. We recognize the merits of collecting data on the same date from the existing wells. However, this was not discussed at the Rhinelander meeting and was not included in the scope of our work. Two discussions with Briand Wu have indicated that the EPA will analyze samples for both the new and existing wells on October 1 and 17th. Briand Wu has also indicated that the EPA will resample and analyze these wells again near November 1.

Page 3, Item 5

Our discussions with the City of Wausau indicate that pumping well No. 4 must be pumped on a continuous use basis during the next several months as a granulated activated carbon experiment is underway which requires continuous pumping. This obviates any long term pumping tests with pumping well No. 4 because the well could not be turned off for a long period of time.

If you have any questions or comments with regard to my summary of our discussion, please contact me. We request that this summary be included as an addendum to your September 17th letter. We will of course provide you with 5 copies of

our field report when completed in the next few weeks.

Yours very truly,

STS CONSULTANTS LTD.

Douglas J. Hermann
Vice President-Environmental Division

DJH/dw
cc: Charne, Glassner, Tehan,
Clancy & Taitelman
211 W. Wisconsin Avenue
Milwaukee, Wisconsin 53203
Attn: Ray Krueger

Wausau Chemical Corporation
P. O. Box 953
Wausau, Wisconsin 54401
Attn: Jim Cherwinka

APPENDIX B

Soil Boring Logs
Permeability Test Results (Table 6 and Figure 2)
General Notes
Field Procedures
Procedures Regarding Field Logs, Laboratory Data Sheets and Samples
Unified Soil Classification Chart

STS Consultants Ltd.

OWNER: Wausau Chemical	LOG OF BORING NUMBER: B-4
PROJECT NAME: Tetrachloroethylene Spill	ARCHITECT—ENGINEER
SITE LOCATION: Wausau, Wisconsin	

SURFACE ELEVATION 1194.7

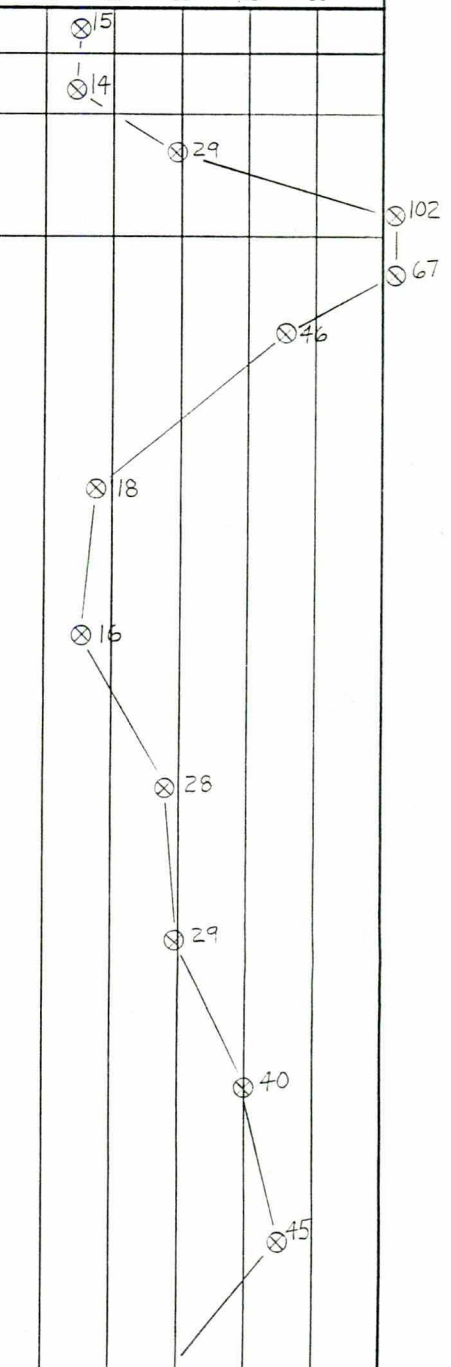
DEPTH / ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³
	1	SS			Fill - brown sand and gravel, with cinders and clay - moist - medium dense	
	2	SS			Possible fill - brown silty fine sand (SM) - moist - medium dense	
5	3	SS			Possible fill - brown fine sand (SP) - with some medium sand - with a trace to some fine to coarse gravel, with a trace of silt - moist - dense to extremely dense	
	4	SS				
10	5	SS				
	6	SS			Grayish brown fine to coarse sand (SP) - with some fine to medium gravel - moist to wet - very dense to medium dense	
15	7	SS				
20	8	SS				
25	9	SS				
30	10	SS				
35	11	SS				
40	12	SS				
45					Continued	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² — 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT %

10 20 30 40 50

STANDARD PENETRATION BLOWS / FT. — 10 20 30 40 50



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

STS JOB NO. 12776-A

SHEET NO. 1 OF 2

BL 4-1183

STS Consultants Ltd.

OWNER: Wausau Chemical	LOG OF BORING NUMBER: B-4 Continued
PROJECT NAME: Tetrachloroethylene Spill	ARCHITECT—ENGINEER
SITE LOCATION: Wausau, Wisconsin	

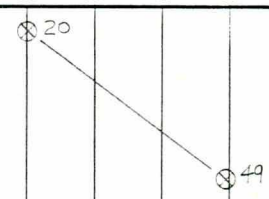
SURFACE ELEVATION 1194.7

DEPTH ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³
	13	SS			Grayish brown fine to coarse sand (SP) - with some fine to medium gravel - moist to wet - very dense to medium dense	
50						
	14	SS				
53.5					End of Boring Boring advanced to 8.0 feet with solid-stem auger Boring advanced from 8.0 to 53.5 feet with roller bit and bentonite 53.0 feet of HW casing used 10.0 feet of 6" casing used 2" ID PVC observation well installed with protector pipe The well tip was placed at a depth of 53.7 feet from the surface The elevation of the top of the galvanized steel riser is 1196.56	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS / FT. (10 20 30 40 50)



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

WL 10.0' WS	BORING STARTED 9-25-84	STS OFFICE	540 Lambeau Green Bay, WI 54303
WL BCR ACR	BORING COMPLETED 9-26-84	DRAWN BY SMD	SHEET NO. 2 OF 2
WL	RIG Mobile B-61 FOREMAN EVH	APP'D BY CJG	STS JOB NO. 12776-A

STS Consultants Ltd.

OWNER: Wausau Chemical	LOG OF BORING NUMBER: B-4A
PROJECT NAME: Tetrachloroethylene Spill	ARCHITECT—ENGINEER
SITE LOCATION: Wausau, Wisconsin	

DEPTH / ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³
					SURFACE ELEVATION 1194.5	
5					See log of boring 4	
10		PA				
15						
19					End of Boring Boring advanced to 19.0 feet with solid-stem auger 2" ID PVC observation well installed with protector pipe The well tip was placed at a depth of 18.8 feet from the surface The elevation of the top of the galvanized steel riser is 1196.39	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² — 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT %

10 20 30 40 50

STANDARD PENETRATION — BLOWS / FT.

10 20 30 40 50

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

WL 10.0' WD	BORING STARTED 9-26-84	STS OFFICE	540 Lambeau Green Bay, WI 54303
WL BCR ACR	BORING COMPLETED 9-26-84	DRAWN BY SMD	SHEET NO. 1 OF 1
WL	RIG Mobile B-61 FOREMAN EVH	APP'D BY CJG	STS JOB NO. 12776-A

STS Consultants Ltd.

OWNER: Wausau Chemical	LOG OF BORING NUMBER: B-5
PROJECT NAME: Tetrachloroethylene Spill	ARCHITECT—ENGINEER

SITE LOCATION: Wausau, Wisconsin

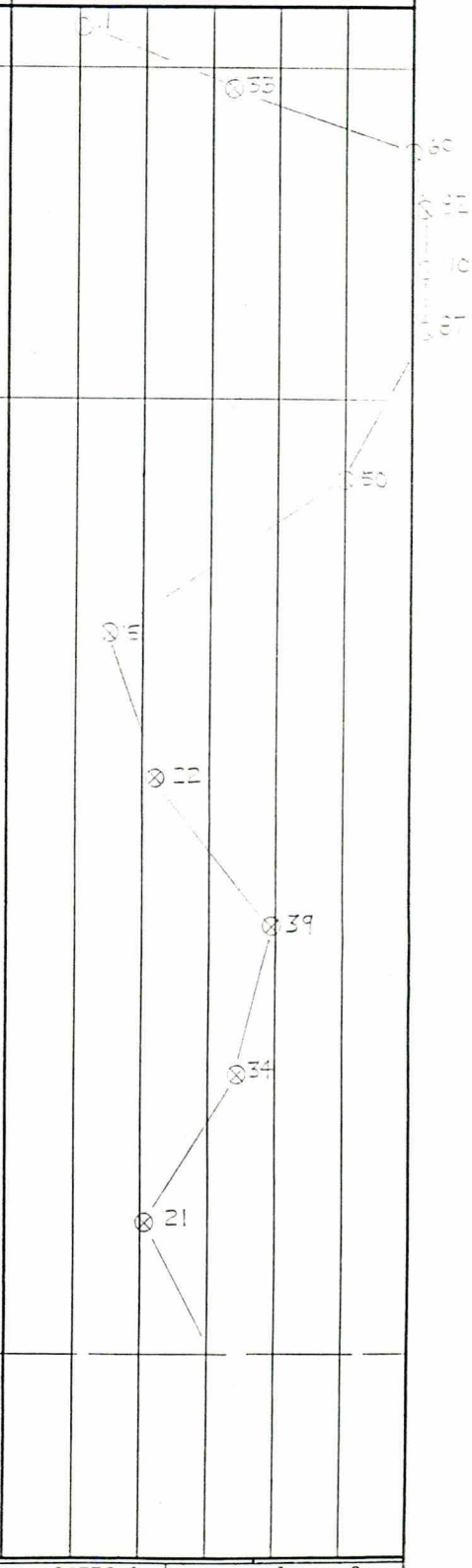
SURFACE ELEVATION 1194.7

DEPTH ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³
	1	SS			Fill - brown silty sand - with a trace of cinders - with gravel - moist - medium dense	
	2	SS			Brown fine to coarse sand (SP) - with some fine to coarse gravel - moist - very dense	
5	3	SS				
	4	SS				
	5	SS				
10	6	SS				
	7	SS			Grayish brown fine to coarse sand (SP) - with some fine to coarse gravel - moist to wet - dense to medium dense	
15						
20	8	SS				
25	9	SS				
30	10	SS				
35	11	SS				
40	12	SS				
45					Continued	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS / FT. (10 20 30 40 50)



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

STS JOB NO. 12776-A

RL 4.1183

STS Consultants Ltd.

OWNER: Wausau Chemical	LOG OF BORING NUMBER: B-5 Continued
PROJECT NAME: Tetrachloroethylene Spill	ARCHITECT—ENGINEER

SITE LOCATION: Wausau, Wisconsin

DEPTH ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³	UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1 2 3 4 5) / PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % (10 20 30 40 50) / STANDARD PENETRATION BLOWS / FT. (10 20 30 40 50)
					SURFACE ELEVATION 1194.7		
	13	SS			Grayish brown fine to coarse sand (SP) - with some fine to coarse gravel - moist to wet - dense to medium dense		
50							
	14	SS					
53.5					End of Boring Boring advanced to 6.0 feet with solid-stem auger Boring advanced from 6.0 to 53.5 feet with roller bit and bentonite 53.0 feet of HW casing used 10.0 feet of 6" casing used 2" ID PVC observation well installed with protector pipe The well tip was placed at a depth of 53.6 feet from the surface The elevation of top of the galvanized steel riser is 1196.49		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

WL 10.0' WS,WD	BORING STARTED 9-26-84	STS OFFICE	540 Lambeau Green Bay, WI 54303
WL BCR ACR	BORING COMPLETED 9-27-84	DRAWN BY SMD	SHEET NO. 2 OF 2
WL	RIG Mobile B-61 FOREMAN EVH	APP'D BY CJG	STS JOB NO. 12776-A

STS Consultants Ltd.

OWNER: Wausau Chemical	LOG OF BORING NUMBER: B-5A
PROJECT NAME: Tetrachloroethylene Spill	ARCHITECT—ENGINEER:

SITE LOCATION: Wausau, Wisconsin

DEPTH / ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³	UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1 2 3 4 5) / PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % (10 20 30 40 50) / STANDARD PENETRATION BLOWS / FT. (10 20 30 40 50)
SURFACE ELEVATION 1194.5							
5		PA			See log of boring 5		
10							
15							
18.5					End of Boring Boring advanced to 18.5 feet with solid-stem auger 2" ID PVC observation well installed with protector pipe The well tip was placed at a depth of 18.7 feet from the surface The elevation of the top of the galvanized steel riser is 1196.53		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

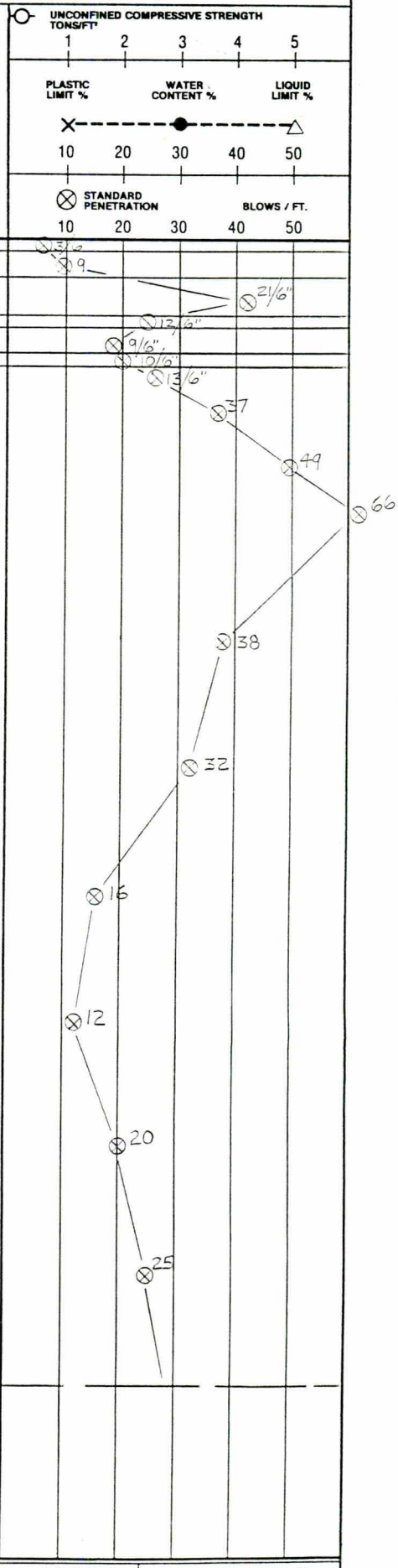
WL ± 10' WS, WD	BORING STARTED 10-1-84	STS OFFICE	540 Lambeau Green Bay, WI 54303
WL BCR ACR	BORING COMPLETED 10-1-84	DRAWN BY SMD	SHEET NO. 1 OF 1
WL	RIG Mobile B-61 FOREMAN EVH	APP'D BY CJG	STS JOB NO. 12776-A

STS Consultants Ltd.

OWNER	LOG OF BORING NUMBER
Wausau Chemical	B-6
PROJECT NAME	**ARCHITECT—ENGINEER**
Tetrachloroethylene Spill	

SITE LOCATION Wausau, Wisconsin

DEPTH / ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³
					SURFACE ELEVATION 1196.2	
	1	SS			Fill - brown silty sandy topsoil	
	1A	SS			Fill-light brown fine to medium sand (SP)-moist-loose	
	2	SS			Fill - greenish brown fine to coarse sand (SP) - with some silt and fine to medium gravel	
	2A	SS				
	3	SS			Fill-dark brown very silty sand (SM)-with a trace of gravel-moist-medium dense	
5	3A	SS				
	3B	SS			Possible fill-greenish brown silty fine to medium sand (SM) with a trace of fine to medium gravel-moist-medium dense	
	4	SS			Reddish brown silty fine sand (SM)-moist-medium dense	
	5	SS				
10	6	SS				
					Brown to grayish brown fine to coarse sand (SP) - with a trace of fine to medium gravel - moist to wet - dense to very dense	
15	7	SS				
20	8	SS				
25	9	SS				
30	10	SS				
35	11	SS				
40	12	SS				
45					Continued	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

STS JOB NO. 12776-A | SHEET NO. 1 OF 2

STS Consultants Ltd.

OWNER: Wausau Chemical	LOG OF BORING NUMBER: B-6 Continued
PROJECT NAME: Tetrachloroethylene Spill	ARCHITECT—ENGINEER:
SITE LOCATION: Wausau, Wisconsin	

DEPTH ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³
					SURFACE ELEVATION 1196.2	
	13	SS			Brown to grayish brown fine to coarse sand (SP) - with a trace of fine to medium gravel - moist to wet - dense to very dense	
50						
	14	SS				
53.5					End of Boring Boring advanced to 4.0 feet with solid-stem auger Boring advanced from 4.0 to 53.0 feet with roller bit and bentonite 53.0 feet of HW casing used 10.0 feet of 6" casing used 2" ID PVC observation well installed with protector pipe The well tip was placed at a depth of 53.3 feet from the surface The elevation of the top of the galvanized steel riser is 1198.00	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS / FT. (10 20 30 40 50)

29

55

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

WL ± 15.0' WS,WD	BORING STARTED 9-27-84	STS OFFICE	540 Lambeau Green Bay, WI 54303
WL BCR ACR	BORING COMPLETED 9-27-84	DRAWN BY SMD	SHEET NO. 2 OF 2
WL	RIG Mobile B-61 FOREMAN EVH	APP'D BY CJG	STS JOB NO. 12776-A

STS Consultants Ltd.

OWNER: Wausau Chemical	LOG OF BORING NUMBER: B-6A
PROJECT NAME: Tetrachloroethylene Spill	ARCHITECT—ENGINEER

SITE LOCATION: Wausau, Wisconsin

DEPTH / ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³	UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1 2 3 4 5) / PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % (10 20 30 40 50) / STANDARD PENETRATION BLOWS / FT. (10 20 30 40 50)
SURFACE ELEVATION 1196.4							
5							
10		PA			See log of boring 6		
15							
20							
21.6					End of Boring Boring advanced to 21.6 feet with solid-stem auger 2" ID PVC observation well installed with protector pipe The well tip was placed at a depth of 21.6 feet from the surface The elevation of the top of the galvanized steel riser is 1198.48		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

WL ± 13.0' WS, WD	BORING STARTED 9-28-84	STS OFFICE	540 Lambeau Green Bay, WI 54303
WL BCR ACR	BORING COMPLETED 10-1-84	DRAWN BY SMD	SHEET NO. 1 OF 1
WL	RIG Mobile B-61 FOREMAN EVH	APP'D BY CJG	STS JOB NO. 12776-A

STS Consultants Ltd.

OWNER: Wausau Chemical	LOG OF BORING NUMBER: B-7
PROJECT NAME: Tetrachloroethylene Spill	ARCHITECT—ENGINEER

SITE LOCATION: Wausau, Wisconsin

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS / FT. (10 20 30 40 50)

DEPTH ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³	STANDARD PENETRATION BLOWS / FT.
					SURFACE ELEVATION 1194.7		
	1	SS			Fill - brown silty fine sand (SM) - with roots, cinders and pieces of clay - with cobbles or rubble from 6.0 to 7.0 feet - moist - loose to medium dense		8
	2	SS					11
5	3	SS					17
	4	SS					8/6"
	4A	SS					
	5	SS					21/6"
10	6	SS					56
					Brown to grayish brown fine to coarse sand (SP) - with some fine to medium gravel and a trace of coarse gravel - moist to wet - dense to very dense		63
15	7	SS					32
20	8	SS					29
25	9	SS					21
30	10	SS					37
35	11	SS					53
40	12	SS					26
45					Continued		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

STS JOB NO. 12776-A

RL 4-1183

STS Consultants Ltd.

OWNER: Wausau Chemical	LOG OF BORING NUMBER: B-7 Continued
PROJECT NAME: Tetrachloroethylene Spill	ARCHITECT—ENGINEER
SITE LOCATION: Wausau, Wisconsin	

DEPTH ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³	UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1 2 3 4 5) / PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % (10 20 30 40 50) / STANDARD PENETRATION BLOWS / FT. (10 20 30 40 50)
					SURFACE ELEVATION 1194.7		
	13	SS			Brown to grayish brown fine to coarse sand (SP) - with some fine to medium gravel and a trace of coarse gravel - moist to wet - dense to very dense		⊗ 22
50							
	14	SS					⊗ 46
53.5					End of Boring Boring advanced to 10.0 feet with solid-stem auger Boring advanced from 10.0 to 53.5 feet with roller bit and bentonite 53.0 feet of HW casing used 10.0 feet of 6" casing used 2" ID PVC observation well installed with protector pipe The well tip was placed at a depth of 53.0 feet from the surface The elevation of the top of the galvanized steel riser is 1196.60		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

WL 10.0' WS,WD	BORING STARTED 9-24-84	STS OFFICE	540 Lambeau Green Bay, WI 54303
WL BCR ACR	BORING COMPLETED 9-25-84	DRAWN BY SMD	SHEET NO. 2 OF 2
WL	RIG Mobile B-61 FOREMAN EVH	APP'D BY CJG	STS JOB NO. 12776-A

STS Consultants Ltd.

OWNER: Wausau Chemical	LOG OF BORING NUMBER: B-7A
PROJECT NAME: Tetrachloroethylene Spill	ARCHITECT—ENGINEER:
SITE LOCATION: Wausau, Wisconsin	

DEPTH / ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³	UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1 2 3 4 5) / PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % (10 20 30 40 50) / STANDARD PENETRATION BLOWS / FT. (10 20 30 40 50)
SURFACE ELEVATION 1194.7							
5		PA			See log of boring 7		
10							
15							
18.5					End of Boring Boring advanced to 18.5 feet with solid-stem auger 2" ID PVC observation well installed with protector pipe The well tip was placed at a depth of 18.6 feet from the surface The elevation of the top of the galvanized steel riser is 1196.79		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

WL	BORING STARTED 9-25-84	STS OFFICE	540 Lambeau Green Bay, WI 54303
WL BCR ACR	BORING COMPLETED 9-25-84	DRAWN BY SMD	SHEET NO. 1 OF 1
WL	RIG Mobile B-61 FOREMAN EVH	APP'D BY CJG	STS JOB NO. 12776-A

TABLE 6

PERMEABILITY TEST RESULTS

Well No.	Depth(ft.)	Permeability cm/sec.) Falling Head	Rising Head
1	23		2×10^{-3}
3	161	$\cdot 9 \times 10^{-2}$	2×10^{-2}
3A	65	$\cdot 2 \times 10^{-1}$	
3C	29	$\cdot 1 \times 10^{-1}$	
4	60	$\cdot 15 \times 10^{-1}$	
4A	30	$\cdot 19 \times 10^{-1}$	$.8 \times 10^{-2}$
5	70	$\cdot 3 \times 10^{-1}$	$\cdot 2 \times 10^{-1}$
6	70	$.4 \times 10^{-2}$	$.4 \times 10^{-2}$
7	60	$\cdot 2 \times 10^{-1}$	$.2 \times 10^{-1}$
7A	30	$.1 \times 10^{-2}$	

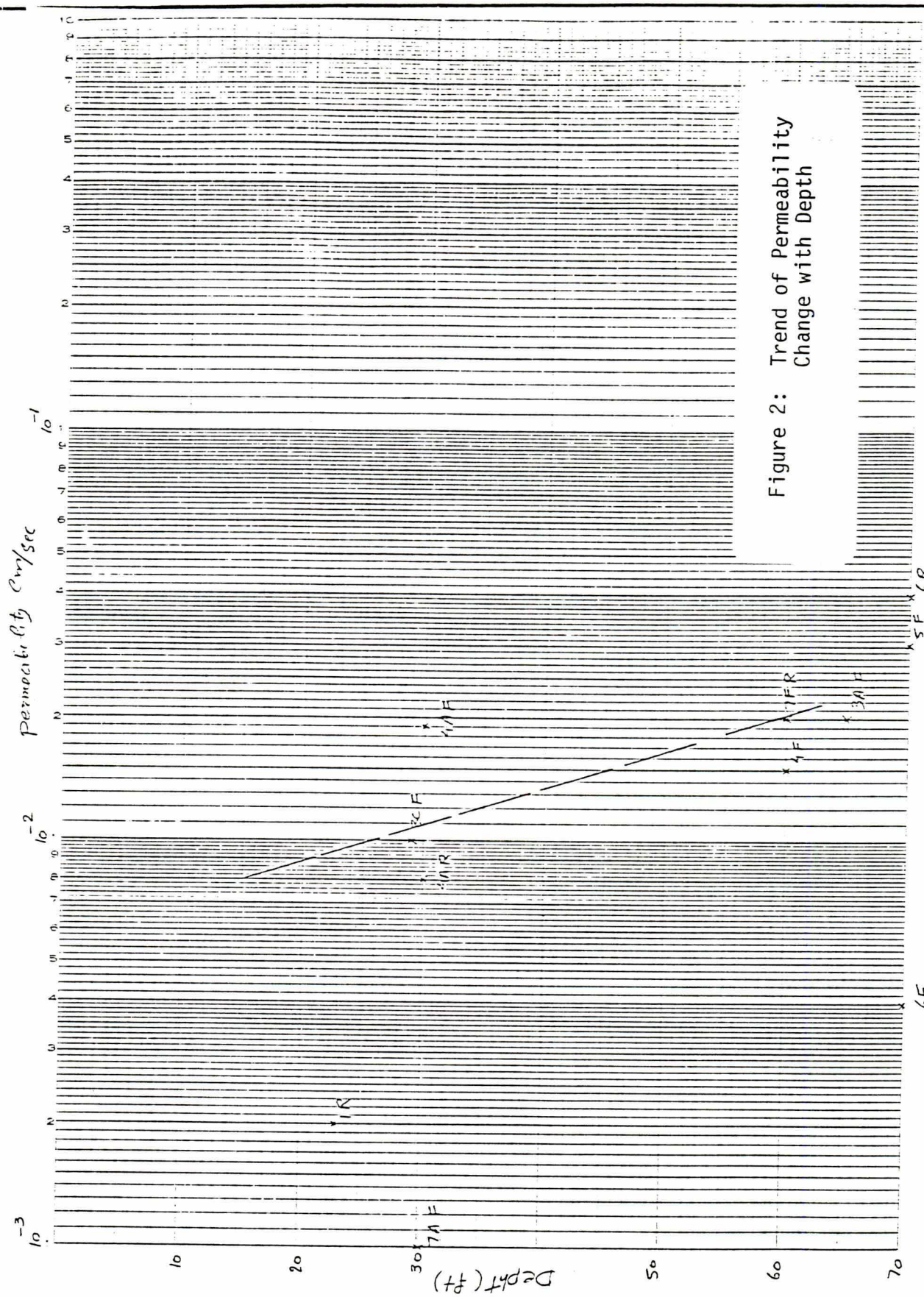


Figure 2: Trend of Permeability Change with Depth

EXTRACTION AND TREATMENT OF
TETRACHLOROETHYLENE
WAUSAU, WISCONSIN

STS CONSULTANTS LTD.
540 LAMBEAU STREET
GREEN BAY, WIS. 54303

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS : Split Spoon – 1 3/8" I.D., 2" O.D., unless otherwise noted
ST : Shelby Tube – 2" O.D., unless otherwise noted
PA : Power Auger
DB : Diamond Bit – NX: BX: AX
AS : Auger Sample
JS : Jar Sample
VS : Vane Shear
OS : Osterberg Sampler – 3" Shelby Tube
HS : Hollow Stem Auger
WS : Wash Sample
FT : Fish Tail
RB : Rock Bit
BS : Bulk Sample
PM : Pressuremeter test - in situ

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch OD split spoon, except where noted.

WATER LEVEL MEASUREMENT SYMBOLS:

WL : Water Level
WCI : Wet Cave In
DCI : Dry Cave In
WS : While Sampling
WD : While Drilling
BCR : Before Casing Removal
ACR : After Casing Removal
AB : After Boring

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious soils, the indicated elevations are considered reliable ground water levels. In impervious soils, the accurate determination of ground water elevations is not possible in even several days observation, and additional evidence of ground water elevations must be sought.

GRADATION DESCRIPTION & TERMINOLOGY:

Coarse Grained or Granular Soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are described as: clays or clayey silts if they are cohesive, and silts if they are non-cohesive. In addition to gradation, granular soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their strength or consistency, and their plasticity.

Major Component Of Sample	Size Range	Descriptive Term(s) (Of Components Also Present in Sample)	Percent of Dry Weight
Boulders	Over 8 in. (200mm)	Trace	1 – 9
Cobbles	8 in. to 3 in. (200mm to 75mm)	Little	10 – 19
Gravel	3 in. to #4 sieve (75mm to 2mm)	Some	20 – 34
Sand	#4 to #200 sieve (2mm to .074mm)	And	35 – 50
Silt	Passing #200 sieve (0.074mm to 0.005mm)		
Clay	Smaller than 0.005mm		

CONSISTENCY OF COHESIVE SOILS:

Unconfined Comp. Strength, Qu, tsf	Consistency
< 0.25	Very Soft
0.25 – 0.49	Soft
0.50 – 0.99	Medium (Firm)
1.00 – 1.99	Stiff
2.00 – 3.99	Very Stiff
4.00 – 8.00	Hard
>8.00	Very Hard

RELATIVE DENSITY OF GRANULAR SOILS:

N – Blows/ft.	Relative Density
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 49	Dense
50 – 80	Very Dense
80+	Extremely Dense

FIELD PROCEDURES

The sandy soils of this site were tested and sampled in general accordance with ASTM Specification D 1586-67, "Standard Method for Penetration Tests and Split-Barrel Sampling of Soils." Briefly, the sampling procedure involved driving a 2-inch OD standard sampler 18 inches with a 140-pound weight freefalling a distance of 30 inches. The number of blows required to drive the sampler the final foot was recorded as the Standard "N" Penetration. This N-value is used by Soils Engineers to make a preliminary estimate of the strength and compressibility of the soil. After driving, the sample was returned to the surface and opened. The length of sample (recovery) was measured and the soil was preliminarily classified according to type by a Soils Technician. A representative portion of each sample was then sealed in a glass jar, labeled, and returned to our laboratory for further examination and testing.

The clayey soils of this site were sampled in general accordance with ASTM Specification D 1587-67, "Standard Method for Thin-walled Tube Sampling of Soils". Briefly, each sample was obtained by hydraulically pushing a 2-inch OD thin-walled tube 2 feet into undisturbed soils at the bottom of the boring. After the tube was retrieved, the length of the sample (recovery) was measured. The soils exposed at the lower end of the tube was preliminarily classified according to type by a Soils Technician and a pocket penetrometer was used to estimate the unconfined compressive strength. The tube was then sealed at both ends with packing and rubber caps and returned to our laboratory for extrusion, additional examination and testing.

The depth at which groundwater was encountered while sampling or drilling was observed and noted on the field logs. Following completion of the borings, the depth to standing water was again observed. These observations are presented on the lower left hand corner of the soil boring logs included in the Appendix.

PROCEDURES REGARDING FIELD LOGS,

LABORATORY DATA SHEETS AND SAMPLES

In the process of obtaining and testing samples and preparing the report, procedures are followed that represent reasonable and accepted practice in the field of soil and foundation engineering.

Specifically, field logs are prepared during performance of the drilling and sampling operations which are intended to portray essentially field occurrences, sampling locations and other information.

Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory by more experienced soils engineers, and differences between the field logs and the final logs exist.

The Engineer preparing the report reviews the field and laboratory logs, classifications and test data, and in his judgement in interpreting this data, may make further changes.

Samples taken in the field, some of which are later subjected to laboratory tests, are retained in our laboratory for sixty (60) days and are then destroyed unless special disposition is requested by our client. Samples retained over a long period of time, even in sealed jars, are subject to moisture loss which changes the apparent strength of cohesive soil, generally increasing the strength from what was originally encountered in the field. Since they are no longer representative of the moisture conditions initially encountered, an inspection of these samples could recognize this factor.

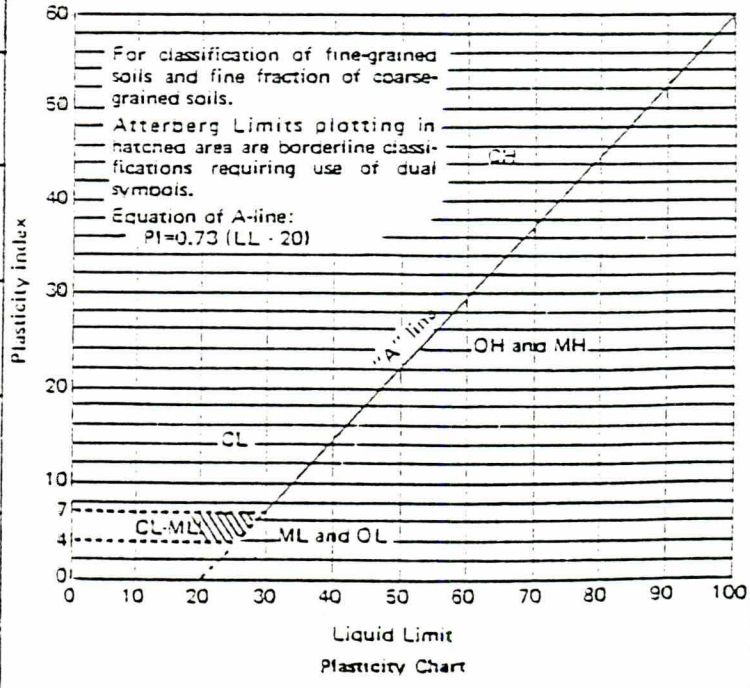
It is common practice in the soil and foundation engineering profession that field logs and laboratory test data sheets not be included in engineering reports, because they do not represent the engineer's final opinion as to the appropriate descriptions for conditions encountered in the exploration and testing work. On the other hand, we are aware that perhaps certain contractors and subcontractors submitting bids or proposals on work might have an interest in studying these documents before submitting a bid or proposal. For this reason, the field logs will be retained in our office for inspection by all contractors submitting a bid or proposal. We would welcome the opportunity to explain any changes that have and typically are made in the preparation of our final reports, to the contractor or sub-contractors, before the firm submits its bid or proposal, and to describe how the information was obtained to the extent the contractor or subcontractor wishes. Results of laboratory tests are generally shown on the boring logs or are described in the text of the report, as appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

Major divisions			Group symbols	Typical names	Laboratory classification criteria	
Coarse grained soils (More than half of material is *larger* than No. 200 sieve size)	Gravels (More than half of coarse fraction larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM d / u	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above "A" line with P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM d / u	Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols.
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above "A" line with P.I. greater than 7	
Fine grained soils (More than half of material is *smaller* than No. 200 sieve)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			OL	Organic silts and organic silty clays of low plasticity		
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts		
			CH	Inorganic clays of high plasticity, fat clays		
			OH	Organic clays of medium to high plasticity, organic silts		
	Highly organic soils		Pt	Peat and other highly organic soils		

Determine percentages of sand and gravel from grain size curve.
Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 per cent	GW, GP, SW, SP
More than 12 per cent	GM, GC, SM, SC
5 to 12 per cent	*Borderline* cases requiring dual symbols



Plasticity Chart

APPENDIX C

Well Installation Diagrams
Well Location Diagrams
Result of Chemical Analysis (Tables 6 to 10)
Groundwater Contours

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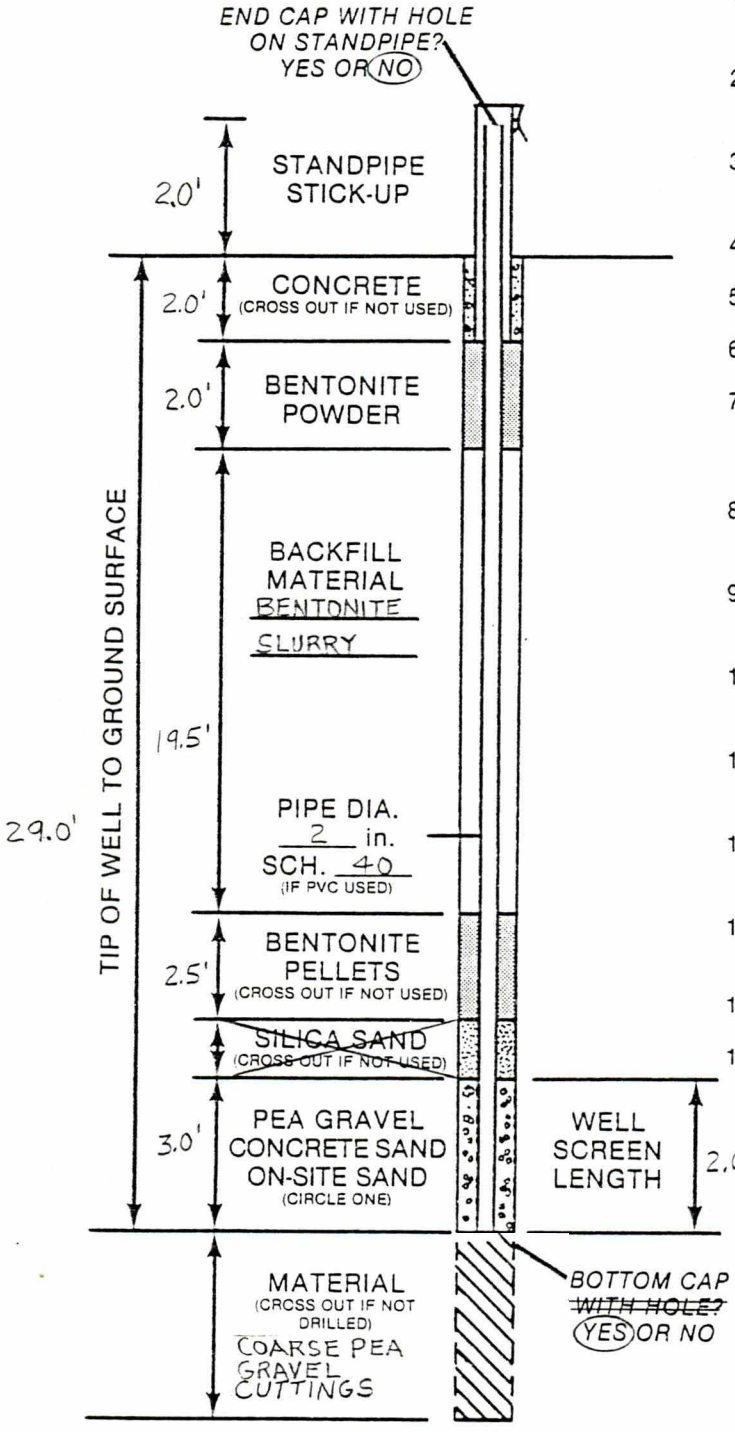
FIELD WELL INSTALLATION DIAGRAM



1) TYPE OF PIPE?
(PVC.) GALVANIZED, STAINLESS, OTHER _____

2) TYPE OF PIPE JOINTS?
(BELLED.) (COUPLINGS.) THREADED, OTHER _____

3) TYPE OF WELL SCREEN
(PVC.) GALVANIZED, STAINLESS, OTHER _____

4) SCREEN SIZE .010

5) INSTALLED PROTECTOR PIPE W/LOCK? (YES) OR NO

6) WAS SOLVENT USED? (YES) OR NO

7) WAS DRILLING MUD USED? NO
SOLID AUGER, HOLLOW STEM AUGER,
(WATER.) REVERT, BENTONITE

8) DID STANDPIPE COME UP WHEN CASING WAS PULLED?
YES OR (NO)

9) HOW WAS WELL DEVELOPED?
BAILING, (PUMPING.) SURGING, COMPRESSED AIR

10) TIME SPENT FOR WELL DEVELOPMENT?
5 min., 15 min., (30 min.) OTHER _____

11) APPROXIMATE WATER VOLUME REMOVED OR ADDED?
5 gal., 10 gal., 15 gal., OTHER 210 GAL.

12) WATER CLARITY BEFORE DEVELOPMENT?
CLEAR, (TURBID.) OPAQUE

13) WATER CLARITY AFTER DEVELOPMENT?
(CLEAR.) TURBID, OPAQUE

14) DID THE WATER SMELL? YES OR (NO)

15) WATER LEVEL SUMMARY

1) DEPTH FROM T. STANDPIPE AFTER DEVELOPMENT?
11.4 Ft. or DRY

2) OTHER MEASUREMENTS:

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

Well No. B-3C DATE INSTALLED 10-1-84/10-2-84 DRILL RIG DR-2

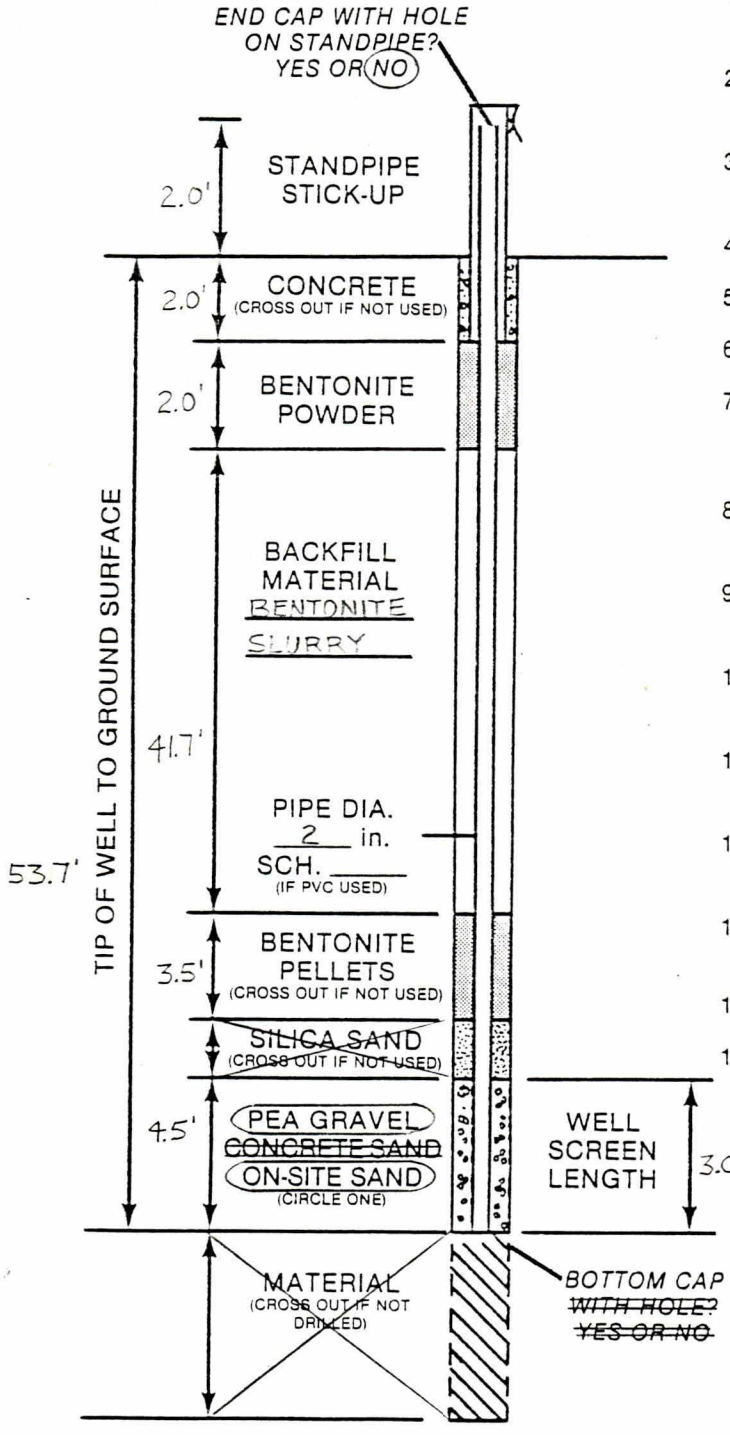
DRILLER EVH DRILL CREW WRZ

JOB/CLIENT WAUSAU CHEMICAL STS JOB No. 12776-4

FW: 1-983

STS Consultants Ltd.

FIELD WELL INSTALLATION DIAGRAM



1) TYPE OF PIPE?
PVC, (GALVANIZED,) STAINLESS, OTHER _____

2) TYPE OF PIPE JOINTS?
BELLED, (COUPLINGS,) THREADED, OTHER _____

3) TYPE OF WELL SCREEN
PVC, (GALVANIZED,) STAINLESS, OTHER _____

4) SCREEN SIZE 60 GAUZE

5) INSTALLED PROTECTOR PIPE W/LOCK? (YES) OR NO

6) WAS SOLVENT USED? (YES) OR NO

7) WAS DRILLING MUD USED? YES
SOLID AUGER, HOLLOW STEM AUGER,
WATER, REVERT, (BENTONITE)

8) DID STANDPIPE COME UP WHEN CASING WAS PULLED?
YES OR (NO)

9) HOW WAS WELL DEVELOPED?
BAILING, (PUMPING,) SURGING, COMPRESSED AIR

10) TIME SPENT FOR WELL DEVELOPMENT?
5 min., 15 min., (30 min.,) OTHER _____

11) APPROXIMATE WATER VOLUME REMOVED OR ADDED?
5 gal., 10 gal., 15 gal., OTHER 210 GAL.

12) WATER CLARITY BEFORE DEVELOPMENT?
(CLEAR,) TURBID, OPAQUE

13) WATER CLARITY AFTER DEVELOPMENT?
(CLEAR,) TURBID, OPAQUE

14) DID THE WATER SMELL? YES OR (NO)

15) WATER LEVEL SUMMARY

1) DEPTH FROM T. STANDPIPE AFTER DEVELOPMENT?
11.0 Ft. or DRY

2) OTHER MEASUREMENTS:

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

Well No. B-4 DATE INSTALLED 9-26-84 DRILL RIG DR-2

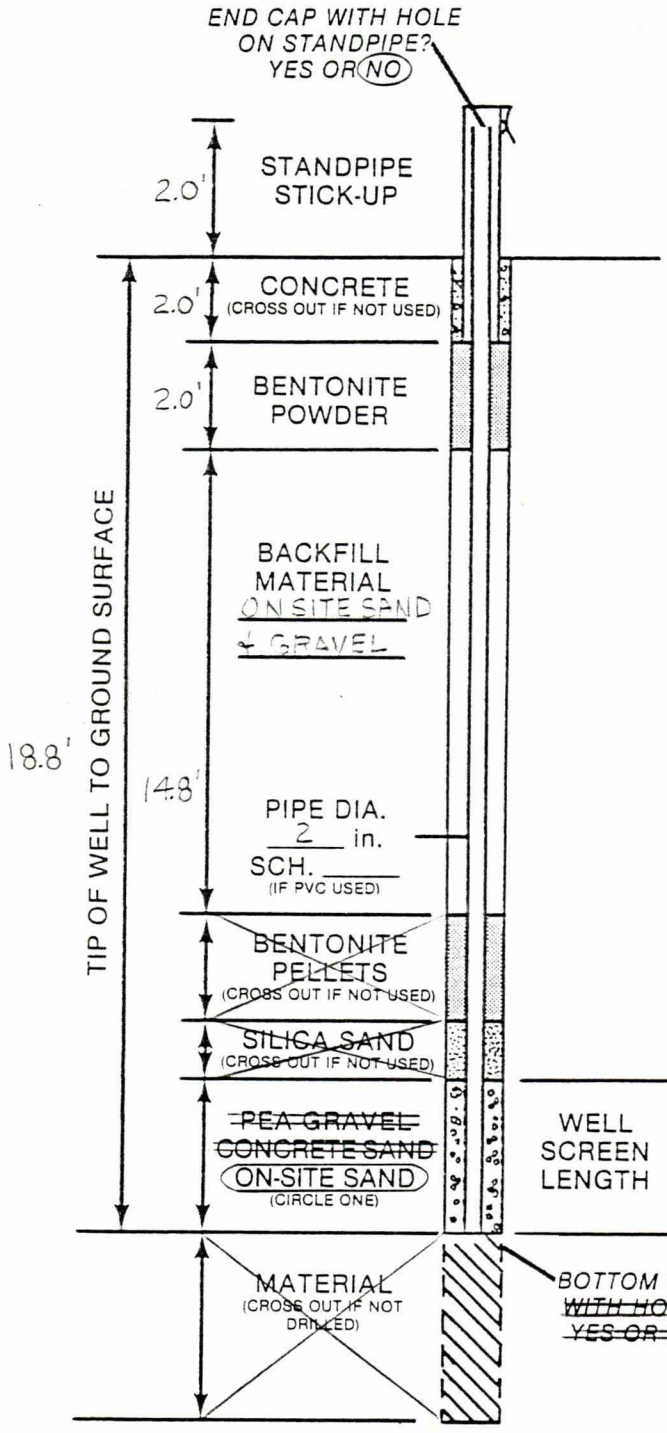
DRILLER EVH DRILL CREW WRZ

JOB/CLIENT WAUSAU CHEMICAL STS JOB No. 12776-A

FW: 1-983

STS Consultants Ltd.

FIELD WELL INSTALLATION DIAGRAM



1) TYPE OF PIPE?
PVC, (GALVANIZED,) STAINLESS, OTHER _____

2) TYPE OF PIPE JOINTS?
BELLED, (COUPLINGS,) THREADED, OTHER _____

3) TYPE OF WELL SCREEN
PVC, (GALVANIZED,) STAINLESS, OTHER _____

4) SCREEN SIZE 60 GAUZE

5) INSTALLED PROTECTOR PIPE W/LOCK? (YES) OR NO

6) WAS SOLVENT USED? YES OR (NO)

7) WAS DRILLING MUD USED? NO
(SOLID AUGER,) HOLLOW STEM AUGER, WATER, REVERT, BENTONITE

8) DID STANDPIPE COME UP WHEN CASING WAS PULLED?
YES OR (NO)

9) HOW WAS WELL DEVELOPED?
BAILING, (PUMPING,) SURGING, COMPRESSED AIR

10) TIME SPENT FOR WELL DEVELOPMENT?
5 min., 15 min., (30 min.,) OTHER _____

11) APPROXIMATE WATER VOLUME REMOVED OR ADDED?
5 gal., 10 gal., 15 gal., OTHER 230 GAL.

12) WATER CLARITY BEFORE DEVELOPMENT?
CLEAR, (TURBID,) OPAQUE

13) WATER CLARITY AFTER DEVELOPMENT?
(CLEAR,) TURBID, OPAQUE

14) DID THE WATER SMELL? YES OR (NO)

15) WATER LEVEL SUMMARY

1) DEPTH FROM T. STANDPIPE AFTER DEVELOPMENT?
10.9 Ft. or DRY

2) OTHER MEASUREMENTS:

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

Well No. B-4A DATE INSTALLED 9-26-84 DRILL RIG DR-2

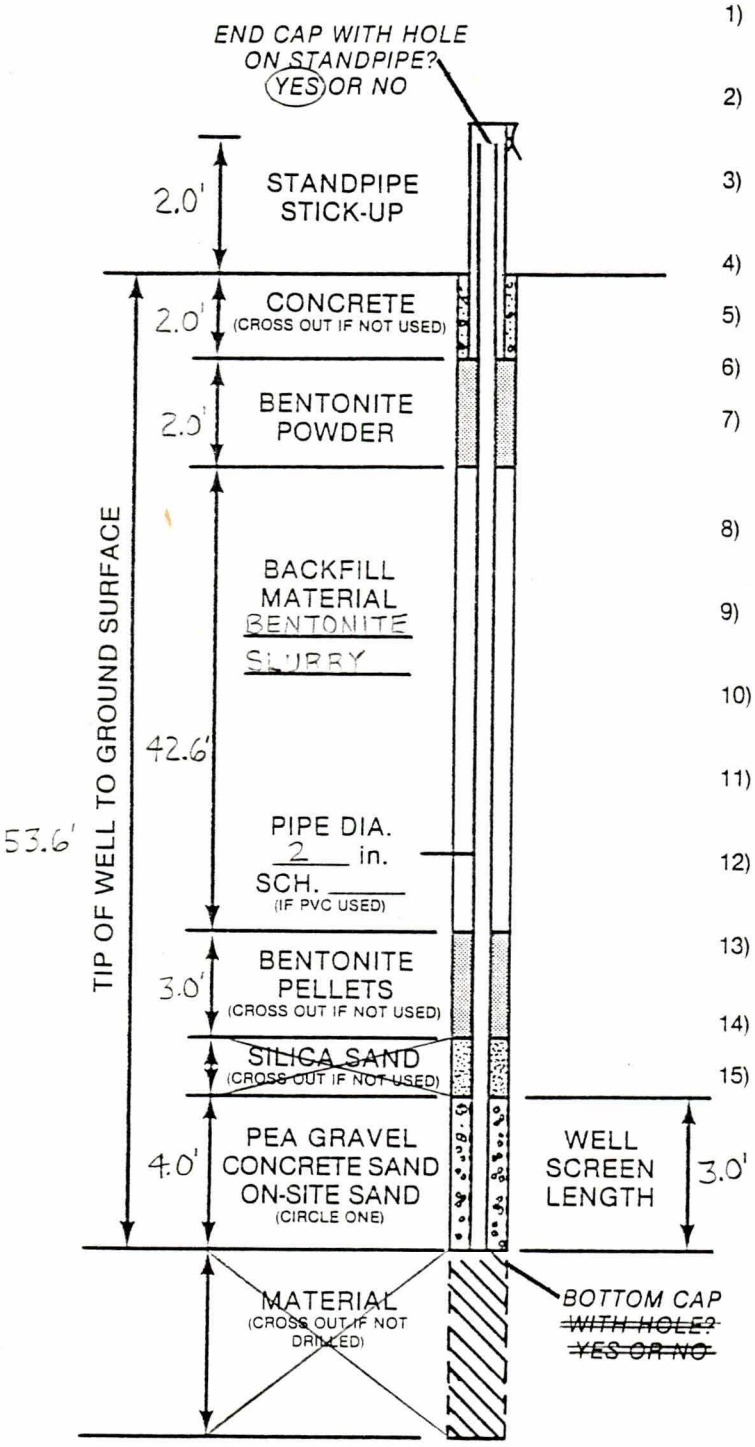
DRILLER EVH DRILL CREW WRZ

JOB/CLIENT WAUSAU CHEMICAL STS JOB No. 12776-A

FW: 1-983

STS Consultants Ltd.

FIELD WELL INSTALLATION DIAGRAM



1) TYPE OF PIPE?
PVC, (GALVANIZED,) STAINLESS, OTHER _____

2) TYPE OF PIPE JOINTS?
BELLED, (COUPLINGS,) THREADED, OTHER _____

3) TYPE OF WELL SCREEN
PVC, (GALVANIZED,) STAINLESS, OTHER _____

4) SCREEN SIZE 60 GAUZE

5) INSTALLED PROTECTOR PIPE W/LOCK? (YES) OR NO

6) WAS SOLVENT USED? YES OR (NO)

7) WAS DRILLING MUD USED? YES
SOLID AUGER, HOLLOW STEM AUGER,
WATER, REVERT, (BENTONITE)

8) DID STANDPIPE COME UP WHEN CASING WAS PULLED?
YES OR (NO)

9) HOW WAS WELL DEVELOPED?
BAILING, (PUMPING,) SURGING, COMPRESSED AIR

10) TIME SPENT FOR WELL DEVELOPMENT?
5 min., 15 min., (30 min.,) OTHER _____

11) APPROXIMATE WATER VOLUME REMOVED OR ADDED?
5 gal., 10 gal., 15 gal., OTHER _____

12) WATER CLARITY BEFORE DEVELOPMENT?
CLEAR, TURBID, OPAQUE

13) WATER CLARITY AFTER DEVELOPMENT?
CLEAR, TURBID, OPAQUE

14) DID THE WATER SMELL? YES OR NO

15) WATER LEVEL SUMMARY

1) DEPTH FROM T. STANDPIPE AFTER DEVELOPMENT?
_____ Ft. or DRY

2) OTHER MEASUREMENTS:

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

Well No. B-5 DATE INSTALLED 9-27-84 DRILL RIG DR-2

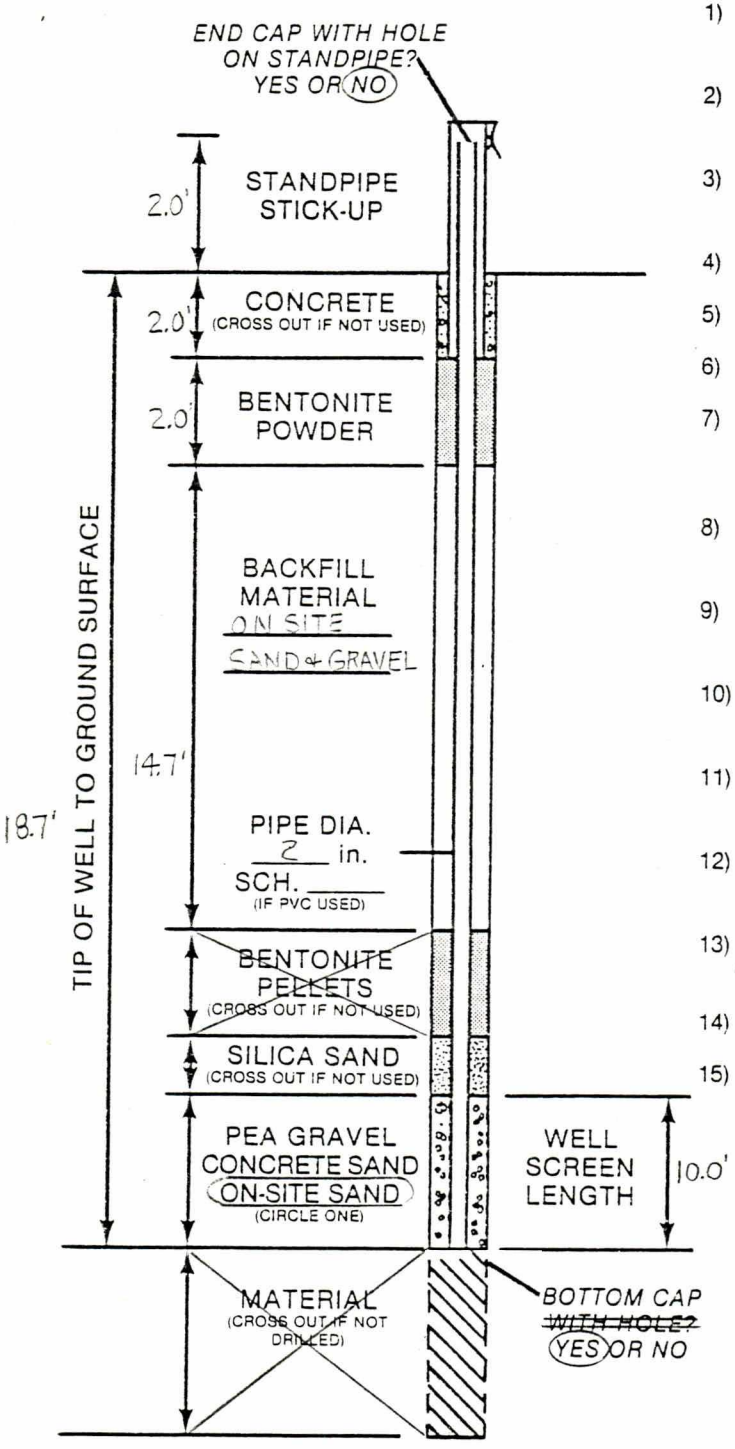
DRILLER EVH DRILL CREW WRZ

JOB/CLIENT WAUSAU CHEMICAL STS JOB No. 12776-A

FW: 1-983

STS Consultants Ltd.

FIELD WELL INSTALLATION DIAGRAM



1) TYPE OF PIPE?
PVC, (GALVANIZED,) STAINLESS, OTHER _____

2) TYPE OF PIPE JOINTS?
BELLED, (COUPLINGS,) THREADED, OTHER _____

3) TYPE OF WELL SCREEN
PVC, (GALVANIZED,) STAINLESS, OTHER _____

4) SCREEN SIZE .010

5) INSTALLED PROTECTOR PIPE W/LOCK? (YES) OR NO

6) WAS SOLVENT USED? YES OR (NO)

7) WAS DRILLING MUD USED? NO
(SOLID AUGER,) HOLLOW STEM AUGER, WATER, REVERT, BENTONITE

8) DID STANDPIPE COME UP WHEN CASING WAS PULLED?
YES OR (NO)

9) HOW WAS WELL DEVELOPED?
BAILING, (PUMPING,) SURGING, COMPRESSED AIR

10) TIME SPENT FOR WELL DEVELOPMENT?
5 min., 15 min., (30 min.,) OTHER _____

11) APPROXIMATE WATER VOLUME REMOVED OR ADDED?
5 gal., 10 gal., 15 gal., OTHER 220 GAL.

12) WATER CLARITY BEFORE DEVELOPMENT?
CLEAR, (TURBID,) OPAQUE

13) WATER CLARITY AFTER DEVELOPMENT?
(CLEAR,) TURBID, OPAQUE

14) DID THE WATER SMELL? YES OR (NO)

15) WATER LEVEL SUMMARY

1) DEPTH FROM T. STANDPIPE AFTER DEVELOPMENT?
11.3 Ft. or DRY

2) OTHER MEASUREMENTS:

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

Well No. B-5A DATE INSTALLED 10-1-84 DRILL RIG DR-2

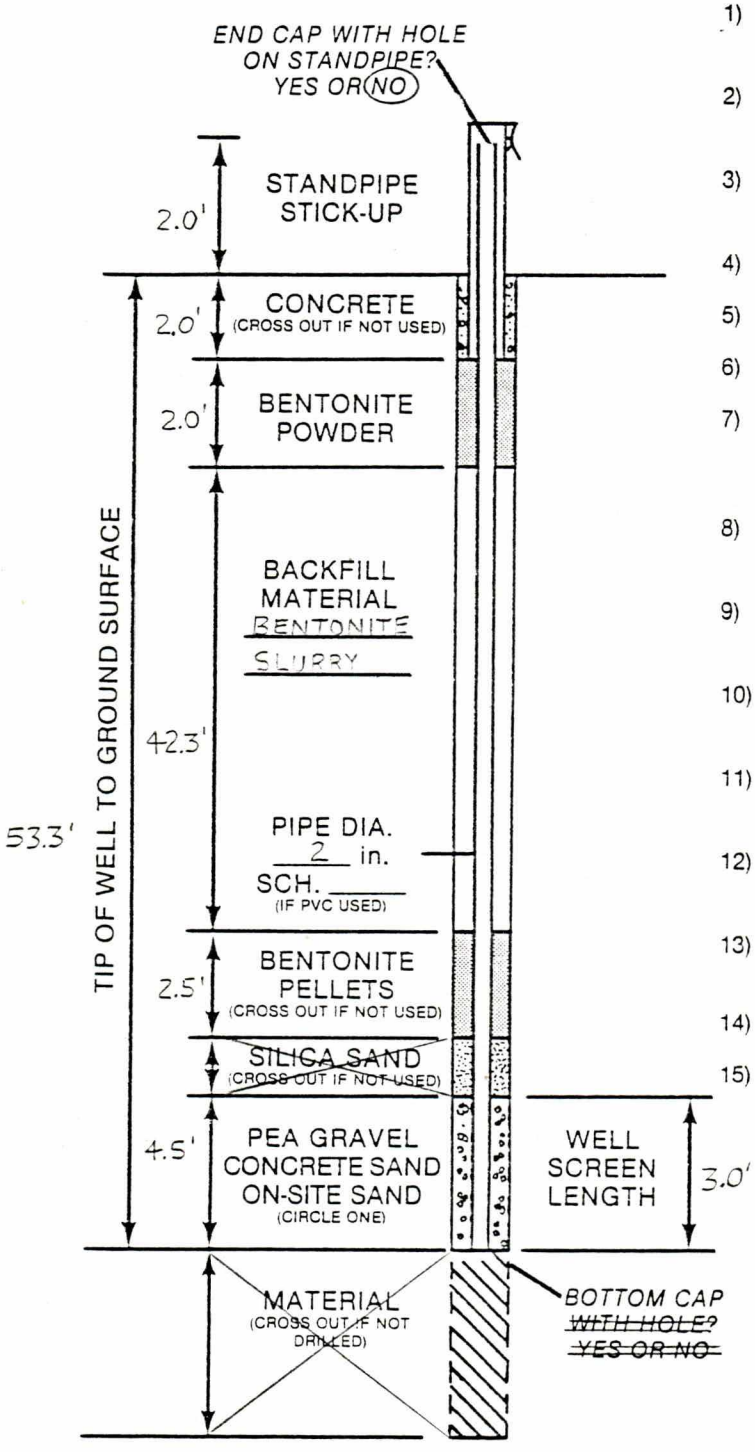
DRILLER EVH DRILL CREW WRZ

JOB/CLIENT WAUSAU CHEMICAL STS JOB No. 12776-A

FW: 1-983

STS Consultants Ltd.

FIELD WELL INSTALLATION DIAGRAM



1) TYPE OF PIPE?
PVC, (GALVANIZED,) STAINLESS, OTHER _____

2) TYPE OF PIPE JOINTS?
BELLED, (COUPLINGS,) THREADED, OTHER _____

3) TYPE OF WELL SCREEN
PVC, (GALVANIZED,) STAINLESS, OTHER _____

4) SCREEN SIZE 60 GAUZE

5) INSTALLED PROTECTOR PIPE W/LOCK? (YES) OR NO

6) WAS SOLVENT USED? YES OR (NO)

7) WAS DRILLING MUD USED? YES
SOLID AUGER, HOLLOW STEM AUGER,
WATER, REVERT, (BENTONITE)

8) DID STANDPIPE COME UP WHEN CASING WAS PULLED?
YES OR (NO)

9) HOW WAS WELL DEVELOPED?
BAILING, (PUMPING,) SURGING, COMPRESSED AIR

10) TIME SPENT FOR WELL DEVELOPMENT?
5 min., 15 min., (30 min.,) OTHER _____

11) APPROXIMATE WATER VOLUME REMOVED OR ADDED?
5 gal., 10 gal., 15 gal., OTHER 210 GAL

12) WATER CLARITY BEFORE DEVELOPMENT?
CLEAR, (TURBID,) OPAQUE

13) WATER CLARITY AFTER DEVELOPMENT?
(CLEAR,) TURBID, OPAQUE

14) DID THE WATER SMELL? YES OR (NO)

15) WATER LEVEL SUMMARY

1) DEPTH FROM T. STANDPIPE AFTER DEVELOPMENT?
15.0 Ft. or DRY

2) OTHER MEASUREMENTS:

DATE _____; _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

Well No. B-6 DATE INSTALLED 9-27-84 DRILL RIG DR-2

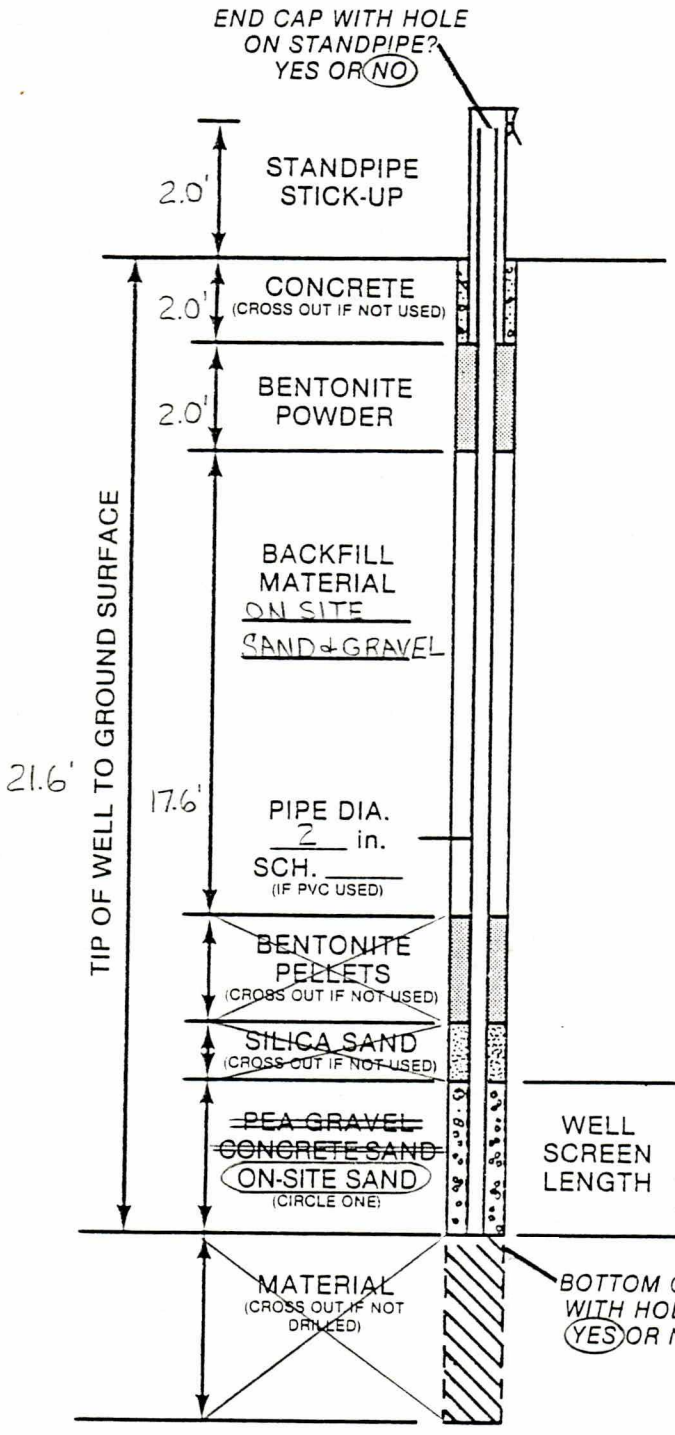
DRILLER EVH DRILL CREW WRZ

JOB/CLIENT WAUSAU CHEMICAL STS JOB No. 12776-A

FW: 1-983

STS Consultants Ltd.

FIELD WELL INSTALLATION DIAGRAM



1) TYPE OF PIPE?
PVC, (GALVANIZED,) STAINLESS, OTHER _____

2) TYPE OF PIPE JOINTS?
BELLED, (COUPLINGS,) THREADED, OTHER _____

3) TYPE OF WELL SCREEN
PVC, (GALVANIZED,) STAINLESS, OTHER _____

4) SCREEN SIZE .010

5) INSTALLED PROTECTOR PIPE W/LOCK? (YES) OR NO

6) WAS SOLVENT USED? YES OR (NO)

7) WAS DRILLING MUD USED? NO
(SOLID AUGER,) HOLLOW STEM AUGER, WATER, REVERT, BENTONITE

8) DID STANDPIPE COME UP WHEN CASING WAS PULLED?
YES OR (NO)

9) HOW WAS WELL DEVELOPED?
BAILING, (PUMPING,) SURGING, COMPRESSED AIR

10) TIME SPENT FOR WELL DEVELOPMENT?
5 min., 15 min., (30 min.,) OTHER _____

11) APPROXIMATE WATER VOLUME REMOVED OR ADDED?
5 gal., 10 gal., 15 gal., OTHER 220 GAL.

12) WATER CLARITY BEFORE DEVELOPMENT?
CLEAR, (TURBID,) OPAQUE

13) WATER CLARITY AFTER DEVELOPMENT?
(CLEAR,) TURBID, OPAQUE

14) DID THE WATER SMELL? YES OR (NO)

15) WATER LEVEL SUMMARY

1) DEPTH FROM T. STANDPIPE AFTER DEVELOPMENT?
14.8 Ft. or DRY

2) OTHER MEASUREMENTS:

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

Well No. B-6A DATE INSTALLED 10-1-84 DRILL RIG DR-2

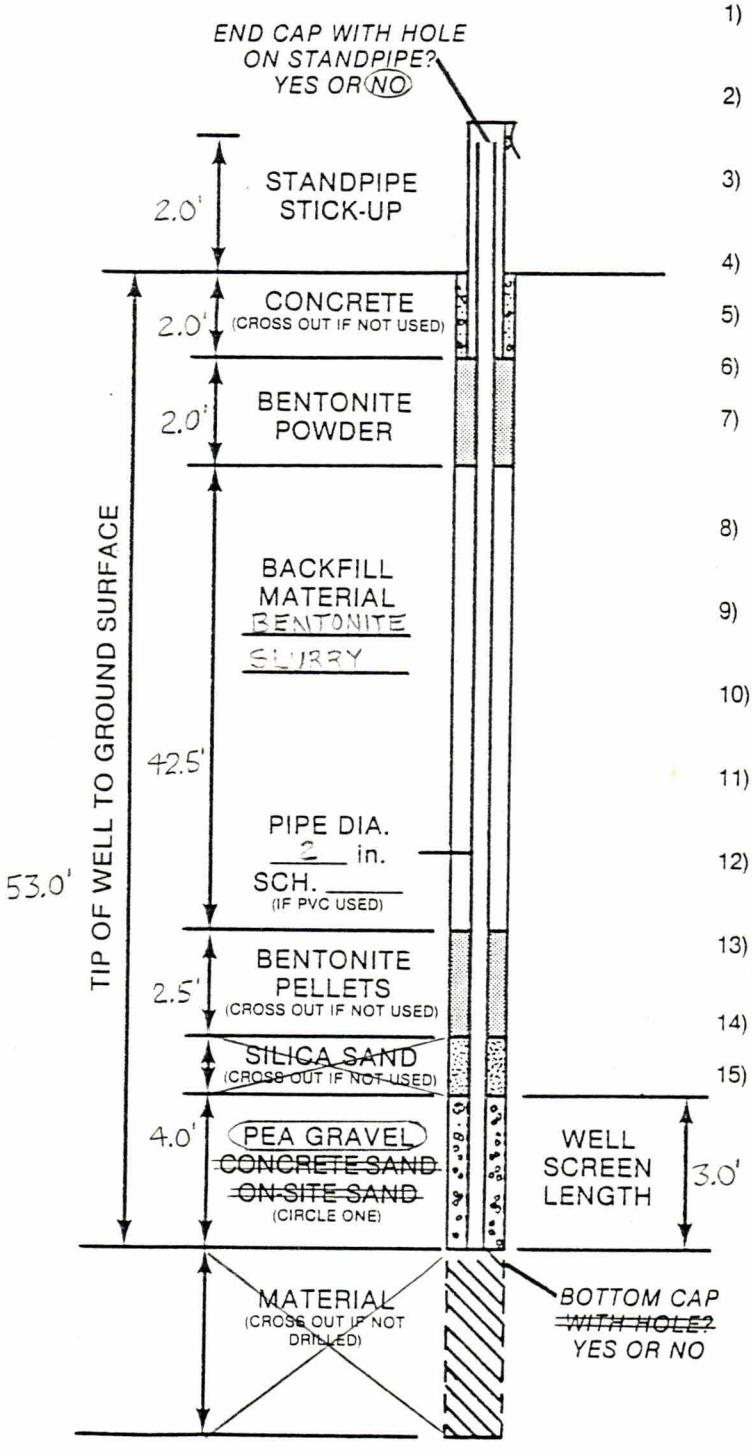
DRILLER EVH DRILL CREW WRZ

JOB/CLIENT WAUSAU CHEMICAL STS JOB No. 12776-A

FW: 1-983

STS Consultants Ltd.

FIELD WELL INSTALLATION DIAGRAM



1) TYPE OF PIPE?
PVC, (GALVANIZED,) STAINLESS, OTHER _____

2) TYPE OF PIPE JOINTS?
BELLED, (COUPLINGS,) THREADED, OTHER _____

3) TYPE OF WELL SCREEN
PVC, (GALVANIZED,) STAINLESS, OTHER _____

4) SCREEN SIZE 60 GAUZE

5) INSTALLED PROTECTOR PIPE W/LOCK? (YES) OR NO

6) WAS SOLVENT USED? YES OR (NO)

7) WAS DRILLING MUD USED? YES (TO ABOVE SCREEN)
SOLID AUGER, HOLLOW STEM AUGER,
WATER, REVERT, (BENTONITE)

8) DID STANDPIPE COME UP WHEN CASING WAS PULLED?
YES OR (NO)

9) HOW WAS WELL DEVELOPED?
BAILING, (PUMPING,) SURGING, COMPRESSED AIR

10) TIME SPENT FOR WELL DEVELOPMENT?
5 min., 15 min., (30 min.,) OTHER _____

11) APPROXIMATE WATER VOLUME REMOVED OR ADDED?
5 gal., 10 gal., 15 gal., OTHER 210 GAL.

12) WATER CLARITY BEFORE DEVELOPMENT?
(CLEAR,) TURBID, OPAQUE

13) WATER CLARITY AFTER DEVELOPMENT?
(CLEAR,) TURBID, OPAQUE

14) DID THE WATER SMELL? YES OR (NO)

15) WATER LEVEL SUMMARY

1) DEPTH FROM T. STANDPIPE AFTER DEVELOPMENT?
12.5 Ft. or DRY

2) OTHER MEASUREMENTS:

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

Well No. B-7 DATE INSTALLED 9-25-84 DRILL RIG DR-2

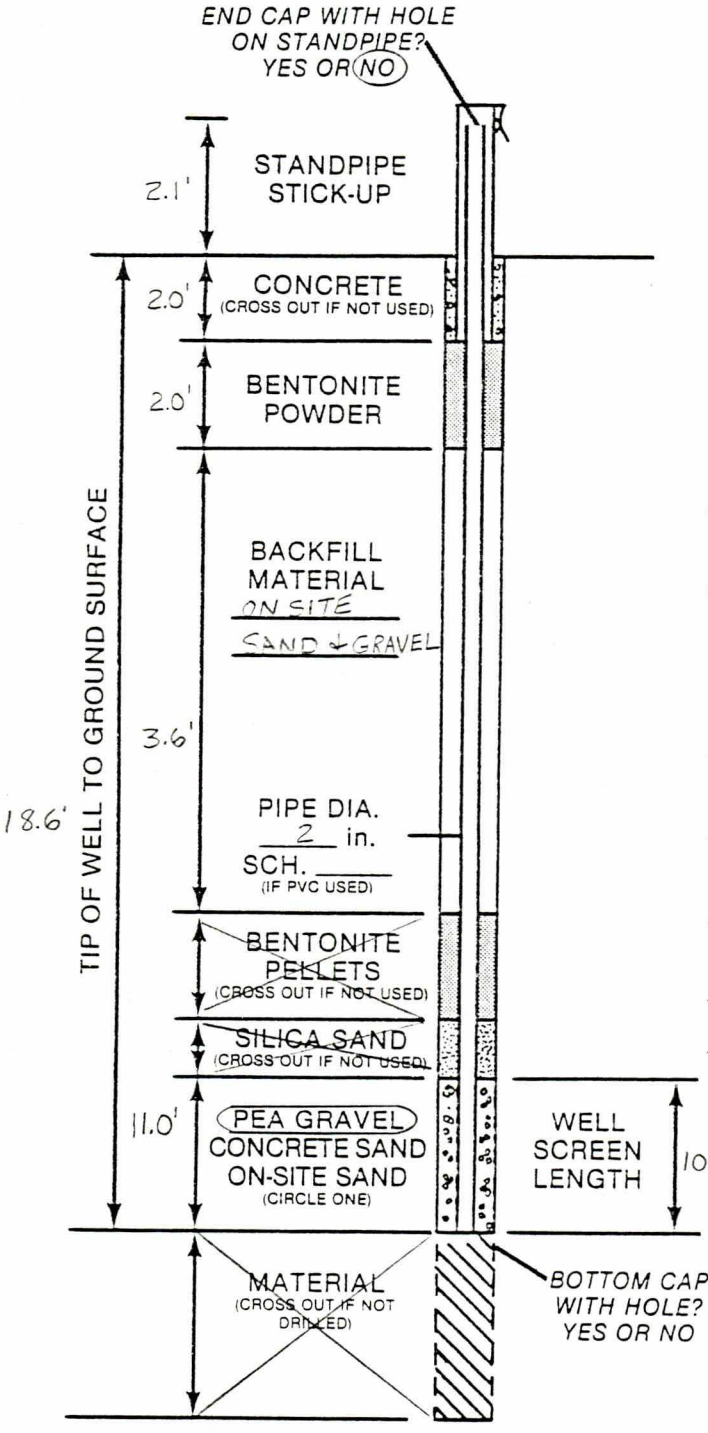
DRILLER EVH DRILL CREW WRZ

JOB/CLIENT WAUSAU CHEMICAL STS JOB No. 12776-A

FW: 1-983

STS Consultants Ltd.

FIELD WELL INSTALLATION DIAGRAM



1) TYPE OF PIPE?
PVC, (GALVANIZED,) STAINLESS, OTHER _____

2) TYPE OF PIPE JOINTS?
BELLED, (COUPLINGS,) THREADED, OTHER _____

3) TYPE OF WELL SCREEN
PVC, (GALVANIZED,) STAINLESS, OTHER _____

4) SCREEN SIZE 60 GAUZE

5) INSTALLED PROTECTOR PIPE W/LOCK? (YES) OR NO

6) WAS SOLVENT USED? YES OR (NO)

7) WAS DRILLING MUD USED? NO
(SOLID AUGER,) HOLLOW STEM AUGER, WATER, REVERT, BENTONITE

8) DID STANDPIPE COME UP WHEN CASING WAS PULLED?
YES OR (NO)

9) HOW WAS WELL DEVELOPED?
BAILING, (PUMPING,) SURGING, COMPRESSED AIR

10) TIME SPENT FOR WELL DEVELOPMENT?
5 min., 15 min., (30 min.,) OTHER _____

11) APPROXIMATE WATER VOLUME REMOVED OR ADDED?
5 gal., 10 gal., 15 gal., OTHER 220 GAL.

12) WATER CLARITY BEFORE DEVELOPMENT?
CLEAR, (TURBID,) OPAQUE

13) WATER CLARITY AFTER DEVELOPMENT?
(CLEAR,) TURBID, OPAQUE

14) DID THE WATER SMELL? YES OR (NO)

15) WATER LEVEL SUMMARY

1) DEPTH FROM T. STANDPIPE AFTER DEVELOPMENT?
13.9 Ft. or DRY

2) OTHER MEASUREMENTS:

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

DATE _____, _____ Ft. FROM T, ST. PIPE

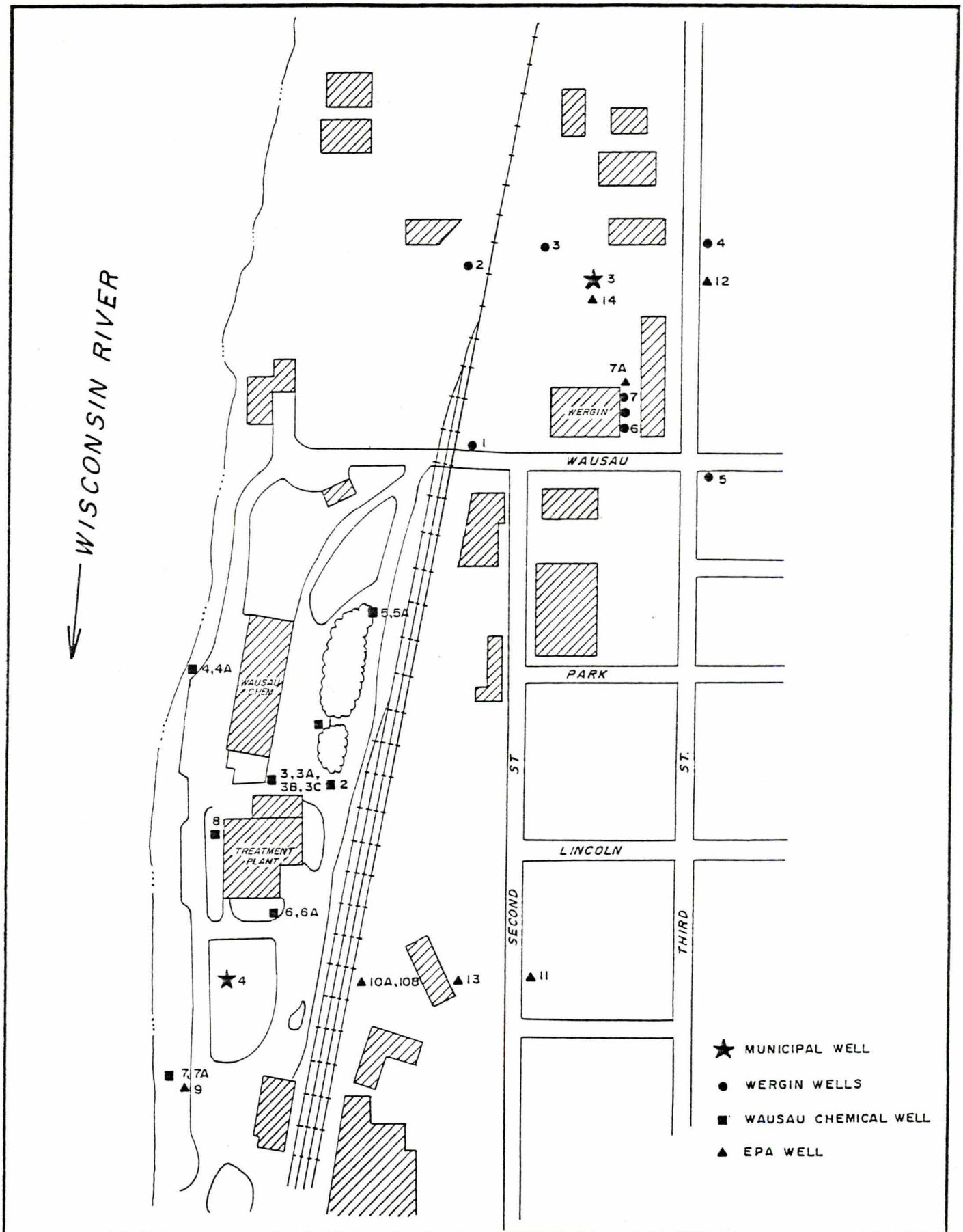
DATE _____, _____ Ft. FROM T, ST. PIPE

Well No. B-7A DATE INSTALLED 9-25-84 DRILL RIG DR-2

DRILLER EVH DRILL CREW WRZ

JOB/CLIENT WAUSAU CHEMICAL STS JOB No. 12776-A

FW: 1-983



WELL LOCATION DIAGRAM

CITY OF WAUSAU, WISCONSIN

N

STS CONSULTANTS LTD.
540 LAMBEAU STREET
GREEN BAY, WIS. 54303

3-29-85 | No Scale | 12776A

SIMULTANEOUS SAMPLING PROGRAM

LAB RESULTS

TABLE 6

WAUSAU, WI

MOBILE LAB RESULTS FOR PROJECT NAME: WAUSAU

DETECTION LIMIT (WATER) = 1 ppb
DETECTION LIMIT (SOIL) = 5ppb

STATN NUMBER	DATE SAMPLED	STATION LOCATION	DCE (ppb)	TCE (ppb)	PCE (ppb)	OTHER VOLATILE ORGANIC COMPOUNDS DETECTED
W001	09/17/84	MONITOR WELL #1	ND	ND	ND	
W002	09/17/84	MONITOR WELL #2	ND	ND	ND	
W003	09/17/84	MONITOR WELL #3	ND	ND	ND	
W004	09/17/84	MONITOR WELL #4	ND	ND	ND	
W005	09/17/84	MONITOR WELL #5	ND	ND	ND	CHLOROFORM-~4.4ppb
W006	09/17/84	MONITOR WELL #6	~1.0	ND	~3.2	
W007	09/17/84	MONITOR WELL #7	~2.4	~1.9	23.4	
W008	09/17/84	MONITOR WELL #8	ND	~1.4	38.6	
W009	09/17/84	WERGEN WELL	13.7	~3.9	65.5	TOLUENE-~2.4
W010	09/17/84	CITY WELL #3	18.1	147.0	~7.8	CHLOROFORM-~2.0ppb, TOLUENE-~3.5ppb
W011	09/17/84	CITY WELL #4	78.8	67.8	47.4	1,1,1-TRICHLOROETHANE-~1.5ppb, TOLUENE-25.6ppb, ETHYLBENZENE~3
W012	09/17/84	CITY WELL #6	~1.0	140.0	ND	
W013	09/17/84	CITY WELL #7	ND	ND	ND	
W014	09/17/84	CITY WELL #8	ND	ND	ND	
W015	09/17/84	CITY WELL #9	ND	ND	ND	
SD014	09/25/84	WEST SIDE RM 2A	ND	ND	ND	CH(CL3) ~3.75ppb
SD015	09/25/84	WELL #6 EFFLUENT	ND	~3.4	ND	
SD016	09/25/84	WELL #6 INFLUENT	ND	170	ND	
SD017	09/25/84	WELL #6 UNIT B	ND	ND	ND	
SD018	09/25/84	WELL #6 UNIT C	ND	ND	ND	
SD019	09/25/84	WELL #6 UNIT B	ND	ND	ND	
SD020	09/25/84	WELL #6 UNIT A	ND	ND	ND	
SD079	10/01/84	EPA RM #1	ND	ND	ND	
SD080	10/01/84	EPA RM #2A	ND	ND	ND	CHLOROFORM ~3.1ppb
SD081	10/01/84	EPA RM #3	ND	ND	ND	
SD082	10/01/84	EPA RM #3A	ND	ND	ND	
SD083	10/01/84	EPA RM #4	ND	ND	~1.1	CHLOROFORM 22.8ppb
SD083						TOLUENE ~1.0ppb
SD084	10/01/84	EPA RM #4A	ND	ND	ND	BENZENE 11.7ppb
SD084						TOLUENE 16.7ppb, ETHYLBENZENE ~2.99ppb
SD085	10/01/84	EPA RM #7A	ND	ND	~1.9	
SD086	10/01/84	EPA RM #9	ND	~2.54	ND	
SD087	10/01/84	EPA RM #10A	~6.37	~7.88	36.7	
SD088	10/01/84	EPA RM #10B	581	65.9	119	1,1-DICHLOROETHENE ~1.8ppb
SD088						1,1,1-TRICHLOROETHANE ~2.1ppb
SD041	10/01/84	MONITORING WELL 1	ND	ND	ND	
SD042	10/01/84	MONITORING WELL 2	ND	ND	ND	
SD043	10/01/84	MONITORING WELL 3	ND	ND	ND	
SD044	10/01/84	MONITORING WELL 4	ND	ND	ND	
SD045	10/01/84	MONITORING WELL 5	ND	ND	ND	CHLOROFORM ~2.4ppb
SD046	10/01/84	MONITORING WELL 6	~1.5	ND	15	
SD047	10/01/84	MONITORING WELL 7	~1.1	ND	~6.1	
SD048	10/01/84	MONITORING WELL 8	ND	~1.1	30.6	
SD049	10/01/84	WERGIN WELL	12.0	~4.0	45.0	TOLUENE ~2.5ppb
SD050	10/01/84	PLANT EFFLUENT	ND	ND	ND	CHLOROFORM 57.3ppb, BROCL2CMETHANE ~4.4ppb
SD051	10/01/84	CITY WELL #7	ND	ND	ND	
SD052	10/01/84	CITY WELL #8	ND	ND	ND	
SD053	10/01/84	CITY WELL #9	ND	ND	ND	
SD054	10/01/84	CITY WELL #3-INFLUENT	ND	~1.5	ND	
SD055	10/01/84	CITY WELL #3-EFFLUENT	~5.14	147	ND	
SD056	10/01/84	CITY WELL #4-INFLUENT	87.0	63.0	38.0	1,1,1-TRICHLOROETHANE ~1.0ppb
SD056						TOLUENE 26ppb, ETHYLBENZENE ~4.8ppb

TABLE 6 (continued)

WAUSAU, WI

MOBILE LAB RESULTS FOR PROJECT NAME: WAUSAU

DETECTION LIMIT (WATER) = 1 ppb
DETECTION LIMIT (SOIL) = 5ppb

STAIN NUMBER	DATE SAMPLED	STATION LOCATION	DCE (ppb)	TCE (ppb)	PCE (ppb)	OTHER VOLATILE ORGANIC COMPOUNDS DETECTED
S0057	10/01/84	CITY WELL 84-EFFLUENT	~2.11	ND	ND	
S0058	10/01/84	CITY WELL 86-INFLUENT	~1.1	151	ND	
S0059	10/01/84	CITY WELL 86-EFFLUENT	ND	~3.26	ND	
S0060	10/01/84	86-UNIT-EFFLUENT	ND	ND	ND	
S0061	10/01/84	86-UNIT B-EFFLUENT	ND	ND	ND	
S0062	10/01/84	86-UNIT C-EFFLUENT	ND	ND	ND	
S0063	10/01/84	86-UNIT B-EFFLUENT	ND	ND	ND	
S0179	10/01/84	CITY HALL	ND	~1.1	ND	CHLOROFORM 49.3ppb, BR(CL2)METH ~4.4ppb
S0180	10/01/84	FIRE STATION	ND	~1.4	ND	CHLOROFORM 50.7ppb, BR(CL2)METH ~4.4ppb
S0181	10/01/84	HEALTH CARE CENTER	ND	~1.3	ND	CHLOROFORM 48.4ppb, BR(CL2)METH ~4.4ppb
S0182	10/01/84	HOLIDAY INN	ND	~1.9	ND	CHLOROFORM 42.5ppb, BR(CL2)METH ~6.5ppb
S0113	10/17/84	MONITORING WELL #1	ND	ND	ND	
S0114	10/17/84	MW #2	ND	ND	ND	
S0115	10/17/84	MW #3	ND	ND	ND	
S0116	10/17/84	MW #4	ND	ND	ND	
S0117	10/17/84	MW #5	ND	ND	ND	
S0118	10/17/84	MW #6	~2.8	~1.6	17.2	
S0119	10/17/84	MW #7	~4.9	~4.1	23.6	
S0120	10/17/84	MW #8	ND	ND	6.5	
S0121	10/17/84	BERGIN WELL	39.8	~9.4	106	TOLUENE ~1.5ppb
S0122	10/17/84	CITY WELL #7	ND	ND	ND	
S0123	10/17/84	CITY WELL #8	ND	ND	ND	
S0124	10/17/84	CITY WELL #9	ND	ND	ND	
S0126	10/17/84	CITY WELL #3-INFLUENT	~3.4	107	ND	
S0127	10/17/84	CITY WELL #3-EFFLUENT	ND	ND	ND	
S0128	10/17/84	CITY WELL #4-INFLUENT	73.6	64.2	43.9	1,1,1-TRICHLOROETHANE ~1.8, TOLUENE 26.5, ETHYL BENZENE ~4.2ppb
S0129	10/17/84	CITY WELL #6-INFLUENT	ND	ND	ND	
S0130	10/17/84	CITY WELL #6-INFLUENT	ND	182	ND	
S0131	10/17/84	CITY WELL #6 - EFFLUENT	ND	11.7	ND	
S0136	10/17/84	DISTRIBUTION SYSTEM	ND	~2.6	ND	CHLOROFORM 50.4ppb, BROMODICHLOROMETHANE ~5.9ppb
S0137	10/17/84	DIST. SYSTEM	ND	~2.6	ND	CHLOROFORM 47.2ppb, BROMODICHLOROMETHANE ~4.9ppb
S0138	10/17/84	DIST. SYSTEM	ND	~2.8	ND	CHLOROFORM 55.1ppb, BROMODICHLOROMETHANE ~5.5ppb
S0139	10/17/84	DIST SYSTEM	ND	~3.2	ND	CHLOROFORM 49.4ppb, BROMODICHLOROMETHANE ~5.8ppb
S0170	10/17/84	EPA MW #1	ND	ND	ND	
S0171	10/17/84	EPA MW #2A	ND	ND	ND	
S0172	10/17/84	EPA MW #3	ND	ND	ND	
S0173	10/17/84	EPA MW #3A	ND	ND	ND	
S0174	10/17/84	EPA MW #4	ND	ND	ND	CHLOROFORM ~6.4ppb
S0175	10/17/84	EPA MW #4A	ND	ND	ND	
S0176	10/17/84	EPA MW #7A	ND	ND	~1.7	
S0177	10/17/84	EPA MW #9	~1.9	~4.7	ND	
S0178	10/17/84	EPA MW #10A	ND	~9.9	60.2	
S0183	10/17/84	EPA MW #10B	483	67.5	121	
S0125	10/17/84	TREATMENT PLANT EFFLUENT	ND	~2.6	ND	CHLOROFORM-56.6ppb, BROMODICHLOROMETHANE ~5.2ppb
S0215	10/17/84	TRIP BLANK	ND	ND	ND	
S0216	10/17/84	TRIP BLANK	ND	ND	ND	
S0217	10/17/84	BLANK RINSE-H. DOI	ND	ND	ND	
S0218	10/17/84	RINSE-POST. WAUSAU CHEM.	ND	ND	ND	METHYLENE CHLORIDE-54.3ppb, TOLUENE ~1.1ppb, ETHYL BENZENE ~1.2pp

TABLE 6 (continued)

WAUSAU, WI

NOPILE LAB RESULTS FOR PROJECT NAME: WAUSAU

DETECTION LIMIT (WATER) = 1 ppb
DETECTION LIMIT (SOIL) = 5ppb

STATN NUMBER	DATE SAMPLED	STATION LOCATION	DCE (ppb)	TCE (ppb)	PCE (ppb)	OTHER VOLATILE ORGANIC COMPOUNDS DETECTED
S0218	11/08/84	CITY WELL #3	~7.6	208	ND	
S0219	11/08/84	CITY WELL #4	73.6	77.2	40.6	1,1-DICHLOROETHYLENE ~1.8, 1,1,1-TRICHLOROETHANE ~2.4. TOLUENE 26.9, ETHYLBENZENE 13.2, TOTAL XYLENES 14.7.
S0219						
S0220	11/08/84	CITY WELL #6	ND	132	ND	
S0221	11/08/84	CITY WELL #7	ND	ND	ND	
S0222	11/08/84	CITY WELL #8	ND	ND	ND	1,1-DICHLOROETHANE ~3.2
S0223	11/08/84	CITY WELL #9	ND	ND	ND	
S0224	11/08/84	CITY MW #1	ND	ND	ND	
S0225	11/08/84	CITY MW #2	ND	ND	ND	
S0226	11/08/84	CITY MW #3	ND	ND	ND	
S0227	11/08/84	CITY WELL #4	ND	ND	ND	
S0228	11/08/84	CITY MW #5	ND	ND	ND	1,1,1-TRICHLOROETHANE ~1.5, BENZENE ~1.0.
S0229	11/08/84	CITY MW #6	~2.9	~1.0	~8.7	
S0230	11/08/84	CITY MW #7	~8.2	~3.2	25.6	
S0231	11/08/84	CITY WELL #8 (PVC)			~5.0	1,1,1-TRICHLOROETHANE ~1.7, BENZENE ~1.2.
S0232	11/08/84	BERGIN WELL	38.0	~8.1	79.9	BENZENE ~1.6, TOLUENE ~3.0.
S0233	11/08/84	EPA MW #1	ND	ND	ND	
S0234	11/08/84	EPA MW #2A	ND	ND	ND	
S0235	11/07/84	EPA MW #3	ND	ND	ND	
S0236	11/07/84	EPA MW #3A	ND	ND	ND	
S0237	11/07/84	EPA MW #4	ND	ND	ND	
S0238	11/07/84	EPA MW #4A	ND	ND	ND	CHLOROFORM ~5.8.
S0239	11/07/84	EPA MW #4B	ND	ND	ND	
S0240	11/07/84	EPA MW #5	ND	ND	ND	
S0241	11/07/84	EPA MW #6	ND	~1.5	ND	
S0242	11/08/84	EPA MW #7A	ND	ND	ND	
S0243	11/08/84	EPA MW #9	ND	~1.4	ND	BENZENE ~1.5.
S0244	11/08/84	EPA MW #10A	29.6	~2.6	~6.3	
S0245	11/08/84	EPA MW #10B	378	44.1	66.8	1,1-DICHLOROETHYLENE ~1.1, 1,1,1-TRICHLOROETHANE ~1.9.
S0246	11/08/84	EPA MW #11	~1.9	~5.4	~8.0	
S0247	11/08/84	EPA MW #12	ND	ND	ND	

TABLE 6 (continued)

WAUSAU CHEMICAL

MOBILE LAB RESULTS FOR PROJECT NAME: WAUSAU

DETECTION LIMIT (WATER) = 1 ppb
DETECTION LIMIT (SOIL) = 5ppb

STAIN NUMBER	DATE SAMPLED	STATION LOCATION	DCE (ppb)	TCE (ppb)	PCE (ppb)	OTHER VOLATILE ORGANIC COMPOUNDS DETECTED
WC001	09/17/84	MONITOR WELL BB-2	70.2	171.0	540.0	1,1,1-TRICHLOROETHANE-11.1ppb
WC002	09/17/84	MONITOR WELL B3-B	3100.0	2700.0	2300.0	BENZENE-250ppb, TOLUENE-2100ppb, ETHYL BENZENE-150ppb
WC003	09/17/84	MONITOR WELL BB3-A	ND	<1.0	<1.4	
WC004	09/17/84	MONITOR WELL B-3	ND	<4.6	ND	
S0028	10/01/84	MONITORING WELL B-2	105	212	333	1,1,1-(CL3)ET 16.5ppb
S0029	10/01/84	MONITORING WELL B3-B	3300	4860	6480	TOLUENE 4660, ETHLYBENZENE 4630, TOTAL XYLENES 30090
S0030	10/01/84	MONITORING WELL B3-A	ND	ND	<1.1	
S0031	10/01/84	MONITORING WELL B-3	<1.8	<3.5	<1.7	
S0032	10/01/84	MONITORING WELL B-1	85.7	147	201	1,1,1-TRICHLOROETHANE <5.0ppb
S0033	10/01/84	MONITORING WELL B-4	ND	ND	<1.1	
S0034	10/01/84	MONITORING WELL B-4A	ND	ND	ND	
S0035	10/01/84	MONITORING WELL B-5	ND	ND	<1.0	
S0036	10/01/84	MONITORING WELL B-5A	ND	<3.9	168	TOLUENE <3.0ppb
S0037	10/01/84	MONITORING WELL B-6	<2.6	ND	ND	
S0038	10/01/84	MONITORING WELL B-6A	306	879	1916	1,1-DICHLOROETHANE <7.1ppb, BENZENE <2.2ppb
S0038						1,1,1-TRICHLOROETHANE 20.4ppb, TOLUENE 13.4ppb, ET BENZENE <2.7pp
S0039	10/01/84	MONITORING WELL B-7	ND	<1.9	12.1	
S0040	10/01/84	MONITORING WELL B-7A	ND	ND	<4.0	CHLOROFORM <5.8ppb, BROMODICHLOROMETHANE <1.5ppb
S0100	10/17/84	MONITORING WELL B-1	83.2	74.2	118	1,1-DICHLOROETHANE-1.2ppb, 1,1,1-TRICHLOROETHANE-3.3ppb
S0101	10/17/84	MW B-2	69.4	91.1	174	1,1-DICHLOROETHANE-2.6ppb, 1,1,1-TRICHLOROETHANE-18.3ppb
S0102	10/17/84	MW B-3	<1.7	<5.8	ND	
S0103	10/17/84	MW B3-A	ND	ND	ND	
S0104	10/17/84	MW B3-B	2100	1500	865	1,1,1-TRICHLOROETHANE-488ppb, BENZENE-306ppb, TOTAL XYLENES 470.
S0104	10/17/84	-MW B3-B				TOLUENE-1170ppb
S0105	10/17/84	MW B-4	ND	ND	ND	
S0106	10/17/84	MW B4-A	ND	ND	ND	
S0107	10/17/84	MW B-5	<1.0	13.8	381	
S0108	10/17/84	MW B5-A	ND	ND	ND	
S0109	10/17/84	MW B-6	ND	ND	ND	
S0110	10/17/84	MW B6-A	570	1100	1100	1,1-DICHLOROETHANE-11.0ppb, 1,1,1-TRICHLOROETHANE-12.7ppb.
S0110	10/17/84	MW B6-A				TOLUENE-1.4ppb
S0111	10/17/84	MW B-7	ND	ND	ND	
S0112	10/17/84	MW B7-A	ND	ND	ND	
S0214	10/17/84	MW B3-C	780	3300	ND	1,1-DICHLOROETHANE-47.8ppb
S0248	11/07/84	WAUSAU CHEM MW B-1	26.5	22.2	25.1	1,1,1-TRICHLOROETHANE <2.6, BENZENE <2.0.
S0249	11/07/84	WAUSAU CHEM MW B-2	31.0	76.7	84.4	1,1-DICHLOROETHANE <6.6. 1,1,1-TRICHLOROETHANE 19.8, BENZENE <1.8
S0249						TOLUENE <1.5
S0250	11/07/84	WAUSAU CHEM MW B-3	<2.7	<4.4	ND	
S0251	11/07/84	WAUSAU CHEM MW BB3-A	ND	<1.3	<1.2	TOLUENE <1.7, ETHYLBENZENE <1.0.
S0252	11/07/84	WAUSAU CHEM MW B3-B	924	1120	1260	1,1-DICHLOROETHYLENE <1.7, 1,1,1-TRICHLOROETHANE 336.
S0252						CARBON TETRACHLORIDE 1040, BENZENE 343, TOLUENE 2190,
S0252						ETHLYBENZENE 926, TOTAL XYLENES 7470. MANY OTHER PEAKS. SHOULD
S0252						BE SENT FOR GC/MS ANALYSIS.
S0253	11/07/84	WAUSAU CHEM MW B3-C	ND	103	<7.1	TOLUENE <1.3. OTHER PEAKS. SHOULD BE SENT FOR GC/MS ANALYSIS.
S0254	11/07/84	WAUSAU CHEM MW BB-4	ND	ND	ND	1,1,1-TRICHLOROETHANE <1.5. TOLUENE <1.3.
S0255	11/07/84	WAUSAU CHEM MW BB4-A	ND	ND	ND	
S0256	11/07/84	WAUSAU CHEM MW BB-5	ND	ND	<3.0	
S0257	11/07/84	WAUSAU CHEM MW B5-A	<6.1	42.6	2600	
S0258	11/07/84	WAUSAU CHEM MW B-6	<2.2	ND	ND	1,1,1-TRICHLOROETHANE <2.7, BENZENE <1.8, TOLUENE <1.1.
S0259	11/07/84	WAUSAU CHEM MW B6-A	726	2040	3930	1,1-DICHLOROETHYLENE <1.0, 1,1-DICHLOROETHANE 13.6.
S0259						1,1,1-TRICHLOROETHANE 25.2, CARBON TETRACHLORIDE 19.8,
S0259						BENZENE 11.1, TOLUENE 15.1, ETHYLBENZENE 25.7, TOTAL XYLENES 60.3
S0259						MANY OTHER PEAKS. SHOULD BE SENT FOR GC/MS ANALYSIS.
S0260	11/07/84	WAUSAU CHEM MW BB-7	ND	ND	<1.3	
S0261	11/07/84	WAUSAU CHEM MW B7-A	ND	ND	ND	

ZIMPRO INC.
A SUBSIDIARY OF STERLING DRUG INC.
POLLUTION CONTROL SYSTEMS

October 11, 1984

PRELIMINARY

Ms. Kathy Huibregtse
STS Consultants
N72 W22405 Jeanine Lane
Sussex, WI 53089

Dear Ms. Huibregtse:

Attached are the results for the soil and water samples collected 9/27, 9/28, and 10/1/84. The water samples were analyzed for volatile organics using EPA Method 601 modified to use photoionization (10.2 eV) and Hall detectors in series. The analyses shows rather high levels of various compounds especially tetrachloroethylene, trichloroethylene, and toluene as well as others in various samples. The two oxidized samples are quite different from one another, this could be due to a change in the operating conditions between the times when the samples were taken. Both oxidized samples are quite high in benzene, and the one from 9/27/84 shows high levels of 1,4-Dichlorobenzene and toluene. Traces of tetrachloroethylene and vinyl chloride were detected in the blanks, these are probably artifacts from samples containing high amounts of these compounds.

The soil samples and filter press cake were analyzed using EPA Methods 5030 and 8010. Briefly, these procedures entail a solvent extraction of the soil using methane followed by gas chromatography. The purge and trap procedure followed by detection with PID (10.2 eV) and Hall detectors in series, as with the water samples, was used for quantitation. Various compounds were detected in these samples with tetrachloroethylene, toluene, and 1,1,1-trichloroethane being the most prominent. Levels in most samples are fairly low with the exception of samples 2, 3 and the filter press cake. You will also note that the detection limits listed for the filter press cake are different from the other soil samples, this is due to a differing sample size for that particular sample.

MILITARY ROAD
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Table 7

Soil Samples (ug/g)

	Detection Limit	#1 2:00 PM 10/1/84	#2 2:30 PM 10/1/84	#3 3:00 PM 10/1/84	#4 3:15 PM 10/1/84	#5 3:30 PM 10/1/84	#6 3:45 PM 10/1/84
Benzene	0.1	X	X	X	X	X	X
Bromoform	0.5	X	X	X	X	X	X
Bromomethane	1.0	X	X	X	X	X	X
Carbon Tetrachloride	0.1	X	X	X	X	X	X
Chlorobenzene	0.1	X	X	X	X	X	X
Chloroethane	1.0	X	X	X	X	X	X
2-Chloroethylvinyl Ether	2.0	X	X	X	X	X	X
Chloroform	0.1	X	X	X	X	X	X
Chloromethane	6.0	X	X	X	X	X	X
Dibromochloromethane	0.1	X	X	X	X	X	X
1,2-Dichlorobenzene	0.3	X	X	X	X	X	X
1,3-Dichlorobenzene	0.3	X	X	X	X	X	X
1,4-Dichlorobenzene	0.3	X	X	X	X	X	X
Dichlorobromomethane	0.1	X	X	X	X	X	X
1,1-Dichloroethane	0.1	X	X	X	X	X	X
1,2-Dichloroethane	0.3	X	X	X	X	X	X
1,1-Dichloroethylene	0.5	X	X	X	X	X	X
1,2-Dichloroethylene	0.3	X	X	X	X	X	X
Dichloromethane	0.2	X	X	X	X	X	X
1,2-Dichloropropane	0.5	X	X	X	X	X	X
cis-1,3-Dichloropropene	0.3	X	X	X	X	X	X
trans-1,3-Dichloropropene	1.0	X	1.2	X	X	X	X
Ethylbenzene	0.2	X	2.0	X	0.3	X	X
1,1,2,2-Tetrachloroethane	0.1	X	X	X	X	X	X
Tetrachloroethylene	0.1	0.8	0.5	0.2	X	0.2	X
Toluene	0.1	X	2.8	2.4	X	X	X
1,1,1-Trichloroethane	0.1	0.1	0.2	X	0.4	0.2	0.4
1,1,2-Trichloroethane	0.1	X	X	X	X	X	X
Trichloroethylene	0.1	0.1	0.4	X	X	X	X
Vinyl Chloride	0.1	X	X	0.1	X	X	X
m-Xylene	0.3	X	0.6	X	X	X	X
o & p-Xylene (as o-Xylene)	0.3	X	0.5	0.3	X	X	0.5
Zimpro Analytical No.		7111	7112	7113	7114	7115	7116

X = not detected

STS

Table 7 (continued)

Soil Samples (ug/g)

	Detection Limit	#7 4:00 PM 10/1/84	#8 4:15 PM 10/1/84	#9 4:30 PM 10/1/84	#9 4:30 PM 10/1/84
Benzene	0.1	X	X	X	X
Bromoform	0.5	X	X	X	X
Bromomethane	1.0	X	X	X	X
Carbon Tetrachloride	0.1	X	X	X	X
Chlorobenzene	0.1	X	X	X	X
Chloroethane	1.0	X	X	X	X
2-Chloroethylvinyl Ether	2.0	X	X	X	X
Chloroform	0.1	X	X	X	X
Chloromethane	6.0	X	X	X	X
Dibromochloromethane	0.1	X	X	X	X
1,2-Dichlorobenzene	0.3	X	X	X	X
1,3-Dichlorobenzene	0.3	X	X	X	X
1,4-Dichlorobenzene	0.3	X	X	X	X
Dichlorobromomethane	0.1	X	X	X	X
1,1-Dichloroethane	0.1	X	X	X	X
1,2-Dichloroethane	0.3	X	X	X	X
1,1-Dichloroethylene	0.5	X	X	X	X
1,2-Dichloroethylene	0.3	X	X	X	X
Dichloromethane	0.2	X	0.1	X	X
1,2-Dichloropropane	0.5	X	X	X	X
cis-1,3-Dichloropropene	0.3	X	X	X	X
trans-1,3-Dichloropropene	1.0	X	X	X	X
Ethylbenzene	0.2	X	X	X	X
1,1,2,2-Tetrachloroethane	0.1	X	X	X	X
Tetrachloroethylene	0.1	0.3	X	X	0.3
Toluene	0.1	X	0.5	X	X
1,1,1-Trichloroethane	0.1	X	0.3	0.2	0.4
1,1,2-Trichloroethane	0.1	X	X	X	X
Trichloroethylene	0.1	X	X	X	0.1
Vinyl Chloride	0.1	X	X	X	X
m-Xylene	0.3	X	X	X	X
o & p-Xylene (as o-Xylene)	0.3	X	0.4	X	X
Zimpro Analytical No.		7117	7118	7119A	7119B

X = not detected

STS

Table 8

Soil Samples (ug/g)

	Detection Limit	Filter Press Cake 9/27/84
Benzene	0.3	X
Bromoform	1.5	X
Bromomethane	3.0	X
Carbon Tetrachloride	0.3	X
Chlorobenzene	0.3	X
Chloroethane	3.0	X
2-Chloroethylvinyl Ether	6.0	X
Chloroform	0.3	X
Chloromethane	18.0	X
Dibromochloromethane	0.3	X
1,2-Dichlorobenzene	0.9	X
1,3-Dichlorobenzene	0.9	X
1,4-Dichlorobenzene	0.9	X
Dichlorobromomethane	0.3	X
1,1-Dichloroethane	0.3	X
1,2-Dichloroethane	0.9	X
1,1-Dichloroethylene	1.5	X
1,2-Dichloroethylene	0.9	X
Dichloromethane	0.6	X
1,2-Dichloropropane	1.5	X
cis-1,3-Dichloropropene	0.9	X
trans-1,3-Dichloropropene	3.0	X
Ethylbenzene	0.6	X
1,1,2,2-Tetrachloroethane	0.3	X
Tetrachloroethylene	0.3	1.3
Toluene	0.3	X
1,1,1-Trichloroethane	0.3	2.0
1,1,2-Trichloroethane	0.3	X
Trichloroethylene	0.3	X
Vinyl Chloride	0.3	X
m-Xylene	0.9	X
o & p-Xylene (as o-Xylene)	0.9	X
Zimpro Analytical No.		6971

X = not detected

STS

Table 9

Water Sample (ug/l)

	Detection Limit	B-5 3:18 PM 10/1/84	B-5A 3:25 PM 10/1/84	B-6 12:25 PM 10/1/84	B-6A 12:38 PM 10/1/84	B-7 11:45 AM 10/1/84	B-7A 12:04 PM 10/1/84	B-4 1:10 PM 10/1/84
Benzene	0.1	0.1	X	X	X	X	X	X
Bromoform	0.5	X	X	X	X	X	X	X
Bromomethane	1.0	X	X	X	X	X	X	X
Carbon Tetrachloride	0.1	X	X	X	X	X	X	X
Chlorobenzene	0.1	X	X	X	X	X	X	X
Chloroethane	1.0	X	X	X	X	X	X	X
2-Chloroethylvinyl Ether	2.0	X	X	X	X	X	X	X
Chloroform	0.1	0.1	X	X	X	X	6.8	X
Chloromethane	6.0	X	X	X	X	X	X	X
Dibromochloromethane	0.1	X	X	X	X	X	X	X
1,2-Dichlorobenzene	0.3	X	X	X	X	X	X	X
1,3-Dichlorobenzene	0.3	X	X	X	X	X	X	X
1,4-Dichlorobenzene	0.3	X	X	X	X	X	X	X
Dichlorobromomethane	0.1	X	X	X	X	X	X	X
1,1-Dichloroethane	0.1	X	X	X	5.6	X	X	X
1,2-Dichloroethane	0.3	X	X	X	X	X	X	X
1,1-Dichloroethylene	0.5	X	X	X	1.2	X	X	X
1,2-Dichloroethylene	0.3	X	0.5	3.1	391.	0.5	X	X
Dichloromethane	0.2	X	X	X	X	X	0.8	X
1,2-Dichloropropane	0.5	X	X	X	X	X	X	X
cis-1,3-Dichloropropene	0.3	X	X	X	X	X	X	X
trans-1,3-Dichloropropene	1.0	X	X	X	X	X	X	X
Ethylbenzene	0.2	X	0.5	X	3.2	X	X	X
1,1,2,2-Tetrachloroethane	0.1	X	X	X	X	X	X	X
Tetrachloroethylene	0.1	1.4	244.	0.2	1730.	15.0	5.6	0.8
Toluene	0.1	0.3	2.1	2.0	13.4	X	0.3	X
1,1,1-Trichloroethane	0.1	0.1	0.2	0.2	19.5	0.1	0.1	0.1
1,1,2-Trichloroethane	0.1	X	X	X	X	X	X	X
Trichloroethylene	0.1	0.4	5.6	0.1	1070.	2.6	0.8	0.2
Vinyl Chloride	0.1	0.3	0.1	2.0	0.7	0.2	X	0.1
m-Xylene	0.3	0.6	0.7	X	2.6	X	X	0.5
o & p-Xylene (as o-Xylene)	0.3	X	0.3	X	0.8	X	X	X
Zimpro Analytical No.		7121	7122	7123	7124	7125	7126	7127

X = Not detected

STS

Table 9 (continued)

Water Samples (ug/l)

	Detection Limit	B-4A 1:23 PM 10/1/84	Field Blank 5:12 PM 10/1/84	Blank #1 9/26/84	Blank #2 9/26/84
Benzene	0.1	X	X	X	X
Bromoform	0.5	X	X	X	X
Bromomethane	1.0	X	X	X	X
Carbon Tetrachloride	0.1	X	X	X	X
Chlorobenzene	0.1	X	X	X	X
Chloroethane	1.0	X	X	X	X
2-Chloroethylvinyl Ether	2.0	X	X	X	X
Chloroform	0.1	X	X	0.1	X
Chloromethane	6.0	X	X	X	X
Dibromochloromethane	0.1	X	X	X	X
1,2-Dichlorobenzene	0.3	X	X	X	X
1,3-Dichlorobenzene	0.3	X	X	X	X
1,4-Dichlorobenzene	0.3	X	X	X	X
Dichlorobromomethane	0.1	X	X	X	X
1,1-Dichloroethane	0.1	X	X	X	X
1,2-Dichloroethane	0.3	X	X	X	X
1,1-Dichloroethylene	0.5	X	X	X	X
1,2-Dichloroethylene	0.3	X	X	X	X
Dichloromethane	0.2	X	X	X	X
1,2-Dichloropropane	0.5	X	X	X	X
cis-1,3-Dichloropropene	0.3	X	X	X	X
trans-1,3-Dichloropropene	1.0	X	X	X	X
Ethylbenzene	0.2	X	X	X	X
1,1,2,2-Tetrachloroethane	0.1	X	X	X	X
Tetrachloroethylene	0.1	0.5	0.1	X	0.3
Toluene	0.1	0.5	X	X	X
1,1,1-Trichloroethane	0.1	0.1	X	X	X
1,1,2-Trichloroethane	0.1	X	X	X	X
Trichloroethylene	0.1	0.1	0.1	X	X
Vinyl Chloride	0.1	0.1	X	0.3	0.4
m-Xylene	0.3	0.6	X	X	X
o & p-Xylene (as o-Xylene)	0.3	X	X	X	X
Zimpro Analytical No.		7128	7129	6972	7047

X = not detected

ZIMPRO INC.
A SUBSIDIARY OF STERLING DRUG INC.
POLLUTION CONTROL SYSTEMS

November 5, 1984

STS Consultants Ltd.
540 Lambeau St.
Green Bay, WI 54303

Attn: Doug Hermann

Attached are the results for the water samples from 10-30-84 for VOC analysis. EPA Method 601 was used to complete the analyses. PID (10.2 eV) and Hall detectors in series were used for quantitation.

If you have any questions, please call.

Sincerely,

ZIMPRO INC.

Mary C. Christie

Mary C. Christie
Analytical Chemist

MCC/ls

cc: J.W. Barr
J.R. Salkowski

Enclosure

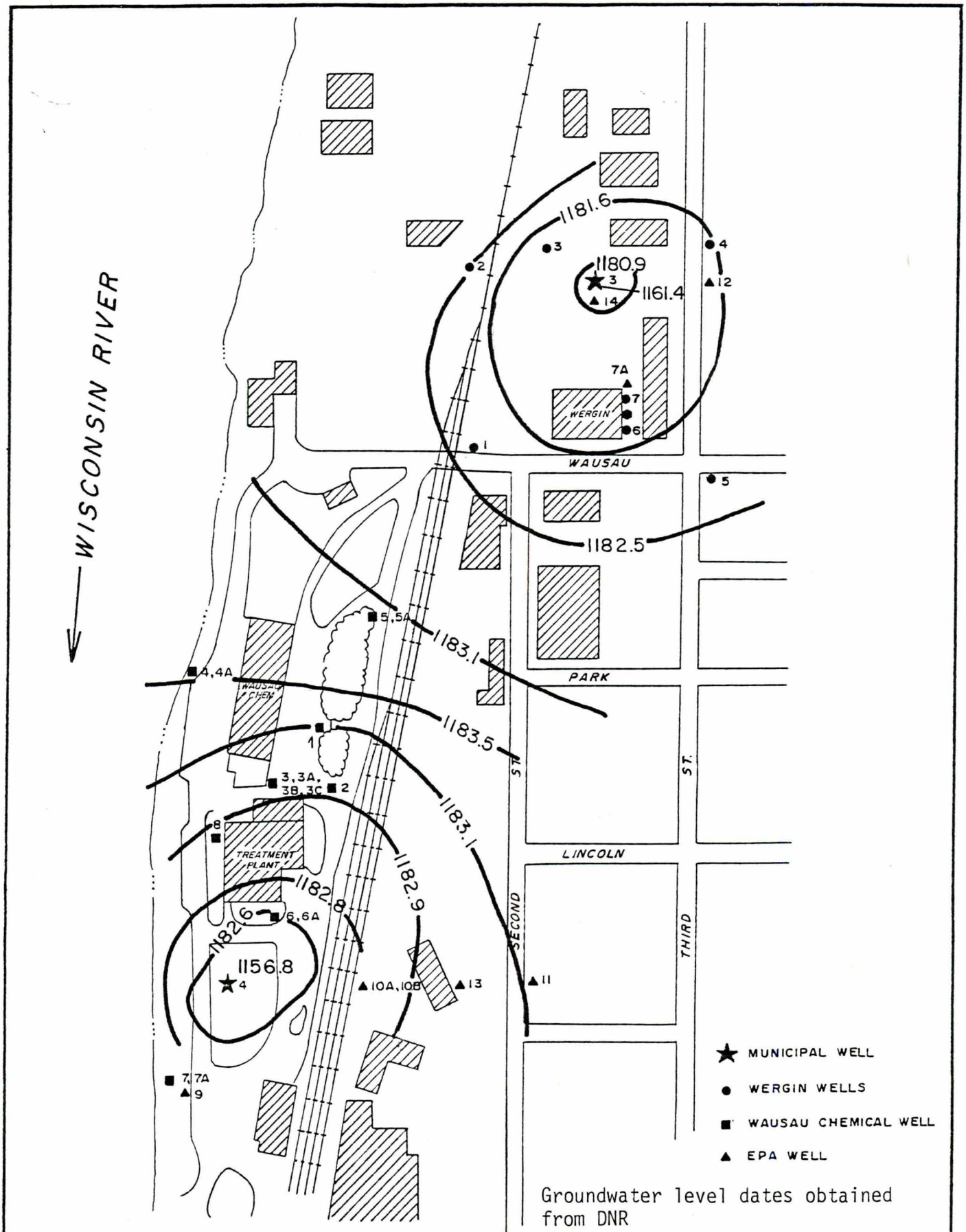
TABLE 10

STS Consultants

Water Sample Analysis (ug/l)

Sample Date: 10-30-84	Time	cis-DCE	TCE	Perc	Benzene	Toluene	Ethyl Benzene	m-Xylene	o & p-Xylene (as o-Xylene)	Anal. No.
B-3B	1:00	840	380	180	160	1260	240	1360	1140	7588
B-3B	1:22	980	720	2100	260	5040	1780	7080	4880	75[illegible]
Field Blank	1:24	X	X	X	X	X	X	X	X	7590

X = Not detected

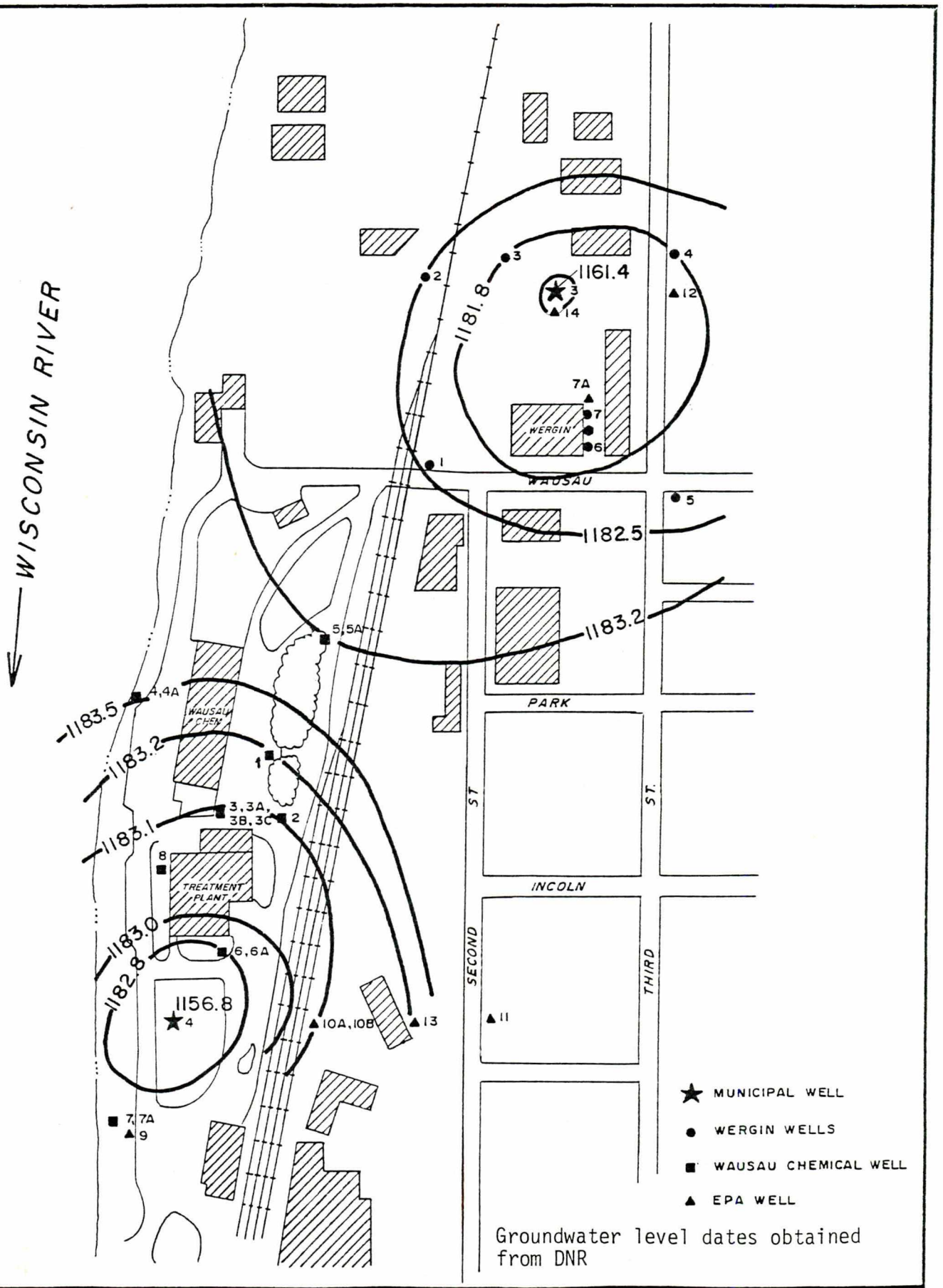


GROUNDWATER CONTOURS
PUMPS 3 & 4 ON
1-21-85
CITY OF WAUSAU, WISCONSIN

N

STS CONSULTANTS LTD.
540 LAMBEAU STREET
GREEN BAY, WIS. 54303

3-29-85 | No Scale | 12776A

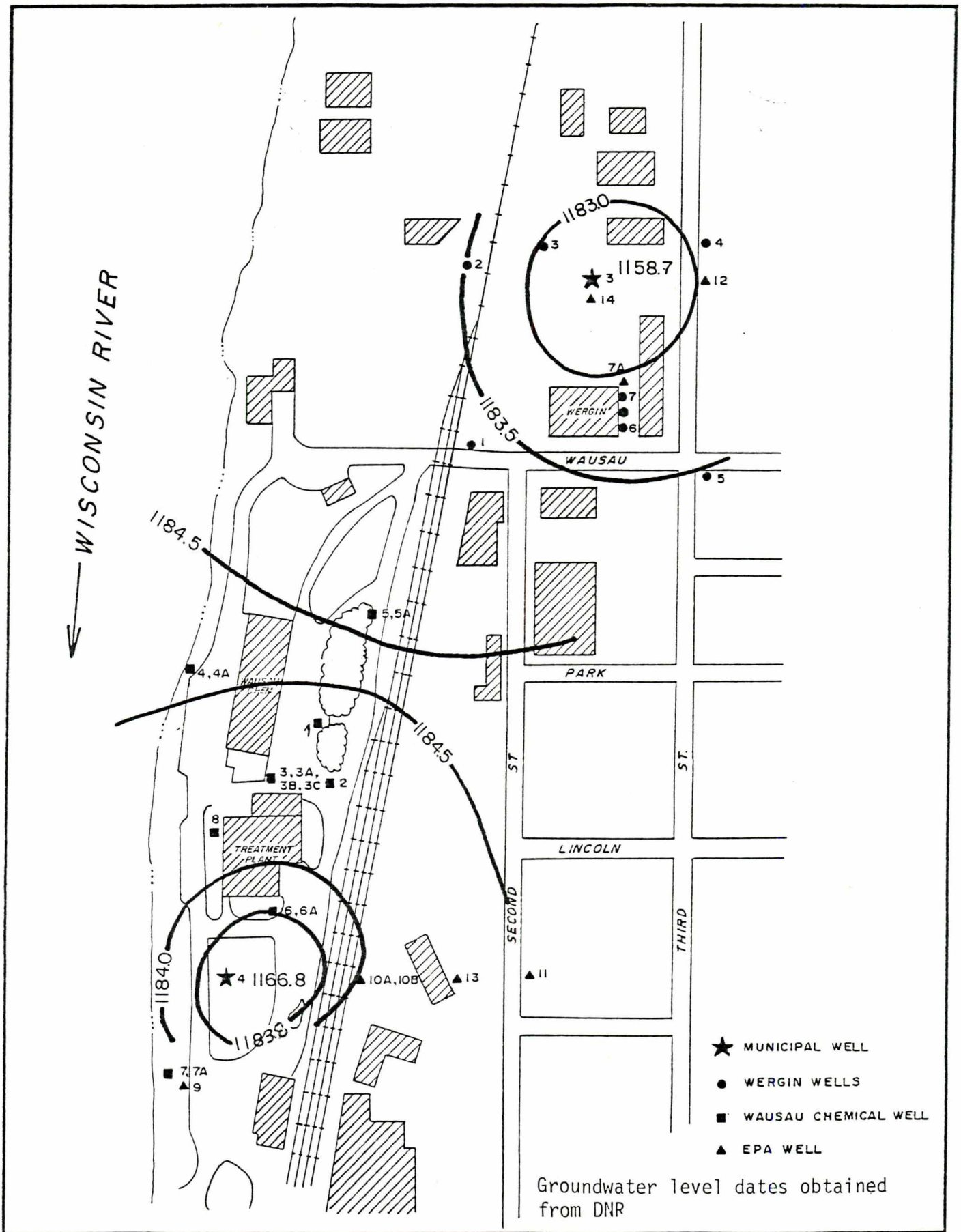


GROUNDWATER CONTOURS
PUMPS 3 & 4 ON
1-14-85
CITY OF WAUSAU, WISCONSIN

N

STS CONSULTANTS LTD.
540 LAMBEAU STREET
GREEN BAY, WIS. 54303

3-29-85 | No Scale | 12776A



GROUNDWATER CONTOURS
PUMPS 3 & 4 ON
10-15-84
CITY OF WAUSAU, WISCONSIN

N

STS CONSULTANTS LTD.
540 LAMBEAU STREET
GREEN BAY, WIS. 54303

3-29-85 | No Scale | 12776A

APPENDIX D

Reference Material on Air Stripper

File 12776A
Please Bind

MANAGED BY
COMMISSION

JOSEPH L. GEHIN
DIRECTOR

WAUSAU **WATER & SEWERAGE** UTILITIES

CITY HALL
WAUSAU, WISCONSIN 54401
715/845-5279

October 29, 1984

STS Consultants Ltd.
Mr. Douglas J. Hermann, P.E.
540 Lambeau
Green Bay, WI 54303

Dear Doug:

Please find enclosed the information received from MTU on air stripping. If you have further questions regarding this information, don't hesitate to contact Mr. Hand or Dr. Crittenden.

Also enclosed is a letter from CBI, this might be an attractive alternative.

Sincerely yours,

Joseph L. Gehin
Utilities Director

JLG/mjg
Enclosures

CBI Industries, Inc.

David R. Hale
Project Engineer
Water Technology

1501 North Division Street
Plainfield, Illinois 60544-8929

815 436 2912

CBI Industries, Inc.

1501 North Division Street
Plainfield, Illinois 60544-8929

815 436 2912

October 15, 1984

Mr. Joe Gehin
Water and Sewerage Facility
407 Grant Street
Wausau, Wisconsin 54401

Dear Mr. Gehin:

As I mentioned in our phone conversation, CBI has developed what we consider an innovative and more cost-effective air stripper product. This product uses a media material manufactured by CBI's Walker Process subsidiary, and I enclose a sample of this media and the Walker brochure detailing its current use so that you might better understand how we intend to incorporate it.

Also enclosed please find a sketch detailing the main parts and configuration of our air stripper product. This unit would utilize the central shaft as both an influent line and as the main structural support. As the media has its own inherent structural strength, rigidity, and airtight sealing, this eliminates the necessity for expensive corrosion resistant containments and structural supports. We are also able to produce the media in such a way that our media cost is substantially lower than other packing media.

As an extension of our R & D program, we can offer a town such as Wausau a CBI air stripper on a subsidized basis. We would offer an appropriate guarantee of its effectiveness in removing volatile organic constituents from your water. As you and I discussed, a pump and some sort of pump surge capacity reservoir would be necessary downstream of the stripper, and we would be happy to design and provide these items at fair market prices as part of our installation.

CBI is prepared to provide this installation to Wausau for a price in the range of $28,000-$32,000. This would include the stripper, blower, and foundation, with all the attendent piping as shown in the attached sketch. CBI would also provide this installation on a turnkey basis, giving you the advantage of sole source responsibility. We are prepared to provide this installation within any reasonable time frame that you might require.

I would welcome the opportunity to further discuss our product, and this proposal, with you. I plan to make a trip up to the Wausau area in the next couple of weeks, and I would like to stop by and meet with you. I will be in contact with you shortly to arrange a time at which we can meet. Thank you again for all of your time and kind considerations, and I look forward to meeting you.

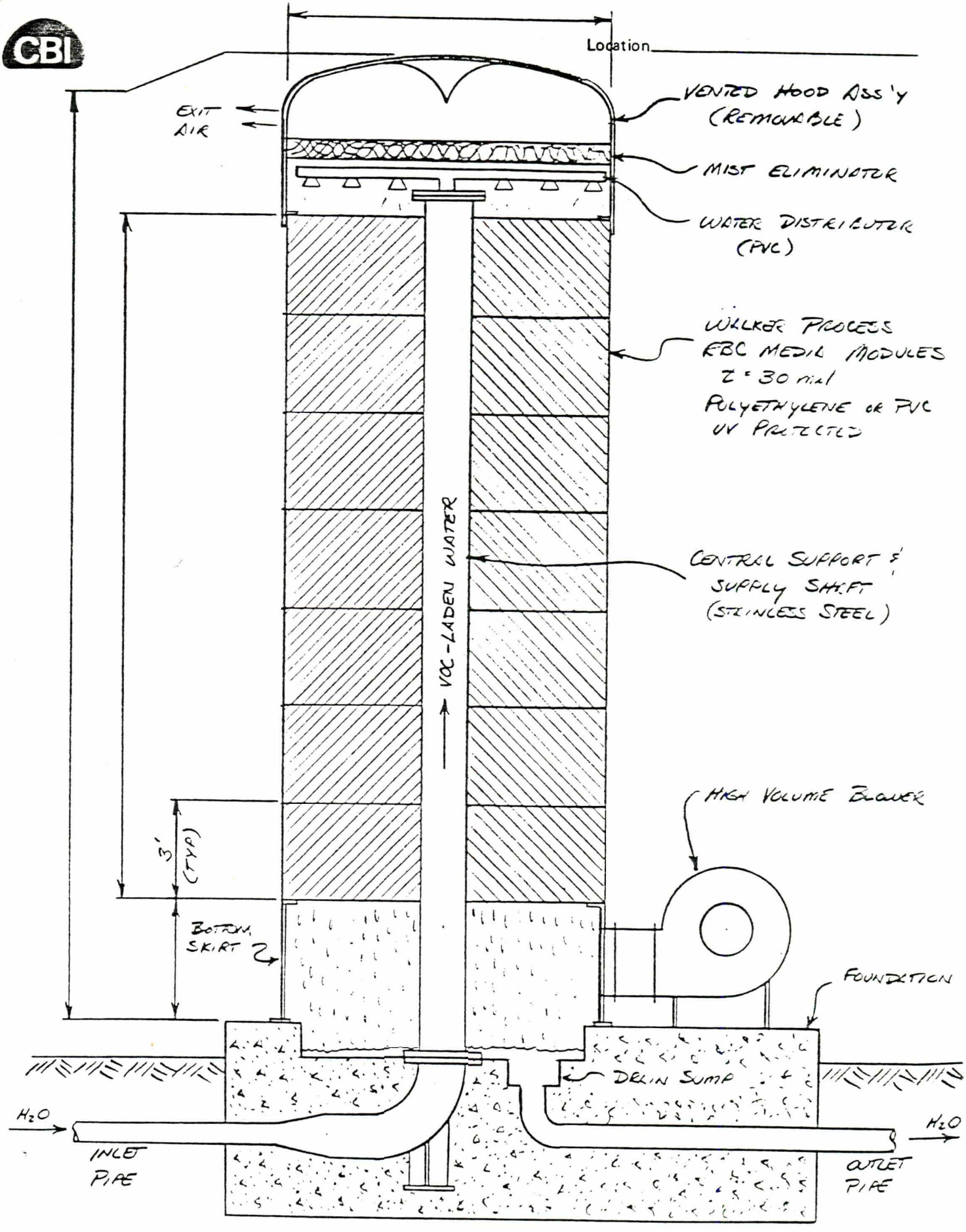
Sincerely,

David R. Hale
Project Engineer
Water Technology

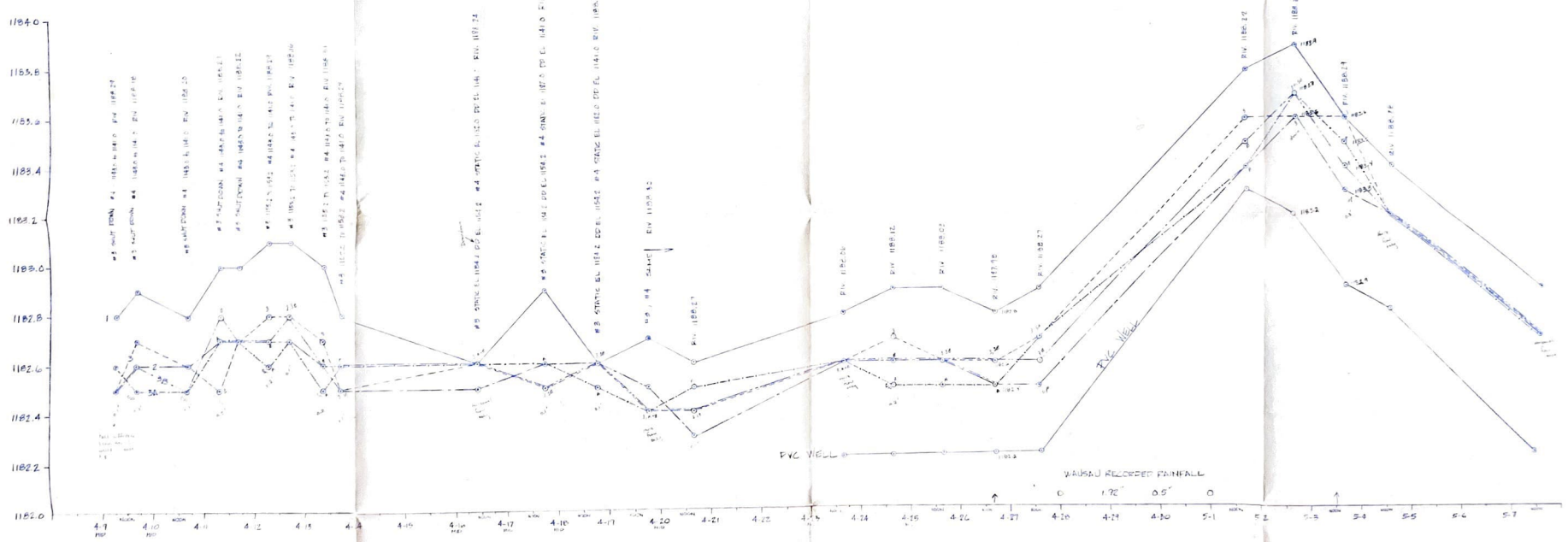
lr
Enc.

CBI

Location _____



SUBJECT	MADE BY	CHKD BY	REV			CHARGE NO.
CBI-WILLKER PROCESS	DRH			By		CWX-4
	DATE	DATE		Chkd		



KEY

- B-1
- B-2
- B-3
- B-3A
- B-3B
- PVC WELL

STS Consultants Ltd.
540 Lambeau St. Green Bay, Wisconsin
ph.414-494-9656

SCALE	DATE 5-11-88	DRAWN BY JJT	APPROVED BY
REVISIONS: DATE / BY / DESCRIPTION			

WAUSAU CHEMICAL

WATER LEVEL DATA SUMMARY

DRAWING NUMBER 12776

Wms. Chem

Joint + Several Liability

DNR investigations are a matter of public record + summary of those should be given.

W.C. always has the right to try to bring other possible contributors in to share in the clean up cost. The Dept, however, can require clean up by a contributing entity w/o finding all sources or dividing responsibility (joint + several liability).

(*) Walking System - move drive point ahead of system.

Dewatering wells - would require hi-cap permit. Prob. not problem.

4" diameter casing might be ok

Summary of Wausau Chemical Water Quality Results

WELL #	SAMPLE DATES	1 PCE	2 TCE	3 1,2-DCE	4 Vinyl Chloride	5 Benzene	6 Toluene	7 ethyl-benzene	8 m-xylene	9 o+p-xylene	10 1,1,1-tri-chloroethane
B-1 (23' deep)	5/16/84	180	26	17			1.9	3.5	4.4	2.8	10
	5/31/84	310	140	78			3.3	3.5	18	11	17
	10/1/84 †	201	147	85.7							5
	10/17/84 †	118.2	74.2	83.2							3.3
	11/7/84 †	25.1	22.2	26.5		2.0					2.6
B-2 (24' deep)	5/16/84	490	49	16	6.7		0.7	0.9	2.2	1.4	1.7
	5/31/84	210	50	11	3.9		1.4	2.3	7.4	5.0	1.6
	9/17/84 †	540	171	70.2							11.1
	10/1/84 †	333	212	105							16.5
	10/17/84 †	174.3	91.1	69.4							18.3
	11/7/84 †	84.4	76.1	31.0		1.8	1.5				19.8
B-3 (161' deep)	5/16/84	1.2	2.8	1.5							
	5/31/84	2.1	3.7	1.7			0.7	1.4	3.2	2.1	
	9/17/84 †		4.6								
	10/1/84 †		3.5	1.8							
	10/17/84 †		5.8	1.7							
	11/7/84 †		4.4	2.7							
B-3A (65' deep)	5/16/84	1.2									
	5/31/84	0.4	0.1						2.5		
	9/17/84 †	1.4	1.0								
	10/1/84 †	1.1									
	10/17/84 †										
	11/7/84 †	1.2	1.3				1.7	1.0			
B-3B (24' deep)	5/16/84	3200	2600	630	1.1		2600	2000	8800	5300	30
	5/31/84	4300	4800	680	0.5		800	660	3020	2150	20
	9/17/84 †	2300	2700	3100		250	2100	1500			
	10/1/84 †	6480	4860	3300		260	4660	46,300			474
	10/17/84 †	865	1520	2090		306	1170				488
1:00	10/30/84	180	380	840		160	1260	240	1360	1140	
1:22	10/30/84	2100	720	980		260	5040	1780	7080	4880	
	11/7/84 †	1260	1120	924		343	2190	926	Total 7470		356

WELL #	SAMPLE DATES	PCE	TCE	DCE	Vinyl Chl.	Benzene	Toluene	Ethyl Benzene	m-Xylene	o+p Xylene	1,1,1-Cl3-Et
PVC (23.5' deep)	5/16/84	32	7.7	1.0			5.6	6.7	31	19	0.2
	5/31/84	31	5.4				0.8	1.7	5.4	2.7	0.2
	9/17/84 †	38.6	1.4								
	10/1/84 †	30.6	1.1								
	10/17/84 †	6.5									
B-4 (53.7' deep)	10/1/84	0.8	0.2		0.1						
	10/1/84 †	1.1									
	10/17/84 †										
	11/7/84 †						1.3				1.5
B-4A (18.8' deep)	10/1/84	0.5	0.1		0.1		0.5		0.6		0.1
	10/1/84 †										
	10/17/84 †										
	11/7/84 †										
B-5 (53.6' deep)	10/1/84 †	1.4	0.4		0.3	0.1	0.3		0.6		0.1
	10/17/84 †	1.0									
	11/7/84 †	3.0									
B-5A (18.7' deep)	10/1/84	244	5.6	0.5	0.1		2.1	0.5	0.7	0.3	0.2
	10/1/84 †	168	3.9				3.0				
	10/17/84 †	381	13.8	1.0							
	11/7/84 †	2600	42.6	6.1							
B-6 (53.3' deep)	10/1/84	0.2	0.1	3.1	2.0		2.0				0.2
	10/1/84 †			2.6							
	10/17/84 †										
	11/7/84 †			2.2		1.8	1.1				2.7
B-6A (21.6' deep)	10/1/84	1730	1070	391	0.7		13.4	3.2	2.6	0.8	19.5
	10/1/84 †	1916	879	306		2.2	13,4	2.7			20.4
	10/17/84 †	790	1103	572			1.4	1.0			12.7
	11/7/84 †	3930	2040	726		11.1	15.1	25.7	Total 60.3		25.2
B-7 (53' deep)	10/1/84	15.0	2.6	0.5	0.2						0.1
	10/1/84 †	12.1	1.9								
	10/17/84 †										
	11/7/84 †	1.3									

WELL #	SAMPLE DATES	PCE	TCE	DCE	Vinyl Chl.	Benzene	Toluene	Ethyl Benzene	m-Xylene	o+p Xylene	1,1,1-Cl3-Et
B-7A (18.6' deep)	10/1/84	5.6	0.8				0.3				0.1
	10/1/84 †	4.0									
	10/17/84 †										
	11/7/84 †										
B-8C (29' deep)	10/17/84 †		3327.6	784.2							
	11/7/84 †	7.1	103				1.3				
9 † (135' deep)	10/1/84 †		2.5								
	10/17/84 †		4.7	1.9							
	11/8/84 †		1.4								
10A † (70' deep)	10/1/84 †	36.7	7.9	6.4							
	10/17/84 †	60.2	9.9								
	11/8/84 †	6.3	2.6	29.6							
10B † (35' deep)	10/1/84 †	119	65.9	581							2.1
	10/17/84 †	120.8	67.5	483							
	11/8/84 †	66.8	46.1	378							1.9
City #4 (132' deep 40' screen)	2/20/84	80	120	140							
	9/17/84 †	47.4	67.8	78.8							
	10/1/84 †	38	63	87							
	10/17/84 †	43	64.2	73.6			26.5	4?			1.8
	11/8/84 †	40.6	77.2	73.6			26.9	13.2	Total 14.7		2.4
City #3 (95' deep 40' screen)	2/20/84	5.4	150	5.1							
	9/17/84 †	7.8	147	18.1							
	10/1/84 †		147	5.1							
	10/17/84 †		106.6	3.4							
	11/8/84 †		208	7.6							
11 (40' deep)	11/8/84 †	? 3.0	5.4	1.9							
13 (45' deep)	11/8/84 †										

NOTES

† indicates samples analyzed by EPA mobile lab or wells installed by EPA

BLANK spaces = Non-detects

} Diff betw these samples?

CCl4 1040

NOTE: EPA sampling date 10/17/84, samples from B-5 + B-5A are probably reversed.

CCl4 19.8

WERGIN CONSTRUCTION

7A

60-70'

(mw-5)

MW-7

WERGIN WELL

MW-6

MW-1

WAUSAU

Deigne
Numb

MW-5
mw-7

WAUSAU CHEMICAL

B-4
B-4A

B-5
B-5A

B-1

TANK FARM

B-3, 3A, 3B

B-2

1975 ADDITION

MW-8
+
PVC

WAUSAU TREATMENT PLANT

15'x8'
2 Air stripping towers

B-6
B-6A

PUMPING WELL 4

10A
10B

13

11

B-7
B-7A

9

River Elev ~ 1188

Area of High Contamination

Area of Highest Contamination

PARK

LINCOLN

ST.

ST.

SECOND

THIRD

RESIDENTIAL

RESIDENTIAL

RESIDENTIAL

● Wausau Chem wells

▲ EPA Wells

⊕ Wergin (City of Wausau) Wells.

1" = 100'

Wausau Chem

ORDER of contamin. conc, decending order.

RANKing contamin - PCE + TCE + DCE = SCORE. ; 10/17/84 sampling

Well #	Score	Rank
B-1	275	7
B-2	334	6
B-3	8	11
B-3A	0	
B-3B	4475	1
B-3C	4111	2
B-4	0	
B-4A	0	
B-5	0	
B-5A	395	5
B-6	0	
B-6A	2465	3
B-7	0	
B-7A	0	
9	7	12
10A	70	10
10B	671	4
PVC	6.5	13
City Well #4	181	8
City Well #3	110	9

RANK order

Rank	Well	Score
1	B-3B	4475
2	B-3C	4111
3	B-6A	2465
4	10B	671
5	B-5A	395
6	B-2	334
7	B-1	275
8	City #4	181
9	City #3	110
10	10A	70
11	B-3	8
12	9	7
13	PVC	6.5
	B-3A	0
	B-4	
	B-4A	
	B-5	
	B-6	
	B-7	
	B-7A	

∴ ① Deep wells generally clean (except 10A)

② Area West of City WC, trt plant, well 4 generally clean

5-8-85

Roster	Phone
Doug Hermann - STS	(414) 494-9656
Mehdi Geraminegad - STS	(414) 494-9656
Terry Evanson - DNR, Solid Waste Bureau	(608) - 266-0941
ED KREUL - DNR - Rhine.	(715) 362-7616
Michael DeBrock DNR - Air Mgt	715-362-7616
Bill Dobbins DNR - Rhinelander	(715) 362-7616
Jack Saltes DNR - Antigo	(715) 627-4317
Mark Giesfeldt DNR - Solid Waste Bur.	(608) 267-7562
Dale T. Urso DNR - Rhinelander	(715) 362-7616
Raymond Krueger Charne, Glassner	(414) 273-2000
James E. Inerwinka Wausau Chem	(715) 8522285

Wausau Chemical
Air Management Concerns

1. Permit required if uncontrolled emissions are greater than 5.7 pounds per hour. Calculated at the maximum capacity of the system - NR 154.04(2)(b)3.

2. NR 154.13(11)(a)1.a.4) states applicability for sources requiring emission limitations. If organic emissions are greater than 15 lbs/day or 3 lbs/hr emission limitation applies.

   Emission limit NR 154.13(11)(a)2.c.1) or 2) 85% control required or latest available control techniques (LACT) if 85% technologically infeasible. Usually means using carbon absorption as the control technique to achieve 85% control.

3. NR 154.19 Control of Hazardous Emissions - DNR will conduct modelling to determine ambient concentrations of organic pollutants. The usual allowed value is 2.4% of the TLV (i.e., trichloroethylene has a TLV of 50 ppm. The ambient value allowed would be 1.2 ppm). To conduct modelling we need exit concentrations of pollutants, exhaust gas volumes, stack height and stack diameter.

4. The data of 5/31/84 from Well B-3B gives a total organic compound concentration of 16,470 ug/1. This would give 59 lbs of emissions per day and 2.5 lbs/hr based on 24 hours/day and a water treatment volume of 432,000 gal./day or 6 wells at 50 gpm.

   This level would not require a permit but the 85% emission limitation would apply. DNR would also conduct ambient air quality modelling.

5. More detailed and up-to-date information is needed to make an accurate assessment of air quality concerns.

   a. Actual volumes of water to be treated.

   b. Current values of VOC inlet concentrations to the stripper column.

   c. Testing schedule to determine future inlet VOC concentrations.

STS Consultants Ltd.
Consulting Engineers

540 Lambeau
Green Bay, Wisconsin 54303
(414) 494-9656

May 23, 1985

Department of Natural Resources
P. O. Box 310
Antigo, Wisconsin 54409

Attention: Mr. Jack Saltes

STS Job 12776-A

RE: Subsurface Exploration and Testing Program to Evaluate Groundwater Quality and Preliminary Extraction and Pre-treatment Design Program at the Wausau Chemical Facility in Wausau, Wisconsin (Addendum 1).

Gentlemen:

Please note the typing corrections made on pages 6 and 7 of the text and Table 6 of the report sent to you on April 3, 1985. For your convenience, the corrected pages are attached. Furthermore, the soil profile encountered at Boring B-3C is included. Also soil borings 1 and 2 conducted on February 16, 1984 on the tank farm and parking lot, about 20 feet south of tank farm, are included. These boring logs were not forwarded to you previously.

Furthermore, we will be forwarding the dewatering well permit and air discharge analysis shortly.

If you have any questions concerning this information, please feel free to contact us.

Very truly yours,

STS CONSULTANTS LTD.

M. Geraminegad

Mehdi Geraminegad
Project Engineer

Douglas J. Hermann, P. E.
Vice President-Environmental Division

MG/dw

cc: Mr. R. Krueger (1)
Charne, Glassner, Tehan, Clancy
and Taitelman
211 West Wisconsin Avenue
Milwaukee, Wisconsin 53203

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TABLE 1

WAUSAU WELL DEPTH AND SCREEN LENGTH

EPA's Monitoring Wells		Wausau Chemical's Monitoring Wells		Wergin Well Monitoring Wells		City of Wausau's Municipal Wells	
1	143' - 10'	8	23.5' - 10'	1	40' - 5'	3	95' - 40'
2	43' - 10'	B1	23' - 10'	2	40' - 5'	4	132' - 40'
3	149' - 10'	B2	24' - 10'	3	40' - 5'	6	143' - 40'
3A	75' - 10'						
		B3	161' - 3'	4	40' - 5'	7	100' - 40'
4	117' - 10'	B3A	65' - 3'				
4A	60' - 10'	B3B	24' - 10'	5	37' - 5'	8	98' - 30'
		B3C	29' - 10' 2'				
4B	40' - 10'			6	41' - 5'	9	105' - 40'
		B4	53.7' - 3'				
5	45' - 10'	B4A	18.8''-10'	7	48' - 5'		
6	45' - 10'						
7	45' - 10'	B5	53.6' - 3'				
8	45' - 10'	B5A	18.7' - 10'				
9W	50' - 15'	B6	53.3' - 3'				
		B6A	21.6' - 10'				
7A	70' - 10'						
		B7	53.0' - 3'				
9	135' - 10'	B7A	18.6' - 10'				
10A	70' - 10'	8 = PVC well					
10B	35' - 10'						
11	40' - 10'						
12	70' - 10'						
13	45' - 10'						
14	45' - 10'						

* Except for the Wausau Chemical monitoring wells, the rest of the data cannot be verified by STS.

** Well names follow DNR names.

ANALYSIS AND RESULTS

Chemical Analysis

Groundwater samples from WCW B-4, B-5, B-5A, B-6, B-6A, B-7, B-7A and a soil sample from B-3C were collected on October 1, 1984 and delivered to Zimpro, Inc. for volatile organic compound analysis. In addition, groundwater samples from WCW B-3B were collected on October 30, 1984 and sent to Zimpro, Inc. for chemical analysis.

In addition to samples taken from monitoring wells, a series of samples were taken from both the City of Wausau water and wastewater treatment plants. Influent and effluent from the water treatment plant were taken on August 7, 1984 to August 10, 1984 and from wastewater treatment plant were taken on September 27, 1984 and September 28, 1984 and delivered to Zimpro, Inc. for chemical analysis.

The results of all available groundwater and soil chemical analyses including EPA analysis are presented in Appendix C, Tables 6 to 10. The soil samples from Boring B-3C (near the tank farm) and sludge filter cakes from the Wausau Wastewater Treatment Plant were analyzed using EPA methods 5030 and 8010. Various compounds were detected in these samples with tetrachloroethylene, toluene, and 1,1,1-trichloroethane being the most prominent. Levels in most samples are fairly low with the exception of samples 2 and 3.

The water samples were analyzed for volatile organics using EPA Method 601 (10.2 ev) photoionization and a Hall detector in series.

TABLE 6

PERMEABILITY TEST RESULTS

Well No.	Depth(ft.)	Permeability cm/sec.) Falling Head	Rising Head
1	23		2×10^{-3}
3	161	$.9 \times 10^{-2}$	2×10^{-2}
3A	65	$.2 \times 10^{-1}$	
3C	29	$.1 \times 10^{-1}$	
4	53.7	$.15 \times 10^{-1}$	
4A	18.8	$.19 \times 10^{-1}$	8×10^{-2}
5	53.6	$.3 \times 10^{-1}$	2×10^{-1}
6	53.3	$.4 \times 10^{-2}$	4×10^{-2}
7	53	$.2 \times 10^{-1}$	2×10^{-1}
7A	18.6	$.1 \times 10^{-2}$	

WAUSAU CHEMICAL COMPANY

Boring B-3C
Drilled 10-1-84

STS Job 12776-A

SAMPLE	DEPTH	CLASSIFICATION
	0-11	See Log of Boring 3
1	11-11.5	Dense Brown Coarse Sand
2	13-14.5	Dense Brown Coarse Sand
3	15-16.5	Dense Brown Coarse Sand
4	17-18.5	Dense Brown Fine to Coarse Sand
5	19-20.5	Dense Brown Fine to Coarse Sand
6	21-22.5	Medium Dense Coarse Sand
7	23-24.5	Medium Dense Pea Gravel
8	25-26.5	Medium Dense Pea Gravel
9	17-18.5	Medium Dense Brown Fine to Coarse Sand
10	29-30.5	Medium Dense Brown Fine to Coarse Sand

Water Level at 11.5 feet while drilling and sampling

30 feet of HW casing used

Boring advanced with solid-stem auger to 11.0 feet

Boring advanced with roller bit and wash water from 11.0 to 30.5 feet

2 inch PVC well installed with protector pipe with the well tip at a depth of 29.0'

Soil Boring for Soil Analysis in Tank farm - 2/16/84

STS Consultants Ltd.

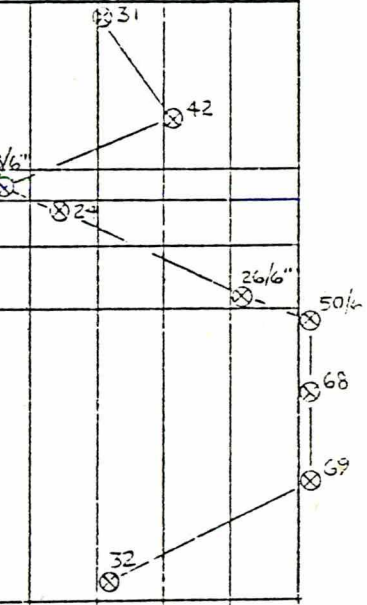
OWNER: Wausau Chemical	LOG OF BORING NUMBER: B-1
PROJECT NAME: Tetrachloroethylene Soill	ARCHITECT—ENGINEER:
SITE LOCATION: Wausau, Wisconsin	

DEPTH / ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³
					SURFACE ELEVATION Tank Farm Grade	
	1	SS			Fill- brown fine to medium sand (SP) - with medium gravel- with some silty clay particles - moist - odor - dense	
	2	SS				
5						
	3	SS			Fill - black organic silt (OL) - with fibers and roots - with some sand - with a trace of gravel - moist - strong odor	
	3A	SS			Brown sandy silt (ML) - with a trace of roots - moist - medium dense - odor	
					Topsoil - black organic silt - (OL) - with fibers and roots - moist - strong odor	
10	4	SS				
	4A	SS				
	5	SS			Brown fine to coarse sand and gravel (SP-GP) - moist to wet at 18 feet - very dense - trace of odor to strong at 18 feet	
15						
	6	SS				
19.5	7	SS				
					End of Boring Boring advanced with hollow stem auger to 19.5 feet 18 feet of casing used	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² — 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % — 10 20 30 40 50

STANDARD PENETRATION BLOWS / FT. — 10 20 30 40 50



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

WL	BORING STARTED 2-16-84	STS OFFICE	Green Bay
WL BCR ARC	BORING COMPLETED 2-16-84	DRAWN BY	SHEET NO 1 OF 1

STS Consultants Ltd.

OWNER: Wausau Chemical

LOG OF BORING NUMBER: B-2

PROJECT NAME: Tetrachloroethylene Spill

ARCHITECT—ENGINEER:

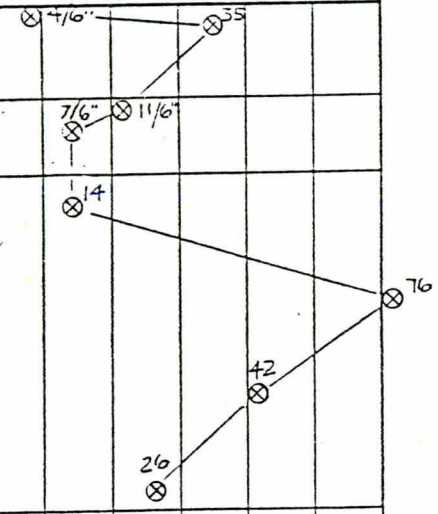
SITE LOCATION: Wausau, Wisconsin

DEPTH ELEVATION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT³
					SURFACE ELEVATION Parking Lot Grade	
	8	SS			Fill - fine to coarse silty sand with fine gravel (SP) - wet	
	8A	SS				
	9	SS			Brown silty sand (SM) - with a trace of organics - wet	
5	9A	SS				
	10	SS			Brown fine to medium sand (SP) - with some fine gravel - moist to wet - medium dense to very dense	
10	11	SS				
	12	SS				
15						
16.5	13	SS			End of Boring Boring advanced with hollow stem auger to 16.5 feet 15 feet of casing used	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1 2 3 4 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10 20 30 40 50)

STANDARD PENETRATION BLOWS / FT. (10 20 30 40 50)



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Wausau Chem - Questions on Rpt.

p. 7. GW + soil samples collected 9/26, 9/27 + 10/1.

Table 9 - GW samples from 10/1 (Blanks 9/26)

Table 7 - Soil samples from 10/1 (B-3C)

Table 8 - Wastewater Trt plant filter cake - 9/27

Any other gw + soil samples from 9/26 + 9/27?

Table 7 - B-3C soil samples. No boring log or sample depths indicated

p. 8 - Says well 7A had no signif. contamination

p. 9 - Contam. of well 7A can not be related to W.C

∴ there are one or more add'l sources.

Resolution of these two statements?

Table 10 - what is the difference betw the sample collected @ 1:00 + @ 1:22?

Wausau Chem

Summary of Major Concerns:

1. Extent And design of extraction system
2. Length of pumping from system. "How clean is clean" NR 140
3. Monitoring of pumping system + existing gw wells.
4. Required approvals
   a. High-Cap Well
   b. Air permit
   c. Haz. Waste-Spill program
   d. Disch. to treatm. plant
5. Air stripping as pre-treatment - where unit to be built, design, etc.

Wausau Chemical - NOTES ON Rept.

- Pumping Wells should be placed in upper portion of Aquifer And extend from B-5 to B-6. Zones of influence need to be calculated to determine total # of wells needed + placement.

- Add'l Work near EPA - 10A, B. GW flow map when Well 4 off shows gw flow toward SE, indicating W.C. could be source for contamination @ EPA - 10 A, B.

- GW maps only when City wells 3 + 4 pumping. DATA when #4 is off? Impt because this was the case for a number of years. Any add'l plans for water level meas. this summer? (expt w/ #4 should be done). Are there any plans to shut well 4 off or can it be done for a time?

- p. 9 - Results.
  1. Highest contam. around tank farm + less than 20' below gw table. Well 6A is likely contamin. ? ⇒ SE of W.C. ¶ 2 - "some migr. of contamination toward pumping well #4".
  2. Claim contam. of Well 7A shows there is a contam. source South of City Well #4, but on p. 8, Rept states this well is clean.
  3. Contam. in Well - 10A, B proves source East of Well #4. May also be migr from W.C. Esp since EPA -11 + -13 are clean.

Wausau Chemical - NOTES

Clean up Program

Extraction + Monitoring -

- series of wells - how many, where, design (depth, zone of influence)
  - 6 wells -
  - 16' spacing
  - 30 - 50 gpm / pump

Result - 6-8' drawdown at ea well

zone of influence ?

Fig. 1 - Portable wells - move every 1 or 2 days

what are these? (driven point ? would need 4" casing)

- Questionable that a portable system would be adeq. for the long-term removal required at a contamin. site.
- Hi-cap discharge permit fr water supply bureau

- Monitoring of system
  - water levels, gw flow
  - periodic water analysis - how often? Probably do more initially, then go to Routine monitoring (1 x/wk?)

- p. 12 - plan to terminate extraction at an area when no change occurs from 2 consecutive samples. This plan is v. dependent on frequency of sampling. We must also consider NR140.

TCE = 1.8ppb PCE = 1.0ppb VC = 0.015 ppb

Benzene = 0.67 ppb Toluene = 343 ppb Xylene = 620 ppb

144.76 requires clean up "to the extent practicable"

Wausau Chem Notes

Extraction Program

To start @ the ~~tank~~ farm + expand immed. east + south if necessary. The AREA around the water trt plant, at least to wells TB-6, 6A + up to B-5, 5A. Extention to the area east of well 4, near the RR tracks should also be considered.

Air Stripper - where built? Sizing. Pump H_2O to ~~tanks~~, then stripper. Air Quality permit? Easier to pipe water directly to What stripper will W.C. use/build? stripper?
Specs? @ 180 gpm = 10,800 gal/hr
Freq of monit in/effluent. ⊛ will fill even lg ~~tank~~ every 1-2 hr.

Discharge of pre-treated H_2O:
What is the limit for discharge to the sewer system?

Treatment Plant -
Reserve capacity? What is the cap. during high flow periods.

Pre-~~treatment~~ efficency - pls explain Table 5.
Does this mean the treatment unit must beable to meet the efficencies stated? Is it possible to get ~100% removal?
What Actual conc. are required in the treated gw before discharge to the treatment plant?