WATER QUALITY MONITORING PLAN
WHITE STREET LANDFILL
PHASE III AREA

WHITE STREET
GREENSBORO, NORTH CAROLINA
S&ME PROJECT NO. 1584-98-081

Prepared For:

THE CITY OF GREENSBORO

Prepared By:

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1.0 WATER QUALITY MONITORING PLAN

1.1 PURPOSE AND INTENT

The purpose of this plan is to provide a program which describes the collection and evaluation of ground-water monitoring samples collected from compliance wells installed within the uppermost aquifer adjacent to the proposed expansion area and surface water quality samples from the same vicinity. The intent of this plan is to provide detection monitoring throughout the active life and post closure care period at the White Street Sanitary Landfill Subtitle D MSWLF expansion.

This plan was prepared in accordance with the rules codified under North Carolina Solid Waste Management Rules 15A NCAC 13B, Sections .1630 through .1637 under the guidance of a North Carolina Professional Engineer, and it is certified that this water quality monitoring plan for the White Street Sanitary Landfill Subtitle D MSWLF expansion is effective in providing early detection of any release of hazardous constituents (from any point in this expansion) to the uppermost aquifer, so as to be protective of public health and the environment.

The plan presented herein is a revision of the Water Quality Monitoring Plan prepared for the facility by HDR Engineering, Inc. of North Carolina dated January 1, 1997. The plan is revised to include procedures to sample ground water monitor wells with dedicated pneumatic sampling pumps. No other parts of the January 1, 1997 plan prepared by HDR have been modified.

1.2 DESCRIPTION OF PLAN COMPONENTS

The following is a brief description of the main components of this water quality monitoring plan.

1.2.1 Water Quality Sampling Locations

The following sections discuss the general ratioale used to select the upgradient (background) compliance well and the downgradient (detection) compliance wells based on the geologic and hydrogeologic data obtained during the development of the Hydrogeologic Design Report. All well locations were selected on their basis to provide water quality data from the uppermost aquifer beneath the facility. The rationale for selection of surface water monitoring points is also discussed.

1.2.1.1 Background Well(s)

Using the historical water-table elevation data collected during multiple ground-water monitoring events at the facility, and the geology of the site, two background compliance wells were selected on the basis of hydraulic position in relation to the solid waste management unit. Background well MW-15 is hydraulically "upgradient" of the unit and was completed in the gneissic material. Background well MW-16 is hydraulically sidegradient of the unit and was completed in the granitic material. Table 1-1 summarizes the proposed background monitoring wells for this plan and their approximate distance from the edge of the proposed solid waste cell.

1.2.1.2 Downgradient (Detection) Wells

The hydrogeologic and geologic characteristics of the facility and surrounding land, the quantity, quality, and direction of ground-water flow were evaluated to determine the appropriate selection of downgradient (detection) wells. In addition to the criteria above, the distance of each proposed well relative to the waste unit (100 to 150 feet) and the boundary of the property (50 feet or greater) were also considered. Table 1-1 summarizes the proposed downgradient (detection) monitoring wells for this plan and their estimated distance from the subject compliance boundary.

Each downgradient well was installed with a screened interval of Schedule 40 PVC well screen with a 0.010-inch slotted opening.

TABLE 1-1
SUMMARY OF PROPOSED DETECTION MONITORING SAMPLE LOCATIONS
White Street Sanitary Landfill
Phase III
Greensboro, North Carolina

SAMPLE ID	SAMPLE TYPE	INTERVAL MONITORED	SAMPLE LOCATION AND POSITION		DETECTION MONITORING FUNCTION
			Distance and Direction From Waste Cell Boundary	Hydrogeologic Position	
MW-15	Ground Water	Uppermost Aquifer Gneissic Material	225 Feet Southwest	Upgradient	Provide Background Water Quality Data
MW-16	Ground Water	Uppermost Aquifer Granitic Material	450 Feet Southeast	Sidegradient	Provide Background Water Quality Data
MW-17	Ground Water	Uppermost Aquifer	125 Feet East	Downgradient	Provide Release Detection Data
MW-18	Ground Water	Uppermost Aquifer	135 Feet East	Downgradient	Provide Release Detection Data
MW-19	Ground Water	Uppermost Aquifer	110 Feet Northeast	Downgradient	Provide Release Detection Data
MW-20	Ground Water	Uppermost Aquifer	125 Feet North	Downgradient	Provide Release Detection Data
MW-21	Ground Water	Uppermost Aquifer	125 Feet West	Downgradient	Provide Release Detection Data
MW-22	Ground Water	Uppermost Aquifer	150 Feet North-Northwest	Downgradient	Provide Release Detection Data
MW-23	Ground Water	Uppermost Aquifer	150 Feet West-Northwest	Downgradient	Provide Release Detection Data
MW-24	Ground Water	Uppermost Aquifer	150 Feet West	Downgradient	Provide Release Detection Data
MW-25	Ground Water	Uppermost Aquifer	135 Feet North	Downgradient	Provide Release Detection Data
MW-25D	Ground Water	Deeper Portions of Uppermost Aquifer	125 Feet North	Downgradient	Provide Release Detection Data
SU-1	Surface Water	Tributary/Stream	See Drawing G-1	Upstream	Provide Background Water Quality Data
SU-2	Surface Water	Tributary/Stream	See Drawing G-1	Downstream	Provide Surface Water Quality Data
SU-3	Surface Water	Tributary/Stream	See Drawing G-1	Downstream	Provide Surface Water Quality Data
SU-4	Surface Water	Tributary/Stream	See Drawing G-1	Downstream	Provide Surface Water Quality Data

Shallow wells have 15-foot screens and deep wells will have 10-foot screens. The construction of the final ground water monitoring wells will be in general accordance with the North Carolina Well Construction Standards. A schematic showing general well construction details is shown on Construction Permit Application Drawing C-12 (see January 1997 plan).

The number and location of the proposed monitoring wells have been selected based on several considerations. First, knowledge of ground water flow at the proposed expansion area, as described in the accompanying "Design Hydrogeologic Report," indicates that these wells encompass the downgradient area of the expansion. Second, each shallow well will be completed in the uppermost aquifer, with well screens that span the water table. Third, the lateral spacing of these wells was chosen because it is more than adequately close together considering the fine-grained nature of the saprolite aquifer in which dispersion is high. Finally, a well was located downgradient of the leachate collection sump, an area that the State considers particularly vulnerable. Well MW-25 will monitor the northeastern sump, as well as provide monitoring for that general portion of the lined facility.

In addition, a deep well, MW-25D, was installed as a nest at MW-25. Note also that this well pair is located along the axis of the prominent bedrock surface valley that trends through that area.

1.2.1.3 <u>Surface Water Sample Locations</u>

Four surface water sample locations have been proposed to monitor the quality of surface water near the solid waste unit. A surface water sample representing background water quality will be collected from the upstream portion of the creek that flows to the east of the disposal area. The downstream surface water samples will be collected from streams that will receive run-off from the landfill area. The location of these proposed surface water sampling locations can be seen on Drawing G-1.

1.2.2 Monitoring Well Data Collection

The following data will be collected and reported during the period of performance for this water quality plan. A brief discussion on the collection of and analysis of these data is provided in the sections to follow.

1.2.2.1 Ground Water Level Data Measurements

Static ground-water levels (and total well depth) will be obtained from the proposed ground-water compliance monitoring wells immediately prior to purging during each required water quality sampling event. An electronic water level meter capable of measuring differences in water levels of 0.01 feet will be used to obtain these measurements.

All measurements will be obtained from a reference point at the top of each PVC well casing which has an elevation established by a North Carolina registered land surveyor. The horizontal position of each well will be established using North Carolina Plane Coordinates. These data will be used to calculate the volume of standing water in each well and will provide information concerning well integrity (e.g., identify the presence of excessive siltation or casing breaches). All measuring equipment will be decontaminated between use at each well by washing in a non-phosphate detergent solution and rinsing in distilled or deionized water.

1.2.2.2 Ground Water Direction and Flow Measurements

Water table elevations will be calculated for each monitoring well using surveyed top-of-casing elevations prepared by a North Carolina registered land surveyor. Calculated potentiometric surface elevations, for each sampling event, will be placed on a scaled base map of the facility beside each respective monitoring point and contoured to produce a water table potentiometric surface map depicting potential ground-water flow direction(s) across the expansion area. In addition, estimated ground-water flow velocities for each compliance monitoring point will be calculated for each water quality sampling event. Using the static water table potentiometric data, effective porosities for each well, hydraulic conductivities determined from slug tests of each well, and the calculated hydraulic gradients at each monitoring well for the respective sample event, an estimated seepage (pore water) velocity at each monitoring well will be calculated to evaluate potential contaminant migration.

1.2.2.3 Ground Water Sampling With Dedicated Pneumatic Pumps

The City of Greensboro has elected to use dedicated sampling pumps to collect groundwater samples from monitor wells at the landfill. With proper techniques for low-flow purging and sampling, the pumps offer the potential of obtaining groundwater samples with lower turbidity than would be obtainable with bailers. The following text provides specifications and procedures applicable to groundwater sampling with dedicated pneumatic pumps.

Dedicated sampling pumps shall be all pneumatic, bladder pumps driven by a portable cycling air controller supplied with compressed air from a portable oil-less air compressor or compressed air bottle. Pump effluent will pass through a portable flow-through cell and water analyzer, which will monitor temperature, pH, conductivity, oxidation-reduction potential (ORP), and dissolved oxygen to indicate when stabilization has occurred.

The sampling pump shall be a positive gas displacement pin construction bladder pump. The pump shall be constructed such that no gas or liquid is introduced into the well during the pump operation. The pump shall be constructed of 316 stainless steel with a Teflon bladder. Bladders shall be field-replaceable and warranted for a period of 10 years. Bladder clamps shall also be constructed of 316 stainless steel. Pumps will be equipped with a screen having an opening not exceeding 0.012 inches. Sample pumps shall employ self-polishing hard seat internal check valves.

The manufacturer shall warrant all pumps to be new construction and shall certify all pumps to be free of all EPA Method 601,602, base neutral, and acid extractable contaminants. Certification and copies of the analytical reports with test batch numbers will be provided with each pump.

Pump airline and discharge tubing shall be of new material, sized to match the fittings supplied with each pump. The tubing bundle will consist of polyethylene air supply line heat bonded to a Teflon-lined polyethylene water supply line. The sample discharge tube shall provide a separate flow path without exposure to pump drive air and shall assure that discharge from the pump contacts only the Teflon inner tubing. The manufacture shall certify that only virgin PTFE (Teflon) has been used in the manufacture of the inner tubing.

The pump air supply line and discharge tubing shall be attached to a well head assembly that will allow attachment of the air supply line to the well head with the use of a quick-connect fitting. The well head assembly shall have an opening to allow measurement of water level with an electric water level probe. The discharge piping shall allow attachment of a Teflon elbow (QED part number 34485 or equivalent) to facilitate collection of the sample.

The air compressor shall be portable, gasoline-powered, of an oil-less design to prevent potential cross-contamination to the sample in the event of malfunction and capable of supplying air to the controller at a minimum rate of 4.3 SCFM at 100 psi. The compressor shall be supplied with a minimum of 40 feet of air-line to allow for operation of the gasoline engine downwind of the well during sampling.

The controller shall be capable of regulating both pressure and duration of bladder inflation and deflation cycles to allow optimum pump performance. A pause feature shall be provided to allow manual discharging and filling of sample during sample collection.

Purging should be performed by removing water from the well at a flow rate of less than 500 ml per minute. Purging rates should be less than the well recovery rate. The purge rate should be low enough that recharge water does not become excessively agitated or that colloids are drawn into the well bore. Purging should be continued until field measurements of turbidity, oxidation-reduction potential (ORP), and dissolved oxygen in-line analyses of groundwater have stabilized to within 10 percent over at least two measurements made 3 minutes apart.

Following stabilization of the field parameters, the well head should be fitted with the Teflon elbow and the discharge regulated to allow the filling of sample containers. Flow rates should be low enough to prevent aeration of the samples. For the volatile organic compound (VOCs) containers, the vials should be filled so that there are no air bubbles or "headspace".

A complete set of pre-cleaned and pre-labeled sample bottles will be removed from the cooler, prior to turning on the pump, to collect the sample. Once collected, a portion of the sample from the pump (for each well) will be transferred into a fresh container. Preservatives will be added as necessary (in accordance with EPA Methods SW-846) to the sample bottles, either by the laboratory or in the field immediately prior to sampling. A duplicate water quality sample will be collected, at least once a year, from a selected monitoring well in order to verify laboratory accuracy and QA/QC. One trip blank prepared by the laboratory will be analyzed for each sampling event. Equipment blanks are not recommended since the equipment is dedicated.

The sample collection sequence will proceed as follows: volatile organics (VOCs) and/or total organic halogens (TOX) will be collected first in 40 ml glass vials with Teflon-lined caps. The vials will be filled completely with no headspace. Samples to be analyzed for inorganic compounds (metals) will be collected next. The containers are most often plastic cubes or bottles that have acid placed inside as a preservative. These containers should not be rinsed prior to filling. Semi-volatiles will be collected following the inorganics. Generally, the semi-volatiles are collected in 1-liter amber glass bottles. Water samples to be analyzed for radiological parameters will be collected next, followed by the bacteriological parameters, if necessary. The radiological parameters will be collected in 1-liter bottles, and the bacteriological parameters will be collected in 120 ml plastic bottles containing sodium thiosulfate as a preservative.

After transferring the samples to the appropriate containers, they will be sealed and placed in a chilled cooler, or transpack, pending the completion of the sampling event. Upon completion of sampling at each well location, the well will be capped and secured.

All samples will be transferred directly to the appropriate sample containers in a manner which minimizes the sample agitation, and the potential for cross-contamination. A Chain of Custody Record will accompany the samples to document changes in the custody of the samples in the period between sampling and receipt of the sealed sample containers by the laboratory. The samples will be analyzed for the designated list of parameters by a North Carolina certified laboratory.

1.2.3 Sample Parameters and Frequency

1.2.3.1 Analytical Methods

All water quality samples will be analyzed for the constituents listed in Appendix I of 40 CFR Part 258 entitled "Constituents for Detection Monitoring." Table 1-2 lists the Appendix I constituents as well as the preferred analytical method and Practical Quantitation Limit (PQL) for each constituent.

During the purging process, field measurements (i.e., pH, temperature, and specific conductance) will be collected at each sample location in order to evaluate the effectiveness of purging procedures. These measurements will be obtained from a field-calibrated instrument in accordance with the manufacturers' specifications and industry standards (SW-846). If these field indicators do not appear to have stabilized after 5 well volumes, then well purging efforts will continue until "stabilized" conditions occur.

TABLE 1-2
SUMMARY OF WATER QUALITY ANALYTICAL PARAMETERS

White Street Sanitary Landfill
Greensboro, North Carolina

Metals:

PARAMETER	CERTIFICATION	METHOD	PQL
Antimony	Low level	7041	30
Arsenic	Low level	7060,7061	10
Barium	(20)	7080,6010	500
Beryllium	Low level	7091	2
Cadmium	Low level	7131	1
Chromium	Low level	7191	10
Cobalt	Low level	7201	10
Copper	Regular level	7210,6010	200
Lead	Low level	7421	10
Nickel	Regular level	7520,6010	50
Selenium	Low level	7740,7741	20
Silver	Low level	7761	10
Thallium	Low level	7841	10
Vanadium	Low level	7911	40
Zinc	Regular level	7950,6010	50

PQL - Practical Quantitation Limit in parts per billion (ppb).

TABLE 1-2 (continuation)

SUMMARY OF WATER QUALITY ANALYTICAL PARAMETERS

White Street Sanitary Landfill
Greensboro, North Carolina

Volatile Organics:

ORGANIC CONSTITUENT	METHOD	PQL
Acetone	8240/8260	100
Acrylonitrile	8240/8260	200
Benzene	8240/8260	5
Bromochloromethane	8240/8260	5
Bromodichloromethane	8240/8260	5
Bromoform	8240/8260	5
Carbon Disulfide	8240/8260	100
Carbon Tetrachloride	8240/8260	10
Chlorobenzene	8240/8260	5
Chloroethane	8240/8260	10
Chloroform	8240/8260	5
Chlorodibromomethane	8240/8260	5
1,2-Dibromo-3-Chloropropane	8240/8260	25
Ethylene Dibromide	8240/8260	5
O-Dichlorobenzene	8240/8260	5
P-Dichlorobenzene	8240/8260	5
T-1,4-Dichloro-2-Butene	8240/8260	100
1,1-Dichloroethane	8240/8260	5
Ethylene Dichloride	8240/8260	5
Vinylidene Chloride	8240/8260	5
Cis-1,2-Dichloroethene	8240/8260	5
T-1,2-Dichloroethene	8240/8260	5
Propylene Dichloride	8240/8260	5
Cis-1,3-Dichloropropene	8240/8260	10

PQL - Practical Quantitation Limit in micrograms per liter (µg /l).

TABLE 1-2 (continuation)

SUMMARY OF WATER QUALITY ANALYTICAL PARAMETERS

White Street Sanitary Landfill
Greensboro, North Carolina

Volatile Organics:

ORGANIC CONSTITUENT	METHOD	PQL
T-1,3-Dichloropropene	8240/8260	10
Ethylbenzene	8240/8260	5
Methyl Butyl Ketone	8240/8260	50
Methyl Bromide	8240/8260	10
Methyl Chloride	8240/8260	10
Methylene Bromide	8240/8260	10
Methylene Chloride	8240/8260	10
MEK; 2-Butanone	8240/8260	100
Methyl Iodide	8240/8260	10
Methyl Isobutyl Ketone	8240/8260	100
Styrene	8240/8260	10
1,1,1,2-Tetrachloroethane	8240/8260	5
1,1,2,2-Tetrachloroethane	8240/8260	5
Tetrachloroethylene	8240/8260	5
Toluene	8240/8260	5
1,1,1-Trichloroethane	8240/8260	5
1,1,2-Trichloroethane	8240/8260	5
Trichloroethylene	8240/8260	5
Trichlorofluoromethane	8240/8260	5
1,2,3-Trichloropropane	8240/8260	15
Vinyl Acetate	8240/8260	50
Vinyl Chloride	8240/8260	10
Xylenes	8240/8260	5

PQL - Practical Quantitation Limit in micrograms per liter (µg /l)

Trip blanks will be analyzed for volatile organics only, while equipment blanks will be analyzed for volatile organics and metals. Duplicate samples will be analyzed for the entire parameter list.

1.2.3.2 Sampling Frequency

Ground-water samples will be obtained during four independent events during the first 6 months of baseline sampling in order to provide enough data to adequately determine background/natural ground-water conditions or trends. For the remainder of the required monitoring period, water quality samples from all sample points will be collected on a semiannual basis.

1.3 STATISTICAL EVALUATION OF MONITORING DATA

Five methods have been deemed acceptable by the NCDEHNR for the statistical evaluation of ground-water quality data from MSWLF facilities (as referenced in Section .1632 of the Ground-Water Sampling and Analysis Requirements, 15A NCAC 13B). Each of these tests have inherent advantages and disadvantages which render them more or less useful, depending on site and data set characteristics. Each method is briefly described below. In addition to the statistical analysis of the data, all sampling analytical data will be compared to the North Carolina Ground-Water Standards, 15A NCAC 2L, .0202.

1.3.1 ANOVA (Parametric)

A parametric analysis of variance (ANOVA) followed by multiple comparison procedures to identify specific sources of difference is the preferred method for a facility in the early stages of monitoring. The procedures include estimation and testing of the contrasts between the mean concentrations at each compliance well and those at the background well for each constituent.

Analysis-of-variance models are used to analyze the effects of an independent variable on a dependent variable. For ground-water monitoring data, a well or group of wells is the independent variable, and the aqueous concentration of certain constituents or of a specified contaminant or contaminants is the dependent variable. An analysis-of-variance can determine whether observed variations (differences) in aqueous concentrations between compliance and background wells are statistically significant. Use of analysis-of-variance models is appropriate in situations where background concentrations of specific constituents can be determined and the data are normally or log normally distributed. The constituents which are most appropriately evaluated using ANOVA approaches are naturally occurring metals and other geochemical parameters such as chloride, nitrate-N, and specific conductivity.

1.3.2 ANOVA (Non-parametric)

A non-parametric analysis of variance (ANOVA) based on ranks followed by multiple comparison procedures to identify specific sources of difference can be used when the data are not normally distributed and cannot be transformed into a log-normal distribution. The procedure includes estimation and testing of the contrasts between the median of each compliance well and the background well for each constituent. This is a non-parametric procedure, which means that the laboratory values are not used; only the relative ranks are used.

1.3.3 Tolerance/Prediction Intervals

A tolerance interval or a prediction interval for each constituent is established from the background data. The concentration of each constituent in each compliance well is compared to set upper (or lower) tolerance or prediction limits.

Tolerance intervals define, with a specified probability, a range of values that are expected to contain a discrete percentage of the sample population (95%). Tolerance intervals are most appropriate for facilities which do not have high degrees of spatial variability between background and compliance well (e.g., areas underlain by homogeneous geologic materials such as granitic saprolite). With ground-water monitoring data, tolerance intervals can be constructed from concentrations found in the background well(s); these intervals are most often expressed as limits defined by the mean background well concentration plus a population size determined multiple of the standard deviation of the mean. Possible ground-water contamination is indicated when concentrations of the specified constituent(s) at the compliance well(s) plot above the calculated tolerance interval limits.

Prediction intervals are intervals in which the user is confident at a specified percentage (95%) that the next observation will lie within the interval, and are based on the number of previous observations, the number of new measurements to be made, and the level of confidence that the user wishes to obtain. This method of statistical analysis can be used in both detection and compliance monitoring programs. The mean concentration and standard deviation are estimated from the background wells. In a compliance monitoring program, prediction intervals are constructed from compliance well concentrations beginning at the time the facility entered the compliance monitoring program. Each compliance well observation is tested to determine if it lies within the prediction interval. If it is greater (or lower) than the historical prediction limits, water quality has deteriorated to such a point that further action may be warranted.

1.3.4 Control Charts

A control chart approach provides control limits for each constituent which can be used to evaluate data produced by repeated sampling and analysis for each well in the monitoring network. This is an intrawell approach which does not involve a comparison between background and compliance wells. If any compliance well has a value or a sequence of values that lie outside of the control limits for that constituent, this may constitute statistically significant evidence of contamination.

Control charts are based on repeated independent sampling events conducted over time and may be developed for each constituent of interest. Different statistical measurements, such as the means, standard deviation and mean of replicate values at a point in time, are computed and plotted graphically together with upper predetermined limits on a chart in which the x-axis represents time. When a data point plots above these boundaries, the process is "out of control," and when it plots below the boundaries the process is "in control." Control charts can be used to analyze the inherent statistical variation of ground-water monitoring data, to note aberrations and to detect trends in the data. Further investigation of "out of control" points is necessary before taking any direct action. A control chart can be constructed for each constituent in each well to monitor the concentration of that constituent over time. New samples can be compared to the historical data from the well to determine if the well is "in or out of control." Control charts can also be used to evaluate ground-water monitoring data when these data have been adjusted and/or transformed as appropriate.

1.3.5 Other Statistical Methods

Other statistical methods submitted by the facility owner or operator and approved by the NCDEHNR may also be used. This could include development of confidence intervals in which data are compared to Federal or State established maximum contaminant limits (MCLs) or alternate contaminant limits (ACLs).

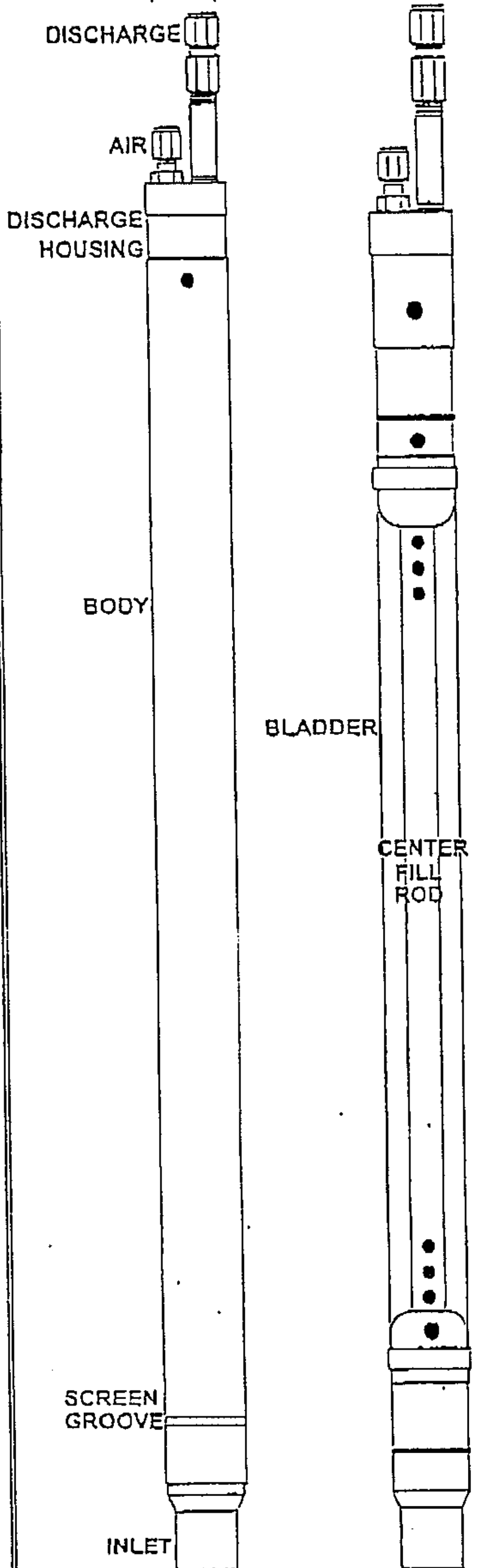
1.4 DETECTION MONITORING REPORTING

The reporting of detection monitoring data will occur within 14 days from the completion of the statistical analysis of the ground-water quality analytical data. A report will be prepared which summarizes the sampling event; including field observations relating to the condition of the monitoring wells, field data, laboratory data, statistical analysis, sampling methodologies, quality assurance and quality control data, information on ground-water flow direction, and calculations of ground-water flow rate.

Appendix

TECHNICAL DATA/SPECIFICATION SHEET

WELL WIZARD® PUMP MODEL T1200(M)



PUMP TYPE: POSITIVE DISPLACEMENT BLADDER PUMP

MATERIALS:

BODY - 316 STAINLESS STEEL
BLADDER - TEFLON®
INLET & DISCHARGE HOUSINGS - 316 STAINLESS STEEL
O-RINGS - VITON

DIMENSIONS:

DIAMETER - 1.5"
LENGTH - 42.25"
LENGTH WITH SCREEN - 47.75"
WEIGHT - 4.05 LBS.
SCREEN MESH - 50 (.010)

FITTINGS:

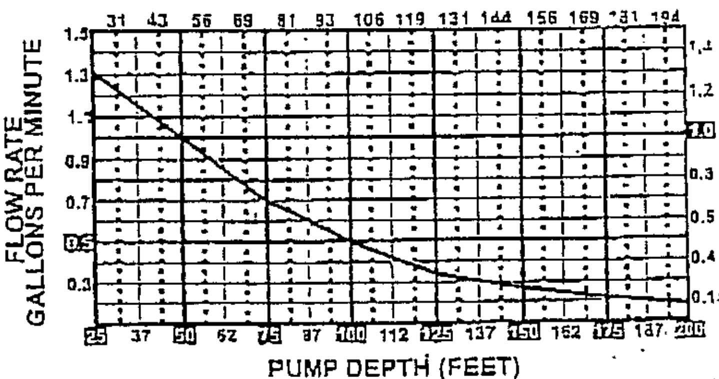
STAINLESS STEEL COMPRESSION-TYPE
AIR - ¼" O.D., 3/16" I.D.
DISCHARGE - 1/2" O.D., 3/8" I.D.
(M) DISCHARGE - 3/8" O.D., 1/4" I.D.

PUMP VOLUME:

LITERS	MILILITERS	GALLONS	OUNCES
.495	495	.13	16.6

MAXIMUM LIFT: 300 FEET

T1200 FLOW RATES

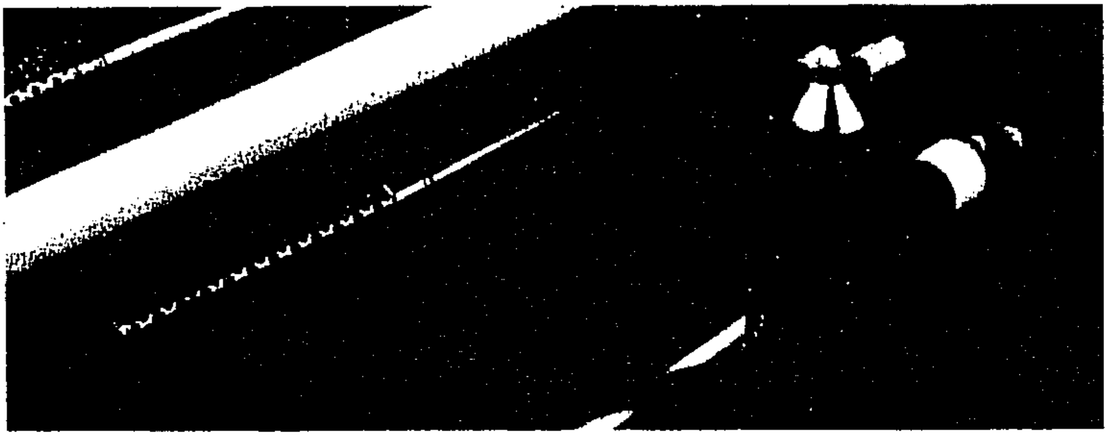


NOTE: Flow rates are based on a pump submergence of 25 feet, 1/2" discharge tubing and an operating gas pressure of 100 P.S.I. from an 3111HR air source/controller

ACCESSORIES:

INLET SCREEN 6" STAINLESS STEEL P/N 35200
BLADDER KIT P/N 35313
CLAMP HAND TOOL/PUNCH KIT P/N 35314

Well Wizard® Bladder Pumps: The Low-Flow Sampling Standard



The leaders since 1982 in dedicated pump technology, performance, and support.

The heart of every MicroPurge low-flow ground water monitoring program is the sampling device. For the system to do its job properly, the sampler must:

- run reliably and at low rates (100 ml/min or less) over a wide range of conditions;
- operate gently without increasing turbidity or altering samples;
- deliver reliable performance for many years without needing frequent repairs.

For nearly 15 years, Well Wizard pumps from QED have been doing all this...at more sites...for more users... then any other system.

The most complete low-flow pump selection

MicroPurge system pumps come in an unsurpassed range of sizes, materials, and capabilities, including models for deep wells, narrow or obstructed casings, and small-volume pumps for low-recovery wells. Together with MicroPurge controllers, flow cells, and accessories, they create the most reliable, cost-effective low-flow system available.

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Bladder pumps, EPA-accepted for low-flow sampling, have been shown to deliver superior sample accuracy in dozens of independent studies. Almost 40,000 Well Wizard bladder pumps are in use — more than all other brands and types of dedicated ground water samplers combined.

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- EPA-accepted low-flow sampling accuracy.
- Models for every well — pump volumes as low as 100ml, well depths to 1,000 feet, casing I.D. from 1.25".
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- Exclusive bladder polymer rated 200,000 cycles for years more flex life.

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HOW THEY WORK

Well Wizard Bladder Pumps

Designed for superior low-flow sampling performance

Pneumatic bladder pumps operate with a unique, gentle action ideal for low-flow sampling. Timed on/off pulses of compressed air alternately squeeze the flexible bladder to displace water out of the pump, and release it to allow the pump to refill under the natural in-situ hydrostatic pressure of the aquifer. Bladder pumps run easily at low rates for extended times, without the problems of other samplers.

- No overheating of high-speed electric pump motors, which can alter samples and even ruin the pumps.
- No churning action, like that of bailers or foot-valve samplers, which increases turbidity.
- No suction to cause degassing of dissolved volatile contaminants.

The bladder prevents contact between the pump drive air and the sample, and the downwell equipment is permanently dedicated to each well, so both samples and the well are protected from disturbance or the threat of cross-well contamination.

The easiest system to order and use

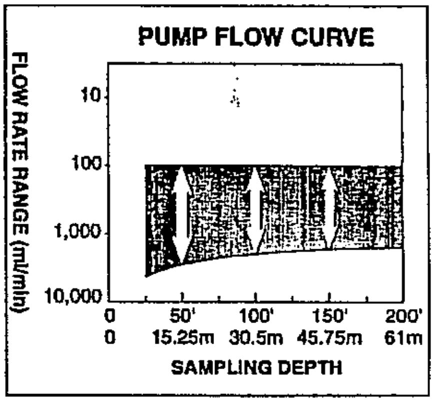
Well Wizard Bladder Pumps are part of the complete low-flow MicroPurge sampling system engineered for easy installation and use. QED application specialists will help specify the most effective, economical pumps and accessories for your site.

Each pump is cleaned and laboratory-certified to be free of all EPA 601, 602, base neutral and acid extractable contaminants. Your system is pre-assembled, with tubing cut to length, ready to install.

If desired, installation by OSHA-certified field engineers can be provided. QED customer support — with trained local representatives, 24-hour toll-free hotline, and next-day loaners or service turnaround — backs you with unmatched expertise and service.

More MicroPurge dedicated sampling systems and pumps have been chosen since 1982 than all other manufacturers' equipment combined.

To find out why, call QED today for a Low-Flow Data Sheet and site-specific cost analysis.



This graph shows the range of precisely controlled flow rates available from Well Wizard Bladder Pumps and the MicroPurge Model 400 controller. Consult QED for flow rates at greater depths or other special applications.

MICROPURGE PUMP SPECIFICATIONS

Model No.	Pump Materials	Length	O.D.	Fitting Material	*Tubing Size	Volume (ml)	Max. Lift
T1100	Teflon	3.3' (1.0 m)	1.66" (4.2 cm)	Teflon	1/4 x 1/2" (6 x 13 mm)	395	250' (75m)
P1101	PVC	3.4' (1.04 m)	1.66" (4.2 cm)	Polypropylene	1/4 x 1/2" (6 x 13 mm)	395	300' (90m)
P1101H	PVC	3.3' (1.0 m)	1.66" (4.2 cm)	Stainless Steel	1/4 x 1/2" (6 x 13 mm)	395	600' (180m)
ST1101P	316 Stainless Steel	3.4' (1.04 m)	1.66" (4.2 cm)	Stainless Steel	1/4 x 1/2" (6 x 13 mm)	395	1,000' (305m)
T1200	316 S.S. and Teflon	3.4' (1.04 m)	1.50" (3.8 cm)	Stainless Steel	1/4 x 1/2" (6 x 13 mm)	495	300' (90m)
T1250	316 Stainless Steel	1.25' (0.38 m)	1.50" (3.8 cm)	Stainless Steel	1/4 x 3/16" (6 x 5 mm)	100	300' (90m)
P1150	PVC, Teflon	1.63' (0.5 m)	1.66" (4.2 cm)	Polypropylene	1/4 x 3/16" (6 x 5 mm)	130	300' (90m)
T1300	316 S.S. and Teflon	3.8' (1.16 m)	1.00" (2.5 cm)	Stainless Steel	1/4 x 3/8" (6 x 9 mm)	220	300' (90m)

* To choose 3/8" (9 mm) rather than 1/2" (13 mm) discharge tube option, add suffix M to pump model number.

Intake Screen Specifications

Model No.	Material	Screen Size	Fits Pump Model(s)
35200	Stainless Steel	0.01" (0.25 mm) mesh	T1200, T1250
37347	PVC	.010" (0.25 mm) slot	P1101, P1101H
37727	PVC	.010" (0.25 mm) slot	P1250 (also P1101, P1101H)
37733	Teflon	.010" (0.25 mm) slot	T1100

Note: Pump models ST1101P, T1300 include intake screens. Screens are optional on other pump models, but are required for full 10-year warranty coverage.

Materials Specifications

Stainless Steel:	Type 316 electropolished
PVC:	NSF-grade, extruded specifically for QED with no markings or lubricants.
Teflon (pumps):	duPont Teflon* and other premium PTFE resins
Teflon (bladders):	Q-flex exclusive 200,000 cycle rated PTFE.

Teflon is a registered duPont trademark.

Dedicated Groundwater Monitoring Pumping System Specifications

1.0 Manufacturer

The manufacturer shall have a minimum of 13 years experience providing pneumatic bladder pumps in groundwater monitoring applications. The manufacturer shall warranty all components for a minimum of one year. Bladder pumps with inlet screens shall be warranted for a period of 10 years. The manufacturer shall have a local, factory trained agent, and shall have OSHA certified technicians available for installation or start-up assistance. The manufacturer shall maintain a toll-free, 24-hour service line, 365 days a year, provide 24-hour service turnaround, have a minimum of eleven (11) years experience with a pump certification program as described in 1.21. Manufacturer's facility shall include a 300' test well for flow rate verification. Manufacturer must be capable of shipping all standard equipment within ten working days of receipt of order. The manufacturer shall provide an instructional video tape with the system.

1.1 Overview of Operation

An all pneumatic, bladder pump will pump water from a groundwater monitoring well. The pump will be driven by a portable cycle controller, with air supplied by a portable air compressor. Pump effluent will pass through a portable flow-through cell and water analyzer which will monitor temperature, pH, conductivity, ORP, and dissolved oxygen to indicate when stabilization has occurred.

1.2 System Components

1.21 Pump. Sampling pumps shall be positive gas displacement, pin construction bladder pumps, constructed such that no gas or liquid is introduced into the well or sample during the pumping operation. The pumps shall be fabricated of electro-polished 316 stainless steel with a Q-flex Teflon bladder. Bladders shall be field replaceable by replacement of the bladder only, and be warranted for a period of ten (10) years (if a pump inlet screen is used). Bladder life shall be rated for a minimum of 200,000 cycles. Bladder clamps shall be electro-polished 316 stainless steel Oetiker low profile earless type. Each pump shall be fitted with an electropolished inlet screen, having a screen opening size not to exceed 0.012 inches. The screen shall attach directly by means of three Allen set screws, to the stainless steel pump body for maximum strength. The screens shall be fabricated of Type 316 stainless steel, and shall have a total surface area of 36 square inches. The screen length shall be eight (8) inches to provide stand off in wells with silt. These pumps shall be designed to pump water which may contain small amounts of fine silt and sand without accumulation of such materials in the pump or bladder. Each pump shall be provided with stainless steel, non-lubricated, replaceable nut compression (not barbed) fittings and hardware needed to connect sample discharge and air supply tubing. Sample pumps shall employ self-polishing, hard seat, internal check valves to eliminate wear prone elastomeric seals and avoid mineral deposit build up. The pump inlets shall be capable of easily adapting to optional flow reducers to reduce the pump refill rate when micropurging/ low flow purging. The pump inlets shall be threaded with 1/2" FNPT threads so as to be easily adapted to dip tubes for specific well applications. Pumps shall be capable of pumping dry without damage. All pumps and screens shall be laboratory-certified to be free of all EPA 601, 602, base neutral, and acid extractable contaminants. This shall be verified by soaking the pumps in lab-grade water for a minimum of 18 hours and analyzing the soak water. The analysis shall be performed by an independent certified laboratory. Copies of the analytical results with test batch numbers must be provided in writing with each pump.

1.22 Sample Pump Tubing. Tubing shall be sized to match the appropriate bladder pump fittings. The tubing bundles shall consist of an air supply line and water sample line that are continuously heat bonded to each other (no adhesives or mechanical fastener) for ease of handling, yet be manually separable and sealable via standard compression fittings. The tubing bundles shall be fabricated of polyethylene with the discharge tube lined with Teflon. All materials are to be 100% virgin grade with no regrind, additives or mold release agents used. The sample discharge tube shall provide a separate flow path without exposure to pump drive air, and be fully and continuously visible and accessible for inspection. Each tubing bundle shall be provided with a Type 316 stainless steel insert for maximum holding strength connection to the pump discharge fitting. The system shall be available with the tubing cut to exact length (to nearest foot) as specified by the customer, pre-assembled to pump and well cap and factory tested for leakage.

1.23 Wellhead Assemblies. Each wellhead assembly shall have a quick-connect fitting for attachment of the air supply line from the air source to the air supply line of the bladder pump. Each wellhead assembly shall have a flexible, corrugated Teflon discharge tubing of appropriate size for ease of sample collection. The corrugated discharge tubing shall be attached to the pump discharge tubing with an Oetiker 316 stainless steel ear clamp, and using a 316 stainless steel insert. Sample discharge line shall be compatible for use with in-line filter attachments.

QED Environmental Systems, Inc.
MicroPurge™ System
Sole Source Justification

QED Environmental Systems, Inc. is the sole vendor able to supply a complete MicroPurge system of its own manufacture to be used for low impact sampling. Only the Well Wizard® MicroPurge system components and accessories are designed to work as a totally integrated system and to achieve all the technical and commercial benefits that are associated with the low impact approach to groundwater sampling: **sample quality, method control, labor savings, flow control accuracy, reliability,** and where applicable **disposal costs.** Additionly, the Well Wizard MicroPurge System leads in the field of low flow sampling; proven both by numbers sold and years of use. It is the combination of these factors and the following criteria listed that make QED the sole source for a MicroPurge system.

The **Well Wizard Programmable Pump Controller/Model 400** was specifically designed to facilitate low flow sampling, making it an integral component of the MicroPurge System from QED. The 400 Digital Controller is capable of storing both site and well identification and timer settings for up to 10 sites and 50 wells per site. This feature insures consistency for subsequent sampling events even with changes in personnel. For micropurging, it is essential the controller be capable of accurately minimizing flow to 100 ml/min. or less. The 400 also has repeatable digital timer settings with 1/10th of a second intervals which allow for accurate adjustment, simplified flow rate control, which insures achievement low flow minimal draw down sampling efforts. The unique drive air regulator allows adjustment of the exact pump discharge pressure without cycling the controller, preventing the unnecessary loss of sample volume. The repeatability and accuracy of QED's Model 400 make it the desired controller for use with low-flow sampling.

NOW FC4000

The **Model FC2000 Water Analyzer** from QED allows for quick, easy monitoring of indicator parameters as requried when micropurging. The flow cell simultaneously measures, compensates, displays and records temperature, dissolved oxygen (DO), conductivity, pH, and oxygen/reduction (ORP) with a single probe and meter. The FC2000, unique in the instrumentation market, is the only flow cell with the capability of simultaneously reading pH and conductivity without drift. The probe may also be used downwell in 2" or larger wells or for surface water sampling. Characteristic only to the FC2000 unit are the specially engineered domed top design and flow distribution plates that eliminate dead space and turbulent flow. The resulting even flow insures accurate readings with quick response time to changes. The cell is designed to be used in its own case, and does not require a level surface at the well site to operate. The meter is capable of storing up to *199* sets of readings and may be downloaded via the RS-232 port.

Well Wizard MicroPurge Pumps are unequaled in terms of the reliability and durability they provide. This can be directly attributed to the most essential part of the pump, the bladder. Well Wizard bladders are made from an *exclusive* proprietary TFE formulation to provide the longest "flex life" in the industry, averaging over 200,000+ cycles. PFA and TEP formulations used by other manufacturers tend to average only a few thousand cycles. A certification program, a *standard* procedure exclusive to QED since 1986, insures that all Well Wizard pumps are **certified clean** for the absence of EPA 601, 602 acid extractables, and base neutral parameters. The analysis is performed by an independent qualified testing laboratory, and the resulting data is logged and stored. This certification is provided in writing with each pump. A comprehensive list of various pump accessories including tubing, caps and discharge adapters is available to complete pump portion of the Well Wizard Micro Purge System from QED.

WELL WIZARD PUMP CERTIFICATION PROCEDURE

After cleaning of all components prior to assembly, all Well Wizard sampling pumps are passed through a rigorous certification procedure before they are shipped. Each batch of pumps to be tested is immersed in a sealed, high purity water bath for 24 hours, with samples taken of the water before and after the soak period. During the soak period the water is recirculated through all of the pumps, to ensure exposure of the internal and external surfaces of the pumps.

No pumps are released for shipment until the test results are received. Each pump is then tagged and shipped with the certification batch number. All results are kept on file, tying pump serial numbers to the specific analytical test results from the pump batch.

In addition to the certification of the sampling pumps, QED keeps a file of vendor affidavits verifying that suppiled materials meet QED's purity and handling requirements. Tubing, packaging materials and raw materials are batch certified at regular intervals.

EVALUATING PUMP CERTIFICATION RESULTS

Enclosed you will find the analytical results of the Well Wizard pump certification batch which included pumps shipped to you. The procedure employed in pump certification is detailed on the attached sheet labeled Well Wizard Pump Certification Procedure.

Note that QED has employed a 20 ppb cut-off limit for any parameter in the total group being analyzed for; pumps with any parameter above 20 ppb are not certified. The level of any parameter that does show up between the detection limit for the parameter and the 20 ppb cut-off is not related to levels detected in actual monitoring use for the following reasons:

1. Certification tests both internal and external surfaces.

2. The ratio of pump surface area(s) to water volume is much higher than that found in monitoring wells.

3. Most importantly, the certification allows pumps to soak for 24 hours in contrast to the 10 second exposure to the internal pump surface a sample normally experiences in actual use.

The results of the certification procedure are carefully monitored by our production and engineering staff. Testing has confirmed that limits of detection for the certification procedure we employ are two or more orders of magnitude better that what would be detected in a normally pumped sample taken with a Well Wizard Teflon bladder pump. What this means is that the 20 ppb cut-off limit employed in the certification procedure translates to a 0.2 ppb cut-off limit for actual pump use.

WELL WIZARD CLEANING PROCEDURES

The following outlines QED's Well Wizard sampling pump cleaning procedures.

1. All pump parts are batch cleaned in an alkaline, non-organic industrial cleaning solution (Alconox type) maintained at 130 degrees Fahrenheit.
2. The parts are rinsed with 130 degree F tap water.
3. The parts are double washed with water which has been treated as follows:
    a. Tap water is filtered to remove particulates.
    b. The filtered water is passed through an activated carbon column to remove organic compounds.
    c. The water is passed through a series of ion-exchange columns to remove inorganic compounds.
4. Assembly and pump testing is done using the treated water.