PRODUCTION WELL TESTING PROGRAM
FOR
COMMUNAL WATER SUPPLY
VILLAGE OF VARS, ONTARIO

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1.0 INTRODUCTION

Water and Earth Science Associates Limited (WESA) was contracted by McNeely Engineering Limited on behalf of the Township of Cumberland to act as the hydrogeological consultant during the completion and testing of a water supply production well for the Village of Vars. An investigation of Ministry of the Environment (MOE) well records and published geological literature identified a glaciofluvial complex located approximately 3 km east of the village as a potential site for communal water supply development (Figure 1).

1.1 Terms of Reference

The purpose of the hydrogeological testing undertaken in the Fall of 1991 was to drill and test a production well (PPW1) for the Town of Vars water supply. The well is intended as a municipal groundwater supply production well in the final system construction. The location of the well is illustrated in Figure 2. The purpose of the test was to verify that the production well could provide the required safe perennial yield. Testing was also conducted to verify the groundwater quality as indicated in previous aquifer testing.

The objective of this report is to outline the physical and geochemical properties associated with the 250 mm (10 in.) nominal diameter production well. Specifically, this work will evaluate the following concerns.

1) To determine the operating efficiency of the well at design discharges.

2) To establish that sand free conditions exist in the well following development procedures.

3) To calculate long term production rates from this well.

4) To determine the quality of groundwater supplied from this well.

2.0 RESULTS

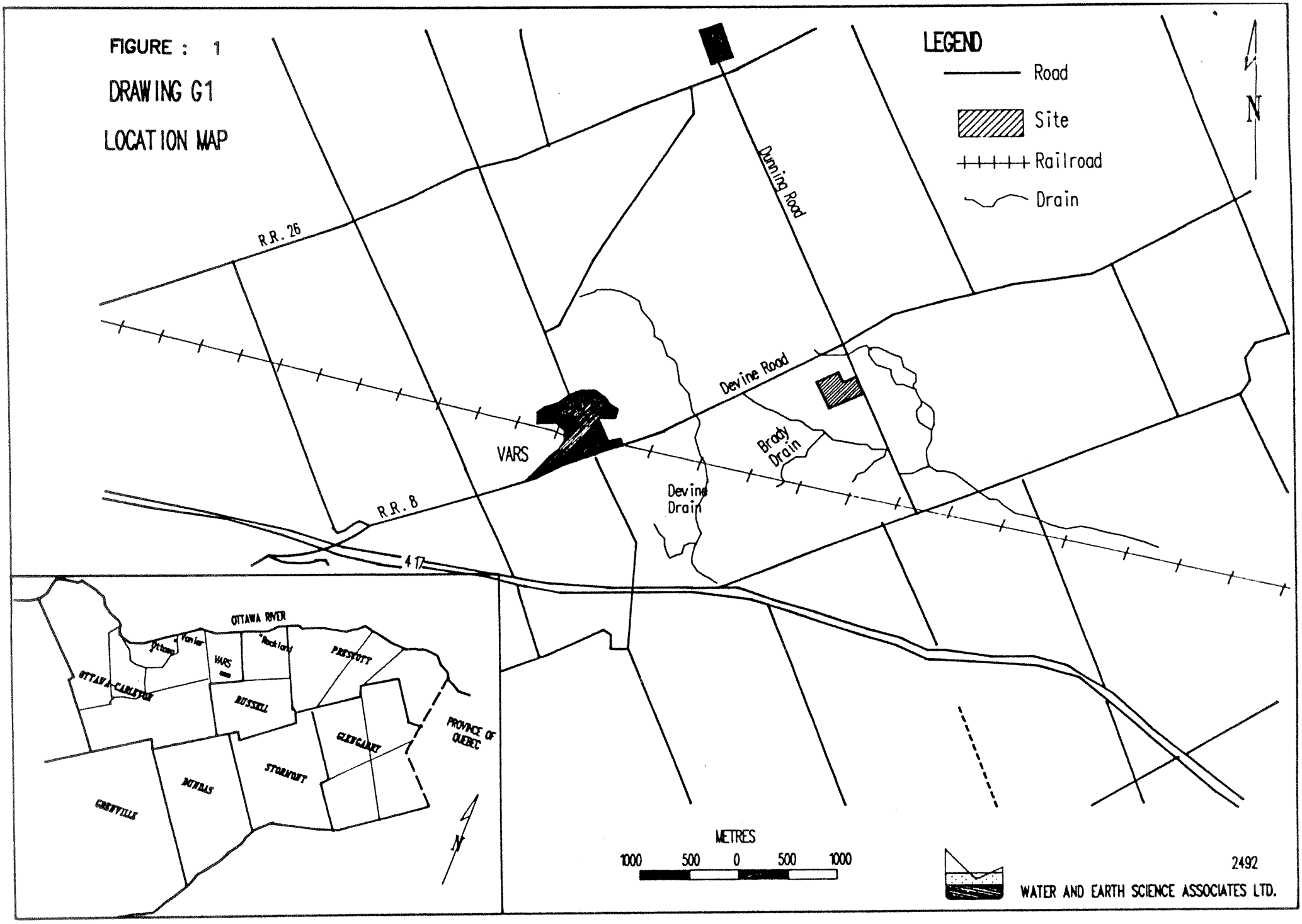
2.1 Background Information

Work on the Vars water supply project has spanned a five year period. As indicated in the following chart, Phase 1 of the investigation consisted of a background study and mapping program. Phase II consisted of a more detailed testing program. Phase III involved a water treatability study.

FIGURE : 1

DRAWING G1

LOCATION MAP



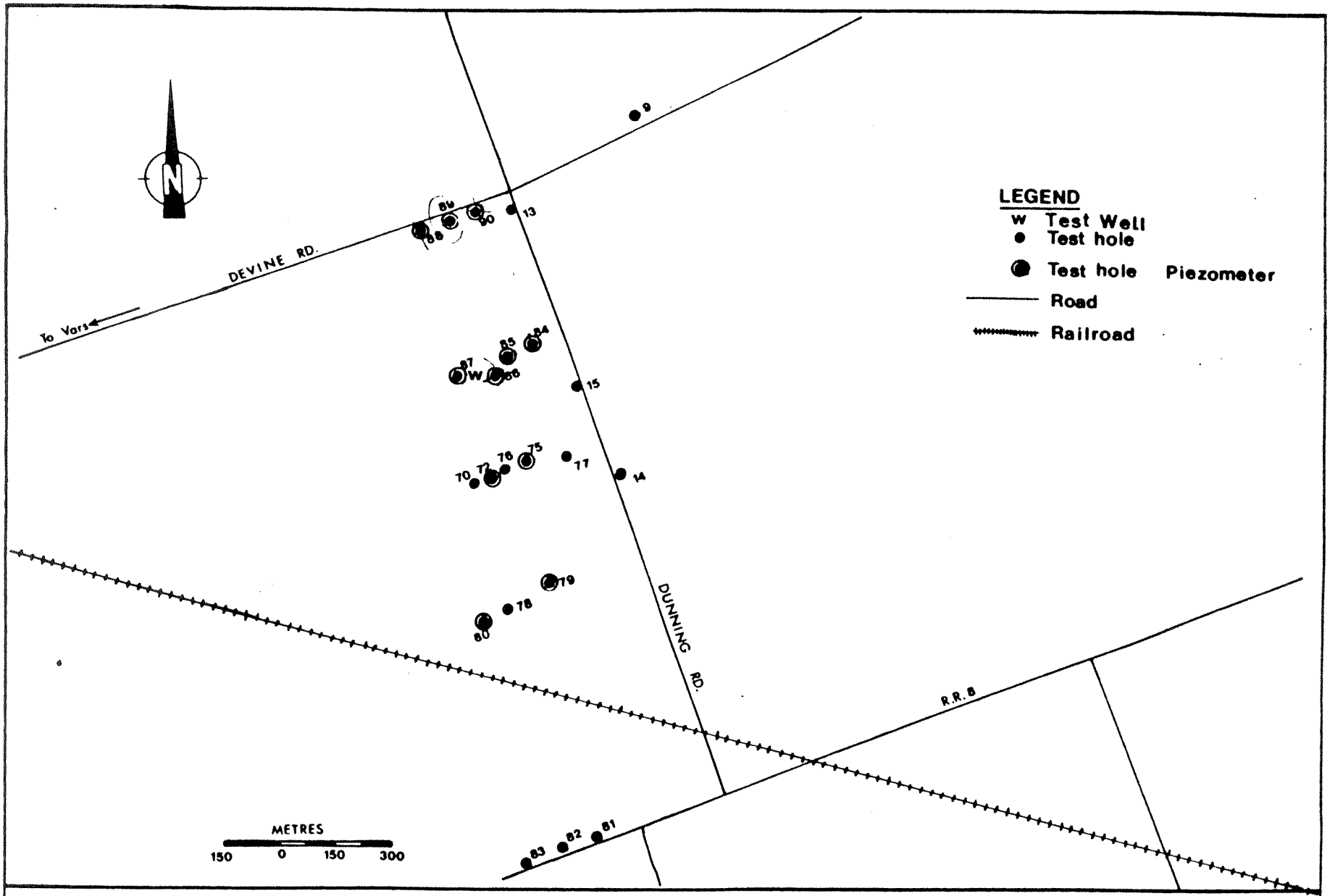


FIGURE 2
MONITORING NETWORK MAP

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Phase III is described in WESA, (1990b). WESA (1992) outlined results from a detailed treatability study (Phase IVb) completed during 1991. This report presents the results of the hydrogeological testing of the fourth phase of the program (Phase IVb).

VARS WATER SUPPLY STUDY CHRONOLOGY

Phase 1	Water supply source identification 1986 (background study) Source investigation and testing 1986-87 (mapping program)
Phase 11a	Source quantification and testing 1987 (test well program)
Phase 11b	Water quality verification testing 1990 (test well program)
Phase III	Water supply treatability study 1990
Phase IVa	Water quality verification testing 1991 (test well program)
Phase IVb	Pilot treatment study involving an activated carbon treatment to treat colour and iron

During Phase I, potential aquifer sites which were identified during the background research and site reconnaissance, were investigated through a geological and hydrogeological mapping program (WESA, 1987). Preliminary mapping of Cumberland Township included observation of natural and man-made exposures in gravel pits and river banks located along the glaciofluvial complex. A buried glaciofluvial complex is intermittent throughout most of its length in this area.

The results of a geophysical survey completed by the Ministry of Natural Resources (MNR) was reviewed, as were internal WESA files detailing the morphology, location and orientation of the esker sand and gravel deposits in eastern Ontario.

During the reconnaissance mapping program, eighty-six test holes were drilled, by either a truck mounted CME 75 or a track mounted CME 55 hollowstem drill rig. The reconnaissance drilling program covered most of the countryside east and north of Vars towards Leonard, Ontario. The program was successful in identifying a number of target locations. Criteria used in identifying potential target areas included: the permeability of the deposit, the thickness of the aquifer, the recharge potential of the aquifer, the proximity and character of potential sources for aquifer contamination, and the required pipeline distance to Vars.

Selected drill holes were instrumented with piezometers to monitor hydraulic head distribution. The locations of selected piezometers are shown on Figure 3. Hydraulic heads were obtained from the piezometer network to establish natural groundwater gradient flow and the recharge/discharge regime of the glacio-fluvial complex.

An initial potential water supply location was identified 7.5 km south of Leonard, Ontario. However, the expense of piping the water to Vars warranted further investigation closer to Vars. A small area just southwest of Vars was investigated in early March, 1987 with no success.

The results of the Phase IIa study identified a second aquifer located further south and closer to the village of Vars. The test well site (TW1) was located close to Devine Road where the aquifer was known to be less than 100 metres wide. It was at this location that a 200 mm (8 inch) diameter, natural gravel packed test well was completed by Olympic Drilling Co. Ltd. A 29T cable tool drill rig was used to install the well to a depth of 22.3 m (73 ft.) from surface. This well was designed initially to be capable of producing a minimum of 7.6 - 11.4 L/s (100-150 IGPM) of potable water. The optimal location was optioned by the Township of Cumberland prior to testing. The well was installed and tested for yield, efficiency, and water quality. Interference effects and a long term appraisal of safe perennial yield, recharge, and water quality were also calculated.

A draft report was prepared and submitted in 1987 to the M.O.E. Regional office in Kingston for review. A final version was submitted in May of 1990 after comments had been received.

Further work on this project was started in April 1990 at the request of McNeely Engineering Ltd. Phase IIb of this study involved the repumping of the water supply test well to collect water samples for the treatability test program. This work was also completed to address water quality concerns identified by the Ontario Ministry of the Environment (MOE) in their review of the report.

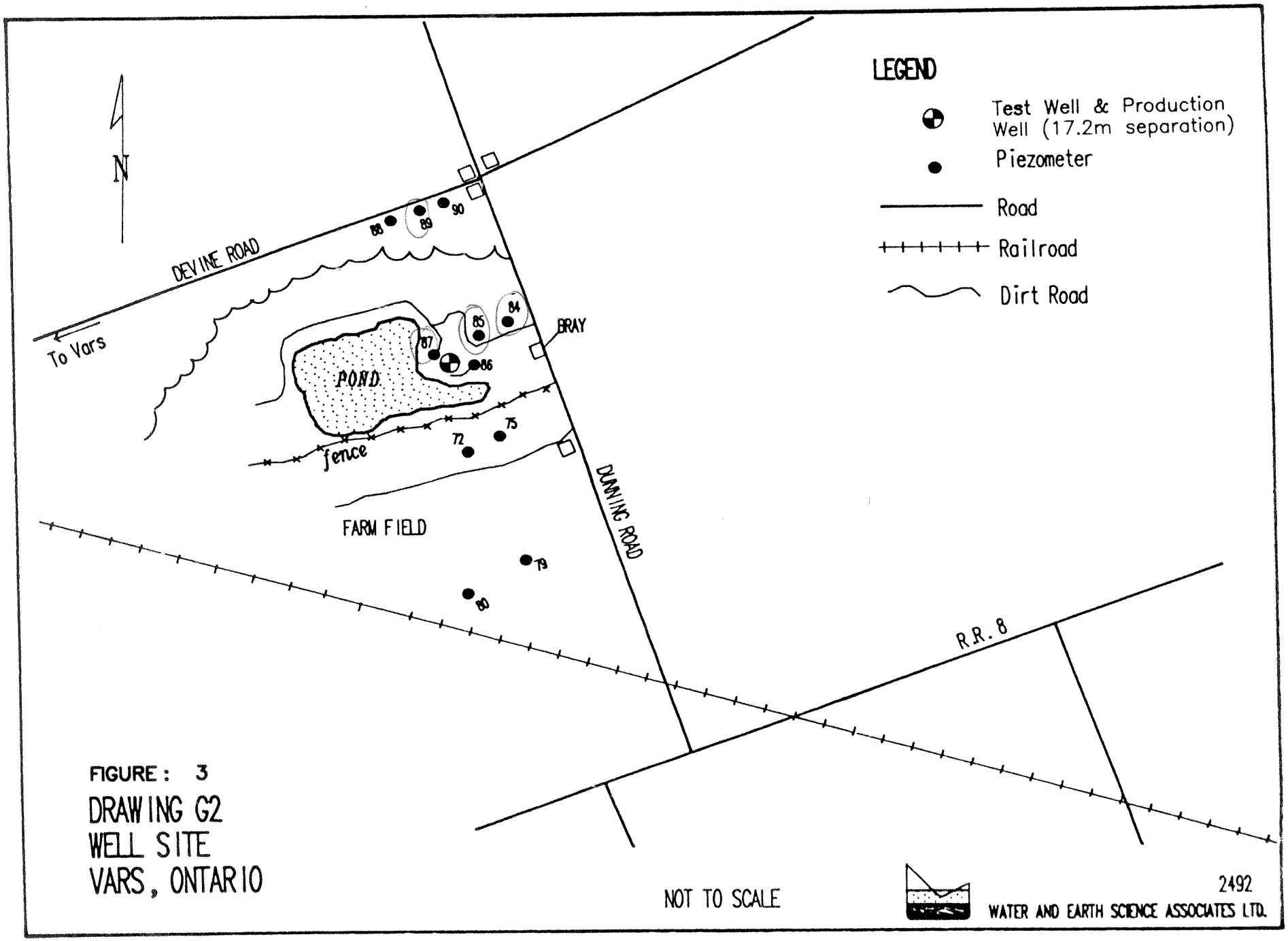


FIGURE : 3

DRAWING G2
WELL SITE
VARS, ONTARIO

In May, 1990 the test well (TW1) was pumped at a revised system design discharge of 26.5 litres/sec (350 IGPM) for a period of seventy-two hours. Physical analysis of the retest was restricted to a brief comparison between the 1987 and the 1990 data and was completed to ensure consistency in the performance of the aquifer.

Phases III and IV entailed components of water quality treatability testing and only involved pumping of the aquifer at relatively low discharge. Details of these programs are reported under separate cover as referenced above.

2.2 Topography and Drainage

The glaciofluvial complex in the study area is completely buried in most areas, and has no surface relief except near test hole OW78 (see WESA, 1990). Recharge precipitation is able to infiltrate rapidly into the underlying permeable formation at locations where the sands and gravels are exposed at surface along the crest of the deposit. However, most of the sands and gravels (on the flanks of the esker complex) are overlain by a clayey silt unit which limits infiltration of precipitation. The glaciofluvial deposit is drained on its western edge by the north/south oriented Devine Drain (Figure 1). The Brady drainage ditch cuts across the study site about midway between the Devine Rd. and Regional Road #8 and flows to the southeast. A second ditch is located on the southwest side of the complex and cuts northeastward to the eastern edge of the deposit near the road.

2.3 Geology

2.3.1 Bedrock Geology

The study area is underlain by Palaeozoic bedrock of the upper Ordovician period described by Williams et. al, (1982) as the Carlsbad Formation. The bedrock consists of interbedded dark grey shale, fossiliferous calcareous siltstone, and silty bioclastic limestone. The water in this unit is characteristically sulphurous and exhibits elevated concentrations of iron.

2.3.2 Surficial Geology

The bedrock in the study area is overlain by a succession of Wisconsinian Epoch glacial, glaciofluvial and glaciomarine unconsolidated sediments. A calcarious compact till with both a clay and sand component, directly overlies the bedrock throughout the study area. The till unit is fairly thin with a maximum thickness of 1.6 metres in the study area at test hole OW72.

Melt water-derived glaciofluvial deposits were deposited by the receding glacial ice at the end of the last glaciation. These esker and buried esker deposits are oriented north-south and have identified at five locations in the study region.

The Vars study area is located on an esker deposit which is a continuation of the same unit identified at Sarsfield and Leonard. The esker also extends beneath Highway 417 southward into the County of Russell. The water supplies for the municipalities of Embrun and Chesterville are developed into this unit to the south. The distances between the centres of pumping of these water supplies are large enough that interference is not considered to be an issue. The complex varies between 15.2 m (49.9 ft.) and 30.5 m (100.1 ft.) in width, and has an average thickness of 24 m (78.7 ft.) in the study area.

The esker body appears to be coarser grained along the main axis but shows significant but less transmissive connection to sand deposits flanking the main core or axis of the deposit. The most transmissive part of the water bearing unit appears to have an average saturated thickness of 13 m (42.7 ft.). The deposit reached its maximum thickness near the test hole (TW1), at 21.6 m (70.9 ft.). The base of the unit lies on a relatively impermeable basal till. The upper surface of the esker is exposed in only a few places and is usually covered by a clayey silt unit. The clay unit acts as a barrier to surface contamination (relatively impermeable), yet also results in reduced recharge capabilities.

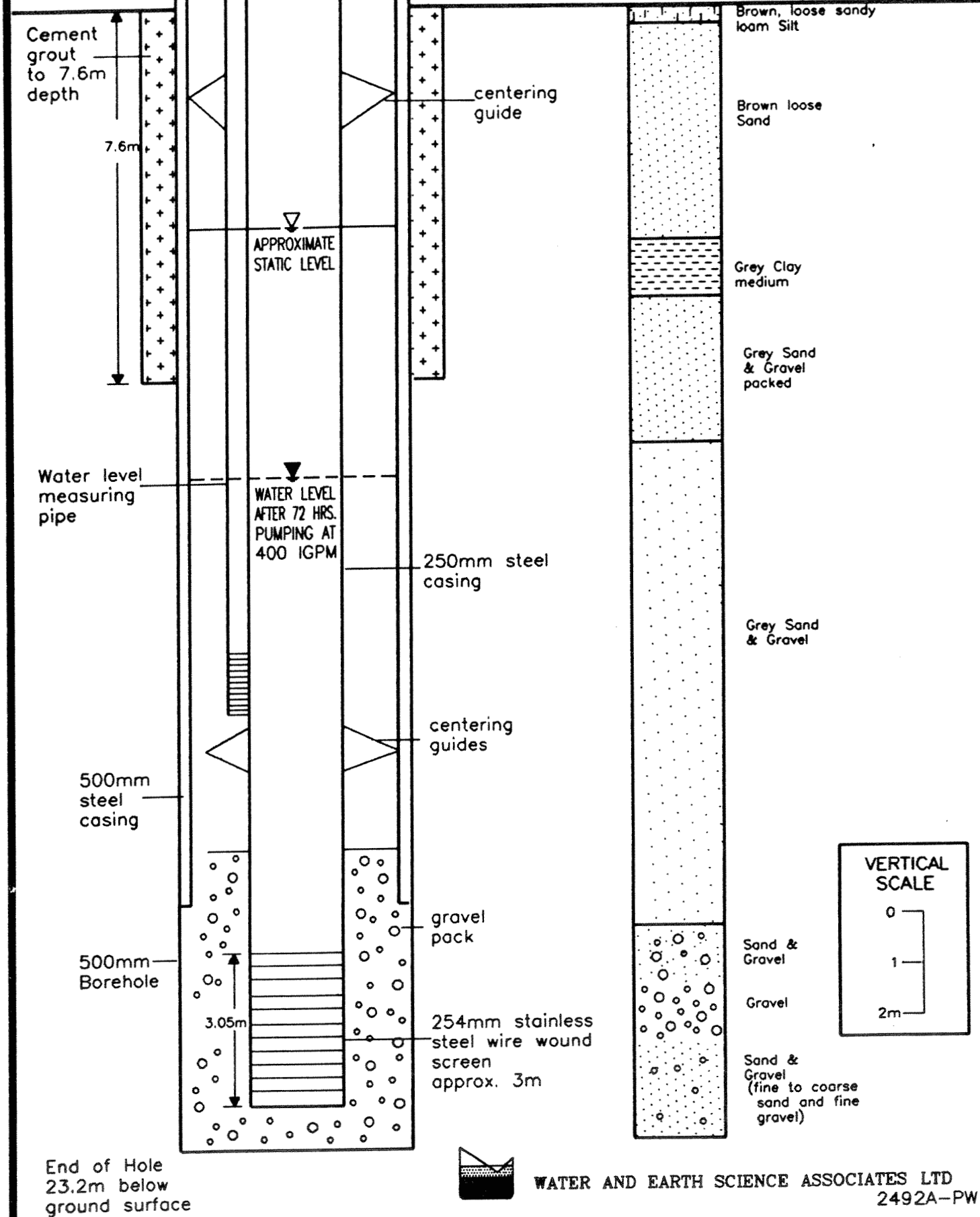
The esker is bounded on both sides by a silty glacio-marine clay deposit of Champlain Sea origin (>10,000 years old). This unit characteristically possesses values of low permeability. The entire complex is overlain by a variable thickness of fine to medium grained silty sand. This unit is described as a regressive sequence by Terasmae (1965) and is composed of material derived from higher topographic sites in the area through water washing and winnowing by the Champlain Sea. The sand reaches a thickness of up to 5.5 metres at OW87.

2.4 Well Construction and Development

A schematic of the production well as built is shown in Figure 4. The production well PPW1 was constructed at a distance of 19.2 metres from well TW1. A 500 mm (19.7 inch) diameter steel casing was installed in the drilled hole to an approximate depth of 19 metres (62.3 ft.)(Figure 4). A 254 mm (10 inch) diameter inner steel casing was installed within the outer casing. A 254 mm, stainless steel wire wound screen (length of 3.05 m) was welded onto the bottom of the inner casing. The top of screen is at a depth of approximately 20.1 metres (65.9 ft.) from ground surface. Approximately 6 metres (19.7 ft.) of artificial gravel pack (1/8 x 1/4 inch silica filter media) was installed in the bottom of the well around the screen.

2492a VARS PRODUCTION WELL - AS BUILT DIAGRAM

FIGURE: 4



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The well was pressure grouted from surface to a depth of 7.6 metres. The outer casing (500 mm diameter) extends approximately 0.60 metres above ground surface. The inner casing (254 m diameter) extends approximately 0.88 metres above ground surface.

Well development was conducted from October 22nd to October 25th, 1991. The well was initially developed with a stop-start air lift method for a period of 22 hours. A shaft line turbine pump was then used to stop-start pump the well at a discharge rate of 45.5 l/s (600 IGPM) until the water discharge was essentially sand free.

2.5 Well Testing Program and Analysis

The aquifer testing program involved an initial step discharge aquifer test followed by a 72 hour constant rate discharge test. Water was pumped using a shaft line turbine pump. The discharge rate was measured with a 101.6 mm X 151.4 mm (4 inch X 6 inch) orifice weir. Water was discharged into a man made pond located adjacent to the test well. This pond had previously been shown to be hydraulically separated from the aquifer. Water levels in the pumping well and in proximal boreholes were measured with an electric water level sounding tape. The results from the tests conducted on the completed production well are described below.

2.5.1 Step Discharge Aquifer Test

The step test was conducted on October 28, 1991. The test was carried out in four steps consisting of discharges of 12.6 L/s (200 IGPM), 18.9 L/s (300 IGPM), 25.2 L/s (400 IGPM) and 27.6 L/s (437.5 IGPM). Each step was 40 minutes in length. Each step was initiated upon the completion of the previous step without allowing for aquifer recovery. Analysis of data is provided in Table 1.

TABLE 1: STEP TEST RESULTS - PPW1

STEP	Q (m/day)	t (days)	sw(n)	sw(n)	sw(n)/Qn (days/m^2)
1	1309	2.43×10^{-2}	0.59	0.59	4.51 x 10
2	1964	2.43×10^{-2}	0.63	1.22	6.21 x 10
3	2618	2.43×10^{-2}	1.16	2.38	9.09 x 10
4	2864	2.43×10^{-2}	0.66	3.04	1.06 x 10

The results of the step discharge test indicate that the test well was capable of producing test flows in excess of the proposed design flow. Data and calculations after Jacob-Rorabough are contained in Appendix D. Results of this imperial method were unsatisfactory at a discharge of 26.5 L/s (350 IGPM). An efficiency of 5.5 percent was calculated. This result does not correspond to the observed drawdown and well efficiency.

2.5.2 Constant Discharge Aquifer Test

A constant rate discharge aquifer test was begun on October 29, 1992 after the water level had returned to static conditions following the step discharge test. The aquifer test spanned a period of seventy-two hours. The well was pumped at a constant discharge of 26.5 L/s (350 IGPM) throughout the test. The water level drawdown in the pumping well and the five observation wells (TW1, OW84, OW85, OW87 and OW89) was measured. These results are shown in Table 2.

TABLE 2: 1991 DISCHARGE TEST DATA

WELL	STATIC (m)	72 hr READING (m)	DRAWDOWN (m)
PPW1	5.39	9.04	3.65
TW1	4.35	5.10	0.75
OW84	4.84	5.92	0.08
OW85	4.83	5.18	0.35
OW87	3.67	4.96	1.29
OW89	5.02	5.62	0.60

The recovery of piezometric levels in the aquifer was monitored for a period of twenty-four hours after the end of pumping. A final water level was obtained from each monitoring point forty-two hours after the end of pumping. A summary of the test results and the corresponding calculated aquifer hydraulic parameters are contained in Table 3.

TABLE 3: AQUIFER ANALYSIS RESULTS - VARS COMMUNAL WATER SUPPLY

WELL	DATA TYPE	TRANSMISSIVITY	STORATIVITY	RADIUS (m)
PPW1	Pumping	319	---	0.127
PPW1	Recovery	1690	---	
TW1	Pumping	682	1.11*	19.22
TW1	Recovery	2490	---	
OW87	Pumping	679	0.147	22.03
OW87	Recovery	2040	---	
OW85	Pumping	788	9.03×10^{-2}	126
OW85	Recovery	---	---	
OW84	Pumping	6090	0.114	184
OW84	Recovery	---	---	
OW89	Pumping	777	3.04×10^{-3}	435
OW89	Recovery	2380	---	

* governing assumptions violated storativity > 1.0 is not valid

Examination of the drawdown curves and the calculated storativities indicate that the aquifer behaves hydraulically as a confined unit with a negative recharge boundary condition. The boundary condition effects are likely felt early after aquifer pumping because of the narrowness of the esker core and the high transmissivity of the aquifer. Calculated storativities, on the order of 1.5 X 10-3 appear to be representative of this aquifer at this location. Measurable drawdowns were recorded in piezometers at large distances north and south of the pumping well down the length of the core of the esker immediately after the start of pumping. Hydraulic response of the piezometers located outside of the highly transmissive core of the esker is delayed but indicate hydraulic connection to the esker core. This connection is imperfect, and in the case of the transition from pumping to recovery, the heads in these piezometers never attain the drawdown levels in piezometers developed into the transmissive core of the deposit.

The transmissivity and storativity values deemed representative for the aquifer were determined by averaging the values obtained for the best responding observation wells. A transmissivity and storativity on the order of 732 m2/day and 8.0 x 10^{-2} respectively are estimated for the core of the esker deposit and are used later in this report for the calculation of long term yield and well interference. All pumping curves (pumping and observation wells) were analyzed using the late data (>2760 minutes) of the curves. This provides the most conservative values of aquifer response.

All pumping data curves (PPW1, TW1, OW84, OW85, OW87 and OW89) show a break in the slopes at two consistent time periods during the seventy-two hour test (at approximately 420 and 2760 minutes respectively). These would appear to be hydraulic responses to boundaries. As the pumping drawdown cone extends laterally and vertically through the esker complex, it encounters geologic materials possessing lower values of hydraulic conductivity (fining of the sediments along the edge of the deposit).

2.6 Water Quality

The chemical and bacteriological quality of the water was monitored during the course of the constant discharge aquifer test. Samples were obtained at regular intervals using MOE and USEPA approved sampling protocol.

The sampling program included both surface and groundwater samples. Analysis of all water samples for inorganic parameters was carried out by Accutest Laboratories Ltd. of Nepean, Ontario. Samples for bacterial analysis were submitted to Accutest Laboratories of Nepean, Bondar-Clegg and Company Ltd. of Ottawa, and the Ministry of Health laboratory. All other water quality parameters (pesticides, herbicides, PCBs, volatile organics GC/MS (US EPA 624) and total phenols) were analysed by Accutest Laboratories. Complete analytical reports are contained in Appendix B. The water quality results obtained from the analysis of samples obtained from PPW1 at the conclusion of the 72 hour constant discharge test are summarized in Table 4, Table 5, Table 6, and Table 7.

3.0 DISCUSSION OF RESULTS

3.1 Well Efficiency

The efficiency of the standby production well PPW1 was calculated by utilizing a number of different methods.

TABLE 4 : PESTICIDES TRIHALOMETHANES AND PCB's

PARAMETER	UNITS	PPW1 72 hrs.	ODWO*
Pesticides			
Aldrin & Dieldrin	mg/L	<0.0007	0.0007
Carbaryl	mg/L	<0.07	0.07
Chlordane	mg/L	<0.007	0.007
DDT	mg/L	<0.03	0.03
Diazinon	mg/L	<0.014	0.014
Endrin	mg/L	<0.0002	0.0002
Heptachlor + Heptachlor Epoxide	mg/L	<0.003	0.003
Lindane	mg/L	<0.004	0.004
Methoxychlor	mg/L	<0.1	0.1
Methyl Parathion	mg/L	<0.007	0.007
Parathion	mg/L	<0.035	0.035
Toxaphene	mg/L	<0.005	0.005
2,4-D	mg/L	<0.1	0.1
2,4,5-TP	mg/L	<0.01	0.01
Trihalomethanes	mg/L	<0.35	0.35
PCB's	mg/L	<0.003	0.003

* ODWO (Ontario Drinking Water Objectives) - Table 4, Water Management, Ontario Ministry of the Environment, Revised, May, 1984.

TABLE 5 : HEAVY METALS AND RADIONUCLIDES

PARAMETER	UNITS	PPW1 72 hrs.	ODWO*
As	mg/L	<0.01	0.05
Ba	mg/L	0.32	1.0
B	mg/L	0.07	5.0
Cd	mg/L	<0.002	0.005
Cr	mg/L	<0.01	0.05
CN-	mg/L	<0.01	0.2
Pb	mg/L	0.003	0.05
Hg	mg/L	<0.001	0.001
Se	mg/L	<0.01	0.01
Ag	mg/L	<0.01	0.05
Cu	mg/L	<0.01	1.0
H2S	mg/L	0.04	** 0.05
Zn	mg/L	<0.01	5.0
U	mg/L	<0.01	0.02
Radionuclides			
Cs 137	Bq/L	<1	5.0
I 131	Bq/L	<1	1.0
Ra 226	Bq/L	<0.1	0.1
Sr 90	Bq/L	<1	1.0
Tritium	Bq/L	<1000	4000

* ODWO (Ontario Drinking Water Objectives) - Table 4, Water Management, MOE, Revised, May, 1984.

** Guidelines for Canadian Drinking Water Quality - Health and Welfare Canada, 1987.

TABLE 6 : VOLATILE ORGANIC COMPOUNDS (VOCs)

PARAMETERS	UNITS	ACCUTEST LABORATORIES												MANN LABORATORIES			
		METHOD DETECTION LIMIT	PPW1 1 hr.	PPW1 6 hrs.	BLANK 1 hr.	BLANK 6 hrs.	PPW1 12 hrs.	BLANK 12 hrs.	PPW1 24 hrs.	BLANK 24 hrs.	PPW1 48 hrs.	PPW1 72 hrs.	TRIP BLANK	MDL	LAB WATER BLANK	TRAVEL BLANK	PPW1 72 hrs.-B
Benzene	µg/L	0.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.5	nd	nd	nd
Bromodichloromethane	µg/L	1										0.7		2.0	nd	nd	nd
Bromoform	µg/L	1										nd		2.0	nd	nd	nd
Bromomethane	µg/L	4										nd		2.0	nd	nd	nd
Carbon tertachloride	µg/L	2										nd		1.0	nd	nd	nd
Chlorobenzene	µg/L	1										nd		0.5	nd	nd	nd
Chloroethane	µg/L	4										nd		2.0	nd	nd	nd
2-Chloroethylvinyl ether	µg/L	5										nd		10	nd	nd	nd
Chloroform	µg/L	1										33		1.0	nd	62.8 *	nd
Chloromethane	µg/L	4										nd		2.0	nd	nd	nd
Dibromochloromethane	µg/L	1										nd		1.0	nd	nd	nd
1,2-Dibromoethane	µg/L	1										nd			nd	nd	nd
m-Dichlorobenzene	µg/L	1										nd		1.0	nd	nd	nd
o-Dichlorobenzene	µg/L	1										nd		1.0	nd	nd	nd
p-Dichlorobenzene	µg/L	1										nd			nd	nd	nd
1,1-Dichloroethane	µg/L	1										nd		1.0	nd	nd	nd
1,2-Dichloroethane	µg/L	2										nd		1.0	nd	nd	nd
c-1,2-Dichloroethene	µg/L	2										nd			nd	nd	nd
1,1-Dichloroethylene	µg/L	1										nd		1.0	nd	nd	nd
t-1,2-Dichloroethylene	µg/L	1										nd		1.0	nd	nd	nd
1,2-Dichloropropane	µg/L	1										nd		1.0	nd	nd	nd
c-1,3-Dichloropropene	µg/L	1										nd		1.0	nd	nd	nd
t-1,3-Dichloropropene	µg/L	1										nd		1.0	nd	nd	nd
Ethylbenzene	µg/L	0.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.5	1.3	nd	nd
Methylene chloride	µg/L	5										nd			nd	nd	nd
Styrene	µg/L	0.2	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd	nd	nd
1,1,2,2-Tetrachloroethane	µg/L	1										nd		2.0	nd	nd	nd
Tetrachloroethylene	µg/L	1										nd		1.0	nd	nd	nd
Toluene	µg/L	1.0	3.3	nd	nd	nd	1.7	nd	nd	1.5	2.5	nd	0.9	0.5	nd	nd	nd
1,1,1-Trichloroethane	µg/L	1										nd		1.0	nd	nd	nd
1,1,2-Trichloroethane	µg/L	1										nd		2.0	nd	nd	nd
Trichloroethylene	µg/L	1										nd		1.0	nd	nd	nd
Trichlorofluoromethane	µg/L	1										nd		2.0	nd	nd	nd
1,3,5-Trimethylbenzene	µg/L	1										nd			nd	nd	nd
Vinyl chloride	µg/L	4										nd		2.0	nd	nd	nd
m/p-Xylene	µg/L	1.0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd	nd	nd
o-Xylene	µg/L	0.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd		nd	nd	nd

nd - not detectable

TABLE 7 : INORGANIC CHEMISTRY RESULTS - PPW1 - 72 HOUR TEST

LIST OF PARAMETERS	UNITS	LOQ	PPW1 1 hr	PPW1 6 hrs	PPW1 12 hrs	PPW1 24 hrs	PPW1 48 hrs	PPW1 72 hrs	ODWO*
Fe	mg/l	0.01	0.54	0.59	0.60	0.62	0.64	0.61	0.30
Mn								0.07	0.05
Hardness	mg/l	3	168					161	
Alkalinity	mg/l	2	186					176	
pH		0.01	7.95					7.95	
Conductivity	umhos/cm	10	310					310	
F	mg/l	0.01	0.11					0.12	2.4
Na	mg/l	1	10					11	200
N-NO3	mg/l	0.1	nd	nd	nd	nd	0.78	<0.10	10.0
N-NO2	mg/l	0.1	nd					<0.10	1.0
N-NH3	mg/l	0.1	0.32					<0.10	
SO4	mg/l	3	9	32	4	3	3	<3	500
Cl	mg/l	1	1	1	2	1	nd	2	250
Phenols	mg/l	0.002	nd	nd	nd	nd	nd	<0.002	0.002
Turbidity	Pt/Co Units	0.1	nd	nd	nd	nd	nd	<1.0	1.0
Colour	mg/l	2	30	30	20	20	26	26	5.0
Ca	mg/l	1	49					48	
Mg	mg/l	1	11					10	
Tann./Lig.								<1.0	1.0
Total N	mg/l	0.1	0.50					<0.10	
K	mg/l	1	3					2	
TOC	mg/l	0.1	5.0	5.0	5.0	4.9	5.4		5.0
TDS	mg/l	1	182	182	204	204	208		500
H2S	mg/l	0.02	0.02	0.02	0.03	0.03	0.04		** 0.05
Ion Balance			0.98					1.05	
Uranium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01		0.02
Diss. Oxygen	mg/l		6.5	5.1	5.95	7.20	5.1		
Temperature ***	°C		22	22	19	19	22		

LOQ = lowest level
nd = not detected

* ODWO (Ontario Drinking Water Objectives) - Table 4, Water Management, MOE, Revised, May, 1984.

** Guidelines for Canadian Drinking Water Quality - Health and Welfare Canada, 1987.

*** Note - Laboratory measurement.

The classical method of analysis of step discharge pumping data is the Jacob-Rorabough method. The result obtained using this method (5 % well efficiency) is inconsistent with the observed well yield (30.3 l/s, 400 IGPM) and observed pumping well drawdown of 4.5 metres after 72 hours of continuous pumping. The failure of the Jacob-Rorabough method may be due to the method assumption of homogeneous and infinite area aquifer conditions. The narrowness of the site aquifer and the complex hydrogeology of the area adjacent to the pumping well suggests the Jacob-Rorabough method may be unsuitable because of site conditions.

An alternate method for the calculation of well efficiency involves a comparative analysis of observed and theoretical drawdown data. The calculated well efficiency obtained using this method yields an efficiency of 37.7% at a discharge rate of 26.5 L/s (350 IGPM). The theoretically derived drawdown in this case was obtained from both recovery data in the pumping well and from the analysis of drawdown in adjacent monitoring wells during the constant discharge aquifer test. The test well ,TW1, (the closest monitoring point) and the production well are situated 19.22 metres apart.

The low well efficiency calculated using the above method may be due to the method requiring that the physical hydrogeologic properties of the aquifer must be consistent between the observation point and the pumping well. The test well (TW1) and the production well are located on a line perpendicular to the core of the esker. However, they are situated in zones of the aquifer with differing transmissivities.

3.2 Water Supply Potential

The glaciofluvial complex situated east of Vars appears to satisfy three of the hydrogeological conditions necessary to meet the water supply demands of the community. These points are listed below.

- The local transmissivity will provide sufficient flow of groundwater to a production well developed at the test well site. The production well can support the design flow plus an adequate margin of safety.

- The water can be extracted by a conventional well design as demonstrated by both the test well and the production well. The production well produces water of a sand free nature whereas the test well may be modified through additional development to produce turbidity free water.

- There appears to be a sufficient aquifer extent with associated recharge area to provide for a long term supply.

3.3 Theoretical Aquifer Yield and Safe Perennial Yield

Theoretical aquifer yields were calculated for a ten year and twenty year period. Values for a ten year design period for aquifer yield were calculated to be 6198 m^3/day (947 igpm). Yield, available drawdown and time are interrelated. This estimate is conservative and does not account for seasonal variations in recharge. The aquifer is capable of transmitting this volume of water down its length under an imposed gradient from a production well. The production well would derive recharge from both the north and the south as well as leakage from above and the less permeable bounding deposits. For a twenty year period the theoretical aquifer yield is 6009 m^3/day (918 igpm). These calculations assume a perfectly efficient well. A safe perennial yield of 3606 m^3/day (551 igpm) or 60% of the theoretical value to account for well efficiency and a factor of safety would be more appropriate. This estimate may no doubt be revised, likely upward when addition information is derived from longer term operation of the pumping facility.

3.4 Well Interference

Well interference calculations were carried out for five of the observation wells for the pumping of PPW1 at the design yield for a specified period of time (10 years). A theoretical calculation of well interference was also done for a hydraulically connected site located 1000 metres from the well. A time period of ten years was chosen for these calculations and results appear in Table 8 with calculations found in Appendix E. A drawdown measurement of 1.43 metres was recorded in TW1 after three days of pumping the production well PPW1 at the design discharge of 30.3 l/s (400 IGPM). The theoretical drawdown in TW1 calculated for a ten year period is 3.50 metres. A number of domestic wells are situated within the theoretical cone of influence of the production well. Because the core of the esker is largely a linear feature, impact to the north and south is anticipated to be of first concern. The predicted influences are anticipated to be acceptable from a water supply perspective.

TABLE 8: WELL INTERFERENCE RESULTS

RADIUS (m)	400 IGPM (2624 m^2/day (m)
0.127 (PPW1)	6.34
19.22 (TW1)	3.50
22.0 (OW87)	3.41
126.0 (OW85)	2.41
435.0 (OW89)	1.71

3.5 Groundwater Quality

The geochemical data listed in Tables 4, 5, 6, 7 meet the MOE drinking water objectives for all parameters except for iron, colour and TOC. Previous concerns regarding turbidity were solved as predicted (WESA, 1987) with the construction of the properly developed production well.

The elevated colour concentrations detected are not uncommon for this type of glaciofluvial deposit, especially those located in a forested area. This is especially true when the geochemical environment is reducing, as indicated here. Colour would appear to be largely derived from organic sources as indicated by the TOC concentration (up to 5.4 mg/L). The colour and iron may most likely be removed by treatment. The type of treatment and its cost effectiveness are currently being appraised by a complete treatability analysis (under separate cover) WESA, 1992).

The 72 hour test for chloroform (Table 6) shows an inconsistency between the results provided by Accutest Laboratories and Mann Laboratories of 33 and 0 ppb respectively. The reason for this inconsistency is unknown; however, a 33 ppb chloroform level is well below the drinking water objective of 350 ppb for trihalomethanes. It is to be noted that the travel blank also registered a chloroform reading of 62.8 ppb. According to Mann Laboratories, this value is typical for Ottawa tap water.

To aid in the final well design, the groundwater chemistry results were used in an adapted equilibrium-based speciation model. The model determines the corrosivity or scaling potential of water pumped from the well. It therefore has implications for the life of the well screen. Calculations indicate that the water is mildly corrosive with a Ryznar Index of 7.7. The model also indicates that the pumped waters are supersaturated with respect to calcium carbonate and magnesium carbonate (dolomite) and some minor encrustation is expected to occur on the well screen. These attributes will likely not impair well operation during the 20 year design period. The impacts of corrosion and encrustation are discussed in Section 3.7.

3.6 Well Head Protection

The long term water quality of overburden aquifers is generally regarded as good, however, a number of considerations are warranted. This system is recharge dominated and therefore prone to groundwater degradation due to various pollutants from the surface (spills, agricultural activities, septic effluent, etc.) if they occur. Flow rates in this type of system are slow and a considerable time lag exists between the time that the contaminant enters the ground and the time that it impacts on the well.

A review of the potential conflicting land uses was undertaken during the course of the earlier investigation (WESA, 1990). The most significant possible source of groundwater contamination in the area was identified as a small scale farming operation located to the south of the site. The existing separation between the operation and the production well should be sufficient for the design period of the system. Long term contaminant loadings from agricultural practices are not expected to exceed present levels, however it would be prudent to monitor land use in the immediate vicinity of the well site (radius of 2 kilometres).

Most of the activities which are associated with water supply contamination are located on the flanks of the esker deposit and therefore the aquifer is isolated by the impermeable clay silt materials. Information to date suggests that, as a result of the hydrogeologically favourable location of the site, no significant conflicts are expected.

Land use control should be exercised by the municipality to protect the well head area. A preliminary zone 500 metres wide on either side of the axis of the esker (WESA, 1987) and 2 kilometres north and south of the well site should be considered. This is generally referred to in the hydrogeological literature as a "well head protection zone". The mechanism by which a municipality institutes such a recommendation may be decided by the municipality in conjunction with their planners. These types of measures are more prevalent in the United States than in Canada and a search for precedent may prove to be valuable. A more comprehensive well head protection plan should be developed for the well site with the objective of possibly reducing the size of the protection zone. A well head protection plan has been developed for the Village of Carp for the Region of Ottawa Carleton and is available for review (WESA, 1992b).

3.7 Production Well Design and Well Maintenance

The completed production well (PPW1) is a 250 mm diameter artificial gravel packed well (Figure 4). This design incorporates a rounded silica gravel pack (sized to the formation) between the 500 mm hole and the 250 mm stainless steel screen. The advantages of this well design are easier well maintenance (removal of well screen encrustation through well acidification) and the screening of fine aquifer material, thereby reducing turbidity.

The standby well should be constructed using the same well design as the completed production well. The proposed location of the standby well is approximately 40 metres north-northeast of PPW1. This separation distance should be sufficient to prevent any impact on pumped water quality during well maintenance activities (ex. acid treatment) on the non-operating production well.

The drilling of a pilot test hole (6" or 8" diameter) is recommended at the proposed location of the standby well for verification of suitable geology for construction of the large diameter production well.

At this time no program of scheduled maintenance of the production well is recommended beyond the weekly monitoring of well specific capacity (discharge/drawdown). A decrease in specific capacity is an indication that well encrustation may be occurring and that periodic acidification by a qualified contractor is required. Care should be taken that the proper chlorine and acid concentrations are maintained during the cleaning process. Hackett and Lehr (1985) have suggested a free chlorine concentration of between 300 and 500 mg/l over an eighteen hour contact time was effective at killing iron bacteria. A concentration of twenty-eight percent hydrochloric acid is also recommended. Hackett and Lehr (1985) also recommend that the chlorinated water be forced out into the aquifer to ensure proper cleaning of the formation around the well. A surge block will effectively force the water out into the formation and also help to physically break up the precipitates. Review of data and the possible design of a maintenance schedule if required should be included in the program at the conclusion of the first year of operation.

The specific capacity is calculated by the maintenance personnel from the weekly record of drawdown in the production well and proximal piezometers. An automated system with a recorder may be preferred for monitoring of this type and would likely be much more cost effective over the longer term. The measurement of water levels should ideally be conducted at the same time and the same day of every week in order that demand induced fluctuations in the system may be minimized. Data collected will also be useful in the appraisal of system expansion potential.

4.0 CONCLUSIONS

The following conclusions have been derived from the work conducted in this study.

1. A sand and gravel glaciofluvial complex is present 3 km south east of the village of Vars. A production well has been successfully completed approximately 700 m south of the Devine Road within this complex.

2. A twenty year theoretical yield of 6009 m^3/d is technically feasible from the production well and aquifer. A safe perennial yield of 3506 m^3/d (551 igpm) or 60% of this value to account for well efficiency and a factor of safety would be more appropriate. The safe perennial yield of the aquifer may be more accurately determined, and possibly enlarged after a period of constant monitoring of the system after its commissioning. The design yield of 2621 m^3/d (400 igpm) falls within these ranges.

3. The means for calculating well efficiency were not effective at this site given the complex aquifer geometry and the orientation of the monitoring network available for the task. The efficiency of the well is such that the design yield and for that matter the safe perennial yield of the aquifer may be obtained from the production well.

4. Depression of the water table or piezometric surface occurs at the site of any groundwater withdrawal scheme. In the case of the Vars well site, the interference effects will be limited due to the fact that few wells are located close to the site. Water table depression due to pumping will most likely be unmeasurable beyond a radius of 500 m at the projected early system discharge rate of 11.4 L/s (first 5 to 10 years). The impact of increased discharge rates is not anticipated to be significant over the long term, for a discharge of up to 30.3 l/s (400 IGPM). Little if any interference on neighbouring farm and domestic water supplies is expected at the design yield of the well. Discharges over and above these levels must be investigated further. If interference in a neighbouring well does occur, it may be easily remedied through either deepening of the well or repair or resetting of the pump.

5. Water quality in the aquifer is superior to that found near or under the village of Vars. Treatment of the supply may be necessary to lower the colour, TOC and iron concentrations in the supply in order that Ontario Water Quality Objectives for drinking water are met (MOE Water Quality Objectives, 1984). Turbidity in the test well (if used as a standby pumping facility) will improve with additional development and pumping.

6. There does not appear to be any potential groundwater contamination sources in the immediate vicinity of the proposed production site. This status should be monitored and possibly some form of land use control be investigated by the municipality. Any spills or potential conflicts should be reported immediately. Access to the well site should be controlled. A provincial system for the immediate reporting of spills already exists, and should serve as an early warning system for the production site.

5.0 RECOMMENDATIONS

The following recommendations have been formulated based on the results of the study.

1. The aquifer at present may be used to meet the long term water supply needs for the village of Vars. Monitoring during its operation may establish a potentially wider service area and yield for some time in the future. Expansion of the water supply requirements placed on the aquifer, beyond those stated, should be accompanied with appropriate investigations and testing prior to detailed planning. Data collected during the early operation of the wells may be used to this end.

2. A pre-development survey of all wells within a one km radius of the production site should be undertaken. In the event of a perceived groundwater interference problem at a later time, the well in question should be examined thoroughly and a short report of the condition of the well should be compared to the initial survey. Rural based water supplies in other municipalities have been subjected to substantial criticism, and their ultimate potential reduced due to public opposition and perceived conflicts. The cost of repairing and even replacing allegedly affected water supplies is small in comparison to the cost for the municipality operating in an adversarial atmosphere.

3. A treatability study under separate cover (WESA, 1990;1992) should be referenced regarding the feasibility and costs associated with treatment of the water supply.

4. A pilot hole is recommended at the proposed location of the standby well for verification of suitable geology for construction of the large diameter production well.

5. A well head protection plan should be developed for the Vars well field over the longer term to protect and maximize the municipalities use of the groundwater resource. Over the short term while such a plan is being developed, an arbitrary protection zone regulating development that may place the aquifer at risk should be instituted. An initial protection zone defined by and area 500 metres wide on either side of the axis of the esker and 2 kilometres north and south of the well site should be enforced.

Respectfully submitted,

Roger M. Woeller, M.Sc.
Hydrogeologist

6.0 REFERENCES

Gorrell, 1987: Unpublished Geological Report Ontario Geological Survey

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Rorabaugh, M.J., 1953: Graphical and Theoretical Analysis of Step- Drawdown Data of Artesian Well. Proc. Amer. Soc. Civil Engineers, Volume 79, Separate No. 362, 23 pp.

Water and Earth Science Associates Ltd., 1992: On-Site Supply Pilot Treatment Study, Village of Vars, Ontario. Unpublished Preliminary Report, 13 p.

Water and Earth Science Associates Ltd., 1992b: Groundwater Protection Study, Carp, Ontario. Unpublished report for the Regional Municipality of Ottawa-Carleton.

Williams, D.A., Rae, A.M. and R.R. Wolf, 1985: Palaeozoic Geology of the Russell-Thurso Area, Southern Ontario; Ontario Geological Survey, Map 2717, Geological Series-Preliminary Map, scale 1:50 000. Geology 1982.

APPENDIX A

GRAIN SIZE DISTRIBUTION RESULTS

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

1 PRINT ONLY IN SPACES PROVIDED
2 CHECK ☑ CORRECT BOX WHERE APPLICABLE

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	LOT, CON., TRACT, SURVEY, ETC.	LOT
OTTAWA-CARLETON	CUMBERLAND ONT.	Con. 6	24
OWNER (SURNAME FIRST)	**ADDRESS**	**DATE COMPLETED**
VILLAGE OF VARS ONT.	VARS ONTARIO	DAY 01 MO 11 YR 91

PRODUCTION WELL

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH FEET FROM	TO
Brown	Loom		Loose	0'	2'
Brown	Sand		Loose	2'	16'
Grey	Clay		Medium	16'	20'
Grey	Stones	Sand & Boulders	Packed	20'	30'
Grey	Till	Stones & Sand	Packed	30'	62'
Grey	Till	Sand & Gravel	Packed	62'	76'

WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER	
63'	☒ FRESH ☐ SALTY	☐ SULPHUR ☐ MINERALS ☐ GAS
73'	☒ FRESH ☐ SALTY	☐ SULPHUR ☐ MINERALS ☐ GAS
	☐ FRESH ☐ SALTY	☐ SULPHUR ☐ MINERALS ☐ GAS
	☐ FRESH ☐ SALTY	☐ SULPHUR ☐ MINERALS ☐ GAS
	☐ FRESH ☐ SALTY	☐ SULPHUR ☐ MINERALS ☐ GAS

CASING & OPEN HOLE RECORD

INSIDE DIAM. INCHES	MATERIAL	WELL IN CASES WALL	DEPTH FEET FROM	TO
20"	☒ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC	.365	+2'	60'
10"	☒ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC	.365	+2'	63'
	☐ STEEL ☐ GALVANIZED ☐ CONCRETE ☐ OPEN HOLE ☐ PLASTIC			

SCREEN

SIZE OF OPENING	DIAMETER	LENGTH
80	10" INCHES	10'
MATERIAL AND TYPE	**DEPTH TO TOP OF SCREEN**	
STAINLESS STEEL	63' FEET	

PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PLUG, ETC.)
4'	20'	CEMENT GROUT
		30 Sacks of High Early Cement

PUMPING TEST

PUMPING TEST METHOD	PUMPING RATE	DURATION OF PUMPING
☒ PUMP ☐ BAILER	400 GPM	72 HOURS

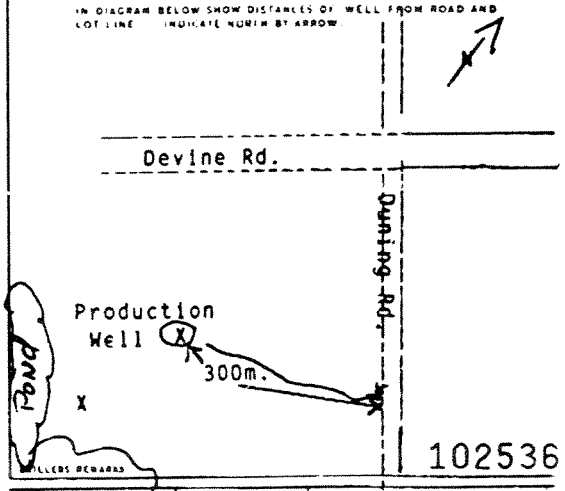
STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING PUMPING: 15 MINUTES	30 MINUTES	RECOVERY: AS SHOWN	30 MINUTES
3.75m FEET	FEET	FEET	FEET	FEET	FEET

IF FLOWING GIVE RATE	PUMP INTAKE SET AT	WATER AT END OF TEST
GPM	66' FEET	☒ CLEAR ☐ CLOUDY
RECOMMENDED PUMP TYPE	**RECOMMENDED PUMP SETTING**	**RECOMMENDED PUMPING RATE**
☐ SHALLOW ☒ DEEP	66' FEET	350 GPM

FINAL STATUS OF WELL	☒ WATER SUPPLY ☐ OBSERVATION WELL ☐ TEST HOLE ☐ RECHARGE WELL ☐ ABANDONED, INSUFFICIENT SUPPLY ☐ ABANDONED, POOR QUALITY ☐ UNFINISHED ☐ OTHER
WATER USE	☐ DOMESTIC ☐ STOCK ☐ IRRIGATION ☐ INDUSTRIAL ☐ COMMERCIAL ☒ MUNICIPAL ☐ PUBLIC SUPPLY ☐ COOLING OR AIR CONDITIONING ☐ OTHER ☐ NOT USED
METHOD OF CONSTRUCTION	☒ CABLE TOOL ☐ ROTARY (CONVENTIONAL) ☐ ROTARY (REVERSE) ☒ ROTARY (AIR) ☐ AIR PERCUSSION ☐ BORING ☐ DIAMOND ☐ JETTING ☐ DRIVING ☐ DIGGING ☐ OTHER

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



CONTRACTOR

NAME OF WELL CONTRACTOR	WELL CONTRACTOR'S LICENCE NUMBER
OLYMPIC DRILLING CO. LTD.	4006
ADDRESS	
Box 9180 OTTAWA, Ontario K1G 3T9	
NAME OF WELL TECHNICIAN	**WELL TECHNICIAN'S LICENCE NUMBER**
CECIL HUNRO	T-198
SIGNATURE OF TECHNICIAN/CONTRACTOR	**SUBMISSION DATE**
(Sec.)	DAY 20 MO 11 YR 91

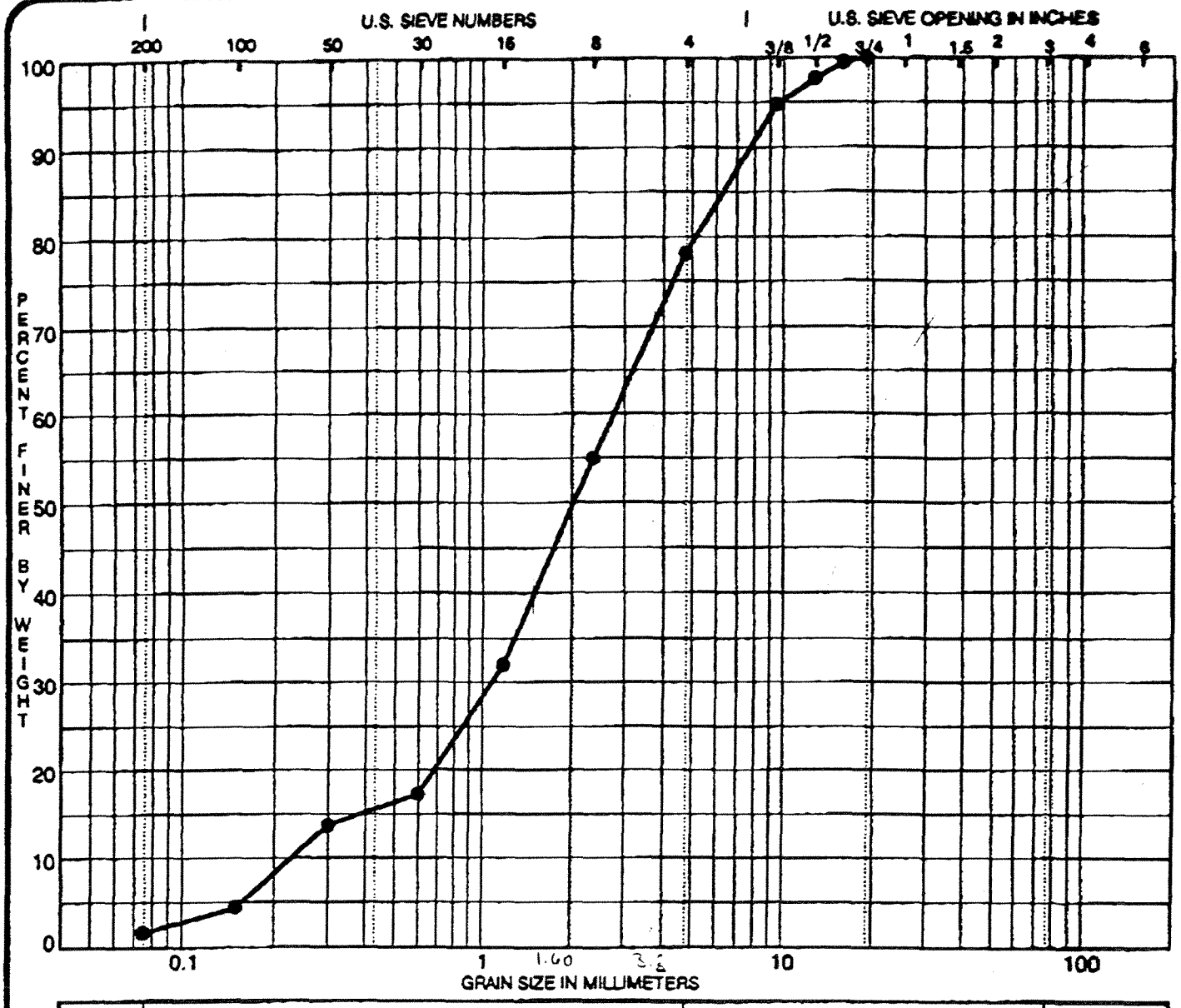
CONTRACTOR'S COPY

OFFICE USE ONLY

FORM NO. 0506 (11-88) FORM

P. 1

DEX 3508



SILT	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	SA 1	SAND-GRAVEL					1.86	12.1
	DEPTH 19.8m							

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	SA 1	19.05	2.75	1.077	0.2270	21.9	76.4	1.7	
			0.108						
			#8 x 1/4"	80 Slot					
			7/16 x 1/8	60 Slot					

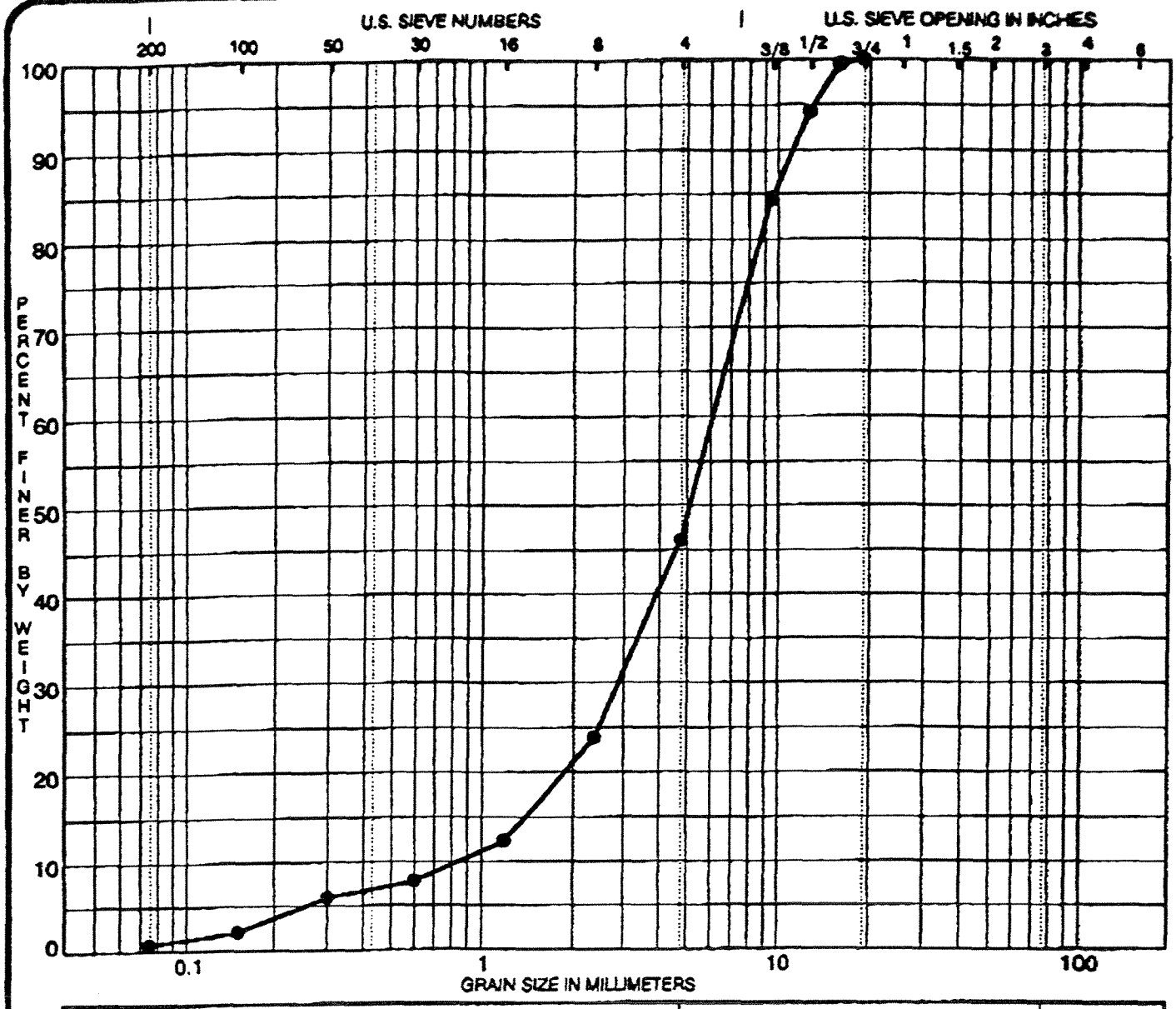
CLIENT Water & Earth Science Assoc. Ltd. FILE NO. M7823

PROJECT Laboratory Testing - Project No. 2492 DATE 11/10/91

74' →

GRAIN SIZE DISTRIBUTION

JOHN D. PATERSON & ASSOCIATES LTD.
28 Concourse Gate, Nepean, Ont. K2E 7T7



SILT	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● SA 2	GRAVEL					1.62	7.4
DEPTH 20.7 m							

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● SA 2	19.05	6.11	2.860	0.8286	53.9	45.3	0.8	
		0.241						

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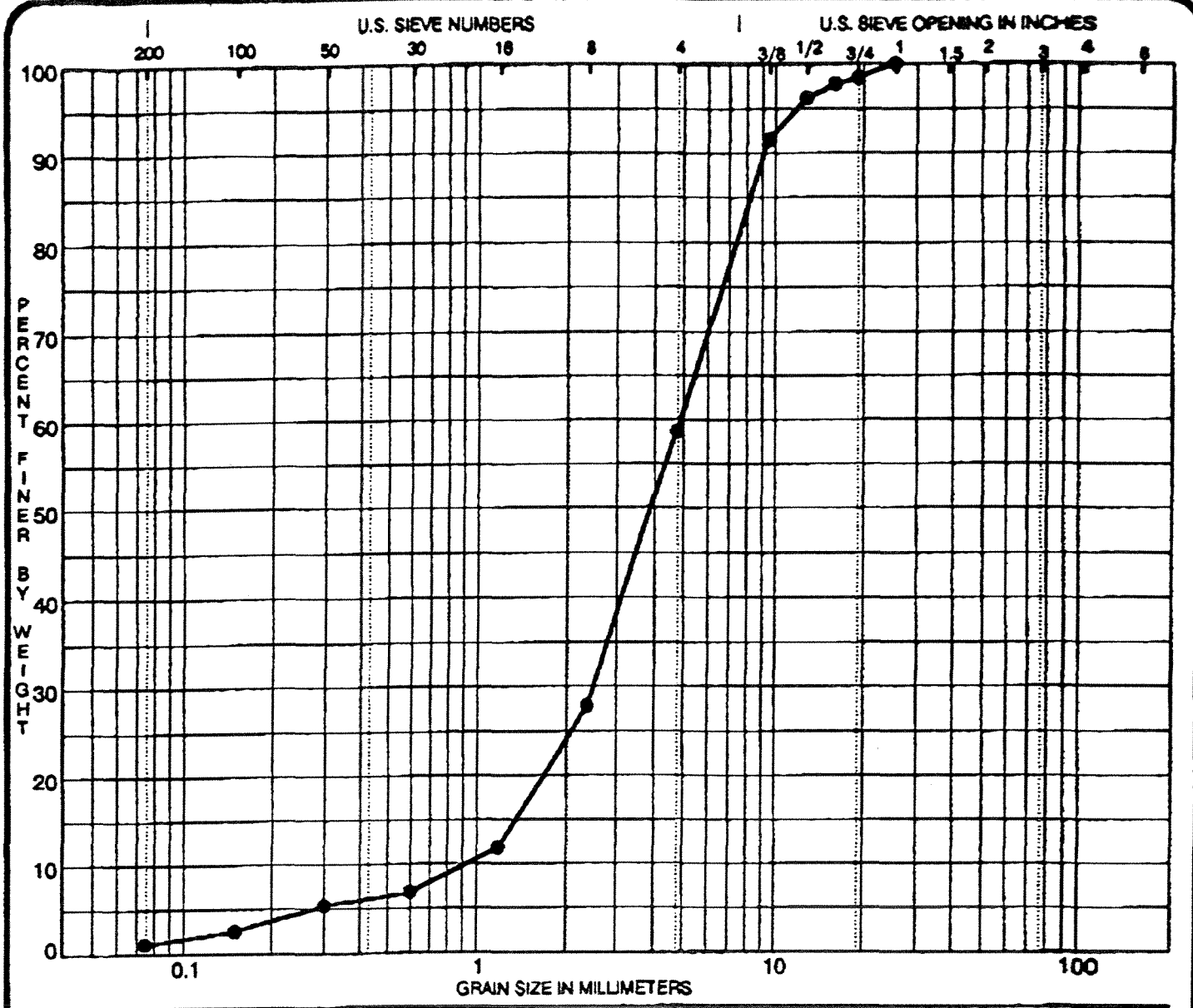

SILT	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	SA 3	SAND-GRAVEL					1.37	5.3
	DEPTH 21.6 M							

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	SA 3	25.40	4.88	2.481	0.9204	41.3	57.5	1.2	
			0.104						

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APPENDIX B

ANALYTICAL REPORTS

Bondar-Clegg & Company Ltd.
2420 Canotek Road
Ottawa, Ontario
K1J 9G2
(613) 749-2220 Telex 053-3233

BONDAR-CLEGG

A DIVISION OF INCHCAPE INSPECTION & TESTING SERVICES

Certificate of Analysis

REPORT: 091-42891.8 (COMPLETE)

REFERENCE INFO: 2492A, NOV.01/91

CLIENT: WATER & EARTH SCIENCES
PROJECT: NONE

SUBMITTED BY: T. SUGARMAN
DATE PRINTED: 5-NOV-91

ORDER	CHEM. ABS. SERVICE #	ELEMENT/COMPOUND NAME	NUMBER OF ANALYSES	DETECTION LIMIT	METHOD
1		Fec C Fecal Coliform/100ml	1	1 /ML	
2		Fec St Fecal Strep/100ml	1	/ML	
3		Pl Cnt Std Plate Cnt/100 ml	1	/ML	
4		TB Col Tot.bacgr.coli/100ml	1	/ML	
5		Tot C Total Coliform/100ml	1	1 /ML	

SAMPLE TYPES	NUMBER	SIZE FRACTIONS	NUMBER	SAMPLE PREPARATIONS	NUMBER
WATER	1	AS RECEIVED	1	As Received, No SP	1

REPORT COPIES TO: TAMI SUGARMAN

INVOICE TO: TAMI SUGARMAN

ondar-Clegg & Company Ltd.
120 Canotek Road
ttawa, Ontario
1J 9G2
(613) 749-2220 Telex 053-3233

BONDAR-CLEGG

A DIVISION OF INCHCAPE INSPECTION & TESTING SERVICES

Certificate of Analysis

REPORT: 091-42891.8 (COMPLETE)

DATE PRINTED: 5 NOV 91
PROJECT: NONE

Compound or C.A.S. Number	Units	Det. Limit	2492A-99W1-72HR NOV1
Fecal Coliform/100ml	/ML	1	<1
Fecal Strep/100ml	/ML		<2
Std Plate Cnt/100 ml	/ML		10
Tot.bacgr.coli/100ml	/ML		10
Total Coliform/100ml	/ML	1	<2

MANN TESTING LABORATORIES LTD.
5550 McADAM ROAD, MISSISSAUGA, ONTARIO L4Z 1P1
PHONE: 890-2555 • TELEX: 06-960496 • FAX: (416) 890-0370

CUSTOMER: WATER AND EARTH SCI.
P.O.BOX 430
CARP ONTARIO
K0A 1L0

REPORT #: 912807

PROJECT # 2492A
PROJECT NAME:

ATTN: T.SUGARMAN

DATE SUBMITTED: 1991-11-05

CERTIFICATE OF ANALYSIS

Sample Description: WATER

Preparation: Samples were prepared as recommended in APHA Standard methods for the examination of water and wastewater, 16th Edition, 1985 or MOE Handbook of analytical methods for environmental samples, 1983

Note: Additional information is available on request.

Instrumentation:

Metals - Jarrell Ash 61E ICAP emission
Perkin Elmer 3030 Zeeman graphite furnace
Perkin Elmer 2380 cold vapour AA

Anions - Dionex 2000i ion chromatograph

Conventionals - Skalar SA5 Segmented flow analyzer

Chemical Results: See attached tables
Quality control data: See attached tables

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
J.E. Forrester
CHEMIST

DATE: 12-10-1991

CERTIFIED BY:
Jim Forrester
Manager, Inorganic Dept.

MANN TESTING LABORATORIES LTD.
5550 McADAM ROAD, MISSISSAUGA, ONTARIO L4Z 1P1
PHONE: 890-2555 • TELEX: 06-960496 • FAX: (416) 890-0370

Water & Earth Science Associates Ltd.
P. O. Box 430
Carp, Ontario
K0A 1L0

ENV-007

ATTN: T. Sugarman

REPORT #: 112300

CUSTOMER REF.#2492 A

DATE SUBMITTED: Nov 5, 1991

DATE REPORTED: Nov 12, 1991

CERTIFICATE OF ANALYSIS

Sample Description: **WATER**

Analysis Performed: **VOLATILE ORGANIC ANALYSIS**

Protocol based upon U.S. EPA Method #624. Samples were received on Nov 5, 1991. Samples were fortified with isotopically labelled internal standards and analyzed by purge and trap gas chromatography/mass spectrometry (PT-GC/MS) on Nov 7, 1991.

Note: Additional information is available on request.

Instrumentation:

- Tekmar ALS 2016 Auto Liquid Sampler.
- Tekmar LSC 2000 Purge and Trap Concentrator.
- Hewlett Packard 5890 Gas Chromatograph.
- Hewlett Packard 5970 Mass Selective Detector.

Analytical Results: See Tables

Comments:

CERTIFIED BY:
Nellie Sio, B.Sc., C.Chem
Project Leader-Volatile Organics

WITNESSED BY:
Richard Szawiola, B.Sc.,C.Chem.*
Manager, Trace Organics
* **Refer inquiries to**

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PHONE: 890-2555 • TELEX: 06-960496 • FAX: (416) 890-0370

WATER & EARTH SCIENCE ASSOCIATES LTD.
P.O. Box 430
Carp, Ontario
K0A 1L0

DATE OF REPORT: November 12, 1991

DATE OF RECEIPT: November 5, 1991

MTL LAB. NO. : 912808

ATTENTION: TAMI SUGARMAN

CLIENT REF. NO.: Proj# 2492A

TYPE OF ANALYSIS REQUESTED: Dissolved Methane
TYPE OF SAMPLE SUBMITTED : Water **CHAIN OF CUSTODY (Y/N):** Y
METHOD : Modified Combustible Gas Indicator Method

ANALYTICAL RESULTS

	COMPONENT ANALYSED		
Sample I.D.	**Dissolved Methane (L/m^3)**		
2492A-PPW1-1 Hr	2.5		
2492A-PPW1-72 Hr	3.9		
MDL	0.005		

COMMENTS:
MDL = Method Detection Limit
BMDL = Below Method Detection Limit
ND = Not Detected

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
Elizabeth M. Cliffe
CHEMIST

CERTIFIED BY: Joyce MacDonald
Joyce MacDonald, B.Sc.,C.Chem.
Air Quality Services

WITNESSED BY: E. Cliffe
Elizabeth Cliffe, C.Chem.
Supervisor, Air Quality Services

ACCUTEST LABORATORIES LTD.
146 Colonnade Road, Unit 8, Nepean, Ontario K2E 7Y3 Tel.: (613) 727-5692 Fax: (613) 727-5222

REPORT OF ANALYSES

CLIENT: *Water & Earth Sc.Assoc.*
T.Sugarman

LAB REPORT NO: A1-2501
DATE: Nov.14,1991
DATE SUBMITTED: Oct.29,1991
PROJECT: 2492A

SAMPLE MATRIX:

PARAMETER	UNITS	LOQ	Sample PPW1-1hr.	Sample PPW1-6hrs.	Sample	Sample
Fe	mg/L	0.01	0.54	0.59		
Hardness	mg/L	3	168			
Alkalinity	mg/L	2	186			
pH		0.01	7.95			
Conductivity	umhos/cm	10	310			
F	mg/L	0.01	0.11			
Na	mg/L	1	10			
N-NO3	mg/L	0.1	nd	nd		
N-NO2	mg/L	0.1	nd			
N-NH3	mg/L	0.1	0.32			
SO4	mg/L	3	9	32		
Cl	mg/L	1	1	1		
Phenols	mg/L	0.002	nd	nd		
Turbidity	NTU	0.1	nd	nd		
Colour	Pt/Co Units	2	30	30		
Ca	mg/L	1	49			
Mg	mg/L	1	11			
Total N	mg/L	0.1	0.50			
K	mg/L	1	3			
TOC	mg/L	0.1	5.0	5.0		
TDS	mg/L	1	182	182		
H2S	mg/L	0.02	0.02	0.02		
Ion.Balance			0.98			

LOQ= lowest level of parameter that can be quantitated with confidence nd= not detected

COMMENTS:

ANALYST: _____

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REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.

LAB REPORT NO: A1-2501

DATE: Nov.14, 1991

Attention: T. Sugarman

PROJECT: 2492A

PARAMETER	UNITS	Sample	Sample	Sample	Sample	Sample
		PPW 1 1hr.	PPW 1 6hrs.			
Uranium	mg/L	<0.01	<0.01			
Diss.Oxygen	mg/L	6.5	5.1			
Temperature	deg.C.	22	22			

ANALYST: _____

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REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.

LAB REPORT NO: A1-2501

DATE: Nov. 14,1991

PROJECT: 2492A

PARAMETER	UNITS	MDL	Sample PPW 1 1hr.	Sample PPW 1 6hrs.	Sample Blank 1hr.
Benzene	ug/L	0.5	nd	nd	nd
Bromodichloromethane	ug/L	1			
Bromoform	ug/L	1			
Bromomethane	ug/L	4			
Carbon tetrachloride	ug/L	2			
Chlorobenzene	ug/L	1			
Chloroethane	ug/L	4			
2-Chloroethylvinyl ether	ug/L	5			
Chloroform	ug/L	1			
Chloromethane	ug/L	4			
Dibromochloromethane	ug/L	1			
1,2-Dibromoethane	ug/L	1			
m-Dichlorobenzene	ug/L	1			
o-Dichlorobenzene	ug/L	1			
p-Dichlorobenzene	ug/L	1			
1,1-Dichloroethane	ug/L	1			
1,2-Dichloroethane	ug/L	2			
c-1,2-Dichloroethene	ug/L	2			
1,1-Dichloroethylene	ug/L	1			
t-1,2-Dichloroethylene	ug/L	1			
1,2-Dichloropropane	ug/L	1			
c-1,3-Dichloropropene	ug/L	1			
t-1,3-Dichloropropene	ug/L	1			
Ethylbenzene	ug/L	0.5	nd	nd	nd
Methylene chloride	ug/L	5			
Styrene	ug/L	0.2	nd	nd	nd
1,1,2,2-Tetrachloroethane	ug/L	1			
Tetrachloroethylene	ug/L	1			

ANALYST: _____

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REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.

LAB REPORT NO: A1-2501

DATE: Nov.14, 1991

PROJECT: 2492A

PARAMETER	UNITS	MDL	Sample PPW 1 1hr.	Sample PPW 1 6hrs.	Sample Blank 1hr.
Toluene	ug/L	1.0	3.3	nd	nd
1,1,1-Trichloroethane	ug/L	1			
1,1,2-Trichloroethane	ug/L	1			
Trichloroethylene	ug/L	1			
Trichlorofluoromethane	ug/L	1			
1,3,5-Trimethylbenzene	ug/L	1			
Vinyl Chloride	ug/L	4			
m/p-Xylene	ug/L	1.0	nd	nd	nd
o-Xylene	ug/L	0.5	nd	nd	nd

ANALYST: _____

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REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.

LAB REPORT NO: A1-2501

DATE: Nov.14,1991

PROJECT: 2492A

PARAMETER	UNITS	MDL	Sample PPW 1 1hr.	Sample	Sample
Benzene	ug/L	0.5	nd		
Bromodichloromethane	ug/L	1			
Bromoform	ug/L	1			
Bromomethane	ug/L	4			
Carbon tetrachloride	ug/L	2			
Chlorobenzene	ug/L	1			
Chloroethane	ug/L	4			
2-Chloroethylvinyl ether	ug/L	5			
Chloroform	ug/L	1			
Chloromethane	ug/L	4			
Dibromochloromethane	ug/L	1			
1,2-Dibromoethane	ug/L	1			
m-Dichlorobenzene	ug/L	1			
o-Dichlorobenzene	ug/L	1			
p-Dichlorobenzene	ug/L	1			
1,1-Dichloroethane	ug/L	1			
1,2-Dichloroethane	ug/L	2			
c-1,2-Dichloroethene	ug/L	2			
1,1-Dichloroethylene	ug/L	1			
t-1,2-Dichloroethylene	ug/L	1			
1,2-Dichloropropane	ug/L	1			
c-1,3-Dichloropropene	ug/L	1			
t-1,3-Dichloropropene	ug/L	1			
Ethylbenzene	ug/L	0.5	nd		
Methylene chloride	ug/L	5			
Styrene	ug/L	0.2	nd		
1,1,2,2-Tetrachloroethane	ug/L	1			
Tetrachloroethylene	ug/L	1			

ANALYST: _____

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REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.

LAB REPORT NO: A1-2501

DATE: Nov.14, 1991

PROJECT: 2492A

PARAMETER	UNITS	MDL	Sample Blank 6hrs.	Sample	Sample
Toluene	ug/L	1.0	nd		
1,1,1-Trichloroethane	ug/L	1			
1,1,2-Trichloroethane	ug/L	1			
Trichloroethylene	ug/L	1			
Trichlorofluoromethane	ug/L	1			
1,3,5-Trimethylbenzene	ug/L	1			
Vinyl Chloride	ug/L	4			
m/p-Xylene	ug/L	1.0	nd		
o-Xylene	ug/L	0.5	nd		

ANALYST: _____

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QUALITY CONTROL CERTIFICATE

CLIENT: Water & Earth Sc.Assoc. LAB REPORT NO:

T.Sugarman DATE:

PROJECT:

PARAMETER	UNITS	LOQ	AL	MTD BLK	STD LAB	STD ACT	ACC DEV	ACC Y/N
Fe	mg/L	0.01	0.01	nd	0.5	0.47	0.07	Y
Hardness	mg/L	3	1	nd	45	45	10	Y
Alkalinity	mg/L	2	1	nd	40	40	8	Y
pH		0.01	0.01	nd	4.5	4.52	0.23	Y
Conductivity	umhos/cm	10	10	nd	350	347	45	Y
F	mg/L	0.01	0.01	nd	2.4	2.2	0.22	Y
Na	mg/L	1	1	nd	39	37	5	Y
N-NO3	mg/L	0.1	0.01	nd	0.37	0.36	0.06	Y
N-NO2	mg/L	0.1	0.01	nd				
N-NH3	mg/L	0.1	0.01	nd	0.23	0.25	0.18	Y
SO4	mg/L	3	3	nd	18	18	3	Y
Cl	mg/L	1	1	nd	56	56	6	Y
Phenols	mg/L	0.002	0.002	nd	0.118	0.112	0.045	Y
Turbidity	NTU	0.1	0.1	nd				
Colour	Pt/Co Units	2	2	nd				
Ca	mg/L	1	1	nd	8	8	1	Y
Mg	mg/L	1	1	nd	6	6	1	Y
Total N	mg/L	0.1	0.1	nd	0.71	0.69	0.46	Y
K	mg/L	1	1	nd	11.6	11.6	1.8	Y
TOC	mg/L	0.1	0.1	nd	26	26	5	Y
TDS	mg/L	1	1	nd				
H2S	mg/L	0.02	0.01	nd				

LOQ=limit of quantitaion
AL=accuracy limit
MTD BLK=method blank
nd=not detectable

STD LAB=Lab generated value of standard
STD ACT=actual value of standard
ACC DEV=acceptable deviation of standard
ACC Y/N=IS STD LAB within deviation

ANALSYT:

ACCUTEST LABORATORIES LTD.
146 Colonnade Road, Unit 8, Nepean, Ontario K2E 7Y3 Tel.: (613) 727-5692 Fax: (613) 727-5222

METHODS/INSTRUMENTS

CLIENT: Water & Earth Sc.Assoc.

T.Sugarman

LAB REPORT NO:

DATE:

PROJECT:

PARAMETER	METHOD	INSTRUMENT
Iron	APHA 303A,303C,305	Jobin Yvon JY24 ICP Spec.
Hardness	APHA 314A,314B	
Alkalinity	APHA 403	
pH	APHA 423	Fisher 119 pH Meter
Conductivity	APHA 205	Extech Oyster Conductivity Meter
Fluoride	APHA 413B	Fisher Accumet pH/ISE Meter
Sodium	APHA 303A,303C,305	Varian SpectrAA-10 AA Spec.
Nitrate	APHA 418F	Technicon Autoanalyser
Nitrite	APHA 418F	Technicon Autoanalyser
Ammonia	APHA 417G	Technicon Autoanalyser
Sulfate	APHA 426D	Technicon Autoanalyser
Chloride	APHA 407A	
Phenols	APHA 510C	Technicon Autoanalyser
Turbidity	APHA 214A	Hach 2100A Turbidimeter
Colour	APHA 204B	Milton Roy Spectronic 20d
Calcium	APHA 303A,303C,305	Varian SpectrAA-10 AA Spec.
Magnesium	APHA 303A,303C,305	Varian SpectrAA-10 AA Spec.
Total Kjeldahl Nitrogen	APHA 420A	Tecator 1007 Dig./1002 Dist.
Potassium	APHA 303A,303C,305	Varian SpectrAA-10 AA Spec.
Total Organic Carbon	APHA 505B	Astro 2001 TOC Analyser
Total Dissolved Solids	APHA 209B	Mettler AJ100 Analytical Balance
Hydrogen Sulfide	APHA 427C	Milton Roy Spectronic 20d

ANALYST: 

LAB REPORT NO.:
Numéro de rapport: A1-2501

(1)

ACCUTEST Laboratories Ltd.

146 Colonnade Road, Unit 8, Nepean, Ontario K2E 7Y1 Tel.: (613) 727-5692 Fax: (613) 727-5222

WESA

BACTERIOLOGICAL ASSESSMENT OF WATER
ÉVALUATION BACTÉRIOLOGIQUE DE L'EAU

NAME/NOM	T. SUGARMAN
COMPANY/SOCIÉTÉ	WESA
STREET, R.R., BOX NO./RUE, R.R., CASIER POSTAL	BOX 430
CITY, TOWN/VILLE	CARP
PROVINCE	ONT.
POSTAL CODE/CODE POSTAL	K0A 1L0
TELEPHONE/TÉLÉPHONE Area Code/Indicatif Régional:	Number/Numéro:

SAMPLE INFORMATION/RENSEIGNEMENTS SUR L'ÉCHANTILLON

Sample location/Lieu de prélèvement	Sample number/No. d'échantillon	Date collected/Date de prélèvement	Reference number/ No. de référence
VARS	2492A PPW1 1HR	OCT. 29 (9:00AM)	

CHECK APPROPRIATE BOXES/COCHER LA CASE APPROPRIÉE

DRINKING WATER/EAU POTABLE

- ☐ Treated/Épurée
- ☐ Non-treated/Non-épurée
- ☐ Existing well/Puits existant
- ☐ New well/Nouveau puits

NON-DRINKING WATER/EAU NON POTABLE

- ☐ River/Rivière
- ☐ Pool/Piscine
- ☐ Sewage/Égout
- ☐ Lake/Lac
- ☐ Other/Autre

Specify: _____
Spécifiez:

SAMPLING INSTRUCTIONS
DIRECTIVES POUR LE PRÉLÈVEMENT

1. Do NOT rinse sample container — it contains sodium thiosulphate preservative.
   NE PAS rincer la bouteille car elle contient l'agent préservateur sodium thiosulphate de sodium.
2. Water must run for 2 to 3 minutes before collecting sample.
   Laisser couler l'eau pendant 2 ou 3 minutes avant de remplir la bouteille.
3. Fill bottle to about ½ inch from the top.
   Remplir la bouteille jusqu'à 2 cm du bouchon.
4. Deliver sample to laboratory immediately. Refrigerate if possible.
   Retourner l'échantillon immédiatement au laboratoire, réfrigéré si possible.

NOTE: Samples must be submitted to the laboratory within 48 hours of collection.
Non potable samples MUST be received within 6 hours if unrefrigerated or within 24 hours if refrigerated.

IMPORTANT: Les échantillons doivent arriver au laboratoire dans les 48 heures après le prélèvement; les échantillons d'eau non-potable doivent être retournés dans les 6 heures ou, si réfrigérés, dans les 24 heures qui suivent le prélèvement.

TEST RESULTS/RÉSULTATS DES TESTS				COMMENTS/REMARQUES
BACTERIAL COUNT/NUMÉRATION DES BACTÉRIES Based on 100 ml volume/Basé sur un volume de 100 ml				
Total coliform/ Total des colibacilles	Faecal Coliform/ Colibacilles Fécaux	Faecal Strep./ Streptocoques Fécaux	Background/ Teneurs de Fond	
4	0	0	<1/ml	

RESULT INTERPRETATION ON REVERSE
Interprétation des Résultats au verso

Date: Nov 1/91

Analyst: L. Rautbar
Technologue:

LAB REPORT NO.:
Numéro de rapport: A1-2501

(2)

ACCUTEST Laboratories Ltd.

146 Colonnade Road, Unit 8, Nepean, Ontario K2E 7Y1 Tel.: (613) 727-5692 Fax: (613) 727-5222

BACTERIOLOGICAL ASSESSMENT OF WATER
ÉVALUATION BACTÉRIOLOGIQUE DE L'EAU

NAME/NOM	T. SUGARMAN
COMPANY/SOCIÉTÉ	WESA
STREET, R.R., BOX NO./RUE, R.R., CASIER POSTAL	BOX 430
CITY, TOWN/VILLE	CARP
PROVINCE	ONT.
POSTAL CODE/CODE POSTAL	K0A 1L0
TELEPHONE/TÉLÉPHONE Area Code/Indicatif Régional:	Number/Numéro:

SAMPLE INFORMATION/RENSEIGNEMENTS SUR L'ÉCHANTILLON

Sample location/Lieu de prélèvement	Sample number/No. d'échantillon	Date collected/Date de prélèvement	Reference number/ No. de référence
ARS	2492A-PWI-UNR	Oct. 29 92 / 2:00 PM	

CHECK APPROPRIATE BOXES/COCHER LA CASE APPROPRIÉE

DRINKING WATER/EAU POTABLE	NON-DRINKING WATER/EAU NON POTABLE
☐ Treated/Épurée ☐ Non-treated/Non-épurée	☐ River/Rivière ☐ Pool/ Piscine
☐ Existing well/ Puits existant	☐ Sewage/ Égout ☐ Lake/Lac
☒ New well/Nouveau puits	☐ Other/Autre
	Specify: _____ Spécifiez:

SAMPLING INSTRUCTIONS
DIRECTIVES POUR LE PRÉLÈVEMENT

1. Do NOT rinse sample container — it contains sodium thiosulphate preservative.
   NE PAS rincer la bouteille car elle contient l'agent préservateur sodium thiosulphate de sodium.
2. Water must run for 2 to 3 minutes before collecting sample.
   Laisser couler l'eau pendant 2 ou 3 minutes avant de remplir la bouteille.
3. Fill bottle to about ½ inch from the top.
   Remplir la bouteille jusqu'à 2 cm du bouchon.
4. Deliver sample to laboratory immediately. Refrigerate if possible.
   Retourner l'échantillon immédiatement au laboratoire, réfrigéré si possible.

NOTE: Samples must be submitted to the laboratory within 48 hours of collection.
Non potable samples MUST be received within 6 hours if unrefrigerated or within 24 hours if refrigerated.

IMPORTANT: Les échantillons doivent arriver au laboratoire dans les 48 heures après le prélèvement; les échantillons d'eau non-potable doivent être retournés dans les 6 heures ou, si réfrigérés, dans les 24 heures qui suivent le prélèvement.

TEST RESULTS/RÉSULTATS DES TESTS				COMMENTS/REMARQUES
BACTERIAL COUNT/NUMÉRATION DES BACTÉRIES Based on 100 ml volume/Basé sur un volume de 100 ml				
Total coliform/ Total des colibacilles	Faecal Coliform/ Colibacilles Fécaux	Faecal Strep./ Streptocoques Fécaux	Background/ Teneurs de Fond	
10	0	—	—	

RESULT INTERPRETATION ON REVERSE
Interprétation des Résultats au verso

Date: Nov 1/92

Analyst: P. Rankin
Technologue:

ACCUTEST LABORATORIES LTD.
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REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.
T.Sugarman

LAB REPORT NO: A1-2514
DATE: Nov.15,1991
DATE SUBMITTED: Oct.29,1991
PROJECT: 2492A

SAMPLE MATRIX:

PARAMETER	UNITS	LOQ	Sample PPW 1-12hrs.	Sample PPW 1-24hrs.	Sample	Sample
Fe	mg/L	0.01	0.60	0.62		
Mn	mg/L	0.01				
Hardness	mg/L	3				
Alkalinity	mg/L	2				
pH		0.01				
Conductivity	umhos/cm	10				
F	mg/L	0.01				
Na	mg/L	1				
N-NO3	mg/L	0.1	nd	nd		
N-NO2	mg/L	0.1				
N-NH3	mg/L	0.1				
SO4	mg/L	3	4	3		
Cl	mg/L	1	2	1		
Phenols	mg/L	0.002	nd	nd		
Turbidity	NTU	0.1	nd	nd		
Colour	Pt/Co Units	2	20	20		
Ca	mg/L	1				
Mg	mg/L	1				
Tann./Lig.	mg/L	0.5				
Total N	mg/L	0.1				
K	mg/L	1				
TOC	mg/L	0.1	5.0	4.9		
TDS	mg/L	1	204	204		
H2S	mg/L	0.02	0.03	0.03		
Ion.Balance						

LOQ= lowest level of parameter that can be quantitated with confidence nd= not detected

COMMENTS:

ANALYST: _____

ACCUTEST LABORATORIES LTD.

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QUALITY CONTROL CERTIFICATE

CLIENT: Water & Earth Sc.Assoc. LAB REPORT NO:

T.Sugarman DATE:

PROJECT:

PARAMETER	UNITS	LOQ	AL	MTD BLK	STD LAB	STD ACT	ACC DEV	ACC Y/N
Fe	mg/L	0.05	0.01	nd	0.43	0.47	0.07	Y
Mn	mg/L	0.05	0.01	nd	0.22	0.2	0.03	Y
Hardness	mg/L	3	1	nd	45	45	10	Y
Alkalinity	mg/L	2	1	nd	38	40	8	Y
pH		0.01	0.01	nd	4.6	4.52	0.46	Y
Conductivity	umhos/cm	10	10	nd	300	315	35	Y
F	mg/L	0.01	0.01	nd	2.4	2.2	0.22	Y
Na	mg/L	1	1	nd	39	37	5	Y
N-NO3	mg/L	0.1	0.01	nd	0.36	0.35	0.06	Y
N-NO2	mg/L	0.1	0.01	nd				
N-NH3	mg/L	0.1	0.01	nd	0.23	0.25	0.18	Y
SO4	mg/L	3	3	nd	18	18	3	Y
Cl	mg/L	1	1	nd	56	56	6	Y
Phenols	mg/L	0.002	0.002	nd	0.115	0.112	0.045	Y
Turbidity	NTU	0.1	0.1	nd				
Colour	Pt/Co Units	2	2	nd				
Ca	mg/L	1	1	nd	8	8	1	Y
Mg	mg/L	1	1	nd	7	6	1	Y
Tann./Lig.	mg/L	0.5	0.5	nd				
Total N	mg/L	0.1	0.1	nd	0.71	0.69	0.46	Y
K	mg/L	1	1	nd	11.6	11.6	1.8	Y
TOC	mg/L	0.1	0.1	nd	26	26	5	Y
TDS	mg/L	1	1	nd				
H2S	mg/L	0.02	0.01	nd				

LOQ=limit of quantitaion
AL=accuracy limit
MTD BLK=method blank
nd=not detectable

STD LAB=Lab generated value of standard
STD ACT=actual value of standard
ACC DEV=acceptable deviation of standard
ACC Y/N=IS STD LAB within deviation

ANALSYT:

ACCUTEST LABORATORIES LTD.
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METHODS/INSTRUMENTS

CLIENT: Water & Earth Sc.Assoc.

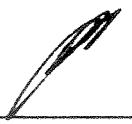
T.Sugarman

LAB REPORT NO:

DATE:

PROJECT:

PARAMETER	METHOD	INSTRUMENT
Iron	APHA 303A,303C,305	Jobin Yvon JY24 ICP Spec.
Manganese	APHA 303A,303C,305	Jobin Yvon JY24 ICP Spec.
Hardness	APHA 314A,314B	
Alkalinity	APHA 403	
pH	APHA 423	Fisher 119 pH Meter
Conductivity	APHA 205	Extech Oyster Conductivity Meter
Fluoride	APHA 413B	Fisher Accumet pH/ISE Meter
Sodium	APHA 303A,303C,305	Varian SpectrAA-10 AA Spec.
Nitrate	APHA 418F	Technicon Autoanalyser
Nitrite	APHA 418F	Technicon Autoanalyser
Ammonia	APHA 417G	Technicon Autoanalyser
Sulfate	APHA 426D	Technicon Autoanalyser
Chloride	APHA 407A	
Phenols	APHA 510C	Technicon Autoanalyser
Turbidity	APHA 214A	Hach 2100A Turbidimeter
Colour	APHA 204B	Milton Roy Spectronic 20d
Calcium	APHA 303A,303C,305	Varian SpectrAA-10 AA Spec.
Magnesium	APHA 303A,303C,305	Varian SpectrAA-10 AA Spec.
Tannin & Lignin	APHA 513	Milton Roy Spectronic 20d
Total Kjeldahl Nitrogen	APHA 420A	Tecator 1007 Dig./1002 Dist.
Potassium	APHA 303A,303C,305	Varian SpectrAA-10 AA Spec.
Total Organic Carbon	APHA 505B	Astro 2001 TOC Analyser
Total Dissolved Solids	APHA 209B	Mettler AJ100 Analytical Balance
Hydrogen Sulfide	APHA 427C	Milton Roy Spectronic 20d

ANALYST: 

ACCUTEST LABORATORIES LTD.
146 Colonnade Road, Unit 8, Nepean, Ontario K2E 7Y3 Tel.: (613) 727-5692 Fax: (613) 727-5222

REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.

LAB REPORT NO: A1-2514

DATE: Nov.15,1991

Attention: T.Sugarman

PROJECT: 2492A

PARAMETER	UNITS	Sample	Sample	Sample	Sample	Sample
		PPW 1 12hrs.	PPW 1- 24hrs.			
Uranium	mg/L	<0.01	<0.01			
Diss.Oxygen	mg/L	5.95	7.20			
Temperature	deg.C.	19	19			

ANALYST: _____

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REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.

LAB REPORT NO: A1-2514

DATE: Nov.15,1991

PROJECT: 2492A

PARAMETER	UNITS	MDL	Sample PPW 1 12hrs.	Sample PPW 1 24hrs.	Sample Blank 12hrs.
Benzene	ug/L	0.5	nd	nd	nd
Bromodichloromethane	ug/L	1			
Bromoform	ug/L	1			
Bromomethane	ug/L	4			
Carbon tetrachloride	ug/L	2			
Chlorobenzene	ug/L	1			
Chloroethane	ug/L	4			
2-Chloroethylvinyl ether	ug/L	5			
Chloroform	ug/L	1			
Chloromethane	ug/L	4			
Dibromochloromethane	ug/L	1			
1,2-Dibromoethane	ug/L	1			
m-Dichlorobenzene	ug/L	1			
o-Dichlorobenzene	ug/L	1			
p-Dichlorobenzene	ug/L	1			
1,1-Dichloroethane	ug/L	1			
1,2-Dichloroethane	ug/L	2			
c-1,2-Dichloroethene	ug/L	2			
1,1-Dichloroethylene	ug/L	1			
t-1,2-Dichloroethylene	ug/L	1			
1,2-Dichloropropane	ug/L	1			
c-1,3-Dichloropropene	ug/L	1			
t-1,3-Dichloropropene	ug/L	1			
Ethylbenzene	ug/L	0.5	nd	nd	nd
Methylene chloride	ug/L	5			
Styrene	ug/L	0.2	nd	nd	nd
1,1,2,2-Tetrachloroethane	ug/L	1			
Tetrachloroethylene	ug/L	1			

ANALYST: _____

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REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.

LAB REPORT NO: A1-2514

DATE: Nov.14,1991

PROJECT: 2492A

PARAMETER	UNITS	MDL	Sample PPW 1 12hrs.	Sample PPW 1 24hrs.	Sample Blank 12hrs.
Toluene	ug/L	1.0	1.7	nd	nd
1,1,1-Trichloroethane	ug/L	1			
1,1,2-Trichloroethane	ug/L	1			
Trichloroethylene	ug/L	1			
Trichlorofluoromethane	ug/L	1			
1,3.5-Trimethylbenzene	ug/L	1			
Vinyl Chloride	ug/L	4			
m/p-Xylene	ug/L	1.0	nd	nd	nd
o-Xylene	ug/L	0.5	nd	nd	nd

ANALYST: _____

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REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.

LAB REPORT NO: A1-2514

DATE: Nov.15,1991

PROJECT: 2492A

PARAMETER	UNITS	MDL	Sample	Sample	Sample
			Blank 24hrs.		
Benzene	ug/L	0.5	nd		
Bromodichloromethane	ug/L	1			
Bromoform	ug/L	1			
Bromomethane	ug/L	4			
Carbon tetrachloride	ug/L	2			
Chlorobenzene	ug/L	1			
Chloroethane	ug/L	4			
2-Chloroethylvinyl ether	ug/L	5			
Chloroform	ug/L	1			
Chloromethane	ug/L	4			
Dibromochloromethane	ug/L	1			
1,2-Dibromoethane	ug/L	1			
m-Dichlorobenzene	ug/L	1			
o-Dichlorobenzene	ug/L	1			
p-Dichlorobenzene	ug/L	1			
1,1-Dichloroethane	ug/L	1			
1,2-Dichloroethane	ug/L	2			
c-1,2-Dichloroethene	ug/L	2			
1,1-Dichloroethylene	ug/L	1			
t-1,2-Dichloroethylene	ug/L	1			
1,2-Dichloropropane	ug/L	1			
c-1,3-Dichloropropene	ug/L	1			
t-1,3-Dichloropropene	ug/L	1			
Ethylbenzene	ug/L	0.5	nd		
Methylene chloride	ug/L	5			
Styrene	ug/L	0.2	nd		
1,1,2,2-Tetrachloroethane	ug/L	1			
Tetrachloroethylene	ug/L	1			

ANALYST: _____

ACCUTEST LABORATORIES LTD.
146 Colonnade Road, Unit 8, Nepean, Ontario K2E 7Y3 Tel.: (613) 727-5692 Fax: (613) 727-5222

REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.

LAB REPORT NO: A1-2514

DATE: Nov.14,1991

PROJECT: 2492A

PARAMETER	UNITS	MDL	Sample Blank 24hrs.	Sample	Sample
Toluene	ug/L	1.0	1.5		
1,1,1-Trichloroethane	ug/L	1			
1,1,2-Trichloroethane	ug/L	1			
Trichloroethylene	ug/L	1			
Trichlorofluoromethane	ug/L	1			
1,3,5-Trimethylbenzene	ug/L	1			
Vinyl Chloride	ug/L	4			
m/p-Xylene	ug/L	1.0	nd		
o-Xylene	ug/L	0.5	nd		

ANALYST: _____

LAB REPORT NO.:
Numéro de rapport: A12514

ACCUTEST Laboratories Ltd.

146 Colonnade Road, Unit 8, Nepean, Ontario K2E 7Y1 Tel.: (613) 727-5692 Fax: (613) 727-5222

(1)

BACTERIOLOGICAL ASSESSMENT OF WATER
ÉVALUATION BACTÉRIOLOGIQUE DE L'EAU

NAME/NOM	Tomi [redacted]
COMPANY/SOCIÉTÉ	[redacted]
STREET, R.R., BOX NO./RUE, R.R., CASE POSTAL	CITY, TOWN/VILLE
PROVINCE	POSTAL CODE/CODE POSTAL
TELEPHONE/TÉLÉPHONE Area Code/Indicatif Régional:	Number/Numéro:

SAMPLE INFORMATION/RENSEIGNEMENTS SUR L'ÉCHANTILLON

Sample location/Lieu de prélèvement	Sample number/No. d'échantillon	Date collected/Date de prélèvement	Reference number/ No. de référence
Vars	24922-PW1-12NR	Oct 29/91	

CHECK APPROPRIATE BOXES/COCHER LA CASE APPROPRIÉE

DRINKING WATER/EAU POTABLE

- ☐ Treated/Épurée
- ☐ Non-treated/Non-épurée
- ☐ Existing well/ Puits existant
- ☑ New well/Nouveau puits

NON-DRINKING WATER/EAU NON POTABLE

- ☐ River/Rivière
- ☐ Pool/ Piscine
- ☐ Sewage/ Égout
- ☐ Lake/Lac
- ☐ Other/Autre

Specify: _____
Spécifiez:

SAMPLING INSTRUCTIONS
DIRECTIVES POUR LE PRÉLÈVEMENT

1. Do NOT rinse sample container — it contains sodium thiosulphate preservative.
   NE PAS rincer la bouteille car elle contient l'agent préservateur sodium thiosulphate de sodium.
2. Water must run for 2 to 3 minutes before collecting sample.
   Laisser couler l'eau pendant 2 ou 3 minutes avant de remplir la bouteille.
3. Fill bottle to about ½ inch from the top.
   Remplir la bouteille jusqu'à 2 cm du bouchon.
4. Deliver sample to laboratory immediately. Refrigerate if possible.
   Retourner l'échantillon immédiatement au laboratoire, réfrigéré si possible.

NOTE: Samples must be submitted to the laboratory within 48 hours of collection.
Non potable samples MUST be received within 6 hours if unrefrigerated or within 24 hours if refrigerated.

IMPORTANT: Les échantillons doivent arriver au laboratoire dans les 48 heures après le prélèvement; les échantillons d'eau non-potable doivent être retournés dans les 6 heures ou, si réfrigérés, dans les 24 heures qui suivent le prélèvement.

TEST RESULTS/RÉSULTATS DES TESTS

BACTERIAL COUNT/NUMÉRATION DES BACTÈRIES
Based on 100 ml volume/Basé sur un volume de 100 ml

Total coliform/ Total des colibacilles	Faecal Coliform/ Colibacilles Fécaux	Faecal Strep./ Streptocoques Fécaux	Background/ Teneurs de Fond
0	0	/	/

RESULT INTERPRETATION ON REVERSE
Interprétation des Résultats au verso

COMMENTS/REMARQUES

Date: Nov 1/91

Analyst: P. Rawlen
Technologue:

WESA

ACCUTEST Laboratories Ltd.

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LAB REPORT NO.: Numéro de rapport: A1-2514

(2)

BACTERIOLOGICAL ASSESSMENT OF WATER
ÉVALUATION BACTÉRIOLOGIQUE DE L'EAU

NAME/NOM	
COMPANY/SOCIÉTÉ	
STREET, R.R., BOX NO./RUE, R.R., CASIER POSTAL	CITY, TOWN/VILLE
PROVINCE	POSTAL CODE/CODE POSTAL
TELEPHONE/TÉLÉPHONE Area Code/Indicatif Régional:	Number/Numéro:

SAMPLE INFORMATION/RENSEIGNEMENTS SUR L'ÉCHANTILLON

Sample location/Lieu de prélèvement	Sample number/No. d'échantillon	Date collected/Date de prélèvement	Reference number/ No. de référence
	2492A Pool	24 HR	

CHECK APPROPRIATE BOXES/COCHER LA CASE APPROPRIÉE

DRINKING WATER/EAU POTABLE	NON-DRINKING WATER/EAU NON POTABLE
☐ Treated/Épurée ☐ Non-treated/Non-épurée	☐ River/Rivière ☐ Pool/ Piscine
☐ Existing well/ Puits existant	☐ Sewage/ Égout ☐ Lake/Lac
☐ New well/Nouveau puits	☐ Other/Autre
	Specify: _____ Spécifiez:

SAMPLING INSTRUCTIONS
DIRECTIVES POUR LE PRÉLÈVEMENT

1. Do NOT rinse sample container — it contains sodium thiosulphate preservative.
   NE PAS rincer la bouteille car elle contient l'agent préservateur sodium thiosulphate de sodium.
2. Water must run for 2 to 3 minutes before collecting sample.
   Laisser couler l'eau pendant 2 ou 3 minutes avant de remplir la bouteille.
3. Fill bottle to about ½ inch from the top.
   Remplir la bouteille jusqu'à 2 cm du bouchon.
4. Deliver sample to laboratory immediately. Refrigerate if possible.
   Retourner l'échantillon immédiatement au laboratoire, réfrigéré si possible.

NOTE: Samples must be submitted to the laboratory within 48 hours of collection.
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IMPORTANT: Les échantillons doivent arriver au laboratoire dans les 48 heures après le prélèvement; les échantillons d'eau non-potable doivent être retournés dans les 6 heures ou, si réfrigérés, dans les 24 heures qui suivent le prélèvement.

TEST RESULTS/RÉSULTATS DES TESTS				COMMENTS/REMARQUES
BACTERIAL COUNT/NUMÉRATION DES BACTÈRIES Based on 100 ml volume/Basé sur un volume de 100 ml				
Total coliform/ Total des colibacilles	Faecal Coliform/ Colibacilles Fécaux	Faecal Strep./ Streptocoques Fécaux	Background/ Teneurs de Fond	
2	0	—	—	

RESULT INTERPRETATION ON REVERSE
Interprétation des Résultats au verso

Date: Nov 1 /91

Analyst: J. Raulen
Technologue:

ACCUTEST LABORATORIES LTD.

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REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.
T.Sugarman

LAB REPORT NO: A1-2527
DATE: Nob.18,1991
DATE SUBMITTED: Oct.31,1991
PROJECT: 2492A

SAMPLE MATRIX:

PARAMETER	UNITS	LOQ	Sample	Sample	Sample	Sample
			PPW 1-48hrs.			
Fe	mg/L	0.01	0.64			
Mn	mg/L	0.01				
Hardness	mg/L	3				
Alkalinity	mg/L	2				
pH		0.01				
Conductivity	umhos/cm	10				
F	mg/L	0.01				
Na	mg/L	1				
N-NO3	mg/L	0.1	0.78			
N-NO2	mg/L	0.1				
N-NH3	mg/L	0.1				
SO4	mg/L	3	3			
Cl	mg/L	1	nd			
Phenols	mg/L	0.002	nd			
Turbidity	NTU	0.1	nd			
Colour	Pt/Co Units	2	26			
Ca	mg/L	1				
Mg	mg/L	1				
Tann./Lig.	mg/L	0.5				
Total N	mg/L	0.1				
K	mg/L	1				
TOC	mg/L	0.1	5.4			
TDS	mg/L	1	208			
H2S	mg/L	0.02	0.04			
Ion.Balance						

LOQ= lowest level of parameter that can be quantitated with confidence nd= not detected

COMMENTS:

ANALYST: _____

ACCUTEST LABORATORIES LTD.
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QUALITY CONTROL CERTIFICATE

CLIENT: Water & Earth Sc.Assoc. LAB REPORT NO:

T.Sugarman DATE:

PROJECT:

PARAMETER	UNITS	LOQ	AL	MTD BLK	STD LAB	STD ACT	ACC DEV	ACC Y/N
Fe	mg/L	0.01	0.01	nd	0.5	0.47	0.07	Y
Mn	mg/L	0.01	0.01	nd	0.22	0.2	0.03	Y
Hardness	mg/L	3	1	nd	45	45	10	Y
Alkalinity	mg/L	2	1	nd	40	40	8	Y
pH		0.01	0.01	nd	4.5	4.52	0.23	Y
Conductivity	umhos/cm	10	10	nd	350	347	45	Y
F	mg/L	0.01	0.01	nd	2.4	2.2	0.22	Y
Na	mg/L	1	1	nd	39	37	5	Y
N-NO3	mg/L	0.1	0.01	nd	0.37	0.36	0.06	Y
N-NO2	mg/L	0.1	0.01	nd				
N-NH3	mg/L	0.1	0.01	nd	0.23	0.25	0.18	Y
SO4	mg/L	3	3	nd	18	18	3	Y
Cl	mg/L	1	1	nd	56	56	6	Y
Phenols	mg/L	0.002	0.002	nd	0.118	0.112	0.045	Y
Turbidity	NTU	0.1	0.1	nd				
Colour	Pt/Co Units	2	2	nd				
Ca	mg/L	1	1	nd	8	8	1	Y
Mg	mg/L	1	1	nd	6	6	1	Y
Tann./Lig.	mg/L	0.5	0.5	nd				
Total N	mg/L	0.1	0.1	nd	0.71	0.69	0.46	Y
K	mg/L	1	1	nd	11.6	11.6	1.8	Y
TOC	mg/L	0.1	0.1	nd	26	26	5	Y
TDS	mg/L	1	1	nd				
H2S	mg/L	0.02	0.01	nd				

LOQ=limit of quantitaion
AL=accuracy limit
MTD BLK=method blank
nd=not detectable

STD LAB=Lab generated value of standard
STD ACT=actual value of standard
ACC DEV=acceptable deviation of standard
ACC Y/N=IS STD LAB within deviation

ANALSYT: _____

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METHODS/INSTRUMENTS

CLIENT: Water & Earth Sc.Assoc.

T.Sugarman

LAB REPORT NO:

DATE:

PROJECT:

PARAMETER	METHOD	INSTRUMENT
Iron	APHA 303A,303C,305	Jobin Yvon JY24 ICP Spec.
Manganese	APHA 303A,303C,305	Jobin Yvon JY24 ICP Spec.
Hardness	APHA 314A,314B	
Alkalinity	APHA 403	
pH	APHA 423	Fisher 119 pH Meter
Conductivity	APHA 205	Extech Oyster Conductivity Meter
Fluoride	APHA 413B	Fisher Accumet pH/ISE Meter
Sodium	APHA 303A,303C,305	Varian SpectrAA-10 AA Spec.
Nitrate	APHA 418F	Technicon Autoanalyser
Nitrite	APHA 418F	Technicon Autoanalyser
Ammonia	APHA 417G	Technicon Autoanalyser
Sulfate	APHA 426D	Technicon Autoanalyser
Chloride	APHA 407A	
Phenols	APHA 510C	Technicon Autoanalyser
Turbidity	APHA 214A	Hach 2100A Turbidimeter
Colour	APHA 204B	Milton Roy Spectronic 20d
Calcium	APHA 303A,303C,305	Varian SpectrAA-10 AA Spec.
Magnesium	APHA 303A,303C,305	Varian SpectrAA-10 AA Spec.
Tannin & Lignin	APHA 513	Milton Roy Spectronic 20d
Total Kjeldahl Nitrogen	APHA 420A	Tecator 1007 Dig./1002 Dist.
Potassium	APHA 303A,303C,305	Varian SpectrAA-10 AA Spec.
Total Organic Carbon	APHA 505B	Astro 2001 TOC Analyser
Total Dissolved Solids	APHA 209B	Mettler AJ100 Analytical Balance
Hydrogen Sulfide	APHA 427C	Milton Roy Spectronic 20d

ANALYST: _____

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REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.

LAB REPORT NO: A1-2527

DATE: Nov.18,1991

Attention: T.Sugarman

PROJECT: 2492A

PARAMETER	UNITS	Sample PPW 1 48hrs.	Sample	Sample	Sample	Sample
Uranium	mg/L	<0.01				
Diss.Oxygen	mg/L	5.1				
Temperature	deg.C.	22.00				

ANALYST: _____

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REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.

LAB REPORT NO: A1-2527

DATE: Nov.18,1991

PROJECT: 2492A

PARAMETER	UNITS	MDL	Sample PPW 1 48hrs.	Sample Trip Blank	Sample
Benzene	ug/L	0.5	nd	nd	
Bromodichloromethane	ug/L	1			
Bromoform	ug/L	1			
Bromomethane	ug/L	4			
Carbon tetrachloride	ug/L	2			
Chlorobenzene	ug/L	1			
Chloroethane	ug/L	4			
2-Chloroethylvinyl ether	ug/L	5			
Chloroform	ug/L	1			
Chloromethane	ug/L	4			
Dibromochloromethane	ug/L	1			
1,2-Dibromoethane	ug/L	1			
m-Dichlorobenzene	ug/L	1			
o-Dichlorobenzene	ug/L	1			
p-Dichlorobenzene	ug/L	1			
1,1-Dichloroethane	ug/L	1			
1,2-Dichloroethane	ug/L	2			
c-1,2-Dichloroethene	ug/L	2			
1,1-Dichloroethylene	ug/L	1			
t-1,2-Dichloroethylene	ug/L	1			
1,2-Dichloropropane	ug/L	1			
c-1,3-Dichloropropene	ug/L	1			
t-1,3-Dichloropropene	ug/L	1			
Ethylbenzene	ug/L	0.5	nd	nd	
Methylene chloride	ug/L	5			
Styrene	ug/L	0.2	nd	nd	
1,1,2,2-Tetrachloroethane	ug/L	1			
Tetrachloroethylene	ug/L	1			

ANALYST: _____

ACCUTEST LABORATORIES LTD.
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REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.

LAB REPORT NO: A1-2527

DATE: Nov.15,1991

PROJECT: 2492A

PARAMETER	UNITS	MDL	Sample PPW 1 48hrs.	Sample Trip Blank	Sample
Toluene	ug/L	1.0	2.5	0.9	
1,1,1-Trichloroethane	ug/L	1			
1,1,2-Trichloroethane	ug/L	1			
Trichloroethylene	ug/L	1			
Trichlorofluoromethane	ug/L	1			
1,3,5-Trimethylbenzene	ug/L	1			
Vinyl Chloride	ug/L	4			
m/p-Xylene	ug/L	1.0	nd	nd	
o-Xylene	ug/L	0.5	nd	nd	

ANALYST: _____

RESULT INTERPRETATION/INTERPRETATION DES RÉSULTATS

RINKING WATER/EAU POTABLE

COLIFORM COUNT/ NUMÉRATION DES COLIFORMES		INTERPRETATION	INTERPRÉTATION
Total/ Totaux	Faecal/ Fécaux		
0 to à 10	0	This represents a bacteriologically SAFE drinking supply, provided that 3 samples, collected 1 to 3 weeks apart, have these result. — See general information below.	Si on obtient les résultats ci-contre à l'analyse de trois échantillons d'eau prélevés à des intervalles de 1 à 3 semaines, on peut en conclure que l'eau de cette source est POTABLE. — voir les renseignements généraux en bas.
1 to à >160	0	UNSAFE for drinking unless boiled or treated.	NON POTABLE à moins de la faire bouillir ou épurer.
to à >160	1 to à >60	UNSAFE for drinking unless boiled or treated.	NON POTABLE à moins de la faire bouillir ou épurer.
O/G		Not recommended for drinking.	On en déconseille la consommation.

GENERAL INFORMATION

The purpose of this test is to provide a bacteriological (not chemical) assessment of the water sample submitted.

If results of 3 initial samples, collected 1 to 3 weeks apart, indicate a safe water source, it is sufficient to repeat testing twice a year thereafter.

Submit additional samples should there be some change in water source conditions, resulting for example, from flooding after heavy rainfall, repairs to the well, etc. or if there is a change in the taste, smell and appearance of the water.

The source of drinking water should be protected and located at least 15 m. (50 ft.) for a drilled well or 30 m. (100 ft.) for other types of wells from any source of human or animal waste.

DO NOT SUBMIT samples from an unprotected source such as a lake, river, stream or pond unless they have been subjected to some sort of treatment. Without treatment, unprotected water sources cannot be judged bacteriologically safe for drinking even if testing finds them free of coliform bacteria.

RENSEIGNEMENTS GÉNÉRAUX

Les échantillons d'eau potable présentés ne seront soumis qu'à l'analyse bactériologique.

Si les résultats indiquent que la source d'eau est «potable»du point de vue bactériologique, il suffira de la faire analyser une ou deux fois par an. Toutefois, si certaines conditions risquent d'avoir modifié l'état de la source d'approvisionnement, par exemple une inondation après des pluies abondantes, des réparations au puits, etc., ou si la qualité de l'eau (goût, odeur, aspect) change, il faudra refaire une analyse.

Le puits d'eau potable doit être protégé et se trouver à une certaine distance de toute source de déchets humains ou animaux: 15 m (50 pieds) pour un puits foré et 30 m (100 pieds) pour tout autre puits.

NE PAS PRÉSENTER d'échantillons prélevés de source libres, tels un lac, une rivière, un cours d'eau ou un étang à moins que l'eau n'ait subi un traitement. Si l'eau de ces sources n'a pas été épurée, on ne doit pas prendre pour acquis qu'elle est potable, même si les résultats de l'analyse bactériologique indiquent qu'elle ne contient pas de bactéries coliformes.

ON-DRINKING WATER/EAU NON POTABLE

AECAL COLIFORM COUNT/ UMÉRATION DES COLIFORMES FÉCAUX	INTERPRETATION	INTERPRÉTATION
less than/ moins de 101	safe for swimming	Acceptable pour la baignade
more than/ plus de 100	not recommended for swimming.	Pas recommandé à la baignade.

ACCUTEST LABORATORIES LTD.
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REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.

LAB REPORT NO: A1-2558

DATE: Nov.25, 1991

Attention: T.Sugarman

PROJECT: 2492 A Vars

PARAMETER	UNITS	Sample	Sample	Sample	Sample	Sample
		PPW 1 72hrs.				
Fe	mg/L	0.61				
Mn	mg/L	0.07				
Hardness	mg/L CaCO3	161				
Alkalinity	mg/L CaCO3	176				
pH		7.95				
Conductivity	umnos/cm	310				
F	mg/L	0.12				
Na	mg/L	11				
N-NO3	mg/L	<0.10				
N-NO2	mg/L	<0.10				
N-NH3	mg/L	<0.10				
SO4	mg/L	<3				
Cl	mg/L	2				
Phenols	mg/L	<0.002				
Turbidity	NTU	<1.0				
Colour	Pt/Co Units	26				
Ca	mg/L	48				
Mg	mg/L	10				
Tann./Lig.	mg/L	<1.0				
Total N	mg/L	<0.10				
K	mg/L	2				
PO4	mg/L					
ION BALANCE		1.05				

ANALYST: _____

ACCUTEST LABORATORIES LTD.
146 Colonnade Road, Unit 8, Nepean, Ontario K2E 7Y3 Tel.: (613) 727-5692 Fax: (613) 727-5222

REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.

LAB REPORT NO: A1-2558

DATE: Nov.25.1991

PROJECT: 2492 A Vars

PARAMETER	UNITS	Sample	Sample	Sample	Sample	Sample
		PPW 1 72hrs.				
As	mg/L	<0.01				
Ba	mg/L	0.32				
B	mg/L	0.07				
Cd	mg/L	<0.002				
Cr	mg/L	<0.01				
CN-	mg/L	<0.01				
Pb	mg/L	0.003				
Hg	mg/L	<0.001				
Se	mg/L	<0.01				
Ag	mg/L	<0.01				
Cu	mg/L	<0.01				
H2S	mg/L	0.04				
TDS	mg/L	190				
TOC	mg/L	6.9				
Zn	mg/L	<0.01				
U	mg/L	<0.01				
Radionuclides						
Cs 137	Bq/L	<1				
I 131	Bq/L	<1				
Ra 226	Bq/L	<0.1				
Sr 90	Bq/L	<1				
Tritium	Bq/L	<1000				

ANALYST: _____

ACCUTEST LABORATORIES LTD.
146 Colonnade Road, Unit 8, Nepean, Ontario K2E 7Y3 Tel.: (613) 727-5692 Fax: (613) 727-5222

REPORT OF ANALYSES

CLIENT: W.E.S.A.

LAB REPORT NO: A1-2558

DATE: Nov.25.1991

PROJECT: 2

PARAMETER	UNITS	MDL	Sample	Sample	Sample
			PPW 1 72hrs.		
Benzene	ug/L	0.5	nd		
Bromodichloromethane	ug/L	0.2	0.7		
Bromoform	ug/L	0.4	nd		
Bromomethane	ug/L	0.3	nd		
Carbon tetrachloride	ug/L	0.3	nd		
Chlorobenzene	ug/L	0.2	nd		
Chloroethane	ug/L	0.5	nd		
2-Chloroethylvinyl ether	ug/L	5.0	nd		
Chloroform	ug/L	0.2	33		
Chloromethane	ug/L	1.0	nd		
Dibromochloromethane	ug/L	0.3	nd		
1,2-Dibromoethane	ug/L	1.0	nd		
m-Dichlorobenzene	ug/L	0.2	nd		
o-Dichlorobenzene	ug/L	0.2	nd		
p-Dichlorobenzene	ug/L	0.2	nd		
1,1-Dichloroethane	ug/L	0.3	nd		
1,2-Dichloroethane	ug/L	0.3	nd		
c-1,2-Dichloroethene	ug/L	0.2	nd		
1,1-Dichloroethylene	ug/L	1.0	nd		
t-1,2-Dichloroethylene	ug/L	0.6	nd		
1,2-Dichloropropane	ug/L	0.7	nd		
c-1,3-Dichloropropene	ug/L	0.2	nd		
t-1,3-Dichloropropene	ug/L	0.3	nd		
Ethylbenzene	ug/L	0.5	nd		
Methylene chloride	ug/L	4.0	nd		
Styrene	ug/L	0.2	nd		
1,1,2,2-Tetrachloroethane	ug/L	0.4	nd		
Tetrachloroethylene	ug/L	0.3	nd		

ANALYST: _____

ACCUTEST LABORATORIES LTD.
146 Colonnade Road, Unit 8, Nepean, Ontario K2E 7Y3 Tel.: (613) 727-5692 Fax: (613) 727-5222

REPORT OF ANALYSES

CLIENT: Water & Earth Sc.Assoc.

LAB REPORT NO: A1-2558

DATE: Nov.25,1991

PROJECT: 2492 A Vars

PARAMETER	UNITS	Sample	Sample	Sample	Sample	Sample
		PPW 1 72 hrs.				
Pesticides						
Aldrin & Dieldrin	mg/L	<0.0007				
Carbaryl	mg/L	<0.07				
Chlordane	mg/L	<0.007				
DDT	mg/L	<0.03				
Diazinon	mg/L	<0.014				
Endrin	mg/L	<0.0002				
Heptachlor + Heptachlor Epoxide	mg/L	<0.003				
Lindane	mg/L	<0.004				
Methoxychlor	mg/L	<0.1				
Methyl Parathion	mg/L	<0.007				
Parathion	mg/L	<0.035				
Toxaphene	mg/L	<0.005				
2.4-D	mg/L	<0.1				
2.4.5-TP	mg/L	<0.01				
Trihalomethanes	mg/L	<0.35				
PCB's	mg/L	<0.003				

ANALYST: _____

LAB REPORT NO.:
Numéro de rapport: A1-2558

ACCUTEST Laboratories Ltd.

146 Colonnade Road, Unit 8, Nepean, Ontario K2E 7Y1 Tel.: (613) 727-5692 Fax: (613) 727-5222

BACTERIOLOGICAL ASSESSMENT OF WATER
ÉVALUATION BACTÉRIOLOGIQUE DE L'EAU

NAME/NOM	[redacted]
COMPANY/SOCIÉTÉ	[redacted]
STREET, R.R., BOX NO./RUE, R.R., CASIER POSTAL	CITY, TOWN/VILLE
PROVINCE	POSTAL CODE/CODE POSTAL
TELEPHONE/TÉLÉPHONE Area Code/Indicatif Régional:	Number/Numéro:

SAMPLE INFORMATION/RENSEIGNEMENTS SUR L'ÉCHANTILLON

Sample location/Lieu de prélèvement	[redacted]	Reference number/ No. de référence
[redacted]		

CHECK APPROPRIATE BOXES/COCHER LA CASE APPROPRIÉE

DRINKING WATER/EAU POTABLE

- ☐ Treated/Épurée
- ☐ Non-treated/Non-épurée
- ☐ Existing well/ Puits existant
- ☐ New well/Nouveau puits

NON-DRINKING WATER/EAU NON POTABLE

- ☐ River/Rivière
- ☐ Pool/ Piscine
- ☐ Sewage/ Égout
- ☐ Lake/Lac
- ☐ Other/Autre

Specify: _____
Spécifiez:

SAMPLING INSTRUCTIONS
DIRECTIVES POUR LE PRÉLÈVEMENT

1. Do NOT rinse sample container — it contains sodium thiosulphate preservative.
   NE PAS rincer la bouteille car elle contient l'agent préservateur sodium thiosulphate de sodium.
2. Water must run for 2 to 3 minutes before collecting sample.
   Laisser couler l'eau pendant 2 ou 3 minutes avant de remplir la bouteille.
3. Fill bottle to about ½ inch from the top.
   Remplir la bouteille jusqu'à 2 cm du bouchon.
4. Deliver sample to laboratory immediately. Refrigerate if possible.
   Retourner l'échantillon immédiatement au laboratoire, réfrigéré si possible.

NOTE: Samples must be submitted to the laboratory within 48 hours of collection.
Non potable samples MUST be received within 6 hours if unrefrigerated or within 24 hours if refrigerated.

IMPORTANT: Les échantillons doivent arriver au laboratoire dans les 48 heures après le prélèvement; les échantillons d'eau non-potable doivent être retournés dans les 6 heures ou, si réfrigérés, dans les 24 heures qui suivent le prélèvement.

TEST RESULTS/RÉSULTATS DES TESTS

BACTERIAL COUNT/NUMÉRATION DES BACTÉRIES
Based on 100 ml volume/Basé sur un volume de 100 ml

Total coliform/ Total des coliformes	Faecal Coliform/ Coliformes Fécaux	Faecal Strep./ Streptocoques Fécaux	Background/ Teneurs de Fond
1	0	0	<1 /ml

RESULT INTERPRETATION ON REVERSE
Interprétation des Résultats au verso

COMMENTS/REMARQUES

Date: Nov 4/91

Analyst: [signature]
Technologue:

Ontario

Ministry of Health / Ministere de la Sante — Laboratory Services Branch / Service de Laboratoire

Date Received / Date Reçue: Nov 1 91

Lab. No. / N° du Lab.: 0160 43

Bacteriological Analysis of Water / Analyse Bactériologique de l'eau

Sample taken by / Echantillon preleve par	Location of supply (Lot, Con., Twp.) / Lieu de Prelevement (Lot, Concession, Commune / Twp	County	Date collected / Date du Prelevement
B. Grover	Lot 26 Con V Cumberland Twp	RMOC	Nov. 1/91

Your name and return address must appear on all copies / Votre nom et votre adresse de retour doivent paraitre sur toutes les copies.

Name. Nom: T. Sugarman

Street, R.R., Box No. / Rue, R.R., Casier Postal: 1365 Raven Ave

City, Town / Ville: Ottawa

Province: Ontario — Postal Code / Code Postal: K1Z 7K3

☐ **Private Citizens:** check this box.
Citoyen Privé: cocher cette case.

Drinking water only. See reverse of report for interpretation.
Eau potable seulement. Voir au verso pour interprétation.

☐ WILL PICK UP REPORT

FOLD

SHADED AREAS FOR OFFICIAL AGENCIES ONLY
ZONE OMBREE RÉSERVÉE AUX AGENTS OFFICIELS

Non potable samples MUST be received within 6 hours if unrefrigerated or within 24 hours if refrigerated.

FOLD

CHECK APPROPRIATE BOXES / COCHER TOUTES LES CASES APPROPRIÉES

DRINKING WATER	NON-DRINKING WATER	COMMENTS
☐ Treated ☐ Non-treated	☐ Recreational ☐ Swimming Pool-Indoor	
☐ Municipal ☐ Well	☐ Hydrotherapy Spa, Whirlpool ☐ Swimming Pool-Outdoor	
☐ Other Public	☐ Wading Pool ☐ Sewage	
☐ Single Household	☐ Other:	

BACTERIAL COUNT / NUMERATION DES BACTÉRIES
Based on 100 ml volume Base sur un volume de 100 ml

Total coliform / Totale des Coliformes	Faecal coliform / Coliformes Fecaux	Faecal Strep / Streptocoques Fecaux	BACTERIAL COUNT Based on 1.0 ml volume — APC
2	0		
Background	Pseudomonas	Presumptive Staphylococci	S. aureus

Technician: C

Checked by: [signature]

Date: 91.11.04

APPENDIX C

STEP DRAWDOWN TEST DATA

QUIFER TEST DATA WELL#: 2492-PPW1

ype of aquifer test: Step Test		Well type:	Production
ow Q Measured: Orifice Weir		Data type:	Pumping
istance from pumping well: 0 m		Depth pump:	20.0 m
leas. point for w. l.'s: T.O.P.		Pump on:	9h30 28-10-91
levation of Measuring Pt.:		Pump off:	14h30 28-10-91
tatic Water Level:	5.39	Discharge rate:	200-437.5 igpm

Time (min.)	Water Level (m)	Drawdown (m)	Discharge (i.g.p.m.)	Comments
1.00	5.90	0.51	200.00	
2.00	5.91	0.52		
3.00	5.92	0.53		
4.00	5.92	0.53		
5.00	5.92	0.53		
6.00	5.93	0.54		
7.00	5.93	0.54		
8.00	5.94	0.55		
9.00	5.94	0.55		
10.00	5.95	0.56		
12.00	5.95	0.56		
14.00	5.95	0.56		
16.00	5.96	0.57		
18.00	5.96	0.57		
20.00	5.96	0.57		
25.00	5.97	0.58		
30.00	5.98	0.59		
35.00	5.98	0.59		
39.00	5.99	0.60		
41.00	6.40	1.01	300.00	
42.00	6.45	1.06		
43.00	6.49	1.10		
44.00	6.52	1.13		
45.00	6.53	1.14		
46.00	6.55	1.16		
47.00	6.57	1.18		
48.00	6.56	1.17		
49.00	6.55	1.16		
50.00	6.56	1.17		
52.00	6.56	1.17		
54.00	6.58	1.19		
56.00	6.59	1.20		
58.00	6.63	1.24		
60.00	6.61	1.22		
65.00	6.61	1.22		
70.00	6.62	1.23		
75.00	6.62	1.23		
79.00	6.66	1.27		
81.00	7.31	1.92	400.00	
82.00	7.42	2.03		
83.00	7.48	2.09		

AQUIFER TEST DATA WELL#: 2492-PPW1

Type of aquifer test:	Step Test	Well type:	Production
Flow Q Measured:	Orifice Weir	Data type:	Pumping
Distance from pumping well:	0 m	Depth pump:	20.0 m
Meas. point for w. l.'s:	T.O.P.	Pump on:	9h30 28-10-91
Elevation of Measuring Pt.:		Pump off:	14h30 28-10-91
Static Water Level:	5.39	Discharge rate:	200-437.5 igpm

Time (min.)	Water Level (m)	Drawdown (m)	Discharge (i.g.p.m.)	Comments
84.00	7.52	2.13		
85.00	7.55	2.16		
86.00	7.59	2.20		
87.00	7.62	2.23		
88.00	7.64	2.25		
89.00	7.65	2.26		
90.00	7.67	2.28		
92.00	7.70	2.31		
94.00	7.73	2.34		
96.00	7.76	2.37		
98.00	7.78	2.39		
100.00	7.81	2.42		
105.00	7.86	2.47		
110.00	7.91	2.52		
115.00	7.94	2.55		
119.00	7.95	2.56		
121.00	8.22	2.83	437.50	
122.00	8.41	3.02		
123.00	8.45	3.06		
124.00	8.49	3.10		
125.00	8.53	3.14		
126.00	8.51	3.12		
127.00	8.51	3.12		
128.00	8.52	3.13		
129.00	8.54	3.15		
130.00	8.55	3.16		
132.00	8.60	3.21		
134.00	8.62	3.23		
136.00	8.65	3.26		
138.00	8.67	3.28		
140.00	8.70	3.31		
145.00	8.75	3.36		
150.00	8.82	3.43		
155.00	8.87	3.48		
160.00	8.91	3.52		
165.00	8.94	3.55		
170.00	8.98	3.59		
175.00	9.01	3.62		
180.00	9.04	3.65		At end of test Sand free
0.10		0.00		(<10-15 grains)
1000.00		10.00		

QUIFER TEST DATA Oct/Nov. 91 WELL#: OW87 (2492A)

pe of aquifer test: Constant Q
)w Q Measured: Orifice Weir
st. from pumping well (m): 22.03 m
)as. point for w. l.'s: T.O.C.
evation of Measuring Pt.:
atic Water Level (m): 3.67

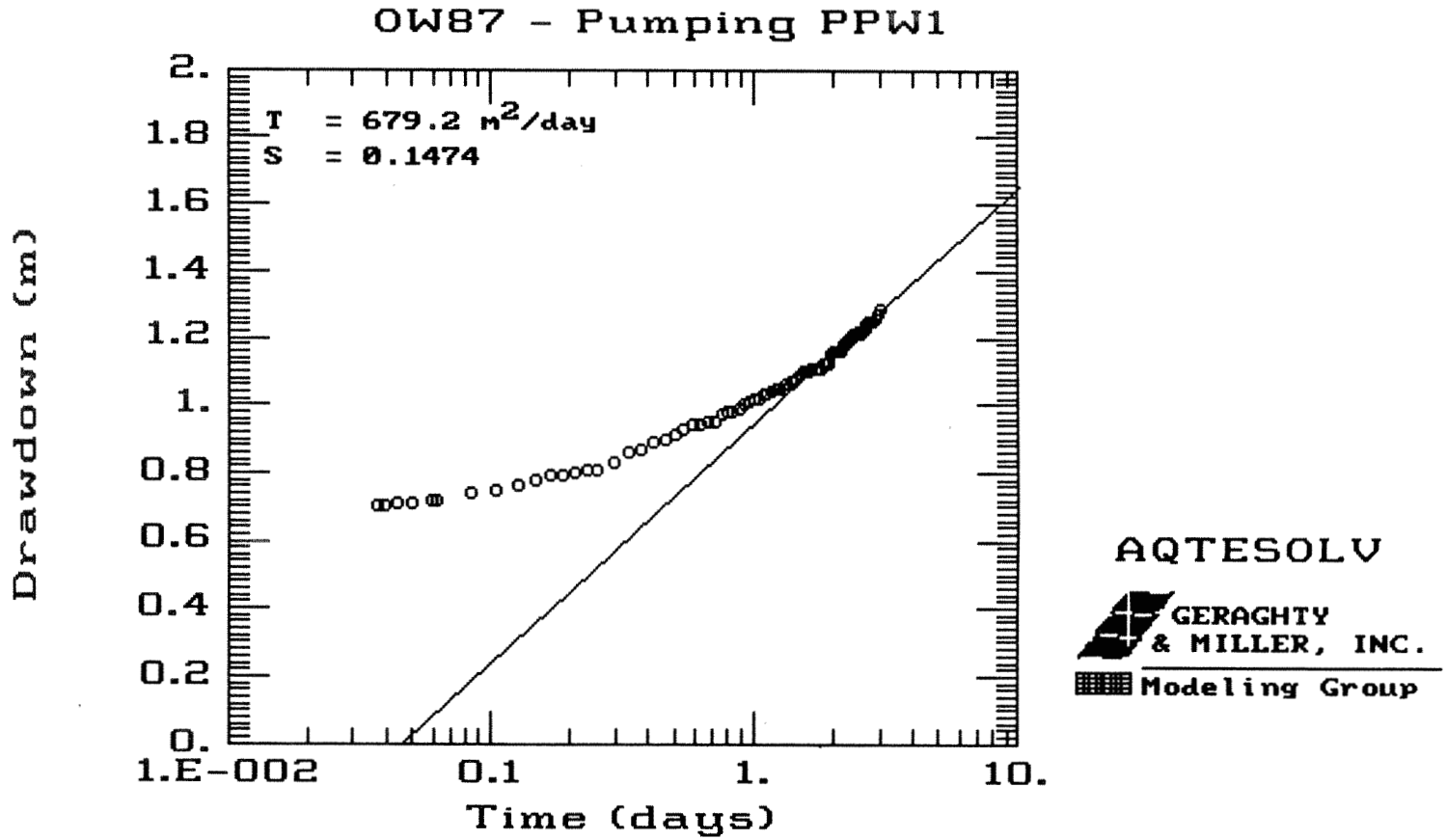
Well type: Observation
Data type: Pumping
Depth well: 25 m
Pump on: 8:00 am 10-29-1991
Pump off: 8:30 am 11-01-1991
Discharge rate: 400 IGPM

Time (min.)	Water Level (m)	Drawdown (m)	Discharge (i.g.p.m.)	Comments
53.00	4.37	0.70	400.00	
57.00	4.37	0.70	400.00	
63.00	4.38	0.71	400.00	
72.00	4.38	0.71	400.00	
85.00	4.39	0.72	400.00	
90.00	4.39	0.72	400.00	
120.00	4.41	0.74	400.00	
150.00	4.42	0.75	400.00	
180.00	4.43	0.76	400.00	
210.00	4.45	0.78	400.00	
240.00	4.46	0.79	400.00	
270.00	4.46	0.79	400.00	
300.00	4.47	0.80	400.00	
330.00	4.48	0.81	400.00	
360.00	4.48	0.81	400.00	
420.00	4.50	0.83	400.00	
480.00	4.53	0.86	400.00	
540.00	4.54	0.87	400.00	
600.00	4.56	0.89	400.00	
660.00	4.57	0.90	400.00	
720.00	4.58	0.91	400.00	
780.00	4.60	0.93	400.00	
840.00	4.61	0.94	400.00	
900.00	4.61	0.94	400.00	
960.00	4.62	0.95	400.00	
1020.00	4.62	0.95	400.00	
1080.00	4.64	0.97	400.00	
1140.00	4.65	0.98	400.00	
1200.00	4.65	0.98	400.00	
1260.00	4.66	0.99	400.00	
1320.00	4.67	1.00	400.00	
1380.00	4.68	1.01	400.00	
1440.00	4.69	1.02	400.00	
1500.00	4.69	1.02	400.00	
1560.00	4.70	1.03	400.00	
1620.00	4.70	1.03	400.00	
1680.00	4.71	1.04	400.00	
1740.00	4.72	1.05	400.00	
1800.00	4.72	1.05	400.00	
1860.00	4.72	1.05	400.00	
1920.00	4.73	1.06	400.00	

AQUIFER TEST DATA Oct/Nov. 91 WELL#: OW87 (2492A)

Type of aquifer test: Constant Q		Well type:	Observation
How Q Measured: Orifice Weir		Data type:	Pumping
Dist. from pumping well (m):	22.03 m	Depth well:	25 m
Meas. point for w. l.'s:	T.O.C.	Pump on:	8:00 am 10-29-1991
Elevation of Measuring Pt.:		Pump off:	8:30 am 11-01-1991
Static Water Level (m):	3.67	Discharge rate:	400 IGPM

Time (min.)	Water Level (m)	Drawdown (m)	Discharge (i.g.p.m.)	Comments
1980.00	4.74	1.07	400.00	
2040.00	4.74	1.07	400.00	
2100.00	4.75	1.08	400.00	
2160.00	4.76	1.09	400.00	
2220.00	4.77	1.10	400.00	
2280.00	4.77	1.10	400.00	
2340.00	4.77	1.10	400.00	
2400.00	4.78	1.11	400.00	
2460.00	4.78	1.11	400.00	
2520.00	4.78	1.11	400.00	
2580.00	4.78	1.11	400.00	
2640.00	4.79	1.12	400.00	
2700.00	4.79	1.12	400.00	
2760.00	4.79	1.12	400.00	
2820.00	4.82	1.15	400.00	
2880.00	4.83	1.16	400.00	
2940.00	4.83	1.16	400.00	
3000.00	4.83	1.16	400.00	
3060.00	4.83	1.16	400.00	
3120.00	4.85	1.18	400.00	
3180.00	4.85	1.18	400.00	
3240.00	4.86	1.19	400.00	
3300.00	4.87	1.20	400.00	
3360.00	4.87	1.20	400.00	
3420.00	4.88	1.21	400.00	
3480.00	4.88	1.21	400.00	
3540.00	4.88	1.21	400.00	
3600.00	4.89	1.22	400.00	
3660.00	4.88	1.21	400.00	
3720.00	4.89	1.22	400.00	
3780.00	4.90	1.23	400.00	
3840.00	4.91	1.24	400.00	
3900.00	4.92	1.25	400.00	
3960.00	4.92	1.25	400.00	
4020.00	4.92	1.25	400.00	
4080.00	4.92	1.25	400.00	
4140.00	4.93	1.26	400.00	
4200.00	4.93	1.26	400.00	
4260.00	4.94	1.27	400.00	
4315.00	4.96	1.29	400.00	
4345.00	4.96	1.29	400.00	


OW87 - Pumping PPW1
T = 679.2 m²/day
S = 0.1474
Drawdown (m)
Time (days)
2.
1.8
1.6
1.4
1.2
1.
0.8
0.6
0.4
0.2
0.
1.E-002
0.1
1.
10.
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

A Q T E S O L V   R E S U L T S

02/12/92 17:24:50

PROBLEM DEFINITION

Problem title: OW87 - Pumping PPW1

Knowns and Constants:
No. of data points............... 82
Pumping rate..................... 2621
Radius to obs. well.............. 22.03

ESTIMATION RESULTS

Analytical method: Cooper-Jacob (confined aquifer)

PARAMETER ESTIMATES

	Estimate		Std. Error
T =	6.7923E+002	+/-	2.4956E+001
S =	1.4737E-001	+/-	1.6077E-002

ANALYSIS OF MODEL RESIDUALS

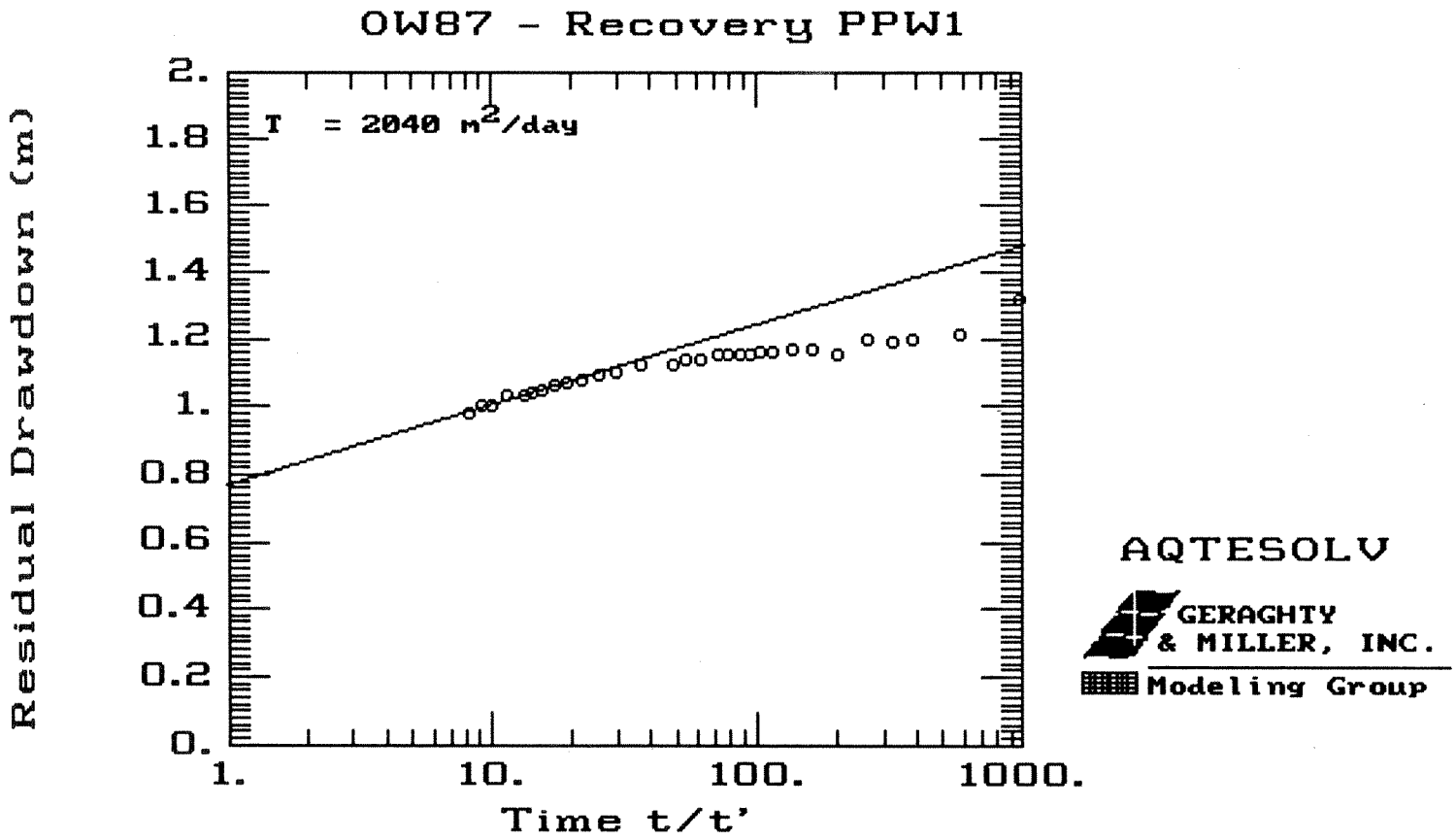
residual = calculated - observed
weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals............... 26
Number of estimated parameters.... 2
Degrees of freedom................ 24
Residual mean..................... -1.043E-010
Residual standard deviation....... 0.007099
Residual variance................. 5.04E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
2	1.16	1.1511	0.0088709	1
2.0417	1.16	1.1575	0.0025469	1
2.0833	1.16	1.1636	-0.0036494	1
2.125	1.16	1.1697	-0.009723	1
2.1667	1.18	1.1757	0.0043214	1
2.2083	1.18	1.1815	-0.0015208	1
2.25	1.19	1.1873	0.0027463	1
2.2917	1.2	1.1929	0.0071185	1
2.3333	1.2	1.1984	0.0015921	1
2.375	1.21	1.2038	0.0061636	1
2.4167	1.21	1.2092	0.00082942	1
2.4583	1.21	1.2144	-0.0044135	1

2.5	1.22	1.2196	0.00043164	1
2.5417	1.21	1.2246	-0.014638	1
2.5833	1.22	1.2296	-0.0096252	1
2.625	1.23	1.2345	-0.0045326	1
2.6667	1.24	1.2394	0.00063735	1
2.7083	1.25	1.2441	0.0058821	1
2.75	1.25	1.2488	0.0011995	1
2.7917	1.25	1.2534	-0.0034127	1
2.8333	1.25	1.258	-0.0079565	1
2.875	1.26	1.2624	-0.0024341	1
2.9167	1.26	1.2668	-0.0068472	1
2.9583	1.27	1.2712	-0.0011977	1
2.9965	1.29	1.2751	0.014868	1
3.0174	1.29	1.2773	0.012743	1


OW87 - Recovery PPW1
T = 2040 m²/day
Residual Drawdown (m)
2.
1.8
1.6
1.4
1.2
1.
0.8
0.6
0.4
0.2
0.
1.
10.
100.
1000.
Time t/t'
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

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A Q T E S O L V   R E S U L T S

02/12/92 17:13:41

PROBLEM DEFINITION

Problem title: OW87 - Recovery PPW1

Knowns and Constants:
No. of data points............... 30
Pumping rate..................... 2621
Total pumping time............... 3.021

ESTIMATION RESULTS

Analytical method: Theis recovery (confined aquifer)

PARAMETER ESTIMATES

	Estimate		Std. Error
T =	2.0397E+003	+/-	3.6415E+000
S' =	5.3148E-004	+/-	0.0000E+000

ANALYSIS OF MODEL RESIDUALS

residual = calculated - observed
weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals............... 9
Number of estimated parameters.... 2
Degrees of freedom................ 8
Residual mean..................... 0
Residual standard deviation....... 0.005458
Residual variance................. 2.979E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.16667	1.07	1.0715	-0.0014654	1
0.1875	1.06	1.0601	-0.00010123	1
0.20833	1.05	1.05	-1.4667E-006	1
0.22917	1.04	1.0409	-0.00092392	1
0.25	1.03	1.0327	-0.0026898	1
0.29167	1.03	1.0182	0.011761	1
0.33333	1	1.0059	-0.0058774	1
0.375	1	0.99511	0.0048913	1
0.41667	0.98	0.98559	-0.0055934	1

AQUIFER TEST DATA Oct/Nov. 91 WELL#: OW85

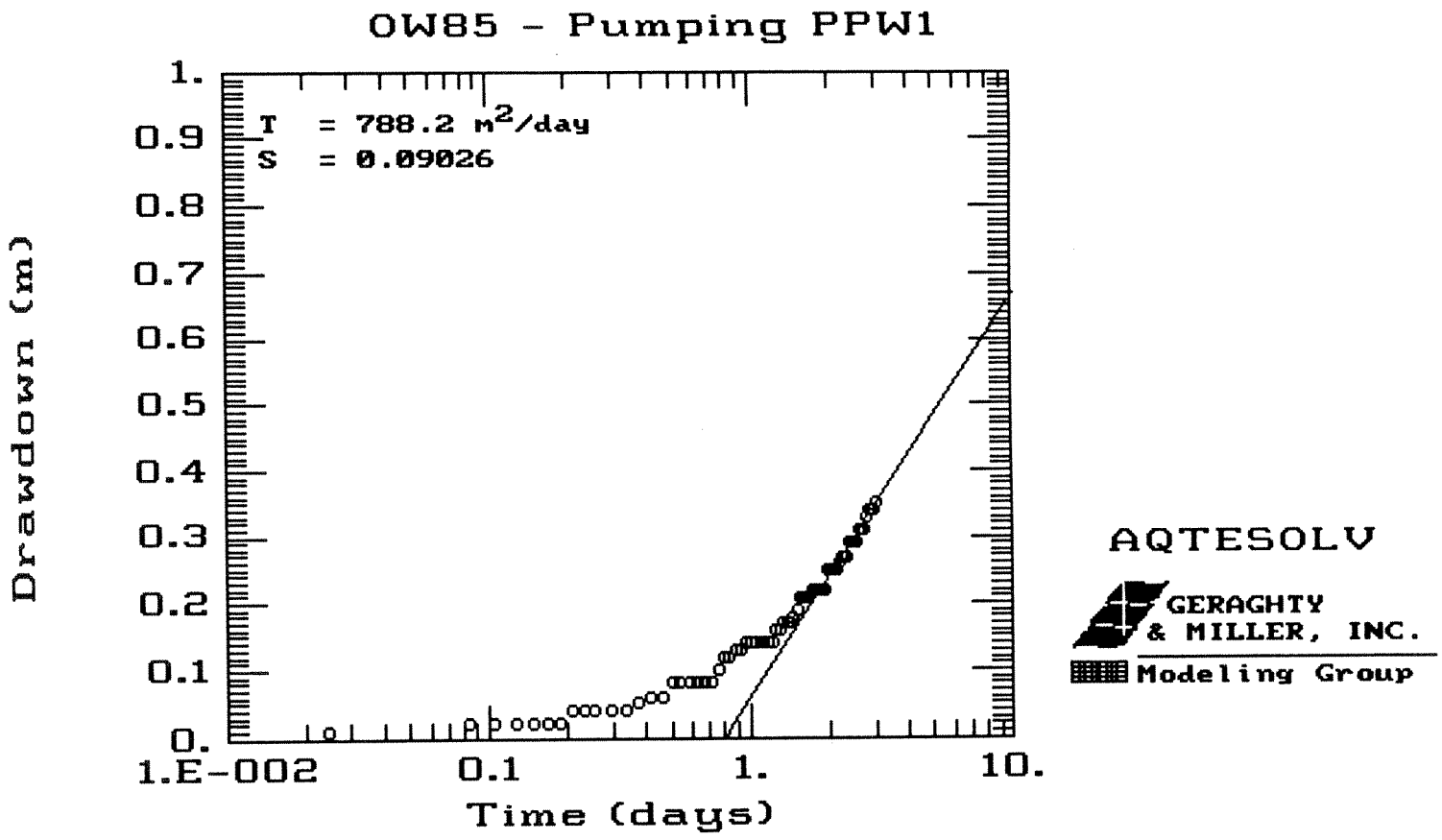
Type of aquifer test: Constant Q		Well type:	Observation
How Q Measured: Orifice Weir		Data type:	Pumping
Dist. from pumping well: (m)	126 m	Depth well:	23.5 m
Meas. point for w. l.'s:	T.O.C.	Pump on:	8:00 am 10-29-1991
Elevation of Measuring Pt.:		Pump off:	8:30 am 11-01-1991
Static Water Level (m):	4.83	Discharge rate:	400 IGPM

Time (min.)	Water Level (m)	Drawdown (m)	Discharge (i.g.p.m.)	Comments
10.00	4.83	0.00	400.00	
35.00	4.84	0.01	400.00	
52.00	4.83	0.00	400.00	
120.00	4.85	0.02	400.00	
150.00	4.85	0.02	400.00	
180.00	4.85	0.02	400.00	
210.00	4.85	0.02	400.00	
240.00	4.85	0.02	400.00	
270.00	4.85	0.02	400.00	
300.00	4.86	0.04	400.00	
330.00	4.86	0.04	400.00	
360.00	4.86	0.04	400.00	
420.00	4.87	0.04	400.00	
480.00	4.87	0.04	400.00	
540.00	4.88	0.05	400.00	
600.00	4.89	0.06	400.00	
660.00	4.89	0.06	400.00	
720.00	4.90	0.08	400.00	
780.00	4.90	0.08	400.00	
840.00	4.91	0.08	400.00	
900.00	4.91	0.08	400.00	
960.00	4.91	0.08	400.00	
1020.00	4.91	0.08	400.00	
1080.00	4.93	0.10	400.00	
1140.00	4.94	0.12	400.00	
1200.00	4.94	0.12	400.00	
1260.00	4.95	0.13	400.00	
1320.00	4.96	0.13	400.00	
1380.00	4.97	0.14	400.00	
1440.00	4.97	0.14	400.00	
1500.00	4.97	0.14	400.00	
1560.00	4.97	0.14	400.00	
1620.00	4.97	0.14	400.00	
1680.00	4.97	0.14	400.00	
1740.00	4.97	0.14	400.00	
1800.00	4.98	0.16	400.00	
1860.00	4.98	0.16	400.00	
1920.00	5.00	0.17	400.00	
1980.00	5.00	0.17	400.00	
2040.00	5.00	0.17	400.00	
2100.00	5.01	0.18	400.00	

AQUIFER TEST DATA Oct/Nov. 91 WELL#: OW85

Type of aquifer test: Constant Q		Well type:	Observation
How Q Measured: Orifice Weir		Data type:	Pumping
Dist. from pumping well: (m)	126 m	Depth well:	23.5 m
Meas. point for w. l.'s:	T.O.C.	Pump on:	8:00 am 10-29-1991
Elevation of Measuring Pt.:		Pump off:	8:30 am 11-01-1991
Static Water Level (m):	4.83	Discharge rate:	400 IGPM

Time (min.)	Water Level (m)	Drawdown (m)	Discharge (i.g.p.m.)	Comments
2160.00	5.02	0.19	400.00	
2220.00	5.03	0.21	400.00	
2280.00	5.03	0.21	400.00	
2340.00	5.03	0.21	400.00	
2400.00	5.04	0.21	400.00	
2460.00	5.05	0.22	400.00	
2520.00	5.05	0.22	400.00	
2580.00	5.05	0.22	400.00	
2640.00	5.05	0.22	400.00	
2700.00	5.05	0.22	400.00	
2760.00	5.05	0.22	400.00	
2820.00	5.07	0.25	400.00	
2880.00	5.08	0.25	400.00	
2940.00	5.08	0.25	400.00	
3000.00	5.08	0.25	400.00	
3060.00	5.08	0.25	400.00	
3120.00	5.09	0.26	400.00	
3180.00	5.10	0.27	400.00	
3240.00	5.10	0.27	400.00	
3300.00	5.10	0.27	400.00	
3360.00	5.10	0.27	400.00	
3420.00	5.11	0.29	400.00	
3480.00	5.12	0.29	400.00	
3540.00	5.12	0.29	400.00	
3600.00	5.12	0.29	400.00	
3660.00	5.12	0.29	400.00	
3720.00	5.14	0.31	400.00	
3780.00	5.14	0.31	400.00	
3840.00	5.14	0.31	400.00	
3900.00	5.14	0.31	400.00	
3960.00	5.15	0.33	400.00	
4020.00	5.15	0.33	400.00	
4080.00	5.16	0.34	400.00	
4140.00	5.16	0.34	400.00	
4200.00	5.17	0.34	400.00	
4260.00	5.17	0.34	400.00	
4320.00	5.18	0.35	400.00	
4345.00	5.18	0.35	400.00	


OW85 - Pumping PPW1
T = 788.2 m²/day
S = 0.09026
Drawdown (m)
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
1.E-002
0.1
1.
10.
Time (days)
AQTESOLV
GERAGHTY & MILLER, INC.
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A Q T E S O L V   R E S U L T S

02/12/92 17:52:49

PROBLEM DEFINITION

Problem title: OW85 - Pumping PPW1

Knowns and Constants:
No. of data points............... 77
Pumping rate..................... 2621
Radius to obs. well.............. 126

ESTIMATION RESULTS

Analytical method: Cooper-Jacob (confined aquifer)

PARAMETER ESTIMATES

	Estimate		Std. Error
T =	7.8818E+002	+/-	2.8806E+001
S =	9.0264E-002	+/-	5.9815E-004

ANALYSIS OF MODEL RESIDUALS

residual = calculated - observed
weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals............... 26
Number of estimated parameters.... 2
Degrees of freedom................ 24
Residual mean..................... -7.108E-011
Residual standard deviation....... 0.006089
Residual variance................. 3.707E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
2	0.25	0.23905	0.010954	1
2.0417	0.25	0.2445	0.0055043	1
2.0833	0.25	0.24984	0.00016453	1
2.125	0.25	0.25507	-0.0050695	1
2.1667	0.26	0.2602	-0.00020184	1
2.2083	0.27	0.26524	0.0047636	1
2.25	0.27	0.27018	-0.00017693	1
2.2917	0.27	0.27503	-0.0050268	1
2.3333	0.27	0.27979	-0.0097892	1
2.375	0.29	0.28447	0.0055326	1
2.4167	0.29	0.28906	0.00093585	1
2.4583	0.29	0.29358	-0.0035824	1

2.5	0.29	0.29802	-0.0080246	1
2.5417	0.29	0.30239	-0.012393	1
2.5833	0.31	0.30669	0.0033087	1
2.625	0.31	0.31092	-0.00092028	1
2.6667	0.31	0.31508	-0.0050827	1
2.7083	0.31	0.31918	-0.0091806	1
2.75	0.33	0.32322	0.0067841	1
2.7917	0.33	0.32719	0.0028094	1
2.8333	0.34	0.33111	0.0088937	1
2.875	0.34	0.33496	0.0050351	1
2.9167	0.34	0.33877	0.001232	1
2.9583	0.34	0.34252	-0.0025171	1
3	0.35	0.34621	0.0037862	1
3.0174	0.35	0.34774	0.0022611	1

QUIFER TEST DATA Oct/Nov. 91 WELL#: OW89 (2492A)

pe of aquifer test: Constant Q
)w Q Measured: Orifice Weir
st. from pumping well (m): 435 m
)as. point for w. l.'s: T.O.C.
evation of Measuring Pt.:
atic Water Level (m): 5.02

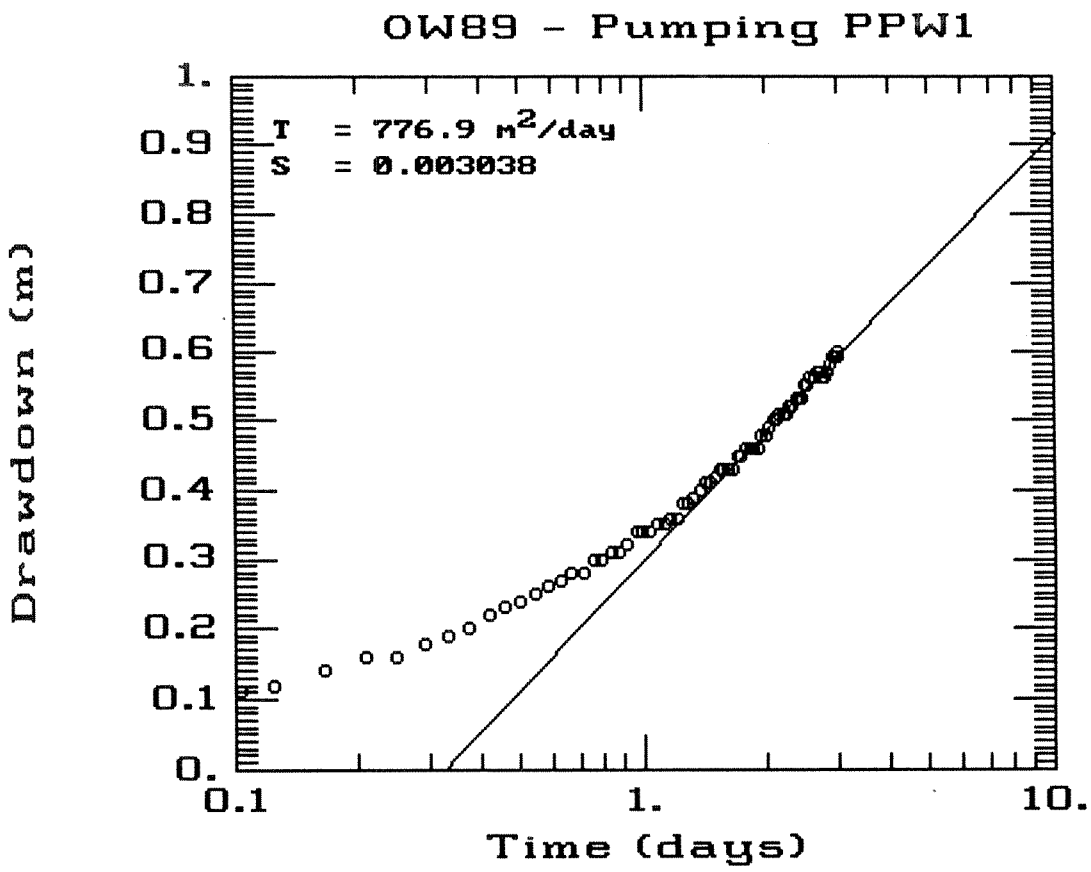
Well type: Observation
Data type: Pumping
Depth well: 24.10 m
Pump on: 8:00 am 10-29-1991
Pump off: 8:30 am 11-01-1991
Discharge rate: 400 IGPM

Time (min.)	Water Level (m)	Drawdown (m)	Discharge (i.g.p.m.)	Comments
150.00	5.13	0.11	400.00	
180.00	5.14	0.12	400.00	
240.00	5.16	0.14	400.00	
300.00	5.18	0.16	400.00	
360.00	5.18	0.16	400.00	
420.00	5.20	0.18	400.00	
480.00	5.21	0.19	400.00	
540.00	5.22	0.20	400.00	
600.00	5.24	0.22	400.00	
660.00	5.25	0.23	400.00	
720.00	5.26	0.24	400.00	
780.00	5.27	0.25	400.00	
840.00	5.28	0.26	400.00	
900.00	5.29	0.27	400.00	
960.00	5.30	0.28	400.00	
1020.00	5.30	0.28	400.00	
1080.00	5.32	0.30	400.00	
1140.00	5.32	0.30	400.00	
1200.00	5.33	0.31	400.00	
1260.00	5.33	0.31	400.00	
1320.00	5.34	0.32	400.00	
1380.00	5.36	0.34	400.00	
1440.00	5.36	0.34	400.00	
1500.00	5.36	0.34	400.00	
1560.00	5.37	0.35	400.00	
1620.00	5.37	0.35	400.00	
1680.00	5.38	0.36	400.00	
1740.00	5.38	0.36	400.00	
1800.00	5.40	0.38	400.00	
1860.00	5.40	0.38	400.00	
1920.00	5.41	0.39	400.00	
1980.00	5.42	0.40	400.00	
2040.00	5.43	0.41	400.00	
2100.00	5.43	0.41	400.00	
2160.00	5.44	0.42	400.00	
2220.00	5.45	0.43	400.00	
2280.00	5.45	0.43	400.00	
2340.00	5.45	0.43	400.00	
2400.00	5.45	0.43	400.00	
2460.00	5.47	0.45	400.00	
2520.00	5.47	0.45	400.00	

AQUIFER TEST DATA Oct/Nov. 91 WELL#: OW89 (2492A)

Type of aquifer test: Constant Q		Well type:	Observation
How Q Measured: Orifice Weir		Data type:	Pumping
Dist. from pumping well (m):	435 m	Depth well:	24.10 m
Meas. point for w. l.'s:	T.O.C.	Pump on:	8:00 am 10-29-1991
Elevation of Measuring Pt.:		Pump off:	8:30 am 11-01-1991
Static Water Level (m):	5.02	Discharge rate:	400 IGPM

Time (min.)	Water Level (m)	Drawdown (m)	Discharge (i.g.p.m.)	Comments
2580.00	5.48	0.46	400.00	
2640.00	5.48	0.46	400.00	
2700.00	5.48	0.46	400.00	
2760.00	5.48	0.46	400.00	
2820.00	5.50	0.48	400.00	
2880.00	5.50	0.48	400.00	
2940.00	5.51	0.49	400.00	
3000.00	5.52	0.50	400.00	
3060.00	5.52	0.50	400.00	
3120.00	5.53	0.51	400.00	
3180.00	5.53	0.51	400.00	
3240.00	5.53	0.51	400.00	
3300.00	5.54	0.52	400.00	
3360.00	5.54	0.52	400.00	
3420.00	5.55	0.53	400.00	
3480.00	5.55	0.53	400.00	
3540.00	5.55	0.53	400.00	
3600.00	5.57	0.55	400.00	
3660.00	5.57	0.55	400.00	
3720.00	5.58	0.56	400.00	
3780.00	5.58	0.56	400.00	
3840.00	5.59	0.57	400.00	
3900.00	5.59	0.57	400.00	
3960.00	5.58	0.56	400.00	
4020.00	5.58	0.56	400.00	
4080.00	5.59	0.57	400.00	
4140.00	5.60	0.58	400.00	
4200.00	5.61	0.59	400.00	
4260.00	5.61	0.59	400.00	
4320.00	5.61	0.59	400.00	
4350.00	5.62	0.60	400.00	



AQTESOLV

GERAGHTY & MILLER, INC.

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A Q T E S O L V   R E S U L T S

02/12/92 17:06:25

PROBLEM DEFINITION

Problem title: OW89 - Pumping PPW1

Knowns and Constants:
- No. of data points............... 72
- Pumping rate..................... 2621
- Radius to obs. well.............. 435

ESTIMATION RESULTS

Analytical method: Cooper-Jacob (confined aquifer)

PARAMETER ESTIMATES

	Estimate		Std. Error
T =	7.7695E+002	+/-	2.6834E+001
S =	3.0380E-003	+/-	1.0852E-004

ANALYSIS OF MODEL RESIDUALS

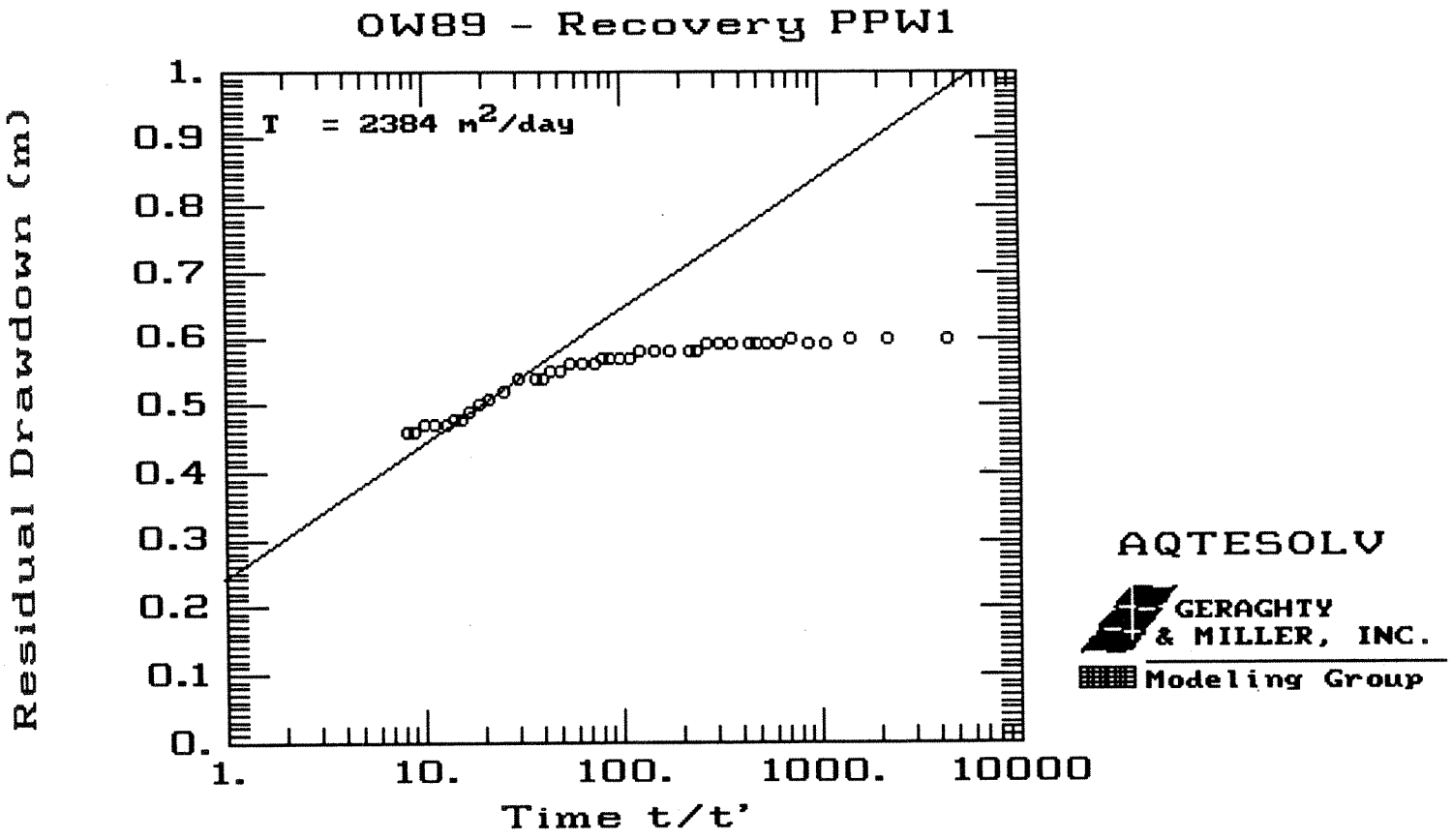
residual = calculated - observed
weighted residual = residual * weight

Weighted Residual Statistics:
- Number of residuals............... 26
- Number of estimated parameters.... 2
- Degrees of freedom................ 24
- Residual mean..................... -7.259E-011
- Residual standard deviation....... 0.00584
- Residual variance................. 3.411E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
2	0.48	0.48357	-0.0035652	1
2.0417	0.49	0.48909	0.00090612	1
2.0833	0.5	0.49451	0.0054892	1
2.125	0.5	0.49982	0.00017951	1
2.1667	0.51	0.50503	0.0049729	1
2.2083	0.51	0.51013	-0.00013444	1
2.25	0.51	0.51515	-0.0051464	1
2.2917	0.52	0.52007	-6.6298E-005	1
2.3333	0.52	0.5249	-0.0048976	1
2.375	0.53	0.52964	0.00035663	1
2.4167	0.53	0.53431	-0.0043066	1
2.4583	0.53	0.53889	-0.0088901	1

2.5	0.55	0.5434	0.0066034	1
2.5417	0.55	0.54783	0.0021714	1
2.5833	0.56	0.55219	0.0078115	1
2.625	0.56	0.55648	0.0035213	1
2.6667	0.57	0.5607	0.0092987	1
2.7083	0.57	0.56486	0.0051416	1
2.75	0.56	0.56895	-0.0089521	1
2.7917	0.56	0.57298	-0.012984	1
2.8333	0.57	0.57696	-0.0069566	1
2.875	0.58	0.58087	-0.00087093	1
2.9167	0.59	0.58473	0.005271	1
2.9583	0.59	0.58853	0.0014677	1
3	0.59	0.59228	-0.0022824	1
3.0208	0.6	0.59414	0.005862	1


OW89 - Recovery PPW1
T = 2384 m²/day
Residual Drawdown (m)
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
1.
10.
100.
1000.
10000
Time t/t'
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

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A Q T E S O L V   R E S U L T S

02/12/92 17:18:21

PROBLEM DEFINITION

Problem title: OW89 - Recovery PPW1

Knowns and Constants:
- No. of data points............... 41
- Pumping rate..................... 2621
- Total pumping time............... 3.021

ESTIMATION RESULTS

Analytical method: Theis recovery (confined aquifer)

PARAMETER ESTIMATES

	Estimate		Std. Error
T =	2.3842E+003	+/-	3.1983E+000
S' =	6.3333E-002	+/-	0.0000E+000

ANALYSIS OF MODEL RESIDUALS

residual = calculated - observed
weighted residual = residual * weight

Weighted Residual Statistics:
- Number of residuals............... 6
- Number of estimated parameters.... 2
- Degrees of freedom................ 5
- Residual mean..................... -1.85E-017
- Residual standard deviation....... 0.00165
- Residual variance................. 2.721E-006

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.10417	0.54	0.53828	0.0017189	1
0.125	0.52	0.52293	-0.0029312	1
0.14583	0.51	0.51004	-3.8925E-005	1
0.16667	0.5	0.49894	0.0010555	1
0.1875	0.49	0.48922	0.00077765	1
0.20833	0.48	0.48058	-0.00058195	1

AQUIFER TEST DATA Oct/Nov. 91 WELL#: TW1 (2492A)

Type of aquifer test:	Constant Q	Well type:	Observation
Flow Q Measured:	Orifice Weir	Data type:	Pumping
Dist. from pumping well (m):	19.22 m	Depth well:	22.2 m
Meas. point for w. l.'s:	T.O.C.	Pump on:	8:00 am 10-29-1991
Elevation of Measuring Pt.:		Pump off:	8:30 am 11-01-1991
Static Water Level (m):	4.35	Discharge rate:	400 IGPM

Time (min.)	Water Level (m)	Drawdown (m)	Discharge (i.g.p.m.)	Comments
7.50	4.45	0.10	400.00	
10.50	4.46	0.11	400.00	
12.00	4.47	0.12	400.00	
14.00	4.47	0.12	400.00	
16.00	4.48	0.13	400.00	
18.00	4.48	0.13	400.00	
20.00	4.48	0.13	400.00	
25.00	4.49	0.14	400.00	
30.00	4.50	0.15	400.00	
36.00	4.50	0.15	400.00	
40.00	4.51	0.16	400.00	
45.00	4.51	0.16	400.00	
50.00	4.52	0.17	400.00	
55.00	4.52	0.17	400.00	
60.00	4.53	0.18	400.00	
70.00	4.53	0.18	400.00	
84.00	4.54	0.19	400.00	
90.00	4.54	0.19	400.00	
120.00	4.56	0.21	400.00	
150.00	4.57	0.22	400.00	
180.00	4.59	0.24	400.00	
210.00	4.60	0.25	400.00	
240.00	4.61	0.26	400.00	
270.00	4.62	0.27	400.00	
300.00	4.63	0.28	400.00	
330.00	4.64	0.29	400.00	
360.00	4.65	0.30	400.00	
420.00	4.66	0.31	400.00	
480.00	4.68	0.33	400.00	
540.00	4.70	0.35	400.00	
600.00	4.71	0.36	400.00	
660.00	4.72	0.37	400.00	
720.00	4.72	0.37	400.00	
780.00	4.75	0.40	400.00	
840.00	4.76	0.41	400.00	
900.00	4.77	0.42	400.00	
960.00	4.77	0.42	400.00	
1020.00	4.78	0.43	400.00	
1080.00	4.80	0.45	400.00	
1140.00	4.80	0.45	400.00	
1200.00	4.81	0.46	400.00	

AQUIFER TEST DATA Oct/Nov. 91 WELL#: TW1 (2492A)

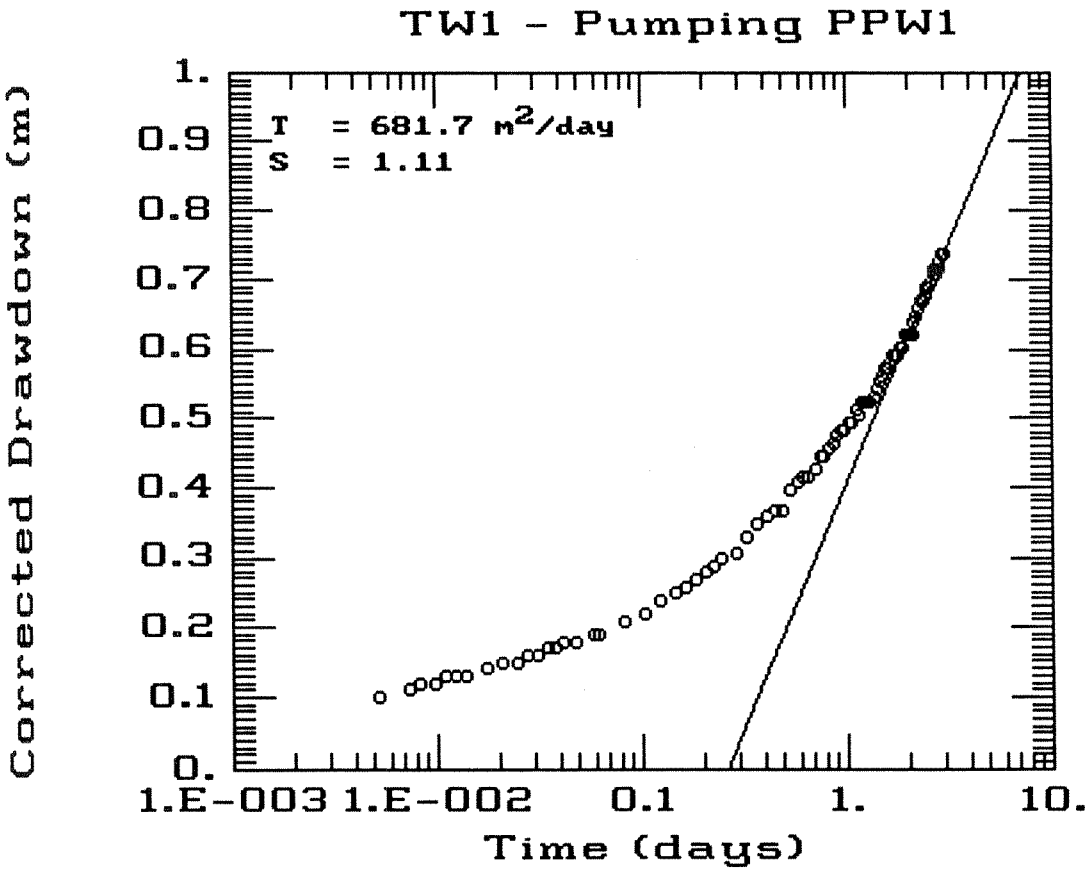
ype of aquifer test:	Constant Q	Well type:	Observation
low Q Measured:	Orifice Weir	Data type:	Pumping
ist. from pumping well (m):	19.22 m	Depth well:	22.2 m
leas. point for w. l.'s:	T.O.C.	Pump on:	8:00 am 10-29-1991
levation of Measuring Pt.:		Pump off:	8:30 am 11-01-1991
tatic Water Level (m):	4.35	Discharge rate:	400 IGPM

Time (min.)	Water Level (m)	Drawdown (m)	Discharge (i.g.p.m.)	Comments
1260.00	4.82	0.47	400.00	
1320.00	4.83	0.48	400.00	
1380.00	4.84	0.49	400.00	
1440.00	4.84	0.49	400.00	
1500.00	4.85	0.50	400.00	
1560.00	4.85	0.50	400.00	
1620.00	4.87	0.52	400.00	
1680.00	4.86	0.51	400.00	
1740.00	4.88	0.53	400.00	
1800.00	4.88	0.53	400.00	
1860.00	4.88	0.53	400.00	
1920.00	4.88	0.53	400.00	
1980.00	4.89	0.54	400.00	
2040.00	4.90	0.55	400.00	
2100.00	4.91	0.56	400.00	
2160.00	4.92	0.57	400.00	
2220.00	4.93	0.58	400.00	
2280.00	4.93	0.58	400.00	
2340.00	4.93	0.58	400.00	
2400.00	4.94	0.59	400.00	
2460.00	4.95	0.60	400.00	
2520.00	4.95	0.60	400.00	
2580.00	4.95	0.60	400.00	
2640.00	4.96	0.61	400.00	
2700.00	4.96	0.61	400.00	
2760.00	4.96	0.61	400.00	
2820.00	4.98	0.63	400.00	
2880.00	4.98	0.63	400.00	
2940.00	4.98	0.63	400.00	
3000.00	4.98	0.63	400.00	
3060.00	4.98	0.63	400.00	
3120.00	5.00	0.65	400.00	
3180.00	5.01	0.66	400.00	
3240.00	5.02	0.67	400.00	
3300.00	5.02	0.67	400.00	
3360.00	5.03	0.68	400.00	
3420.00	5.03	0.68	400.00	
3480.00	5.03	0.68	400.00	
3540.00	5.04	0.69	400.00	
3600.00	5.05	0.70	400.00	
3660.00	5.05	0.70	400.00	

AQUIFER TEST DATA Oct/Nov. 91 WELL#: TW1 (2492A)

Type of aquifer test:	Constant Q	Well type:	Observation
Flow Q Measured:	Orifice Weir	Data type:	Pumping
Dist. from pumping well (m):	19.22 m	Depth well:	22.2 m
Meas. point for w. l.'s:	T.O.C.	Pump on:	8:00 am 10-29-1991
Elevation of Measuring Pt.:		Pump off:	8:30 am 11-01-1991
Static Water Level (m):	4.35	Discharge rate:	400 IGPM

Time (min.)	Water Level (m)	Drawdown (m)	Discharge (i.g.p.m.)	Comments
3720.00	5.05	0.70	400.00	
3780.00	5.06	0.71	400.00	
3840.00	5.07	0.72	400.00	
3900.00	5.08	0.73	400.00	
3960.00	5.07	0.72	400.00	
4020.00	5.08	0.73	400.00	
4080.00	5.08	0.73	400.00	
4140.00	5.09	0.74	400.00	
4200.00	5.10	0.75	400.00	
4260.00	5.10	0.75	400.00	
4315.00	5.10	0.75	400.00	
4345.00	5.10	0.75	400.00	



AQTESOLV

GERAGHTY & MILLER, INC.

Modeling Group

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A Q T E S O L V   R E S U L T S

02/12/92 16:44:17

PROBLEM DEFINITION

Problem title: TW1 - Pumping PPW1

Knowns and Constants:
- No. of data points............... 94
- Pumping rate..................... 2621
- Radius to obs. well.............. 19.22

ESTIMATION RESULTS

Analytical method: Cooper-Jacob (confined aquifer)

PARAMETER ESTIMATES

	Estimate		Std. Error
T =	6.5683E+002	+/-	1.7904E+001
S =	1.1148E+000	+/-	3.6401E-002

ANALYSIS OF MODEL RESIDUALS

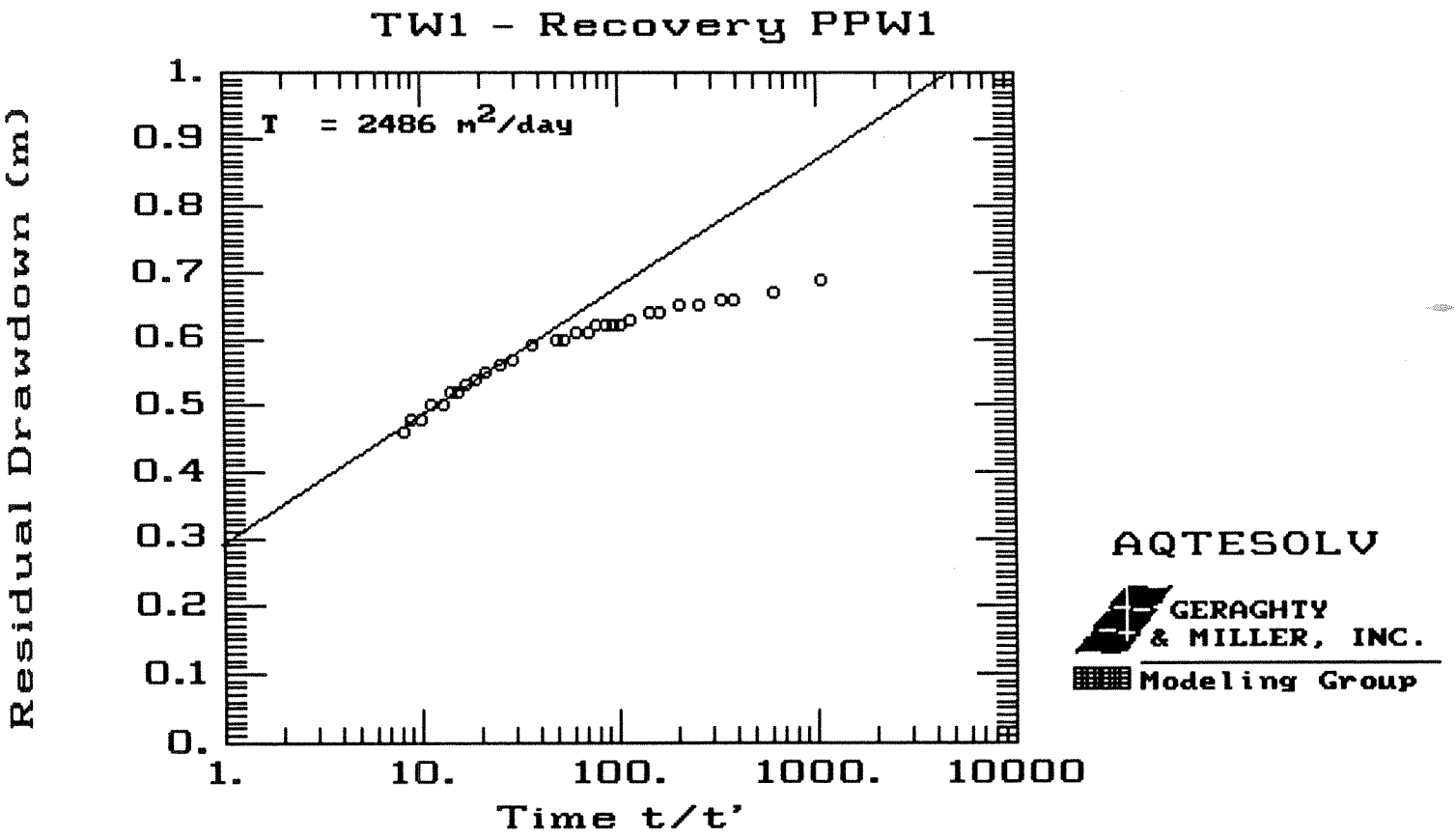
residual = calculated - observed
weighted residual = residual * weight

Weighted Residual Statistics:
- Number of residuals............... 26
- Number of estimated parameters.... 2
- Degrees of freedom................ 24
- Residual mean..................... -8.667E-011
- Residual standard deviation....... 0.005447
- Residual variance................. 2.967E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
2	0.63	0.62456	0.0054421	1
2.0417	0.63	0.6311	-0.0010986	1
2.0833	0.63	0.63751	-0.0075056	1
2.125	0.63	0.64379	-0.013787	1
2.1667	0.65	0.64995	5.3176E-005	1
2.2083	0.66	0.65599	0.0040123	1
2.25	0.67	0.66192	0.0080829	1
2.2917	0.67	0.66774	0.0022624	1
2.3333	0.68	0.67345	0.0065481	1
2.375	0.68	0.67907	0.00093356	1
2.4167	0.68	0.68458	-0.0045833	1
2.4583	0.69	0.69	-4.5541E-006	1

2.5	0.7	0.69534	0.004664	1
2.5417	0.7	0.70058	-0.00057926	1
2.5833	0.7	0.70574	-0.005736	1
2.625	0.71	0.71081	-0.00081155	1
2.6667	0.72	0.71581	0.0041929	1
2.7083	0.73	0.72072	0.009276	1
2.75	0.72	0.72557	-0.0055671	1
2.7917	0.73	0.73034	-0.00033725	1
2.8333	0.73	0.73504	-0.0050356	1
2.875	0.74	0.73967	0.00033344	1
2.9167	0.75	0.74423	0.0057692	1
2.9583	0.75	0.74873	0.0012707	1
2.9965	0.75	0.7528	-0.0027988	1
3.0174	0.75	0.755	-0.004996	1


TW1 - Recovery PPW1
T = 2486 m²/day
Residual Drawdown (m)
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
1.
10.
100.
1000.
10000
Time t/t'
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A Q T E S O L V   R E S U L T S

02/12/92   16:52:49

PROBLEM DEFINITION

Problem title: TW1 - Recovery PPW1

Knowns and Constants:
   No. of data points............... 30
   Pumping rate..................... 2621
   Total pumping time............... 3.021

ESTIMATION RESULTS

Analytical method: Theis recovery (confined aquifer)

PARAMETER ESTIMATES

	Estimate		Std. Error
T =	2.4864E+003	+/-	6.6501E+000
S' =	3.1179E-002	+/-	0.0000E+000

ANALYSIS OF MODEL RESIDUALS

residual = calculated - observed
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 12
   Number of estimated parameters.... 2
   Degrees of freedom................ 11
   Residual mean..................... 1.064E-016
   Residual standard deviation....... 0.004757
   Residual variance................. 2.263E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.10521	0.57	0.57473	-0.0047304	1
0.125	0.56	0.56082	-0.00081713	1
0.14583	0.55	0.54845	0.0015453	1
0.16667	0.54	0.53782	0.0021838	1
0.1875	0.53	0.52849	0.0015064	1
0.20833	0.52	0.52021	-0.00020828	1
0.22917	0.52	0.51276	0.0072385	1
0.25	0.5	0.50601	-0.0060067	1
0.29167	0.5	0.49415	0.0058482	1
0.33333	0.48	0.48401	-0.0040112	1
0.375	0.48	0.47518	0.0048228	1
0.41667	0.46	0.46737	-0.0073713	1

AQUIFER TEST DATA Oct/Nov. 91 WELL#: OW84 (2492A)

Type of aquifer test:	Constant Q	Well type:	Observation
Flow Q Measured:	Orifice Weir	Data type:	Pumping
Dist. from pumping well (m):	184 m	Depth well:	23.8 m
Meas. point for w. l.'s:	T.O.C.	Pump on:	8:00 am 10-29-1991
Elevation of Measuring Pt.:		Pump off:	8:30 am 11-01-1991
Static Water Level (m):	4.84	Discharge rate:	400 IGPM

Time (min.)	Water Level (m)	Drawdown (m)	Discharge (i.g.p.m.)	Comments
12.00	4.84	0.00	400.00	
38.00	4.84	0.00	400.00	
54.00	4.84	0.00	400.00	
120.00	4.84	0.00	400.00	
150.00	4.84	0.00	400.00	
180.00	4.85	0.01	400.00	
210.00	4.85	0.01	400.00	
240.00	4.85	0.01	400.00	
270.00	4.85	0.01	400.00	
300.00	4.86	0.03	400.00	
330.00	4.86	0.03	400.00	
360.00	4.86	0.03	400.00	
420.00	4.86	0.03	400.00	
480.00	4.86	0.03	400.00	
540.00	4.86	0.03	400.00	
600.00	4.86	0.03	400.00	
660.00	4.86	0.03	400.00	
720.00	4.86	0.03	400.00	
780.00	4.86	0.03	400.00	
840.00	4.86	0.03	400.00	
900.00	4.86	0.03	400.00	
960.00	4.86	0.03	400.00	
1020.00	4.86	0.03	400.00	
1080.00	4.86	0.03	400.00	
1140.00	4.86	0.03	400.00	
1200.00	4.87	0.04	400.00	
1260.00	4.87	0.04	400.00	
1320.00	4.87	0.04	400.00	
1380.00	4.87	0.04	400.00	
1440.00	4.87	0.04	400.00	
1500.00	4.87	0.04	400.00	
1560.00	4.87	0.04	400.00	
1620.00	4.87	0.04	400.00	
1680.00	4.87	0.04	400.00	
1740.00	4.87	0.04	400.00	
1800.00	4.88	0.04	400.00	
1860.00	4.88	0.04	400.00	
1920.00	4.88	0.04	400.00	
1980.00	4.88	0.04	400.00	
2040.00	4.88	0.04	400.00	
2100.00	4.89	0.05	400.00	

AQUIFER TEST DATA Oct/Nov. 91 WELL#: OW84 (2492A)

Type of aquifer test:	Constant Q	Well type:	Observation
Flow Q Measured:	Orifice Weir	Data type:	Pumping
Dist. from pumping well (m):	184 m	Depth well:	23.8 m
Meas. point for w. l.'s:	T.O.C.	Pump on:	8:00 am 10-29-1991
Elevation of Measuring Pt.:		Pump off:	8:30 am 11-01-1991
Static Water Level (m):	4.84	Discharge rate:	400 IGPM

Time (min.)	Water Level (m)	Drawdown (m)	Discharge (i.g.p.m.)	Comments
2160.00	4.89	0.05	400.00	
2220.00	4.89	0.05	400.00	
2280.00	4.89	0.05	400.00	
2340.00	4.89	0.05	400.00	
2400.00	4.89	0.05	400.00	
2460.00	4.89	0.05	400.00	
2520.00	4.89	0.05	400.00	
2580.00	4.89	0.05	400.00	
2640.00	4.89	0.05	400.00	
2700.00	4.89	0.05	400.00	
2760.00	4.89	0.05	400.00	
2820.00	4.89	0.05	400.00	
2880.00	4.90	0.07	400.00	
2940.00	4.90	0.07	400.00	
3000.00	4.90	0.07	400.00	
3060.00	4.90	0.07	400.00	
3120.00	4.90	0.07	400.00	
3180.00	4.90	0.07	400.00	
3240.00	4.90	0.07	400.00	
3300.00	4.90	0.07	400.00	
3360.00	4.90	0.07	400.00	
3420.00	4.90	0.07	400.00	
3480.00	4.90	0.07	400.00	
3540.00	4.90	0.07	400.00	
3600.00	4.90	0.07	400.00	
3660.00	4.90	0.07	400.00	
3720.00	4.91	0.08	400.00	
3780.00	4.91	0.08	400.00	
3840.00	4.91	0.08	400.00	
3900.00	4.91	0.08	400.00	
3960.00	4.91	0.08	400.00	
4020.00	4.91	0.08	400.00	
4080.00	4.91	0.08	400.00	
4140.00	4.91	0.08	400.00	
4200.00	4.92	0.08	400.00	
4260.00	4.92	0.08	400.00	
4320.00	4.92	0.08	400.00	
4345.00	4.92	0.08	400.00	

\QUIFER TEST DATA Oct/Nov. 91 WELL#: OW84 (2492A)

'ype of aquifer test: Constant Q		Well type:	Observation
low Q Measured: Orifice Weir		Data type:	Recovery
)ist. from pumping well: (m)	184 m	Depth well:	23.8 m
leas. point for w. l.'s:	T.O.C.	Pump on:	8:00 am 10-29-1991
:levation of Measuring Pt.:		Pump off:	8:30 am 11-01-1991
itatic Water Level (m):	4.84	Discharge rate:	400 IGPM

At t' = 0, t = 4350.00

Time (min.)	t/t'	Water Level (m)	Residual Drawdown (m)	Comments
1.00	4351.00	4.92	0.08	
2.00	2176.00	4.92	0.08	
3.00	1451.00	4.92	0.08	
4.00	1088.50	4.92	0.08	
5.00	871.00	4.92	0.08	
6.00	726.00	4.92	0.08	
7.00	622.43	4.92	0.08	
8.00	544.75	4.92	0.08	
9.00	484.33	4.92	0.08	
10.00	436.00	4.92	0.08	
12.00	363.50	4.92	0.08	
14.00	311.71	4.92	0.08	
16.00	272.88	4.92	0.08	
18.00	242.67	4.92	0.08	
20.00	218.50	4.92	0.08	
25.00	175.00	4.92	0.08	
30.00	146.00	4.92	0.08	
35.00	125.29	4.92	0.08	
40.00	109.75	4.92	0.08	
45.00	97.67	4.92	0.08	
50.00	88.00	4.92	0.08	
55.00	80.09	4.92	0.08	
60.00	73.50	4.92	0.08	
70.00	63.14	4.92	0.08	
80.00	55.38	4.92	0.08	
90.00	49.33	4.92	0.08	
120.00	37.25	4.92	0.08	
130.00	34.46	4.92	0.08	
140.00	32.07	4.92	0.08	
150.00	30.00	4.92	0.08	
180.00	25.17	4.92	0.08	
210.00	21.71	4.92	0.08	
240.00	19.13	4.92	0.08	
270.00	17.11	4.92	0.08	
300.00	15.50	4.93	0.09	
330.00	14.18	4.93	0.09	
360.00	13.08	4.93	0.09	
390.00	12.15	4.93	0.09	
420.00	11.36	4.93	0.09	
480.00	10.06	4.93	0.09	
540.00	9.06	4.93	0.09	
600.00	8.25	4.93	0.09	

AQUIFER TEST DATA Oct/Nov. 91 WELL#: OW85 (2492A)

Type of aquifer test: Constant Q		Well type:	Observation
Flow Q Measured: Orifice Weir		Data type:	Recovery
Dist. from pumping well (m):	126 m	Depth well:	23.5 m
Meas. point for w. l.'s:	T.O.C.	Pump on:	8:00 am 10-29-1991
Elevation of Measuring Pt.:		Pump off:	8:30 am 11-01-1991
Static Water Level (m):	4.83	Discharge rate:	400 IGPM

At t' = 0, t = 4350.00

Time (min.)	t/t'	Water Level (m)	Residual Drawdown (m)	Comments
1.00	4351.00	5.18	0.35	
2.00	2176.00	5.18	0.35	
3.00	1451.00	5.18	0.35	
4.00	1088.50	5.18	0.35	
5.00	871.00	5.18	0.35	
6.00	726.00	5.18	0.35	
7.00	622.43	5.17	0.34	
8.00	544.75	5.17	0.34	
9.00	484.33	5.17	0.34	
10.00	436.00	5.17	0.34	
12.00	363.50	5.17	0.34	
14.00	311.71	5.17	0.34	
16.00	272.88	5.17	0.34	
18.00	242.67	5.17	0.34	
20.00	218.50	5.17	0.34	
25.00	175.00	5.17	0.34	
30.00	146.00	5.17	0.34	
35.00	125.29	5.17	0.34	
40.00	109.75	5.17	0.34	
45.00	97.67	5.17	0.34	
50.00	88.00	5.17	0.34	
55.00	80.09	5.17	0.34	
60.00	73.50	5.17	0.34	
70.00	63.14	5.17	0.34	
80.00	55.38	5.17	0.34	
90.00	49.33	5.17	0.34	
120.00	37.25	5.17	0.34	
150.00	30.00	5.17	0.34	
180.00	25.17	5.17	0.34	
210.00	21.71	5.17	0.34	
240.00	19.13	5.17	0.34	
270.00	17.11	5.17	0.34	
300.00	15.50	5.17	0.34	
330.00	14.18	5.17	0.34	
360.00	13.08	5.17	0.34	
420.00	11.36	5.17	0.34	
480.00	10.06	5.17	0.34	
540.00	9.06	5.17	0.34	
600.00	8.25	5.17	0.34	

AQUIFER TEST DATA Oct/Nov. 91 WELL#: OW87 (2492A)

Type of aquifer test: Constant Q		Well type:	Observation
Flow Q Measured: Orifice Weir		Data type:	Recovery
Dist. from pumping well (m):	22.03 m	Depth well:	25 m
Meas. point for w. l.'s:	T.O.C.	Pump on:	8:00 am 10-29-1991
Elevation of Measuring Pt.:		Pump off:	8:30 am 11-01-1991
Static Water Level (m):	3.67	Discharge rate:	400 IGPM

At t' = 0, t = 4350.00

Time (min.)	t/t'	Water Level (m)	Residual Drawdown (m)	Comments
4.50	967.67	4.99	1.32	
7.50	581.00	4.88	1.21	
11.50	379.26	4.87	1.20	
13.50	323.22	4.86	1.19	
17.00	256.88	4.87	1.20	
22.00	198.73	4.82	1.15	
27.00	162.11	4.84	1.17	
32.00	136.94	4.84	1.17	
38.50	113.99	4.83	1.16	
43.00	102.16	4.83	1.16	
47.00	93.55	4.82	1.15	
51.50	85.47	4.82	1.15	
56.50	77.99	4.82	1.15	
62.50	70.60	4.82	1.15	
72.00	61.42	4.81	1.14	
82.50	53.73	4.81	1.14	
93.00	47.77	4.79	1.12	
122.50	36.51	4.79	1.12	
152.50	29.52	4.77	1.10	
180.00	25.17	4.76	1.09	
210.00	21.71	4.75	1.08	
240.00	19.13	4.74	1.07	
270.00	17.11	4.73	1.06	
300.00	15.50	4.72	1.05	
330.00	14.18	4.71	1.04	
360.00	13.08	4.70	1.03	
420.00	11.36	4.70	1.03	
480.00	10.06	4.67	1.00	
540.00	9.06	4.67	1.00	
600.00	8.25	4.65	0.98	

AQUIFER TEST DATA Oct/Nov. 91 WELL#: OW89 (2492A)

Type of aquifer test: Constant Q		Well type:	Observation
How Q Measured: Orifice Weir		Data type:	Recovery
Dist. from pumping well (m):	435 m	Depth well:	24.1 m
Meas. point for w. l.'s:	T.O.C.	Pump on:	8:00 am 10-29-1991
Elevation of Measuring Pt.:		Pump off:	8:30 am 11-01-1991
Static Water Level (m):	5.02	Discharge rate:	400 IGPM

At t' = 0, t = 4350.00

Time (min.)	t/t'	Water Level (m)	Residual Drawdown (m)	Comments
1.00	4351.00	5.62	0.60	
2.00	2176.00	5.62	0.60	
3.00	1451.00	5.62	0.60	
4.00	1088.50	5.61	0.59	
5.00	871.00	5.61	0.59	
6.00	726.00	5.62	0.60	
7.00	622.43	5.61	0.59	
8.00	544.75	5.61	0.59	
9.00	484.33	5.61	0.59	
10.00	436.00	5.61	0.59	
12.00	363.50	5.61	0.59	
14.00	311.71	5.61	0.59	
16.00	272.88	5.61	0.59	
18.00	242.67	5.60	0.58	
20.00	218.50	5.60	0.58	
25.00	175.00	5.60	0.58	
30.00	146.00	5.60	0.58	
35.00	125.29	5.60	0.58	
40.00	109.75	5.59	0.57	
45.00	97.67	5.59	0.57	
50.00	88.00	5.59	0.57	
55.00	80.09	5.59	0.57	
60.00	73.50	5.58	0.56	
70.00	63.14	5.58	0.56	
80.00	55.38	5.58	0.56	
90.00	49.33	5.57	0.55	
100.00	44.50	5.57	0.55	
110.00	40.55	5.56	0.54	
120.00	37.25	5.56	0.54	
150.00	30.00	5.56	0.54	
180.00	25.17	5.54	0.52	
210.00	21.71	5.53	0.51	
240.00	19.13	5.52	0.50	
270.00	17.11	5.51	0.49	
300.00	15.50	5.50	0.48	
330.00	14.18	5.50	0.48	
360.00	13.08	5.49	0.47	
420.00	11.36	5.49	0.47	
480.00	10.06	5.49	0.47	
540.00	9.06	5.48	0.46	
600.00	8.25	5.48	0.46	

AQUIFER TEST DATA Oct/Nov. 91 WELL#: PPW1 (2492A)

Type of aquifer test: Constant Q		Well type:	Pumping
Flow Q Measured: Orifice Weir		Data type:	Recovery
Dist. from pumping well (m):	0 m	Depth well:	22.86 m
Meas. point for w. l.'s:	T.O.C.	Pump on:	8:00 am 10-29-1991
Depth of Pump (m):	18.6 m	Pump off:	8:30 am 11-01-1991
Static Water Level (m):	5.41	Discharge rate:	400 IGPM

At t' = 0, t = 4350.00

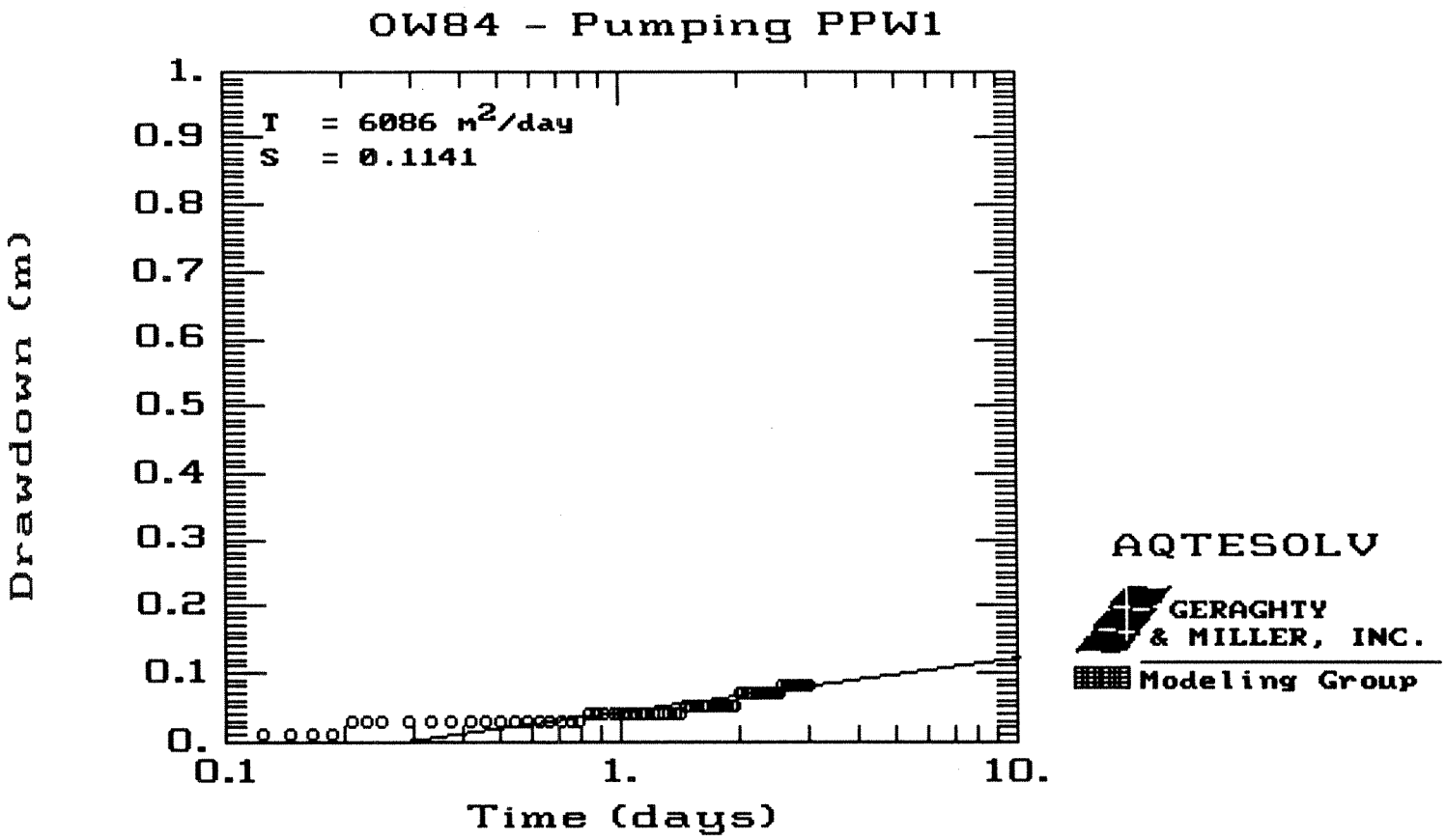
Time (min.)	t/t'	Water Level (m)	Residual Drawdown (m)	Comments
1.00	4351.00	6.13	0.72	
2.00	2176.00	6.13	0.72	
3.00	1451.00	6.12	0.71	
5.00	871.00	6.10	0.69	
9.00	484.33	6.10	0.68	
10.00	436.00	6.09	0.68	
12.00	363.50	6.08	0.67	
14.00	311.71	6.08	0.67	
16.00	272.88	6.08	0.67	
20.00	218.50	6.07	0.66	
25.00	175.00	6.07	0.66	
30.00	146.00	6.06	0.65	
35.00	125.29	6.06	0.65	
40.00	109.75	6.05	0.64	
45.00	97.67	6.04	0.63	
50.00	88.00	6.04	0.63	
55.00	80.09	6.04	0.63	
60.00	73.50	6.03	0.62	
70.00	63.14	6.03	0.62	
80.00	55.38	6.03	0.62	
90.00	49.33	6.02	0.60	
120.00	37.25	6.00	0.59	
150.00	30.00	6.00	0.59	
180.00	25.17	5.98	0.57	
210.00	21.71	5.97	0.56	
240.00	19.13	5.96	0.55	
270.00	17.11	5.95	0.54	
300.00	15.50	5.95	0.54	
330.00	14.18	5.94	0.53	
360.00	13.08	5.93	0.52	
420.00	11.36	5.93	0.52	
480.00	10.06	5.91	0.50	
540.00	9.06	5.90	0.49	
600.00	8.25	5.89	0.48	

AQUIFER TEST DATA Oct/Nov. 91 WELL#: TW1 (2492A)

Type of aquifer test: Constant Q		Well type:	Observation
Flow Q Measured: Orifice weir		Data type:	Recovery
Dist. from pumping well (m):	19.22 m	Depth well:	22.2 m
Meas. point for w. l.'s:	T.O.C.	Pump on:	8:00 am 10-29-1991
Elevation of Measuring Pt.:		Pump off:	8:30 am 11-01-1991
Static Water Level (m):	4.35	Discharge rate:	400 IGPM

At t' = 0, t = 4350.00

Time (min.)	t/t'	Water Level (m)	Residual Drawdown (m)	Comments
4.00	1088.50	5.04	0.69	
7.00	622.43	5.02	0.67	
11.00	396.45	5.01	0.66	
13.00	335.62	5.01	0.66	
16.50	264.64	5.00	0.65	
21.00	208.14	5.00	0.65	
26.50	165.15	4.99	0.64	
30.00	146.00	4.99	0.64	
37.00	118.57	4.98	0.63	
41.50	105.82	4.97	0.62	
46.50	94.55	4.97	0.62	
50.50	87.14	4.97	0.62	
56.00	78.68	4.97	0.62	
61.50	71.73	4.96	0.61	
71.00	62.27	4.96	0.61	
81.50	54.37	4.95	0.60	
90.50	49.07	4.95	0.60	
121.50	36.80	4.94	0.59	
151.50	29.71	4.92	0.57	
180.00	25.17	4.91	0.56	
210.00	21.71	4.90	0.55	
240.00	19.13	4.89	0.54	
270.00	17.11	4.88	0.53	
300.00	15.50	4.87	0.52	
330.00	14.18	4.87	0.52	
360.00	13.08	4.85	0.50	
420.00	11.36	4.85	0.50	
480.00	10.06	4.83	0.48	
540.00	9.06	4.83	0.48	
600.00	8.25	4.81	0.46	


OW84 - Pumping PPW1
T = 6086 m²/day
S = 0.1141
Drawdown (m)
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
0.1
1.
10.
Time (days)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

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A Q T E S O L V   R E S U L T S

02/12/92 17:31:29

PROBLEM DEFINITION

Problem title: OW84 - Pumping PPW1

Knowns and Constants:
No. of data points............... 74
Pumping rate...................... 2621
Radius to obs. well.............. 184

ESTIMATION RESULTS

Analytical method: Cooper-Jacob (confined aquifer)

PARAMETER ESTIMATES

	Estimate		Std. Error
T =	6.0863E+003	+/-	7.5371E+002
S =	1.1413E-001	+/-	1.6756E-002

ANALYSIS OF MODEL RESIDUALS

residual = calculated - observed
weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals............... 26
Number of estimated parameters.... 2
Degrees of freedom................ 24
Residual mean..................... -9.346E-012
Residual standard deviation....... 0.002672
Residual variance................. 7.138E-006

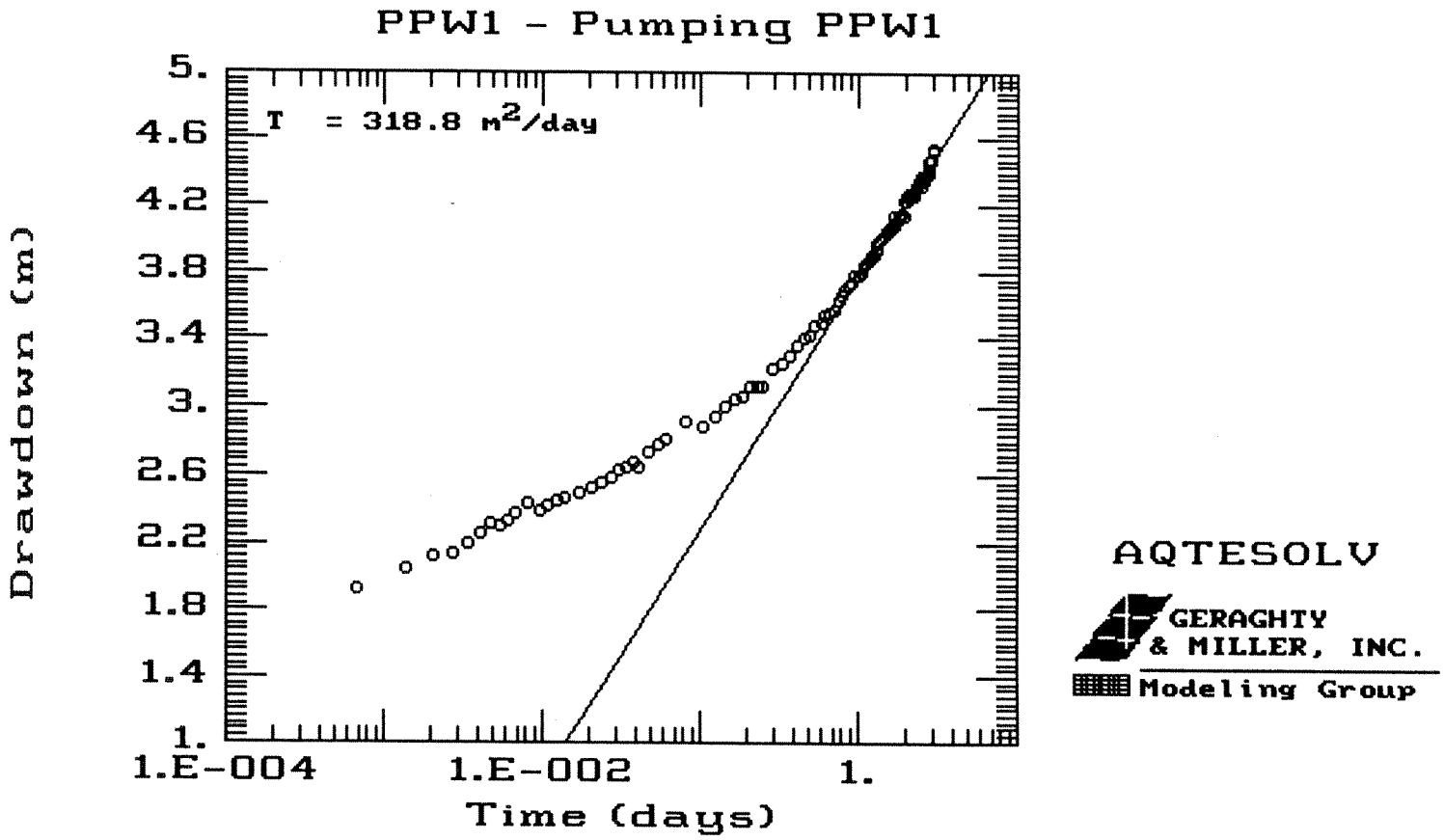
Model Residuals:

Time	Observed	Calculated	Residual	Weight
2	0.07	0.066971	0.0030291	1
2.0417	0.07	0.067677	0.0023234	1
2.0833	0.07	0.068368	0.0016319	1
2.125	0.07	0.069046	0.00095408	1
2.1667	0.07	0.069711	0.00028944	1
2.2083	0.07	0.070363	-0.00036254	1
2.25	0.07	0.071002	-0.0010023	1
2.2917	0.07	0.07163	-0.0016304	1
2.3333	0.07	0.072247	-0.0022471	1
2.375	0.07	0.072853	-0.0028529	1
2.4167	0.07	0.073448	-0.0034482	1
2.4583	0.07	0.074033	-0.0040333	1

2.5	0.07	0.074609	-0.0046086	1
2.5417	0.07	0.075174	-0.0051744	1
2.5833	0.08	0.075731	0.0042691	1
2.625	0.08	0.076279	0.0037214	1
2.6667	0.08	0.076818	0.0031824	1
2.7083	0.08	0.077348	0.0026517	1
2.75	0.08	0.077871	0.0021291	1
2.7917	0.08	0.078386	0.0016144	1
2.8333	0.08	0.078893	0.0011073	1
2.875	0.08	0.079392	0.00060762	1
2.9167	0.08	0.079885	0.00011512	1
2.9583	0.08	0.08037	-0.00037039	1
3	0.08	0.080849	-0.00084911	1
3.0174	0.08	0.081047	-0.0010466	1

APPENDIX D

AQUIFER TEST DATA AND CALCULATIONS


PPW1 - Pumping PPW1
T = 318.8 m²/day
Drawdown (m)
5.
4.6
4.2
3.8
3.4
3.
2.6
2.2
1.8
1.4
1.
1.E-004
1.E-002
1.
Time (days)
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

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A Q T E S O L V   R E S U L T S

02/12/92 16:20:00

PROBLEM DEFINITION

Problem title: PPW1 - Pumping PPW1

Knowns and Constants:
- No. of data points............... 102
- Pumping rate..................... 2621
- Radius to obs. well.............. 0.127

ESTIMATION RESULTS

Analytical method: Cooper-Jacob (confined aquifer)

PARAMETER ESTIMATES

		Estimate		Std. Error
T	=	3.1883E+002	+/-	3.0295E-001
S	=	1.3797E+002	+/-	0.0000E+000

ANALYSIS OF MODEL RESIDUALS

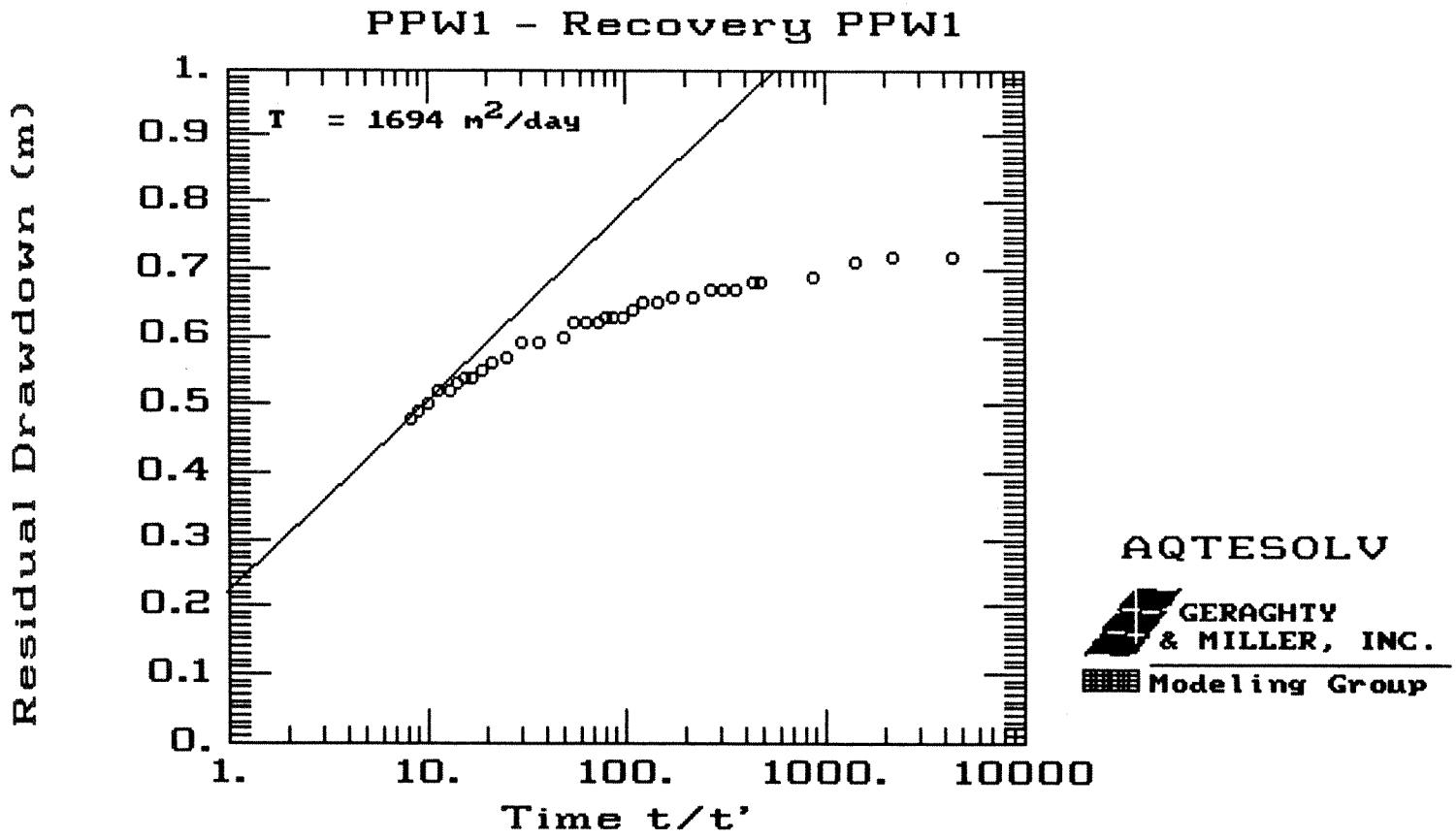
residual = calculated - observed
weighted residual = residual * weight

Weighted Residual Statistics:
- Number of residuals............... 50
- Number of estimated parameters.... 2
- Degrees of freedom................ 49
- Residual mean..................... 4.109E-006
- Residual standard deviation....... 0.02366
- Residual variance................. 0.0005598

Model Residuals:

Time	Observed	Calculated	Residual	Weight
1	3.79	3.7726	0.017394	1
1.0417	3.8	3.7993	0.00071921	1
1.0833	3.84	3.8249	0.015097	1
1.125	3.86	3.8496	0.010435	1
1.1667	3.88	3.8733	0.006671	1
1.2083	3.9	3.8963	0.0037462	1
1.25	3.91	3.9184	-0.0084068	1
1.2917	3.93	3.9398	-0.0098332	1
1.333	3.98	3.9604	0.019587	1
1.375	3.99	3.9807	0.009318	1
1.4167	4.01	4.0002	0.0098107	1
1.4583	4.02	4.0191	0.00087341	1

1.5	4.05	4.0375	0.012465	1
1.5417	4.07	4.0554	0.014561	1
1.5833	4.06	4.0729	-0.012861	1
1.625	4.08	4.0898	-0.0098343	1
1.6667	4.09	4.1064	-0.016378	1
1.7083	4.14	4.1225	0.01749	1
1.75	4.12	4.1383	-0.018256	1
1.7917	4.13	4.1536	-0.023632	1
1.8333	4.14	4.1687	-0.028651	1
1.875	4.16	4.1833	-0.023336	1
1.9167	4.14	4.1977	-0.057698	1
1.9583	4.23	4.2117	0.018252	1
2	4.23	4.2255	0.0044951	1
2.0417	4.26	4.239	0.021021	1
2.0833	4.27	4.2522	0.017823	1
2.125	4.28	4.2651	0.014883	1
2.167	4.28	4.2779	0.002095	1
2.2083	4.28	4.2902	-0.010249	1
2.25	4.27	4.3025	-0.032464	1
2.2917	4.32	4.3145	0.005546	1
2.3333	4.33	4.3262	0.0037747	1
2.375	4.34	4.3378	0.0022089	1
2.4167	4.35	4.3492	0.00084434	1
2.4583	4.33	4.3603	-0.030323	1
2.5	4.37	4.3713	-0.0013059	1
2.5417	4.39	4.3821	0.0078931	1
2.583	4.37	4.3926	-0.022646	1
2.625	4.36	4.4032	-0.043185	1
2.6667	4.38	4.4135	-0.033476	1
2.7083	4.4	4.4236	-0.023605	1
2.75	4.4	4.4336	-0.033581	1
2.7917	4.43	4.4434	-0.013408	1
2.8333	4.47	4.4531	0.016914	1
2.875	4.48	4.4626	0.017374	1
2.9167	4.49	4.472	0.017972	1
2.9583	4.55	4.4813	0.068705	1
3	4.53	4.4904	0.039566	1
3.0174	4.55	4.4942	0.055796	1


PPW1 - Recovery PPW1
T = 1694 m²/day
Residual Drawdown (m)
1.
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.
1.
10.
100.
1000.
10000
Time t/t'
AQTESOLV
GERAGHTY & MILLER, INC.
Modeling Group

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A Q T E S O L V   R E S U L T S

02/12/92 16:36:28

PROBLEM DEFINITION

Problem title: PPW1 - Recovery PPW1

Knowns and Constants:
- No. of data points............... 34
- Pumping rate..................... 2621
- Total pumping time............... 3.021

ESTIMATION RESULTS

Analytical method: Theis recovery (confined aquifer)

PARAMETER ESTIMATES

	Estimate		Std. Error
T =	1.6940E+003	+/-	3.8995E+000
S' =	1.6824E-001	+/-	0.0000E+000

ANALYSIS OF MODEL RESIDUALS

residual = calculated - observed
weighted residual = residual * weight

Weighted Residual Statistics:
- Number of residuals............... 4
- Number of estimated parameters.... 2
- Degrees of freedom................ 3
- Residual mean..................... -1.388E-017
- Residual standard deviation....... 0.002269
- Residual variance................. 5.147E-006

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.29167	0.52	0.51801	0.0019894	1
0.33333	0.5	0.50313	-0.0031266	1
0.375	0.49	0.49016	-0.00016006	1
0.41667	0.48	0.4787	0.0012973	1

QUIFER TEST DATA Oct/Nov. 91 WELL#: PPW1 (2492A)

ype of aquifer test: Constant Q
low Q Measured: Orifice Weir
ist. from pumping well (m): 0 m
leas. point for w. l.'s: T.O.C.
epth of Pump (m): 18.6 m from TOC
tatic Water Level (m): 5.41

Well type: Pumping
Data type: Pumping
Depth well: 22.86 m
Pump on: 8:00 am 10-29-1991
Pump off: 8:30 am 11-01-1991
Discharge rate: 400 IGPM

Time (min.)	Water Level (m)	Drawdown (m)	Discharge (i.g.p.m.)	Comments
1.00	7.34	1.93	400	
2.00	7.46	2.05	400	
3.00	7.53	2.12	400	
4.00	7.55	2.14	400	
5.00	7.61	2.20	400	
6.00	7.66	2.25	400	
7.00	7.72	2.31	400	
8.00	7.71	2.30	400	
9.00	7.74	2.33	400	
10.00	7.78	2.37	400	
12.00	7.85	2.44	400	
14.00	7.80	2.39	400	
16.00	7.83	2.42	400	
18.00	7.86	2.45	400	~ 20 sand grains
20.00	7.88	2.47	400	
25.00	7.90	2.49	400	
30.00	7.94	2.53	400	
35.00	7.97	2.56	400	
40.00	7.99	2.58	400	slight H2S odour
45.00	8.04	2.63	400	
50.00	8.06	2.65	400	
55.00	8.08	2.67	400	
60.00	8.07	2.65	400	<15 silt/sand grains
70.00	8.15	2.74	400	(sand free)
80.00	8.19	2.78	400	
90.00	8.22	2.81	400	
120.00	8.32	2.91	400	
150.00	8.29	2.88	400	
180.00	8.35	2.94	400	
210.00	8.41	3.00	400	
240.00	8.46	3.05	400	
270.00	8.49	3.07	400	
300.00	8.53	3.12	400	
330.00	8.54	3.13	400	
360.00	8.53	3.12	400	
420.00	8.64	3.23	400	
480.00	8.67	3.26	400	
540.00	8.72	3.31	400	
600.00	8.77	3.36	400	
660.00	8.82	3.41	400	
720.00	8.84	3.43	400	

\QUIFER TEST DATA Oct/Nov. 91 WELL#: PPW1 (2492A)

'ype of aquifer test: Constant Q
low Q Measured: Orifice Weir
)ist. from pumping well (m): 0 m
Meas. point for w. l.'s: T.O.C.
)epth of Pump (m): 18.6 m from TOC
Static Water Level (m): 5.41

Well type: Pumping
Data type: Pumping
Depth well: 22.86 m
Pump on: 8:00 am 10-29-1991
Pump off: 8:30 am 11-01-1991
Discharge rate: 400 IGPM

Time (min.)	Water Level (m)	Drawdown (m)	Discharge (i.g.p.m.)	Comments
780.00	8.89	3.48	400	
840.00	8.91	3.50	400	
900.00	8.95	3.54	400	
960.00	8.97	3.56	400	
1020.00	8.99	3.58	400	
1080.00	9.05	3.64	400	
1140.00	9.07	3.66	400	
1200.00	9.10	3.69	400	
1260.00	9.13	3.72	400	
1320.00	9.15	3.74	400	
1380.00	9.20	3.79	400	
1440.00	9.20	3.79	400	
1500.00	9.21	3.80	400	
1560.00	9.25	3.84	400	
1620.00	9.27	3.86	400	
1680.00	9.29	3.88	400	
1740.00	9.31	3.90	400	
1800.00	9.32	3.91	400	
1860.00	9.34	3.93	400	
1920.00	9.39	3.98	400	
1980.00	9.40	3.99	400	
2040.00	9.42	4.01	400	
2100.00	9.43	4.02	400	
2160.00	9.46	4.05	400	
2220.00	9.48	4.07	400	
2280.00	9.47	4.06	400	
2340.00	9.49	4.08	400	
2400.00	9.50	4.09	400	
2460.00	9.55	4.14	400	
2520.00	9.53	4.12	400	
2580.00	9.54	4.13	400	
2640.00	9.55	4.14	400	
2700.00	9.57	4.16	400	
2760.00	9.55	4.14	400	
2820.00	9.64	4.23	400	
2880.00	9.64	4.23	400	
2940.00	9.67	4.26	400	
3000.00	9.68	4.27	400	
3060.00	9.69	4.28	400	
3120.00	9.69	4.28	400	
3180.00	9.69	4.28	400	

QUIFER TEST DATA Oct/Nov. 91 WELL#: PPW1 (2492A)

/pe of aquifer test: Constant Q
ow Q Measured: Orifice Weir
ist. from pumping well (m): 0 m
eas. point for w. l.'s: T.O.C.
epth of Pump (m): 18.6 m from TOC
tatic Water Level (m): 5.41

Well type: Pumping
Data type: Pumping
Depth well: 22.86 m
Pump on: 8:00 am 10-29-1991
Pump off: 8:30 am 11-01-1991
Discharge rate: 400 IGPM

Time (min.)	Water Level (m)	Drawdown (m)	Discharge (i.g.p.m.)	Comments
3240.00	9.68	4.27	400	
3300.00	9.73	4.32	400	
3360.00	9.74	4.33	400	
3420.00	9.75	4.34	400	
3480.00	9.76	4.35	400	
3540.00	9.74	4.33	400	
3600.00	9.78	4.37	400	
3660.00	9.80	4.39	400	
3720.00	9.78	4.37	400	
3780.00	9.77	4.36	400	
3840.00	9.79	4.38	400	
3900.00	9.81	4.40	400	
3960.00	9.81	4.40	400	
4020.00	9.84	4.43	400	
4080.00	9.88	4.47	400	
4140.00	9.89	4.48	400	
4200.00	9.90	4.49	400	
4260.00	9.96	4.55	400	
4320.00	9.94	4.53	400	
4345.00	9.96	4.55	400	

APPENDIX E

Theoretical Aquifer Yield
and
Well Interference Calculations

THEORETICAL AQUIFER YIELD CALCULATIONS

$u = \frac{r2S}{4Tt\ W(u)}$ $\quad Q(max) = \frac{4\pi T(s_0-s)}{}$

$T = 732\ m^2/day$
$s_0-s = 15$ metres
$S = 8.0 \times 10^{-2}$
$r = .127$

Well Efficiency, Theoretical Aquifer Yields and Well Interference Calculations

(a) Theoretical Aquifer Yields :

$S = 8.0 \times 10^{-2}$
$r = 0.127$

$s(max) = 15$ m

(1) 10 year design yield:

for $t = 3650$ days

$u = 1.21 \times 10^{-10}$

$W(u) = 22.26$

$Q(max) = 6198\ m^3/day$ (947 igpm)

(2) 20 year design yield:

for $t = 7305$ days

$u = 6.0 \times 10^{-11}$

$W(u) = 22.95$

$Q(max) = 6009\ m^3/day$ (918 igmp)

(3) Safe perennial yield:

Q = 3606 m^3/day (551 igpm)

Theoretical Aquifer Yield (10 years): 6198 m^2/day

Theoretical Aquifer Yield (20 years): 6009 m^2/day

Safe Perennial Yield (10 years) : 3506 m_2/day

(b) Well Interference Calculations:

Calculations based on a 10 year period (3650 days).
T = 732 m^2/day
S = $8x10^{-2}$

The Table following shows drawdown for various radial distances from PPW1 in 1 year of pumping at a discharge rate of 400 IGPM (2624 m3/day).

Drawdown of Observation Wells (one year period)

RADIUS (m)	u	W(u)	s(m)
0.127 (PPW1)	$1.2x10^{-9}$	19.96	5.7
19.22 (TW1)	$2.7x10^{-5}$	9.94	2.84
22.03 (OW81)	$3.6x10^{-5}$	9.66	2.75
126 (OW85)	$1.2x10^{-3}$	6.15	1.75
184 (OW84)	$2.5x10^{-3}$	5.41	1.54
435 (OW89)	$1.4x10^{-2}$	3.7	1.05
500	$1.9x10^{-2}$	3.4	0.97
1000	$7.4x10^{-2}$	2.1	0.60

Well interference results

Radius (m)	400 IGPM (2624 m2/day) (m)
0.127 (PPW1)	6.34
19.22 (TW1)	3.50
22.0 (OW87)	3.41
126.0 (OW85)	2.41
435.0 (OW89)	1.71

CALCULATIONS FOR THEORETICAL DRAWDOWN (Well Interference)

Calculations based on a 10 year period:

$t = 3650$ days

$T = 732\ m^2/day$

$S = 8 \times 10^{-2}$

$Q = 224\ m^2/day$

$u = (r^2S) / (4Tt)$

$W(u)$ = values taken from table

$\Delta s = (QW(u)) / (4\pi T)$